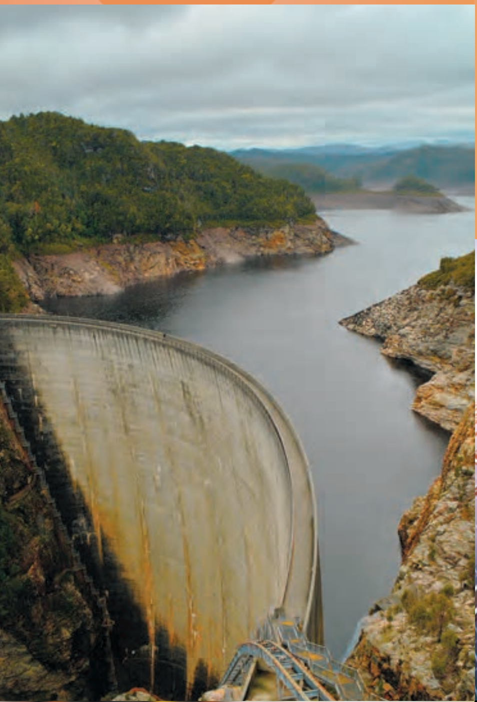





Tasmanian Energy Security Taskforce

Interim Report | December 2016

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Tasmanian Energy Security Taskforce

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Glossary

Acronym	Meaning
ACCC	Australian Competition and Consumer Commission
ACCESS-S	Australian Community Climate and Earth System Simulator
ACE CRC	Antarctic Climate and Ecosystem Corporate Research
ACT	Australian Capital Territory
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AETV Power	Aurora Energy (Tamar Valley) Power
ARENA	Australian Renewable Energy Agency
BCG	Boston Consulting Group
BOA	Basslink Operations Agreement
BOM	Bureau of Meteorology
BSA	Basslink Services Agreement
CCGT	Combined cycle gas turbine
CCIA	Climate Change in Australia
CEFC	Clean Energy Finance Corporation
CEO	Chief Executive Officer
CER	Clean Energy Regulator
CFT	Climate Futures Tasmania
CIGRE	International Council on Large Electrical Systems
CO_2	Carbon dioxide
CO2CRC	Cooperative Research Centre for Greenhouse Gas Technologies
$CO_{2\text{-}e}$	Carbon dioxide emissions
COAG	Council of Australian Governments
COP21	21st Conference of the Parties
CSIRO	Commonwealth Scientific and Industrial Organisation
DIER	Department of Infrastructure Energy & Resources
DWGM	Declared Wholesale Gas Market
EAAP	Energy Adequacy Assessment Projection

Acronym	Meaning
EERZ	Extreme Environmental Risk Zone
EGS	Enhanced geothermal system
ENSO	El Niño Southern Oscillation
EP&C Act	*Energy Planning and Coordination Act 1995*
ESI	*Electricity Supply Act 1995*
EV	Electric vehicle
FCAS	Frequency Control Ancillary Services
FiT	Feed-in tariff
GBE	Government Business Enterprise
GCM	Global climate model
GWh	Gigawatt hours
HEC	Hydro-Electric Commission
HRL	High Reliability Level
HSA	Hot sedimentary aquifer
HVAC	High voltage alternating current
HVDC	High voltage direct current
IEA	International Energy Agency
IOD	Indian Ocean Dipole
IPCC	Intergovernmental Panel on Climate Change
IPSS	Integrated solar photovoltaic and storage systems
IRENA	International Renewable Energy Agency
JCO	Jurisdictional Contact Officer
JSSC	Jurisdictional System Security Coordinator
LCC	Line Communicated Converter
LCOE	Levelised cost of energy
LGC	Large-scale generation certificate
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
LRET	Large-scale Renewable Energy Target

Acronym	Meaning
MOSES	Model of Short-Term Energy Security
MOU	Memorandum of Understanding
MRET	Mandatory Renewable Energy Target
MW	Megawatt
MWh	Megawatt hour
NEFR	National Energy Forecast Report
NEL	National Electricity Law
NEM	National Electricity Market
NER	National Electricity Rules
NESA	National Energy Security Assessment
NGERAC	National Gas Emergency Response Advisory Committee
NGIL	National Grid International Ltd
NGL	National Gas Law
NTNDP	National Transmission Network Plan Development Plan
NRR	Network Reliability Review
NVE	Norwegian Water Resource and Energy Directorate
OCGT	Open cycle gas turbine
OTTER	Office of the Tasmanian Economic Regulator
PJ	Petajoule
POAMA	Predictive Ocean Atmosphere Model for Australia
POM	Preferred operating minimum
PPA	Power purchase agreement
PSEMP	Power System Emergency Management Plan
PSL	Prudent Storage Level
PV	Photovoltaic
REC	Renewable energy certificate
REN21	Renewable Energy Policy Network for the 21st Century
RERT	Reliability and Reserve Trader
RET	Renewable Energy Target

Acronym	Meaning
RO	Responsible officer
SAIDI	System average interruption duration index
SAIFI	System average interruption frequency index
SAM	Southern Annular Mode
SOC	State Owned Company
SPS	System Protection Scheme
SRES	Small-scale Renewable Energy Scheme
STC	Small-scale technology certificate
TGP	Tasmanian Gas Pipeline
TasSY	Tasmania Sustainable Yields Project
TER	Tasmanian Economic Regulator
TJ	Terajoule
TMEC	Tasmanian Minerals and Energy Council
TREIDB	Tasmanian Renewable Energy Industry Development Board
TVPS	Tamar Valley Power Station
TWh	Terawatt hour
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USE	Unserved energy
VSC	Voltage source converter
WEC	Wave energy converter
WSAC	Water Storage Advisory Committee

Foreword

During 2015-16 Tasmania experienced one of the most significant energy security challenges in its history. The combined impact of two extreme events – record low rainfall during spring, combined with the Basslink interconnector being out of service – resulted in Hydro Tasmania's water storage levels falling to historically low levels. An Energy Supply Plan (the Plan) was implemented that included the rapid commissioning of more than 200 MW of temporary diesel generation capacity. The Plan slowed the rate of decline in water storages through the dry period. Since May 2016 there has been heavy rainfall and water storages have risen to the mid 40 per cent range at the end of November 2016, from a low point of 12.5 per cent in late April 2016.

As a result of these events, and in parallel with the Plan, the Tasmanian Government established the Tasmanian Energy Security Taskforce (the Taskforce) to advise Government on how it can better prepare for and mitigate against the risk of future energy security threats.

The Taskforce has adopted an evidence-based approach to undertaking its energy security risk assessment. The findings and recommendations contained within the Interim Report have been developed on the basis of information made available to the Taskforce. While much of the Taskforce's thinking has been guided by analysis undertaken by the Secretariat and the Taskforce's external expert advisors, information provided by stakeholders has also played an important role.

The Taskforce released a Consultation Paper on 3 August 2016 seeking the views of stakeholders interested in the energy supply security challenges for Tasmania. Submissions were provided by large and small customer representatives, industry bodies and key energy sector participants. Across the 32 submissions received there have been useful insights and consistent messages against the Taskforce's Terms of Reference that the Taskforce has taken into consideration when developing its assessments. The Taskforce is grateful to all who took the time to prepare a submission.

The Taskforce has also actively met with relevant stakeholders (including industry participants and customers or their representative organisations) and this has provided important information and context additional to what the Taskforce has learnt through the Consultation Paper process. The Taskforce appreciates the time and input that stakeholders have put into these meetings.

As required under its Terms of Reference, the Taskforce has provided the Interim Report to the Minister for Energy. It contains the Taskforce's preliminary assessment of energy security now and into the future, having regard to the specific issues that its Terms of Reference require it to investigate, and includes initial findings and recommendations to the Tasmanian Government for actions to support Tasmania's energy security, particularly focused on the short term. The Final Report, which is to be presented to the Minister for Energy within 12 months of the Taskforce's establishment, will present the Taskforce's final energy security assessment for Tasmania and recommend evidence-based solutions to strengthen Tasmania's energy security in the medium to long term.

Executive Summary

From the outset the Taskforce makes it clear that energy security is the responsibility of the Tasmanian Government. The assessments and recommendations in the Interim Report are all provided within that context and they aim to strengthen the frameworks and more clearly articulate the roles of those charged with delivering the Government's responsibility to the community to maintain energy security.

The Taskforce's overall assessment of the current situation is that there are no immediate threats to energy security now that water storages have returned to higher levels and Basslink is back in service.

However, an examination of recent history reveals four energy security threats this century, with the recent 2015-16 situation being the most significant energy security risk to Tasmania since 1968. The Taskforce concludes that the incidence and the severity of these events calls for more conservative energy security settings. The Taskforce's consultation process also revealed heightened community concern and an appetite for a higher level of insurance to improve the security of energy supply.

Tasmania's energy system is unique in the National Electricity Market (NEM). It is characterised by having high capacity relative to peak demand, but being energy constrained. Hydro generation, Basslink, wind generation and the Tamar Valley Power Station (TVPS) are all options that Tasmania is afforded as to how it meets current and future energy demands, but due to the variability of rainfall, water storages prevail as the most important factor in setting Tasmania's energy security.

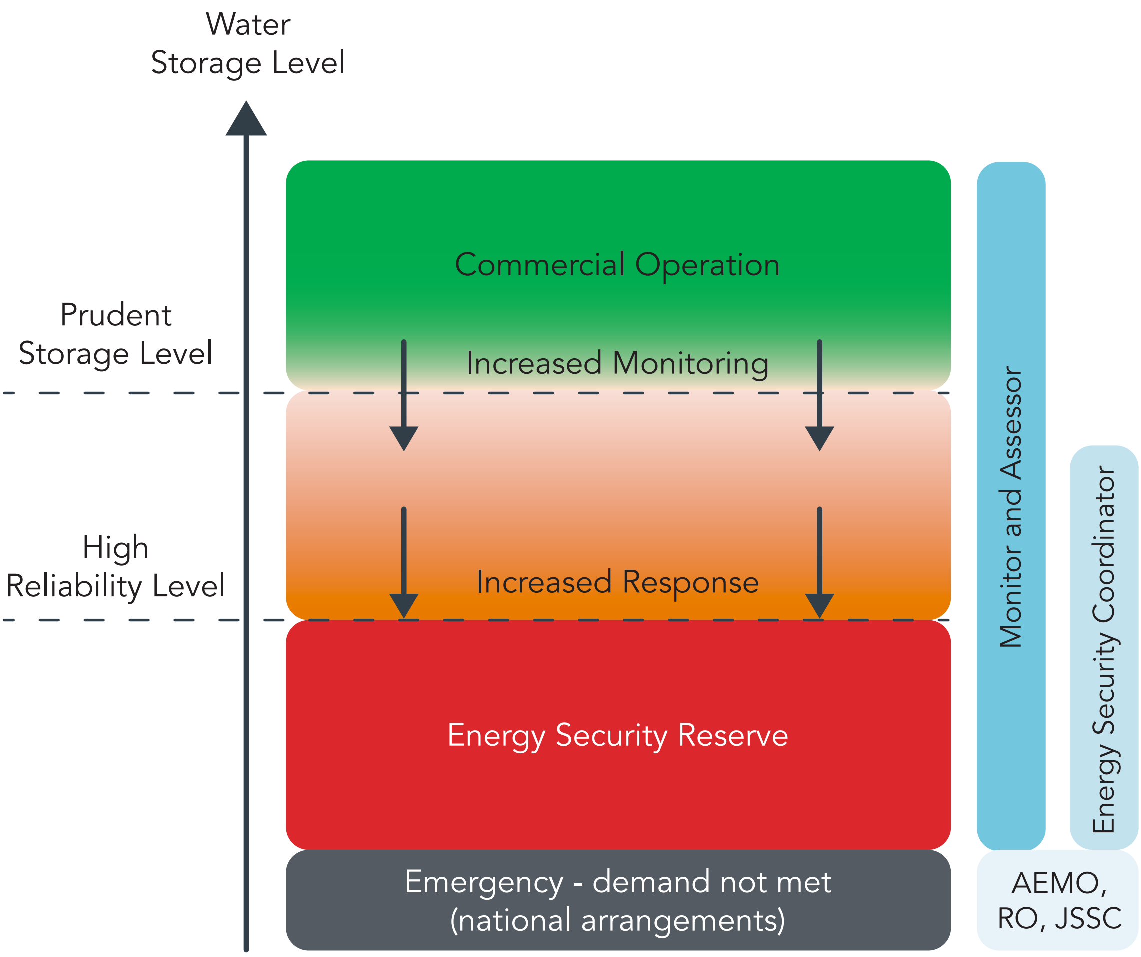
The Taskforce recommends five priority actions for the Tasmanian Government.

1. **Define energy security and responsibilities.**
   - Several recommendations are provided to make roles and responsibilities absolutely clear.
2. **Strengthen independent energy security monitoring and assessment.**
   - Energy security risk should be monitored and assessed by a capable independent body, with transparent public communication of risk status.
   - The Taskforce expects that this could be achieved with a modest cost impost on the sector with no material pass through to customer prices.
   - The Taskforce expects the roles, responsibilities and frameworks for monitoring and assessing energy security to be in place before it completes the Final Report and will comment on implementation progress at that time.
3. **Establish a more rigorous and more widely understood framework for the management of water storages.**
   - A strong fundamental basis that makes water storage levels a function of energy security risk should be established. The Taskforce has recommended an Energy Security Risk Response Framework, which is depicted in Figure 1.
   - Planning should be conducted with more conservative assumptions for rainfall variability and Basslink availability.
   - It should be made clear when Hydro Tasmania can operate freely within its commercial interests and any occasions where it needs to take steps to redress/avoid energy security risks that are inconsistent with Government policy.
   - Right now, Hydro Tasmania's targeted water storage levels of 30 per cent at the end of June and 40 per cent at the end of spring are appropriate, and whilst still subject to a full examination before the Final Report, the Taskforce assesses that storages should not be allowed to fall below those levels.

4. **Retain the TVPS as a backup power station for the present and provide clarity to the Tasmanian gas market.**
    - The TVPS is currently required as a backup generator when Tasmania faces a prolonged low rainfall sequence and a six month Basslink outage. No matter that such concurrence is rare, from a risk management perspective, they are both credible scenarios.
    - The transportation of gas to Tasmania is currently contracted until December 2017. Arrangements beyond that date are currently under negotiation. The Taskforce considers it important to see those arrangements in place before it completes the Final Report in June 2017, and usual commercial timeframes suggest this should be possible.
    - Tasmania's other important gas users are most interested in this matter and it will be important to them that the direction this takes be known to the market before the end of March 2017.
    - The long-term energy security need for the TVPS is less certain, especially where new generation is introduced, or a second interconnector is built, or there is a major downturn in demand. These scenarios will be modelled in the Final Report.
5. **Support new on-island generation and customer innovation.**
    - Tasmania has a deficit of on-island hydro-electric and wind generation to on-island consumption of some 700 GWh to 1 000 GWh (approximately 7 per cent to 10 per cent) based on long-term average inflows. All other things being equal, a more secure setting would be created if this deficit was reduced or eliminated by new entrant renewable energy developments.
    - New entrant developments should not face barriers to entry due to Tasmania's market structure and energy projects which are well progressed should not be delayed because of the Taskforce's work.
    - Tasmania is an excellent test bed for energy innovation. The Taskforce considers that Tasmania's features make it ideal for private sector interests to partner with local businesses and researchers to trial new products and services, such as storage integration and electric vehicles.

Finally, the feasibility of a second interconnector is currently under review by a joint Australian and Tasmanian Government study and the outcome of that review will be available for inclusion in the Taskforce's Final Report. At this point, the Taskforce notes that a second interconnector would afford a substantial increase in Tasmania's energy security resilience and allow some other supply security measures to be set aside. However, these energy security attributes are unlikely to be the major commercial driver for a second interconnector, whereas the scope for a national impact from Tasmania's hydro-electric system and its renewable energy development potential is likely to be relatively more important.

Figure 1. Proposed Energy Security Risk Response Framework



Key Findings and Recommendations

KEY FINDINGS

Energy security in Tasmania

- As an island that is small in population and isolated from major markets, Tasmania needs to place additional emphasis on ensuring its energy security.
- Tasmanian demand is unusual in the NEM due to the substantial requirements of four large major industrial customers, who account for around 55 per cent of the State's electricity load.
- Because of the importance of energy security to households and businesses, the responsibility for energy security ultimately rests with Government.
- Energy security comes at a cost which is ultimately borne by Tasmanian consumers, either through the prices they pay or through the impact on the financial returns of Government businesses.
- Tasmania has experienced four energy security events this century that have been classed as low probability. This recent history indicates that two or more separate low probability events can occur within a short period.

Tasmania's energy system

- Tasmania's energy system is diverse, though dominated by hydro-electric generation (which represents three quarters of stationary energy use) and liquid fuels (for non-stationary/transport energy use).
- Tasmania's electrical energy system is energy constrained rather than capacity constrained – this means that Tasmania has sufficient generators to meet peak demand, but that the fuel sources (principally water) for these generators to operate can sometimes be in short (and even critically low) supply.
- The Taskforce estimates that Tasmania currently has an annual energy deficit between on-island generation and Tasmanian consumption of between 700 GWh and 1 000 GWh, based on long-term averages. This means Tasmania relies on interconnection with the mainland, though variability in inflows provides opportunities to export energy.
- While the risk of low inflows into Hydro Tasmania's dams can be managed in most instances (through drawing down the 'stock' of water held in storage, Basslink imports, gas generation and wind generation) the 2015-16 energy security event demonstrates that Tasmania's energy security is severely tested by concurrent events.

Definition and assessment of energy security in Tasmania

- Energy security definitions exhibit common features focussing on 'adequacy', 'reliability' and 'competitiveness/affordability'.
- Existing frameworks for assessing energy security use both quantitative and qualitative data and generally look across different time horizons.
- A transparent assessment of Tasmania's energy security risks would help promote business and household confidence in the Tasmanian economy and society.

- Tasmania's electricity energy security in the short term is assessed as Managed. Tasmania's electricity reliability is Resilient due to the number and diversity of generators, and a network that generally performs well against independent assessments. However, Tasmania lacks some competitiveness features and its on-island energy deficit is a less secure state than if local supply and demand were in balance.
- Tasmania's electricity energy security in the medium and long term is indicatively assessed as Managed. Tasmania has opportunities to strengthen this assessment over time, and this will depend on how: the on-island energy deficit is addressed; the network adapts to new generation forms and how customers manage their demand; and the realisation of consumer benefits that innovation in technology and services has the potential to deliver.
- Tasmania's gas energy security in the short term is assessed as being Susceptible. While the reliability of gas infrastructure is assessed as Managed, there is considerable uncertainty currently facing the market with respect to the adequacy of gas supply and its competitiveness.
- Tasmania's gas energy security in the medium and long term is indicatively assessed as being Susceptible, based on the current outlook for gas prices and supply.

Energy security oversight

- State and national arrangements for managing energy emergency situations, in particular capacity risks arising from sudden weather events, are well understood, practiced and implemented when necessary. Significant reforms are not needed for these emergency arrangements, but rather continuous improvement should be pursued through engagement, practice and learning amongst the key bodies and persons involved.
- Frameworks to monitor, assess and respond to avoid energy supply security threats becoming an emergency situation do not appear as defined as for emergencies resulting from capacity events.
- Existing arrangements are based on legislation that is two decades old and have not been updated for major changes in the energy market.
- Tasmania's energy security oversight would be improved by enhancing independent oversight of water storages in the context of all energy supplies and demand. This is a common feature of the hydro systems that the Taskforce examined, including Norway, New Zealand, Manitoba and Iceland.
- When energy supply threats increase, but before they become an emergency situation, there is a need for a clear authority in the State to coordinate and manage the situation from a State perspective.
- Clearer roles and responsibilities would also enhance independent oversight, create transparency and public confidence, and provide Hydro Tasmania with clarity and reduce perceptions of it being conflicted between commercial drivers and its role in maintaining energy security.
- Gas oversight arrangements could be strengthened through greater clarity between the Department of State Growth and the Director of Gas Safety.
- Regular assessments and communication of energy security risks would enhance public confidence.

Management of Tasmania's hydro-electric storages

- Additional generation sources outside the existing hydro and wind generation are required to prevent an annual reduction in storages under average, or below average, inflow conditions. In most cases, Basslink alone is a sufficient source of energy to maintain annual energy storage levels in times of low inflow. Thermal generation is currently depended upon if Basslink is unavailable.

- Hydro Tasmania's interim storage targets of between 30 and 40 per cent, together with the return of Basslink and higher inflows, have improved Tasmania's energy security at least over the next year.
- The establishment of a prudent storage level (PSL) profile, below which operation should be minimised or avoided and above which would allow Hydro Tasmania the freedom to operate commercially, would clearly articulate the Tasmanian Government's risk appetite to Hydro Tasmania.
- Hydro Tasmania's High Reliability Line concept of the unserved energy (USE) measure is based on a national standard that is accepted and well understood in the energy industry.
- The use of extreme low inflow sequences in modelling and planning will result in improved prudent planning for energy supply risks.
- Further work is required to set High Reliability Level (HRL) and PSL profiles to appropriately secure storage levels.
- The energy stored below Great Lake's Environmental Extreme Risk Zone (EERZ) may not be accessed even in high energy security risk situations.
- Other jurisdictions with a dominant hydro generation profile offer good examples of planning, communication and regulator involvement that can be leveraged for the Tasmanian energy system.
- Escalation of communication and responses is required when energy security risks increase to ensure that the public are aware of the risks involved and the actions being taken to mitigate these risks.

Impact of climate change

- Tasmania has experienced a downward trend in total annual rainfall and runoff since 1970, with the largest changes being observed in autumn. Concurrent with these decreases, a significant reduction in inflows to hydro-electric catchments has been observed in Tasmania since the mid 1970s, with an acceleration of the trend since the mid 1990s.
- Climate change is projected to decrease inflows in the central plateau catchments, which may have a significant impact on power generation as these feed into the major storage of Great Lake. Projected changes to the seasonality of inflows in the western catchments may also reduce power generation.
- These changes have implications for Hydro Tasmania's long-term average yield assumptions and management of water storages over the next 10 to 20 years, particularly Great Lake and Lake Gordon/Pedder.
- Seasonal and inter-annual rainfall variability will continue to pose the largest hydrological risks over the short to medium term, rather than long-term climate change impacts.
- Other climate change projections relevant to energy security include decreased summer and autumn wind speeds that may reduce wind generation capacity (and coincide with projected declines in inflows during these months), and an increase in extreme events that may affect electricity infrastructure (e.g. bushfires, intense rainfall events and flooding).

Role of gas for energy security

- The viability of the Tasmanian gas market appears susceptible given its scale and increasing supply and price risks associated with both gas commodity and pipeline access. The TVPS is currently an important factor in helping to support the viability of Tasmania's gas market.
- Gas generation is a common feature of hydro-electric systems across the world as a backup generation source to manage hydrological risk. However, gas generation has become increasingly uneconomic to operate in the NEM (particularly as base load generation) due to increased fuel and operational costs.

- In the absence of reliable alternatives, gas generation remains important to Tasmania to mitigate against hydrological and Basslink failure risks. As such, the TVPS provides a 'back-up' energy generation source for Tasmania.
- The contractual arrangements to support standby gas generation at the TVPS could be made on an as-needed basis. While this may be the most cost effective approach for Hydro Tasmania, it may result in greater transportation price increases for non-TVPS customers.
- There is also a risk that in a tight east coast gas market, contracting gas and pipeline access on an as–needed basis could be difficult, if gas commodity becomes fully (or near fully) contracted and pipeline storage becomes a valuable product in the Victorian gas market.
- Locking in long-term gas supply and transportation agreements in the current market comes with high costs and risks, and may forego the opportunity to add more cost effective energy supply options over the medium to long term.
- Transportation price increases to non-TVPS customers are limited by customers' capacity to pay, otherwise the risk of fuel switching or other actions will increase.
- In the medium to long term, the role of gas generation in Tasmania will depend on the competitiveness of gas relative to other energy sources. Similarly, gas will need to remain competitive to retain and attract gas consumers, or risk being transitioned out of the Tasmanian market through customer fuel switching.

Interconnection with the National Electricity Market

- Basslink represents the single largest alternative energy source for Tasmania after hydro-electric inflows and storages, meaning that it is also an important mitigation asset for hydrological risk. It can import up to 40 per cent of Tasmania's consumption needs and meet around a quarter of Tasmania's peak demand.
- In the absence of specific information or independent assessments since the outage, the Taskforce is currently not in a position to assess the reliability of Basslink into the future.
- However, based on how interconnectors (particularly subsea interconnectors) have performed historically in other jurisdictions, and having now experienced a six month outage, there is sufficient evidence to consider a six month outage of Basslink to be a scenario that should be planned for.
- In most scenarios, Tasmania can manage its hydrological risk without there being a challenge to energy security through Basslink imports alone. However, Tasmania should not solely rely on Basslink being available to ensure energy security and, hence, other contingencies are required in addition to Basslink.
- The future energy mix in the NEM and how it will be managed to maintain adequate and reliable supply is uncertain, meaning the implications for energy imports to Tasmania in the medium to long term are also presently unclear.
- The case for a second electricity interconnector appears to be more strongly linked to the potential benefits it may provide to the NEM in terms of maximising the role of hydro-electric generation in supporting greater renewable energy development both in Tasmania and on the mainland. Whether these benefits can be realised relative to the costs and technical issues that require resolving is a matter currently the focus of a joint Australian and Tasmanian Government feasibility study.
- Interconnection with the NEM is perhaps the most significant strategic issue facing Tasmania over the medium to long term. Greater interconnection could create more revenue opportunities for Tasmania from a higher priced NEM but could increase prices and load risk in Tasmania.

Renewable energy, emerging technologies and consumer participation

- During the 2015-16 energy security event, wind made an important contribution to meeting Tasmanian electricity demand. Without this contribution, additional draw down of hydro storages and/or additional load reductions would have been required to meet demand until sufficient temporary diesel generation was commissioned.
- Tasmania's current on-island energy deficit can be addressed by building additional renewable energy projects, which will also serve to diversify the State's generation mix and reduce its dependence on energy imports.
- Tasmania has a world class wind resource, but the cost competitiveness of wind could be challenged over time as the cost of other technologies decline. Large scale solar development should not be dismissed, despite Tasmania's resource being relatively more limited than mainland Australia.
- The potential role of other renewable energy sources such as wave, tidal, biomass and geothermal will depend on their competitiveness relative to other technologies and investor interest.
- Small scale renewable energy, such as household integrated solar photovoltaic (PV) and storage, has the potential to make a small contribution to reducing Tasmania's on-island energy deficit, but provides 'consumer-level energy security', whereby consumers perceive they have greater energy security when they are able to control some of their supply and demand.
- A more technologically advanced network could also improve the reliability of the network (particularly in the face of future challenges) and minimise the impact of emergency power restrictions if they were ever needed.
- There may be aggregate energy security benefits in the form of network optimisation when embedded storage technologies are combined with new products and services (e.g. time-of-use tariffs, advanced meters) that allow consumers greater control and choice over their own energy use.
- Greater consumer control and choice can also enable improved energy efficiency. Tasmania's building stock is relatively old and there is an opportunity to improve the energy efficiency in residential homes and commercial premises.
- While there are a range of predictions regarding the rate of take-up of new technologies and services, changes in other sectors have occurred more rapidly and differently than thought possible.
- Electric vehicles may assist in reducing Tasmania's dependence on liquid fuels in the non-stationary energy sector in the longer term and provide other benefits to the State.

Priority Actions and Recommendations

Table 1 presents the Taskforce's five priority actions and the recommendations to the Tasmanian Government that support those actions. The recommendations are organised logically with each of the priority actions rather than presented sequentially in recommendation number order, as presented through the body of the Interim Report. Readers should refer to the recommendations in the chapters to understand the context in which they have been made.

Table 1 Priority actions and recommendations

Priority Actions	Recommendations	Number in Report
1. Define energy security and responsibilities	The following definition of energy security should be adopted for Tasmania: Energy *security is the adequate, reliable and competitive supply of low carbon emissions energy across short, medium and long-term timeframes that supports the efficient use of energy by Tasmanians for their economic and social activities.*	1
	Responsibility for developing an energy security policy that clearly articulates Tasmania's approach to energy security should rest with the Department responsible for the energy portfolio.	2
	Responsibility for monitoring and assessing energy security should rest with an external body with pre-established market monitoring capabilities. A new Monitor and Assessor role should be established to provide independent oversight and transparent public reporting. The Tasmanian Economic Regulator (TER), the Australian Energy Market Operator (AEMO) and the Director of Energy Planning are identified as potential authorities to undertake the Monitor and Assessor role.	3
	An Energy Security Coordinator role should be established to coordinate responses across market participants to manage electricity supply risks when water storages are near or below an identified 'energy security reserve' level. TasNetworks (preferably the Responsible Officer) or AEMO are identified as potential options for the Energy Security Coordinator role.	6
	Where necessary, legislation should be enacted or amended to ensure relevant officers or bodies have the appropriate functions and powers to support the roles and responsibilities. More efficient organisation of policy and regulatory resources across Government should also be investigated, to improve role clarity and the critical mass of existing small resources spread across several agencies.	7
	A review of the Director of Energy Planning's role, the *Energy Planning and Coordination Act 1995* and the *Electricity Supply Industry Act 1995* (at least as it relates to energy security matters) should be undertaken to modernise and streamline arrangements with the other reform considerations.	8
	The Department of State Growth should limit itself to a policy role with respect to gas energy security, with the Monitor and Assessor role considering forward gas supply and demand risks as part of its broader consideration of energy security. The Director of Gas Safety should be responsible for engaging and coordinating responses with industry and gas customers on potential or actual emergency gas supply risks as they emerge.	10
	The Tasmanian Government should explore whether AEMO should have a role in the Tasmanian gas market, given the Tasmanian Gas Pipeline (TGP) is now connected to the Victorian Declared Wholesale Gas Market.	11

Priority Actions	Recommendations	Number in Report
2. Strengthen independent energy security monitoring and assessment	Additional resources of sufficient size to maintain capability should be provided for the monitoring and assessing function. Funding for these resources could initially come via a Budget appropriation, though a regulatory charge on relevant market participants to ensure the function is sustainable would appear appropriate as a permanent funding source.	4
	The Monitor and Assessor role should utilise existing expertise where possible, such as within TasNetworks (particularly its modelling capacity).	5
	The Monitor and Assessor role should publish an annual assessment of Tasmania's energy security status and make available on a website a dynamic (at least monthly) forecast of energy supplies relative to forecast Tasmanian consumption, as well as an assessment of hydrological risk.	9
	Hydro Tasmania should undertake an annual review and forecasting process in October each year, near the end of the high inflow season between May and October. This should provide sufficient time to implement measures, if required, to maintain energy security over the dry period from November to April and beyond if dry conditions continue into May, as has historically occurred. The annual review should be independently verified by the Monitor and Assessor and the outcomes transparently made publicly available as part of the annual assessment.	18
3. Establish a more rigorous and widely understood framework for the management of water storages	A High Reliability Level (HRL) should be adopted as the threshold to which reserve water is held for energy security purposes, where the reserve is sufficient to withstand a six month Basslink outage coinciding with a very low inflow sequence, and avoid extreme environmental risk in Great Lake.	12
	A prudent storage level (PSL) should be set to create a 'storage buffer' from the HRL that is sufficiently conservative that the likelihood of storages falling below the HRL is very low.	13
	While the Taskforce will engage further with Hydro Tasmania before recommending in its Final Report the PSL and HRL profiles, the PSL should be no lower than the interim storage targets Hydro Tasmania has put in place (40 per cent by the end of spring and 30 per cent by the end of June 2016).	14
	Future changes to the HRL and PSL should only be considered when there are material changes to supply and/or demand, and require endorsement by the Monitor and Assessor.	15
	Energy stored in Great Lake below the Environmental Extreme Risk Zone (EERZ) should be clearly identified as constrained when communicating total energy in storage levels.	17

Priority Actions	Recommendations	Number in Report
	A transparent scale of escalating actions should be implemented as energy in storage approaches lower levels with higher energy security risk. The following response levels should be implemented. • 'Commercial operation' - if storage levels are above the PSL, Hydro Tasmania operates commercially and with only routine reporting obligations. • 'Increased monitoring' - if Hydro Tasmania's forecasts indicate plausible scenarios of falling below the PSL, or storages actually falling below the PSL, Hydro Tasmania would provide the Monitor and Assessor with a recovery plan that demonstrated how storages are intended to be returned above the PSL. • 'Increased response' - if Hydro Tasmania's scenarios indicate plausible scenarios of needing to access storages below the HRL, Hydro Tasmania would be required to provide a recovery plan that demonstrated how storages will be maintained to avoid entering the HRL or, if deemed unavoidable, how storages will be returned above the HRL once entered. • 'Energy security reserve' – if operating storages under the HRL, Hydro Tasmania would be required to work with the Energy Security Coordinator to ensure the recovery plan is being implemented and is working as intended.	19
	Hydro Tasmania could be required to seek authorisation from the Energy Security Coordinator to access energy security reserve storage below the proposed HRL, and the authorisation would be subject to a clear plan to return storages above this level.	16
	Hydro Tasmania should be required, through an appropriately robust governance mechanism (legislation or through a ministerially directed mechanism), to comply with the proposed Energy Security Risk Response Framework.	21
	Contingency measures should be evaluated using a competitive process to determine the most effective supply and/or demand measures, with key criteria used to select preferred options. The criteria should include cost, reliability and environmental impact.	20
	More conservative assessments of hydro generation output and consideration of potential seasonal changes to average wind speeds should be included in energy security planning to account for the combination of climate change impact projections and historical rainfall variability. All historical low inflow sequences should be used to assess risks, not just those associated with more recent trends.	22
	Hydro Tasmania should specifically model lower inflows into Great Lake that are projected as a result of climate change, and advise the Monitor and Assessor of the implications for balancing storages across the hydro system and any increased dependence on one (particularly Lake Gordon) or more storages.	23
	Hydro Tasmania and TasNetworks should closely engage with the Bureau of Meteorology and other experts to fully understand the opportunities to use improved climate modelling and weather forecasting for underlying assumptions of historical and future rainfall, wind variability and extreme events.	24
	The TER should seek an independent appraisal of Basslink's asset management plans (including its Marine Disaster Recovery Plan) as soon as possible.	28
	Energy security planning should include planning for at least a six month Basslink outage.	29

Priority Actions	Recommendations	Number in Report
4. Retain the TVPS as a backup power station for the present and provide clarity to the Tasmanian gas market.	The TVPS, particularly the combined cycle gas turbine (CCGT), should be retained at least until there is a reliable alternative in place to mitigate against hydrological and Basslink failure risk.	25
	Commercial negotiations currently underway to resolve the gas commodity and transportation arrangements to support the TVPS should be allowed every opportunity to be realised with an agreement to be in place before the Taskforce's Final Report is completed.	26
	Agreed key features to be included in a new contract between Hydro Tasmania and the TGP's owner should be communicated to the Tasmanian gas market by the end of first quarter of 2017.	27
5. Support new on-island generation and customer innovation	The Tasmanian Government should ensure that new entrant renewable energy development is able to establish in Tasmania where such an outcome is consistent with that which would be expected to be seen in a competitive market.	30
	Direct negotiations with new renewable energy projects that are already progressed and have a sound business case should not be delayed because of the Taskforce's work.	31
	The Tasmanian Government should prudently facilitate, enable and ensure there are no unnecessary barriers to consumer-controlled energy management opportunities and choices, as a contribution to reducing Tasmania's energy deficit, optimising network outcomes and improving competitiveness for consumers.	32

1. Introduction

1.1 Background

During 2015-16 Tasmania experienced one of the most significant energy security challenges in its history. The combined impact of two extreme events – record low rainfall during spring together with the Basslink interconnector being out of service – resulted in Hydro Tasmania's water storage levels falling to historically low levels.

Following the implementation of an Energy Supply Plan and the breaking of dry conditions in May 2016, water storages have returned to much higher levels than they have been in recent years.

As a result of these events, and in parallel with the Energy Supply Plan, the Tasmanian Government established the Tasmanian Energy Security Taskforce (the Taskforce) to advise Government on how it can better prepare for and mitigate against the risk of future energy security threats.

1.2 Terms of Reference

The Taskforce has been established by the Minister for Energy as a Committee under section 12 of the *Energy Co-ordination and Planning Act 1995*. The Taskforce was formally constituted by legal instruments on 15 June 2016 for the purpose of undertaking an independent energy security risk assessment for Tasmania, having regard to the following matters:

a. best practice water management including consideration of water requirements across a range of stakeholders;
b. Tasmania's future load growth opportunities and risks and likely impact on projected energy supply and demand;
c. the opportunity for further renewable energy development in Tasmania, including in wind, solar, biomass and other renewable technologies considered in the context of anticipated transition of the national electricity market and the potential for a second interconnector;
d. likely developments in technology including battery storage and electric vehicles;
e. Tasmania's future exposure to gas price risk;
f. the potential impact of climate change on energy security and supply; and
g. a review of energy security oversight arrangements.

In carrying out its assessment, the Taskforce's Terms of Reference state that an interim progress report must be provided to the Minister for Energy within six months from its establishment. A final report is to be provided within 12 months, which is to include recommendations to the Tasmanian Government on appropriate energy security risk mitigation measures.

1.3 Taskforce members

Geoff Willis – Chair

The Taskforce is chaired by Mr Geoff Willis AM, former Chairman of Aurora Energy and Chief Executive Officer of Hydro Tasmania. Mr Willis has extensive experience in the energy sector and was a Member of the Australian Energy Market Commission Reliability Panel.

Sibylle Krieger

Ms Sibylle Krieger is a non-executive director and former partner with Clayton Utz. She is a lawyer with extensive energy experience in the regulatory sphere having been a member of the Independent Pricing and Regulatory Tribunal in New South Wales for six years. Ms Krieger is currently a non-executive director of the Australian Energy Market Operator.

Tony Concannon

Mr Tony Concannon is currently Chair of a solar energy start-up and formerly an executive director of International Power (a Financial Times Stock Exchange 50 corporation). He is an engineer with extensive international experience in all forms of energy generation and other aspects of energy business. Mr Concannon is an accomplished public figure having chaired the Electricity Supply Association of Australia for three years.

1.4 Approach adopted by the Taskforce

The Taskforce has approached its tasks by:

- discussing with the Minister for Energy the Taskforce's Terms of Reference to ensure their context was clear early;
- engaging with stakeholders and the broader community;
- establishing a secretariat consisting of staff with a broad range of energy sector experience;
- engaging external expert advice to assist the Taskforce with the strategic direction of its work program and on specific topics; and
- taking an evidence-based approach to its work.

Upon its establishment, and in consultation with the Minister for Energy, the Taskforce has interpreted its Terms of Reference with regard to the context in which it has been asked to undertake its review. This led to the following approaches to specific elements of its Terms of Reference.

- The Taskforce's focus is predominantly on the stationary energy sector in Tasmania and not the non-stationary (transport) sector.
- Water management is being considered in terms of the availability of water for the purpose of electricity generation. The requirement in the Terms of Reference to consider water management across a range of stakeholders will be addressed through considering the impact other water uses have on water availability for electricity generation.
- Consideration of Tasmania's future exposure to gas price risk will include a broader consideration of the overall Tasmanian gas market in the context of energy security.

As guided by its Terms of Reference, the Taskforce has to date undertaken its work program across the following key themes:

- energy security in Tasmania (definition and assessment);
- energy security oversight;
- management of hydro-electric storages;
- impact of climate change;
- role of gas for energy security;
- renewable energy and emerging technology;
- interconnection with the National Electricity Market (NEM); and
- scenario modelling and assessment.

While energy (primarily petroleum products) for transportation purposes is also critical to Tasmania's energy security at present, the Taskforce's Terms of Reference are focused on the stationary energy sector and do not include undertaking a detailed assessment of the non-stationary energy sector. However, the definition and framework to assess and monitor Tasmania's energy security that is provided in this Interim Report may be adaptable to transport fuels.

The Taskforce is being supported by a five person Secretariat seconded from within State Government and the energy sector. Boston Consulting Group (BCG) has been engaged as a strategic advisor to help the Taskforce frame how it will undertake its assessments and to provide additional insight into how the energy sector could change over the next 10-20 years. An independent expert consultant, Oakley Greenwood, has also been engaged to assist the Taskforce work through the challenges facing the Tasmanian gas market in the context of overall energy security. Other independent expert consultants may be engaged by the Taskforce as it works towards delivering its Final Report.

The Taskforce's Terms of Reference require it to consult with relevant stakeholders and the broader community as part of its work. The Taskforce released a Consultation Paper on 3 August 2016 seeking the views of stakeholders interested in the energy supply security challenges for Tasmania. Submissions were received from large and small customer representatives, industry bodies and key energy sector participants. Across the 32 submissions received there have been useful insights and consistent messages against the Taskforce's Terms of Reference that the Taskforce has taken into consideration when developing its views.

The Taskforce has also actively met with relevant stakeholders (including industry participants and key customers or their representative organisations) and this has provided important information and context additional to what the Taskforce has learnt through the Consultation Paper process.

The Taskforce has adopted an evidence-based approach to undertaking its energy security risk assessment. The findings and recommendations contained within this Interim Report have been developed on the basis of information made available to the Taskforce. While much of the Taskforce's thinking has been guided by analysis undertaken by the Secretariat and the Taskforce's external expert advisors, information provided by stakeholders has also been an important consideration in the Taskforce's deliberations.

As required under its Terms of Reference, this Interim Report provides a progress report on the Taskforce's work to date. It contains the Taskforce's assessment of short term (1-5 years) and preliminary assessment of medium (5-10 years) and long (beyond 10 years) term energy security in Tasmania, having regard to the specific issues that its Terms of Reference require it to investigate. It includes initial findings and recommendations to the Tasmanian Government for priority actions to support Tasmania's energy security.

1.5 Structure of Interim Report

The Interim Report has been structured so that the Executive Summary can be read as a standalone document from the full report. The Executive Summary includes a summary of the Taskforce's key findings, priority actions and recommendations.

The body of the Interim Report is organised into parts and contains detailed information and analysis that underpins the discussion, priority actions, findings and recommendations that are contained within the Executive Summary.

Part A provides the context for energy security in Tasmania and describes Tasmania's energy system. This part also sets out how the Taskforce defines energy security, the framework it uses to assess Tasmania's energy security, and presents the Taskforce's assessment against that framework. Tasmania's energy security oversight arrangements are also reviewed in this part.

Part B provides an overview of storages and inflow sensitivities and then discusses the review of prudent water storage management undertaken to date. Proposed improvements to communication and response frameworks are also presented. Part B also includes the Taskforce's understanding of the implications of climate change.

Part C discusses the challenges facing the Tasmanian gas market and what these challenges potentially mean for the role of gas generation and gas use in the State, in the context of energy security.

Part D discusses Basslink's history, its reliability and its value to energy security in Tasmania. Part D also summarises the status of work currently underway to examine the feasibility of a second electricity interconnector across Bass Strait.

Part E provides an account of trends in various renewable energy sources and their potential for use in Tasmania. This part also discusses emerging technologies and customer participation opportunities and challenges.

Appendix 1 provides an indicative set of performance indicators and measures which the Taskforce has used to support its energy security assessments. Other appendices provide more detailed information on existing energy security oversight arrangements, modelling assumptions, and examples of what the Taskforce has learnt from other jurisdictions.

1.6 Next steps

The Interim Report has set out the Taskforce's assessment of Tasmania's energy security risks and, in doing so, has identified strengths and areas which require action to improve Tasmania's energy security.

The Taskforce has concentrated more closely on the short term to ensure Tasmanians can be confident that, following the events of 2015-16, their energy needs can be met.

The Taskforce is required to deliver its Final Report by June 2017, in accordance with its Terms of Reference. The Taskforce intends to focus its attention in the Final Report more to the medium and long term, including by evaluating options that can address some of the issues and challenges that it has identified in the Interim Report.

The Taskforce will use a robust methodology and framework to evaluate options and will consider both supply and demand side opportunities. As part of that process, the Taskforce has developed, with the assistance of BCG, the following criteria:

- 'Availability' – solutions that improve Tasmania's resilience to shocks;
- 'Affordability' – solutions that are low in expected system costs, are viable under a range of future fuel price scenarios, and do not unfairly impact particular user groups;
- 'Environmental sustainability' – solutions that have low impact on land, water and air quality;
- 'Regulation' – solutions that are consistent with energy policies and energy security objectives; and
- 'Economic development' – solutions that support the sustainability of the Tasmanian economy.

The Taskforce expects that its evaluation of options will produce outcomes where options do not necessarily meet all the above criteria, and that some options will be stronger against some criteria than others. The Taskforce may need to use some judgement regarding the trade-off between options that satisfy different criteria by differing degrees, to determine a 'holistic view' of the best options.

The Taskforce has made indicative energy security risk assessments for the medium and long-term periods in the Interim Report. To support the evaluation of options, the Taskforce will undertake more detailed scenario analysis for its Final Report and finalise the energy security risk assessments for these periods. These scenarios will include changes to both supply and demand, which will address the term of reference relating to load growth risks and opportunities more explicitly than has been done in this Interim Report. The Taskforce will use existing projections (such as those produced by AEMO) where possible, though will consider variations or additional scenarios where existing projections do not extend to realistic possible futures for Tasmania. The Taskforce canvassed potential scenarios in its Consultation Paper and will use this as a basis to proceed with this work.

The Taskforce envisages that the opportunities that it evaluates will assist the Tasmanian Government to make strategic decisions about how best to enhance and maintain Tasmania's energy security over time, consistent with the definition of energy security the Taskforce has recommended. The Taskforce anticipates that its Final Report will assist the market to respond to opportunities in Tasmania, and the Tasmanian Government will mainly act as a facilitator, where appropriate, where there is a compelling case that the market alone will not deliver an outcome that is in the State's best interests. This may be the case, for example, where the lack of competition impedes outcomes which would logically be expected in a fully competitive environment.

The Taskforce finalised the Interim Report on 28 November 2016 in readiness for publication. In this context, any reports or studies relevant to the Taskforce's Terms of Reference that may have been released since that date have not been considered when developing the Interim Report. The Taskforce will consider relevant reports and studies released after that time during the development of the Final Report.

Following the delivery of the Interim Report to the Minister for Energy, the Taskforce will begin planning its work for the Final Report in the final weeks of 2016 and into the early part of 2017. The Taskforce expects that it will undertake considerable analytical and modelling work in the first quarter of 2017, and will seek to leverage the expertise and resources of others where appropriate (such as the national energy market institutions). The Taskforce will also continue to engage with key industry participants and customer representatives on the development of its Final Report.

The Taskforce expects that the drafting of its Final Report will occur through the early part of the second quarter of 2017, so that it can meet its Terms of Reference and submit the Final Report to the Minister for Energy in June 2017.

Part A

Energy Security Assessment and Oversight

2. Energy Security Context

KEY FINDINGS

- As an island that is small in population and isolated from major markets, Tasmania needs to place additional emphasis on ensuring its energy security.
- Tasmanian demand is unusual in the NEM due to the substantial requirements of four large major industrial customers, who account for around 55 per cent of the State's electricity load.
- Because of the importance of energy security to households and businesses, the responsibility for energy security ultimately rests with Government.
- Energy security comes at a cost which is ultimately borne by Tasmanian consumers, either through the prices they pay or through the impact on the financial returns of Government businesses.
- Tasmania has experienced four energy security events this century that have been classed as low probability. This recent history indicates that two or more separate low probability events can occur within a short period.

2.1 The importance of energy security to Tasmania

Energy security is vital to support the functioning of modern society. Arguably its importance is increasing as technology dependence within workplaces, homes, public spaces and transport also increases. The state-wide black out experienced in South Australia in September 2016 is evidence of both the impact a loss of energy supply can create (both during and after the event), as well as how intrinsically dependent people are on energy.

Tasmania is no different with regard to its dependence on energy and indeed, is a relatively energy intensive state in the national context, given the presence of major industrial businesses and a cool climate where energy is important for home heating. It is reasonable to assume that Tasmania's economy would suffer significantly from a lack of energy security, with the withdrawal of capital from the State and consequential job losses. Tasmania's industry profile would also look significantly different, with industries that are more reliant on energy being less dominant than they are currently. Economic impacts would create and compound social impacts, including health and education outcomes.

As an island that is small in population and isolated from major markets, Tasmania needs to place additional emphasis on ensuring its energy security, compared with larger and more interconnected population centres on the mainland. This contention is supported by a report by EURELECTRIC in 2012, which examined small European island communities.[1] Three of the major challenges identified in that report resonate with Tasmania's situation.

- Market failure – due to their small size, islands lack economies of scale in financing and power production.
- Inconsistent regulation – islands too often suffer from 'copy-paste' reasoning, whereby solutions from the mainland are applied to a different reality. Island markets are different and therefore require a different approach that is both reasonable and proportionate.
- Security of supply – due to their isolation, islands have to take extra measures to ensure system stability and security of supply.

Fortunately, Tasmania has a number of advantages and strengths that many other small islands do not have (e.g. significant hydro-electric capacity, significant renewable energy resources, interconnection with

[1] EURELECTRIC, 2012, *EU Islands: Towards a Sustainable Energy Future.*

the mainland), and the State is well placed to obtain resilient levels of energy security into the future with appropriate planning, investment and management.

Because of the importance of energy security to households and businesses, the responsibility for energy security ultimately rests with government. Markets generally function well and deal successfully with many supply and demand challenges without the need for intervention, but where this is not the case, it is essential that governments have frameworks in place to 'step in' to maintain or restore energy security where necessary.

The Taskforce has considered the community and the Tasmanian Government's 'risk appetite' to energy security threats, given there is a cost to higher levels of security of energy supplies. Tasmania could have 'low insurance' levels, whereby the costs would be lower most of the time but the risk of significant events, such as those Tasmania has experienced this century, are higher (and come with significant costs when they occur). Alternatively, Tasmania can have a higher insurance level, where costs are spread more evenly over time and the risk of significant events is minimised. Consistent with the incidence of recent events and the feedback received through consultations, the Taskforce considers that a higher level of insurance is now appropriate. Such an approach also more equitably shares the benefits and costs of energy security across generations.

2.2 Historical energy security challenges in Tasmania

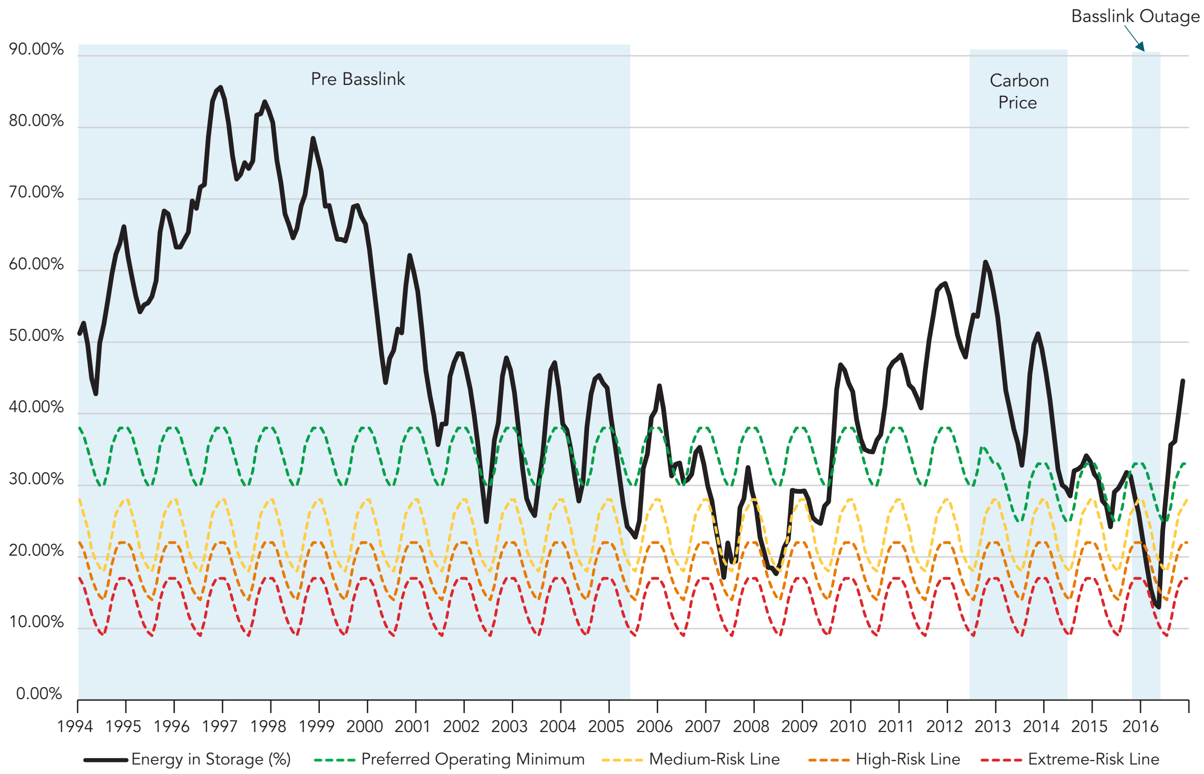
The series of events that occurred in Tasmania during 2015-16 represented the most significant energy security risk to Tasmania since 1968 (when power rationing occurred). A record dry spring in 2015 (with continued dry conditions through to the end of April 2016) resulted in very low inflows into Hydro Tasmania's dams. This coincided with the first prolonged outage of the Basslink electricity interconnector, which lasted from late December 2015 to June 2016.

The concurrence of these events saw water storages fall well below Hydro Tasmania's preferred operating minimum level to as low as 12.5 per cent (refer Figure 2.1), before significant rainfall from May 2016 rapidly returned water storage levels to lower risk levels. The availability of the combined cycle gas turbine (CCGT) at the Tamar Valley Power Station (TVPS), and the process that was underway to seek expressions of interest to sell the unit, has been highlighted as a contributing factor by some stakeholders who made submissions to the Taskforce.

The 2015-16 energy security event was managed through the implementation of an Energy Supply Plan, which included using gas generation at the TVPS (including the recommissioning of the CCGT), wind generation, temporary diesel generation and commercially agreed demand reductions from some major industrial customers. These measures partially offset the need for hydro-electric generation and, therefore, slowed the rate of decline in water storages.

While the Energy Supply Plan was successful in slowing the rate of decline in water storages until winter rains arrived, the energy security situation created significant concern and uncertainty for Tasmanian businesses and households. Some businesses (particularly major industrials who reduced load) reported loss of customers as they reduced production, with the recovery of these impacts lasting beyond the return of Basslink and the point when storages began to increase. Similarly, some businesses were exposed to price shocks through direct spot price exposure or their contracts coming due for renewal (where contract prices were being impacted by spot prices).

Figure 2.1 Energy in Storage versus Hydro Tasmania's preferred operation minimum and risk lines, 1994 to 2016



Source: Hydro Tasmania data
Note: Historical data begins in 1994, which represents the year where the current hydro-electric capacity was reached with the commissioning of Tribute Power Station. Risk lines shown in the figure were introduced with the commissioning of Basslink in 2005.

As illustrated in Figure 2.1, the 2015-16 event is not the only recent threat Tasmania has experienced to its energy security. Between 2007 and 2009, water storages also fell below Hydro Tasmania's preferred operating minimum level (to a low of 17 per cent in May 2007) as a consequence of a prolonged dry period and low inflows. This event saw the then Tasmanian Government acquire the TVPS in 2008. Prior to the commissioning of Basslink, low water storages between 2002 and 2003, and again in 2005 saw responses which included commercial arrangements between Hydro Tasmania and major industrial customers to 'buy back' energy.

Arguably Tasmania's most significant energy security threat was in 1968. Tasmania's energy system was very different at that time compared with today, with the hydro-electric system being the only material source of energy and its capacity yet to reach its current level. Drought conditions resulted in there being low water storages and consequently power rationing was introduced as part of the response, authorised via emergency legislation that passed the Tasmanian Parliament in the spring of 1967 following a very dry winter. The 1968 event was also the reason for the commissioning of the former thermal Bell Bay Power Station.

These historical events indicate that Tasmania is susceptible to energy security risks, and that the response on each occasion was informed by the conditions and the availability of options at the time. Each of these experiences, particularly the most recent events, provide an opportunity to learn and consider how mitigation and responses can be enhanced for the future.

The cost of potential investments to strengthen energy security needs to be balanced against the probability of supply risks eventuating. Hydro Tasmania has stated that it has assessed the probability of the recent 2015-16 experience to be lower than a 1 in 3 000 year event.[2] In 2012, the Electricity Supply Industry Expert Panel (the Expert Panel), which was established by the Tasmanian Parliament to undertake an independent review of the Tasmanian electricity industry, reported that *"[a]ccording to Hydro Tasmania, the hydrological circumstances over the first decade of the century reflected 1 in 1 000 year outcomes."*[3] While these events were considered to have a low probability of occurring, recent history indicates that two or more low probability events can occur within a short period.

2.3 Recent reforms and policy

The Taskforce's focus on energy security cannot be undertaken in isolation from understanding the structure of the Tasmanian energy industry and how it developed. Throughout most of the twentieth century, the development of large scale hydro-electric schemes by the former Hydro-Electric Commission (HEC) supported Tasmania's industrial development and modernisation. The focus of successive Tasmanian Governments over this period for energy policy was, therefore, strongly driven by economic development objectives.

As the large scale hydro-electric generation development era ended (which many people associate with the Australian Government's intervention to stop the Gordon below Franklin scheme in the early 1980s), the next significant development occurred in the 1990s. Driven by National Competition Policy, the HEC was 'corporatised' in 1995 and the business separated in 1998 into Hydro Tasmania (as the generating business), Transend (the transmission business) and Aurora Energy (the distributor and retail business).

Tasmania was joined to the national gas network in 2002 with the commissioning of the Tasmanian Gas Pipeline (TGP). In 2005, Tasmania joined the National Electricity Market (NEM) when the Basslink electricity interconnector was commissioned, physically allowing the transfer of electricity to and from Tasmania and Victoria. Entry into the NEM also saw Tasmania progressively open its electricity market to retail contestability, which occurred in tranches starting with large customers and finally ending with residential and small business customers (although a competitor to Aurora Energy for residential customers has yet to emerge).

In 2012, the Expert Panel released its Final Report, which recommended significant structural reform to Tasmania's electricity industry. In response to the Expert Panel's recommendation, the then Tasmanian Government implemented a number of actions, including the separation on 1 July 2014 of the distribution business out of Aurora Energy (which resulted in Aurora Energy becoming a stand-alone retailer) and the creation of TasNetworks as the network business (combining transmission and distribution). The Tasmanian Government also decided to transfer the TVPS from Aurora Energy to Hydro Tasmania on the basis that Hydro Tasmania was best placed to optimise gas generation as part of its overall generation portfolio in the context of the TVPS providing an energy security role for the State.

In May 2015, the current Tasmanian Government released its Energy Strategy, *Restoring Tasmania's Energy Advantage*. The Strategy focusses on delivering affordable and predictable prices, and leveraging economic opportunities from our energy sources and infrastructure, in an environment of significant change in the energy sector.

This recent history is backed by significant legislative reform, policy decisions and governance frameworks. Some of these have implications for how energy security is managed today, particularly through the various roles and responsibilities that have evolved over time (and sometimes as outcomes of other objectives).

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2 Hydro Tasmania transcript from appearance at the Parliamentary Standing Committee of Public Accounts inquiry, 1 September 2016.
3 Electricity Supply Industry Expert Panel, 2016, *An independent review of the Tasmanian electricity supply industry, Final Report, Volume 1.*

3. Tasmania's Energy System

KEY FINDINGS

- Tasmania's energy system is diverse, though dominated by hydro-electric generation (which represents three quarters of stationary energy use) and liquid fuels (for non-stationary/transport energy use).
- Tasmania's electrical energy system is energy constrained rather than capacity constrained – this means that Tasmania has sufficient generators to meet peak demand, but that the fuel sources (principally water) for these generators to operate can sometimes be in short (and even critically low) supply.
- The Taskforce estimates that Tasmania currently has an annual energy deficit between on-island generation and Tasmanian consumption of between 700 GWh and 1 000 GWh, based on long term averages. This means Tasmania relies on interconnection with the mainland, though variability in inflows provides opportunities to export energy.

While the risk of low inflows into Hydro Tasmania's dams can be managed in most instances (through drawing down the 'stock' of water held in storage, Basslink imports, gas generation and wind generation), the 2015-16 energy security event demonstrates that Tasmania's energy security is severely tested by concurrent events. Tasmania's energy system is diverse, though dominated by hydro-electric generation for stationary energy use and liquid fuels for non-stationary energy use (transport). Figure 3.1 illustrates energy supply and end use in Tasmania.

The Taskforce's Terms of Reference dictate a primary focus on stationary energy. An energy system needs both adequate supplies of energy in the form of energy sources (water, wind, gas, etc), and enough generation capacity (primarily power stations but can include interconnectors to other energy systems) to ensure consumers' energy needs can be met at any point in time (demand), and over time (consumption). There also needs to be a safe and reliable network to convey energy from generators to customers.

3.1 Tasmania's electrical system capacity

Large scale renewable energy currently comprises 87 per cent of Tasmania's total on-island installed generation capacity, with 2 281 MW of installed hydro-electric generation and 308 MW of wind generation. This large scale renewable generating capacity is supplemented by distributed (or embedded) renewable generation, predominantly in the form of household solar photovoltaic (PV), as shown in Figure 3.2.

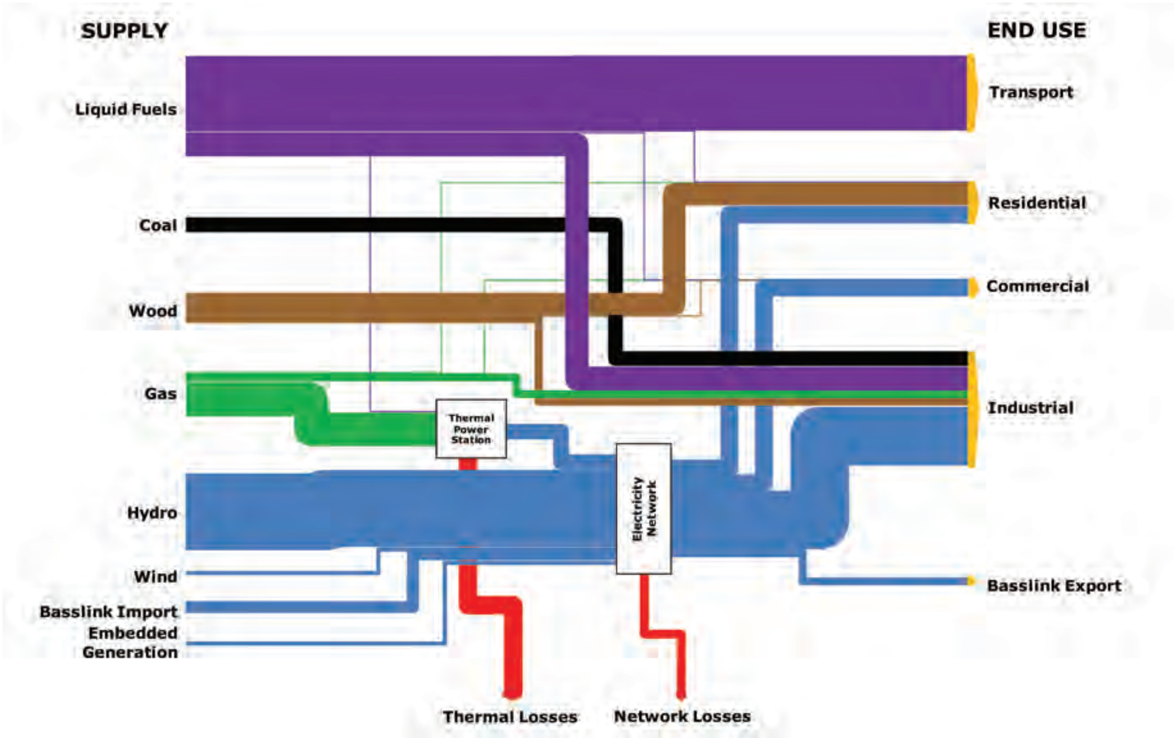
Tasmania's hydro-electric generation capacity is provided by 30 power stations in six major catchments, which cover a large proportion of the western and central areas of Tasmania (refer Figure 3.3). The system is comprised of two major storages (Lake Gordon/Pedder and Great Lake), five seasonal storages and a number of run-of-river storages which utilise seasonal flows.

The State's wind generation capacity is comprised of three large scale wind farms - Woolnorth Bluff Point Wind Farm (65 MW) and Woolnorth Studland Bay Wind Farm (75 MW) in the north west of the State, and Musselroe Wind Farm (168 MW) in the north east.[4] The combined output from the three wind farms in 2014-15 was 898 GWh, which accounted for nearly 10 per cent of electricity generated within Tasmania in that year.[5]

4 The three wind farms are managed and operated by Woolnorth Wind Farm Holdings, a joint venture between Hydro Tasmania (25 per cent share) and Shenhua Clean Energy Holdings (75 per cent).

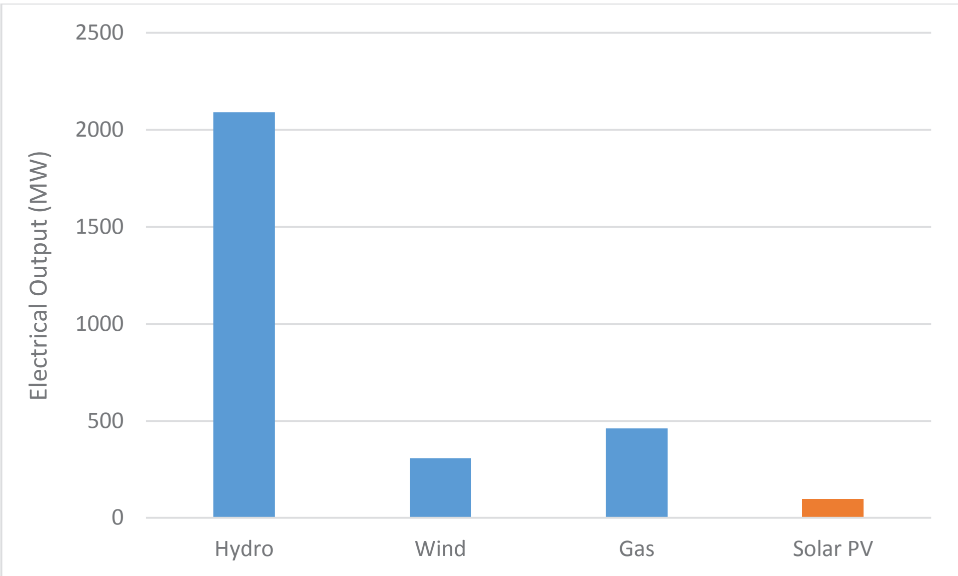
5 OTTER, 2016, *Energy in Tasmania – performance report 2014-15*. Report for 2015-16 not yet released.

Figure 3.1 Tasmanian energy flows (2013-14)



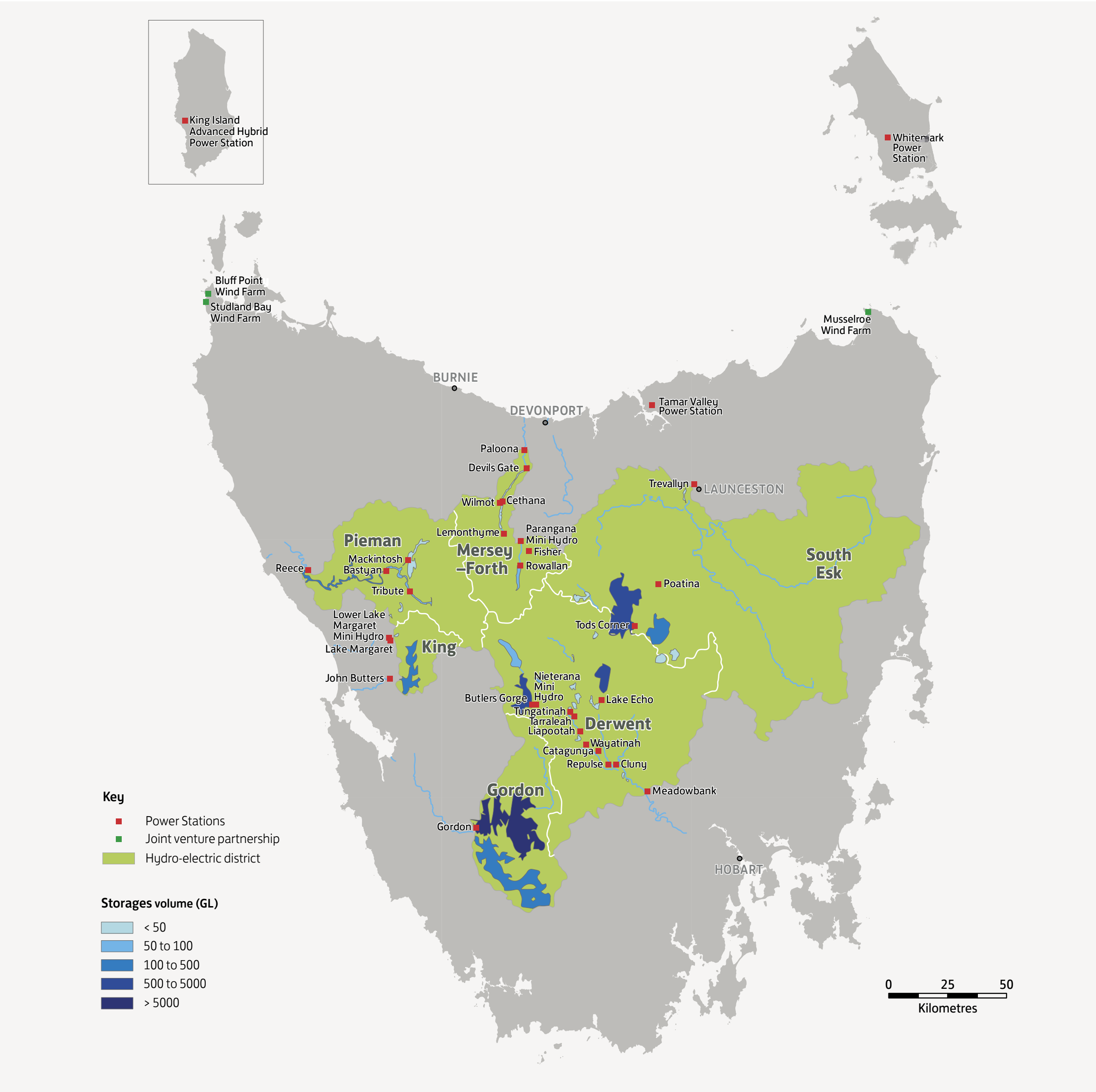
Source: OTTER, 2015, *Energy in Tasmania – Performance Report 2014-15*

Figure 3.2 Total on-island installed electricity generating capacity in Tasmania



Source: OTTER, 2016, *2016 Tasmanian Electricity Network Reliability Review*

Figure 3.3 Hydro Tasmania's catchment areas and power stations



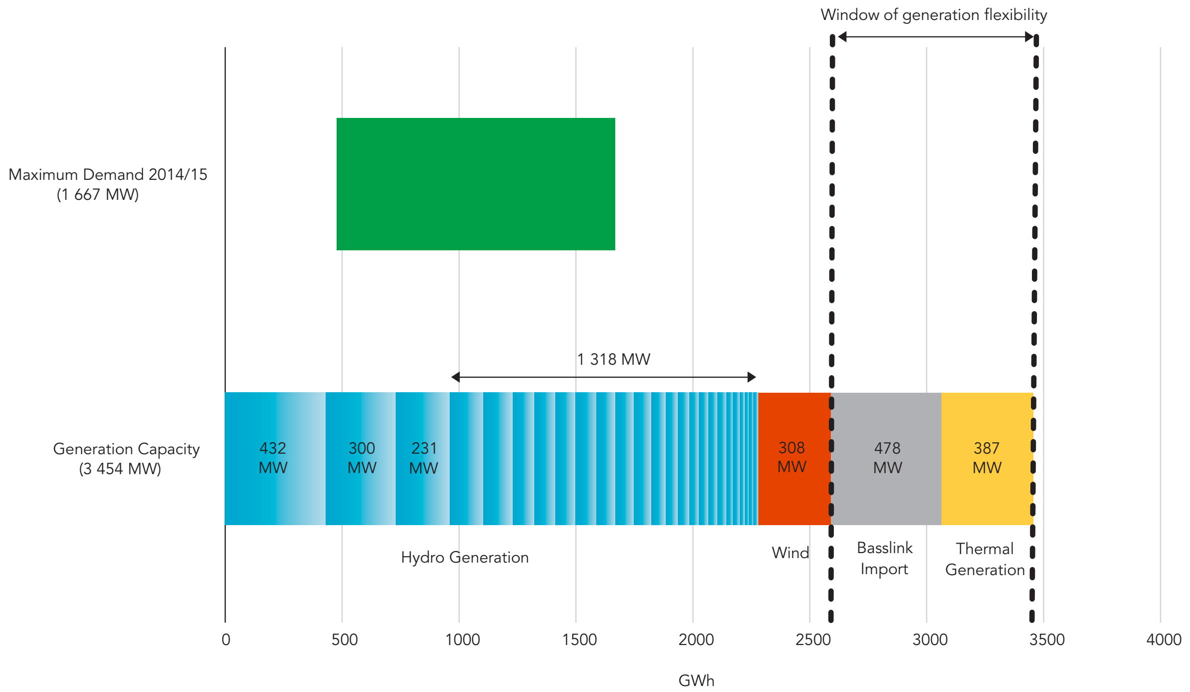
Source: Hydro Tasmania, 2016, *2016 Annual Report*

In recent years there has been an increasing trend of consumer led small-scale embedded generators connecting to the distribution network, particularly household solar PV. Solar PV currently produces around 100 GWh per annum, which represents approximately 2.5 per cent of Tasmania's non-industrial consumption and 1 per cent of Tasmania's total consumption.[6] There are also a number of larger renewable embedded generators installed across the State, including small hydro (total installed capacity 10 MW), mini-hydro (9.4 MW), landfill gas (3.7 MW) and small wind (0.45 MW).[7] This provides some customers with at least some reliance on their own energy production, but the vast majority of businesses and households still rely on grid connected electricity to meet all of their energy needs. This situation is evolving however with new technologies and services.

[6] OTTER, 2016, *2016 Tasmanian Electricity Network Reliability Review.*
[7] OTTER, 2016, *Energy in Tasmania – performance report 2014-15.*

The relationship between the State's generation capacity (by generation source) and Tasmanian maximum demand is illustrated in Figure 3.4. Tasmania has considerable generation capacity to meet Tasmania's maximum demand, which occurs in winter mainly as a result of Tasmania's heating load requirements during this season. Indeed Tasmania has the highest 'reserve plant margin' of any NEM jurisdiction. The reserve plant margin measures the amount of available installed capacity compared with peak demand. Tasmania has approximately 80 per cent more capacity compared with peak demand.[8] This figure does not include Basslink given it is not an on-island generation unit.

Figure 3.4 Tasmania's generation capacity by generation source



Source: Taskforce analysis

Note: Solar PV and other 'behind the meter' generation is not shown. According to the Clean Energy Coucil's Clean Energy Australia Report 2015, Tasmania has approximately 91 MW of solar generation capacity.

The concept of a 'window of generation flexibility' is illustrated in Figure 3.4 to demonstrate the flexible generation options available in the event that on-island hydro-electric and wind generation is constrained. However, the number and diversity of the hydro-electric power stations, combined with wind generators, the gas-fired TVPS and Basslink, means that the number of outages of generating assets (and/or Basslink) would need to be significant before there would be risks to not being able to meet Tasmanian demand. Such an event would likely be a result of a low probability, catastrophic event (such as a large impact earthquake).

Tasmania's electrical energy capacity also relies on the network (transmission and distribution) to convey electricity from generators (and Basslink) to customers. The Tasmanian transmission network is illustrated in Figure 3.5. The network must meet a number of regulatory standards to ensure a high level of safety and reliability of supply. Supply disruptions due to a network outage generally occur when there are bushfire or storm events. Even in these circumstances the outages are usually localised (though can occur in several locations at the same time) and not long lasting.

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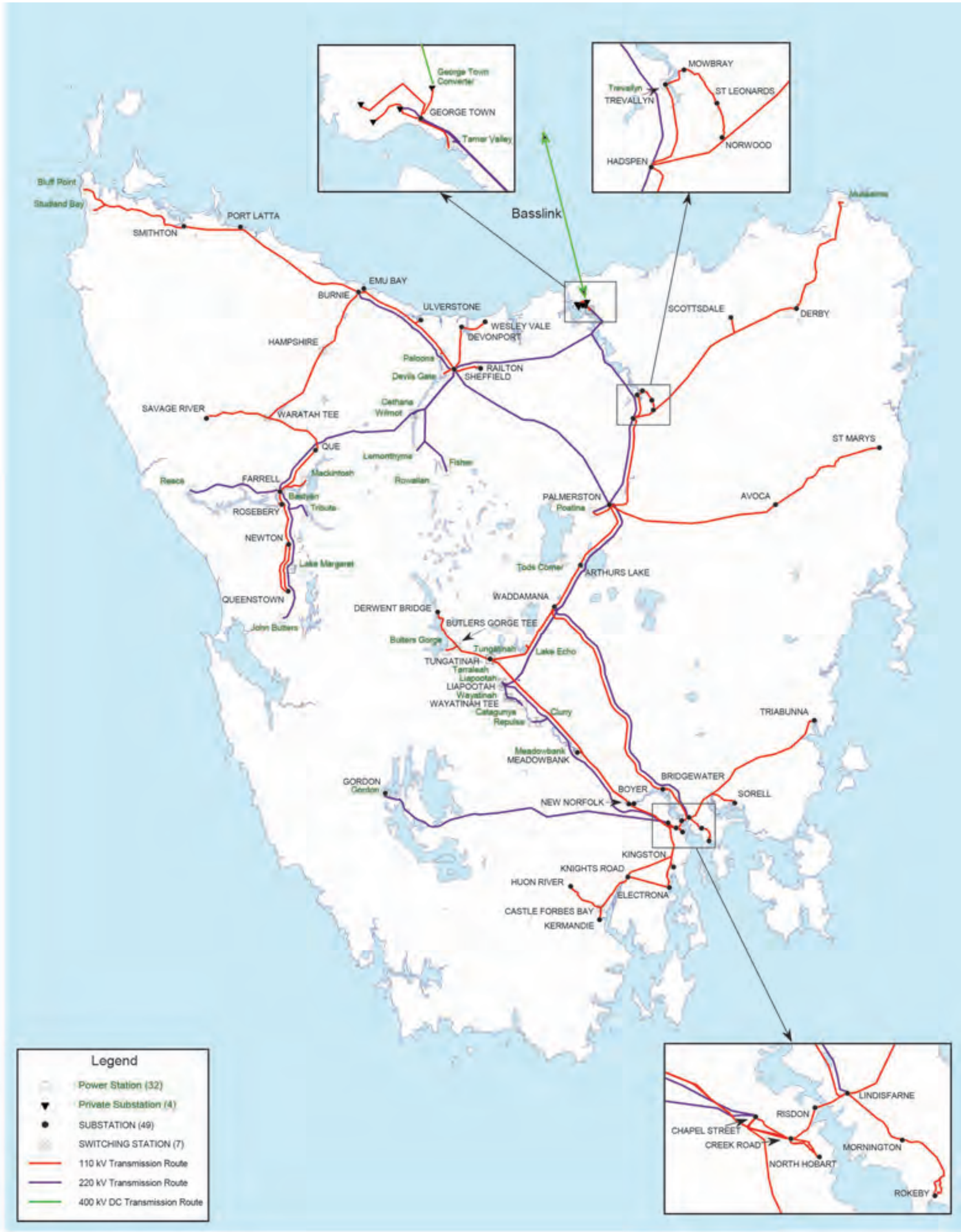
8 OTTER, 2016, *Energy in Tasmania – performance report 2014-15.*

Figure 3.5 Tasmanian transmission network



Source:TasNetworks, 2015, *Annual Planning Report 2015*

The Tasmanian Economic Regulator (TER) published its *2016 Tasmanian Electricity Network Reliability Review – Final Report* in October 2016, which states that Tasmania's transmission network performance reliability has been satisfactory. It similarly states that the distribution network performance reliability has been satisfactory for most Tasmanian communities. However, there remain a number of communities where distribution network performance is below applicable standards in relation to frequency and duration of interruptions. The TER also highlighted the role of Basslink, not just for the energy it can provide to and from Tasmania, but also its frequency control capabilities to help maintain network reliability.

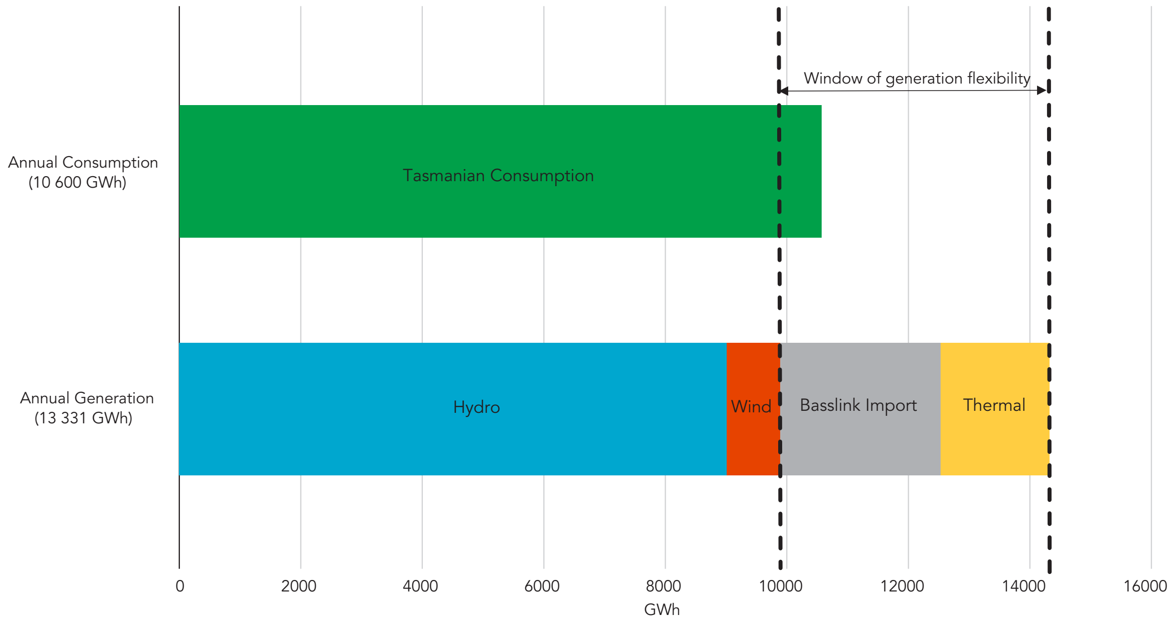
The TER also acknowledges future challenges to network reliability.

"The increasing penetration of renewables, such as solar PV and wind, as well as technologies which utilise the electricity network, such as battery storage and electric vehicles, will present a number of challenges to network planning and management. Addressing these challenges in the medium term is likely to require a mixture of pricing incentives, technological solutions and network augmentation."[9]

3.2 Tasmania's electrical energy supply

The contribution of Tasmania's electrical energy sources to meeting Tasmanians consumption needs is illustrated in Figure 3.6, which presents a hypothetical maximum energy source availability.[10]

Figure 3.6 Tasmania's electrical energy sources and consumption



Source: Taskforce analysis

Notes:

(1) Tasmanian consumption is based on the average annual energy consumption in the Australian Energy Market Operator's National Electricity Forecasting Report.

(2) Average hydro inflows are 9 000 GWh, as per reported Hydro Tasmania assumed long term average.

(3) Wind generation is 900 GWh, based on 2014-15.

(4) Basslink total annual energy transfer capabillity is 2 665 GWh based on the maximum annual gross transfer of electricity (imports plus exports), averaged between 2010-11 and 2014-15. This assumed value is close to actual hightest import levels that were observed during 2008 and 2009.

(5) Thermal generation assumes a 24 hour, 200 MW average output for the CCGT per annum (open cycle gas turbine (OCGT) units are not included due to their predominant peaking use and high failure risk when run as baseload)

(6) Solar PV and other behind the meter energy sources are not shown. While the Clean Energy Council estimates there is approximately 91 MW of solar PV capacity in Tasmania, the amount of energy generated annually from solar PV is relatively small (estimated at an average of less than 10 GWh per month).

Based on average inflows, hydro-electric generation on its own (and even together with wind) is insufficient to meet Tasmania's consumption needs. On average Tasmania's consumption, therefore, must be met through a combination of Basslink imports and thermal generation. However, the situation is more complex

[9] OTTER, 2016, *2016 Tasmanian Electricity Network Reliability Review.*

[10] Basslink imports and, in particular, thermal generation would be lower in actual operation when inflows are around average.

than this due to the high variability of inflows and the capacity to store water in major storages from high inflow periods to use in low inflow periods. Nevertheless, the assumed long-term average inflows indicate that Tasmania has an energy deficit from on island energy sources (as demonstrated by the fact that Tasmanian consumption crosses into the window of generation flexibility). Therefore, in contrast to Tasmania's system capacity, Tasmania's available energy is relatively more constrained.

Based on long-term average inflows of 9 000 GWh per annum and annual wind generation of 900 GWh (based on 2014-15), this deficit is approximately 700 GWh, based on long-term averages. There is evidence to suggest that the long-term average should be revised down to 8 700 GWh, which would increase the deficit to 1 000 GWh.

In its Final Report in 2012, the Expert Panel, distinguished between 'hydrological risk' and 'energy supply' risk. The Expert Panel defined hydrological risk as: "*the risk that the hydro-generation system will not be able to meet residual demand in the medium to long term due to an extended period of lower than expected inflows*".[11] Energy supply risk was recognised by the Expert Panel to be broader because of the availability of non-hydro-electric generation sources, although the two are linked given the high proportion of hydro-electric generation.

Hydrological risk is managed by Hydro Tasmania according to 'prudent water storage management guidelines' that it has established. These guidelines establish a preferred operating minimum (POM) level and risk lines ('medium', 'high' and 'extreme'). Both the POM and risk lines change through the year (as illustrated in Figure 2.1 in Chapter 2), reflecting the rainfall variation associated with seasonality.

While the risk of low inflows into Hydro Tasmania's dams can be managed in most instances (through drawing down the stock of water held in storage, Basslink imports, gas generation and wind generation), the 2015-16 energy security event demonstrates that Tasmania's energy security is severely tested by concurrent events. Low inflows combined with the Basslink outage showed that two concurrent major failures can create risks to there being enough energy to meet Tasmania's consumption needs, as opposed to there needing to be a significant number of failures before Tasmania's generation capacity cannot meet Tasmanian demand.

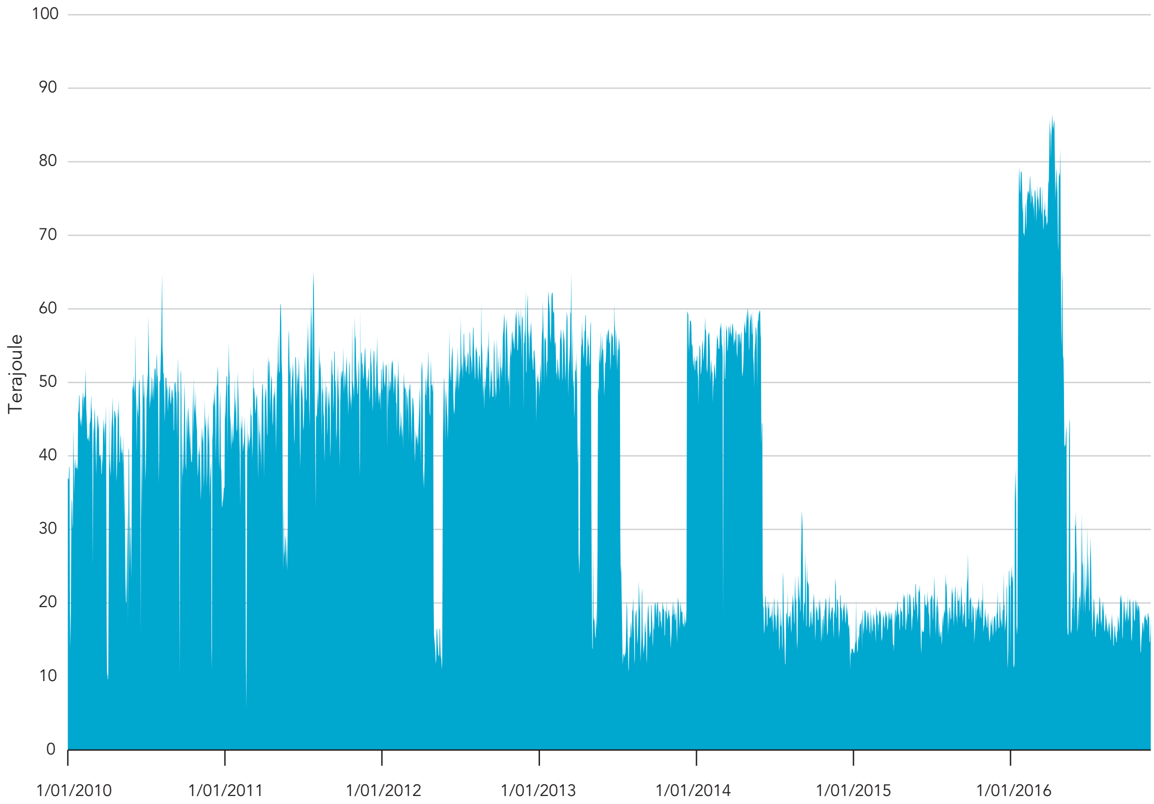
3.3 Gas use and other energy sources

Aside from its use to generate electricity at the TVPS, gas is used as an energy source by many industrial customers in Tasmania and a small proportion of small businesses and households. From an energy security perspective, consumer gas use offsets some electrical energy demand and consumption, and therefore creates some diversification of risk away from dependence on electrical energy. That said, Tasmania does not produce any gas and is highly dependent on gas transportation from Victoria via the TGP. This creates an energy security risk in itself, in that a material supply disruption to the TGP could result in Tasmanian gas customers' demand not being met.

Gas demand in Tasmania is low, as illustrated in Figure 3.7 which summarises Tasmania's historical gas use against the TGP's capacity to carry 129 TJ per day. The operation of the TVPS (and particularly the CCGT) has historically underpinned Tasmania's gas use. When the TVPS CCGT has not been in use, gas demand in recent years has generally been around 20 TJ per day, compared with around 50 to 60 TJ per day with gas generation (and higher during the recent energy security event). The low level of demand for gas in Tasmania creates commercial challenges for the viability of the gas market for both market participants (the owners and operators of gas infrastructure and retailers) and their customers.

[11] Electricity Supply Industry Expert Panel, 2016, *An independent review of the Tasmanian electricity supply industry, Final Report Volume 1.*

Figure 3.7 Daily gas flows on the Tasmanian gas pipeline since 2010



Source: Tasmanian Gas Pipeline

The above discussion focusses purely on the natural gas sector. There is some diversification in the Tasmanian gas sector in the form of liquefied petroleum gas (LPG), which generally comes in the form of bottled gas for residential and commercial use.

Other sources of energy, such as wood heating, create further diversification of risk away from dependence on electrical energy. These sources of energy tend to be available on-island and, therefore, present less risk to customers of not being able to be supplied.

4. Defining Energy Security in Tasmania

KEY FINDINGS

- Energy security definitions exhibit common features focussing on 'adequacy', 'reliability' and 'competitiveness/affordability'.

How energy security is defined depends on the context and environment to which it is applied. The Taskforce examined a number of potential definitions before proposing 'what energy security means' in the context of the Taskforce's Terms of Reference.

4.1 Examples of energy security definitions

The International Energy Agency (IEA) defines energy security as *"the uninterrupted availability of energy sources at an affordable price"*,[12] and asserts that energy security has many dimensions. Long-term energy security mainly deals with timely investments to supply energy in line with economic developments and sustainable environmental needs. Short-term energy security focuses on the ability of the energy system to react promptly to sudden changes within the supply-demand balance. Lack of energy security is thus linked to the negative economic and social impacts of either physical unavailability of energy, or prices that are not competitive or are overly volatile.[13]

The Australian Government, in its National Energy Security Assessment (NESA), states that in the Australian context, energy security is defined as *"the adequate, reliable and competitive supply of energy to support the functioning of the economy and social development, where:*

- *adequacy is the provision of sufficient energy to support economic and social activity;*
- *reliability is the provision of energy with minimal disruptions to supply; and*
- *competitiveness is the provision of energy at an affordable price that does not adversely affect the competitiveness of the economy and that supports continued investment in the energy sector."* [14]

The NESA states that these three dimensions of energy security are interrelated and, to a large extent, mutually reinforcing. For example, in a situation where energy supplies are not adequate to meet the needs of the economy or community, the price of energy will need to rise or intervention in the market will be required to allocate scarce energy resources. Conversely, the interaction of these three dimensions can lead to trade-offs. For instance, ensuring or increasing reliability can require sustained or greater investments, which may place upward pressure on energy prices. Both situations could adversely affect the competitiveness of the economy.

Outside of Australia, most countries have their own definitions of energy security that generally exhibit some commonality, particularly around the concepts of adequacy, reliability and competitiveness/ affordability. However, there is also some diversity. Some definitions focus on energy security being a situation where the supply (and its associated concepts) is maintained [such as the European Union, Japan and the United Kingdom (UK)], whereas others, notably the United States (US), focus on energy security being a situation where supply disruptions can be accommodated without material disruption or additional cost.

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12 www.iea.org/topics/energysecurity/

13 The design of an 'energy-only' market, such as the NEM, requires some volatility so that the long run efficiency of the market can be sustained. In theory, price signals are necessary to balance demand and supply through encouraging (or discouraging) investment, with the market responding through the most efficient supply or demand side responses. This may lead to periods where prices are relatively high (to attract investment in new supplies and/or demand side management) or low (where excess supply is encouraged to exit and/or demand increases).

14 Australian Government, Department of Resources, Energy and Tourism, 2011, *National Energy Security Assessment 2011.*

How energy security is defined is sometimes contested. For example, Engineers Australia contends (in its submission on the Taskforce's Consultation Paper) that the manner in which governments in Australia define energy security is too narrow, and it should be broader as it is a multi-dimensional concept intertwined with issues across the social, political, economic and environmental spectrum. Engineers Australia has previously proposed that energy security should be defined as follows:

"Energy security is the adequate, reliable and competitive supply of sustainable, low-carbon energy and energy services at global, national and local scales; across short, medium and long-term timeframes; and in the context of minimising consumption and demand, maximising energy intensity, and balancing the trade-offs and complementarities between energy and other security referents of value, notably the four key domains of 1) national economic and national security, 2) food and water security, 3) sustainable development and environmental security, and 4) social stability and energy stress."[15]

Definitions of energy security and measuring energy security have also been the focus of academic study. In general these studies also indicate that energy security definitions range from a narrow focus on demand/supply balance to a broad focus encompassing many other interdependent elements across politics, the economy, environment and society.

4.2 The Taskforce's definition of energy security

There are some common features of the examples described in section 4.1 that are instructive for the Taskforce's consideration as to what energy security means in the Tasmanian environment, and in the context of the Taskforce's Terms of Reference.

The Taskforce has adopted the following definition of energy security for Tasmania:

Energy security is the adequate, reliable and competitive supply of low carbon emissions energy across short, medium and long-term timeframes that supports the efficient use of energy by Tasmanians for their economic and social activities.

The Taskforce considers that the first part of this definition is broadly consistent with definitions used elsewhere and provides a clear statement linking energy security to adequate, reliable and competitive supply. The Taskforce has purposefully included the term 'low carbon emissions' in the definition. While the presence of gas generation (in the stationary sector) and liquid fuels (in the transport sector) mean that there are further opportunities to reduce Tasmania's carbon emissions over time, it must be recognised that Tasmania already has a low carbon emissions energy profile, predominantly due to its hydro-electric generation system.

Energy systems nationally and globally are transitioning toward lower carbon intensive energy sources, and over the long term it is expected that these sources will be dominant and cost competitive. It is logical for Tasmania, therefore, to at least sustain its current low carbon emissions status and to seek to make further progress over time. It also provides an opportunity to enhance Tasmania's brand through its clean energy status and potentially leverage economic development opportunities, particularly as the rest of the world and nation continue to transition to a lower carbon emissions intensive future.

The Taskforce agrees that the definition should recognise differing timeframes (short, medium and long term) as proposed by Engineers Australia. Ensuring that energy security is planned for across these timeframes will better strengthen Tasmania's resilience to changes that can occur both rapidly and over time (such as new technologies and climate change).

[15] Engineers Australia, 2014, *Energy Security for Australia: Crafting a comprehensive energy security policy.*

The latter part of the Taskforce's definition includes the concept of supporting the efficient use of energy by Tasmanians for their economic and social activities. The Taskforce considers that the term 'efficient use' to be sufficiently broad to include a range of demand side responses by consumers. This is likely to become increasingly prevalent over time as new products and services (supported by new technologies) continue to give greater information and control to consumers over their energy use.

The Taskforce also considers that the above elements implicitly capture risk appetite. Consistent feedback through submissions to the Taskforce's Consultation Paper suggests there is:

- no appetite for unplanned and mandatory power rationing resulting from an energy shortage (as opposed to some acceptance of unavoidable, short term capacity outages);
- low appetite for new infrastructure if that comes at high cost;
- high appetite for better utilising existing energy sources and assets;
- reasonable appetite for better demand side opportunities for customers and 'planned' customer participation for emergency situations; and
- reasonable appetite for customer-led technology solutions including energy storage (either in the form of EVs or as stand-alone systems) and participation in sophisticated aggregation technologies.

RECOMMENDATION

1. The following definition of energy security for Tasmania should be adopted:
   Energy security is the adequate, reliable and competitive supply of low carbon emissions energy across short, medium and long-term timeframes that supports the efficient use of energy by Tasmanians for their economic and social activities.

5. Energy Security Assessment for Tasmania

KEY FINDINGS

- Existing frameworks for assessing energy security use both quantitative and qualitative data and generally look across different time horizons.
- A transparent assessment of Tasmania's energy security risks would help promote business and household confidence in the Tasmanian economy and society.
- Tasmania's electricity energy security in the short term is assessed as Managed. Tasmania's electricity reliability is Resilient due to the number and diversity of generators, and a network that generally performs well against independent assessments. However, Tasmania lacks some competitiveness features and its on-island energy deficit is a less secure state than if local supply and demand were in balance.
- Tasmania's electricity energy security in the medium and long term is indicatively assessed as Managed. Tasmania has opportunities to strengthen this assessment over time, and this will depend on how: the on-island energy deficit is addressed; the network adapts to new generation forms and how customers manage their demand; and the realisation of consumer benefits that innovation in technology and services has the potential to deliver.
- Tasmania's gas energy security in the short term is assessed as being Susceptible. While the reliability of gas infrastructure is assessed as being Managed, there is considerable uncertainty currently facing the market with respect to the adequacy of gas supply and its competitiveness.
- Tasmania's gas energy security in the medium and long term is indicatively assessed as being Susceptible, based on the current outlook for gas prices and supply.

This chapter presents the Taskforce's assessment of Tasmania's energy security.

The Taskforce has reviewed a number of frameworks that are used to assess energy security risks. The Taskforce considers that a framework should be adopted for Tasmania that is based on qualitative and quantitative information, is robust and credible, and transparent. The purpose of assessing Tasmania's energy security risks is to establish areas of concern that need to be addressed over the short, medium and long term. Examining solutions to these areas of concern will be the Taskforce's primary focus in its Final Report.

5.1 Examples of energy security risk frameworks and assessments

The Taskforce has reviewed frameworks used by others to assess energy security risks.

The Australian Government's NESA provides an 'on balance' assessment of energy security over the short, medium and long term for the liquid fuels, natural gas and electricity sectors. It is predominantly a qualitative assessment based on a range of factors, and assesses energy security as either 'low', 'moderate' and 'high'. The NESA makes these assessments for each sector against each of its three criteria of 'adequacy', 'reliability' and 'competitiveness'. The most recent NESA was published in 2011, though the Taskforce understands (through discussions with the Australian Government department responsible for the NESA) that an updated NESA is being developed.[16]

The IEA has developed a Model of Short-Term Energy Security (MOSES), a tool that quantifies the vulnerabilities of energy systems using a set of quantitative indicators that measure risks of energy supply disruptions and resilience of a national energy system to cope with such disruptions.[17] The MOSES takes an

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16 Australian Government, Department of Resources, Energy and Tourism, 2011, *National Energy Security Assessment 2011.*
17 International Energy Agency, 2011, *Measuring Short-Term Energy Security.*

energy systems approach to analysing energy security from energy supply to transformation and distribution to end-use energy services. It also examines risks and resilience by external and domestic factors.

The US Chamber of Commerce publishes an annual *US Energy Security Risk Index*. The index is a quantitative assessment derived from a large number of data sources and contains sub-indices ('geopolitical', 'economic', 'reliability' and 'environmental').[18]

An academic article published in *Energy – The International Journal*, considers energy security to be a multi-dimensional phenomenon, with energy reserves and stockpiles, fuel mixes and diversification, price stability and affordability, justice and equity, technology development, energy efficiency, resilience, investment, environmental quality, governance, and regulation all influence and form part of contemporary national energy security issues.[19]

5.2 Framework for assessing energy security in Tasmania

The Taskforce has considered various approaches and has decided to use a framework to assess energy security in Tasmania that is clearly linked to the proposed definition of energy security. From a presentational perspective, the framework developed by the Taskforce is similar to the approach the Australian Government uses for the NESA. The inputs are a range of qualitative and quantitative assessments.

The framework assesses energy security risk by the three criteria in the definition of adequacy, reliability and competitiveness, and across the three time frames of short term (1-5 years), medium term (5-10 years) and long term (beyond 10 years).

Statements supporting the three criteria link to the definition of energy security are as follows:

- adequacy: supplies of energy are adequate to meet the efficient use needs of Tasmanian consumers over time;
- reliability: the supply of energy to consumers is reliable; and
- competitiveness: supplies of energy are low in carbon emissions, affordable and offer consumers choice about price and how they use and manage their energy.

Conventionally, some energy security assessments have been expressed in terms of 'high', 'moderate' and 'low'. The Taskforce has concluded that a rating system with four assessment levels (rather than three) that separates the moderate rating into two levels enables greater granularity and would provide further insights into the strengths and weaknesses of Tasmania's energy security.

In this context, an energy security rating is given to each criteria and by each timeframe. An overall energy security rating is also given for each sector by each timeframe. The ratings are as follows:

- 'Impacted' - when economic and social activities of Tasmanians are significantly affected by major shocks to the energy system;
- 'Susceptible' – when economic and social activities of Tasmanians might be affected and resilience to a major shock is low;
- 'Managed' - when economic and social activities of Tasmanians are supported. However, there could be a number of emerging issues that will need to be addressed to maintain energy security; and
- 'Resilient' - when economic and social activities of Tasmanians are supported and resilience to a potential shock is high.

[18] http://www.energyxxi.org/energy-security-risk-index
[19] Sovacool BK and Mukherjee I, 2011, *Conceptualising and measuring energy security: A synthesized approach, Energy, 36(8).*

The framework is designed to undertake an assessment of the electricity and gas sectors. The Taskforce notes that an assessment of liquid fuels/petroleum could also be undertaken using this framework. However, as petroleum does not feature in the Taskforce's Terms of Reference, a separate assessment has not been undertaken in this Interim Report. Governments in the future may wish to undertake regular updates of Tasmania's energy security risks using this framework, and future updates could be expanded to liquid fuels/petroleum.

The Taskforce considers that the definition and assessment approach it has taken will increase transparency regarding Tasmania's energy security risks. While this assessment will highlight areas that require strengthening, this level of transparency will ultimately increase business and household confidence in the Tasmanian economy and society. Increased transparency was highlighted as a significant priority by stakeholders during the Taskforce's consultation.

5.3 Energy security assessment

Table 5.1 presents the Taskforce's energy security assessment for electricity in Tasmania. It includes an assessment for each of the criteria of adequacy, reliability and competitiveness across the three time periods of short term, medium term and long term. An overall assessment is then presented together with a summary comment.

Table 5.2 to Table 5.4 present in more detail the basis for the individual criteria ratings for adequacy, reliability and competitiveness.

Table 5.5 to Table 5.8 present the Taskforce's energy security assessment for gas on the same basis as for electricity.

The commentary in each assessment is based on quantitative information presented throughout the Interim Report and the indicative performance indicators presented in Appendix 1. The rating of Resilient, Managed, Susceptible or Impacted energy security is a qualitative assessment inferred from the quantitative information and analysis in the Interim Report.

The Taskforce's assessments for the medium and long term should be considered indicative only at this time (and hence are italicised in the tables). The Taskforce intends to finalise these assessments in its Final Report, once it has conducted more detailed scenario analysis as part of its future work program.

5.3.1 Electricity energy security assessment

Table 5.1 Electricity energy security assessment for Tasmania

Timeframe	Criteria	Rating	Overall Rating	Comment
Short Term	Adequacy	Managed	Managed	Over the short term, Tasmania's electricity energy security is assessed as Managed. There are no immediate threats now that water storages have returned to higher levels and Basslink is back in service. There are some challenges that could create energy security risks, however these can be managed and addressed to strengthen Tasmania's energy security into the future. For confidence in Tasmania's energy security to improve following the events of 2015-16, actions that are put into place will be important to stakeholders and investors.
	Reliability	Resilient		
	Competitiveness	Managed		
Medium Term	Adequacy	*Managed*	*Managed*	*In the medium term, Tasmania's electricity energy security is assessed as Managed, reflecting the current supply and demand risk but uncertainty as to what changes may occur. If certain challenges and opportunities are proactively planned for and managed, Tasmania is in a good position to have Resilient energy security by this period. However, poor planning and management leads to an increased risk of Tasmania potentially having Susceptible energy security.*
	Reliability	*Managed*		
	Competitiveness	*Managed*		
Long Term	Adequacy	*Managed*	*Managed*	*Tasmania's electrical energy security in the long term is highly dependent on the interaction between market developments, consumer choices and strategic decisions made by governments. A Managed assessment is appropriate at this time.*
	Reliability	*Managed*		
	Competitiveness	*Managed*		

Note: The Taskforce's assessments for the medium and long term should be considered indicative only at this time (and hence are italicised). The Taskforce intends to finalise these assessments in its Final Report, once it has conducted more detailed scenario analysis as part of its future work program.

Table 5.2 Electricity adequacy assessment for Tasmania

ELECTRICITY ADEQUACY	
Supplies of energy are adequate to meet the efficient use needs of Tasmanian consumers over time	
Short Term	**Managed**
	Water storages at the end of November 2016 are at significantly higher levels than they have been in recent years, being in the mid 40 per cent range. Gas supply arrangements for the TVPS are in place until the end of 2017. While the TVPS is understood to be retained for standby purposes, there is some uncertainty as to what gas supply arrangements will be in place to support the TVPS post 2017. Basslink is available and operating and, as long as it continues to do so, provides significant electricity import capacity. Wind generation contributes close to 10 per cent of Tasmania's consumption needs. Regulation and oversight of energy supply requires strengthening over this period to ensure any future emerging supply challenges are identified and mitigated. Tasmania's energy supplies for electricity generation are sufficient at least over the next 12 months, and likely beyond. However, Tasmania's energy deficit (based on long-term averages) together with historical inflow variability means that it is difficult to assess Tasmania as having Resilient energy security in relation to electricity supply adequacy over the entire five year period of this assessment. Hence a Managed assessment is appropriate.
Medium Term	***Managed***
	Unless there is additional on-island energy by this period, Tasmania will continue to have an energy deficit based on long-term averages. This, together with inflow variability, will mean Tasmania will continue to be dependent on energy imports to meet our electricity consumption needs. *There is a possibility that consumption could be materially lower due to the loss of significant load. However, this risk is offset in the medium term given existing energy contracts held by major industrial customers are understood to be in place for at least most of this period.* *Gas supply for gas generation is uncertain in this period. The cost of gas commodity and the tightening of supply in the east coast gas market may make gas generation in Tasmania increasingly uncompetitive (even taking into account its energy security value) relative to other options. This trend is already emerging across the NEM. However, forecast gas commodity increases may not eventuate (or may ameliorate over time), and the potential for a carbon pricing mechanism could assist gas generation remaining a viable option.* *Basslink should be expected to remain available over this period, though planning should take into account the possibility of at least a six month outage.* *A second electricity interconnector, if proceeded with, may be operational toward the end of this period. If this were the case, it would represent a significant strengthening of Tasmania's energy security.* *The amount of wind energy in Tasmania should at least be consistent with current output, though could be significantly greater by this period depending on other variables (particularly if a second electricity interconnector is built).* *The pace of increase in other forms of generation, particularly solar, is uncertain, as is the emergence of new products and services (such as EVs, battery storages and other demand side participation options). However, even with rapid transformation, there is unlikely to be a material impact on aggregate demand/supply.* *In summary, there are both risks and opportunities over this period that, due to uncertainties, makes a Managed assessment appropriate.*

Long Term	***Managed***
	Inflow variability together with the potential emergence of climate change implications will influence hydrological risks. The extent that these risks create energy supply risks will depend on a number of factors, all of which are uncertain at this time. *Tasmania may still have an energy deficit, though this may not be the case by this period if there is increased on-island generation and/or loss of significant load.* *Gas generation for energy security purposes (if still present in Tasmania by this period) would likely not be necessary if there were a second electricity interconnector, and even without it remains uncertain and dependent on its competitiveness with other alternatives. The status of interconnectors and their role for energy security purposes versus other objectives will depend on a range of factors. With additional on-island generation and/or load loss, Basslink, on average, should be used more for export purposes and less for importing to manage hydrological risk.* *A second electricity interconnector, if proceeded with, would be expected to be operational by this period.* *The amount of wind energy in Tasmania should at least be consistent with current output, though could be significantly greater by this period depending on other variables (particularly if a second electricity interconnector is built).* *The role of other generation sources could emerge, depending on how market circumstances evolve. Small scale solar (e.g. solar PV) can be expected to continue to grow, particularly if coupled with the possible emergence of EVs and battery storage. Large scale solar may also be cost competitive as an alternative to wind generation in Tasmania, though its output is expected to still be well below the capacity of wind generation. Wave technology, biomass and geothermal are all uncertain though plausible, given the right circumstances.* *There are many possibilities over this period that are difficult to predict at this time, although there are no significant concerns that Tasmanian consumption cannot be met. As such a Managed assessment is appropriate.*

Note: The Taskforce's assessments for the medium and long term should be considered indicative only at this time (and hence are italicised). The Taskforce intends to finalise these assessments in its Final Report, once it has conducted more detailed scenario analysis as part of its future work program.

Table 5.3 Electricity reliability assessment for Tasmania

<table>
<tr><th colspan="2">ELECTRICITY RELIABILITY</th></tr>
<tr><td colspan="2">The supply of energy to consumers is reliable</td></tr>
<tr><td rowspan="2">Short Term</td><td>Resilient</td></tr>
<tr><td>Hydro Tasmania’s power stations are ageing and are being managed on a risk basis through Hydro Tasmania’s asset management program. The number and locational spread of the power stations provides significant mitigation from plant outages.

The electricity network in Tasmania has performed satisfactorily according to independent assessments. At a transmission level, while Tasmania’s network has some challenges with respect to power system reliability, these are dealt with through specific measures (such as Special Protection Schemes). Customer reliability at the distribution level is generally satisfactory for the majority of community categories in Tasmania, though there have been instances of below applicable standards for some communities in relation to the frequency and duration of interruptions.

Basslink is available and provides significant capacity to contribute to meeting Tasmanian demand and consumption, though outages are possible and should be planned for.

The TVPS has been assessed as being well maintained and is available to be used when required to manage hydrological risks.

The TGP, which supplies the TVPS, is currently a single point of dependency for gas generation in the State and, as such, represents a risk. However, this risk is low given the pipeline is relatively new and the probability of failure (through damage) to the TGP is low.

Wind generation is, by its nature, intermittent and, therefore, not reliable in terms of meeting demand. It does, however, add to the overall generation portfolio that in aggregate provides significantly reliable generation options for Tasmania.

In summary, while there are issues that require monitoring and attention, Tasmania’s electricity reliability provides a Resilient level of energy security given the high reserve plant margin and network performance.</td></tr>
<tr><td rowspan="2">Medium Term</td><td>Managed</td></tr>
<tr><td>The reliability of Hydro Tasmania’s power stations will partly depend on how successful Hydro Tasmania has been in completing its major refurbishment projects in accordance with the risk profile of each power station and associated machines, dams, civil works, etc. Hydro Tasmania’s asset management plan indicates that there is little scope for delaying some refurbishments without increasing risk.

The reliability of the Tasmanian electricity network in this period will depend on how it manages and responds to emerging challenges, including how quickly it can adapt to cope with increased intermittent generation sources (more solar PV and potentially wind generation). Increasing uptake or emergence of battery storage, EVs and demand management products at a household and business level are all possibilities in this period that would require network adaptation to ensure reliability.

Increased bushfire and storm risks (both in terms of frequency and severity) resulting from predicted climate change impacts will need to be factored into asset management and planning, as well as operational responses.

Basslink’s operational life and contract for service is still within this period and should be expected to continue to significantly contribute to the reliability of supply to Tasmanians, though outages are possible and should be planned for.

The TVPS and the TGP physical infrastructure should still be expected to be in good condition. However, there is uncertainty as to whether gas generation will remain viable and necessary in this period.

In summary, Tasmania’s reserve plant margin is likely to still remain relatively high, though may change relative to the short term depending on developments with gas and new forms of renewable generation. However, given increasing challenges to the Tasmanian electricity network, a Managed rating is appropriate at this time until it becomes clearer that the challenges identified will be satisfactorily managed.</td></tr>
</table>

<table>
<tr><td rowspan="2">Long Term</td><td>Managed</td></tr>
<tr><td>Many of Hydro Tasmania's power stations will be aged between 50 and 70 years (some older and a few younger). The success of major refurbishments will be a key to reliability of these stations over the long term, though given the significant investment required, decisions will need to take into account changes in supply and demand.

The Tasmanian network will need to be highly adaptable to remain reliable and relevant to consumers, as the availability and costs of new supply and demand options increases over time (at both the utility and small scale levels). To the extent that consumers go 'off grid' or integrate their own supply and demand management with grid connection, they may need to take greater responsibility for their own reliability (or rely on service providers other than the network). The network will also need to continue to ensure resilience to climate change threats in terms of the intensity and frequency of storm and bushfire events.

Basslink's contract for service expires in 2027 but there are provisions to extend the contract beyond this date. Basslink should be assumed to be available for operation to at least 2045, given a 40 year period for the availability of an interconnector was a key feature of the expression of interest process which led to Basslink's development. Outages during this period, however, are possible and should be planned for.

There is uncertainty as to whether gas generation will be viable and necessary in this period.

The above essentially extends the issues highlighted during the medium term, but poses a greater level of uncertainty and potential change over the long term. For this reason, a Managed rating at this time is appropriate.</td></tr>
</table>

Note: The Taskforce's assessments for the medium and long term should be considered indicative only at this time (and hence are italicised). The Taskforce intends to finalise these assessments in its Final Report, once it has conducted more detailed scenario analysis as part of its future work program.

Table 5.4 Electricity competitiveness assessment for Tasmania

<table>
<tr><th colspan="2">ELECTRICITY COMPETITIVENESS</th></tr>
<tr><td colspan="2">Supplies of energy are low in carbon emissions, affordable and offer consumers choice about price and how they use and manage their energy.</td></tr>
<tr><td rowspan="2">Short Term</td><td>Managed</td></tr>
<tr><td>Tasmanian electricity prices and bills are assessed as below the average of other jurisdictions for most residential and small business customers (based on certain usage assumptions). While this is a positive outcome, Tasmanians are more electricity dependent and there are proportionately a large number of financially disadvantaged customers in Tasmania.

There is little information available to assess how competitive electricity costs are for commercial, industrial and major industrial customers.

Network costs (both transmission and distribution) are estimated to reduce in the short term, based on recent revenue determinations. Wholesale energy prices and environmental charges are, however, increasing across the NEM.

There is little or no competition in the retail or wholesale electricity markets in Tasmania. In regard to the former, this relates to both lack of choice of retailers and to limited opportunities for consumers to choose and understand how they manage their supply and demand.

Tasmania's electricity sector has the lowest carbon emission intensity in Australia by a significant margin.

In summary, while electricity costs for many customers compare well nationally and Tasmania's electricity sector is low in carbon emissions, lack of competition and choices for consumers limits their capacity to use energy as efficiently and productively as possible. Hence, the competitiveness aspect of energy security is assessed as Managed in the short term.</td></tr>
<tr><td rowspan="2">Medium Term</td><td>Managed</td></tr>
<tr><td>Predicting electricity prices and costs is difficult, even over the short term. Electricity sector efficiency will be critical in ensuring electricity prices are competitive over this period.

Tasmania's electricity sector is likely to remain low in carbon emissions intensity. This may provide greater growth opportunities for Tasmania in this period, particularly if reliability and price challenges in the rest of the NEM increase. For example, Tasmania may become relatively more attractive to energy intensive loads looking for greater certainty.

Competition may increase in the Tasmanian market in this period. However, it may not be in the form of traditional electricity retailing, but from new service and product providers that offer consumers both new supply and demand management options. The extent to which this occurs will partly depend on market developments. Tasmania's small scale may not be as significant a challenge under new business models that are heavily technology based, and Tasmania could be an attractive 'test bed' for innovation such as EVs and smarter grid design.

At this time, a Managed assessment is appropriate in the medium term. While there are some risks to Tasmania's competitiveness, Tasmania also has advantages that, if capitalised upon, could increase Tasmania's competitiveness to a Resilient rating by this period.</td></tr>
</table>

Long Term	*Managed*
	The electricity market in the long term is likely to look very different, but there is uncertainty as to exactly how it will look. *Competitors to traditional electricity business models are likely to become established over the long term, significantly changing how consumers interact with the electricity market. This should give consumers greater control over their supply and demand choices, and how they pay for electricity.* *Tasmania's electricity sector should remain low in carbon emissions and could be completely carbon emissions free during this period. Tasmania should still have a relative advantage over mainland states that will still be transitioning to the proportional mix of renewable energy that Tasmania has enjoyed for decades.* *It may not make sense for Tasmania to remain a standalone NEM region over the long term, under certain market conditions. If this is the case, there could be greater competition benefits from Tasmania joining Victoria as one region. How those benefits are provided back to Tasmanian consumers will be important from an overall Tasmanian competitiveness perspective.* *As with the medium term, a Managed assessment is appropriate at this time, with Tasmania in a position to potentially improve this rating to Resilient over time.*

Note: The Taskforce's assessments for the Medium and Long Term should be considered indicative only at this time (and hence are italicised). The Taskforce intends to finalise these assessments in its Final Report, once it has conducted more detailed scenario analysis as part of its future work program.

5.3.2 Gas energy security assessment

Table 5.5 Gas energy security assessment for Tasmania

<table>
<tr><th>Timeframe</th><th>Criteria</th><th>Rating</th><th>Overall Rating</th><th>Comment</th></tr>
<tr><td rowspan="3">Short Term</td><td>Adequacy</td><td>Susceptible</td><td rowspan="3">Susceptible</td><td rowspan="3">Over the short term, energy security for gas users is assessed as Susceptible due to significant uncertainty with gas commodity and transportation prices. While there is little competition within the reticulated natural gas sector, competition from alternative gas products and other fuels may mitigate potential price outcomes, but this remains to be tested.</td></tr>
<tr><td>Reliability</td><td>Managed</td></tr>
<tr><td>Competitiveness</td><td>Susceptible</td></tr>
<tr><td rowspan="3">Medium Term</td><td>Adequacy</td><td>Susceptible</td><td rowspan="3">Susceptible</td><td rowspan="3">The medium term outlook, based on projections for the east coast gas market and the uncertainty in the Tasmanian market, results in the current assessment of medium term energy security for gas customers being Susceptible</td></tr>
<tr><td>Reliability</td><td>Managed</td></tr>
<tr><td>Competitiveness</td><td>Susceptible</td></tr>
<tr><td rowspan="3">Long Term</td><td>Adequacy</td><td>Susceptible</td><td rowspan="3">Susceptible</td><td rowspan="3">Energy security for gas customers in the long term is assessed as Susceptible for the same reasons as articulated in the short and medium term assessments.</td></tr>
<tr><td>Reliability</td><td>Managed</td></tr>
<tr><td>Competitiveness</td><td>Susceptible</td></tr>
</table>

Note: The Taskforce's assessments for the medium and long term should be considered indicative only at this time (and hence are italicised). The Taskforce intends to finalise these assessments in its Final Report, once it has conducted more detailed scenario analysis as part of its future work program.

Table 5.6 Gas adequacy assessment for Tasmania

GAS ADEQUACY	
Supplies of energy are adequate to meet the efficient use needs of Tasmanian consumers over time	
Short Term	**Susceptible**
	Tasmania currently has no on-island gas resources to supply domestic demand and relies completely on the TGP or alternative imported gas products (i.e. bottled gas). To date, reliance on imported gas supplies has been adequate to meet the needs of consumers and, indeed, there has been significantly more gas that could have been supplied if demand were higher. There are challenges facing reticulated natural gas customers over the short term, particularly those whose contractual arrangements are due to expire by the end of 2017. Gas supply in the east coast gas market is tightening. While it is unlikely there will be a shortage of gas, the price of gas and transportation arrangements may be high. It is for these reasons that the adequacy of gas supply to meet demand from gas consumers is assessed as Susceptible at this time.
Medium Term	***Susceptible***
	It is unlikely that Tasmania will have its own gas resources within this period and its dependency on gas imports will remain. *Whether there are adequate natural gas supplies to meet Tasmanian demand will depend on the level of demand in Tasmania and overall demand and supply across the east coast gas market.* *Until these uncertainties are resolved, a Susceptible assessment is appropriate.*
Long Term	***Susceptible***
	The long term assessment of the adequacy of gas supplies is similar to the medium term assessment. Until current uncertainties are resolved and the overall demand and supply balance in the east coast gas market (and the implications for Tasmania) becomes clearer over time, a Susceptible assessment is appropriate.

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Table 5.7 Gas reliability assessment for Tasmania

GAS RELIABILITY	
The supply of energy to consumers is reliable	
Short term	**Managed**
	Tasmania's gas infrastructure, particularly the transmission and distribution networks, is relatively new, well managed (according to independent verification) and can therefore be considered reliable to deliver gas to customers. While the TGP is a single point of dependency in terms of gas supply, the likelihood of physical pipeline failure is low. Similarly, the production and processing facilities at Longford in Victoria are a single point of dependency for gas into the TGP. There have been two major incidents at such facilities in Australia in the past two decades (including Longford in 1998). Emergency arrangements revised in response to these incidents, particularly Longford in 1998, have produced robust frameworks able to deal with the potential safety and economic disruption that could occur. Alternative gas supply products (i.e. bottled gas) also rely on imported gas to Tasmania (including through shipping) and there is a considerable distribution network which meets the needs of residential and business customers. The reliability of the physical infrastructure and logistical arrangements to supply customers is high but the single point of dependency supports a Managed assessment.
Medium Term	***Managed***
	There are no obvious risks currently identified to indicate that the reliability of the physical infrastructure and logistical arrangements to supply gas customers will change materially in the medium term, compared with the short term. For this reason, a Managed assessment is appropriate.
Long Term	***Managed***
	Reticulated natural gas infrastructure (transmission and distribution) are generally built to standards that can last several decades. Failure rates of gas pipelines are low internationally and evidence suggests are even lower in Australia. As such, the gas network to and in Tasmania should still expect to be physically in good condition and reliable (as long as maintained appropriately). However, Tasmania's single point of dependency on the TGP and on the production and processing facilities in Victoria is likely to remain. *As long as there is demand for alternative gas products to reticulated natural gas, it should be expected that supply chains remain reliable for these products. A Managed assessment is therefore appropriate for the long term.*

Note: The Taskforce's assessments for the medium and long term should be considered indicative only at this time (and hence are italicised). The Taskforce intends to finalise these assessments in its Final Report, once it has conducted more detailed scenario analysis as part of its future work program.

Table 5.8 Gas competitiveness assessment for Tasmania

GAS COMPETITIVENESS	
Supplies of energy are low in carbon emissions, affordable and offer consumers choice about price and how they use and manage their energy.	
Short Term	**Susceptible**
	Residential gas customers pay prices that, according to independent assessment, are competitive with mainland gas customers. Small business gas customers, however, pay prices that are above the mid range of prices available in other jurisdictions. While there is little information publicly available, it is understood that commercial, industrial and major industrial customers have to date experienced relatively competitive gas prices, given the take up of natural gas by many of these businesses since natural gas was brought to the State. However, most if not all gas customers are facing potential increased prices in the short term, due to commodity and transportation cost increases. The extent of these increases, however, is currently uncertain. While there are two retailers present in the market, there is little active competition for reticulated natural gas customers in Tasmania. The presence of alternative natural gas products, or the potential to fuel switch to other energy sources, does however put some competitive pressure on the gas market. Gas is a fossil fuel and releases carbon emissions, though is significantly 'cleaner' than most other fossil fuels (such as coal and diesel fuel). Gas is also only a relatively small component of Tasmania's overall energy sector and, therefore, the absolute and relative amount of emissions are low. While some may consider that any emissions should be avoided, Tasmania's overall renewable mix and low emissions compares favourably internationally and nationally. In summary, there is Susceptible energy security in relation to the competitiveness of gas as an energy source in Tasmania, due to the dominance of current uncertainty regarding reticulated natural gas supply prices for commodity and transport.
Medium Term	**Susceptible**
	There is considerable uncertainty as to whether the gas market in Tasmania will be competitive and viable in the medium term. This will depend on how current uncertainty regarding gas and transportation arrangements are resolved and the price trends in the east coast gas market. *For some gas customers, switching to alternative gas products or alternative fuel sources may actually be the best way in which energy security is strengthened for these customers. However, this fact alone may create enough competitive pressure for the owners and operators of reticulated natural gas businesses in Tasmania to keep prices and terms and conditions acceptable to customers.* *It is difficult to see significant growth in gas demand in Tasmania, and therefore the prospect of increased competition within the sector is considered to be unlikely.* *The extent that gas use contributes to Tasmania's carbon emissions will depend on how much gas continues to be used in this period.* *Given current uncertainties, a Susceptible assessment is appropriate.*
Long Term	**Susceptible**
	The issues identified in the medium term apply equally to the long term. The future of gas in Tasmania will ultimately rest with its competitiveness with other supply options. *Carbon emissions from gas use are expected to remain low in both absolute and relative terms, and may be negligible by this period.* *A Susceptible energy security assessment is considered appropriate for the long term.*

Note: The Taskforce's assessments for the medium and long term should be considered indicative only at this time (and hence are italicised). The Taskforce intends to finalise these assessments in its Final Report, once it has conducted more detailed scenario analysis as part of its future work program.

6. Review of Energy Security Oversight

KEY FINDINGS

- State and national arrangements for managing energy emergency situations, in particular capacity risks arising from sudden weather events, are well understood, practiced and implemented when necessary. Significant reforms are not needed for these emergency arrangements, but rather continuous improvement should be pursued through engagement, practice and learning amongst the key bodies and persons involved.
- Frameworks to monitor, assess and respond to avoid energy supply security threats becoming an emergency situation do not appear as defined as for emergencies resulting from capacity events.
- Existing arrangements are based on legislation that is two decades old and have not been updated for major changes in the energy market.
- Tasmania's energy security oversight would be improved by enhancing independent oversight of water storages in the context of all energy supplies and demand. This is a common feature of the hydro-electric systems that the Taskforce examined, including Norway, New Zealand, Manitoba and Iceland.
- When energy supply threats increase, but before they become an emergency situation, there is a need for a clear authority in the State to coordinate and manage the situation from a State perspective.
- Clearer roles and responsibilities would also enhance independent oversight, create transparency and public confidence, and provide Hydro Tasmania with clarity and reduce perceptions of it being conflicted between commercial drivers and its role in maintaining energy security.
- Gas oversight arrangements could be strengthened through greater clarity between the Department of State Growth and the Director of Gas Safety.
- Regular assessments and communication of energy security risks would enhance public confidence.

Energy security oversight frameworks provide formal structures for a jurisdiction to manage its energy security risks and respond to supply and demand imbalances that may constrain the supply of energy to customers. All Australian jurisdictions have frameworks in place to manage energy security risks. In most instances the market successfully resolves supply and demand imbalances without significant detriment to consumers. However, where the market is unable to function, governments have established frameworks where intervention occurs through graduated measures.

During the 2015-16 energy security event, Tasmania's existing energy security arrangements were strongly tested. The Taskforce has therefore identified a need to review and modernise the energy security oversight framework for Tasmania to ensure all roles and responsibilities for energy security are relevant, appropriately allocated and adequately resourced.

Tasmania's circumstances are unique in the NEM due to its energy constrained system (as opposed to the capacity constraints that feature in other jurisdictions). Tasmania needs to pay close attention to its energy supplies, and therefore the frameworks to monitor, assess and respond to supply challenges are important to avoid energy supplies reducing to the point where not all demand can be met, and emergency arrangements are required. Such a scenario could be more severe for Tasmania than for other jurisdictions as capacity driven emergencies can usually be resolved quickly, whereas a supply driven emergency can take much longer to recover from (particularly where hydro generation is the dominant source and the supply constraint is the lack of water in storages).

It is for these reasons that the Taskforce has concentrated on the energy security oversight arrangements that are in place to avoid, where possible, a supply driven emergency situation from occurring.

Options for roles and responsibilities for energy security policy, monitoring and assessing, and coordination of energy supply security situations are examined in the context of bringing greater clarity and capability to the requirements for managing long-term energy security events. Gas market oversight is also reviewed.

6.1 Tasmania's electricity energy security governance

Before reviewing existing arrangements and considering options for improvement, it is appropriate to summarise the existing key roles and arrangements in Tasmania.

The existing Tasmanian energy security oversight framework is a mix of state-based laws and rules, national energy market architecture and prescribed regulatory roles placed on both government officers and energy entities. With roles and responsibilities spread so broadly it presents a complex set of obligations that is not easily identifiable by all market participants, nor is every obligation or role solely for energy security or emergency management purposes.

There are two distinct features of energy security oversight which are important to understand:

- frameworks that are in place to monitor, assess and respond to *avoid* an energy security threat becoming an emergency situation; and
- frameworks that are in place to manage emergency situations *when* they occur (where there is not enough supply to meet demand), including ensuring customers who need energy the most are protected as much as possible from supply restrictions, and that normal supply is restored as safely and as soon as possible.

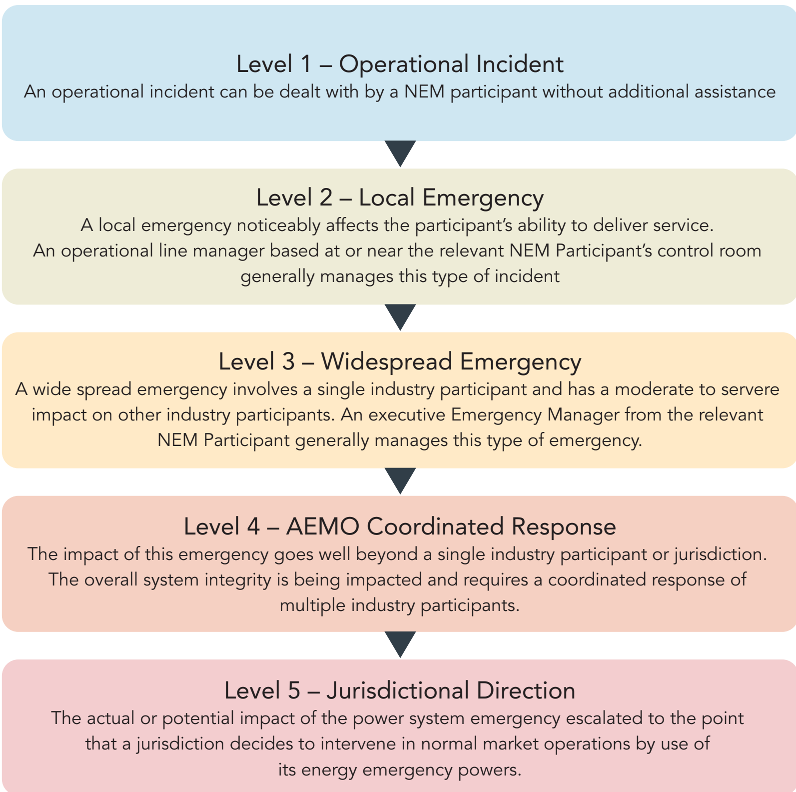
An overview of current electricity security governance arrangements and the legislative frameworks and tools that underpin them is provided in Appendix 2. For the purpose of this chapter, the key contextual points are as follows.

- Tasmanian laws and rules provide the Minister for Energy powers to restrict energy supply in emergency situations as well as the ability to appoint key roles and/or committees to assist energy planning and coordination, such as the Director of Energy Planning.
- The Director of Energy Planning is a statutory role under State law and has broad energy portfolio functions that contain some supply security powers amongst others. The Director also chairs the Water Storage Advisory Committee (WSAC; on appointment by the Minister) and has historically been appointed by the Minister for Energy to the role of Jurisdictional System Security Coordinator (JSSC) under national law.
- The Department of State Growth (State Growth) supports the Minister for Energy, administers relevant legislation, prepares energy policy and is typically where the Director of Energy Planning role is situated.
- Hydro Tasmania's responsibility to ensure the prudent management of its water storages is currently articulated by the Tasmanian Government through Hydro Tasmania's Ministerial Charter. The Ministerial Charter outlines the 'Principal Purpose' of Hydro Tasmania to "*efficiently generate, trade and sell electricity in the National Electricity Market.*" In relation to water management, the 'Strategic Expectation' requires Hydro Tasmania to "*prudently manage its water resources consistent with the long run energy capability of its system.*"[20]

[20] Hydro Tasmania Ministerial Charter, November 2012.

- National market rules and procedures relating to energy emergencies are overseen by the Australian Energy Market Operator (AEMO). These provide guidance in the management of emergencies that typically face mainland Australian jurisdictions in the form of capacity constraints, caused through significant and immediate events such as bushfire, storm or flood.
- AEMO operates a NEM emergency management protocol and the Power System Emergency Management Plan (PSEMP) that dictate the level of response to be undertaken to ascending levels of emergency criticality (refer Figure 6.1). There are two key roles in Tasmania under this national framework.
  - The Responsible Officer (RO) is a statutory role under National Law and has the key responsibility to enact load shedding directed by AEMO, or the jurisdiction, as part of an emergency response. The RO has historically been an officer in the transmission business in Tasmania (now TasNetworks).
  - The JSSC is appointed by the Tasmanian Minister for Energy in accordance with Section 110 of the National Electricity Law (NEL). The JSSC has the key responsibility to prepare load shedding priorities and sensitive loads for Tasmania and arrange their authorisation.
- TasNetworks publishes an Annual Planning Report to fulfil its transmission and distribution planning functions under the National Electricity Rules and state-based requirements under licences issued by the TER. This report includes information on future requirements to accommodate changes to load and generation, assessments of the adequacy of electrical energy availability for low, medium and high rainfall scenarios, and evaluates significant risks to the security of supply from extreme events.

Figure 6.1 Emergency response levels for electricity incidents



Source: AEMO, *Power System Emergency Management Plan* overview data

6.2 Lessons learnt from the 2015-16 energy security event

The events of 2015-16 offer an opportunity to review Tasmanian energy security oversight frameworks.

Despite the significance of the 2015-16 energy security event, and its potential to ultimately constrain energy supply within Tasmania, its circumstances did not warrant AEMO intervention to coordinate a response to mitigate its impact (i.e. Level 4 in the PSEMP). Instead, the 2015-16 event was managed by Tasmanian-based officers within the State Government and local energy businesses.

Other elements of the national market structures were also not required. The PSEMP and NEM emergency management protocols prescribe market mechanisms for organising reduction of load in the form of schedules approved by the JSSC and implemented by the RO. However, as Tasmania did not reach the point where supply could not meet all demand, the Minister for Energy was not required to authorise the use of load shedding. The Taskforce understands that Tasmania's load shedding and mandatory restriction schedules were reviewed by the JSSC and RO, who found that, because they are primarily designed for capacity shortage situations, they were likely to be impractical and/or ineffectual for an energy supply shortage situation that could be long lasting.

In terms of management and mechanisms to address the 2015-16 energy security event, Tasmania essentially acted alone without intervention at a national level. When considered against the PSEMP, this suggests that Tasmania was in a Level 3 situation. The key actions taken to respond to the situation were:

- the design and implementation of the Energy Supply Plan; and
- the triggering of planned energy security monitoring and advisory functions, but supplemented with additional governance structures created in response to this particular event.

Whilst the actions taken to establish mitigation responses ultimately assisted in the avoidance of energy supply shortages, the Taskforce's examination of the response has highlighted that the framework to monitor, assess and respond is not as clear as it could be. In particular, the Taskforce considers that the arrangements in Tasmania need to be designed so that they effectively deal with the PSEMP Level 1 to Level 3 situations from a supply challenge perspective. From a supply context, these can be described as pre-emergency levels that, if managed appropriately, can avoid the Level 4 and Level 5 emergency levels.

During the 2015-16 energy security event there was extensive public concern about the potential for restrictions in supply. Media coverage on the outage of Basslink and the low levels of water storages in Hydro Tasmania catchments fuelled this concern. A number of energy sector stakeholders have stated (both in written submissions and during meetings with the Taskforce) that communication during the energy security event was poor, including the quality, content and timing of information being released. Stakeholders noted that clear and informed public communications on the relative level of energy security could increase community confidence and assist business planning across periods of potential constraint.

6.3 Review of energy security oversight framework

Based on the key lessons learnt from the 2015-16 event and a comparative review of frameworks across Australia and internationally (primarily in relation to hydro-electric dominated systems), it is clear there are aspects of the Tasmanian energy security oversight framework that could be enhanced to produce a clearer set of governance arrangements.

In relation to the frameworks to manage electricity emergency situations when they occur, Tasmania is part of a national emergency framework that is highly organised and tested regularly. The NEM Emergency Protocol and AEMO's PSEMP provide strong guidance in the management of emergencies that typically face mainland Australian jurisdictions. The PSEMP articulates those levels which are a jurisdictional responsibility and those for which AEMO will begin to involve itself in an emergency situation.

The types of emergencies that the PSEMP is designed around generally occur rapidly and with little warning through the availability loss of some generation and/or transmission assets. They often arise because of a sudden weather event (storms or bushfires), and create a *capacity* shortage. In general, the NEM arrangements and AEMO's roles and responsibilities for managing sudden demand and supply imbalances are well understood, practiced and implemented when necessary.

The state-based roles under this NEM framework (principally the JSSC and RO) also appear reasonably robust, though the role of JSSC as a policy setter for load shedding priorities and authoriser of mandatory demand reductions could be made clearer (particularly in terms of the intersection of seeking Ministerial approval under Tasmanian law for demand reductions). As such, the Taskforce considers that significant reforms are not needed for these emergency arrangements, but rather continuous improvement be pursued through engagement, practice and learning amongst the key bodies and persons involved. Modernising existing arrangements for load shedding and mandatory restriction schedules to reflect significant changes in consumer energy use and behaviour (including increased technology dependence) should be a priority task for the continuous improvement approach.

The arrangements for energy *supply* situations are not as clear or as robust as they could be. The reasons for this appear to be related to:

- lack of clarity over a long period of time as to who is responsible for energy supply security;
- the overlap of the NEM framework with state-based arrangements being unclear and in some instances not fit for purpose; and
- the NEM being designed to provide a framework which encourages competition and provides timely market signals for investment, which is problematic in Tasmania given the lack of competition.

The following sections outline specific challenges and identified gaps in the Tasmanian energy supply security oversight arrangements.

6.3.1 Ambiguity over energy supply security responsibility

A number of energy sector participants have varying degrees of involvement in Tasmanian energy supply security oversight including the State Government (through its departmental structures and statutory offices, including the TER), AEMO, and energy entities such as Hydro Tasmania and TasNetworks. The dispersed nature of oversight responsibilities was identified as a key issue by stakeholders in submissions to the Taskforce's Consultation Paper.

Much of the practical responsibility for energy supply security in Tasmania has been placed with Hydro Tasmania. Prior to 2001, Tasmanian energy supply security was essentially the same as hydrological risk, with no Basslink or wind generation (with the oil fired Bell Bay Power Station the only material back up). With the present supply mix, despite their ownership by Hydro Tasmania, the link between hydrological risk and energy supply risk is lower, though at a point the two do still converge.

Since Basslink's commissioning, the Tasmanian Government has at certain times acknowledged that Hydro Tasmania cannot be fully responsible for Tasmania's energy supply security. This was particularly the case when the TVPS was owned by Aurora Energy, and therefore a competitor. However, due to the dominance and therefore importance of hydro-electric generation to Tasmania's energy security, the Tasmanian Government, over time, has placed obligations on Hydro Tasmania with regard to water management (currently this is through the Ministerial Charter). Hydro Tasmania also controls most of the 'levers' to ensure energy supply security, such as non-hydro generation and the ability to agree load reductions with major customers. This has historically made responsibility for energy supply security ambiguous. The Taskforce is of the view that responsibility for energy security should unambiguously reside with the Tasmanian Government.

6.3.2 Roles and responsibilities

The overlap of the NEM framework with State-based arrangements is itself not necessarily an issue. There should be State-based arrangements that complement and work within the NEM framework. However, the Taskforce observes that existing Tasmanian-based arrangements are based on legal frameworks that were introduced prior to the NEM (going back two decades), and the integration of State-based roles and responsibilities under State law versus those under national law could be clearer.

The Director of Energy Planning is one of the longstanding roles that was created prior to the entry of Tasmania to the NEM, the commissioning of Basslink and the disaggregation of the HEC. Since that time, no material amendments have been made to the role, despite significant changes including the creation of national energy institutions [(in the form of the Australian Energy Market Commission (AEMC), AEMO and the Australian Energy Regulator (AER)] and the pursuit of market-driven outcomes. These developments make many of the broad functions and powers of the Director of Energy Planning effectively redundant or superseded.

The Director of Energy Planning role also appears to have been rarely, if ever, appropriately resourced to be able to undertake all of the responsibilities it is required to perform under the *Energy Planning and Coordination Act 1995* (EP&C Act). When first established, the EP&C Act envisaged that the Office of Energy Planning (which the Director would head) would be an agency in itself. Conceptually it is a statutorily independent office that, in most similar arrangements (such as the TER) would have dedicated resources to support it, and not simply be part of a broader agency. Its main relevance today is its ability to provide policy advice to the Minister for Energy and in certain information gathering powers it has, which can be (and has previously been) used to support energy security responses.

The department responsible for energy policy (currently State Growth) has historically been involved in energy security matters. Indeed, there have been times where State Growth has taken a broader role in energy emergency planning, though this in itself appears to have created overlap with the responsibilities of others.

State Growth has, over considerable time, had a small resource base but lack of clarity in role. The Expert Panel commented in its Final Report that the energy policy function of the (then) Department of Infrastructure, Energy and Resources (DIER), despite having a legislative basis (in the form of the EP&C Act), appeared to have a broad yet indistinct mandate, with its limited resources focussed on national energy policy forums, thus leaving little opportunity to focus on State-based strategic policy development.[21] A confidential review completed for DIER in 2005 came to a similar conclusion.

While there has been some re-alignment of focus in more recent years to specific State-based energy issues, the Taskforce observes there is a sustainability question for State Growth's energy policy function. State Growth currently engages in:

- State-based energy issues (including implementation of the Tasmanian Government's Energy Strategy);
- national policy reform processes under the auspices of the Council of Australian Governments (COAG) Energy Council;

[21] Electricity Supply Industry Expert Panel, 2016, *An Independent Review of the Tasmanian Electricity Supply Industry, Final Report Volume 1.*

- shareholder relations as far as they relate to the Tasmanian Government's energy policy objectives; and
- energy security policy, monitoring and response coordination.

The first three of these activities are highly inter-related, are difficult to disentangle, and demand significant resource focus. However, with respect to energy security, the monitoring and response coordination roles do not necessarily fit with a policy function within Government.

There is also a mix of energy policy (or highly related policy) and regulatory functions across Government, including in Treasury, the TER and the Tasmanian Climate Change Office. The relatively small quantity of resources spread across these agencies could be better organised to create clearer roles and responsibilities and an efficient critical mass of resources in appropriate agencies.

Another challenge is the information and resource asymmetry between Government officials and/or statutory officers and the energy businesses. In the case of energy supply, Hydro Tasmania necessarily has intimate knowledge of Tasmania's hydro-electric system at the operational level and has relatively considerable resources deployed in managing and optimising the system. This is appropriate for Hydro Tasmania as the system operator charged with operating commercially to return the most value from the State's hydro-generation resources to the Tasmanian Government, on behalf of the Tasmanian community. However, this creates a challenge of having external oversight with enough knowledge, capability and credibility to independently check, on behalf of the Government, that supply risks are prudently managed in the context of overall energy security risks.

6.3.3 Monitoring and reporting on Tasmanian energy security

Stakeholders have commented to the Taskforce that the existing frameworks did not produce good communication during the events to credibly convey the 'facts' and assist consumers to understand how they should respond.

At a national level, the main mechanism for monitoring and reporting of hydrological supply risk is the Energy Adequacy Assessment Projection (EAAP) published by AEMO. The EAAP uses three rainfall scenarios in its assessments and, until recently, was published quarterly (it will now be published annually, though more frequently if there are material changes in circumstances). The low rainfall scenario used in the EAAP to date has generally been materially higher than what has been considered appropriate for prudent energy supply planning amongst Tasmanian departmental and statutory officers, given hydrological risk is the most significant risk to Tasmania (compared with mainland states).

At the Tasmanian level, State Growth has historically monitored energy supply risks, including hydrological risks as reported by Hydro Tasmania. Over time there has been changes in resources and committee structures involved in energy supply monitoring.

The main mechanism currently in place to monitor hydrological risk is the WSAC. As with the Director of Energy Planning, the provisions which provide for the establishment of WSAC are in legislation that is two decades old [within the *Electricity Supply Act 1995* (ESI Act)]. The effect of this is a focus on hydrological risk with no clear ability to address energy security purely outside a water storage management context. It also provides little practical power to members of the WSAC other than to advise the Minister for Energy whether there is enough water to generate electricity to meet demand, and it has no legal authority to advise mitigation actions or to direct them.

There are extensive external reporting obligations on TasNetworks regarding system reliability, across both State and national legislative requirements. This is partly due to the greater regulated nature of network businesses compared to generators. The extent of reporting obligations, and the transparency that comes with it, does not appear as great on Hydro Tasmania relative to TasNetworks. While care should always be taken with regard to not having unnecessarily onerous reporting obligations, greater information transparency on energy supply status and risks would enhance public confidence.

Protocols for communicating energy security matters for Tasmania are present but lack integration and clarity. Hydro Tasmania provides information on total water held in storage in its dams, publically available on its website. However this provides no context as to the relative level of energy security provided by this water. Beyond this, there are emergency management plan communication protocols as part of the PSEMP overseen by AEMO and State-based emergency management plans. However, there are no similar plans for pre-emergency situations to communicate energy security challenges as they pertain to Tasmania.

6.3.4 Prudent management of water storages

Water holds the greatest role in shaping supply security outcomes in Tasmania.

Hydro Tasmania, as the operator of the State's hydro-electric system, is principally responsible for managing hydrological risk and has its own framework for doing so. This has historically been in the form of prudent water storage management guidelines, which essentially establish a preferred operating minimum level for water storages and various risk thresholds. Hydro Tasmania is currently reviewing its framework in light of the 2015-16 events. These matters are discussed in detail in Part B of the Interim Report.

With regard to the manner in which the Tasmanian Government communicates its energy supply risk appetite through Hydro Tasmania's Ministerial Charter, there are concerns from some stakeholders that the operational and strategic goals placed on Hydro Tasmania have the potential to drive outcomes incongruent with energy security. Specifically, that despite requirements to work sustainably and with regard to the well-being of the Tasmanian community, the obligations to deliver a commercial return creates ambiguity as to the level of importance placed on energy security. Reducing Hydro Tasmania's conflict, regardless of whether real or perceived, would create public confidence as well as provide Hydro Tasmania with clarity and transparency around its operations.

6.4 Options to enhance energy security oversight arrangements

The following sections analyse options for improving Tasmanian energy supply security oversight arrangements, according to what the Taskforce considers to be the key roles in an oversight framework. These are:

- responsibility for energy security;
- responsibility for monitoring and assessing energy security;
- responsibility for water storage management; and
- responsibility for energy security co-ordination.

6.4.1 Responsibility for energy security

In terms of the ultimate responsibility for the management of energy security, it is clear this sits with the Tasmanian Government. In all examples the Taskforce has examined, governments are responsible for energy security for their citizens as the 'owner of last resort'.

In taking responsibility for energy security, Government's role is to ensure an appropriate and robust framework is in place so that energy security can be monitored and managed and emergency situations are prevented where possible. The key actions arising from the framework rest with instrumentalities that are put in place (such as regulators) and energy entities, whether government or non-government owned.

The need to seek government endorsement of actions should, however, be required in certain but limited (usually critical or emergency) situations.

In setting a framework for energy security, there should be a clear energy security policy that articulates the Tasmanian Government's approach to energy security. This includes clearly defining what energy security means for the jurisdiction. The recommendations the Taskforce is making in its Interim Report will go a considerable way towards establishing an energy security policy framework for the Tasmanian Government. However, ongoing maintenance and review of the energy security policy should be the responsibility of the department responsible for the energy portfolio (currently State Growth).

State Growth should review the energy security policy, including the framework that is established to support it, on a routine basis. The Taskforce considers that around every three years would be appropriate, or when there are material changes to the environment (such as a material change in supply and/or demand). Government endorsement should then be provided for any changes to the policy and this should be transparently communicated to the public.

6.4.2 Responsibility to monitor and assess energy security

The Taskforce proposes that an explicit energy security 'Monitor and Assessor' role and function be established, including through streamlining and modernising existing arrangements.

The Monitor and Assessor would provide independent oversight and transparent public reporting of energy security (taking a holistic view of at least electricity and gas energy) that would be informed by primary level data provided by relevant energy supply providers.

As hydrological risk is the largest risk for Tasmania, a strong relationship and regular engagement with Hydro Tasmania would be expected, with Hydro Tasmania required to provide necessary data and forecasts. A close working relationship with the Bureau of Meteorology (BOM) could also be established, given rapidly improving and sophisticated tools and information to assist in planning are becoming available. Hydro Tasmania and TasNetworks could also benefit from a close working relationship with the BOM to ensure they understand what capability exists, or will exist, and how it may be used for their respective planning purposes.

The Monitor and Assessor could publish an assessment of Tasmania's energy security status at regular intervals (for example, annually updating the energy security assessment the Taskforce has undertaken) and make available on a website a dynamic set of key indicators (such as up-to-date monthly forecasts of energy supply relative to forecast Tasmanian consumption and hydrological risk status). This is further discussed in Chapter 9.

The Taskforce has identified three existing statutory bodies suitable for undertaking the Monitor and Assessor role.

- TER – Despite its name, the TER also regulates non-economic activities in the energy sector. The TER has powers related to energy security through its issuing of licences to TasNetworks and Hydro Tasmania to undertake their transmission, distribution and generation functions in Tasmania. It undertakes regular reporting and review of the practices of these entities and holds enforcement powers to ensure compliance with regulatory obligations through a range of mechanisms. The TER also has the capacity to levy fees and ensure a continuous funding model which incentivises participants to be efficient and compliant.

  Generally, regulators are equipped with mechanisms to manage technical or detailed data provision such as performance reporting, compliance testing and price determinations. The TER also undertakes an Annual Reliability Review that provides analysis on Tasmanian reliability standards.

The Taskforce considers the TER is well placed to undertake the Monitor and Assessor role, though would likely require supplementing of its existing resources to make the function sustainable. The amount of supplementation could be minimised through utilising expertise in other organisations (such as TasNetwork's modelling capacity).

- AEMO – AEMO currently undertakes a role as defined in the National Electricity Rules (NER) and NEL, and has considerable expertise with emergency management plans that apply to all NEM jurisdictions. These plans and review points are predominantly focussed on reliability of supply as opposed to a lack of available energy due to low reserves of water and/or long-term generation outages. AEMO has considerable expertise and resources that cannot be matched in Tasmania and, therefore, there is an opportunity to explore with AEMO whether it is able to fulfil the Monitor and Assessor role. There are arrangements under the National Energy Law to establish advisory functions and this could include clear obligations on AEMO, which may need to be supported by additional information gathering powers.
- Director of Energy Planning/State Growth – this is essentially a 'status quo' option but the Taskforce considers it the least appropriate for the reasons outlined earlier (i.e. broad remit and small resource base). If the Director and State Growth were to continue with this role, resource supplementation and/or departmental reorganisation across Government would be necessary to enhance the current resource and skill profile, given the Monitor and Assessor role proposed is greater than what is currently in place.

The Taskforce has canvassed these options with the current stakeholders in these organisations. Each has indicated in-principle potential to fulfil the proposed Monitor and Assessor role, subject to working through detailed implementation issues.

Funding for additional resources could initially come via a Budget appropriation. However, a regulatory charge on relevant market participants to ensure the function is sustainable over the long term would be appropriate and consistent with the rationale for other regulatory charges (this would particularly be the case if AEMO undertook the role, and likely also for the TER).

In exploring the above options (and the other reforms canvassed in this paper), existing arrangements should be reviewed with a view to streamlining and modernising them. In particular, the Taskforce recommends the following.

- The Director of Energy Planning's powers and functions should be reviewed to ensure their relevance to the structure of the Tasmanian energy sector today and into the future. It may be the case that the Director role is no longer relevant and the information gathering powers could be consolidated with the TER (if the first option is preferred). If the Director position is to be maintained, its role should at least be clarified from the role of others and its independent statutory basis appropriately supported.
- Committee structures and their legal basis should be reviewed. The need for the WSAC and its role should be considered in the context of a broader review of necessary committee structures. A principle of generic committee establishment powers available to the Minister and statutory officers (such as the Monitor and Assessor) should be favored over specific committee structures in legislation, unless there is a compelling reason to do so and in as far as legal authority is clear.
- The Minister for Energy's power to invoke mandatory restrictions should also be reviewed and modernised in the context of other reforms and to ensure operability with NEM arrangements, as well as clarity as to use in capacity versus supply situations.

Legislative change is likely to be required to support reforms of this nature. The Taskforce notes that the energy legislation (including the ESI and EP&C Acts) are scheduled to be reviewed as part of the Tasmanian Government's Energy Strategy. A broad review of energy legislation is likely to take considerable time and require considerable, dedicated project resources. It would be appropriate for changes to energy security arrangements to be included in this larger work, though there is a risk of implementation delay. Should the changes be incorporated into a broader energy legislation review, interim changes where possible should be implemented on a clearly prioritised basis until legislative changes take effect.

6.4.3 Responsibility for water storage management

Given the significant role of water storages and hydro generation to ensuring continuity of supply, Hydro Tasmania's approach to prudent water storage management is an essential aspect of the broader energy security oversight framework for Tasmania.

Hydro Tasmania should have responsibility for managing hydrological risk given its direct control of water catchment areas. However, the management of this risk should be within a clear framework where the State's energy security policy remains paramount.

By introducing independent oversight of water storages, the capacity to consider their impact in line with all factors that influence energy security will be improved. This is standard practice in the reviews of international energy sectors, which show independent oversight is a common feature of hydro-electric systems around the world, such as in Norway, New Zealand, Manitoba and Iceland.

The Monitor and Assessor role proposed above should take on an independent oversight role in monitoring and reporting publicly on water storages in the context of all supply and demand risks.

Submissions to the Taskforce asserted there is a lack of transparency in the management of water storages. Clearer roles and responsibilities, including the introduction of stronger independent oversight, would create transparency and public confidence, and provide Hydro Tasmania with clarity and reduce perceptions of its role in maintaining energy security.

These issues are further explored in Part B of the Interim Report.

6.4.4 Energy supply security situation coordination

A key learning from the 2015-16 energy security event was the need to have greater clarity of who is in control when energy security risks become heightened. In a capacity situation, the arrangements are clear through the roles of AEMO, the RO and JSSC. However, in a pre-emergency low supply situation where demand is still being met, but there is credible risk that demand may not be met in the near future (months or even weeks), there is a need to ensure the situation is managed through appropriate governance.

In the first instance, the principle should be that market participants are left to manage demand and supply for as long as possible. Only when material impacts on the general economy are likely should intervention into normal market operations occur. This is the principle behind the PSEMP Level 3 emergency level and Tasmania needs an equivalent for a pre-emergency supply situation.

Historically, because of Hydro Tasmania's dominance in the Tasmanian market and its ownership or interests in all the utility scale generation, the Tasmanian Government has turned to the business to manage energy security challenges. While this has been a practical response, it has created tension between what is in the best commercial interests of Hydro Tasmania versus what is in the State's interest. This should not be seen as a criticism of Hydro Tasmania, but rather the need for a clearer framework and set of expectations for Hydro Tasmania to operate under.

A common feature of other energy systems is an independent coordinator or system operator, who is responsible for overall system security and has certain powers to support this. This is essentially what AEMO does in the NEM but the focus, as discussed previously, is mostly on capacity issues given this is the challenge facing most of the rest of the NEM. A similar role for supply shortages is not as clear.

In this context, the Taskforce considers that an 'Energy Security Coordinator' role should be established in Tasmania to coordinate responses across market participants to manage electricity supply risks when water storages are at or below an 'energy security reserve' level.

The Taskforce has identified two options that could take on such a role in Tasmania.

- TasNetworks – TasNetworks already performs a range of system security functions for Tasmania under national and State laws, and is well practiced in terms of emergency preparedness and response for capacity situations. It is therefore reasonably placed to take on a system coordinator role for energy supply situations. Hydro Tasmania would likely still be required to be the main agent to implement actions (particularly on the supply side), but the Energy Security Coordinator may have an authorisation and decision making role where the State's interests require action across multiple parties and/or where Hydro Tasmania may need to act against what it considers to be its commercial interests. TasNetworks would also be well placed to evaluate supply side options from a technical perspective, in terms of connection to the Tasmanian power system.

  It may be preferable that the RO within TasNetworks also acts as the Energy Security Coordinator. This would create a seamless approach, in that the same person would have continuity in managing the responses between the two roles as a pre-emergency situation moved into an actual emergency (i.e. moving from State-based responses to national-based ones).

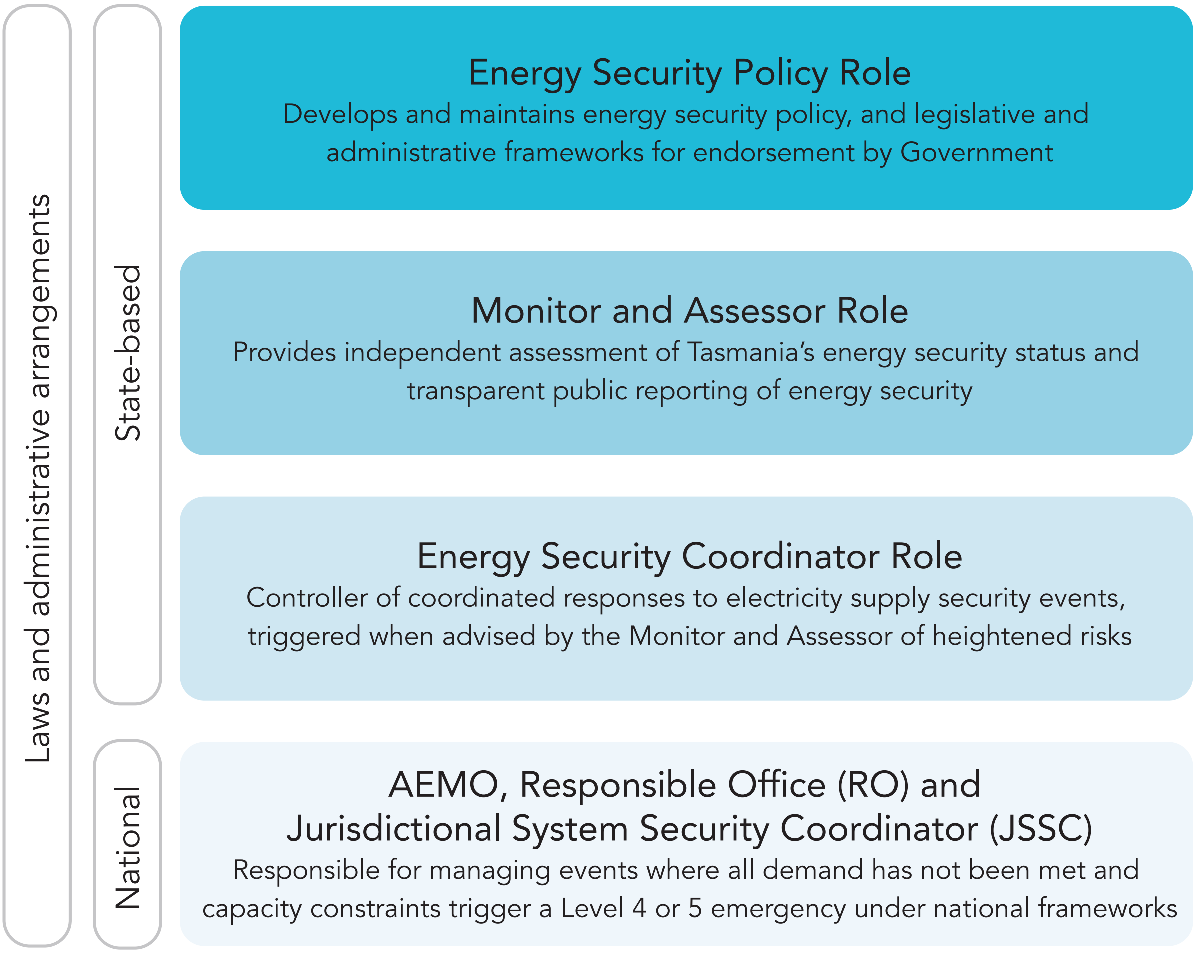
- AEMO – as previously discussed, AEMO's role is already clear under the NEM arrangements but focussed on capacity situations. AEMO could possibly take on the Energy Security Coordinator role (this is more likely to occur if it does not take on the role of Monitor and Assessor). Whether there are issues with the way AEMO is required to manage the NEM against specific State interventions required under Tasmanian law or other instruction, needs further investigation. Clear authorisations from Tasmania to request AEMO to fulfil this role are likely to be required.

The Taskforce envisages that the Energy Security Coordinator role would in all but rare instances be a 'standby' role, and only be activated once the Monitor and Assessor requests the Energy Security Coordinator to be the controller of coordinated responses across market participants to manage an energy supply security situation.

Whilst being a standby role, the Energy Security Coordinator could assist in reviewing all planned mitigation strategies including gas generation, demand side management and temporary generation. A template plan for response to events could be maintained by the Energy Security Coordinator and reviewed periodically. The Energy Security Coordinator could also work with the Monitor and Assessor to ensure simulation exercises for energy supply situations are conducted, including testing 'black swan' events to see how Hydro Tasmania and other industry and customer participants would respond. Such exercises are conducted routinely to test capacity emergencies, but a renewed focus on testing responses to the types of energy security events experienced in 2015-16 would help both industry and customers gain confidence that frameworks and procedures are robust and transparent.

A pictorial representation of the recommended energy security oversight roles is provided in Figure 6.2.

Figure 6.2 Proposed electricity energy security oversight roles



The Energy Security Coordinator role would require a supporting regulatory framework to ensure market participants provide information as to planned contingency responses and, where relevant, fully implement those responses. This is further discussed in Chapter 9 of Part B.

The regulatory framework to support the Energy Security Coordinator would be based around the passing of contingency thresholds set by the Monitor and Assessor and assist the planning to return water storages above those thresholds. The framework could also include powers to authorise Hydro Tasmania to access water storages below a certain deemed 'reserve level', whereby permission is granted upon a clear plan being presented that demonstrates how storages will be returned above the reserve level and to safer levels. This is further discussed in Part B.

RECOMMENDATIONS

2. Responsibility for developing an energy security policy that clearly articulates Tasmania's approach to energy security should rest with the department responsible for the energy portfolio.
3. Responsibility for monitoring and assessing energy security should rest with an external body with pre-established market monitoring capabilities. A new Monitor and Assessor role should be established to provide independent oversight and transparent public reporting. The TER, the AEMO and the Director of Energy Planning are identified as potential authorities to undertake the Monitor and Assessor role.
4. Additional resources of sufficient size to maintain capability should be provided for the monitoring and assessing function. Funding for these resources could initially come via a Budget appropriation, though a regulatory charge on relevant market participants to ensure the function is sustainable would appear appropriate as a permanent funding source.
5. The Monitor and Assessor role should utilise existing expertise where possible, such as within TasNetworks (particularly its modelling capacity).
6. An Energy Security Coordinator role should be established to coordinate responses across market participants to manage electricity supply risks when water storages are near or below an identified energy security reserve level. TasNetworks (preferably the Responsible Officer) or AEMO are identified as potential options for the Energy Security Coordinator role.
7. Where necessary, legislation should be enacted or amended to ensure relevant officers or bodies have the appropriate functions and powers to support the roles and responsibilities. More efficient organisation of policy and regulatory resources across Government should also be investigated, to improve role clarity and the critical mass of existing small resources spread across several agencies.
8. A review of the Director of Energy Planning's role, the *Energy Planning and Coordination Act 1995* and the *Electricity Supply Industry Act 1995* (at least as it relates to energy security matters) should be undertaken to modernise and streamline arrangements with the other reform considerations.
9. The Monitor and Assessor role should publish an annual assessment of Tasmania's energy security status and make available on a website a dynamic (at least monthly) forecast of energy supplies relative to forecast Tasmanian consumption, as well as an assessment of hydrological risk.

6.5 Oversight of gas energy security

The majority of this chapter has focussed on energy security in the context of electricity, given the State's relatively high dependence on this form of energy. The Taskforce has found that existing arrangements for gas are generally sound, or where they require enhancement, can either be dealt with by the options outlined for electricity or through some minor role clarity improvement. For this reason, this section is briefer than the rest of this chapter.

An overview of current gas security governance arrangements and the legislative frameworks and tools that underpin them is provided in Appendix 2.

Whilst a short outage of the TVPS or the gas pipeline would unlikely threaten electricity energy security (given the many other generation options), the loss of gas supply would affect thousands of Tasmanian customers, both residential, small business and large industrial consumers.

While supply certainty in the future is a concern for many stakeholders, these are likely to be more concentrated on price and terms and conditions than the actual availability of gas. The issues for gas energy security in Tasmania, in contrast to electricity, are therefore likely to be more concerned with the emergency arrangements in response to sudden events.

An important distinction in the Tasmanian gas market is that it is predominantly privately owned. The TGP, Tas Gas Networks and Tas Gas Retail are all private assets and businesses. Furthermore, the sole source of wholesale supply is provided by Esso out of Victoria and the gas production plant at Longford. By comparison, electricity generation and transmission in Tasmania is provided by State-owned business.

In terms of emergency management, gas is covered by both State-based and national emergency management frameworks. The key features of these include:

- powers under State legislation for the Minister for Energy to direct customers connected to the distribution network not to use gas during certain emergency events to ensure the most efficient and appropriate use of the available gas;
- the statutory position of Director of Gas Safety under Tasmanian legislation;
- the National Gas Emergency Response Advisory Committee (NGERAC), which is constituted with jurisdictional representatives (including Tasmania) and industry members to set the policy framework for managing gas supply emergencies that affect more than one jurisdiction; and
- the Jurisdictional Contact Officer (JCO), which is a nominated officer in each jurisdiction to advise other JCOs of gas supply emergencies that may impact, or are impacting, other jurisdictions.

The Taskforce has consulted with stakeholders and considers that, in general, these arrangements appear sound. However, the Taskforce makes the following observations.

- State Growth has historically had a role in gas, in terms of both policy and emergency management planning. However, this has created some overlap with others, particularly the Director of Gas Safety. It would be clearer if State Growth limited itself to policy roles, which principally involves representing Tasmania on NGERAC.
- Supply shortages are most likely to arise from a gas safety issue. In this context, the Director of Gas Safety currently performs a significant role working with industry and major gas customers and is well placed to be the clear, responsible authority for gas emergency situations.
- Even where a supply issue is not safety related, it is very likely to create a safety issue (such as potential depressurisation of a pipeline). In this context, the Director of Gas Safety also appears best placed to be the responsible authority for such a situation. However, the Director should work closely with State Growth, particularly in regard to participation on NGERAC. The Director could be assigned the JCO role, and attend NGERAC meetings with State Growth's NGERAC representative.
- Outside of emergency response and policy roles, the proposed Monitor and Assessor role should at a high level examine forward looking gas market demand and supply risks, as part of its proposed overall energy security monitoring and assessing role. However, an alternative or complimentary role may be provided by AEMO. AEMO currently does not have a role in the Tasmanian gas market, but with the TGP's entry into the Victorian Declared Wholesale Gas Market (DWGM), there is merit in considering whether AEMO should have a greater role across the DWGM and the Tasmanian gas market.

The Taskforce notes that there are proposed revisions to Tasmanian gas legislation currently under consideration, including enhancing and clarifying gas safety arrangements. These revisions should ensure that roles and responsibilities are clear, and that any legal powers (including for the restriction of supply) are appropriately vested with these roles and responsibilities.

RECOMMENDATIONS

10. The Department of State Growth should limit itself to a policy role with respect to gas energy security, with the Monitor and Assessor role considering forward gas supply and demand risks as part of its broader consideration of energy security. The Director of Gas Safety should be responsible for engaging and coordinating responses with industry and gas customers on potential or actual emergency gas supply risks as they emerge.
11. The Tasmanian Government should explore whether AEMO should have a role in the Tasmanian Gas Market, given the TGP is now connected to the Victorian Declared Wholesale Gas Market.

Part B

Management of Hydro-Electric Storages

7. Overview of Storages and Inflows

KEY FINDINGS

- Additional generation sources outside the existing hydro and wind generation are required to prevent an annual reduction in storages under average or below average inflow conditions. In most cases Basslink alone is a sufficient source of energy to maintain annual energy storage levels in times of low inflow. Thermal generation is currently depended upon if Basslink is unavailable.

Energy stored via water held in hydro power lakes is the single biggest contributor to energy security in Tasmania. Hydro-electricity provides 77 per cent of generation capacity in Tasmania and delivers most of the energy to meet demand. As a result, the management of energy in storage is of critical importance to maintaining long-term energy security for Tasmania. This chapter examines the challenges in managing the water in storage with respect to the patterns of rainfall in Tasmania.

7.1 Storage and inflow management

Hydro-electric power stations in Tasmania can be broken into three categories: long-term storage, intermediate storage and run-of-river. There are two long-term high capacity storages in Tasmania: Lake Gordon (combined with Lake Pedder) and Great Lake. Intermediate storages are lakes with some degree of storage capacity and are often at the head of a chain of run-of-river storages. These headwaters release water downstream into a series of small, low capacity run-of-river storages where the associated generators must be operating when inflows are incoming or the storages will quickly fill above capacity and spill over the dam.

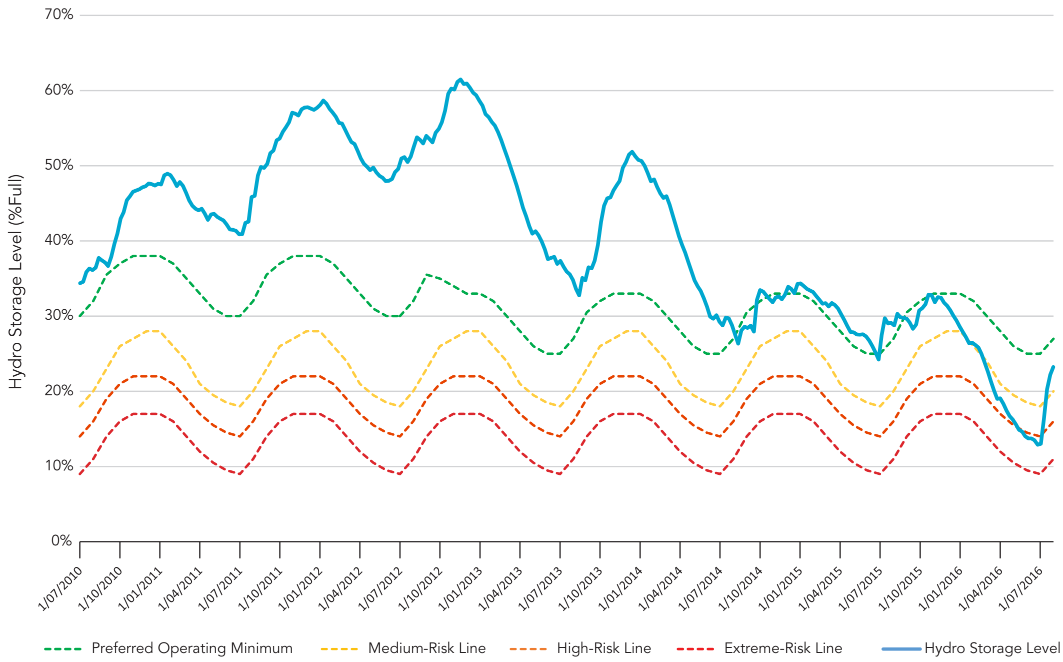
Figure 7.1 illustrates hydro storage levels relative to Hydro Tasmania's risk lines since 2010 (noting these are currently under review). The risk lines presented refer to the following risks.[22]

- Preferred operating minimum level (POM): analysis performed by Hydro Tasmania established the POM as the minimum level which maintains environmental, plant and energy security risks at acceptable levels.
- Medium risk: the medium risk line is around five to seven per cent below the POM and four to six per cent above the high risk line.
- High risk: five per cent above extreme risk level. Five per cent of total energy in storage is an approximate representation of the maximum energy that can be imported over Basslink in two months. This is reflective of a two month Basslink outage scenario, which was considered by Hydro Tasmania to be the credible outage period prior to the six month outage of 2015-16.
- Extreme risk: the level at which there is a risk of Great Lake needing to be drawn down below its Extreme Environmental Risk Zone (EERZ; currently set at 9.1 per cent).[23]

Prior to September 2012, the POM was set at 30 per cent. Since 2012, Hydro Tasmania has targeted a financial year end minimum total storage level of 25 per cent (around 3 600 GWh). The change was based on Hydro Tasmania's assessment that the combination of Basslink and thermal generation at the TVPS, together with increased wind generation capacity and changed demand projections, would result in the ability to operate storages at the lower levels. As an interim response to the 2015-16 energy security event, Hydro Tasmania has recently revised the level at which it will manage storages to the end of June 2017 to 30 per cent. The 2015-16 energy security event saw total energy in storage reduced to half of the POM in place at the time.

22 Information sourced from Hydro Tasmania's prudent water storage management guidelines.
23 When the level of Great Lake is below the EERZ there is an extreme risk of permanent damage to a threatened species of galaxiid fish and the habitat in which it resides.

Figure 7.1 Energy in storage relative to system risk

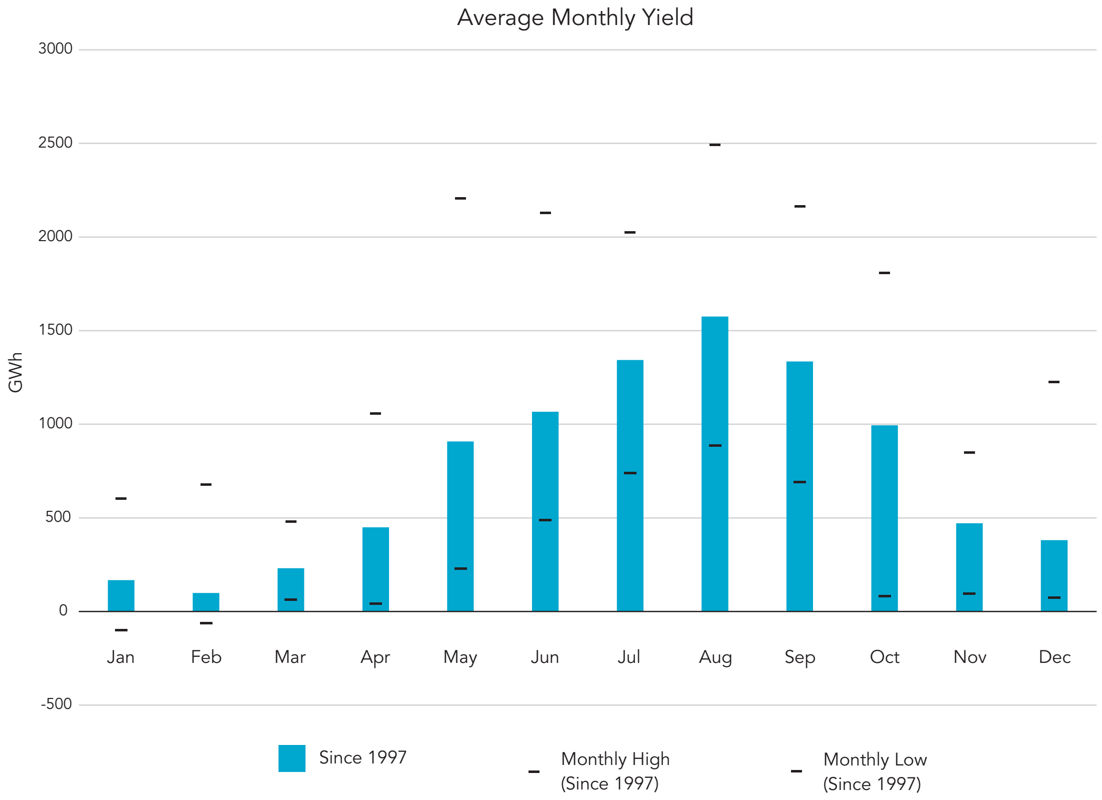


Source: Hydro Tasmania data

Water inflows into energy storage lakes are highly seasonal. Peak inflow season occurs in the winter and spring periods with seasonal lows occurring in the summer between January and February (refer Figure 7.2). The mix of hydro-electric generation must follow these seasonal patterns in order to maximise the utilisation of available water and minimise the spill over dam walls. During high inflows, generation from run-of-river power stations and intermediate storages is more prevalent in the generation mix as a result of using the inflows as they occur. During dry periods, generation from long-term storages helps meet demand when run-of-river generation needs to be used sparingly as a result of low inflows. In the lead up to expected high inflows in winter and spring, intermediate and run-of-river storages must be operated at lower levels in order to maximise the capture of inflows in the period ahead. There is a reasonable level of risk in this particular situation when storages are at their lowest and expected high seasonal inflows are delayed or well below average. Without the expected inflows, generation may not be available from these sources.

The six month period between May and October represents 80 per cent of the annual inflows into Tasmania's hydro-electric system under average conditions. Energy security issues begin to arise when a number of these months pass with significantly below average inflows. This is evident in Figure 7.2, which illustrates the significant inflow variability into Hydro Tasmania's catchments. While the profile of monthly inflows since 1997 generally follows the average, the monthly variance on a year to year basis (as demonstrated by the lows and highs) creates material uncertainty (particularly without robust rain or inflow prediction capability). Hydro Tasmania has indicated that monthly inflows are statistically independent, meaning that high inflows in any given month do not rule out the chance of very low inflows in the following months (or vice versa). In this context, inflow variability (rather than long-term averages) should be the main focus of hydrological risk planning.

Figure 7.2 Average monthly inflows to Hydro Tasmania's storages since 1997



Source: Hydro Tasmania data
Note: Hydro Tasmania currently uses inflow data from 1997 onward for system modelling purpose as it considers that inflow data prior to 1997 contains a level of high inflows which is not representative of current climate conditions.

7.2 Water storages in the 2015-16 energy security event

In the lead up to the 2015-16 energy security event, total energy in storage decreased from a high of 61.6 per cent (at 8 October 2012) to 28.1 per cent (at 30 June 2014). This large reduction of storage position was a result of heavy export flow over Basslink in response to the spot prices resulting from the national carbon price mechanism that was in operation at the time. Hydro Tasmania believes the net impact of the exports was close to zero, since storage levels prior to the pre-carbon price storage build up was 27.7 per cent (at 30 June 2009).[24] One year after the end of the carbon price mechanism, the total energy in storage was 29.7 per cent (at 29 June 2015).

Since the end of the carbon price mechanism on 1 July 2014, there have been lower than average inflows resulting in storage levels being close to the POM. Storage levels were just below the POM for most of the second half of 2014-15, until significant rainfall in May 2015 resulted in a sudden improvement.

Monthly inflows during the September to November 2015 period were among the lowest observations on record, resulting in the calendar year of 2015 being approximately 1 500 GWh below average. Similar annual inflow years to the 2015 outcome were observed in 2008 and 2014.

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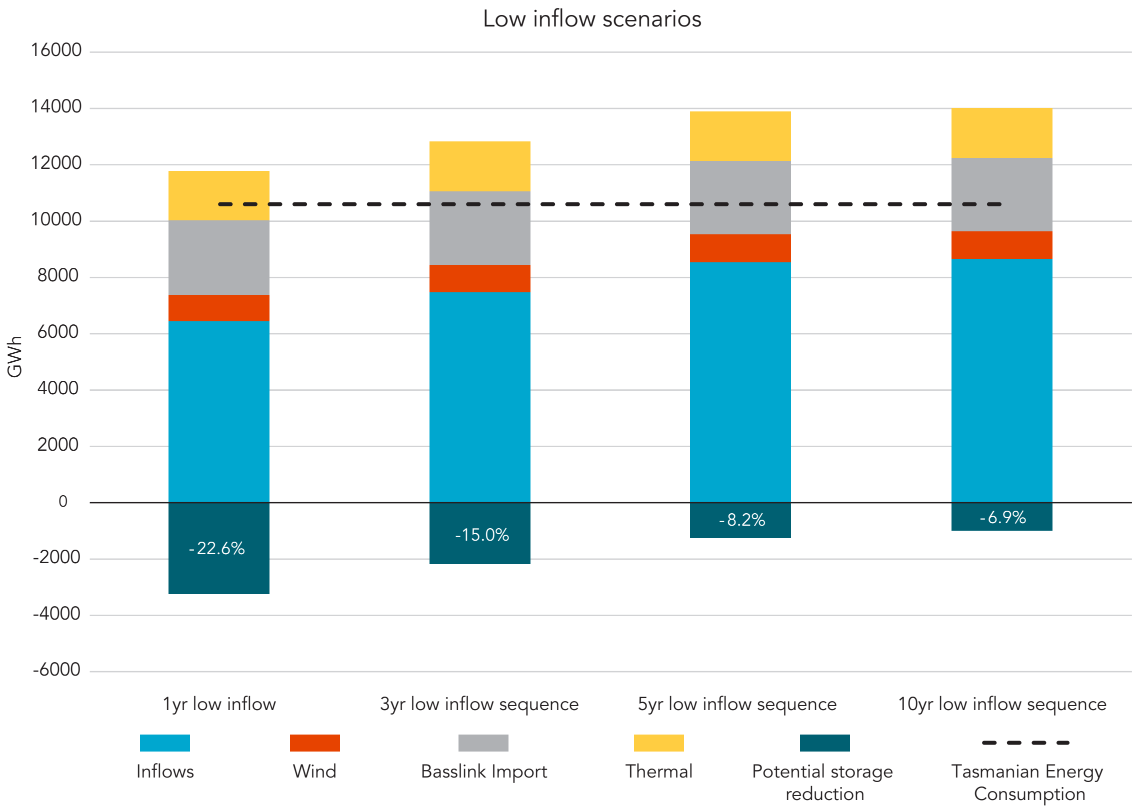
[24] Hydro Tasmania, 2016, submission to Parliamentary Standing Committee of Public Accounts inquiry into the financial position and performance of Government owned energy entities.

7.3 Low inflow scenarios

The Taskforce has explored the impact of record low inflows on the energy security position for the one, three, five and 10 year time periods. A summary of the scenarios is presented in Figure 7.3. Each scenario evaluates the equilibrium requirement whereby Basslink is used to maintain total energy in storage on an annual basis. Further detail behind each scenario, including assumptions, is presented in Appendix 3 and Appendix 4.

Figure 7.3 Annualised low inflow scenarios



Source: Taskforce analysis

The dashed line in Figure 7.3 shows average annual Tasmanian energy consumption. Where the generation provided by wind and hydro inflows is below this line, the shortfall must be provided by a combination of Basslink import, thermal generation and/or drawdown of total energy in storage. If the total energy in storage were to be used as the only source of meeting this shortfall, the quantum of energy in storage required to meet the annualised shortfall is shown in the negative data in Figure 7.3. Table 7.1 presents the energy in storage drawdown requirement to meet Tasmanian consumption under a number of supply scenarios (based on historical inflow data).

This analysis shows that without Basslink or thermal baseload generation available, an average annual storage drawdown is required in each scenario. With Basslink available as the sole source of generation support, only the lowest single inflow year would require an annual storage drawdown. With thermal baseload as the sole source of generation support the lowest single year and three year sequences require an annual storage drawdown. With both Basslink and thermal baseload generation available, even the lowest historical inflow year does not require an annual storage drawdown.

Table 7.1 Annual drawdown in energy storage to meet Tasmanian consumption

Scenario	No Basslink, Nothermalbaseload	Basslink only	Thermal baseload only	Basslink and thermal baseload
Lowest inflow year	-22.6%	-4.2%	-10.5%	-
Lowest 3 year sequence	-15.0%	-	-2.9%	-
Lowest 5 year sequence	-8.2%	-	-	-
Lowest 10 year sequence	-6.9%	-	-	-

Note: Scenarios are based on lowest historical inflow data.

7.4 Impact of climate change on inflow scenarios

Information presented in Chapter 10 shows that the average inflows into the hydro-electric system have been reducing over time. This may continue into the future according to current climate projections. The future pattern of inflows may contain longer periods of low rainfall in between periods of higher intensity rainfall events. There is also a chance of reducing inflows over the central catchment area which feeds into Great Lake. This combination of projections results in an increased likelihood of the low inflow scenarios presented above. In the case of the 10 year low inflow sequence (and to a lesser extent the five year inflow sequence), there is also a chance that the magnitude of inflows over the period could reduce as a result of the projected impact of climate change. However, as noted earlier, the more significant issue is the variability of inflows on an inter and intra annual basis.

7.5 Intra year storage levels and prudent water storage management

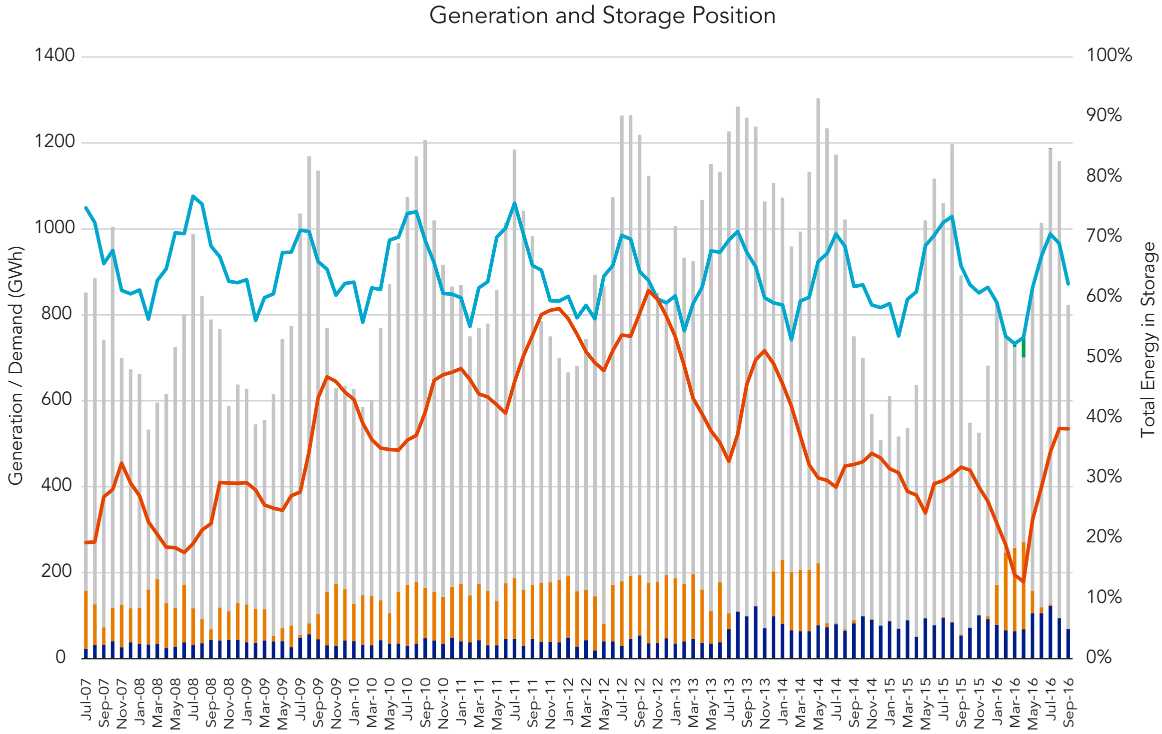
The scenarios presented in section 7.3 analyse the requirements for maintaining an unchanged storage position on a year to year basis. In reality, this involves the raising of storages in the period following high inflows so that there is enough energy in storage to meet operational requirements during the low inflow period and still meet or exceed preferred minimum operating levels. The period between the end of June 2015 and the end of June 2016 represented an extreme example of this intra year variation, whereby storage levels were maintained above the POM by the end of June 2016, but the intra year variation saw extremely low levels of storage offset only by very high levels of short-term rainfall at the end of the period. The storage position as at the end of June 2015 was 29.1 per cent (4.1 per cent above the POM). The lowest storage level in the following 12 month period was 12.5 per cent, a 16.6 per cent reduction from the start of the 12 month period. Storage levels recovered to 28.5 per cent by the end of June 2016 (3.5 per cent above the POM). This potential for extremes, together with the additional responses that were required during the low inflows, suggests that the POM is currently set too low when taking into account an extended outage of Basslink.

The addition of the Basslink failure caused the total energy in storage to fall to levels below the high risk line and very close to the extreme risk line (refer Figure 7.1). Using Hydro Tasmania's assumption that five per cent total energy in storage level represents full Basslink import flow over two months, if Basslink had not failed in December 2015 then total energy in storage would likely have remained between high risk and medium risk for the first half of 2016, with an estimated lowest storage position of around 20 per cent.

7.6 Rebuilding storages

The period prior to the carbon price mechanism of 2012-14 indicates how Hydro Tasmania's storage position can be increased over time. The information presented in Figure 7.4 shows that the increasing storage position between 2009 and 2011 was influenced by heavy importing in 2009 and high levels of thermal generation in 2010 and 2011. Import flow over Basslink can be identified when the cumulative generation column is lower than the Tasmanian demand line in blue. Not shown in Figure 7.4 is the fact the all three years from 2009 to 2011 had above average inflows (10 364 GWh, 9 612 GWh and 9 707 GWh respectively). The combination of thermal generation and above average inflows represents the equivalent of 15 per cent in storage position in each year from 2009 to 2011.

Figure 7.4 Generation, demand and storage position

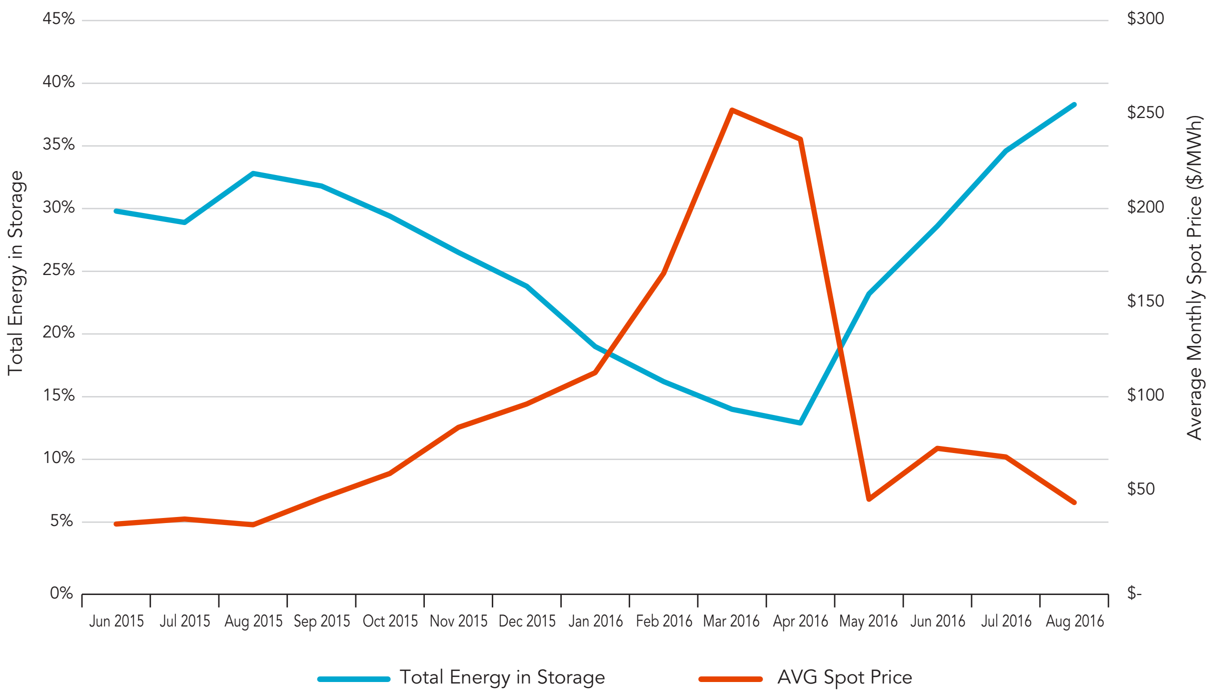


Source: TasNetworks data

7.7 Energy in storage and spot prices

The energy security assessment framework developed by the Taskforce includes a measure of competitiveness as a component of energy security. This refers to the price competitiveness of the available energy among other measures of competitiveness. In the 2015-16 energy security event, as storages fell below 25 per cent, the corresponding spot price was over $100/MWh (noting that the drivers of spot price changes are many and complex, and no single factor can usually be attributed to causing a change). The full comparison of price and storage during the 2015-16 event can be seen in Figure 7.5.

Figure 7.5 Interaction between storage position and spot price



Source: TasNetworks data

The trend of price increases as supply reduces is a natural occurrence in markets, and price signals are important to provide incentives for new supply or demand changes (either reduced consumption or alternative supply options). However, sudden and significant price volatility usually creates little time for consumers (and producers) to adjust, resulting in an increase in economic and financial threats during these periods. The high energy prices and their sudden increase were a concern during the 2015-16 energy security event for those customers with an exposure to spot prices (noting that customers who choose to take spot price exposure should do so with full knowledge of potential risks) and those whose wholesale contracts were expiring. Fortunately most other customers, such as those who pay regulated prices or with ongoing contracts, were protected from these price increases at the time. Nonetheless, sudden large increases in prices creates investment uncertainty and contributes to confidence concerns in the economy.

7.8 Other uses of hydro-electric water

Water held in Hydro Tasmania's dams is primarily used for the purposes of electricity generation. However there are a number of circumstances where Hydro Tasmania will release water for other purposes, including:

- commercial obligations (e.g. aquaculture and irrigation);
- recreational purposes (e.g. kayaking, rowing and angling); and
- environmental purposes (e.g. water level constraints and environmental flow releases).

Facilitating these alternative water uses imposes additional constraints on Hydro Tasmania's management of various water storages. During periods of normal or typical inflows, the costs associated with these constraints is understood to be relatively minimal. However, during periods where inflows are low (or in a flood) meeting the requirements of the alternative water uses is not always possible, or at least challenging. Depending on the use, this may have contractual and/or legal ramifications.

Hydro Tasmania supplies water for irrigation as part of its Special Water Licence Agreement and through agreements with Tasmanian Irrigation and other irrigators. [25]

In most instances the alternative uses of hydro-electric water does not pose a risk to energy security in Tasmania. The volumes of water in question are considerably lower than the volumes of water required for electricity generation and often the water requirement is downstream of electricity generation (i.e. after its value has been extracted by Hydro Tasmania). However, as the value of water increases with low water storages, tension can arise in the trade-off between uses.

Following clarification of its Terms of Reference with the Minister for Energy, the Taskforce has not conducted an in-depth review of alternative uses for hydro-electric water storages but, rather, considers that these alternative uses must be considered as constraints as to the water available for generation in the context of energy security planning.

[25] Hydro Tasmania's Special Water Licence for the purpose of electricity generation is granted under section 116 of the Tasmanian *Water Management Act 1999*.

8. Review of Prudent Water Storage Management

KEY FINDINGS

- Hydro Tasmania's interim storage targets of between 30 and 40 per cent, together with the return of Basslink and higher inflows, have improved Tasmania's energy security at least over the next year.
- The establishment of a prudent storage level (PSL), below which operation should be minimised or avoided and above which would allow Hydro Tasmania the freedom to operate commercially, would clearly articulate the Tasmanian Government's risk appetite to Hydro Tasmania.
- Hydro Tasmania's High Reliability Line concept of the unserved energy (USE) measure is based on a national standard that is accepted and well understood in the energy industry.
- The use of extreme low inflow sequences in modelling and planning will result in improved prudent planning for energy supply risks.
- Further work is required to set High Reliability Level (HRL) and PSL profiles to appropriately secure storage levels.

The energy stored below Great Lake's Environmental Extreme Risk Zone (EERZ) may not be accessed even in high energy security risk situations. To support energy security in Tasmania, a prudent water storage management regime is of critical importance. Hydro Tasmania operates a detailed Monte Carlo simulation model (called TEMSIM) to assist with the water storage management decision making process. In this chapter the Taskforce examines Hydro Tasmania's review of prudent water storage management and presents its own initial assessment of Tasmania's energy security requirements relating to water storage management.

8.1 Hydro Tasmania's internal review

Hydro Tasmania has provided information to the Taskforce outlining: the interim measures it has put in place prior to the outcome of the Taskforce's work; immediate changes in response to the 2015-16 energy security event; and possible changes to facilitate discussion with the Taskforce around prudent water storage management. Hydro Tasmania has provided this information on a confidential basis, given that the business itself has not made any final decisions on some of the concepts it has put forward. The Taskforce welcomes the fact that Hydro Tasmania has undertaken a review of its own procedures and has 'opened its books' to the Taskforce, as well as to other independent expert advisors Hydro Tasmania has engaged to assist it with its own review.

8.1.1 Interim water storage management measures

To allow suitable time for a more comprehensive review, the Hydro Tasmania Board approved an interim operating regime for the 2016-17 financial year as part of its annual budget approval process. Hydro Tasmania intends to operate its energy portfolio during 2016-17 in the following manner:

- operate minimum storage levels in the range of 30 per cent to 40 per cent total energy in storage;
- maintain the TVPS CCGT on standby for commercial operation or energy security operation; and
- restore the collective capacity of the TVPS open cycle gas turbines (OCGT) to 148 MW by the end of 2016.

8.1.2 Immediate water storage management measures

The energy security event of 2015-16 has resulted in a view from Hydro Tasmania that a number of key planning assumptions are no longer representative of what can be reasonably expected going forward.

Hydro Tasmania has provided revised modelling which assumes:

- Great Lake EERZ has been increased from 6.2 per cent to 9.1 per cent of Great Lake energy in storage;
- Basslink outage duration has increased from 60 days to 180 days; and
- inflow assumptions have been updated to reflect drier and more volatile inflow sequences.

During March 2016, Hydro Tasmania received and accepted scientific advice that the EERZ for Great Lake be lifted from 6.2 per cent to 9.1 per cent storage to protect threatened species habitat and mitigate a range of other environmental risks. At its March 2016 meeting, the Hydro Tasmania Board invoked a change to the prudent water storage management guidelines that required Board approval to enter the EERZ. Hydro Tasmania has stated that the level of the EERZ may change in the future as more information becomes available through ongoing monitoring, management and scientific assessment.

Historically, the longest Basslink outage scenario was considered by Hydro Tasmania to be 60 days. Hydro Tasmania has stated that this was verified by an independent inspector as feasible for the State's acceptance in 2007. A number of factors caused the repair of Basslink to take longer than expected in the 2015-16 energy security event.

Hydro Tasmania has also taken the decision to use more conservative assumptions with regard to modelling inputs. Hydro Tasmania indicates that the result of the modelling inputs will increase the volatility of inflow results.

8.1.3 Proposed water storage management measures

Hydro Tasmania has developed the concept of a 'High Reliability Line' measure to replace the existing risk lines that have historically been used. The proposed High Reliability Line is intended to communicate the level of total energy in storage whereby the NEM Reliability Standard of 0.002 per cent unserved energy (USE) can still be met with a six month Basslink outage and a very dry inflow sequence, assuming 200 MW (864 GWh) of generation from the TVPS is utilised and there is no incursion into the Great Lake EERZ. The High Reliability Line represents a minimum level of storage in each month which Hydro Tasmania considers would ensure that demand can be met according to the USE standard with the conditions provided above.

The High Reliability Line would not represent a new POM storage level to which Hydro Tasmania would operate to. Hydro Tasmania has proposed that a POM should be set so that there can be high confidence that there is enough energy to remain above the High Reliability Line over the following three months from a given point in time. Energy below the High Reliability Line would only be available to be accessed during a Basslink outage.

Hydro Tasmania has also discussed an approach where it would produce modelling to show the probability of entering below the High Reliability Line (according to multiple scenarios produced by its Monte Carlo outputs). Hydro Tasmania considers such an approach could better communicate risks and alert the business to the need for earlier responses to emerging risks.

8.1.4 Proposed governance, monitoring and reporting

Hydro Tasmania has advised the Taskforce that it considers an effective governance framework should contain independent verification of assumptions and model outputs.

Hydro Tasmania is of the opinion that a regular review of modelled outputs and modelling assumptions would be appropriate to ensure these factors do not become outdated. Hydro Tasmania also notes that it would be appropriate that this review could be triggered immediately as a result of material changes.

As a result of the 2015-16 energy security event, Hydro Tasmania has advised the Taskforce that it is supportive of a set of energy security health indicators that provide maximum transparency without compromising commercially sensitive information.

8.2 Taskforce prudent water storage management assessment

8.2.1 Interim water storage measures

The interim water storage targets (minimum levels between 30 and 40 per cent) established by Hydro Tasmania are welcomed by the Taskforce. The Taskforce assesses that operation in a more conservative range than recent years is appropriate during the period in which the Taskforce is conducting its investigations. The 2016-17 year to date has contained a very high level of inflows when compared to recent historical inflow patterns. This has aided the rebuilding of storages and the Taskforce considers that it is appropriate to keep total energy in storage at levels higher than those observed in the past two years. Maintaining the CCGT in an operational state until the end of 2016-17 is also considered appropriate given the desire for maintaining higher energy in storage over the short term.

The Taskforce assesses it is appropriate to be using a lower inflow sequence when forecasting system yield and planning for extreme variations. The use of dry inflow sequences from all historical data (including prior to 1997) would ensure that actual extreme low inflow sequences can be used to test the probability that the new 'safe' storage levels could be breached. While it may be the case that there is a noticeable change in inflow trends since 1997, this is more relevant when observing changes to the average, and the variability to the new average. Excluding the full data series of just over 100 years potentially removes the low range of 'extremes' that have been part of the historical record.

In the international management of hydro-electric systems, it is a common feature to use the worst inflow year of historical data when planning for system inflows. While it could be argued that this is an extreme position to take given the level of variability in Tasmanian inflows, having a bias toward dry inflows when modelling would closer align the setting of prudent water storage levels to practices used in international examples. This position would also better prepare Hydro Tasmania for the possibility of short term severe inflow shortages such as those seen in September to November of 2015.

8.2.2 Energy security reserve and prudent storage level

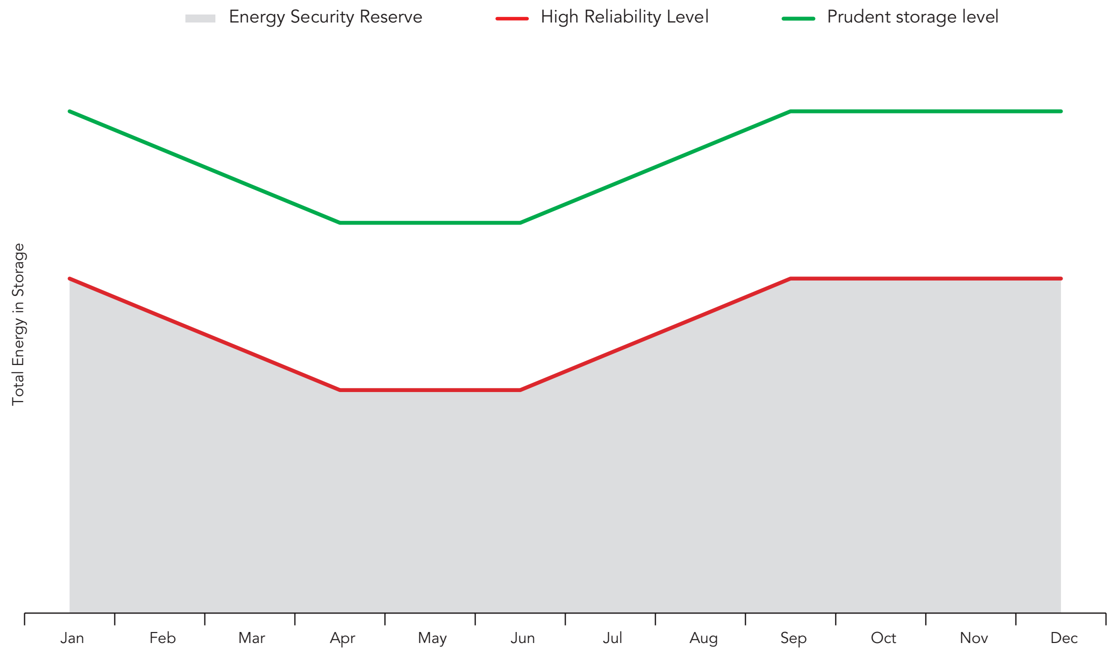
The Taskforce has tested Hydro Tasmania's High Reliability Line concept by examining the amount of energy required to meet Tasmanian demand with Basslink unavailable for a six month period. This analysis assumes the availability of 200 MW of thermal generation, historically low inflows and an annualised wind generation assumption of 900 GWh (as per the Taskforce's standard wind assumption described at Appendix 3). The result of this calculation determines what the Taskforce considers to be an energy security reserve requirement for Tasmania. The Taskforce prefers the term 'High Reliability Level' (HRL) rather than 'Line', where the energy security reserve is the storage level under the HRL. An illustration of the concept is depicted in Figure 8.1.

The red line in Figure 8.1 shows a High Reliability Level (HRL) and consequently, the energy security reserve below it. The green line shows what the Taskforce terms a 'prudent storage level' (PSL)[26], which provides a storage buffer from the HRL that is intended to be sufficient enough to make the probability of breaching the HRL very remote. The HRL refers to the energy security reserve whereby a six month Basslink outage

[26] The Taskforce has decided to use the term PSL to distinguish it from the historically used POM. A POM should be distinguished as a Hydro Tasmania modelling output, which is principally aimed to consider storage levels from the perspective of optimising generation and Basslink flows. Setting a POM (or a similar alternative) should be an action performed by Hydro Tasmania.

would end with a total energy in storage just at the level where demand can still be met.[27] The indicative annual profile of the respective levels shown in Figure 8.1 shows the changing risk profile associated with a system where around 80 per cent of annual inflows will arrive, on average, between May and October. Hence a higher HRL and PSL is required in spring, before the dry period.

Figure 8.1 Energy security reserve analysis



Source: Taskforce analysis
Note: This figure illustrates the concepts of the HRL, the energy security reserve and the PSL. Actual levels and the shape of the HRL and PSL are yet to be determined.

The Taskforce's analysis of the PSL is informed by the low inflow patterns of the energy security event of 2015-16. In the months of September, October and November in 2015 an unprecedented level of low inflows was experienced. In order to determine the chance of breaching the HRL and entering the energy security reserve, the Taskforce has considered the amount of energy required to meet Tasmanian demand in a three month period with a dry sequence consisting of record low inflows from the full historical data set for each of the three months. This assumption is paired with an assumption of net import over Basslink for the full three months and 200 MW of thermal generation baseload for half of the three months (allowing for a delay in recognising a low inflow sequence and subsequently preparing the CCGT for operation).

The Taskforce has not outlined the specific storage levels that its analysis indicates may be appropriate. The Taskforce intends to engage further with Hydro Tasmania prior to the Final Report. This engagement will primarily be to ensure the technical analysis is accurate, rather than to debate the principles upon which the Taskforce considers the HRL and PSL should be set. However, based on the Taskforce's analysis, the PSL should not be lower than the current interim targets of between 30 and 40 per cent.

While the Taskforce acknowledges that higher storage levels do have a cost, given the importance of water storages to Tasmania's energy security and in the absence of material alternatives at this time, holding water storages higher than in recent years is prudent.

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[27] Hydro Tasmania has informed the Taskforce of the level which it indicatively assesses all demand may not be met, but has requested that this figure be kept confidential.

8.2.3 Probability approach

In discussions with Hydro Tasmania, an alternative to using the POM (or PSL) was discussed. This alternative would focus on Hydro Tasmania running its TEMSIM Monte Carlo simulations and presenting them to the proposed independent Monitor and Assessor (discussed in Chapter 6). The simulations would show multiple scenarios over a least a year, ranging from both low and high inflow scenarios with varying degrees of probability. The simulations would be overlayed with the HRL to indicate if any scenarios are projected to enter into the HRL and, if so, would act as an early warning and allow responses to be put in place earlier than currently is the case. The type of response would depend on the probability and the timing. For example, a one per cent probability scenario of breaching the HRL in 10 months may only require a 'watch and monitor' response at the time (given that future modelling would most likely see that scenario disappear, all other things being equal), while a 25 per cent probability scenario of breaching the HRL within three months should elicit a significant response to mitigate the risk.

The Taskforce considers there is merit in this approach and that regular reporting by Hydro Tasmania to the proposed independent Monitor and Assessor (described in Chapter 6) of such a presentation is likely to be highly useful to the Monitor and Assessor in determining its own assessment of risks. Such a presentation, however, is unlikely to be easily understood by the general public or some stakeholders, and other means of communication would be better suited for such purposes.

This approach would also be a departure from historical practice and would remove external focus on a POM (or PSL), which has been viewed as a benchmark for a 'safe level' (though the specific level at which it has been set has been debated). The Taskforce considers there is value in maintaining a reported PSL but that this could be used in conjunction with Hydro Tasmania's proposed probability reporting against a HRL. The PSL could be dispensed with if the independent Monitor and Assessor deems it appropriate at a later time, once the probability approach has been tested and confidence in its appropriateness increases.

RECOMMENDATIONS

12. A High Reliability Level (HRL) should be adopted as the threshold to which reserve water is held for energy security purposes, where the reserve is sufficient to withstand a six month Basslink outage coinciding with a very low inflow sequence, and avoid extreme environmental risk in Great Lake.
13. A prudent storage level (PSL) should be set to create a 'storage buffer' from the HRL that is sufficiently conservative that the likelihood of storages falling below the HRL is very low.
14. While the Taskforce will engage further with Hydro Tasmania before recommending in its Final Report the PSL and HRL profiles, the PSL should be no lower than the interim storage targets Hydro Tasmania has put in place (40 per cent by the end of spring and 30 per cent by the end of June 2016).
15. Future changes to the HRL and PSL should only be considered when there are material changes to supply and/or demand, and require endorsement by the Monitor and Assessor.
16. Hydro Tasmania could be required to seek authorisation from the Energy Security Coordinator to access energy security reserve storage below the proposed HRL, and the authorisation would be subject to a clear plan to return storages above this level.

8.2.4 Great Lake Extreme Environmental Risk Zone (EERZ)

There appears to be a degree of uncertainty when it comes to the risks involved with the Great Lake EERZ. The magnitude of the variation made to the EERZ during the 2015-16 energy security event reinforces this fact. The Taskforce believes that the energy stored below the Great Lake EERZ should be clearly communicated as unavailable despite being included in the total energy in storage measure. The potentially severe implications of incursion into the EERZ, combined with the need for the Hydro Tasmania Board approval to access this energy, suggests that this energy is unlikely to be accessed in high energy security risk situations.

The Taskforce acknowledges that updated research could further revise the level of the EERZ in either direction and suggests that any revision of the EERZ based on scientific evidence should be reflected in the future communications of total energy in storage.

RECOMMENDATION

17. Energy stored in Great Lake below the EERZ should be clearly identified as constrained when communicating total energy in storage levels.

8.2.5 Capacity management

The Taskforce acknowledges that its current analysis does not account for the balancing of storages for the purposes of managing capacity. However, this is only important if total energy in storage reaches very low levels and Hydro Tasmania is unable to generate from some of its power stations, to the point where it cannot supply all demand (particularly peak demand). Storage levels that remain above the HRL should not result in capacity challenges. The Taskforce notes that Hydro Tasmania was able to manage capacity with storages as low as 12.5 per cent during the 2015-16 energy security event.

Managing capacity, through balancing energy in storage across the hydro system, is a complicated task that only Hydro Tasmania has the expertise to conduct. The Taskforce expects to be informed by Hydro Tasmania of the outcomes of its internal reviews that relate to capacity management, and will report on this in the Final Report.

9. Water Storage Management Communication and Response

KEY FINDINGS

- Other jurisdictions with a dominant hydro generation profile offer good examples of planning, communication and regulator involvement that can be leveraged for the Tasmanian energy system.
- Escalation of communication and responses is required when energy security risks increase to ensure that the public are aware of the risks involved and the actions being taken to mitigate these risks.

A key point of feedback from stakeholders on the 2015-16 energy security event was that there was a lack of communication and transparency, making it difficult for interested observers to access information about the energy security situation at any given point in time. Questions have also been raised regarding who makes decisions and what controls are in place, when water storages are low enough to raise energy supply risks for the State. In order to assess ways in which that situation could be improved, the Taskforce has examined other energy jurisdictions to learn new practices and principles that could be applied to the Tasmanian environment.

This chapter presents the learnings from other jurisdictions and the proposed changes which could enhance Tasmanian energy security. These are integrated with the recommended energy security oversight changes outlined in Chapter 6.

9.1 Learning from examples of hydro-electric water storage management

A high level overview of water storage management communication and responses used in other international and Australian hydro-electric systems is provided at Appendix 5. A summary of these learnings is presented below.

In most of the examples examined, there is a significant role played by a local regulator with regard to the monitoring, preservation and communication of energy security. Chapter 6 discusses the potential involvement of a Monitor and Assessor role and other options for enhancing Tasmania's energy security governance arrangements for energy supply events, and these proposals are consistent with the examples the Taskforce has reviewed.

Examples of communication in other jurisdictions are applicable to the Tasmanian energy system. In Norway there is a practice of escalating communications in times of increasing energy security risk. Depending on the prevalent energy security risk profile, increasing levels of risk result in a range of responses. At relatively low levels of energy security risk the response is to increase communication above normal levels, while regulatory intervention by governments or market operators occurs at very high levels of energy security risk. The communication aspect appears to be simple to implement and would add significant value when communicating the risks associated with differing levels of energy in storage.

The implementation of a similar system to New Zealand, whereby a proportion of energy in storage is clearly labelled as 'contingency storage', has merit as there is a reserve of supplies which stakeholders can be confident should only ever be accessed in rare and extreme circumstances. As outlined in Appendix 5, New Zealand also publishes a 'dashboard' type presentation of the current risk assessment, which would provide an easily understood approach for Hydro Tasmania or an independent energy security Monitor and Assessor to publish.

Another good example of communication that could be applied in Tasmania is the annual water report produced by Snowy Hydro.[28] This type of concise annual report on the historical inflow year and communication on water storage management at a high level would provide a useful analysis over a longer period of time (compared with the point in time communication in the dashboard example from New Zealand).

In Norway and Manitoba (Canada), planning activities are conducted on the modelling assumption of historically low inflows. In Tasmania, inflow modelling is conducted by Hydro Tasmania on the basis of average historical inflows from 1997 onward (with probabilities of variances from the average also modelled), which requires revision if there is a change in the long-term data trend. Although the basis on which Norway and Manitoba model inflows is driven by a system where inflows almost always exceed annual consumption, it is useful to observe that using 'extreme' low inflow assumptions is the prudent approach used elsewhere.

The energy system in Iceland operates at a higher level of overall energy security risk as a result of the lack of interconnection with other jurisdictions. As a result, Iceland has a response plan for energy security which relates largely to the reduction of major industrial load such as aluminium smelters. In the Tasmanian situation, the Taskforce notes that demand management should be part of the response plan to a high energy security risk environment, but such an approach should be planned for and negotiated during 'normal' conditions to ascertain what is possible and affordable for all parties relative to additional supply options (which Tasmania is likely to have more of than Iceland).

9.2 Proposed communication and response protocols

Based on examples from other jurisdictions and feedback from stakeholders, the Taskforce believes that there is a strong case to improve the transparent communication of Tasmania's energy security risk with regard to the total energy in storage position. The Taskforce proposes a system of escalating communication and response requirements depending on storage position and the extent to which low storages expose the community to increased energy security risks. The system would work by having defined thresholds which result in increasing preparedness and mitigation actions, and would be overseen by the independent Monitor and Assessor and involve the Energy Security Coordinator at particular points. The response thresholds, which are illustrated in Figure 9.1, are:

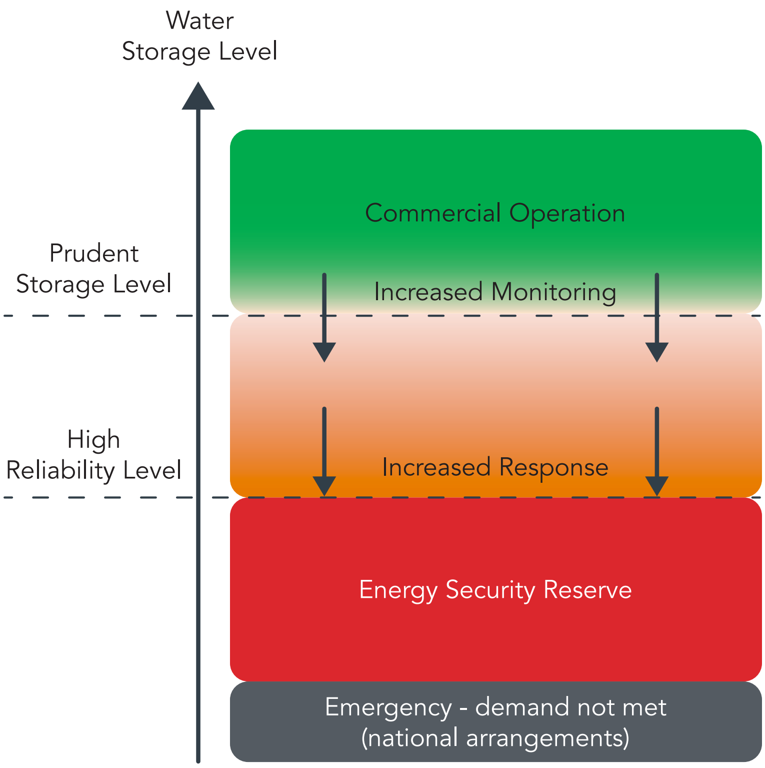
- commercial operation;
- increased monitoring;
- increased response; and
- energy security reserve.

The response thresholds are designed to intersect with the proposed HRL and PSL (once appropriate levels have been set). These thresholds are intended to provide the framework for the pre-emergency situations identified in Chapter 6 as requiring greater clarity for energy supply constraints in Tasmania.

As shown in Figure 9.1, commercial operation would simply represent Hydro Tasmania operating above the PSL. Routine reporting requirements to the independent Monitor and Assessor would be expected (as described below), as well as any public communication and information provision.

[28] http://www.snowyhydro.com.au/waterenvironment/water-operations-report/

Figure 9.1 Energy security risk response thresholds



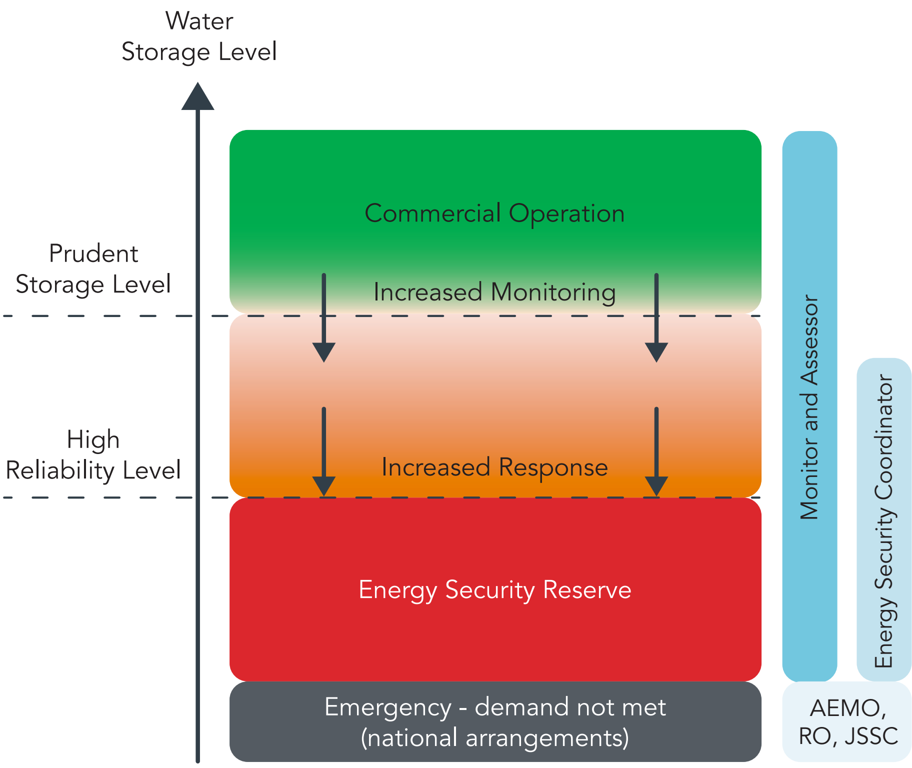
Increased monitoring would occur if Hydro Tasmania's forecasts indicate plausible scenarios of falling below the PSL. Increased monitoring would require Hydro Tasmania to continue its routine reporting, though the independent Monitor and Assessor may seek additional information and the reporting could be requested to be more frequent. Hydro Tasmania would also provide the Monitor and Assessor with a recovery plan that demonstrated how storages are intended to be returned above the PSL.

Increased response would occur if Hydro Tasmania's scenarios indicate plausible scenarios of needing to access storages below the HRL. In this instance, the independent Monitor and Assessor would alert the Energy Security Coordinator to the possibility that storages may fall below the HRL. Hydro Tasmania would be required to provide a recovery plan demonstrating how storages will be maintained to avoid entering the HRL or, if deemed unavoidable, how storages will be returned above the HRL once entered. On acceptance of the recovery plan by the independent Monitor and Assessor and Energy Security Coordinator, authority would be provided to access storages below the HRL.

The energy security reserve threshold refers to operation of storages under the HRL. Hydro Tasmania would be required to work with the Energy Security Coordinator to ensure the recovery plan is being implemented and is working as intended. The Energy Security Coordinator would work closely with the independent Monitor and Assessor, including participating in the receiving of information and reports from Hydro Tasmania. The Energy Security Coordinator would also regularly brief the Minister for Energy and the department responsible for policy on the situation, so that policy responses to decisions can be made if necessary.

These response thresholds would be integrated with the roles and responsibilities recommended to strengthen energy security oversight in Chapter 6. These elements together form an Energy Security Risk Response Framework, which is illustrated conceptually in Figure 9.2. As discussed in Chapter 6, legislation or another authority mechanism may be required to support the proposed powers and functions of these roles.

Figure 9.2 Proposed Energy Security Risk Response Framework



De-escalation from any of these thresholds would occur once storages return above each threshold and Hydro Tasmania's projections are accepted as showing very low probability of returning to the higher risk thresholds.

In terms of public communication, the independent Monitor and Assessor should communicate the status of energy security risks as storages pass through the above thresholds. However, Hydro Tasmania should engage with its customers on how it is managing the risks as it is in the interests of the company to be transparent. Confidence in Hydro Tasmania's information is likely to be higher if the Monitor and Assessor is separately reporting its own assessment of risks.

9.3 Contingency options

There may be circumstances where the risk that available energy supplies may be insufficient to meet demand is high. This is most likely in a scenario similar to the 2015-16 event, where Basslink is unavailable for a number of months (and no certainty as to its return date) and there is uncertainty as to whether there will be sufficient inflows, together with storages. There is, therefore, a need to have contingency plans for measures that can be implemented in addition to the energy sources that are normally in place.

The Energy Supply Plan implemented mitigation measures predominantly in the form of temporary diesel generation and commercially agreed load reductions with major industrial customers. These measures were developed and implemented after the situation had emerged. While that response was effective from the perspective of ensuring demand could be met if extreme circumstances continued, a more proactively planned approach could result in more effective contingencies when considered against criteria such as cost, reliability (including integration with the network), and environmental impacts.

A market bidding process is one way in which the most effective option(s) for contingency mitigation measures could be determined. A market based process would consider both supply and demand opportunities, and evaluate each option against the criteria. The process could be conducted during times when there is low risk, with a small retainer fee paid to successful bidders as part of a firm contractual obligation for those bidders to provide the supply (or load reduction) if called upon. Alternatively, a process could be run when risks begin to increase.

A market process to have contingencies for Tasmanian energy supply constraints could be run by either the Energy Security Coordinator or by AEMO.

Supply options are likely to be in the form of temporary generation. Diesel generators were used in the 2015-16 situation and there is the advantage that the connections and ground works at the sites they were used at are still available. However, they are not the only options, with temporary gas units also potentially viable options (and these would have less environmental impact).

Demand options are likely to be most effective from major industrial customers. The more that load reduction arrangements can be tailored to each of these customers, the greater the likelihood that the impact on them will be less whilst still achieving material reductions in demand. Hence, a market process where a major industrial bids in what it is able and willing to offer, and the associated conditions, allows demand and supply opportunities to be evaluated against each other.

Outside of large industrials, there are also demand opportunities from other customer classes. The amount of demand reduction from these customers has generally been considered to be small, given Tasmania's customer profile. However, more sophisticated technology and services could make it easier for small loads who are willing to offer energy back in exchange for payment, to be aggregated into a material demand saving.

A regulatory framework to support the use of a market process may be required and should be based around maintaining the energy security reserve. The Energy Security Coordinator would therefore be the appropriate authority to call upon the contingency measures, if pre-contracted, or to trigger the market process if not.

9.4 Proposed communication requirements

There should be two separate objectives for communication of energy in storage. One objective is to ensure the data and information necessary for the independent Monitor and Assessor is available and of sufficient technical and operational detail to enable the Monitor and Assessor to independently form a view of Tasmania's energy security status. The second objective is to improve communication with the public and stakeholders in an easily understood manner.

In order to improve the public communication with regard to the 'business as usual' operation of the hydro-electric system, the Taskforce proposes the following ongoing communications:

- an energy in storage dashboard;
- an annual water report (i.e. a historical report); and
- an annual energy security review process (i.e. a forward looking report).

The energy in storage dashboard should include information regarding: the current total energy in storage; the energy security status associated with the current level of energy in storage; the number of months or weeks of average demand in storage; and the monthly or weekly change in measures of both per cent of total and months or weeks of average demand. This dashboard should be updated monthly or weekly, as is currently the case for storage information presented on the Hydro Tasmania website. Hydro Tasmania could publish the dashboard or it may be more appropriate for the independent Monitor and Assessor to do so as part of its overall proposed energy security communications role. An example of what the dashboard could like is provided in Figure 9.3.

The Taskforce considers it would be beneficial for Hydro Tasmania to produce an annual water report (whether standalone or as part of another routine publication) in a manner similar to that of the example provided by Snowy Hydro. This report should be produced after the completion of the wet season in October of each year so that the adequacy of the recent inflow season can be reviewed by interested stakeholders.

In addition to having a dynamic reporting tool such as the dashboard, an annual energy security review should be undertaken to ensure that energy security is communicated to the Tasmanian public in a transparent and consistent manner. It would be appropriate for this review to occur after the completion of the wet season in October of each year and the review should be led by the independent Monitor and Assessor, based on information provided by Hydro Tasmania and taking into account all energy supply and demand projections.

RECOMMENDATIONS

18. Hydro Tasmania should undertake an annual review and forecasting process in October each year, near the end of the high inflow season between May and October. This should provide sufficient time to implement measures, if required, to maintain energy security over the dry period from November to April and beyond if dry conditions continue into May, as has historically occurred. The annual review should be independently verified by the Monitor and Assessor and the outcomes transparently made publicly available as part of the annual assessment.
19. A transparent scale of escalating actions should be implemented as energy in storage approaches lower levels with higher energy security risk. The following response levels should be implemented.
    - Commercial operation - if storage levels are above the PSL, Hydro Tasmania operates commercially and with only routine reporting obligations;
    - Increased monitoring - if Hydro Tasmania's forecasts indicate plausible scenarios of falling below the PSL, or storages actually falling below the PSL. Hydro Tasmania would provide the Monitor and Assessor with a recovery plan that demonstrated how storages are intended to be returned above the PSL;
    - Increased response - if Hydro Tasmania's scenarios indicate plausible scenarios of needing to access storages below the HRL. Hydro Tasmania would be required to provide a recovery plan that demonstrated how storages will be maintained to avoid entering the HRL or, if deemed unavoidable, how storages will be returned above the HRL once entered.
    - Energy security reserve – if operating storages under the HRL, Hydro Tasmania would be required to work with the Energy Security Coordinator to ensure the recovery plan is being implemented and is working as intended.
20. Contingency measures should be evaluated using a competitive process to determine the most effective supply and/or demand measures, with key criteria used to select preferred options. The criteria should include cost, reliability and environmental impact.
21. Hydro Tasmania should be required, through an appropriately robust governance mechanism (legislation or through a ministerially directed mechanism), to comply with the proposed Energy Security Risk Response Framework.

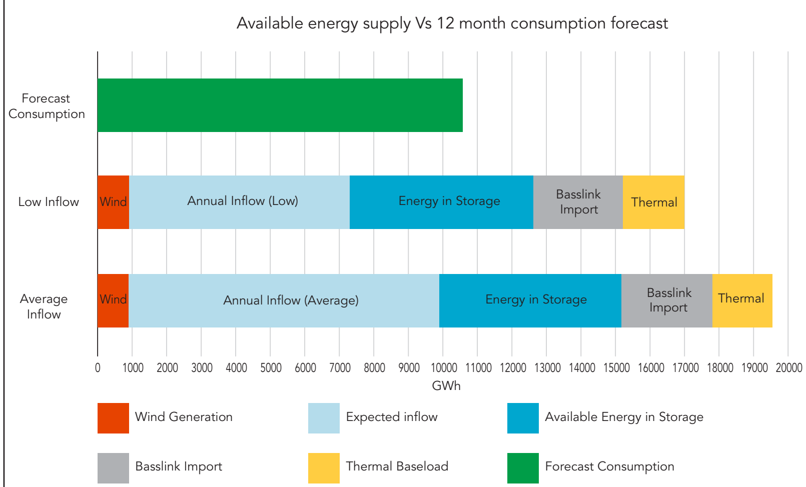
Figure 9.3 Example Energy Security Dashboard for Tasmania

<table>
<tr><th colspan="3">Energy Security Dashboard</th></tr>
<tr>
<td>Energy security status</td>
<td>
Green: Above prudent storage level
Orange: Below prudent storage level
Red: Below High Reliability Level
Black: Not all demand can be met</td>
<td><u>Current Energy in Storage:</u>
44.5% or equivalent to 7 months average demand[1]

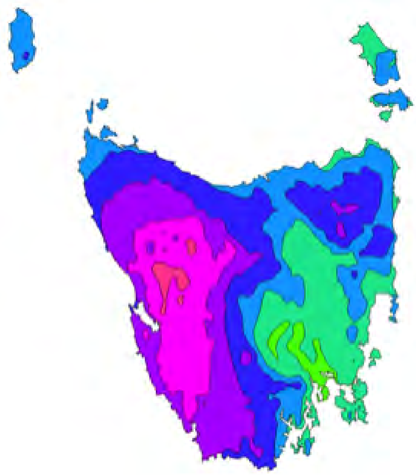
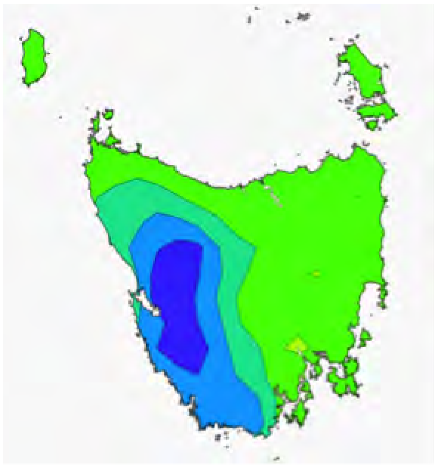
<u>Current Energy Risk Profile</u>:
Green

No current energy security concerns

Energy in storage above prudent storage level

Commercial operation of hydro generation</td>
</tr>
<tr>
<td>Available energy supply</td>
<td>
</td>
<td><u>Average Inflows:</u>
19 565 GWh or 22 months supply

<u>Low Inflows:</u>
16 999 GWh or 19 months supply</td>
</tr>
</table>

Rainfall – Year to date		Annual rainfall year to date have been above average
Rainfall – Three month forecast[2]		Forecasts indicate a continuation of above average rainfall over most catchment areas for the next three months
Basslink operation	Basslink status: Operational	Year to date Basslink flow: GWh net export % storage equivalent
Thermal generation backup	Thermal generation status: On standby	Year to date thermal generation: GWh % storage equivalent

[1] Average monthly demand is 833 GWh. Demand in summer months is generally below average. Demand in winter months is generally above average.
[2] Source: BOM. Data relates to rainfall totals that have a 75% chance of occurring over the next three months.

10. Impact of Climate Change

KEY FINDINGS

- Tasmania has experienced a downward trend in total annual rainfall and runoff since 1970, with the largest changes being observed in autumn. Concurrent with these decreases, a significant reduction in inflows to hydro-electric catchments has been observed in Tasmania since the mid 1970s, with an acceleration of the trend since the mid 1990s.
- Climate change is projected to decrease inflows in the central plateau catchments, which may have a significant impact on power generation as these feed into the major storage of Great Lake. Projected changes to the seasonality of inflows in the western catchments may also reduce power generation.
- These changes have implications for Hydro Tasmania's long-term average yield assumptions and management of water storages over the next 10 to 20 years, particularly Great Lake and Lake Gordon/Pedder.
- Seasonal and inter-annual rainfall variability will continue to pose the largest hydrological risks over the short to medium term, rather than long-term climate change impacts.
- Other climate change projections relevant to energy security include decreased summer and autumn wind speeds that may reduce wind generation capacity (and coincide with projected declines in inflows during these months), and an increase in extreme events that may affect electricity infrastructure (e.g. bushfires, intense rainfall events and flooding).

The Taskforce's Terms of Reference require it to undertake its independent energy security risk assessment for Tasmania having regard to the potential impact of climate change on energy security and supply.

According to the Intergovernmental Panel on Climate Change (IPCC), there is now unequivocal evidence that the Earth is warming, particularly since the mid-20th century.[29] Tasmania has also experienced a rising mean temperature since the 1950s, with a rise of approximately 0.1°C per decade since the middle of the 20th century.[30] While higher temperatures are a key feature of climate change, global warming also causes changes to other climate variables such as rainfall, evaporation and wind. Variations in the frequency of climate events and the strength of climate extremes are likely.

Heavy reliance on hydro-electric generation leaves Tasmania exposed to the risk of variations in rainfall. Changes to the quantity, seasonal timing and spatial variation of rainfall (and subsequent inflows) will potentially impact the amount of water available for hydro-electric generation and how water storages are managed. For example, the two major storages are used to buffer the system during drought periods; however a long term decline in rainfall in the Gordon and/or Great Lake catchments may impact on this ability in the future. Conversely, run-of-river schemes cannot store significant quantities of water and are necessarily operated according to seasonal fluctuations in rainfall.

The Taskforce has therefore sought to gain an understanding of the impact that climate change could have on rainfall patterns and future inflows into the State's hydro catchments. An understanding of the frequency and intensity of extreme weather events such as storm and bushfire events is also relevant to the security of energy assets. In this context, the Taskforce has engaged with experts, such as the BOM and the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) to understand the latest climate change information relevant to Tasmania.

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[29] IPCC, 2013, Summary for Policymakers. In: *Climate change 2013: the physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.*

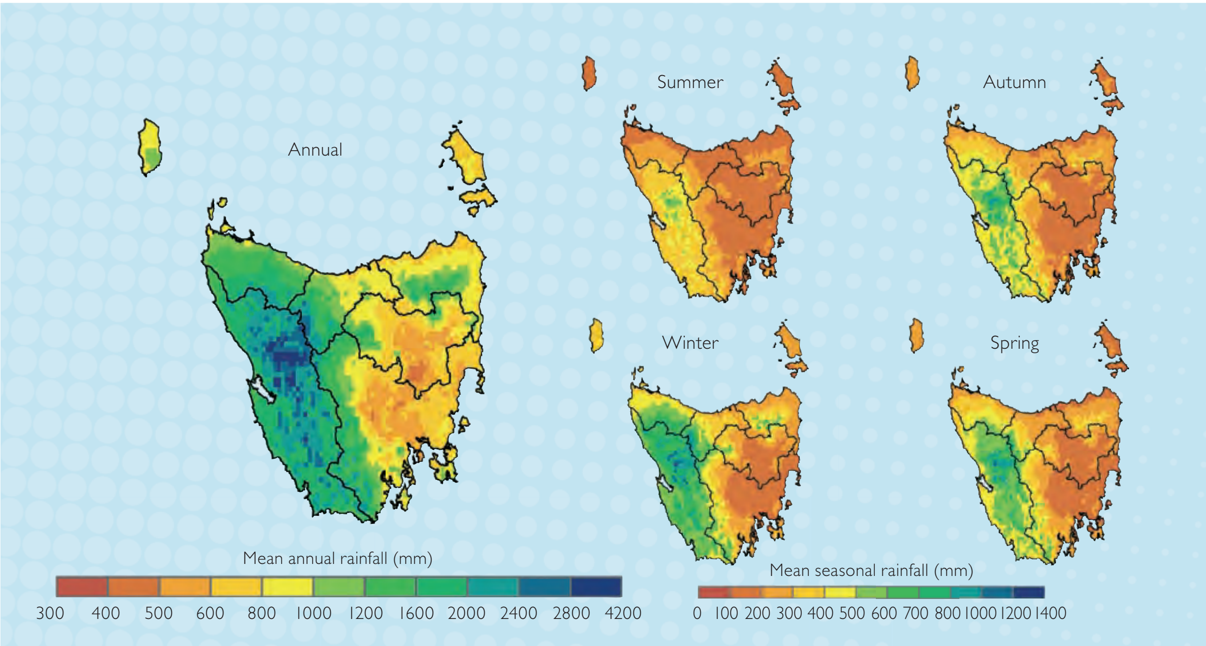
[30] Grose MR, Barnes-Keoghan I, Corney SP, White CJ, Holz GK, Bennett JB, Gaynor SM and Bindoff NL, 2010, *Climate Futures for Tasmania: general climate impacts technical report.*

This chapter examines historical and future climate change influences on Tasmania and the potential implications of these for Tasmania's future energy security and supply.

10.1 Drivers of Tasmania's climate

Tasmania's climate is largely driven by the interaction between the prevailing 'Roaring 40s' westerly winds and the mountainous topography near the west coast and central plateau, which together strongly influence the spatial variation of rainfall across Tasmania. There is a steep gradient in total annual rainfall from the west coast across the central plateau (with rainfall in western Tasmania being highly sensitive to the prevailing westerly flow), with mean annual rainfall varying from 600 mm in the midlands to over 3 000 mm on the west coast (refer Figure 10.1).

Figure 10.1 Spatial distribution of historical mean Tasmanian annual and seasonal rainfall

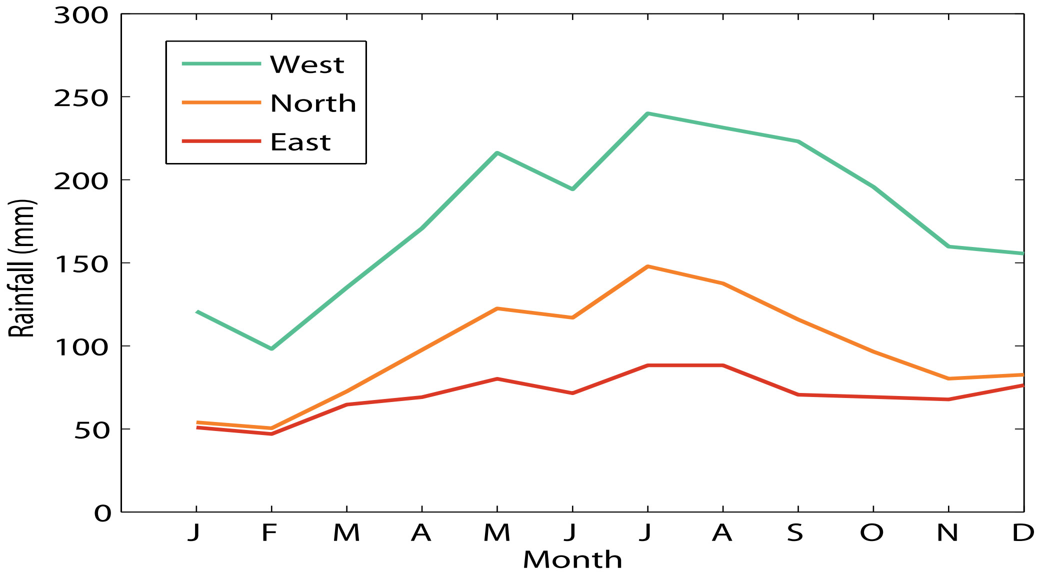


Source: CSIRO, 2009, *Climate change projections and impacts on runoff for Tasmania*

Different seasonal cycles of rainfall are observed between the west, north and eastern regions of the State (refer Figure 10.2). The west coast has a distinct seasonal cycle with the highest rainfalls occurring in winter and early spring (predominantly as prolonged heavy rainfall events) and the least rainfall falling in the summer months. A similar but smaller seasonal cycle occurs in the north, with rainfall peaking through autumn and winter. There is no distinct annual cycle in the east, with little variation in monthly rainfall seen throughout the year.

Tasmania's climate is influenced by several naturally occurring, large scale ocean-atmosphere climate drivers. The influence of, and interaction between, these drivers contributes to the year-to-year and inter-regional variability of rainfall across Tasmania. The climate drivers most relevant to Tasmania are the El Niño Southern Oscillation (ENSO), the Indian Ocean Dipole (IOD), the Southern Annular Mode (SAM) and atmospheric blocking highs.

Figure 10.2 Annual cycles of rainfall in Tasmania's west, north and east



Source: ACE CRC, 2010, *Climate Futures for Tasmania general climate impacts: the summary*

According to the Climate Futures Tasmania (CFT) project, rainfall across Hydro Tasmania's catchments is most strongly correlated with the SAM, blocking highs and the IOD as follows: [31]

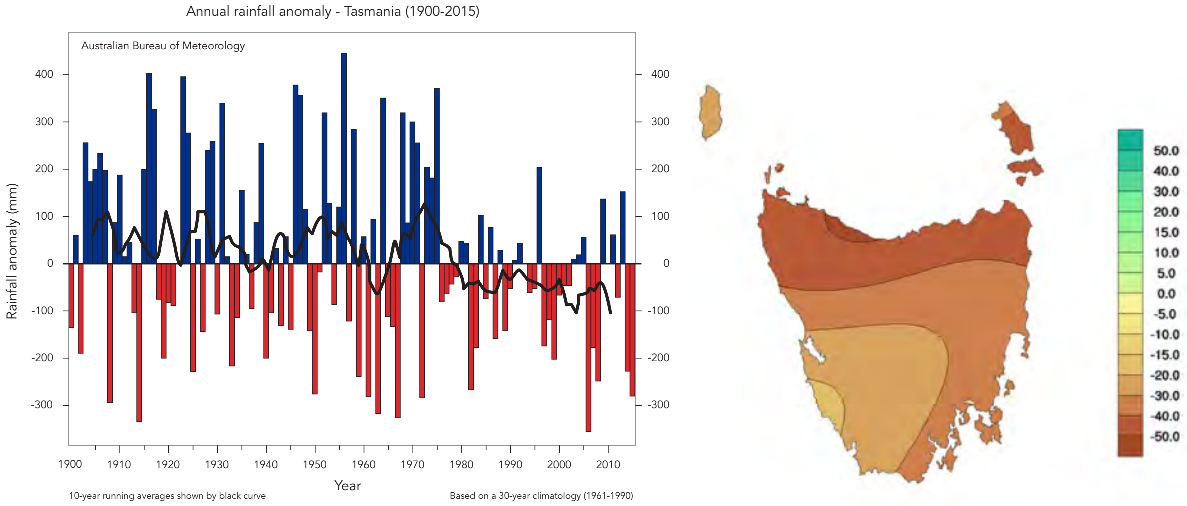
- the SAM's influence on rainfall is greater than the other climate drivers in the west of Tasmania throughout winter, spring and summer, and it explains up to 15 per cent of winter and spring weekly rainfall variance;
- blocking events have the highest correlation with rainfall in the west of Tasmania in autumn and winter, and prolonged blocking events can significantly impact annual rainfall across Tasmania, with well below mean annual rainfall on the west coast and above average rainfall in the north and east in some years;
- the combination of a positive IOD phase and a strong El Niño event can result in lower than average June to October rainfall in Tasmania, as occurred during the second half of 2015; and
- the ENSO is most strongly correlated with autumn and winter rainfall in the north and east rather than rainfall in the State's major hydro catchment areas.

[31] Grose MR, Barnes-Keoghan I, Corney SP, White CJ, Holz GK, Bennett JB, Gaynor SM and Bindoff NL, 2010, *Climate Futures for Tasmania: general climate impacts technical report.*

10.2 Historical trends in Tasmania's rainfall

Tasmania has experienced a downward trend in total annual rainfall since 1970, as illustrated in Figure 10.3. Tasmanian runoff, the distribution of which closely follows rainfall, has also declined over this period.[32] The observed decline in rainfall was greatest in autumn in the period from 1970 to 2007,[33] although there is evidence of a possible reversal since then. Spring and summer rainfall have also shown a negative trend across the State over the past 20 years (refer Figure 10.4).

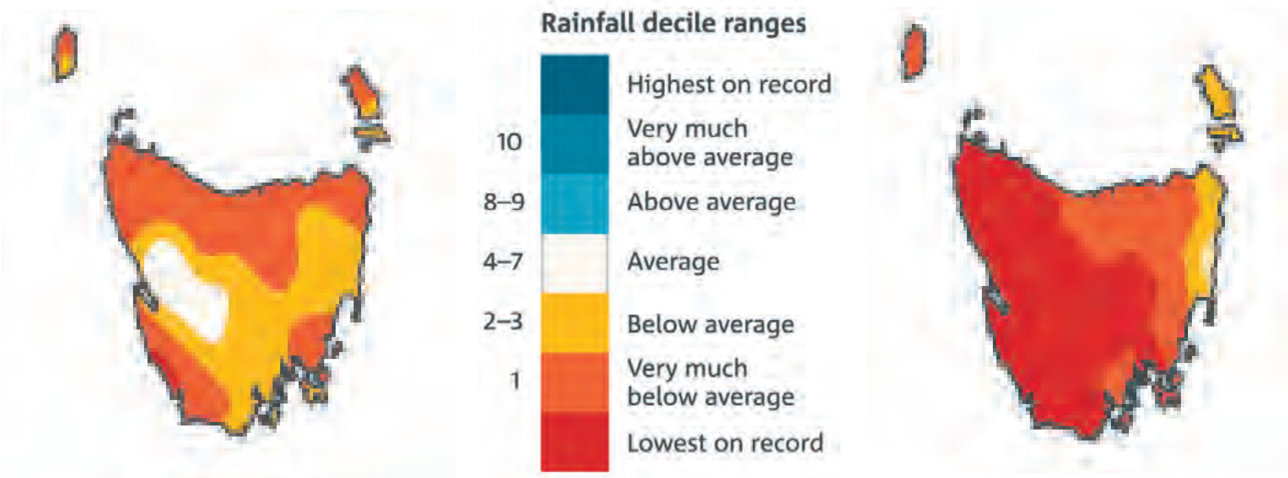
Figure 10.3 Trends in Tasmania's annual total rainfall (a) 1900 to 2015 and (b) 1970 to 2015



(a) (b)

Source: Bureau of Meteorology

Figure 10.4 Rainfall declines for the last 20 years (1996-2015)



April – October October – April

Source: adapted from BOM and CSIRO, 2016, *State of Climate 2016*

32 Runoff is influenced by rainfall, evapotranspiration and rainfall intensity.

33 Grose MR, Barnes-Keoghan I, Corney SP, White CJ, Holz GK, Bennett JB, Gaynor SM and Bindoff NL, 2010, *Climate Futures for Tasmania: general climate impacts technical report.*

Concurrent with this decrease in rainfall and runoff is a decrease in water inflows to Tasmania's hydro-electric catchments. Figure 10.5 illustrates system yield observed across the hydro system during the period 1924-2015. A progressive decrease in catchment inflows has been observed since the mid 1970s, with an acceleration of the trend since the mid 1990s.[34] The years 2006 to 2008 were the driest three-year period on record, and resulted in Hydro Tasmania undertaking a reassessment of the impact of climate change on rainfall and inflows, and progressively lowering its estimate of annual energy yield from 10 000 GWh per annum to 8 700 GWh for planning purposes. In 2014, this was revised to 9 000 GWh based on average inflows since 1997.

OCEAN-ATMOSPHERE CLIMATE DRIVERS

El Niño Southern Oscillation (ENSO) – a naturally occurring ocean-atmosphere phenomenon that affects weather patterns across the Pacific Ocean. The ENSO fluctuates between 'El Niño', 'neutral' and 'La Niña' phases approximately every three to eight years. An El Niño event is characterised by greater than average sea surface temperatures in the eastern Pacific and is associated with a decrease in rainfall across Australia. A La Niña event occurs when the eastern Pacific Ocean is much cooler than usual and is associated with higher annual mean rainfall in Australia. Global warming is expected to increase the frequency of extreme El Niño and La Niña events.

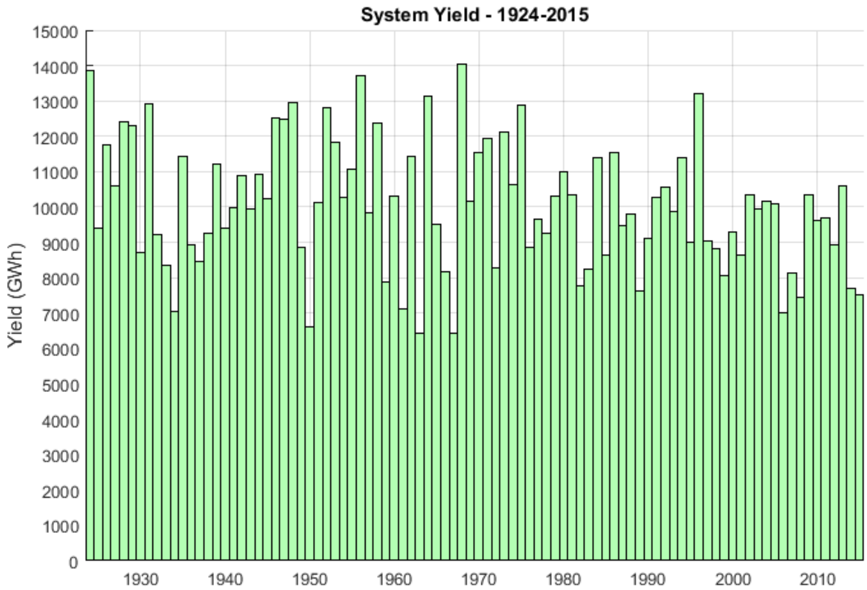
Indian Ocean Dipole (IOD) – an ocean-atmosphere phenomenon that affects weather patterns and extreme events across the Indian Ocean. The IOD fluctuates between positive, neutral and negative phases approximately every three to eight years, and affects rainfall in Australia from May to November. The positive phase occurs when the western Indian Ocean is warm relative to the eastern Indian Ocean and tends to cause drought conditions. For example, the prolonged drought observed in south eastern Australia and Tasmania from 2006 to 2008 was attributed to three consecutive years of positive IOD events. There is some evidence that positive IOD events may become more frequent with global warming.

Southern Annular Mode (SAM) – also known as the Antarctic Oscillation, the SAM describes the north-south variation of the strong westerly wind belt that circles Antarctica. In a positive SAM event, the westerly wind belt contracts towards Antarctica, resulting in a reduction in the frequency of westerly cold fronts passing over southern Australia and a subsequent reduction in rainfall.

Blocking highs are strong, slow moving high pressure systems that can alter rainfall over Tasmania by disrupting the passage of rain-bearing cold fronts. They may also occur in association with cut-off lows which may form to the north of the blocking high.

[34] Hydro Tasmania, 2009, *Electricity in Tasmania: a Hydro Tasmania perspective.*

Figure 10.5 System yield (inflows) across Tasmania's hydro-electric system, 1924-2015



Source: Hydro Tasmania

10.3 Future impact of climate change on water and catchments

10.3.1 Long range forecasting of Tasmania's climate

The BOM provides monthly, seasonal and long-range forecasting of Australia's climate. The Predictive Ocean Atmosphere Model for Australia (POAMA) is the BOM's current long range climate model used for these climate outlooks.[35] The BOM also surveys eight international climate models when developing its outlooks.

El Niño events can be predicted relatively accurately up to nine months in advance, while predictability of IOD phases is limited to lead times of less than three months. There is currently no long range forecasting of SAM and blocking highs. Long range forecasting of rainfall across Tasmania's hydro-electric catchments is also limited due to POAMA's 250 km resolution, which effectively means that Tasmania is represented as part of the ocean rather than a land mass and does not allow distinction between western and eastern Tasmania. The BOM is in the process of upgrading POAMA with a new seasonal forecasting model called the Australian Community Climate and Earth System Simulator (ACCESS-S), which will operate at a 60 km resolution compared to POAMA's 250 km resolution. At this resolution, the model will be able to provide seasonal forecasts with greater regional detail, such as differentiating between western and eastern Tasmania which is currently not possible with POAMA. Increased resolution may also improve the representation of large-scale climate drivers, with the potential for improvements to multi-week and seasonal forecast accuracy.

A vast range of scientific information about the historical and projected impacts of climate change exists at the local, national and international levels. Recent advances in climate modelling techniques have enabled simulations of extreme climatic events at regional scales, such as Tasmania, to be undertaken. The Taskforce has reviewed a number of existing information sources to develop an understanding of the potential future impact of climate change in Tasmania, including the CFT project and a suite of information prepared by the Commonwealth Scientific and Industrial Organisation (CSIRO) and BOM.

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[35] For further information about POAMA see: http://poama.bom.gov.au/

Key sources of climate change projections

Climate Futures for Tasmania (CFT) – the comprehensive CFT project, undertaken by the University of Tasmania's ACE CRC in 2010-2012, is currently the most important source of climate change projections for Tasmania.[36] The CFT project used six global climate models (GCMs) to model changes to Tasmania's climate from 1961 to 2100 based on two scenarios of future greenhouse gas emissions: a high emissions scenario and a low emissions scenario. Three time periods were used to describe future changes in Tasmania's climate: the near future (2010-2039); medium-term future (2040-2069) and the end-of-the-century (2070-2099). The CFT modelling provides an understanding of how Tasmania's climate may change between now and 2100, including projected changes in rainfall, runoff and inflows to the hydro-electric system. Hydro Tasmania was a key partner in the CFT project.

Climate Change in Australia (CCIA) – in 2015, the CSIRO and BOM released a comprehensive suite of information about observed and projected climate change in Australia.[37] Projections based on intermediate and high emissions scenarios are given for two 20 year periods: the near future (2020-2039) and the late century (2080-2099). This includes climate change projections for the Southern Slopes region of Australia, of which Tasmania is a component

State of the Climate 2016 – this report, which is the fourth in a series produced by the CSIRO and BOM, provides a summary of observations of Australia's climate and analysis of the factors that influence it.[38]

10.3.2 Changes to rainfall

Over the next 20 years, natural variability is projected to remain the major driver of rainfall changes in Tasmania rather than trends due to global warming. However, by the middle of the century changes due to climate change are projected to be evident against natural variability.

While statewide annual rainfall is not projected to change markedly in the short, medium or long term, shifts in the seasonal and spatial distribution of rainfall are projected. Under high emissions scenarios, there is a projection for a lesser proportion of rain falling in the drier warmer months of the year (November to April) and more in the wetter, cooler months of the year (May to October).

Both the CFT and Climate Change in Australia (CCIA) project that, under a high emissions scenario, there will generally be less rainfall throughout Tasmania in spring and little change or an increase in winter rainfall by the end of the century, with the changes most marked in the western half of Tasmania. Notably, these long-term projected changes differ to what has been observed in recent years, where historical decreases in autumn rainfall have been more significant than decreases in spring.

Rainfall on the west coast is projected to increase by up to 20 per cent in winter and decrease by up to 33 per cent in summer, although total annual west coast rainfall shows little change overall. Rainfall in the central highlands is projected to decrease in all seasons by the end of the century. As Tasmania's hydro-electric system covers a large proportion of the western and central areas of Tasmania, these seasonal changes in rainfall are likely to have implications for the timing of inflows to Hydro Tasmania's western catchments and the quantity of rain received in the central catchments (including Great Lake).

36 For further information on the Climate Futures for Tasmania project see http://acecrc.org.au/climate-futures-for-tasmania/
37 The suite of Climate Change in Australia products is available at: http://www.climatechangeinaustralia.gov.au/en/
38 The full report and an overview of its key points are available at: http://www.bom.gov.au/state-of-the-climate/

10.3.3 Changes to runoff

On average, CFT modelling projects that statewide annual runoff will decrease slightly in both the 2010-2039 and 2040-2069 periods under a high emissions scenario, before increasing by 1.1 per cent by 2100. More importantly, significant regional and seasonal changes to runoff are projected (refer Figure 10.6). These changes include:

- a marked decrease in annual runoff in the central highlands (evident across all seasons), with 30 per cent less annual runoff in some areas;
    - this trend, which commences in the period 2010-2039 and intensifies towards the end of the century, may have important implications for long-term inflows to the hydro-electric catchments and dams in this area (including Great Lake);
- a progressive decrease in summer and autumn runoff throughout the century in the west, and an increase in winter runoff in this region;
    - although little change in total annual runoff is projected, these seasonal changes are likely to have implications for managing storage levels (including Lake Gordon) and run-of-river systems in Hydro Tasmania's western catchments; and
- a progressive increase in total annual runoff in the east of the State, with significant increases projected in summer and autumn.

Runoff projections for 2030 were also produced by the CSIRO Tasmania Sustainable Yields Project (TasSY) in 2009. The TasSY projections for central and western Tasmanian runoff broadly align with that of the CFT, including a marked decrease in annual runoff in the central highlands. However, the two studies differ in their assessment of future changes to runoff on Tasmania's east coast, with the TasSY study projecting a marked decrease in this region, particularly in spring and summer. This difference may be attributed to differences in the downscaling techniques and the different global climate models (GCMs) used by the two studies, and illustrates that a degree of caution needs to be undertaken when interpreting modelling results.

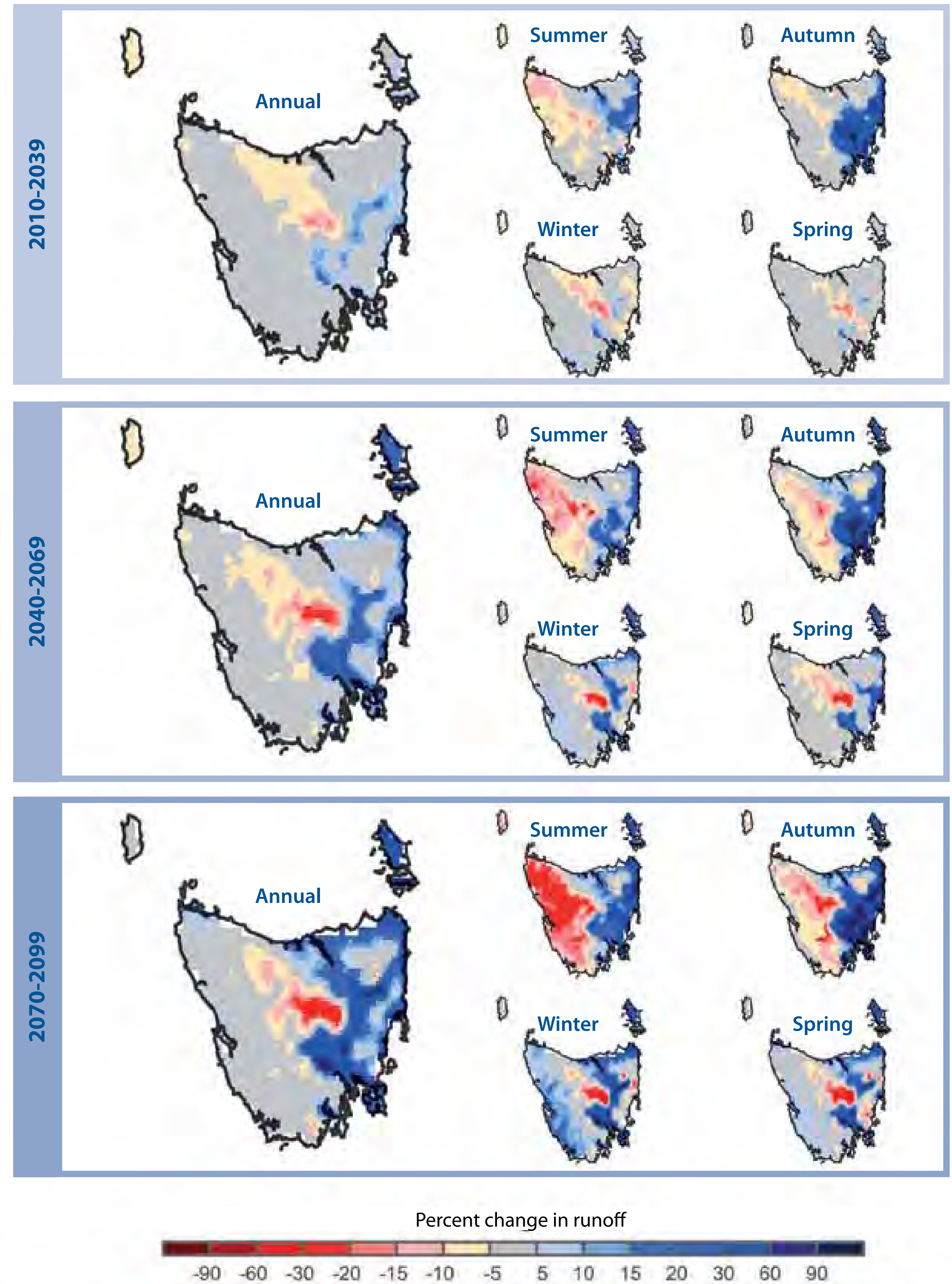
Global warming is expected to increase the magnitude of heavy rainfall events due to a warmer atmosphere being able to hold more moisture. Both the CFT and CCIA project that the intensity of extreme rainfall events will increase, particularly in late summer and autumn, although the magnitude of the changes is uncertain. More intense rainfall usually leads to proportionately more runoff, as proportionately more water flows into rivers under more intense rainfall.

10.3.4 Changes to inflows to hydro-electric catchments

CFT projections indicate that climate change is likely to continue to reduce inflows to Tasmania's hydro-electric catchments throughout the 21st century, albeit at a rate less than the historical trend (refer Figure 10.7). A decline of eight per cent is projected, which has been estimated to reduce annual power generating capacity to 8 857 GWh per annum during the period 2070-2099.[39]

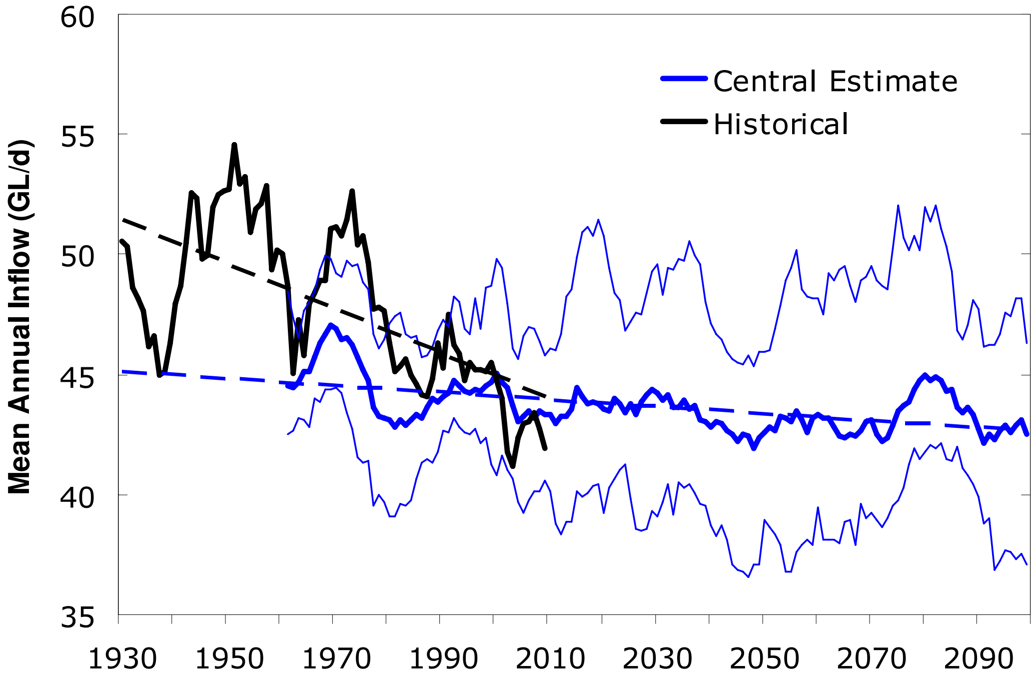
[39] Bennett JC, 2013, *Impacts of future climate on Tasmanian rivers.*

Figure 10.6 Changes to annual and seasonal run-off for three future periods: 2010-2039, 2040-2069 and 2070-2099



Source: ACE CRC, 2010, *Climate Futures for Tasmania - general climate impacts: the summary*

Figure 10.7 Observed and projected inflows to Hydro Tasmania's catchments 1930-2100



Source: ACE CRC, 2010, *Climate Futures for Tasmania general climate impacts: the summary.*
Note: Black line shows synthesised inflow record from Hydro Tasmania; blue line shows modelled mean and range of inflows under a high emissions scenario; dashed lines show linear trends.

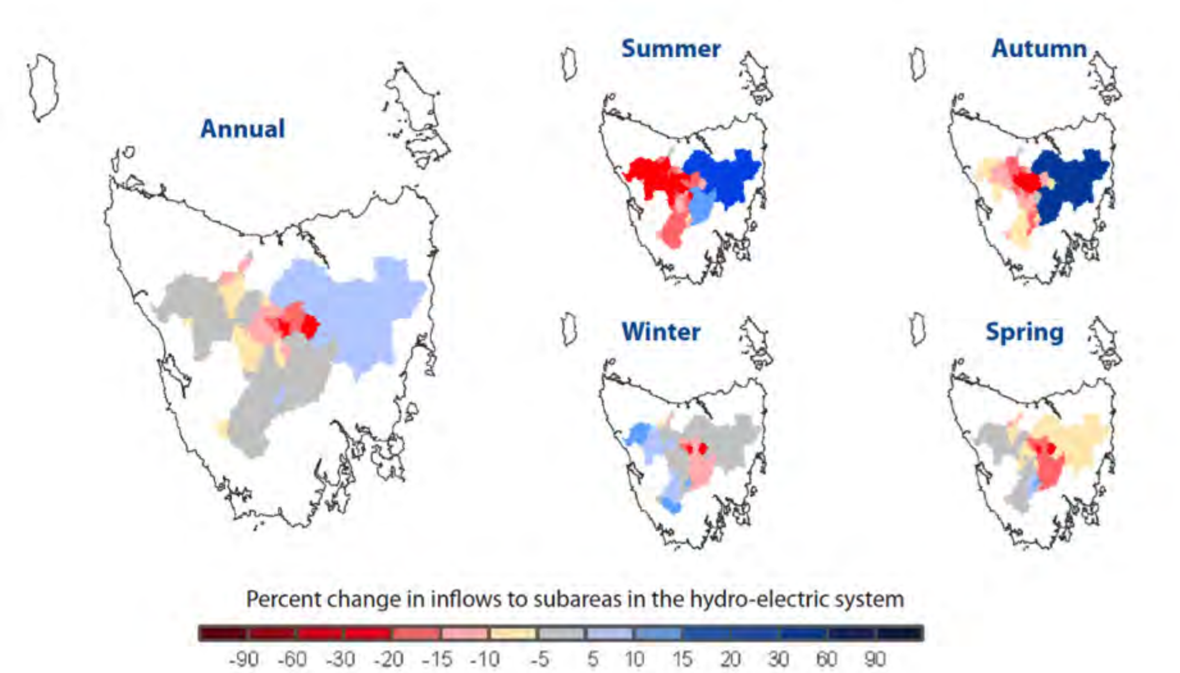
Consistent with projected changes in rainfall and runoff due to climate change, the following changes to inflows are projected under a high emissions scenario by 2100 (refer Figure 10.8):

- storages that rely on inflows from the central highlands (in particular Great Lake) are projected to receive up to 30 per cent less inflows annually, with reductions projected across all seasons;
- inflows to storages fed by the western catchments show little annual change but marked seasonal variations are projected, with reduced inflows in summer and autumn and increased inflows in winter;
- storages in the east of Tasmania are projected to receive increased inflows by the end of the century, predominantly in summer and autumn.

The projected decreased inflows in the central plateau catchments may have a significant impact on electricity generation, as these feed into the major storage of Great Lake and the State's second largest power station, Poatina Power Station (300 MW). The high head of this power station means that small reductions in water volumes result in large reductions in electricity generation, and this in turn may also affect the remainder of the system (e.g. lake levels at Lake Gordon may decline as water is used to compensate for reduced inflows to Great Lake). [40]

[40] Bennett JC, 2013, *Impacts of future climate on Tasmanian rivers.*

Figure 10.8 Percentage change of mean annual and seasonal inflows to Hydro Tasmania's catchments to the end of the century



Source: ACE CRC, 2010, *Climate Futures for Tasmania general climate impacts: the summary*

Spatial and seasonal changes to inflows could also contribute to an overall reduction in electricity generation capability by the end of the century. Changes to the runoff variability in the western catchments may result in less power generation from the run-of-river schemes in this area during summer and autumn and more spill events in winter. This again has implications for the use of the major storages, which may be drawn upon to compensate for this reduction in run-of-river power generating capacity.

Increased inflows in the eastern catchment will likely only be of benefit to the smaller run-of-river Trevallyn Power Station.

While CFT does not specifically provide projections for seasonal changes in inflows in the period 2010-2039, the annual and seasonal trends in rainfall and runoff during this period are similar to those observed by 2100, albeit less pronounced. From an energy security perspective, these changes may have implications for Hydro Tasmania's long-term average yield assumptions and management of water storages over the next 10-20 years, including prudent water storage management guidelines.

Climate change may not only impact on energy security from the perspective of changes to rainfall patterns, but also from the perspective of extended low rainfall periods. The ability to predict this is an important consideration from an energy security perspective. The proportion of time spent in drought is projected to increase over the next century, with global warming expected to increase the frequency of extreme El Niño and positive IOD events. In particular, CFT projects an increase in drought periods in the central highlands and north-west regions of Tasmania.[41] These projections support the need for non-hydro generation sources to be available during drier periods.

41 Holz GK, Grose MR, Bennett JC, Corney SP, White CJ, Phelan D, Potter K, Kriticos D, Rawnsley R, Parsons D, Lisson S, Gaynor SM and Bindoff NL, 2010, *Climate Futures for Tasmania: impacts on agriculture technical report.*

In light of the projections described above, the Taskforce considers that more conservative assessments of hydro generation output should be included in energy security planning for Tasmania, although inflow variability is most likely to remain the more significant factor affecting energy supply from an energy security perspective.

10.4 Wind patterns

By 2030, negligible changes to average surface wind speeds are projected due to climate change, and only a small decline is projected by the end of the century (less than five per cent).[42] However, both the CFT and CCIA project a change in seasonality of mean wind speed later in the century, with stronger average wind speeds during winter (primarily in western Tasmania) and lower wind speeds from November to May.

Lower wind speeds in summer and autumn coincide with projected decreases in rainfall on the west coast, meaning that the capacity to generate electricity from both wind and hydro may be reduced simultaneously during these months. This may have implications for the management of the State's energy security during summer and autumn in the long term. While further work is required to more fully understand the magnitude of these changes, the Taskforce considers that it is prudent to include the potential for seasonal changes to average wind speeds in energy security planning.

RECOMMENDATIONS

22. More conservative assessments of hydro generation output and consideration of potential seasonal changes to average wind speeds should be included in energy security planning to account for the combination of climate change impact projections and historical rainfall variability. All historical low inflow sequences should be used to assess risks, not just those associated with more recent trends.
23. Hydro Tasmania should specifically model lower inflows into Great Lake that are projected as a result of climate change, and advise the Monitor and Assessor of the implications for balancing storages across the hydro system and any increased dependence on one (particularly Lake Gordon) or more storages.

10.5 Extreme events

The IPCC's Fifth Assessment Report concluded that climate change will be accompanied by changes in both the frequency and intensity of extreme weather events. The increased risk of extreme weather patterns, including storm events and bushfire, is an important consideration in relation to the security of energy assets managed by Hydro Tasmania and TasNetworks. For example, bushfires have the capacity to destroy transmission infrastructure or power station assets, severe storms may cause fallen trees across access roads and transmission lines, and flooding has the potential to damage canals, flumes and access roads.

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[42] Grose MR, Barnes-Keoghan I, Corney SP, White CJ, Holz GK, Bennett JB, Gaynor SM and Bindoff NL, 2010, *Climate Futures for Tasmania: general climate impacts technical report.*

Modelling undertaken as part of the CFT project found that climate change is projected to extend the bushfire season and increase the number of 'Very High Fire Danger' days over a larger land area, particularly in spring.[43] The 2016 Tasmanian State Natural Disaster Risk Assessment Report concludes that this has the potential to increase the State's overall bushfire risk.[44] Rainfall intensity and associated flooding is also projected to increase across the State.

Positive IOD activity, which may become more frequent with global warming, has also been shown to be a precondition for major bushfires in south eastern Australia.[45]

Extreme events tend to cause 'capacity emergencies' through damaging electricity infrastructure, rather than a deficit in available energy sources. This was demonstrated in South Australia on 28 September 2016, when severe weather triggered multiple transmission system faults (including the loss of three major transmission lines) resulting in a 'Black System' event.[46]

10.6 Future modelling work

The CFT project is currently the most important source of Tasmanian climate change projections at a local scale. However, this work is becoming outdated as improvements are made to climate models and the BOM's ability to more precisely analyse past climate observations.

The BOM recently commenced the Australian Regional Reanalysis Project, which is generating a reconstruction of the weather every hour over Australia and the surrounding region from 1990 to 2015 (including wind, temperature, rainfall, relative humidity, soil moisture and solar radiation). An additional higher resolution regional subdomain is being implemented for Tasmania (and four other regions), where the horizontal resolution is being increased to 1.5 km from the national 12 km grid and will cover the entire State and surrounding waters. Once complete, data generated from this reanalysis will lead to an unprecedented understanding of Tasmania's weather, and will be highly valuable in planning water storage management as well as investigating opportunities for further renewable energy development in Tasmania.

A future update to CFT using this new modelling input may be prudent to improve current projections, particularly in the near (next 20 years) and medium-term future. In the interim, in light of recent and upcoming improvements to climate forecasting and modelling, the Taskforce considers that Hydro Tasmania should engage more closely with the BOM to understand trends in historical and future rainfall and wind variability as improvements to climate forecasting and modelling are made. Similarly, an understanding of potential increases in frequency and intensity of extreme events will be important for both Hydro Tasmania and TasNetworks in the context of network and emergency planning.

RECOMMENDATION

24. Hydro Tasmania and TasNetworks should closely engage with the BOM and other experts to fully understand the opportunities to use improved climate modelling and weather forecasting for underlying assumptions of historical and future rainfall, wind variability and extreme events.

[43] Fox–Hughes P, Harris RMB, Lee G, Jabour J, Grose MR, Remenyi TA and Bindoff NL, 2010, *Climate Futures for Tasmania future fire danger: the summary and the technical report.*

[44] White CJ, Remenyi T, McEvoy D, Trundle A and Corney SP, 2016, *2016 Tasmanian State Natural Disaster Risk Assessment.*

[45] Cai W, Cowan T and Raupach M, 2009, *Positive Indian Ocean Dipole events precondition southeast Australia bushfires.*

[46] AEMO, 2016, *Update report – Black System event in South Australia on 28 September 2016.*

Part C

The Tasmanian Gas Market

11. Role of Gas for Energy Security

KEY FINDINGS

- The viability of the Tasmanian gas market appears susceptible given its scale and increasing supply and price risks associated with both gas commodity and pipeline access. The TVPS is currently an important factor in helping to support the viability of Tasmania's gas market.
- Gas generation is a common feature of hydro-electric systems across the world as a backup generation source to manage hydrological risk. However, gas generation has become increasingly uneconomic to operate in the NEM (particularly as base load generation) due to increased fuel and operational costs.
- In the absence of reliable alternatives, gas generation remains important to Tasmania to mitigate against hydrological and Basslink failure risks. As such, the TVPS provides a 'back-up' energy generation source for Tasmania.
- The contractual arrangements to support standby gas generation at the TVPS could be made on an as-needed basis. While this may be the most cost effective approach for Hydro Tasmania, it may result in greater transportation price increases for non-TVPS customers.
- There is also a risk that in a tight east coast gas market, contracting gas and pipeline access on an as-needed basis could be difficult, if gas commodity becomes fully (or near fully) contracted and pipeline storage becomes a valuable product in the Victorian gas market.
- Locking in long-term gas supply and transportation agreements in the current market comes with high costs and risks, and may forego the opportunity to add more cost effective energy supply options over the medium to long term.
- Transportation price increases to non-TVPS customers are limited by customers' capacity to pay, otherwise the risk of fuel switching or other actions will increase.
- In the medium to long term, the role of gas generation in Tasmania will depend on the competitiveness of gas relative to other energy sources. Similarly, gas will need to remain competitive to retain and attract gas consumers, or risk being transitioned out of the Tasmanian market through customer fuel switching.

In the past decade, the Tasmanian gas market has grown to become a small but important element of the energy sector in Tasmania. During the 2015-16 energy security event, energy supplied by the TVPS was essential in maintaining continuity of supply. Natural gas is also used by many of Tasmania's large industrial customers and is embedded in the homes and businesses of small gas consumers.

However, due to its relatively small size, the Tasmanian gas market is partly dependent on the retention of significant customer loads to ensure system wide affordability. Consequently, pressures from rising commodity prices as well as an underutilised gas transmission pipeline may threaten the viability of the market and, in turn, the energy security it provides to Tasmania.

This chapter considers the future role of gas in supporting Tasmanian energy security by:

- summarising the development, utilisation and challenges facing the Tasmanian gas market today;
- assessing the contribution of gas generation to the recent threats to continuity of supply;
- evaluating the sensitivity of Tasmanian gas customers to gas prices and the potential for this to impact energy security; and
- examining the role of gas commodity and transportation contracts in underpinning energy security.

The Taskforce notes that commercial discussions are currently underway concerning future commodity and transportation contracts between major Tasmanian gas market participants. The Taskforce is mindful of this and has consequently presented its discussion in a way designed not to prejudice these sensitive negotiations.

11.1 Development of the Tasmanian gas market

From 1997 onwards, the State Government has played a role in developing the natural gas market in Tasmania. This was initially done with the call for expressions of interest from national and international parties to investigate the feasibility of introducing natural gas to the State.

In 2001, a development agreement between Duke Energy and the State was signed which resulted in the construction of the transmission pipeline from Longford in Victoria to Bridgewater and Port Latta via Bell Bay in Tasmania. The pipeline became known as the TGP and a natural gas distribution network was progressively rolled out to domestic and small to medium sized commercial customers.

As noted by the Expert Panel in its review of the development and acquisition of the TVPS, securing a large gas-fired power station for Tasmania to provide alternative wholesale energy supplies had been an energy policy objective of successive Tasmanian Governments. This objective was closely linked to the introduction of natural gas to Tasmania, with a power station providing a foundation customer for the TGP.[47] The conversion of the Bell Bay Power station from fuel oil, starting in 2003, signalled the first steps towards natural gas thermal powered generation.

Support for the Tasmanian gas market continued in 2008 when Aurora Energy was directed to purchase the partially completed TVPS by the State Government in response to ongoing drought conditions and the sale of the TVPS by the previous developer, Babcock & Brown. The TVPS was commissioned in 2009 and operated by Aurora Energy under its subsidiary Aurora Energy (Tamar Valley) Power (AETV Power).

THE TAMAR VALLEY POWER STATION GENERATION UNITS

The TVPS uses a combination of combined and open cycle gas turbines (CCGT and OCGT respectively), this allows the station to provide base load and peaking generation. The station includes four peaking units, totaling 178 MW, and one base-load combined cycle unit of 208 MW.

The four peaking units are three 40 MW (total 120 MW) Pratt & Whitney FT8 Twin Pac gas turbine alternators and a single 58 MW Rolls Royce Trent 60WLE gas turbine alternator.

The base load unit is a Mitsubishi M701DA gas turbine operating in combined cycle mode with a M701 gas turbine providing two-thirds of the unit's output with the remaining third generated by a steam turbine generator set.

On 1 June 2013, responsibility for the TVPS was transferred from Aurora Energy to Hydro Tasmania as part of the reforms that followed the conclusion of the Expert Panel's work. This included a range of other assets and liabilities, including associated debt of $205 million.

In August 2015, Hydro Tasmania announced that expressions of interest for the sale of the CCGT would be sought. This announcement was subject to certain conditions that the Tasmanian Government placed on the process, including a requirement for Hydro Tasmania to review its prudent water storage management guidelines and provide assurance that energy security could be maintained without the CCGT. However, the expression of interest process and the energy security reviews required to support any prospective sale were not advanced by the time that the record low spring 2015 inflows became evident and storages began to decline. The expression of interest process was subsequently abandoned and the Tasmanian Government has since stated that the TVPS will not be sold.[48]

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47 Electricity Supply Industry Expert Panel, 2011, *Tamar Valley Power Station: Development, Acquisition and Operation.*

48 Minister for Energy media release 20 September 2016.

11.2 Tasmanian gas market structure and utilisation

The Tasmanian gas market structure consists of a gas transmission pipeline, the TGP, which is operated by a company with the same name and currently owned by an investment company, Palisade Investment Partners (Palisade).

Tas Gas Networks owns and operates the gas distribution network that runs off the TGP. The Tasmanian gas network contains over 800 km of pipeline and extends to parts of Hobart, Launceston, Longford, Westbury, Bell Bay, Wynyard and Devonport.

Two retailers of gas operate in Tasmania:

- Tas Gas Retail, which is the largest gas retailer with two-thirds of the retail market; and
- Aurora Energy.

To date, the gas market in Tasmania remains relatively underutilised compared to mainland Australian jurisdictions, in which gas is used far more extensively at all levels of customer classes.

During a period of dry lay-up for the TVPS (3 June 2014 to 20 January 2016), the TGP operator reported the pipeline was operating at less than 20 per cent of its design capacity. The majority of this gas consumption is by large industrial businesses directly connected to the TGP. Even with the contribution of gas generation, the pipeline has historically only supplied approximately 50 to 60 TJ per day, compared with its daily capacity of 129 TJ. However, during the six month Basslink outage, when the TVPS (both CCGT and OCGT units) was operated at high capacity, daily flows through the TGP were at historically high levels of over 80 TJ per day.

The underutilisation of gas is further demonstrated by the rollout of the gas distribution network. Of the approximately 46 000 connections to the distribution network, only around 12 700 are connected. Of this latter figure, around three quarters of the gas consumed by distribution customers was by 37 large customers who each consume greater than 10 TJ per annum.[49]

11.3 Changing market structures

Market dynamics, both within Tasmania and outside its borders, are changing.

- Transformation of the east coast gas market – Australia's east coast gas market has been undergoing a rapid transformation over the past decade. This transformation has been driven by demand for liquefied natural gas (LNG) export projects located in Queensland, which has put upward pressure on gas prices as the pricing of LNG is typically linked to the international oil price. A consequence of this has been that gas users have pursued a portfolio approach to sourcing gas (from basins, suppliers and use of storage) which has in turn resulted in a more flexible grid of pipelines on the east coast of Australia. In part due to rising commodity prices, the outlook for domestic gas demand in Australian gas markets is weak and declining.[50]
- Greater scrutiny of gas pipeline operators by national regulators and rule-makers - following the AEMC *Eastern Australian Wholesale Gas Market and Pipelines Framework Review* and the Australian Competition & Consumer Commission's (ACCC) *Inquiry into the East Coast Gas Market*, the COAG Energy Council has established a 'Gas Market Reform Package'. The COAG package is in response to the significant market change being witnessed in the Australian gas market and may result in

[49] OTTER, 2016, *Energy in Tasmania – performance report 2014-15.*
[50] Australian Competition and Consumer Commission, 2016, *Inquiry into the east coast gas market.*

redesigned gas wholesale and transportation markets as well as regulation of previously unregulated pipelines (or at a minimum changes to regulatory tests that would aim to keep monopoly power in check through a more realistic threat of regulation).

- Expiry of state-wide commodity and transportation contracts - the majority of the Tasmanian gas market commodity and transportation requirements are covered by a gas supply agreement and gas transportation agreement. Most of these agreements are set to expire by the end of December 2017. Many stakeholders have submitted that this is an issue for the Tasmanian Government to take action on, both in public and private submissions to the Taskforce and via other forums such as the Parliamentary Standing Committee of Public Accounts inquiry into the financial position and performance of Government owned energy entities (the PAC Inquiry).[51]

These market dynamics are factors in the consideration of gas generation and gas consumption as they relate to energy security.

11.4 Taskforce approach to reviewing the Tasmanian gas market

The development and utilisation of the Tasmanian gas market, combined with the changing nature of market structures, has created an environment where the Taskforce's review has been required to consider confidential and time sensitive matters.

As such, the Taskforce sought and received commercial-in-confidence material from a number of interested stakeholders. The Taskforce acknowledges the 'open book approach' that stakeholders took in sharing their information and is grateful for their participation.

To assist with assessing this material, the Taskforce engaged an expert advisor on natural gas, Oakley Greenwood. The Taskforce is mindful that its findings and recommendations may be at odds with the position taken by one or more of the interested stakeholders who participated in the process. However, with the assistance of Oakley Greenwood, the Taskforce has objectively and methodically worked through the evidence it has before it to arrive at its conclusions.

11.5 Role of gas generation in short-term energy security

Gas generation units, in particular CCGTs are a common feature of hydro-electric systems across the world as a backup generation source to manage hydrological risk.

Prior to the energy security challenges of 2015-16, the CCGT (the major unit for the TVPS), was in a dry lay-up mode. Hydro Tasmania had taken this action on the basis of its assessment that baseload gas generation (which the CCGT is designed for) was highly expensive relative to the other sources of generation available to it. This assessment was consistent with trends observed in other parts of the NEM, where gas price increases (actual and forecast) had resulted in gas generation becoming increasingly uncompetitive, and some gas generation units were being retired or mothballed.[52]

As discussed above, while Hydro Tasmania had intended to seek expressions of interest in the CCGT, given the record low rain evident by October 2015 and the emerging challenge of responding to low storage levels, a decision was taken by Hydro Tasmania in November 2015 to restore production from the CCGT. The unit was returned to service on 20 January 2016 and began to generate energy into the Tasmanian market.

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[51] http://www.parliament.tas.gov.au/ctee/Joint/pacc.htm

[52] Mothballing *"is the preservation of a production facility without using it to produce. Machinery in a mothballed facility is kept in working order so that production may be restored quickly if needed."* (Source: Investopedia). By contrast, retirement of production units is the complete shutdown with intent to never restore.

Table 11.1 shows the value of overall gas generation to meeting the overall Tasmanian demand during the first four months of 2016 when Basslink was out of service and dry conditions continued from spring. In the months of February, March and April the TVPS provided approximately a quarter of Tasmanian consumer demand. Against the total demand for this period, it provided over 20 per cent of Tasmania's energy needs. The contribution of gas generation in this time was the most significant mitigating action to reducing the draw-down of water storages.

Table 11.1 Gas generation as percentage of total Tasmanian energy demand, January to April 2016

	Tas Demand (GWh)	Gas generation (GWh)	Gas % of Tas Demand
January 2016	829	93	11.22%
February 2016	750	181	24.13%
March 2016	733	194	26.47%
April 2016	747	203	27.18%
Total	3 059	671	21.94%

The TVPS demonstrated that, as a market ready asset supported by established pipeline infrastructure, it was able to move quickly from dry lay-up mode to being operational. Further, the TVPS is the only controllable base load generation for Tasmania outside of hydro-electric power stations. As such, it is a firm alternative supply source when compared to wind or temporary generation such as diesel. The TVPS can also assist in maintaining the strength of the network, and therefore network solutions and their costs would need to be considered in a scenario where gas generation was no longer a feature of the Tasmanian energy market.

Taskforce analysis has shown that in any future scenario of low water in-flows to catchment areas and an extended outage of Basslink, gas generation remains important to Tasmanian energy security in the absence of other supply or demand changes. The primary role of the TVPS is therefore to provide a 'back-up' energy generation source for the Tasmanian energy sector. The need for the TVPS to play this role may diminish if additional on-island energy supply is developed (or significantly higher levels of water storages were to be permanently held).

The role of direct gas consumption also requires recognition. Use of gas instead of electricity by major industrial and commercial customers effectively offsets further demands on water storages (noting that the alternative fuel source for some of these customers may not be electricity but other fuel sources). Similarly, small customer load does offset some electrical energy demand and therefore creates some diversification of risk away from dependence on electrical energy.

RECOMMENDATION

25. The TVPS, particularly the CCGT, should be retained at least until there is a reliable alternative in place to mitigate against hydrological and Basslink failure risk.

11.6 Medium to long-term outlook for gas generation

Due to the changing nature of the broader energy sector, it is difficult to firmly state the need for, and viability of, gas fired generation as a back-up energy source beyond the short term. Reticulated natural gas may face competition from alternative fuel sources or from other factors, such as changes in technology or declining consumption patterns (driven by the price pressures already evident as a result of demand for LNG exports). There is currently considerable uncertainty in the east coast gas market, which impacts both on gas generation and gas customers.

Some renewable energy generation technologies such as wind have progressed to a stage where they are now competitive with gas generation, and over the coming years the costs of other technologies are projected to decline. This in turn could lead to additional on-island utility scale generation in Tasmania being a more cost effective option than retaining gas generation (particularly as a standby option only).

However, gas market reform packages recently initiated by the COAG Energy Council also show the intent of market operators and competition regulators to strengthen the competitiveness of the gas market. Frameworks for managing wholesale prices and transportation agreements may appear very different in the next five to 10 years.

Recent work by the AEMC on the integration of energy and climate policy has identified the role of gas as a low emissions energy source to replace more emissions intensive baseload fossil fuel generators. Alongside the possible return of a carbon pricing mechanism and/or subsidies to support low emissions base load generation, gas could improve its competitiveness within Australian energy markets.

For gas to be viable in the medium to long term in the Tasmanian gas market, it will need to remain competitive and responsive to market needs in order to retain its current base as well as attracting new customers.

11.7 Gas commodity and transmission prices

Rising gas prices (both commodity and transmission components) have the potential to drive changes in customer behaviour such as reductions in consumption, switching to alternative fuels or downsizing production. Given the dependence of the Tasmanian gas market on the retention of large gas customers to support system wide affordability, the loss of any large customer could pose a threat to energy security. Higher transportation costs as a result of a large customer loss may in turn drive other customers away from gas and, in a worst case scenario, trigger an eventual collapse of the entire market. This would result in some disruption and transitional issues, which in itself would diminish energy security for affected customers.

Through engaging with key customer participants, either directly or through its consultation process, the Taskforce has analysed the degree of sensitivity toward gas price increases. The overriding trend in gas prices is for an increase in commodity prices due to their linkage to international LNG and oil prices.[53] Further, there is a need for new gas supplies to respond to demand and these are likely to come from new developments, such as in Bass Strait. The timing of these developments is dependent on whether it is economic to invest in these fields.[54] Restrictions (such as through moratoria) and community opinion, however, are limiting the capacity to expand gas supply through unconventional extraction methods. These factors create a market where power rests with long-term gas producers such as Esso and BHP. Significantly, this is a paradigm facing all Australian gas consumers, regardless of the jurisdiction in which they are based.

Recent coal fired generation closures such as those in South Australia and announced closures of large-scale generators in Victoria (namely the coal fired Hazelwood Power Station) have the potential to affect both the price of gas and its availability. A continuing withdrawal of coal-fired base load generation may create a dependence on gas for system security through its ability to provide inertia to support the broader power system. In the absence of growth in new gas supplies, the markets for gas may become constrained and high cost.

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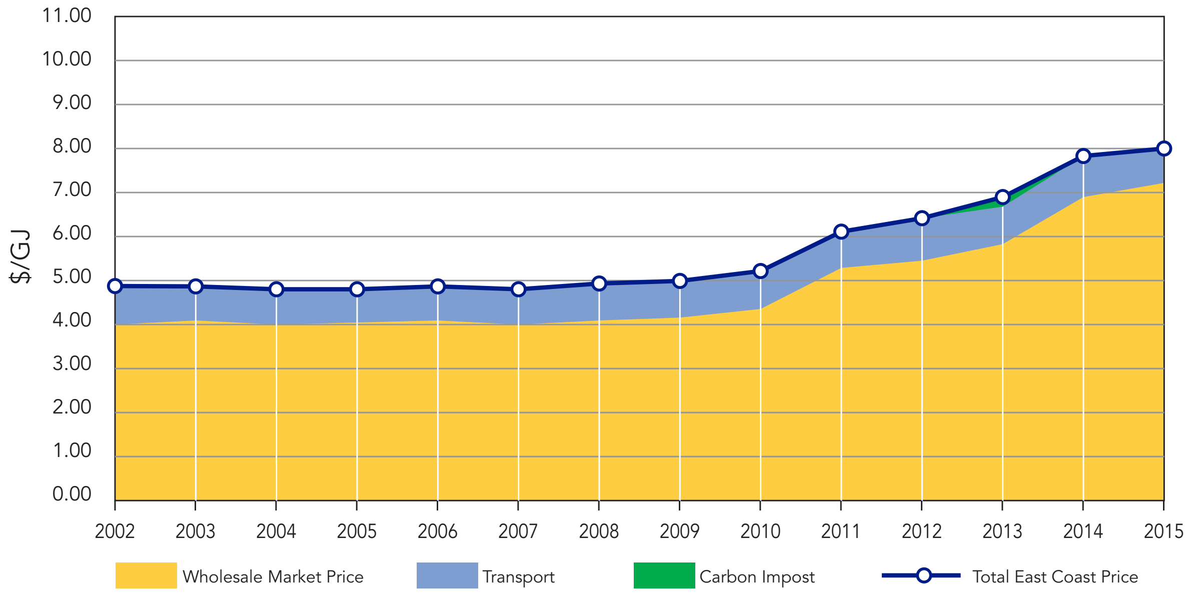
53 Australian Competition and Consumer Commission, 2016, *Inquiry into the east coast gas market.*
54 Ibid.

The Tasmanian Minerals and Energy Council (TMEC) noted in its submission to the Taskforce that: "*Wholesale prices for 2018 are being offered and being negotiated currently in the range of $8 to $9/GJ which is about a 30 per cent increase on Major Industrial and smaller business 2017 estimates*" and "*[m]arket indications are suggesting TGP are looking to raise the Transportation Cost to about $4/GJ which is double current rates*".[55] The commodity costs quoted by the TMEC are reflective of the trends of Australian gas markets over the past five years, which are illustrated in Figure 11.1.

Figure 11.1 Large industrial customer (>I PJ per annum) delivered gas price on the east coast of Australia (weighted zones)



Source: Oakley Greenwood, 2016, *Gas Price Trends Review*

The Taskforce has examined the range of potential large customer price increases that could occur under a scenario that commodity prices increase from $6/GJ to $9/GJ and indicative transportation costs increase from $2 to $4/GJ. This analysis, which was provided to the Taskforce by Oakley Greenwood is presented in Table 11.2.

Table 11.2 Assessment of potential wholesale customer gas price increases

Scenario	Gas Price ($)	Transport cost ($)	Total cost ($)	Increase
No change in transport or gas price	6	2	8	Base case
Gas price increase only	9	2	11	38%
Transport cost increase only	6	4	10	25%
Gas and transport cost increase	9	4	13	63%

Source: Taskforce analysis

Assuming the base case is generally reflective of the costs faced by most major gas customers, gas commodity currently comprises three quarters of the total price. This means that a given percentage increase in gas commodity prices would result in a greater absolute increase in gas costs, relative to the increase in gas costs arising from the same percentage increase in transport costs.

55 TMEC submission to the Taskforce Consultation Paper.

Despite the potential for significant increases in gas costs, large Tasmanian customers may be able to accept some level of increasing prices so long as gas remains competitive and a manageable part of their business. If price outcomes grow beyond a customer's capacity to pay, owners of gas infrastructure should expect to see fuel switching by customers that may further diminish the size of market in which revenue can be recovered.

Customers have indicated to the Taskforce that a number of factors in addition to gas costs are likely to shape future operational decisions. For example, if a customer does ultimately choose to switch from gas to an alternative fuel, there are barriers that must be overcome. For large gas customers there are costs in converting production, input costs from alternative fuels and the exposure to higher emissions intensity associated with fuels such as black coal and oil. Table 11.3 summarises the advantages and disadvantages of gas alternatives facing large gas customers, based on the analysis provided to the Taskforce by Oakley Greenwood.

Table 11.3 Summary of advantages and disadvantages of alternatives to gas

Fuel	Advantages	Disadvantages
Coal	• Cheap • Available locally	• Cost of conversion • High emissions intensity • Additional labour for boiler (ticket) and supervision 24 hours
Heavy fuel oil	• Cheap	• Cost of conversion • High emissions intensity
LNG	• Competitive • Same emissions intensity as pipeline gas	• Exposure to oil price • Additional site infrastructure and traffic
LPG	• Marginally competitive with pipeline gas • Readily available	• Cost of conversion (burners and storage) • Additional site infrastructure and traffic • Exposure to oil price • Higher emissions intensity
Diesel	• At current oil price, marginally competitive with pipeline gas • Readily available	• Cost of conversion (burners and storage) • Additional site traffic • Exposure to oil price • Higher emissions intensity
Biomass	• Fuel cost low or zero • Fuel is otherwise waste	• Generally, not cost competitive • R&D risk • Varying fuel stock size and type • Fuel supply risk • Additional labour for boiler (ticket) and supervision 24 hours

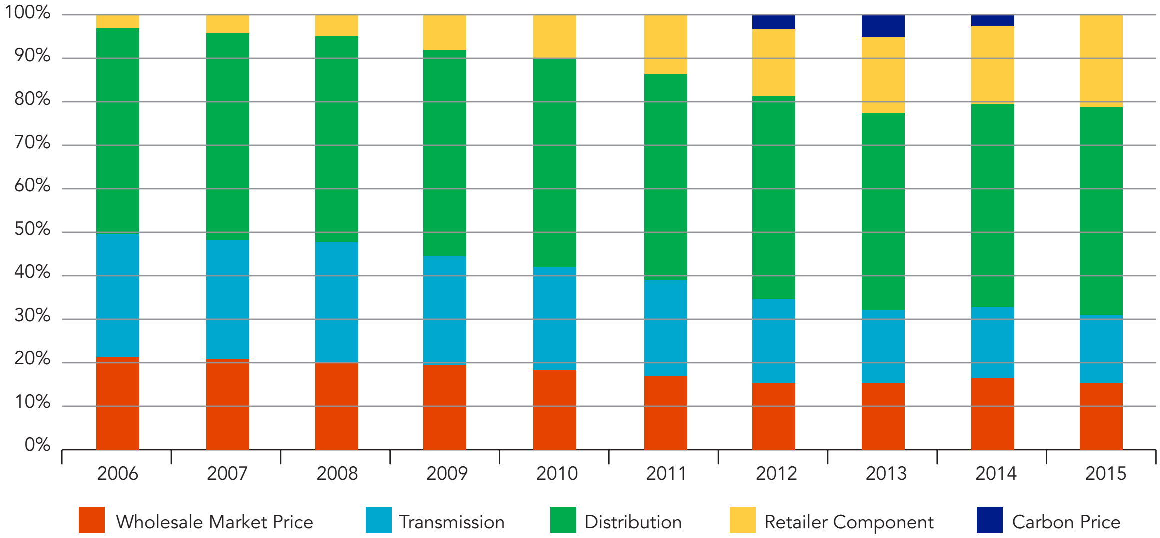
Source: Oakley Greenwood

Reticulated natural gas still remains a competitive and incumbent fuel at present, given the recommissioning costs to service coal, diesel and oil and the need to prepare additional site transport and safety management practices for competing gas based fuels such as LPG or LNG. However, predicted price increases and tight supply mean the competitiveness of gas is uncertain. Increases in transportation costs that are proportionally greater than faced by businesses on the mainland may also create a relative disadvantage for Tasmanian businesses, even if the increase in transportation costs is smaller than increases in commodity price (because commodity price increases should impact businesses equally regardless of their location).

Residential and small business customer load, despite its size, is also important. Once a customer has chosen gas for their home or business they are then exposed to the parameters and fluctuations of that market. Fuel switching in most instances would require high capital costs of removing gas appliances and replacing them with other energy appliances (e.g. electricity appliances for heating, cooking and hot water, wood heaters).

In its 2015-16 comparison of gas prices across Australia, the TER notes that Tasmanian residential gas customers continue to pay prices in the low range of prices compared to other jurisdictions.[56] Components of Tasmanian residential gas prices are shown in Figure 11.2. For residential customers, transmission and commodity prices are also a small percentage of end use retail prices relative to distribution prices. Hence residential customers are less exposed to increases in supply and transportation costs.

Figure 11.2 Indicative Tasmanian residential gas pricing – bill component percentages



Source: Oakley Greenwood, 2016 *Gas Price Trends Review*

11.8 Commodity and transportation contracts

Long-term commodity and transportation contracts have kept Tasmanian gas prices consistent and competitive with other fuels. Under these arrangements, Hydro Tasmania acts as a wholesaler and shipper of gas for a number of large customers. Most importantly, these supply and transportation agreements have to date underpinned the operation of the TVPS. A secure supply of gas and use of the TGP to source this gas is essential.

A further benefit of these arrangements is the concentration of risk and responsibility with only a small number of counter parties. Tas Gas Networks noted in its submission to the Taskforce that, with natural gas demand aggregated with Hydro Tasmania, the gas market is afforded secure gas at competitive prices. However, any move away from current arrangements "may lead to lower economies of scale and reduced purchasing power of *consumers. This in turn may increase natural gas prices, making it unsustainable for the many business and residential customers that depend on it.*"[57]

56 OTTER, 2016, *Comparison of Standing Offer Energy Prices as at 1 August 2016.*
57 Tas Gas Networks submission to the Taskforce Consultation Paper.

The arrangements that are currently in place for the supply and transportation agreements supporting the TVPS implicitly result in two key outcomes:

- they provide energy security for Tasmania by supplying the TVPS so that it can generate electricity when required; and
- they help underpin the Tasmanian gas market and therefore act as an implicit subsidy to other gas users. This provides a form of energy security in that it supports gas as a competitive energy source, but also represents an economic development policy objective.

Determining the allocation of the current agreement costs between these two outcomes is difficult.

The issue now facing Tasmania is what is in the State's best interests in the face of significant challenges for the gas market nationally, to which Tasmania is not immune.

The retention of the TVPS for the foreseeable future is based on having it available in standby mode to operate at relatively short notice. Under this scenario, the commodity and transportation services to run the TVPS will be required on as-needed basis (i.e. during periods of potential energy supply shortfall which may only occur rarely). In this context, it could be argued that the TVPS does not need long-term gas supply and transport agreements to support its operation.

Conversely, firm transportation contracts do have the effect of securing pipeline access and guaranteeing the availability of gas (subject to an agreement to source gas). This may be important given a tight east coast gas market where gas supply and pipelines (including for storage) could become fully (or near fully) contracted. In this regard, long-term contracts can be seen as enhancing energy security because they provide more certainty. The key issue is the cost and risk they 'lock in' relative to the potential benefits. Long-term arrangements come with high risks and forgo flexibility to pursue opportunities for more cost effective outcomes over the medium to long term. This risk is supported by analysis provided to the Taskforce which indicates a trend away from long-term contracting arrangements.[58] National market conditions are not seen as conducive to the previous practice of long term contracting due to escalating gas commodity prices prompting a need for short term flexibility.

If the Tasmanian gas market had grown to use more of the full potential of the existing pipeline (with the TVPS being a much smaller customer), the most prudent approach would appear to be for Hydro Tasmania to only contract for the gas and pipeline access that it needs to support gas generation in the short term, as and when it is required. Under this scenario, the impact on gas customers from such action would be expected to be negligible.

However, this scenario is not the reality and the concern is what impact such action would have on other gas customers. The Taskforce recognises the importance placed on Hydro Tasmania by stakeholders who seek Hydro Tasmania to commit to long term commodity and transportation contracts not only for the TVPS but the broader Tasmanian gas market. These customers are clearly concerned about how TGP's revenue would be recovered over the much smaller customer base without a long-term, firm capacity contract for the TVPS. Customers are also concerned with timing, given they have no certainty regarding their gas supply arrangements a year out from contracts expiring.

Some stakeholders have also argued that as the Tasmanian Government facilitated the entry of gas into the State's energy market, including through using the TVPS as a foundation customer, it has an obligation to continue to support the gas market. However, it is noted that the gas market and its outlook at the time gas

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[58] In its October 2015 submission to the AEMC *Pipeline Regulation and Capacity Trading Discussion Paper*, APA Group (Australia's largest pipeline owner) stated that the duration of gas transportation agreements "*range from one year to around 20 years. Moreover, in recent times the average duration appears to have shortened, with long-term agreements now more commonly for durations around five years.*"

was facilitated was very different to today (i.e. gas commodity prices were considerably lower and gas was seen as a reasonably cheap and available energy source). Today, with LNG exports, the gas market is tight in terms of supply and demand, and prices are much higher.

The Tasmanian Government could take a policy decision to continue to support a level of implied subsidy for non-TVPS customers through directing Hydro Tasmania to take longer term gas contractual arrangements than it would commercially enter itself. However, even this decision comes at some considerable risk as commodity price outcomes may ultimately lead to gas customers switching away from gas, despite Government support.

Furthermore, locking in similar arrangements to the current agreements could simply result in the same set of challenges having to be revisited the next time agreements are due for renewal. Growth in non-TVPS load and/or a reduction in the implied subsidy to other users would be the main measures to mitigate future risk, though the prospects for growing non-TVPS load materially is low in the current market environment (with a much higher risk of load loss).

If a long-term deal of 10 years or more is agreed to on terms similar to those currently in place, then there is no recognition of the changing nature of gas markets. The capacity of Hydro Tasmania as the owner of the TVPS to respond to these evolving conditions would essentially be removed at a potentially high cost. As such, any eventual agreement to support the TVPS with a long-term gas transportation agreement should signal to market participants a declining level of risk consolidation and market support over time, due to the potential for gas to become uncompetitive and costly. This may be done through transparent reporting on the costs and liabilities for gas transportation agreements. The proposal to reflect the insurance value of the TVPS is a concept that was observed by the Expert Panel.[59] Long term agreements could consider options to provide flexibility and share the burden of risk between customers and infrastructure owners, such as 'take-or-pay' arrangements, use of storage or release clauses based on further market developments.

If the Tasmanian Government decides not to take a policy decision to subsidise non-TVPS customers, then the likely outcome is some increase in transportation costs for these customers. However, these increases should be mitigated by the customers' capacity to pay. TGP would not be able to pass on all of the revenue it loses from the TVPS arrangements if non-TVPS customers are unable to pay. TGP would either have to lower its revenue expectations of these customers or lose them altogether as they switch fuels or take other actions. Some of these actions could result in economic impacts for the State, particularly if some businesses change or downsize their operations. This is a policy issue for the Tasmanian Government to consider and, in this context, the sensitivity of particular gas customers to gas prices is a relevant consideration.

Contractual arrangements could ultimately balance a number of the risks discussed above. For example, a firm capacity contract for a short period and/or with flexibility to apportion risks between parties would provide all parties with at least some level of certainty.

For some time now commercial negotiations have been underway between Hydro Tasmania and TGP's owner over a long term gas transportation agreement to support the TVPS. This is reflected publicly across submissions and representations from both parties to the PAC Inquiry. Differing proposals and valuations have been provided on the cost of maintaining long-term arrangements for the TVPS. It is clear that these proposals are not 'like-for-like' and can only be resolved during firm commercial negotiations.

The Taskforce has engaged with relevant parties and identified the key issues pertaining to the Tasmanian gas market. While recognising the concerns expressed by gas customers, the Taskforce considers a commercial outcome between Hydro Tasmania and Palisade should be allowed every opportunity to be

59 Electricity Supply Industry Expert Panel, 2012, *An Independent Review of the Tasmanian Electricity Supply Industry – Final Report Volume 2.*

realised, and it does not seek to influence commercial negotiations that are currently in place. The Taskforce has concluded that an agreement between these parties should be reached before the Taskforce's Final Report is completed in June 2017, and usual commercial timeframes suggest this should be possible. It will be important to Tasmania's other gas users that the intended key features for the agreement (such as length of term) be communicated to the market before the end of March 2017 to enable them to make their own commercial decisions.

RECOMMENDATIONS

26. Commercial negotiations currently underway to resolve the gas commodity and transportation arrangements to support the TVPS should be allowed every opportunity to be realised, with an agreement to be in place before the Taskforce's Final Report is completed.
27. Agreed key features to be included in a new contract between Hydro Tasmania and the TGP's owner should be communicated to the Tasmanian gas market by the end of first quarter of 2017.

11.9 Physical gas market energy security

The previous sections dealt with gas energy security from a fuel supply and economic security perspective. Gas energy security also includes the physical security of the gas, including:

- the risk of physical interruptions to supply at gas processing facilities; and
- the risk of physical interruptions to supply on transmission or distribution assets .

In the past 20 years there have been two major events at production and processing facilities in Australia, one in June 2008 at the Western Australian Varanus Island facility and, most relevantly to the TGP, the September 1998 explosion and fire at the Esso operated gas processing plant at Longford in Victoria. Significant responses to both the above incidents were provided by the respective governments, with Victorian safety requirements now significantly enhanced and overseen by Energy Safe Victoria.

Transmission pipelines in Australia can have a technical design life of approximately 80 years. The TGP was commissioned in 2002 and is one of the newest pipelines in Australia. Age is a contributing factor to losses of containment on pipelines and therefore the age of the TGP reduces the risk of loss of containment on that pipeline. The TGP is also subject to extensive safety, environmental and operating plans required by State and national regulators.

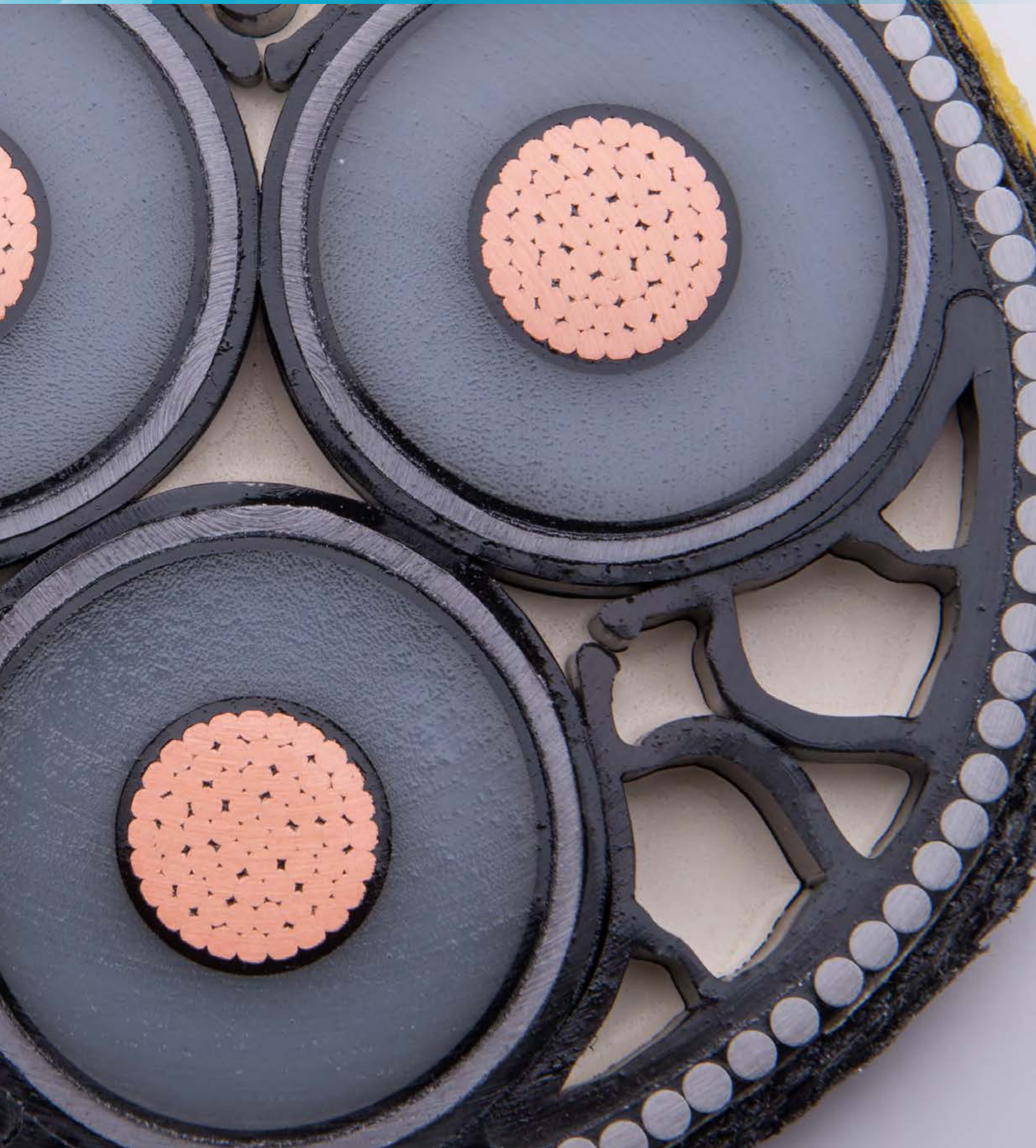
Gas safety issues do occur and these are regularly monitored, with the market receiving regular advice through either local safety regulators or the national market operator. To date these have been resolved without disruptions to supply, an example being the recent shut down of the Esso Longford gas production facility.[60] Section 6.5 describes in more detail the State and national emergency management frameworks that oversee gas energy security arrangements.

Based on the above and evidence provided to the Taskforce, it is concluded that there is a high level of physical energy security associated with the Tasmanian gas market. However, dependency on one pipeline and no on-island gas resources or storage is in itself a risk that must be factored into any future energy security assessment

[60] AEMO, 2016, *DWGM Event – Intervention – 1 October 2016.*

Part D

Interconnection with the National Electricity Market



12. Basslink

KEY FINDINGS

- Basslink represents the single largest alternative energy source for Tasmania after hydro-electric inflows and storages, meaning that it is also an important mitigation asset for hydrological risk. It can import up to 40 per cent of Tasmania's consumption needs and meet around a quarter of Tasmania's peak demand.
- In the absence of specific information or independent assessments since the outage, the Taskforce is currently not in a position to assess the reliability of Basslink into the future.
- However, based on how interconnectors (particularly subsea interconnectors) have performed historically in other jurisdictions, and having now experienced a six month outage, there is sufficient evidence to consider a six month outage of Basslink to be a scenario that should be planned for.
- In most scenarios, Tasmania can manage its hydrological risk without there being a challenge to energy security through Basslink imports alone. However, Tasmania should not solely rely on Basslink being available to ensure energy security and, hence, other contingencies are required in addition to Basslink.
- The future energy mix in the NEM and how it will be managed to maintain adequate and reliable supply is uncertain, meaning the implications for energy imports to Tasmania in the medium to long term are also presently unclear.

The Expert Panel provided a detailed account of the decision making, expectation and outcomes for Basslink in Volume 2 of its Final Report in March 2012. As this work remains publicly available, the Taskforce has not sought to repeat a similar detailed account of the process and decisions which resulted in the commissioning of Basslink. This chapter does, however, provide summary information relevant to the Taskforce's Terms of Reference, with references to the work done by the Expert Panel where appropriate.

The two chapters in this part of the Interim Report discuss:

- the history, capability and reliability (past and future) of Basslink;
- the status of the case for a second interconnector;
- subsea interconnectors - international context and technology; and
- analysis of the energy security value to Tasmania of Basslink and a second interconnector.

12.1 History of Basslink

The concept of an electricity interconnector between Tasmania and the mainland had been discussed for a number of decades. However, it was not until 1997 that the framework for Basslink's eventual commissioning began. The end of large scale hydro-electric development in Tasmania, the need to secure the next electricity supply option for the State, improving hydrological risk management options and the development of the NEM, led to expressions of interest being sought through a competitive process for a private sector party to develop Basslink.

In 1998 the following objectives for Basslink were set:

- improve the security of electricity supply and reduce the exposure to drought conditions in Tasmania;
- provide Tasmania with access to electricity prices determined competitively in the NEM;
- provide a means by which electricity generated in Tasmania can be sold into the NEM and provide a new source of peak generating capacity in the NEM;

- ensure that, through a competitive selection process, the cost of Basslink to users is minimised; and
- ensure that the returns to the State from the State Owned Electricity Businesses are maximised.[61]

The process from commitment to developing Basslink, through to selecting a private developer and eventual commissioning was lengthy and complex. Two final proposals emerged from the competitive selection process and both involved commercial arrangements between Hydro Tasmania and the proposed developer to fund the project. The option of having a regulated interconnector, funded by customers through transmission charges, was not considered viable by developers.

In February 2000, the Tasmanian Government accepted the Basslink Development Board's recommendation that National Grid International Ltd (NGIL) be selected as the preferred developer.[62] NGIL then established Basslink Pty Ltd to proceed with the project.

The operation of Basslink was established contractually by two main contracts.[63]

- Basslink Operations Agreement (BOA) – the BOA is an agreement between the State and Basslink Pty Ltd. The BOA is designed to ensure that an interconnector is available to the State for a period of 40 years, but does not contain financial incentives or penalties relating to the interconnector's performance.
- Basslink Services Agreement (BSA) – the BSA is an agreement between Hydro Tasmania and Basslink Pty Ltd. The BSA establishes the rights and obligations of Hydro Tasmania and Basslink Pty Ltd with respect to the operation of Basslink, including financial incentives relating to the interconnector's performance in terms of its availability.

The business case for Basslink evolved considerably over time as both the costs of the project increased and the potential benefits became better understood. The Expert Panel commented that the business case was regularly scrutinised not just by Hydro Tasmania's Board, but also by the Tasmanian Government and its independent advisors. These reviews were reported to have shown that Basslink remained a positive commercial proposition for Hydro Tasmania.

Notice to proceed with the project was issued in November 2002. Basslink Pty Ltd's project plan had Basslink commencing operations by late 2005 but, following a number of incidents during construction, commercial operation commenced midnight on 28 April 2006. The total cost to complete the project at operational commencement was $874 million.

12.2 Capability and features

Basslink has now been in operation for a decade and has played a significant role in Tasmania's energy market.

Basslink's import capacity is 478 MW, which means that it can meet up to approximately a quarter of Tasmania's maximum demand and can provide up to 40 per cent of Tasmania's consumption needs. Basslink represents the single largest alternative energy source for Tasmania after hydro-electric inflows and storages, meaning that it is also the single most important mitigation asset for hydrological risk. Given that Tasmania has a long-term average energy deficit, Basslink is the first option used to meet the difference between on-island consumption and generation.

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[61] Electricity Supply Industry Expert Panel, 2012, *An Independent Review of the Tasmanian Electricity Supply Industry – Final Report Volume 2.*

[62] The Basslink Development Board was established by the Government to facilitate the development of Basslink as a commercial opportunity in the NEM.

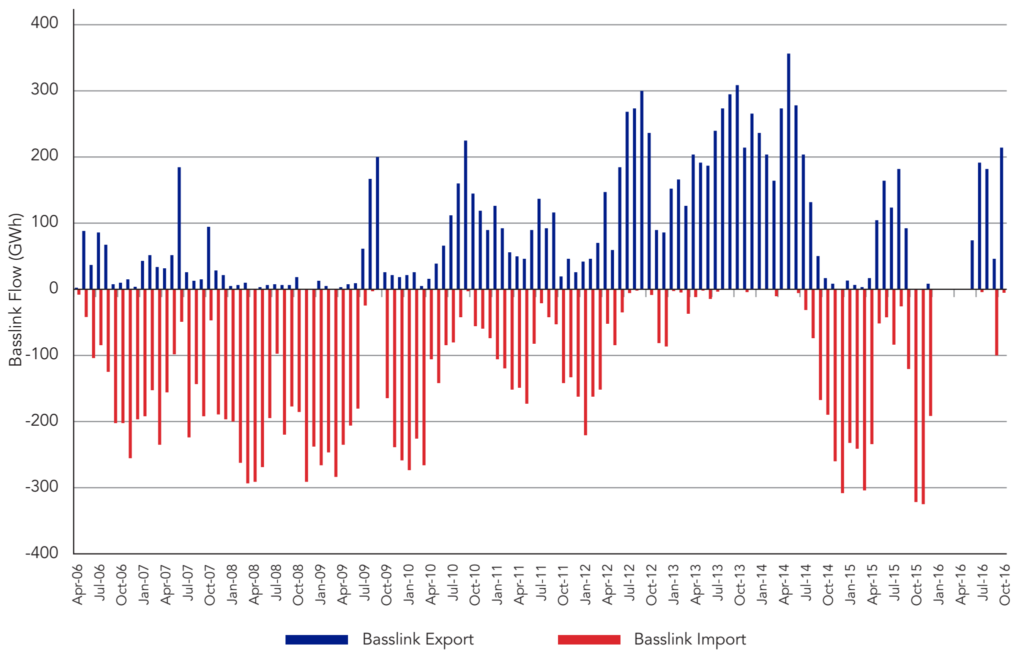
[63] Electricity Supply Industry Expert Panel, 2012, *An Independent Review of the Tasmanian Electricity Supply Industry – Final Report Volume 2.*

If Basslink were to import at full capacity for a month, the amount of energy imported would be equivalent to close to 2.5 per cent of hydro water storages. Put another way, in a dry period, Basslink could offset the need to draw down water storages by just under 2.5 per cent per month if fully utilised.

Basslink's export capacity is 500 MW on a continuous basis (though it can export up to 630 MW for limited periods).

Historical Basslink flows are illustrated in Figure 12.1. The process by which flows (imports and exports) on Basslink are determined is complex and is decided by AEMO based on bids by Hydro Tasmania and other generators, Basslink's technical specifications and any constraints. Simplistically, Basslink is used to import electricity into Tasmania in times of low inflows and/or when Victorian spot prices are lower than in Tasmania, and to export electricity into Victoria when Tasmania has excess supply and/or Victorian spot prices are higher than in Tasmania. Basslink also enhances Hydro Tasmania's capacity to optimise generation across its water storages, as well as gas generation. Indeed this reflects key features of the business case for Basslink, in that it was intended to provide commercial opportunities for Hydro Tasmania through arbitraging price differentials between Tasmania and Victoria, as well as energy security for Tasmania.

Figure 12.1 Monthly Basslink flow from July 2007 to October 2016



Source: Hydro Tasmania data

Basslink is a high voltage direct current (HVDC), Line Communicated Converter (LCC), monopolar interconnector with a metallic return, and its configuration means that it cannot operate below 50 MW in either direction. To reverse flow it requires a step from 50 MW power transfer to zero, a wait for a period of time for the cable to deionise and then step to 50 MW power transfer in the other direction. This 'dead band' is commonly referred to as the 'no-go zone'. Operation in the no-go zone requires Tasmania to source all Frequency Control Ancillary Services (FCAS) locally.[64] While Basslink can transfer FCAS between regions, the no-go zone puts restrictions on the amount of ancillary services that can be transferred between Tasmania and Victoria. It also limits how quickly Hydro Tasmania can access market opportunities.

[64] FCAS are used by AEMO to maintain the frequency on the electrical system, at any point in time, close to fifty cycles per second as required by the NEM frequency standards. Frequency deviations outside of the standards can result in power system security threats.

CABLE TECHNOLOGY

High voltages allow the efficient transmission of large quantities of power over long distances. High voltages can be transmitted via high voltage alternating current (HVAC) or HVDC. Without going into the technical differences and features, HVDC is generally favoured over HVAC for subsea cables (including for Basslink, where HVDC is the only option for the length of cable).

HVDC cables can be configured as either monopolar or bipolar. Bipolar configurations can transmit twice as much power as a monopolar equivalent and can function as a monopolar cable if one of its poles fails. A monopolar configuration can be the first stage of a bipolar configuration (and sometimes is built with a metallic return). Monopolar interconnectors comprise a single conductor line, with the return path being made through the ground or sea using electrodes. Environmental conditions can influence the effectiveness of the return path and in such cases a 'metallic neutral' (low voltage cable) is used, though this results in an increase in energy losses. More recently a new 'symmetrical monopole' configuration has emerged which contains two power cables each carrying 50 per cent of the load and significantly reducing energy losses.

The choice as to whether a HVDC cable is configured as monopolar or bipolar is based predominantly on cost and reliability requirements.[65]

There are two HVDC technologies:

- Line Commutated Converter (LCC) – used on Basslink, LCC technology has historically been used in most subsea interconnectors. LCC technology has the limitation of a single interconnector and constraints on power direction reversal, which limits its ability to provide power balance and FCAS; and
- Voltage Source Converter (VSC) – VSC technology is suitable for larger power transfers and high direct current voltage, and has only been developed in recent years. VCC converters are becoming more prominent, due to better technical performance and greater operational flexibility.

VSC technology has lower fault current requirements than LCC technology (which is important in a market with less synchronous generation), it can inject reactive power to the energy system during faults, does not suffer from commutation failures, provides significant reactive power support and can provide black start capability. VSC technology is also easier to connect to AC systems which is advantageous when connecting to weak energy systems (including those with a high penetration of non-synchronous generation).

For Basslink to transfer power at or near its capacity, dedicated protection schemes have been put in place to ensure the Tasmanian power system is protected from network contingencies or a Basslink outage (which increases the size of the largest generator/load contingency in Tasmania). The System Protection Schemes (SPSs) allow contracted generators or loads to trip to ensure Tasmania's power system remains secure. The SPSs have generally been effective in protecting Tasmanian customers from sudden power losses that could occur from certain contingencies. Some of the major load customers in the State are contracted to participate in the SPSs by providing for their loads to be tripped in certain circumstances. In general, the tripping of these loads are infrequent and for very short periods of time, and load is restored without significant impact to operations (particularly given each load customer has plans to manage their load being tripped in accordance with their contractual arrangement).

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65 Ardelean M and Minnebo P, 2015, *HVDC submarine power cables in the world.*

12.3 Past reliability and outages

The BOA sets out the following performance requirements for Basslink:

- a minimum availability of 97 per cent, and a performance target of 97.5 per cent (excluding 'force majeure' events), assessed on a rolling 12 month basis and taking into account unavailability due to both planned and unplanned outages;
- a cable failure frequency not exceeding once in 10 years;
- a maximum of five unplanned interruptions to transfers across Basslink per annum (excluding interruptions that last for less than 500 milliseconds); and
- a maximum repair time per cable failure of two months (not including failures caused by force majeure events).[66]

Basslink has had planned and unplanned outages during its operational life. As at the end of September 2016, there have been 67 outages recorded. Apart from the six month outage from December 2015 to June 2016, most outages were less than a day, with the longest outage being nine days.[67]

Prior to the outage of December 2015 to June 2016, Basslink had performed well according to independent assessments. The context for this performance can be considered by noting the Expert Panel's report that since it began operating commercially in April 2006, performance had generally been consistent with the requirements set out in the BOA and BSA. The Expert Panel cited the International Council on Large Electrical Systems (CIGRE) annual surveys of over 30 HVDC systems from across the world. The Expert Panel noted (at the time it reported in March 2012) that Basslink had performed above the average of the interconnectors included in the survey and, with the exception of 2008 and to a lesser extent 2010, was amongst the best performing HVDC systems globally.[68]

The CIGRE surveys that are publicly available since the Expert Panel continue to indicate that Basslink has performed well (noting that CIGRE has yet to release a survey covering the period of the six month Basslink outage). Basslink Pty Ltd has advised the Taskforce that the CIGRE data demonstrates that Basslink had been the world's most reliable monopole HVDC interconnector until the submarine fault, and that it was more reliable than many bipolar HVDC interconnectors (which are generally more reliable due to outages only removing half the capacity of a cable). More recently, the TER reported in its 2016 Network Reliability Report that Basslink's technical performance between 2010-11 and 2014-15 was above the minimum availability of 97 per cent and the performance target of 97.5 per cent.

These reports indicate that, until the six month outage in 2015-16, Basslink had performed reliably against its performance requirements and relative to other interconnectors.

Basslink Pty Ltd is required under its licence to maintain compliance, asset management, vegetation management and land access plans. The TER has advised the Taskforce that in April 2014 it decided that there was no need for independent appraisals of Basslink Pty Ltd's vegetation management and land access plans, as these aspects were covered off by other regulatory requirements.

In November 2014, an independent appraisal of Basslink Pty Ltd's compliance and asset management plan was undertaken for the TER. In its report, the independent appraiser considered Basslink Pty Ltd to be an industry leader in aspects of its asset management practices and that the asset management plan demonstrated:

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[66] Electricity Supply Industry Expert Panel, 2012, *An Independent Review of the Tasmanian Electricity Supply Industry – Final Report Volume 2.*
[67] Information supplied by Hydro Tasmania.
[68] Electricity Supply Industry Expert Panel, *2012, An Independent Review of the Tasmanian Electricity Supply Industry – Final Report Volume 2.*

- application of contemporary asset management practices;
- focus on continuous improvement in asset management processes and systems;
- identification and management of the risk of asset failure; and
- adequate identification and management of technical risks associated with the operation of its assets.

This 2014 appraisal also included in its scope consideration of Basslink Pty Ltd's Marine Disaster Recovery Plan, though was not a significant focus of the appraisal and appeared to rely on advice provided by the company.

In developing its independent appraisal schedule for 2016-17, the TER considered whether it would be appropriate to undertake another independent appraisal of Basslink Pty Ltd's compliance and asset management plans. The Taskforce has been advised that the TER decided to defer the appraisal until 2017-18 This was based on the positive result of the recent appraisal in 2014 and the various inquiries relating to the Basslink outage that are currently being conducted, meaning a 2017-18 appraisal could assess any changes to management practices that Basslink may implement.[69]

12.4 Future reliability

Basslink Pty Ltd has advised the Taskforce that it has no reason to consider that Basslink is less reliable than before the six month outage from December 2015 to June 2016. There has been little information provided in the public domain regarding the cause of the outage and any remedial actions.

In the absence of specific information or independent assessments since the outage, the Taskforce is currently not in a position to assess the reliability of Basslink into the future. The Taskforce's engagement with Basslink Pty Ltd to date has been respectful of current sensitivities relating to contractual matters. The Taskforce intends to engage further with Basslink Pty Ltd before it completes its Final Report.

While the TER's decision to defer the next independent appraisal of Basslink Pty Ltd's asset compliance and asset management plans is understandable from the perspective of allowing Basslink Pty Ltd time to implement changes, many stakeholders have told the Taskforce that confidence in Tasmania's energy security is undermined by the lack of information about Basslink's reliability being provided in the public domain (by Basslink Pty Ltd or any other party). Given that Basslink Pty Ltd has not provided the Taskforce with any evidence to support its claim that the cable's reliability is any different to prior to the outage, an updated independent appraisal by the TER of the asset management and compliance plans could provide some assurance to stakeholders. This is unlikely to include resolving the cause of the fault or what the future failure rate may be, but it could at least evaluate asset monitoring, maintenance and recovery plans to ensure risks are still being managed and that recovery plans for outages are appropriate. Closer scrutiny on the Marine Disaster Recovery Plan would, in particular, be appropriate to ensure a robust independent assessment of Basslink Pty Ltd's ability to respond to similar circumstances is satisfactory.

RECOMMENDATION

28. The TER should seek an independent appraisal of Basslink's asset management plans (including its Marine Disaster Recovery Plan) as soon as possible.

[69] Information supplied by OTTER.

Arguably a more important question than whether Basslink is less reliable than previously, is whether another significant Basslink outage period is possible and, if so, whether the State should prudently prepare for a similar event.

In its 2016 Tasmanian Electricity Network Reliability Report, the TER highlighted the example of the outage of the Moyle HVDC electricity interconnector between Northern Ireland and Scotland. The report includes a reference to a report from the Chief Executive Officer (CEO) of the interconnector's owner to a Northern Ireland Assembly Committee. The CEO states that the interconnector achieved 'world class' availability up to September 2010 but then suffered a series of faults and has since operated at half of its 500 MW capacity.[70]

Other examples indicate that subsea interconnectors in Europe (the Skagerrak scheme between Denmark and Norway, and the Baltic Cable between Germany and Sweden), the US (the Cross Sound Cable linking Long Island with Connecticut) and New Zealand (HVDC Inter-Island link between the North and South Islands) have all suffered unplanned outages, ranging from weeks to months and from reduced capacity to no capacity. While interconnectors vary significantly in terms of their technology and operational setting, and conclusions from one interconnector should not necessarily be applied to another, it is the case in general that, while interconnectors on average have a good record in terms of availability, failures can and do occur.

Faults generally tend to occur to land-based equipment failure. Where the cause of an outage is in the subsea cable itself, human causes (damage caused by ship anchors) are amongst the reasons. Subsea outages tend to be more challenging and take longer to repair, due to the difficult nature and logistics required (such as organising a suitable vessel and repair crew, and stable weather conditions).[71] This was clearly the case with the six month Basslink outage in 2015-16.

Based on how interconnectors (particularly subsea interconnectors) have performed historically in other jurisdictions, and having now experienced a six month outage, the Taskforce considers there is sufficient evidence to consider a six month outage of Basslink to be a plausible scenario.[72] While it may be possible to repair a subsea cable fault in less than six months, such a fault provides significant challenges in terms of logistics, fault identification and repair, and weather. On the basis of Tasmania's own recent experience and observed international experience, a prudent approach would be for Tasmania to ensure planning is for at least a six month Basslink outage. Hydro Tasmania has advised the Taskforce that, as part of its internal review following the 2015-16 energy security event, a six month Basslink outage is now included as a plausible scenario in its planning assumptions.

The Taskforce considered whether a longer outage of 12 months could be considered plausible but no evidence or information has been provided to date to the Taskforce in support of this. Hydro Tasmania has advised the Taskforce that it has not committed to planning for an outage beyond six months based on the fact that it considers that the measures that would be put in place for a six month outage would effectively be extended for a longer outage.

Aside from Basslink's future reliability, there is also the question of the reliability of the supply of energy in Victoria (and the broader NEM) to which Tasmania may need to rely upon to import via Basslink. It is reasonable to expect that regulatory and market developments will continue to prioritise adequate and reliable supplies of electricity across the NEM. However, how this will be achieved as the transition to

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70 OTTER, 2016, *Tasmanian Electricity Network Reliability Report*

71 Various sources, including Worzyk T, 2011, *Submarine power cables*; and publicly reported information available on the internet.

72 The Taskforce has distinguished a six month Basslink outage as a 'plausible scenario' for Tasmanian planning purposes, rather than a 'credible contingency event'. The term credible contingency event is used in the electricity market and has a particular meaning under the National Electricity Rules (clause 4.2.3). The Taskforce has avoided using this term given that AEMO is responsible for determining credible contingency events.

intermittent renewable generation sources increases remains unclear and is currently the focus of much attention at a national level. This means that the future energy mix and the implications for energy imports in the medium to long term into Tasmania are also presently unclear.

The above discussion does not diminish the fact that Basslink has provided significant energy security for Tasmania and should be expected to do so into the future. In most scenarios, Tasmania can manage its hydrological risk (including any climate change impacts on rainfall patterns) without there being a challenge to energy security through Basslink imports alone. However, Tasmania should not solely rely on Basslink being available to ensure energy security and, hence, other contingencies are required in addition to Basslink.

RECOMMENDATION

29. Energy security planning should include planning for at least a six month Basslink outage.

12.5 Basslink's value to energy security in Tasmania

The following discussion focuses on Basslink's energy security value to Tasmania, primarily in the context of the supply of significant volumes of energy over time to contribute to meeting Tasmania's consumption needs. Basslink is also important for power system security in Tasmania and can be used to contribute to meeting demand at a point in time in Tasmania, and to provide some ancillary services. However, as hydrological risk is one of the main risks to Tasmanian energy security (for which Basslink was partly designed to mitigate), its energy security value in Tasmania is generally focussed on the energy it can inject into Tasmania during dry inflow periods.

As stated previously, Basslink imports can meet around a quarter of Tasmania's peak demand and around 40 per cent of its consumption needs. This means that it can offset the need to draw down water storages by around 2.5 per cent per month if importing at full capacity. To put this into context, consumption in the warmer (and drier months) of the year in Tasmania is usually around 800 GWh per month. Hypothetically, if there were no inflows or other generation supply source (such as wind, gas or Basslink), then the draw down on Hydro Tasmania's water storages would be approximately 5.5 per cent per month in summer to meet Tasmanian consumption. Table 12.1 presents the hypothetical contributions to offsetting storages that various energy sources (other than inflows) can make.

Table 12.1 Hypothetical maximum monthly energy contributions to Tasmanian consumption by energy source

Energy Source[1]	Approximate monthly contribution (GWh)	Approximate water storage offset
Basslink	350	2.5%
CCGT	145	1%
Wind	75[2]	0.5%

Source: Taskforce analysis
Note 1) Solar generation, other embedded generation or energy sources are not shown due to their contribution being relatively immaterial at this time. While there is approximately 100 MW of solar generation installed in Tasmania, the annual output is estimated to be less than 10 GWh per month on average, which is equivalent to less than 0.1 per cent of water storages. 2) Wind generation is variable and, therefore, could be considerably more or less than 75 GWh in any given month. 75 GWh is the monthly average based on an assumed 900 GWh per annum of wind generation.

In practice, Basslink is unlikely to import at full capacity for a prolonged period, given normal operating conditions would include some planned or unplanned outages. There may also be times where export is 'unavoidable', due to a short but high rainfall event and the need to avoid or minimise spilling in smaller storages. Commercial drivers are also a consideration for Hydro Tasmania whereby, even during dry periods, high spot prices in Victoria may justify commercial decisions to export small amounts of energy. The balance between commercial decisions and energy security considerations is obviously an area of particular focus for many stakeholders and the Tasmanian Government, and is discussed in other sections of the Interim Report.

The quantity of energy that could be imported to mitigate against the risk of low water storages is therefore a complex question. The annual volume of energy imported via Basslink during the low inflow years of 2007-08 and 2008-09 was 2 508 GWh and 2 634 GWh respectively. These historical import levels are reasonable proxies for the maximum annual Basslink import potential, given they were recorded in the type of circumstances where Basslink would be used primarily for energy security purposes.

Basslink's energy security value to Tasmania can also be considered from a financial and economic perspective. The case for Basslink was partly, but importantly, based on the energy security value it would provide to Tasmania's energy constrained system. The Expert Panel analysed the value Basslink provided in the period 2006-07 to 2010-11. Hydro Tasmania advised the Expert Panel that between the years 2006-07 and 2009-10, there would have been a shortfall in the capacity of hydro-electric generation to meet Tasmanian demand of just over 7 000 GWh. In the absence of Basslink, the shortfall would needed to have been met by other means.

Hydro Tasmania provided the Expert Panel with a hypothetical view on how that shortfall could have been met, which principally involved investing in gas-fired generation and, in times of extremely low inflows, negotiated load reductions by major industrial customers. Hydro Tasmania estimated that the avoided cost of having Basslink available was $314 million (in nominal terms) over the period 2006-07 to 2010-11. This was based on the hypothetical cost of additional gas generation ($513 million) and major industrial customer buybacks ($125 million), offset by the actual cost of net inflows to Tasmania via Basslink ($324 million).[73]

The Expert Panel undertook its own alternative hypothetical scenarios. Instead of load reductions, the Expert Panel modelled one scenario that assumed greater gas generation than Hydro Tasmania's scenario, and another scenario that modelled additional wind generation (instead of gas and/or load reductions). The Expert Panel calculated that Basslink provided avoided costs of $205 million and $351 million respectively, compared with Basslink unavailability.

These hypothetical examples only deal with the financial implications for Hydro Tasmania during the 2006-07 to 2010-11 period. Following the six month Basslink outage and low storage experience in 2015-16, major industrial customers and other stakeholders have commented on the broader financial and economic impacts to their businesses and the economy as a whole, principally as a result of reduced output and loss of trade from load reductions as well as decreased business and investor confidence in Tasmania. These stakeholders have advised the Taskforce that, while demand was met, confidence in Tasmania's energy security was challenged and this created flow on impacts.

The Taskforce considered undertaking a similar hypothetical exercise as used in the Expert Panel's report, but applied to the actual events of 2015-16. Rather than avoided costs, such a hypothetical exercise could estimate the cost of the response to the low inflow period in 2015-16 had Basslink not suffered an outage and remained available. Conceptually, the key assumptions to calculate the estimates would involve:

- assuming which actual responses would not have been put in place had Basslink remained available (which would represent a cost saving); and

73 Electricity Supply Industry Expert Panel, 2012, *An Independent Review of the Tasmanian Electricity Supply Industry – Final Report Volume 2.*

- calculating the cost of using Basslink (facility fees that would have been paid) and the net cost of energy transfers (which would be based on an assumed significant volume of net import).

It would be reasonable to assume that no diesel generation capacity would have been put in place and that gas generation may have been lower than actually used. It would also be likely that no major industrial customer load reductions would have been negotiated.

While the Taskforce is able to identify how the hypothetical exercise could be constructed, it does not have access to sufficient information to undertake it. In particular, the cost of major industrial load reductions is commercially sensitive and the Taskforce would require Hydro Tasmania to provide estimates of the cost of using Basslink and the net cost of energy transfers. Furthermore, given current contractual issues being discussed between Hydro Tasmania and Basslink Pty Ltd relating to financial obligations arising from the Basslink outage, the Taskforce considers that providing an estimate of a hypothetical scenario in the public domain at this time would not be appropriate.

13. Second Bass Strait Electricity Interconnector

KEY FINDINGS

- The case for a second electricity interconnector appears to be more strongly linked to the potential benefits it may provide to the NEM in terms of maximising the role of hydro-electric generation in supporting greater renewable energy development both in Tasmania and on the mainland. Whether these benefits can be realised relative to the costs and technical issues that require resolving is a matter currently the focus of a joint Australian and Tasmanian Government feasibility study.
- Interconnection with the NEM is perhaps the most significant strategic issue facing Tasmania over the medium to long term. Greater interconnection could create more revenue opportunities for Tasmania from a higher priced NEM but could increase prices and load risk in Tasmania.

13.1 The case for a second electricity interconnector

The focus of a second interconnector is on an electricity interconnector. However, it is important to note that Tasmania already has two energy interconnectors with mainland energy markets, in the form of Basslink (electricity) and the TGP (which is used to supply gas for on island electricity generation and as a direct energy source by small and large customers). A number of stakeholders highlighted to the Taskforce the need to optimise the assets Tasmania already has before considering new investments, and this included acknowledging the TGP as the existing second interconnector. The Taskforce has considered the TGP in its analysis of the Tasmanian gas market in Chapter 11.

The concept of a second electricity interconnector has been discussed since the commissioning of Basslink. In 2011, the Tasmanian Renewable Energy Industry Development Board (TREIDB) investigated the potential for a new HVDC interconnection across Bass Strait (termed 'RELink') to support further on-island renewable energy development by allowing substantially more energy to be exported from Tasmania than is possible through the existing Basslink interconnector. The TREIDB commissioned Marchment Hill to deliver a Preliminary Proof of Concept Study and its associated economic modelling of the NEM, focused on the questions of:

- how much renewable energy Tasmania might feasibly develop, with or without RELink;
- whether RELink is economically justified at present; and
- which plausible future scenarios would create this justification.

The modelling indicated that further renewable energy development (630 MW by 2015) could occur in Tasmania without a second interconnector and that, in the absence of other conditions (primarily changes in demand and carbon pricing), Marchment Hill did not recommend that the TREIDB proceed with more detailed modelling at that time. However, it did recommend monitoring the environment for when conditions became more favourable, and then to initiate further work.[74]

State Growth began to investigate the case for a second Bass Strait electricity interconnector from 2014 following State Government Budget funding allocated for this purpose. State Growth contracted the majority of the technical work to Hydro Tasmania, with involvement from TasNetworks in the project. The focus of this work was predominantly identifying the preconditions (since the TREIDB work) necessary for a second interconnector to be viable both commercially and technically.

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74 Marchment Hill, 2011, *RELink Proof of Concept.*

While this work was nearing completion, the Australian and Tasmanian Governments announced in April 2016 a Joint Feasibility Study of whether a second electricity interconnector would help to address long-term energy security issues and facilitate investment in renewable energy. The Joint Feasibility Study is currently in the process of undertaking significant analytical work involving power system, market and financial modelling and analysis, drawing on work already completed by State Growth as a key input. The Taskforce will consider the Feasibility Study's findings in the Final Report.

AUSTRALIAN AND TASMANIAN GOVERNMENT'S JOINT FEASIBILITY STUDY

In April 2016, the Australian and Tasmanian Governments announced a Joint Feasibility Study of whether a second electricity interconnector would help to address long-term energy security issues and facilitate investment in renewable energy.

The Hon Warwick Smith AM was initially appointed to head the review and he delivered a preliminary report in June 2016. The preliminary report provided an initial conclusion that, if viable, a second interconnector would support long-term energy security in Tasmania, assist in the integration of Tasmanian renewable energy into the NEM, support the operation of the NEM and could open the pathway for more than 1 000 MW of new renewable energy development in Tasmania.

The preliminary recommendations were:

- the Australian and Tasmanian Governments should commit to supporting a second interconnector, subject to the final report demonstrating there is a likely long-term benefit to consumers from its development; and
- the Clean Energy Finance Corporation (CEFC) should be actively involved in the process from the start, bringing its expertise, analytical and financial capacity to the decision making process.[75]

Shortly after the release of the preliminary report, Mr Smith stood down from the role and Dr John Tamblyn became the head reviewer in September 2016. Dr Tamblyn is supported by a dedicated team from within the Australian Department of Environment and Energy and the AEMC, and is being assisted by AEMO, the CEFC and Tasmanian's State Growth. Dr Tamblyn is due to deliver the final report by the end of January 2017.

Attention on the role of interconnectors (including the possibility of a second Bass Strait interconnector) has increased significantly due to growing awareness of the need to manage the transition from reliable but carbon emissions intensive generation, to low carbon emitting but intermittent generation. The COAG Energy Council is also considering the role of interconnectors and whether the process for assessing and making decisions on interconnector investment could be improved.

Interconnection with the NEM is perhaps the most significant strategic energy issue facing the State over the medium to long term. With the recent announcement of the retirement of the Hazelwood Power Station in Victoria, and increasing intermittent renewable energy generation creating power system security challenges in the NEM (most notably in South Australia at this time), Tasmania is strongly placed to offer competitive and secure energy supplies. This is because its hydro-electric system (and storage potential) provide much greater availability than other forms of renewable energy. How Tasmania takes advantage of this will be critical.

75 The Hon Warwick Smith AM, 2016, *Feasibility of a Second Interconnector- Preliminary Report.*

One option is to use this advantage to offer competitive and secure energy to energy intensive businesses looking to be in Australia but where the uncertainties on the mainland make Tasmania an attractive option. The other option is to maximise export energy (and ancillary services) and increase income to the State (via higher returns to Hydro Tasmania). The second approach would be more consistent with an objective supporting a second electricity interconnector, and would also challenge the need for Tasmania to remain a separate NEM region. If Tasmania became part of a region with Victoria, there could be competition benefits (and current interregional risk would end) but there is also a risk that Tasmanian customers could face higher prices if a Victorian dominated single region becomes a 'high cost' region with the retirement of low cost, base-load generation. This risk could be mitigated, however, if the Tasmanian Government uses much of the revenue proceeds in ways that return the benefits to Tasmanian consumers and to ensure Tasmania remains a competitive and secure location for energy intensive business.

The Joint Feasibility Study is understood to be considering whether a second electricity interconnector is a cost effective solution and whether the implications (particularly from a technical perspective) on the Tasmanian power system can be managed, as well as determining equitable cost sharing. The Taskforce acknowledges this is a challenging task given the uncertainty of what the energy market will look like in the long term.

SUBSEA INTERCONNECTORS – INTERNATIONAL CONTEXT

Since Basslink was commissioned, advances in technology mean that new subsea interconnectors can provide additional functionality to that which Basslink currently provides in the NEM. Interconnectors (both land and subsea) are also becoming an increasingly prominent feature of global energy systems, particularly in Europe as part of the solution to maintaining energy security and integrating intermittent renewable energy. Europe has the greatest number of cables, the longest and deepest cables, and one of the most powerful cables.

According to Ardelean and Minnebo (2015) there are 36 major subsea HVDC cables in the world, and another 14 planned or currently being constructed.[76] The majority of existing cables are less than 300 kms in length, but the newer cables are increasing materially in length and power capacity. For example, the NorNed cable between Norway and the Netherlands is 580 km long, and four other cables are planned (two between Norway and Germany and a further two between Norway and the UK) ranging from between 500 km and 730 km in length. Japan has the highest capacity cable in the world with its 1 400 MW Kii Channel HVDC interconnector between Honshu and Shikoku (the planned cables from Norway to Germany and the UK are also expected to be around this capacity). The Cross-Channel cable between the UK and France is 2 000 MW, but consists of two 1 000 MW bipoles and, therefore, each bipole has lower capacity than the Kii Channel cable.[77]

Comparing Australia to the European context, the transition of the NEM to low carbon sources is likely to see increased penetration of distributed renewable generation which will reduce system inertia, fault level and the availability of FCAS services typically provided by synchronous generators. Europe has turned to interconnection to help deal with these issues. Whether such an approach is the most efficient outcome for Australian consumers is currently a matter being closely scrutinised by a number of government initiated reviews.

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76 Ardelean M and Minnebo P (2015), *HVDC Submarine Power Cables in the World.*
77 Ibid.

13.2 Energy security value of a second interconnector

A second interconnector would provide energy security benefits both in Tasmania and to the rest of the NEM, and consideration of these benefits is a part of the focus of the Joint Feasibility Study. Therefore, the Taskforce has not attempted to assess the energy security value of a second interconnector for Tasmania ahead of the Joint Feasibility Study's final report.

In simplistic terms, if there were a second interconnector with the same import capacity as Basslink, Tasmania would have access to close to 1 000 MW of imported electricity. This would be a significant amount of energy, representing over 50 per cent of peak demand and possibly able to meet nearly 90 per cent of Tasmania's consumption needs in a summer month if both interconnectors were importing at full capacity simultaneously. Such a scenario is likely to be hypothetical only, however, given that with two interconnectors, it is unlikely they would import at full capacity simultaneously. There are also many technical considerations about how the capacity of both interconnectors could work in the presence of each other, what limits this would place on overall power transfers, and what network issues a second interconnector would create in Tasmania that would need resolution (and at what cost).

Discussion of a second interconnector has been based around an assumption of a build cost in the order of $1 billion, although the actual cost could be more (particularly when the cost of supporting infrastructure, such as transmission enhancements and connections in Tasmania and Victoria are fully known). Given the additional energy a potential second interconnector could potentially import, a second interconnector could be considered as the ultimate solution to ensuring Tasmania's energy security. However, the benefits of a second interconnector should be evaluated on the incremental marginal benefits that it can provide in addition to Basslink.

While the cost will be analysed more robustly by the Joint Feasibility Study, even if 10 per cent of the indicative $1 billion value is assumed to be the marginal value to improve Tasmanian energy security, this represents $100 million.[78] In such a scenario, there would need to be more than $900 million in other benefits to justify the second interconnector. Therefore, from a pure energy security perspective, there are likely to be other investments Tasmania can make to achieve enhanced energy security that are significantly less expensive.

[78] The energy security value to Tasmania of a second interconnector would be expected to be lower proportionately than the energy security value of one interconnector (Basslink) alone, because the value would be equal to the marginal value above that provided by Basslink.

Part E

Renewable Energy, Emerging Technologies and Consumer Participation

14. Renewable Energy in Tasmania

KEY FINDINGS

- During the 2015-16 energy security event, wind made an important contribution to meeting Tasmanian electricity demand. Without this contribution, additional draw down of hydro storages and/or additional load reductions would have been required to meet demand until sufficient temporary diesel generation was commissioned.
- Tasmania's current on island energy deficit can be addressed by building additional renewable energy projects, which will also serve to diversify the State's generation mix and reduce its dependence on energy imports.
- Tasmania has a world class wind resource, but the cost competitiveness of wind could be challenged over time as the cost of other technologies decline. Large scale solar development should not be dismissed, despite Tasmania's resource being relatively more limited than mainland Australia.
- The potential role of other renewable energy sources such as wave, tidal, biomass and geothermal will depend on their competitiveness relative to other technologies and investor interest.

As detailed in Part A, there is a current on-island energy deficit based on long-term averages to meet Tasmanian demand, which is currently addressed through Basslink imports and thermal generation. Based on average inflows of 9 000 GWh per annum and annual wind generation of approximately 900 GWh (based on 2014-15), this deficit is approximately 700 to 1 000 GWh per annum. One of the options for reducing this risk is to introduce additional and diversified on-island generation.

This chapter considers the potential for future renewable energy development in Tasmania to provide this additional and diversified generation by:

- summarising the current profile of renewable energy in Tasmania and the existing role of non-hydro renewables in providing energy security;
- exploring the impact of Australian and State government policies, including the introduction of a carbon price signal; and
- evaluating national/international renewable energy and emerging technology trends/costs and exploring potential for Tasmanian uptake.

As described in Part D, the Australian and Tasmanian Government Joint Feasibility Study is currently assessing the potential role of a second Bass Strait interconnector to facilitate the development of Tasmania's large scale renewable energy resources. The Taskforce proposes to await the outcomes of that study before assessing as part of its Final Report more precisely the quantum of large-scale renewable energy that could be developed in Tasmania, particularly any additional generation above that which would eliminate Tasmania's on-island energy deficit.

14.1 Current policy environment

In December 2015, a global climate agreement was reached under the United Nations Framework Convention on Climate Change (UNFCCC) at the 21st Conference of the Parties (COP21) in Paris. The Paris Agreement, which was adopted by all 196 Parties to the UNFCCC, establishes a framework requiring all Parties (including Australia) to take coordinated climate action from 2020 to limit global warming to well below 2°C, and pursue efforts to limit the temperature increase to 1.5°C.

As part of its Paris Agreement commitment, the Australian Government has committed to reducing national greenhouse gas emissions by five per cent below 2000 levels by 2020, and by 26 to 28 per cent below 2005 levels by 2030.[79] Key national measures currently underpinning this commitment are the Emissions Reduction Fund, the Safeguard Mechanism and the Renewable Energy Target (RET). In order to reach its emissions target, the Australian Government has committed to reviewing its domestic policies in detail in 2017-18. It is expected that the energy sector will need to make a large contribution in order to help reach this target.

RENEWABLE ENERGY TARGET (RET)

The RET has to date been the key driver of renewable energy development in Australia. Originally introduced as the Mandatory Renewable Energy Target (MRET) in 2001, the scheme is designed to reduce greenhouse gas emissions from the electricity sector, encourage the additional generation of renewable energy above 1997 levels, and ensure that at least 20 per cent of Australia's electricity is supplied by renewable energy sources by 2020.

The RET currently consists of two schemes:

- the Large-scale Renewable Energy Target (LRET), which targets an additional 33 000 GWh of renewable energy generation by 2020 and maintained until 31 December 2030 to encourage investment in large scale renewable energy generators;[80] and
- the Small-scale Renewable Energy Scheme (SRES), which supports investment in small scale renewable energy installations (such as solar panels and solar water heaters) by households, small businesses and community groups. The SRES has no set target.

The RET operates by creating a market for renewable energy certificates (RECs). Large renewable energy generators are eligible to create large-scale generation certificates (LGCs) for every megawatt hour of power they produce, while small-scale systems are eligible to create small-scale technology certificates (STCs). Wholesale purchasers of electricity (mainly retailers) must purchase a quantity of LGCs and STCs each year based on the volume of electricity they acquire. Liable entities have an obligation to ensure they secure the necessary LGCs and STCs to meet their annual obligation. For LGCs, this is often achieved either through the spot market or through long-term power purchase agreements (PPAs) with generators (which provide greater long term certainty for both parties). LGCs are effectively only sold on contract or spot markets.

Since its introduction, the RET has driven investment in large scale renewable energy power stations and increased the uptake of small-scale renewable energy installations. In particular, the revenue that large-scale generators receive from selling LGCs to liable parties supplements the revenue that can be earned by selling electricity into the NEM, thus making these large scale projects viable.

[79] https://www.environment.gov.au/climate-change/publications/factsheet-australias-2030-climate-change-target

[80] The CER estimates that accredited power stations will need to generate approximately 37 000 GWh of renewable electricity in 2020 to satisfy the total demand (legislated and voluntary) for large-scale generation certificates.

The RET is supported by national funding aimed at supporting innovation and early stage deployment of Australian renewable and other low emissions technologies. The Clean Energy Finance Corporation (CEFC) and the Australian Renewable Energy Agency (ARENA) were established in 2012 and work in a complementary manner to provide financial assistance for the research, development, demonstration, deployment and commercialisation of clean energy technologies in Australia. In March 2016, a $1 billion Clean Energy Innovation Fund (to be jointly managed by ARENA and the CEFC) was announced which will allocate up to $100 million each year to commercialise innovative renewable energy projects using equity and debt instruments.[81]

In addition to the RET, there are a number of state and territory based targets and programs designed to promote investment in renewable energy projects in the short term (refer Appendix 6). These targets are primarily aimed at introducing additional renewable energy to reduce the carbon emissions profiles in these jurisdictions. Tasmania does not have its own renewable energy target, although the Tasmanian Government supports the RET as a policy to allow Tasmania to develop its renewable energy capabilities.[82] As Tasmania is already predominantly renewable, it could be argued that the State does not need a specific target to work towards. Tasmania should be in a favourable position to achieve a net zero carbon emissions profile from its energy sector but setting firm targets (and dates to achieve these) can create perverse outcomes such as higher prices and less reliable energy supplies if a transition is not well managed.

The Clean Energy Regulator (CER) estimates that an additional 6 000 MW of installed renewable capacity is required to meet the Large-scale Renewable Energy Target (LRET) through to 2020, and that the majority of that new renewable energy generation must be committed in 2016 and 2017 to ensure generation is occurring by 2020.[83] Over 10 500 MW of large-scale renewable energy projects are under construction or have planning approval which, if built, are more than sufficient to meet the 2020 target.[84]

Whether these projects are built will depend on the ability of the project proponents to secure financing, including power purchase agreements (PPAs). Some states and territories have facilitated this through the introduction of an auctioning process. For example, the Australian Capital Territory (ACT) Government has conducted a series of reverse auctions for wind and large scale solar projects, which has secured the future of a number of projects that may otherwise not have been financially viable in the current investment climate. These auctions have been agnostic to the location of the development (although the projects must demonstrate economic development benefits to renewable energy industries in the ACT) to broaden competition and facilitate least cost developments through competitive bidding between project proponents. Victoria is following suit with its own competitive auction scheme aimed at incentivising significant new renewable energy investment within Victoria. The scheme aims to drive least cost development within Victoria (as opposed to encouraging least cost projects from throughout the NEM), as well as drive industry development and job creation in that State.

Any future changes to government emissions policy will influence the viability of future renewable energy projects. The COAG Energy Council is currently considering how to better integrate energy and emissions policy in order to meet Australia's Paris Agreement commitment and facilitate the transition of the NEM to a lower emissions intensity. This includes understanding the potential impact of carbon policies on the energy sector as well as consideration of the economic and operational impacts of existing state and territory emissions reduction policies and renewable energy targets. Recent events and developments have highlighted the challenge of introducing intermittent generation into the NEM (most notably in South Australia at this time), and incentives to increase renewables need to be balanced with managing power system security.

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81 https://www.environment.gov.au/news/2016/03/23/clean-energy-innovation-fund

82 Department of State Growth, 2015, *Tasmania's Energy Strategy – Restoring Tasmania's Energy Advantage.*

83 Clean Energy Regulator, 2016, *Renewable Energy Target 2015 Administrative Report.*

84 Clean Energy Council, 2016, *Clean Energy Australia Report 2015.*

It is unclear what the implications of this work might be for an expansion of the RET beyond 2020 and/or the introduction of a national carbon price signal. However, for the purposes of modelling, the COAG Energy Council has advised AEMO that a 28 per cent reduction of 2005 electricity sector emissions by 2030 is an appropriate assumption to use in forecasting and planning.[85] With this in mind, AEMO is using the following assumptions to model a 28 per cent reduction in NEM emissions by 2030 in its 2016 National Transmission Network Plan Development Plan (NTNDP; to be released in late 2016):[86]

- implementation of the LRET and SRES schemes as currently legislated; and
- introduction of a proxy emissions abatement cost of \$25/t $CO_{2\text{-}e}$ in 2020, increasing linearly to \$50/t $CO_{2\text{-}e}$ in 2030, and then sustained.[87]

AEMO is also examining a 45 per cent by 2030 emissions reduction scenario which will be published after the 2016 NTNDP is released. Consistent with AEMO's modelling, the Taskforce proposes to use AEMO's two scenarios of 2030 emissions reductions and the assumptions behind these in any modelling that requires a future carbon price to be factored in.

14.2 Commercial viability

APPA is a contract to buy the electricity generated by a power station, and is a critical part of planning a large scale renewable energy project because it secures a long-term stream of revenue for the project through the sale of the electricity generated by the project. The ability to secure project financing is generally reliant on a PPA, which is key to securing the necessary revenue to warrant the substantial capital investment in a large scale renewable energy project. As well as contracting to purchase electricity, a PPA will usually also include provisions for the purchase of LGCs and other environmental credits.

Liable parties under the RET have recognised the role of PPAs in underpinning investment and providing security for meeting their LRET liabilities. Since the RET's introduction, there has been considerable variability in the price of LGCs which has created uncertainty with regard to long-term prices. This variability is attributable to a range of factors, including investor uncertainty arising from periodical reviews of the legislation and, more recently, the fact that the current RET peaks in four years (in 2020) and the scheme ends in 2030. Certainty of price and volume through a long-term contract has benefits for both project proponents (through securing a revenue stream) and liable entities (through securing the volume of RECs necessary to meet their obligation under the scheme) and is important for investor certainty.

However, as is the nature of commercial negotiations, there will always be a tension between the desire of liable parties to minimise their cost and commercial exposure and the project proponent's need to secure an appropriate return on their investment. Some retailers have sought to overcome these tensions by becoming directly involved in the development of new projects, while in other instances state and territory governments have intervened through conducting auctioning processes to ensure renewable energy projects are able to proceed.

The electricity produced from renewable energy technologies such as wind and solar is intermittent, and without a long-term PPA for this component proponents will necessarily need to take the NEM pool price, which in Tasmania is effectively set by Hydro Tasmania. Furthermore, the firming capacity of hydro-electric generation for intermittent renewable energy technologies such as wind makes Hydro Tasmania a key player in any PPA. New entrant renewable energy development should not face barriers to entry in

85 AEMO, 2016, *National Electricity Forecasting Report.*
86 Ibid.
87 This carbon price cost is assumed by AEMO as a way of introducing an approximate valuation of the cost of achieving the 2030 emissions target.

Tasmania that are a result of Tasmania's market structure. However, the Taskforce considers that a level of market failure is apparent in Tasmania at this time, evidenced by the fact that the proponents of wind farms with a world class wind resource and planning approvals are unable to secure a PPA. It is important that the Tasmanian Government ensures that any barriers to outcomes that would be expected to be seen in a competitive market are removed or addressed.

RECOMMENDATION

30. The Tasmanian Government should ensure that new entrant renewable energy development is able to establish in Tasmania where such an outcome is consistent with that which would be expected to be seen in a competitive market.

14.3 Renewable energy technology costs

14.3.1 Levelised cost of energy (LCOE)

An understanding of the relative costs of renewable energy technologies is useful in the context of assessing the potential for uptake of additional renewable energy in Tasmania compared to other generation sources.

A standard metric used by many studies to measure the overall competitiveness of different electricity generating technologies is the Levelised Cost of Energy (LCOE). The LCOE represents the average cost of producing electricity from a particular technology over its entire life, given assumptions about how the generator will operate. It enables the comparison of different technologies which may have very different cost profiles; for example, wind or solar (high up front cost but low ongoing running costs) versus new gas fired generation (moderate up front cost but ongoing fuel and operational costs). Costs are calculated at the plant level and therefore do not include transmission and distribution costs. This measure is therefore useful for comparing the cost of energy provision by different technologies.

The Taskforce has examined a range of studies which estimate the LCOE of energy technologies both internationally and within Australia. Care must be taken when comparing LCOE analyses due to the different assumptions made across studies and the different sensitivities of technologies to those assumptions. As well, the rapidly declining costs of some technologies mean that studies produced only a year or two ago may already be out of date. With this in mind, the Taskforce has chosen to focus on the most recent publicly available studies which are discussed in further detail below.

14.3.2 Global trends and projections

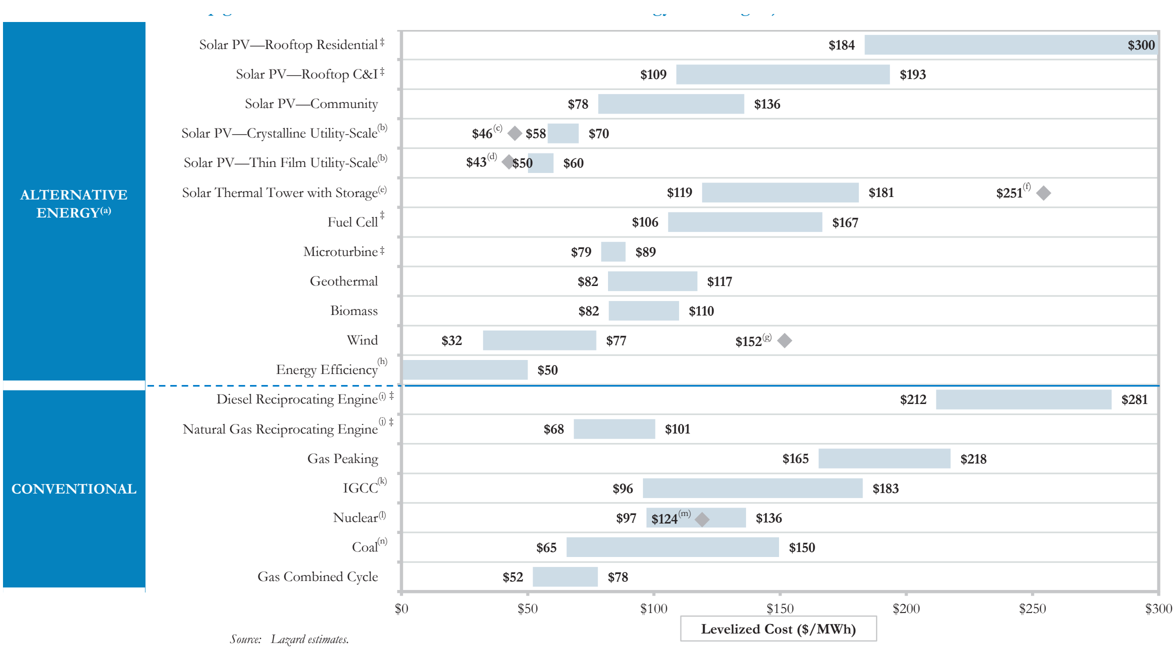
At a global level, wind power and solar are becoming increasingly cost-competitive with conventional energy generation technologies.

One of the most detailed publically available assessments of comparative costs for various technologies at a global level is published by Lazard (an international financial and management consultancy) in its annual LCOE analysis. The most recent analysis, released in November 2015, shows that onshore wind and utility-scale solar are already cost-competitive with conventional generation technologies (including gas) on an unsubsidised basis (refer Figure 14.1).[88] These observations are consistent with other publically available international estimates, such as those prepared by the IEA,[89] the International Renewable Energy Agency

88 Lazard, 2015, *Lazard's levelized cost of energy analysis – version 9.0.*
89 IEA, 2015, *Medium-term renewable energy market report 2015: Executive summary.*

(IRENA)[90] and the Renewable Energy Policy Network for the 21st Century (REN21)[91]. Rooftop solar PV is currently not cost competitive globally without subsidies, primarily due to higher installation costs.

Figure 14.1 Unsubsidised levelised cost of energy (USD$/MWh) comparison



Source: Lazard, 2015, *Lazard's levelized cost of energy analysis – version 9.0*
Note: Analysis excludes integration costs for intermittent technologies, which may range from USD$2 to USD$10 per MWh. Footnotes pertaining to this figure are available at: https://www.lazard.com/media/2390/lazards-levelized-cost-of-energy-analysis-90.pdf, page 3

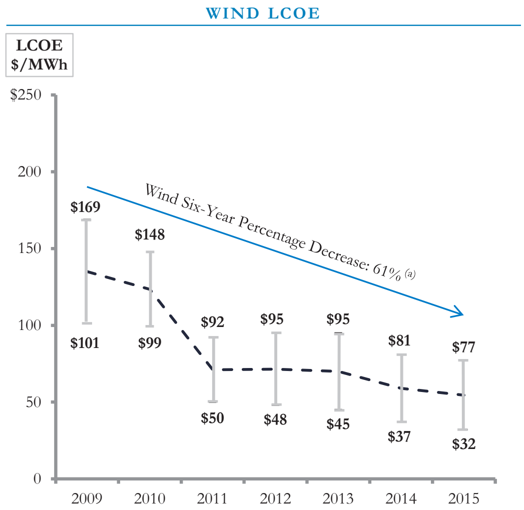
This cost-competitiveness can be attributed to significant declines in the costs of both of these technologies in recent years. According to Lazard, since 2009 the average LCOE of wind has declined by approximately 60 per cent (refer Figure 14.2a) and utility-scale solar by 80 per cent (refer Figure 14.2b). The IEA has estimated a similar rate of decline in solar costs during that period but a more conservative estimate of 35 per cent reduction in the LCOE of wind.[92] As discussed previously, this difference can likely be attributed to different assumptions made between studies; however the overall trend is similar. These reductions are attributed to increased economies of scale, greater competition between suppliers and technological innovation.

In general, the more mature the technology, the less opportunity there is for further cost reductions, However, although wind energy and solar technologies are commercially mature, they are far from mature from a cost perspective. The IEA forecasts that by 2020, new onshore wind costs could decline by a further 15 per cent and utility-scale solar PV by an additional 25 per cent.[93] By 2025, IRENA estimates that the LCOE of wind and utility-scale solar PV could fall by 26 per cent and 59 per cent respectively between 2015 and 2025.[94] With these reductions, new wind and solar will become increasingly competitive over fossil fuel technologies. The LCOE of rooftop solar PV is also expected to decline in the future as installation techniques become more efficient, capital costs decline and supply chains improve.[95] The convergence

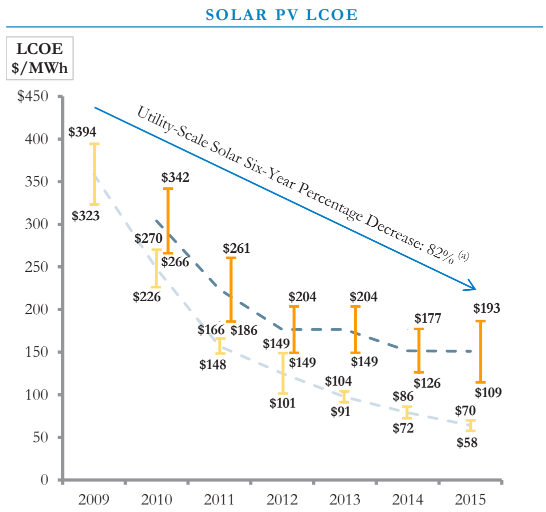
90 IRENA, 2014, *Renewable power generation costs in 2014.*
91 REN21, 2016, *Renewables 2016 Global Status Report.*
92 IEA, 2016, *Next-generation wind and solar power: from cost to value.*
93 IEA, 2016, *Medium-term renewable energy market report 2016: Executive summary.*
94 IRENA, 2016, *The power to change: solar and wind cost reduction potential to 2025.*
95 Lazard, 2015, *Lazard's levelized cost of energy analysis – version 9.0.*

of renewable energy and fossil fuel technology costs is sensitive to the relative capital costs of these energy sources, which tend to decline as a technology progresses through different levels of technical and commercial maturity.

Figure 14.2 Historical unsubsidised levelised cost of energy (USD$/MWh) of (a) wind and (b) utility scale solar PV



(a)



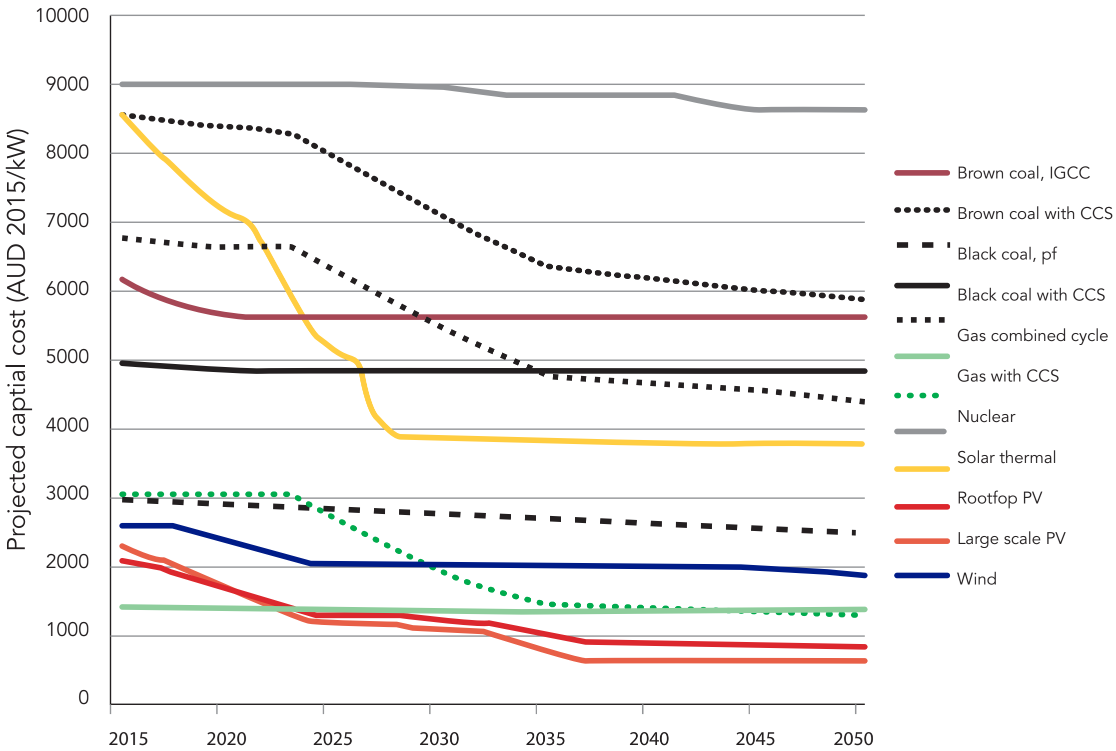
(b)

Source: Lazard, 201, *Lazard's levelized cost of energy analysis – version 9.0*

The rate at which costs decline will also be influenced by the introduction of a global carbon price signal, which is relevant in the context of the Paris Agreement. The CSIRO has modelled the projected capital costs of electricity generation technologies under the scenario of the world reaching 550 ppm $CO_{2\text{-}e}$ in the atmosphere by 2050 (refer Figure 14.3). Under this scenario, the largest reduction in capital costs for large scale solar is projected to occur by 2025 to 2030 and for wind and small scale solar by around 2035, with solar PV capital costs more competitive than wind. Under a 450 ppm scenario, the reduction is similar but accelerated by approximately five years. [96]

[96] 450 ppm $CO_{2\text{-}e}$ is consistent with keeping global warming below 2˚C, as agreed by countries under the Paris Agreement.

Figure 14.3 Projected electricity technology capital costs under a 550 ppm carbon price scenario



Source: https://blog.csiro.au/wind-solar-coal-gas-to-reach-similar-costs-by-2030/

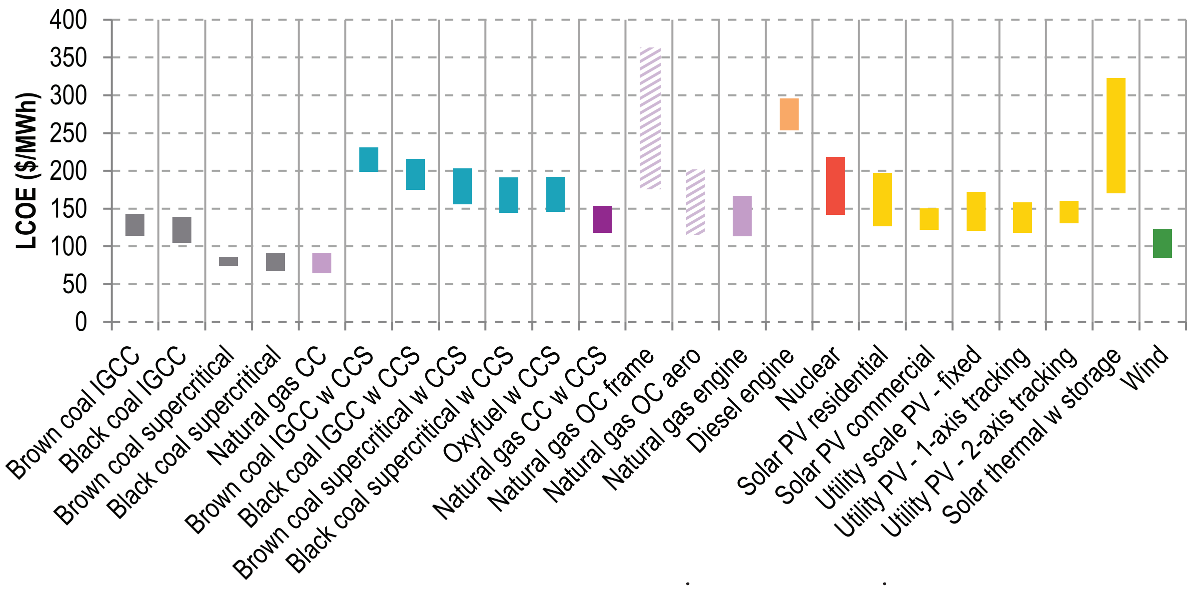
14.3.3 Australian trends and projections

The range of costs for renewable energy technologies remain both market and technology specific, and thus the LCOE of a particular technology can vary markedly between regions. Importantly, the IEA notes that market structure and policy environment, as well as resource availability, all play an important role in determining the final LCOE of any investment.[97] For example, IRENA notes that despite higher installation costs, the LCOE of residential solar PV in Australia is highly competitive due to the country's excellent solar resources.[98] It is therefore important to consider global renewable energy technology trends in the context of the Australian market and environment. The most recent publically available assessment of comparative costs for various energy technologies in Australia was published by the Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC), which summarises the LCOE for a range of technologies if they were built in Australia today under current conditions (refer Figure 14.4).[99] Consistent with global trends, wind generation is currently the lowest cost renewable energy technology.[100]

The CO2CRC projects further cost reductions are projected for both wind and solar in Australia by 2030 (refer Figure 14.5), with wind becoming the lowest cost technology and a convergence in LCOEs of wind and solar technologies being projected. More importantly, this analysis shows that wind and most current forms of solar have the potential to be cost competitive with black coal, brown coal and natural gas.

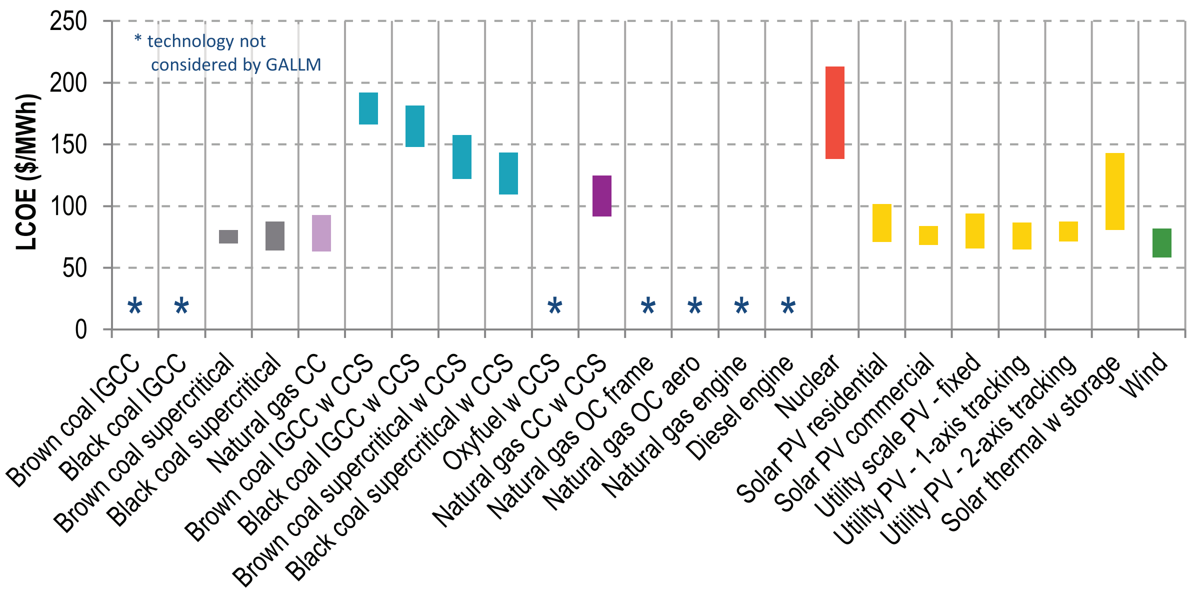
[97] IRENA, 2016, *The power to change: solar and wind cost reduction potential to 2025.*
[98] IRENA, 2014, *Renewable power generation costs in 2014.*
[99] CO2CRC, 2015, *Australian Power Generation Technology Report.*
[100] The cost of new hydro power generation was not assessed as new large scale hydro power generation is unlikely to be deployed in Australia, and the cost of refurbishments and mini-hydro were considered to be too site specific.

Figure 14.4 Levelised cost of electricity in Australia, 2015 (AUD$/MWh)



Source: CO2CRC, 2015, *Australian Power Generation Technology Report*

Figure 14.5 Levelised cost of electricity in Australia, 2030 (AUD$/MWh)



Source: CO2CRC, 2015, *Australian Power Generation Technology Report*
Note: * technology not considered in the analysis

REAL MARKET PRICES

Given the propensity for costs to decline over short periods (which can render even recent analyses obsolete), The Taskforce has also examined real market prices in Australia.

The 2015 and 2016 ACT reverse auctions have seen record low wind energy prices in Australia, with prices below $80/MWh for 20 years achieved. However, these low prices likely reflect the lowest end of the wind scale due to the highly competitive nature of the auction process. ARENA expects the LCOE for utility scale wind power in Australia to remain in the range of $80-100/MWh in the medium term.[101]

ARENA's most recent competitive tender round for large-scale solar has demonstrated that solar LCOEs below $135/MWh are currently achievable in Australia,[102] although a proportion of this cost reduction is credited to the competitive nature of the bidding process.

As noted previously, the policy environment within which a technology is built will play an important role in determining the final LCOE of a technology. In particular, the presence of a carbon price has the potential to significantly reduce the LCOE of renewable energy technologies compared to fossil fuel generation sources. The CSIRO has examined the LCOE in 2020 and 2030 for baseload coal and gas technologies and lowest capital cost solar and wind in Australia, with and without a carbon price (refer Figure 14.6).[103] Without a carbon price, wind is projected to be the lowest cost technology in both 2020 and 2030, with little change in costs during this time due to the maturity of the technology. Solar becomes increasingly competitive with fossil fuel technologies by 2030, with the LCOE decreasing by around $15/MWh during this period. With the addition of a carbon price, solar has an LCOE similar to that of black and brown coal and gas in 2020, and with a higher carbon price in 2030 it becomes lower cost than all fossil fuel technologies

Other renewable energy technologies (such as wave, tidal and geothermal) are expected to take longer to become cost competitive with fossil fuel technologies, even in the presence of a carbon tax. This is discussed further in Section 14.4.

14.4 Large scale renewable energy potential

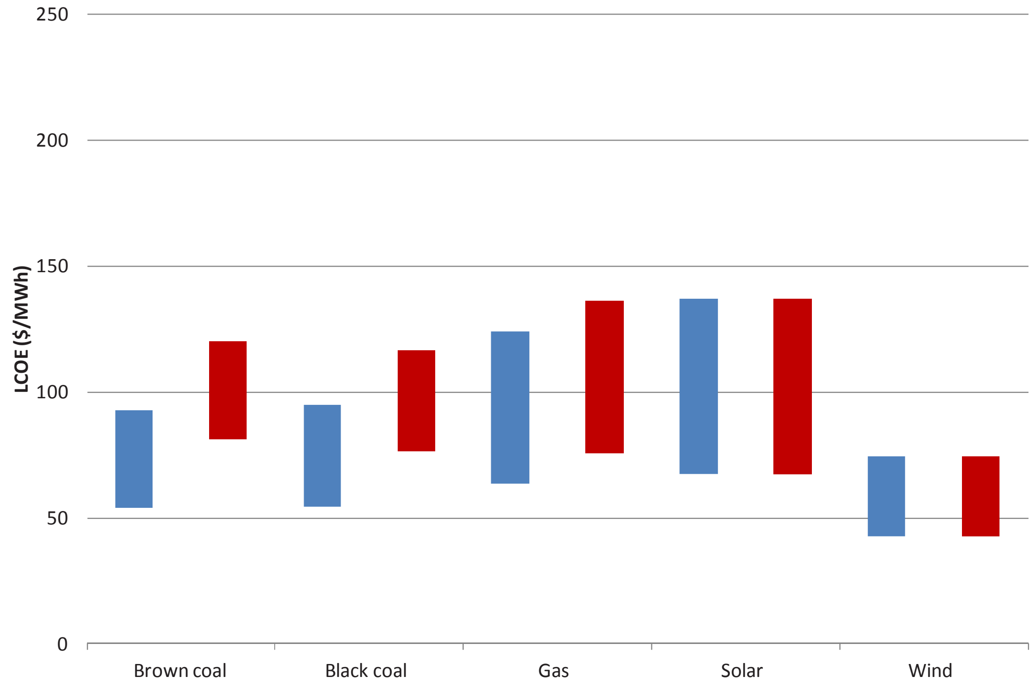
14.4.1 Wind

Due to the prevailing 'Roaring 40s' westerly winds, Tasmania has some of the best wind resources in Australia, with speeds of over 11 m/s in some areas (refer Figure 14.7). Wind energy data indicates that the wind resource is reliable on an annual basis, although daily and seasonal fluctuations are observed.

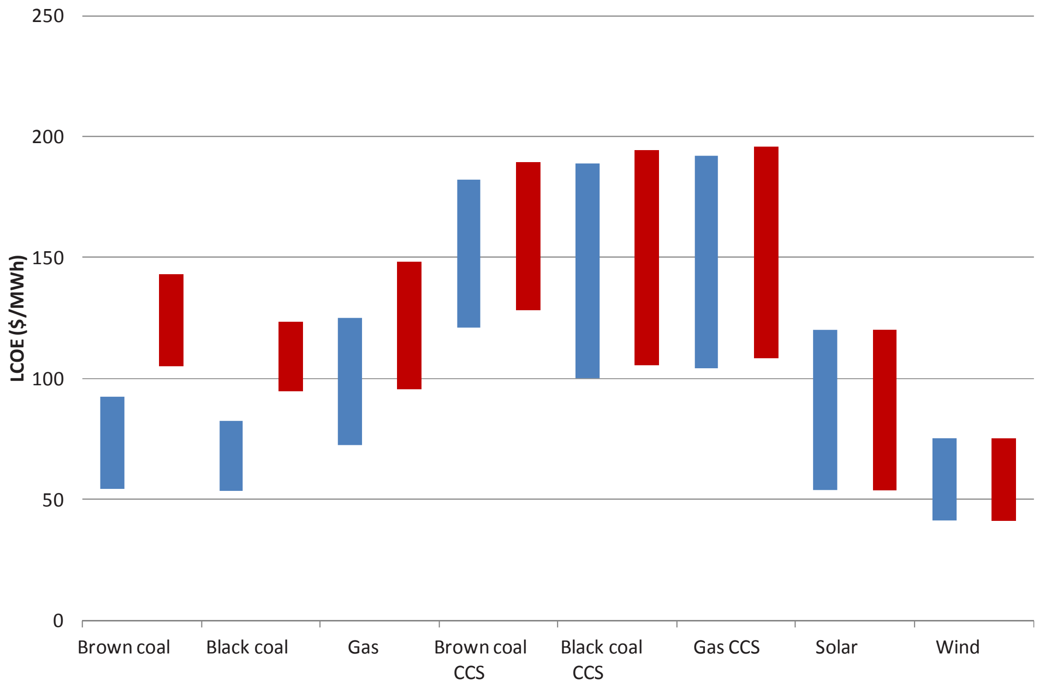
A number of greenfield wind farm sites are currently under consideration by various proponents, ranging from projects at the pre-feasibility stage to others that are 'investor-ready'. The Joint Feasibility Study into a second Bass Strait interconnector has identified that the potential for wind farm sites totalling over 1 000 MW of generation capacity, predominantly in the north-west and north-east of the State.[104] In 2011, the TREIDB identified that it would be technically feasible to develop up to 1 250 MW of installed wind capacity in Tasmania without a second interconnector.[105]

101 http://arena.gov.au/funding/investment-focus-areas/wind-energy/
102 http://arena.gov.au/programs/advancing-renewables-program/large-scale-solar-pv/
103 CSIRO, 2014, *Australian electricity market analysis report to 2020 and 2030.*
104 The Hon Warwick Smith AM, 2016, *Feasibility Study of a second Tasmanian interconnector - Preliminary Report.*
105 TREIDB, 2011, *Advice to the Tasmanian Government on a Tasmanian Renewable Energy Strategy.*

Figure 14.6 Projected LCOEs with (red bars) and without (blue bars) a carbon price in (a) 2020 and (b) 2030



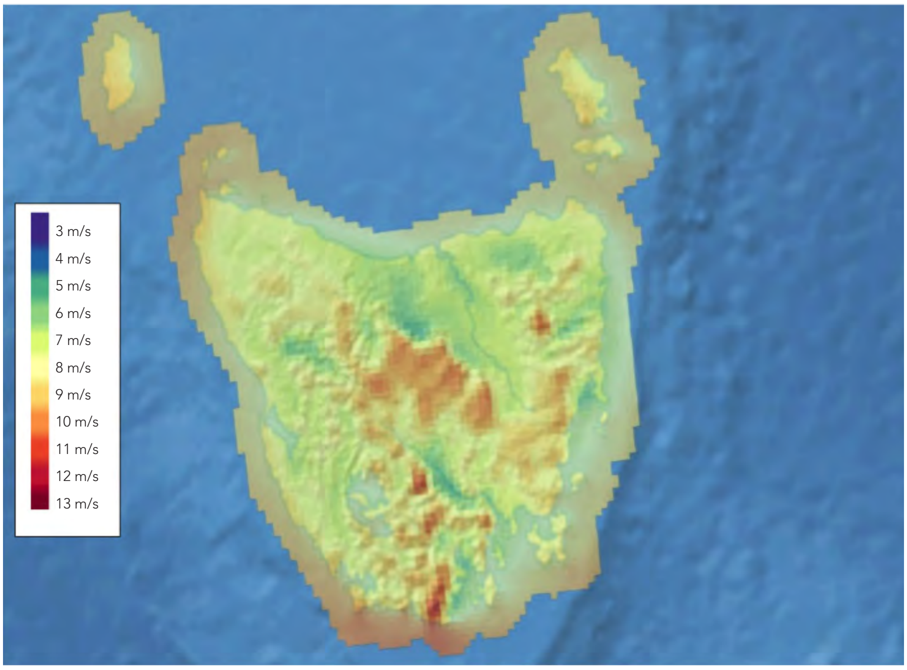
(a)



(b)

Source: CSIRO, (2014), *Australian electricity market analysis report to 2020 and 2030*
Note: Carbon prices values used were \$28.40/tCO_2 in 2020 and \$56.60/tCO_2 in 2030

Figure 14.7 Average wind speed at 100m above ground level



Source: AREMI, http://nationalmap.gov.au/renewables/

There are currently 369 MW of wind farm developments in the State that have attained or are currently seeking planning approval: Granville Harbour Wind Farm (99 MW), Cattle Hill Wind Farm (240 MW) and Low Head Wind Farm (30 MW). However, financing and the ability to secure PPAs will be a key determinant of when and if these projects are ultimately built. As has been observed in the ACT, an auctioning process can be useful for facilitating least-cost development of large scale wind farms where projects may not be able to secure a PPA under the LRET alone.

Wind energy is intermittent and non-dispatchable (i.e. must be used immediately), and is therefore not reliable for providing baseload generation. While Tasmania's hydro-power system provides substantial flexibility to manage the natural variation of wind, the TER's 2016 Network Reliability Review (NRR) notes that further development of large scale wind in Tasmania could present additional challenges due to a reduction in the inertia of the Tasmanian electrical system.[106] As there is currently no explicit incentive for generators to provide these services, AEMO may prevent generators from dispatching electricity at certain times if system inertia is insufficient to maintain frequency within set limits. The risk is compounded in Tasmania as its ability to rely on other NEM regions for system control is limited by the capacity and availability of Basslink. While it is understood that AEMO and the AER are currently reviewing this issue nationally, the TER notes that a requirement for new wind farm developers in Tasmania to invest in equipment to provide synthetic inertia is a potential solution. Depending on the solution ultimately adopted, system inertia issues may risk the economic viability of some investments in large scale wind power.

This and other network issues surrounding a greater penetration of wind in Tasmania are understood to be being considered within the scope of the Joint Feasibility Study into a second Bass Strait interconnector. The Taskforce therefore proposes to defer consideration of how much new wind could be developed to meet Tasmania's on-island energy deficit versus the maximum quantity of wind that could be technically feasible in Tasmania until the outcomes of that study are known, and the Taskforce has conducted its own more detailed scenario analysis.

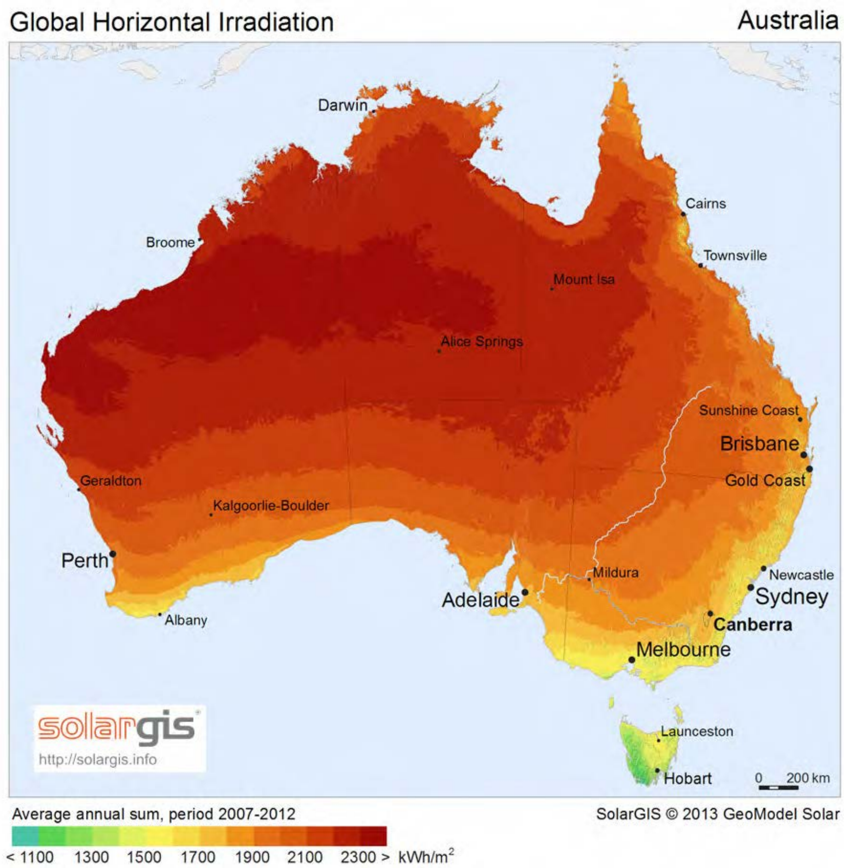
[106] OTTER, 2016, *2016 network reliability review.*

14.4.2 Utility scale solar

Utility scale solar is generally classified as a system of greater than 1 MW installed capacity that feeds into the grid. Large scale solar technologies that have been deployed to date in Australia are solar PV (including 17 solar farms) and solar thermal, with 216 MW installed capacity at the end of 2015.[107]

The amount of sun available for use by utility scale solar systems is influenced by the number of daylight hours and the intensity of the sunlight. Tasmania's average annual solar resource is low compared to other states, with the State having fewer average daily sunshine hours and a lower daily sun exposure on an annual basis. Solar PV systems use global horizontal irradiance and, as shown in Figure 14.8, Tasmania's solar global horizontal irradiance is the lowest in Australia. Consequently, projects built in Tasmania have a lower solar generation capacity factor than projects built elsewhere, although the State's longer summer daylight hours may offset this to some extent during the summer months.

Figure 14.8 Average annual solar global horizontal irradiance



Source: *http://solargis.com/assets/graphic/free-map/GHI/Solargis-Australia-GHI-solar-resource-map-en.png*

As discussed in section 14.3, a rapid reduction in large-scale solar generation technology costs is projected by 2030. This cost reduction may make the development of large scale solar in Tasmania more attractive in the medium to long term, despite the State's lower solar resource. A 2011 report by Transend notes that sites with good potential for large scale solar are very remote from the existing transmission network and connection costs could be high.[108] Also, as for wind, integration of large scale solar is not without its challenges due to its intermittent nature, and key issues requiring resolution include voltage control and

107 Clean Energy Council, 2016, *Clean Energy Australia Report 2015.*
108 Transend, 2011, *Grid vision 2040.*

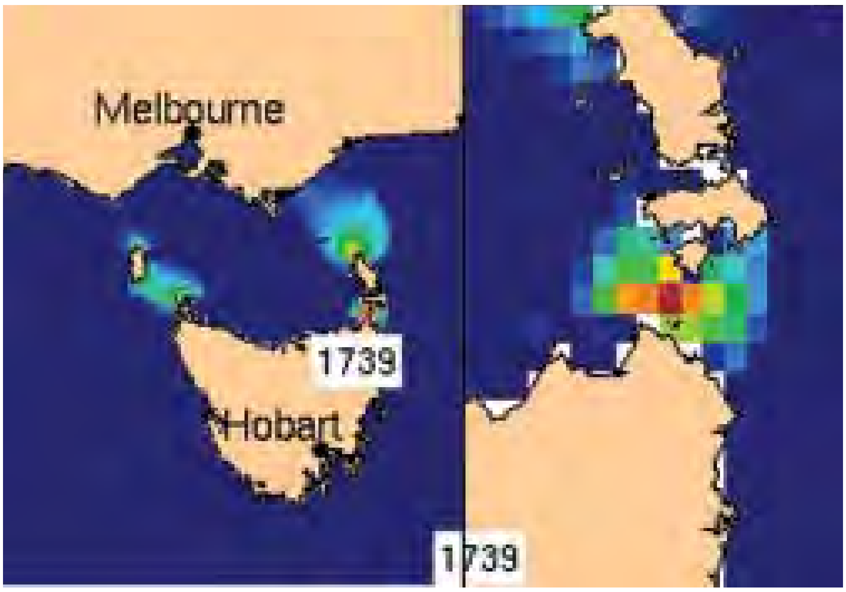
network congestion. However, with development costs becoming competitive with remote wind farm sites, this does not exclude the possibility that future investment in Tasmania may occur. Consequently, large-scale solar should not be dismissed as an option for diversifying the State's renewable energy mix in the medium to long term.

14.4.3 Ocean renewable energy

There is only a small global market at present for ocean renewable energy. However, feasibility assessments and research, development and deployment investments in ocean energy technologies are taking place in several countries, including Australia. The key challenge facing the uptake of ocean energy technology is proving its commercial feasibility, and the industry will likely require government support to realise its full potential in Australia. The two main ocean energy sources that appear feasible within the Tasmanian context are wave and tidal.

Tidal energy is a form of ocean energy that converts the energy of the tides into electricity. It can be broken down into two main categories: tidal impoundment, where barrages and lagoons are built on tidal estuaries or basins, and tidal streams, where typically underwater devices take advantage of the natural currents within a body of water. A significant tidal resource has been identified in Banks Strait, which is located between the north east tip of Tasmania and Furneaux Group of Islands (refer Figure 14.9). Recent work by the CSIRO has identified that a Banks Strait tidal stream project could produce up to 130 GWh per annum, although further work is required to fully understand the available extractable power from tidal flows.[109] The Taskforce understands that there are at least two proponents examining the potential for harnessing tidal energy in this area. However, tidal stream technologies are still in the development and demonstration phase and the LCOE of this technology is not projected to decline until deployment increases at a global level. Large scale tidal renewable energy projects are therefore unlikely to proceed in the short to medium term, and in the longer term are likely to require significant investment by an entrepreneur or some form of government support to be financially viable.

Figure 14.9 Average tidal current power around Tasmania (inset shows zoom-in on Banks Strait)



Source: CSIRO, 2012, *Ocean renewable energy: 2015-2050*

[109] CSIRO, 2012, *Ocean renewable energy: 2015-2050.*

Another form of ocean renewable energy is wave power. Waves are ultimately powered by wind, which transfers energy to waves over short distances (i.e. kilometres) to create 'wind waves' or over a longer period of time and over longer distances (i.e. thousands of kilometres) to create ocean swell.[110] Wave energy converters (WECs, including oscillating water columns that drive air turbines, oscillating body systems that float on the surface of the water, and overtopping devices that drive hydro turbines) are being tested around the world to harness the potential energy contained in waves. There are a range of technologies under development, and the technology chosen for a particular site will vary depending on its location and depth (shoreline, nearshore or offshore). In Australia, ARENA has been supporting some of the most advanced wave technology projects globally to test the performance of new technologies in ocean conditions and improve understanding of the technical and economic feasibility of grid integration. Several universities, including the University of Tasmania, are also researching the future application of wave energy technologies.

Tasmania has significant wave energy resources along its west coast. The CSIRO has identified that off Cape Sorell, the long-term average energy flux is approximately 50 kW per metre. Along the length of the west coast, which is approximately 300 km, this equates to total energy influx of about 134 TWh per annum,[111] although the amount of energy that could actually be harnessed from this resource would ultimately depend on the size, number and location of WECs and the type of technology deployed. Wave power is relatively uncorrelated with local wind (particularly swell, which accumulates over a long distance and time period) and is also more forecastable, which makes it a good complementary energy source to wind generation.

The levelised cost of wave energy production is not yet fully understood as most technologies are still in the research and development stage. The LCOE will depend greatly on construction and maintenance and will not fully be understood until large scale power plants are connected. Furthermore, a key challenge to wave technology is that WECs must be designed to survive extreme wave heights and currents that may develop during severe storms, whilst still remaining cost effective. Developing resistant infrastructure and strong seabed tethering techniques will play an important role in the future development of this technology.

Based on this assessment, it is considered unlikely that tidal or wave energy will play a role in Tasmania's energy mix in the short to medium term, although they could play a role in the long term as costs decline and technical issues are overcome with increased deployment.

14.4.4 Geothermal

Geothermal energy is the energy stored in the earth as heat. Harnessing this heat into electricity production is typically achieved by bringing the heat energy to the surface in a liquid (steam or water). The water is then used directly, or indirectly via a second working liquid, in turbines similar to other thermal power stations.

There are two broad categories of geothermal resources - convective and conductive. Most geothermal projects around the world are based on convective geothermal resources which bring energy to the surface by the movement of water or steam. These resources are typically shallow in depth below the surface, have high temperatures and are associated with volcanic activity. However, Australia's geothermal resource is characterised by conductive processes where heat moves through the earth without the movement of another material or liquid. These resources typically have lower temperatures and occur at greater depths within the Earth. Two types of projects are being explored: enhanced geothermal systems (EGS, or hot dry rocks) and hot sedimentary aquifers (HSA).

There is currently little activity in the Australian geothermal industry, a key reason for which is the difficulty in attracting commercial funding for current and proposed developments. The International Geothermal Energy Group estimates that the base LCOE of geothermal energy in Australia will be in the range of

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110 CSIRO, 2012, *Ocean renewable energy: 2015-2050.*
111 Ibid.

$170-$300/MWh by 2020, with this wide range reflecting the uncertainty in assumptions such as drilling costs and achievable temperatures and flow rates.[112] While the LCOE is projected to reduce by 2030 as the cost and success of drilling techniques advance over time, geothermal is still not expected to be cost competitive with other renewable energy resources (such as wind and solar) and will only become competitive with fossil fuel technologies under the most favourable cost reduction scenarios and the introduction of a carbon price.

Significant EGS geothermal resources have been previously identified within Tasmania. Between 2005 and 2012, KUTh Exploration received licenses to undertake geothermal explorations in the Tasmania Basin (a region in the east of Tasmania from Beaconsfield to Hobart and covering 12 360 km^2) and identified several locations of interest in the eastern half of Tasmania (including the midlands near Tunbridge and the Fingal Valley). Heat flow values recorded at these sites were reportedly in the top 17 per cent of values recorded on the Global Heat Flow Database for Australia.[113] However, further exploration of these sites ceased due to lack of investment funds.

There are significant barriers to the uptake of geothermal energy production in Tasmania, primarily around costs for further exploration, licences and infrastructure. The remote location of some sites may also increase the cost of transmission lines and other necessary infrastructure. Furthermore, the social license for developing EGS in Tasmania is unclear given its similarity to the mining process of hydraulic fracturing (known as 'fracking'), for which there is currently a moratorium in Tasmania.

Given that geothermal energy production in Australia is still in its infancy, it is unlikely in the short to medium term that geothermal energy will be developed in Tasmania. However, this does not preclude a role for this technology in providing baseload electricity in the longer term if significant investor interest in geothermal exploration and development were to occur.

14.4.5 Bioenergy

Bioenergy is produced from the combustion of biomass. There are a variety of forms of biomass suitable for producing bioenergy, including wood residues from forestry processing and by-products from agricultural cropping and processing. Tasmania has a large forest resource (including both native forest and plantations) together with a well-established and growing agricultural sector which provide potential bioenergy generation opportunities.

In particular, the State has a significant biomass resource in the form of wood residues, and biomass from native forest wood waste is an eligible renewable energy source under the LRET. However, aside from its use as an energy source for domestic heating, there is currently no electricity production from wood biomass combustion in Tasmania.

In 2016, the Tasmanian Government commissioned a study that considered the potential for renewable electricity generation from the State's woody biomass residues.[114] The study found that while the state has sufficient quantities of wood biomass residues available to support a large scale combustion bioenergy facility, the cost to produce energy from wood biomass is not economically viable over the short term based on current wholesale electricity prices (even with eligibility for the LRET), although this may change in the future if electricity prices increase or explicit government support is provided.

The study also found that, in the short term, well-sited industrial cogeneration (i.e. the combined production of heat and electricity) using wood biomass residues may become commercially viable

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112 ARENA, 2014, *Looking Forward: Barriers, Risks and Rewards of the Australian Geothermal Sector to 2020 and 2030.*

113 ASX Announcement, 2008, Strong Surface Heat Flow Values Recorded in Tasmania, KUTh Exploration Pty Ltd. http://www.asx.com.au/asxpdf/20080428/pdf/318s0qmnk4s9bt.pdf

114 Indufor, 2016. *Forest Residues Stage 2 Analysis Final Report.*

(particularly given uncertainty over future gas prices for users of gas for industrial heat). There may also be a future role for biomass generators to meet increases in electricity demand through strategic placement within the grid and this may be more effective than a grid upgrade (although no such opportunities have as yet been identified by TasNetworks).

A range of mature technologies can be used to generate electricity from biomass, with combustion systems being the most commonly used. Given the maturity of these technologies globally, major cost reductions due to technology enhancements are considered unlikely into the future. The viability of a bioenergy project is sensitive to the delivered cost of the feedstock and the distance to connect the facility to the grid. There are also environmental and social aspects of biomass combustion that must be overcome, including Environmental Protection Agency requirements for emissions and the social licence for sourcing feedstock from native forest residues.

Based on this evidence, while it is unlikely that bioenergy will make a significant contribution to Tasmania's renewable energy profile in the short to medium term, there may be opportunities for well-sited industrial cogeneration plants using wood biomass for the combined production of industrial heat and electricity in Tasmania. Should a carbon price mechanism be reintroduced in the future, the viability of a bioenergy facility may further improve as wholesale electricity prices rise.

14.5 Small scale renewable generation

Throughout Australia there has been an increasing trend towards consumer led small-scale embedded generators connecting to the distribution network, particularly household solar PV. This has also been observed in Tasmania where, despite the State having a lower average annual solar resource than other states, there has been a substantial increase in the number of solar PV installations since 2009 (refer Figure 14.10a). This has been driven largely by rapidly declining technology costs and government subsidies such as the national SRES and a solar feed-in tariff. Following a reduction of the feed-in tariff from September 2013, growth has slowed, although installations rates are still positive (refer Figure 14.10b). Average capacity is also increasing as the technology develops and costs decline.

AEMO projections indicate that solar PV uptake will increase from 113 MW effective capacity in 2016-17 to 526 MW in 2035-36 (equivalent to six per cent of the State's annual operational consumption).[115] This growth, while the slowest among the NEM regions (due to lower levels of sunshine reducing the financial attractiveness of the systems), is consistent with the projected national trend for an increased uptake of household solar PV until the mid-2030s before market saturation occurs.

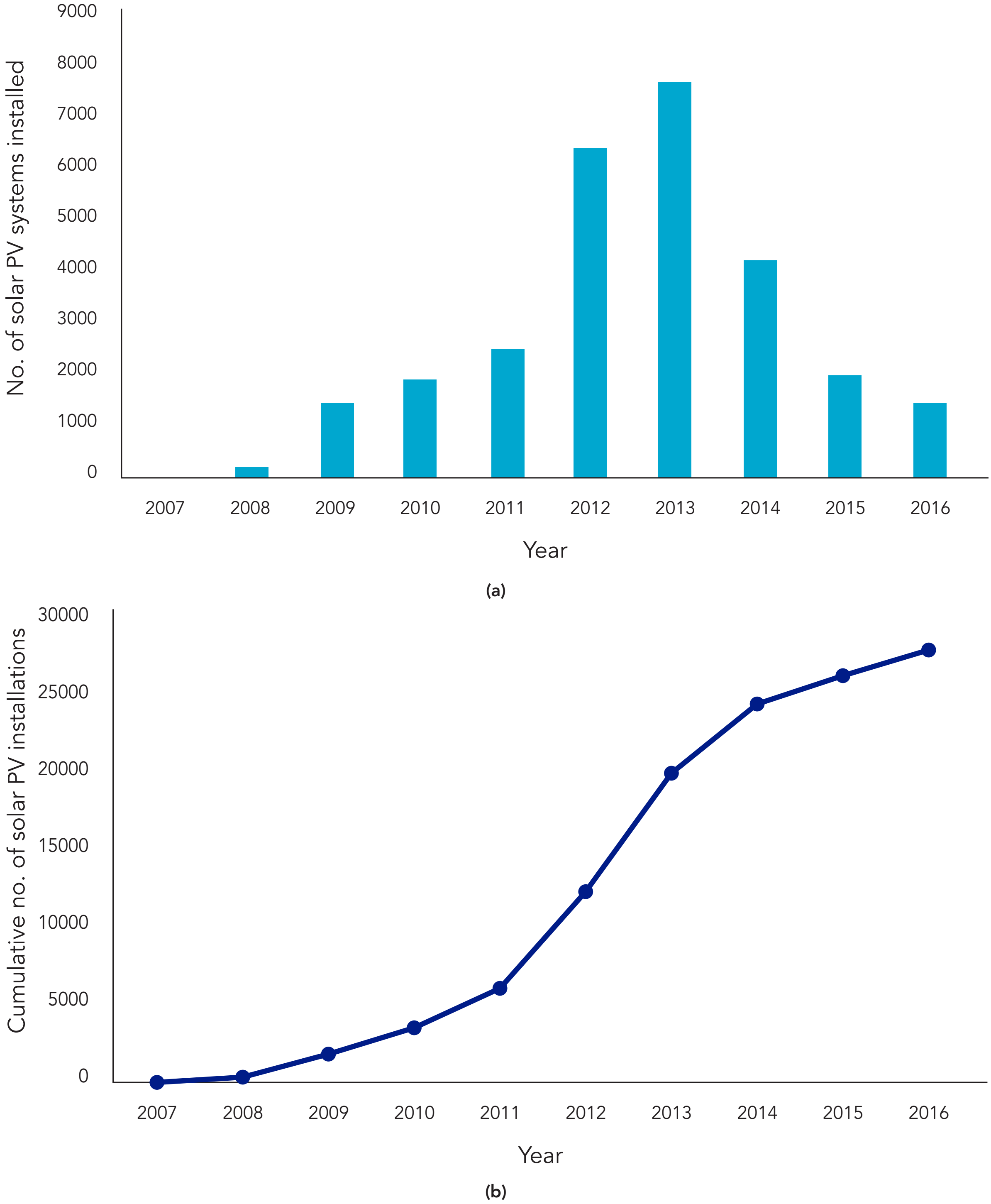
This increased uptake has been attributed to a range of factors, including rapidly declining solar PV technology and installation costs (refer section 14.3), government policies to promote renewable energy uptake and an increasing number of consumers wanting to become more actively involved in their electricity supply. The emergence of new supporting technologies, such as battery technology and EVs, is expected to further promote the uptake of solar PV as consumers seek the ability to optimise the management of their own electricity and potentially lower their power bills. These and other demand side technologies are examined in Chapter 15.

Embedded small scale generators such as solar PV can provide energy security benefits through diversified electricity generation. However, a larger penetration of household solar PV may pose some technical issues for the Tasmanian system due to its intermittent nature and the fact that these systems cause households to be both producers and consumers, thus making forecasting, managing and planning network operations more difficult. A localised high penetration of solar PV can also impact network stability. The TER's 2016

115 AEMO, 2016, *National Electricity Forecasting Report.*

NRR found that in the short term, solar PV uptake is unlikely to have a significant impact on the Tasmanian network. However, further investigations are required to determine the potential impact of higher solar PV uptake in the medium to long term, including implications for power quality, network and customer safety, system inertia and network costs.

Figure 14.10 (a) Total and (b) cumulative number of solar PV installations in Tasmania

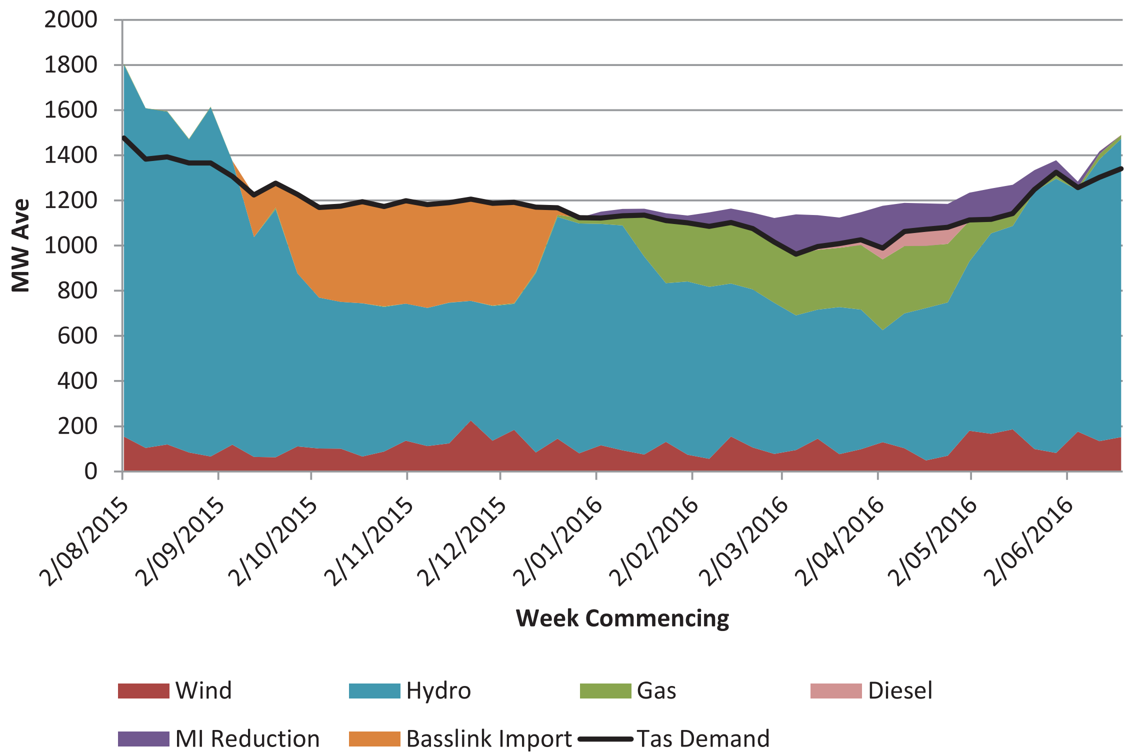


Source: Clean Energy Regulator. Postcode data for small installations, current at 15 September 2016
Note: This data represents the number of solar PV systems that have created STCs under the SRES The number of solar PV installations in 2015 and 2016 will continue to rise as there is a 12 month period to create STCs from the date of installation.

14.6 Energy security value of additional renewables

During the 2015-16 energy security event, wind made an important contribution to meeting Tasmanian electricity demand (refer Figure 14.11), contributing approximately 700 GWh (or close to five per cent hydro storage equivalent) from September 2015 to May 2016. Without this contribution, additional draw down of hydro storages (and potentially additional demand side responses) would have been required to meet demand until sufficient temporary diesel generation was commissioned.

Figure 14.11 Mix of generation supply used to meet Tasmanian demand during the 2015-16 energy security event



Source: Hydro Tasmania, 2016 *Energy supply plan 2015-16 final summary*

A broad range of stakeholders support the introduction of additional utility scale renewable energy generation investment as a means of managing energy security challenges over the long term, provided it is economic to do so.

The current deficit of on-island generation to meet Tasmanian demand of 700 to 1 000 GWh per annum (based on long-term averages) could be addressed by building additional renewable energy projects, which will also serve to diversify the State's generation mix. While options for bridging the energy deficit will be provided for consideration in the Final Report, the Taskforce considers that direct negotiations with new renewable energy projects that are already progressed and have a sound business case should not be delayed if there is the opportunity for PPAs for these projects to be progressed in the intervening period.

RECOMMENDATION

31. Direct negotiations with new renewable energy projects that are already progressed and have a sound business case should not be delayed because of the Taskforce's work.

15. Emerging Technologies and Consumer Participation

KEY FINDINGS

- Small scale renewable energy, such as household integrated solar PV and storage, has the potential to make a small contribution to reducing Tasmania's on-island energy deficit, but provides 'consumer-level energy security', whereby consumers perceive they have greater energy security when they are able to control some of their supply and demand.
- A more technologically advanced network could also improve the reliability of the network (particularly in the face of future challenges) and minimise the impact of emergency power restrictions if they were ever needed.
- There may be aggregate energy security benefits in the form of network optimisation when embedded storage technologies are combined with new products and services (e.g. time-of-use tariffs, advanced meters) that allow consumers greater control and choice over their own energy use.
- Greater consumer control and choice can also enable improved energy efficiency. Tasmania's building stock is relatively old and there is an opportunity to improve the energy efficiency in residential homes and commercial premises.
- While there are a range of predictions regarding the rate of take-up of new technologies and services, changes in other sectors have occurred more rapidly and differently than thought possible.
- Electric vehicles (EVs) may assist in reducing Tasmania's dependence on liquid fuels in the non-stationary energy sector in the longer term and provide other benefits to the State.

As discussed in Chapter 14, there has been an increasing trend throughout Australia towards consumer led small-scale embedded generators connecting to the distribution network, particularly household solar PV. This has also been observed in Tasmania where, despite the State having a lower average annual solar resource than other states, there has been a substantial increase in the number of solar PV installations since 2009.

This increased uptake has been attributed to a range of factors, including rapidly declining solar PV technology and installation costs, government policies to promote renewable energy uptake and an increasing number of consumers wanting to become more actively involved in their electricity supply. The emergence of new supporting technologies, such as battery technology and EVs, is expected to further promote the uptake of solar PV as consumers seek the ability to optimise the management of their own electricity and potentially lower their power bills.

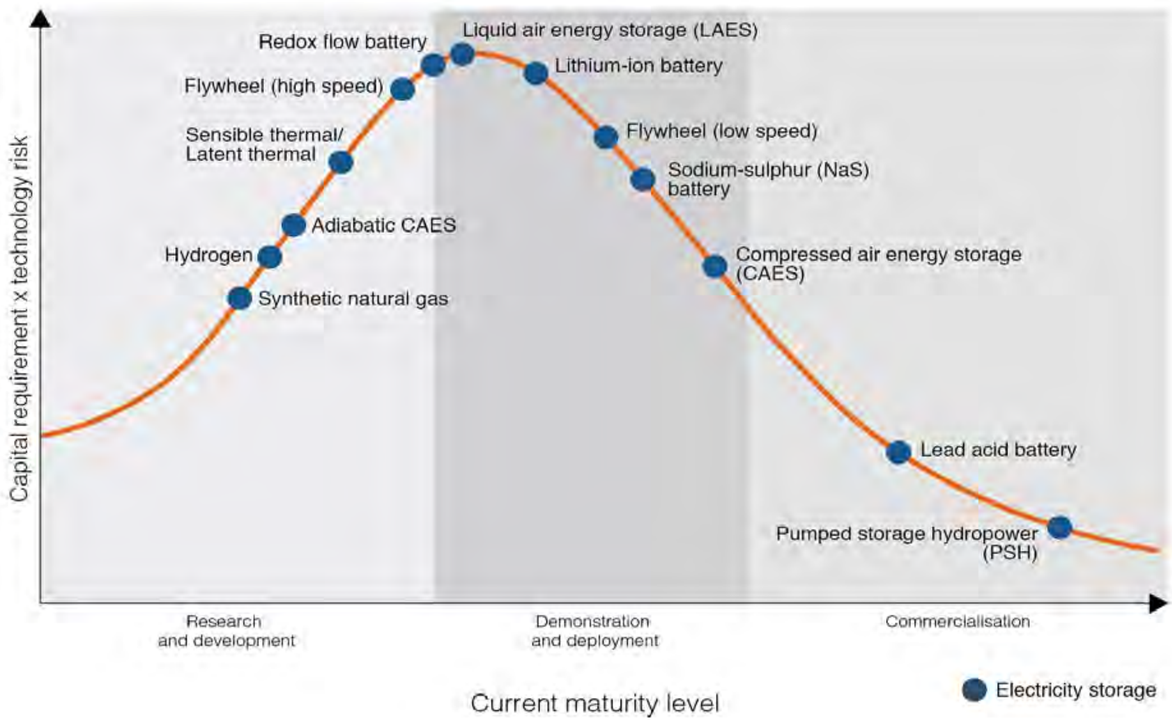
This chapter examines the potential for emerging technologies to support consumer-driven demand side management in Tasmania. The Taskforce intends to examine how Tasmania can position itself for the uptake of emerging technologies in the context of energy security in the Final Report.

15.1 Energy storage technologies

15.1.1 Overview

Energy storage technologies can be classified according to how they store their energy, such as mechanical (e.g. flywheels, pumped hydropower storage), thermal (hot water, molten salt), electrochemical/electrical (batteries), or chemical (hydrogen) storage. Globally, energy storage technologies exist at many levels of deployment. While some are at or near commercial maturity (e.g. pumped storage), most remain in the development stages and have yet to be commercially deployed. Figure 15.1 illustrates the current phase of development for various electricity storage technologies, with many hovering around the high capital cost high technology risk stage of development.

Figure 15.1 Electricity storage technology maturity curve



Source: World Energy Council, 2016, *E-storage: Shifting from cost to value, wind and solar applications*

Energy storage technologies enable improved matching between load and generation by enabling the storage of renewable energy for later use. Their application can be used to aid the integration of intermittent renewables (e.g. wind and solar) into the grid through managing peak demand (hence acting as an alternative to peaking generation) and smoothing demand across the day (hence supporting traditional baseload generators). Their distributed nature may also relieve network congestion constraints and contribute ancillary services to the network (e.g. frequency control, power quality support), thus reducing network costs. However, the current cost of energy storage technologies, as well as a number of performance and safety issues, need to be overcome before battery storage becomes a mainstream component of electricity generation systems globally and nationally.

Table 15.1 provides a summary of the potential application of different battery technologies in the Australian electricity market context.

Table 15.1 Application of battery technologies in the Australian electricity market context

	Application	Advance lead-acid	Lithium iron phosphate	Lithium nickel manganese cobalt oxide	Zinc bromide flow	Sodium nickel chloride molten salt
Grid-side	Large-scale renewable integration	✓✓✓	✓	✓	✓	✓✓✓
	Distribution network support	✓✓	✓✓	✓✓	✗	✗
Customer-side	Commercial and industrial energy management	✓✓ ✓	✓✓	✓✓	✓✓	✓
	Residential energy management	✓✓	✓✓ ✓	✓✓ ✓	✓	✓
	Electric vehicles	✓	✓	✓✓	✗	✗

Source: Cavanagh K, Ward JK, Behrens S, Bhatt AI, Ratnam EL, Oliver E and Hayward J, 2015, *Electrical energy storage: technology overview and applications*

The future cost of energy storage technologies is uncertain, although there is generally expected to be a sharp decline in the cost of some technologies over the next five to 10 years. Both IRENA[116] and the IEA[117] predict that energy storage technology will be deployed to a much greater extent than in the past, particularly if government financial incentives and policies are introduced. For example, the value of government intervention in promoting the uptake of emerging technologies in Australia has been demonstrated by the historical rapid national uptake of rooftop solar PV as a result of government financial incentives, including feed-in tariffs and the SRES. If this translates to energy storage becoming a mainstream consumer technology in the future, there may be significant implications for the way energy is generated and used in Australia.

Funding targeted demonstration projects for promising storage technologies is also valuable in improving the technical application of emerging storage technologies and to help accelerate uptake, although most storage trials tend to focus on remote systems. ARENA is investing in a number of energy storage demonstration projects to test a range of battery storage technologies and business models that may ultimately allow for a higher penetration of intermittent renewable energy in Australia. For example, one project currently underway is examining the role of medium to large scale storage (5-30 MW) in harnessing overnight generation from wind farms in South Australia. Other projects are examining small scale 'behind-the-meter' solutions aimed at enabling consumers to maximise the value of their own solar PV generation while also providing aggregated network services.

[116] IRENA, 2015, *Battery storage for renewables: market status and technology outlook.*
[117] IEA, 2014, *Technology roadmap: energy storage.*

CASE STUDY - BRUNY ISLAND CONSORT PROJECT

The consumer energy systems providing cost-effective grid support (CONSORT) project on Bruny Island is using an innovative automated control system and new payment structures to encourage consumers with solar PV battery systems to provide network support and relieve the undersea cable supplying the island during peak load events.

CONSORT is a collaboration between three universities (The Australian National University,The University of Sydney, and The University of Tasmania), TasNetworks, and-Canberra-based startup Reposit Power.

Funded by ARENA, the CONSORT project will install up to 40 battery systems in homes with solar PV on Bruny Island. A control system, the first of its kind, will be used to coordinate these batteries during peak load events on Bruny Island to:

- alleviate congestion on the undersea power cable and reduce reliance on diesel generation;
- stabilise network voltages within acceptable levels; and
- encourage householders to make optimal use of their solar power generation.

ARENA envisages that, in the future, this solution could carry over to other types of consumer systems, including EVs, hot water heating and smart appliances.

The Taskforce has identified two key storage technologies relevant in the Tasmanian context – battery storage (particularly household systems) and pumped hydro storage. The potential uptake of these is discussed in further detail below.

15.1.2 Battery storage

The Taskforce has examined a number of recent reports into the projected uptake of embedded battery storage and found that a range of projections exist. The most recent reports are considered the best indicators due to the rapid growth in some storage technologies meaning that reports on storage costs are likely to be outdated quickly. However the modelling of battery storage is challenging and care needs to be taken when comparing results as the assumptions used by different models can vary substantially. For example, AEMO's modelling only considers new combined installations and not existing rooftop solar PV being retrofitted with battery storage, and other analyses assume different rates of cost reductions which in turn affect the rate of uptake.

An increased uptake of residential battery storage is forecast by 2030 across all studies examined by the Taskforce. For example, in its 2016 National Electricity Forecasting Report, AEMO forecasts a low uptake of integrated solar PV and storage systems (IPSS) nationally until the early 2020s, after which time a steady uptake is forecast with an energy storage potential of 6.6 GWh by 2035-36. Declining battery costs and the transition to a time-of-use tariff structure are expected to drive this uptake in both the residential and the commercial sectors. In an analysis for the Clean Energy Council, Marchment Hill found that battery storage uptake could reach between 1.9 to 3.3 GW by 2030, while a more aggressive analysis recently undertaken by Morgan Stanley Research Australia has estimated that installed storage could increase more rapidly to 6 GWh (around one million households) by 2020.[118]

This forecast increased uptake is largely due to projected declines in unit costs for batteries and inverters.[119]

118 Morgan Stanley Research, 2016, *Asia insight: solar and batteries, Australia*.

119 For a battery to function as an energy storage device, it requires other components, including an inverter, which interact to form an energy storage system.

Modelling by the CSIRO projects significant baseline cost reductions in all types of batteries in Australia, with even the more mature technologies (advanced lead acid and lithium ion) projected to decline to half the costs of today's units and that of emerging technologies (zinc bromide and molten salt) by 79 per cent by 2025 (refer Figure 15.2). When combined with a forecast 35 per cent reduction in inverter costs this has the potential to significantly improve the financial attractiveness of embedded battery storage in the medium to long term.

Figure 15.2 Projected battery costs in Australia

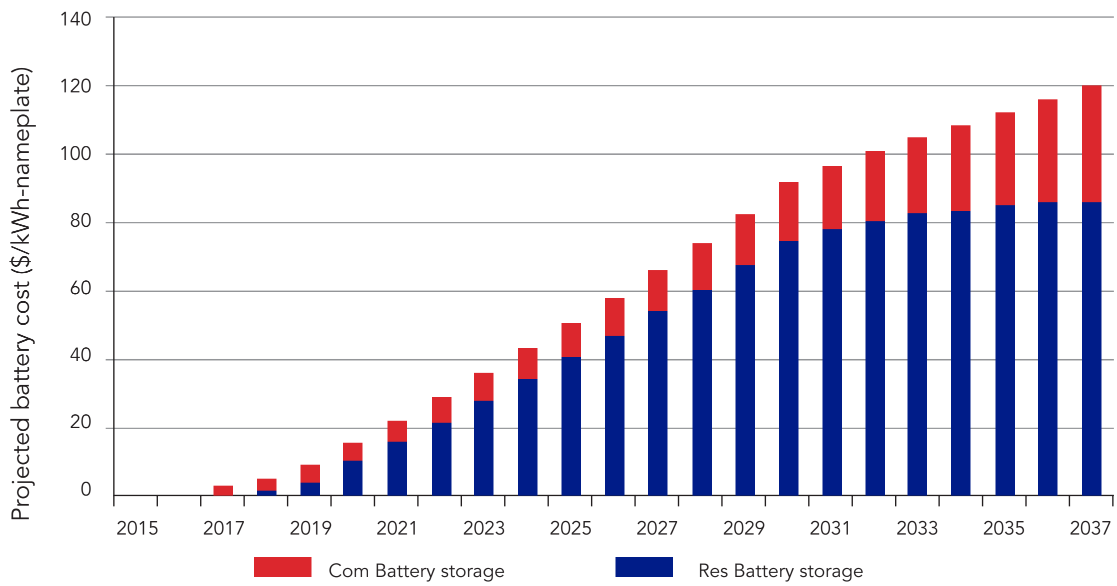
Source: CO2CRC, 2015, *Australian Power Generation Technology Report*

CASE STUDY - TESLA POWERWALL

The capacity for technological advances in batteries and inverters to rapidly reduce unit costs is demonstrated by Tesla's Powerwall residential battery storage system. The first generation 7 kWh Tesla Powerwall, which went on sale in Australia in late 2015, has recently been superseded by the 14 kWh Powerwall 2, which doubles the energy storage capacity at nearly half the cost (in terms of price per kWh). This demonstrates the potential for new technologies to develop more rapidly than anticipated.

The forecast national penetration of battery storage systems is not uniform in all states. In Tasmania, the uptake of IPSSs is projected to be weaker than other states due to the lower solar resource increasing pay back periods and thus reducing the financial attractiveness. Modelling performed by Jacobs for AEMO projects a total installed capacity of 69 MW by 2036-37 (at which point saturation is reached in the residential market), with 29 per cent of that being from commercial business uptake (refer Figure 15.3). However, this analysis only considered new combined installations and not existing rooftop solar PV being retrofitted with battery storage, hence actual uptake may ultimately be higher than this.

Figure 15.3 Cumulative projected installed battery storage capacity in Tasmania



Source: Jacobs, 2016, *Projections of uptake of small-scale systems*

In its 2015 Emerging Technologies Information Paper, AEMO forecasts that the impact of storage on demand in Tasmania will be small in the short term, but by 2034-35 could reduce summer and winter maximum demand by 18 MW and 5 MW respectively.[120] Under time-of-use tariffs, household IPSS would shift the morning and evening peaks to off-peak hours in summer, while in winter only the morning peak would shift due to lower solar PV generation in winter. With ongoing time-of-use incentives, residential solar PV battery storage could provide ongoing network benefits by levelling demand.

With regard to large scale (network level) battery storage, the TER's 2016 Network Reliability Review notes that many of the transmission network benefits offered by large scale battery technology interstate are already provided by Tasmania's hydro-electric system, which acts as a 'battery' by storing water in reservoirs while other renewables are generating and then releasing it to generate electricity at a later time. Thus the provision of additional support for embedded battery storage technology in Tasmania will ultimately depend on the extent to which this technology can reduce peak demand and reduce the need for network investments.

15.1.3 Pumped hydro storage

Globally, pumped hydro storage is the most mature and widespread energy storage technology, and the only technology currently capable of storing large quantities (GWh scale) of energy. Conventional pumped hydro storage systems pump water from a water reservoir at a low elevation to a reservoir at a higher elevation. When needed, the water is released back to the lower reservoir and passes through a hydro generator to produce electricity.

Pumped hydro storage is currently underutilised in Tasmania, with only one pumping system installed. In order to increase the water available at Great Lake, Arthurs Lake was created, from which water is pumped up 140 metres to a five kilometre flume which then travels back to Great Lake. Part of the energy used in pumping is recovered by Tods Corner Power Station (1.7 MW), while the rest (and more) is recovered when the water is reused at Poatina Power Station.

[120] AEMO, 2015, *Emerging technologies information paper.*

Several submissions received during the consultation process identified the potential role of additional pumped storage in enhancing Tasmania's energy security. From a purely energy supply security perspective, pumped hydro storage is not particularly relevant for additional energy as the amount of energy harnessed is small relative to the capital costs required. However, in the context of a second Bass Strait interconnector, there is the potential for pumped storage in Tasmania to provide additional capacity to the NEM as it transitions towards low carbon generation. Depending on the technology installed, pumped storage could also be used for ancillary services including voltage and/or frequency stabilisation in the context of a high penetration of renewables.

Preliminary investigations by Hydro Tasmania have identified a number of pump storage opportunities that could be developed in Tasmania, the most prospective of which could provide around 2-3 GWh of storage. Hydro Tasmania considers that it is possible that a second interconnector could enable pumped storage to be developed in the State if future market conditions can create an economic return on its investment. There are also political, social and environmental aspects that would need to be overcome, particularly if the construction of new reservoirs is proposed..

15.2 Technologies empowering consumer choice

During the consultation process, the Taskforce heard that consumers increasingly want to be able to more actively manage their own energy. This could be considered as 'consumer-level energy security', whereby consumers feel they have greater energy security when they can control some of their supply and demand. Greater consumer control over their energy use and power bills can be achieved through ensuring there are no unnecessary barriers to the uptake of new products and services.

In November 2015, the AEMC determined changes to the NER to provide a national framework for a market-led rollout of advanced meters from 1 December 2017. This was undertaken in the context of facilitating greater commercial investment in metering technologies that provide consumers with better information about their energy use and greater control over how they manage it. The rule change means that a roll-out of advanced meter products can occur in response to customer demand (e.g. consumers wanting to have their meters upgraded to better manage their electricity consumption) without the need for Government intervention.

TARIFF CHOICES IN TASMANIA

Aurora Energy has made new tariff products available from 1 July 2016. Time of use tariffs that charge a low rate during off peak times and a higher rate during peak times may be a cheaper option for some customers than remaining on historical tariff arrangements. Customers who have relatively flat electricity use because they use other forms of energy in their homes (e.g. gas and wood heating) are most likely to benefit. To date, around 500 residential and small business customers are understood to have taken up these time of use tariffs.

Time of use tariffs require a change to a customer's current meter. While the new meters are not 'advanced', they demonstrate how technology can provide more choice for customers.

Advanced meters measure and record energy consumption on a near real time basis (15-30 minute intervals), and allow customers to access real-time information about their electricity consumption. They also send data remotely to the provider, meaning that data on electricity consumption, outages and other distribution system performance measures can be obtained almost instantaneously. In some advanced meter specifications throughout Australia, two-way communication capabilities also provide network operators with the capacity to manage demand and loads more effectively.

This smart network capability provides additional energy security benefits through providing greater control over network services (i.e. demand management, circuit control). For example, Tasmania's load shedding arrangements currently include the option for individual feeders to be switched on/off in an emergency event. However, smart network technologies can enable demand to be 'turned down' or rationed in an escalating energy security situation, so that energy is limited to consumers rather than not available at all.

Advanced metering also provides a number of customer benefits, such as time-of-use tariff choices, more frequent billing cycles and lower costs because of remote reading and connections.

An example of a successful market roll-out of advanced meters is that which occurred in New Zealand, where more than 70 per cent of connections now have advanced meters installed.[121] Strong competition from retailers has seen meters being installed free of charge, with the business case based on retailer savings being achieved from the advanced metering technology (due to automated rather than manual processes) being equivalent to the cost of the new advanced meter installation.

TasNetworks has commenced a small tariff trial enabled by advanced meters to understand how the technology can be applied to the Tasmanian electricity network and understand customer usage patterns.[122]

New advanced network technologies also enable the opportunity for 'aggregating', whereby energy produced from a large number of behind-the-meter battery storage systems is aggregated to create a virtual large-scale storage capacity. This could enable network operators to manage demand more effectively (by delivering stored power into the grid at peak times) and provide grid services such as frequency control. Aggregating is an emerging approach being trialled by a number of companies globally. In Australia, following a successful pilot trial funded by ARENA, Reposit Power has launched a control module that can be added to solar PV storage batteries. The software automatically manages the dispatch of grid tied storage based on the demand profile of a residence, allowing network operators to manage demand more effectively by delivering stored power into the grid at peak times and enabling consumers to gain greater value from their solar systems by selling energy into the grid.

CONSUMER DRIVEN ENERGY SAVING OPPORTUNITIES

Technology developments are anticipated to provide consumers with greater choice and control. They also provide the opportunity to use energy more efficiently.

Energy efficiency can be achieved through means such as:

- changing energy use behaviour, which can be supported by technology that enables consumer's to have greater control timely information of their energy use;
- improving the energy efficiency of appliances, which has been a feature of the Australian market in recent years (and to which Tasmania is a beneficiary); and
- improving the energy efficiency of buildings (both residential homes and commercial premises), which, despite cooler conditions and the dependence on heating, provides a significant opportunity as Tasmania's building stock is reported to be the oldest in the nation.

At a State level, new technologies, products and services create the potential for greater productivity and efficiency in the Tasmanian economy and may enable new business opportunities in and outside of the energy sector. Tasmania is well suited to be a test bed for trials of new technologies and services, given its small geographic size, population and relatively isolated energy market. The State already has some examples of this (e.g. the Bruny Island CONSORT project).

[121] Electricity Authority Te Mana Hiko, 2016, *Businesses getting smart with smart meters.*
[122] http://www.tasnetworks.com.au/customer-engagement/tariff-reform/tariff-trial/

The combination of battery storage and smart grid technologies may provide consumers with the option to go 'off-grid'. This may actually incentivise network providers to offer products and services that keep grid connections attractive. In Tasmania, it is likely to be more cost effective and reliable for most Tasmanians to remain on grid, particularly in the larger population centres and towns. However, micro-grid opportunities utilising embedded generation technologies may be an appropriate option in remote and small population centres.

The Taskforce intends to examine how Tasmania can position itself for the uptake of emerging technologies in the context of energy security in the Final Report. However, given the potential upside from new smart network and advanced meter technologies, the Taskforce considers that the Tasmanian Government should ensure that there are no unnecessary barriers to enabling consumer-led energy management opportunities as a contribution to reducing Tasmania's energy deficit and enabling customers to have greater choice and information regarding the management of their energy use.

RECOMMENDATION

32. The Tasmanian Government should prudently facilitate, enable and ensure there are no unnecessary barriers to consumer-controlled energy management opportunities and choices, as a contribution to reducing Tasmania's energy deficit, optimising network outcomes, and improving competitiveness for consumers.

15.3 Electric vehicles

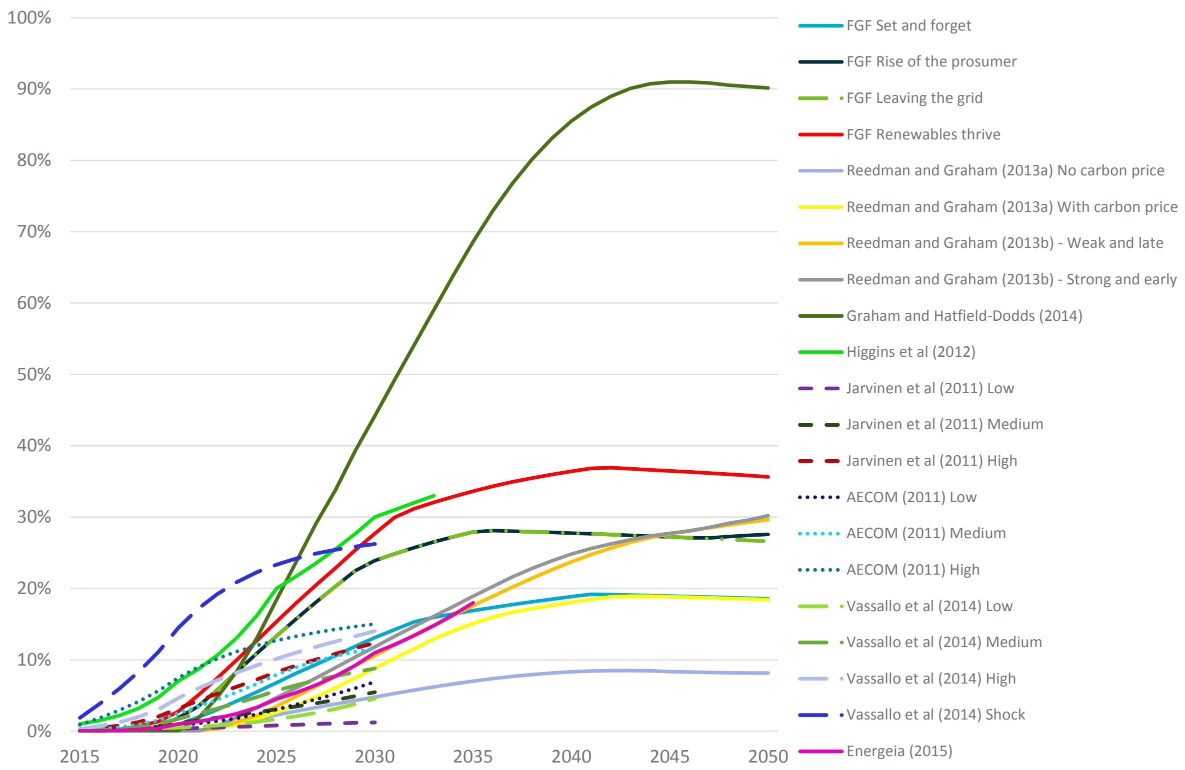
Electric vehicle (EV) uptake is increasing globally with over 300 000 EVs sold internationally in 2014.[123] Early adopter markets such as Norway, the Netherlands and California have relatively high rates of EV uptake compared to the rest of the world. Targeted policy and regulation have played a key role in encouraging this uptake. However, the EV industry is rapidly evolving, with technology currently in a highly competitive innovation phase, and uptake is likely to increase in coming years due to declining costs and increased availability and capability of new EVs. A range of projections for future global deployment are available, with studies that assume greater technological advancement and policy support projecting 20 to 50 per cent greater share of EVs in 2025-2030 than studies with less optimistic assumptions.

EV penetration in Australia remains low, making up only 0.2 per cent of Australia's annual vehicle sales in 2015.[124] This is likely to increase in coming years due to declining costs and increased availability and capability of new EVs, and a range of projections of future EV fleet share exist (refer Figure 15.4). While not shown, AEMO projections for EV fleet share by 2036 (17.7 per cent) fall within the middle of the range of projections illustrated in Figure 15.4.[125]

AEMO projects that the impact of EV uptake in Australia on energy consumption over the next 20 years will be small (around four per cent of 2035-36 consumption). This is much smaller than projected trends in consumer-led solar-PV uptake and is attributed to a number of factors, including the current lack of public charging infrastructure, economic viability and a large range of models not yet being available. The lack of a national EV policy framework and a lack of light vehicle CO_2 emissions standards are also seen as a barrier to uptake. This may change as Australia moves towards achieving its emissions reduction target of 26 to 28 per cent of 2005 levels by 2030 (e.g. if a fleet based light vehicle greenhouse gas emissions standard is introduced), and history shows that new technology can reach a point where very high uptake occurs more rapidly than predicted (such has been seen with the rapid uptake in solar PV in Australia).

123 Climateworks Australia, 2016, *The path forward for electric vehicles in Australia: stakeholder recommendations.*
124 AEMO, 2016, *AEMO insights: electric vehicles.*
125 Ibid.

Figure 15.4 Projections of EV fleet share in Australia



Source: Climateworks Australia, 2016, *The path forward for electric vehicles in Australia: stakeholder recommendations.*

EVs could also become highly attractive to some consumers who desire certainty of low ongoing running costs. Once the purchase price of EVs becomes competitive with liquid fuel based cars, EVs have relatively low fuel and maintenance costs.

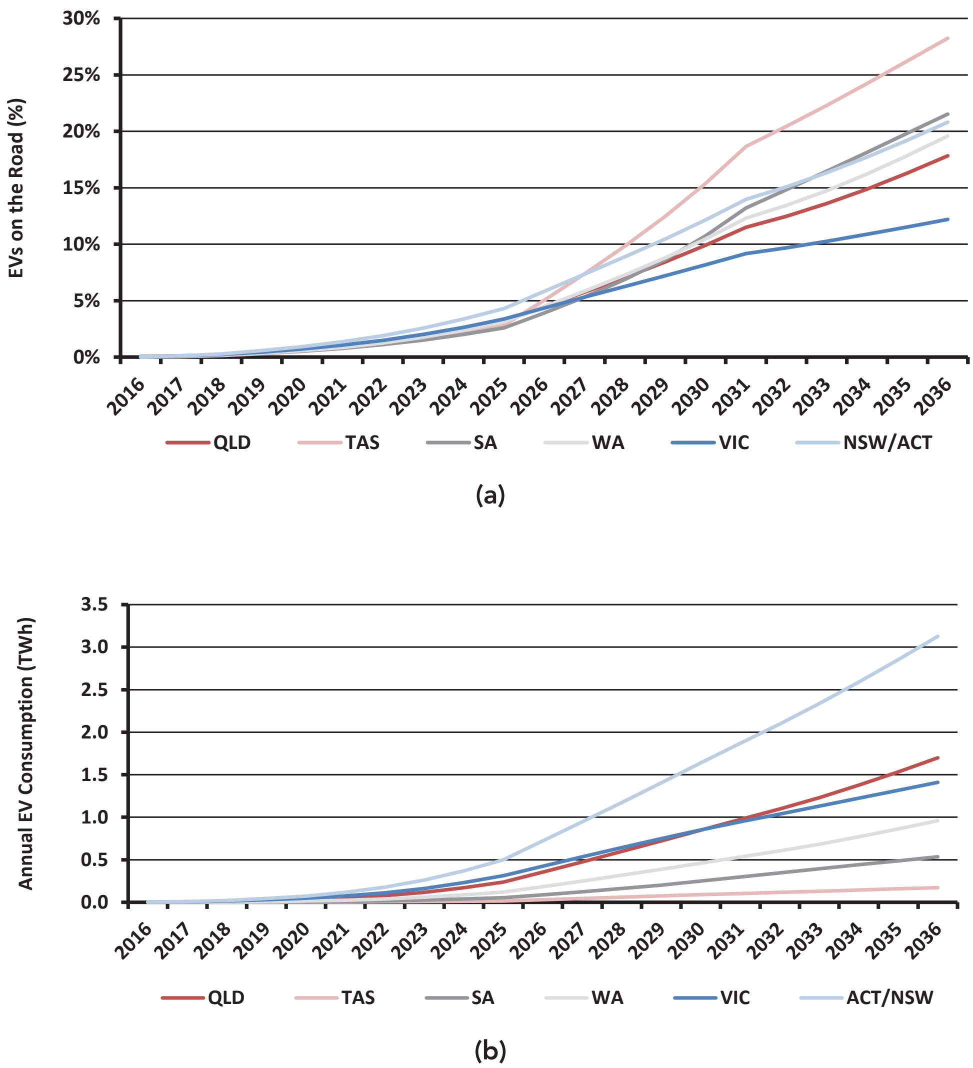
In Tasmania, penetration of EVs is currently low and expected to remain so in the short to medium term. An estimated 150 EVs were registered in Tasmania at the end of 2015.[126] While AEMO modelling (which assumes a fleet based greenhouse gas emissions standard is introduced from 2026) shows that EV sales will increase markedly from 2026 in regions such as Tasmania which have a lower emissions intensity of grid electricity (refer Figure 15.5a), EVs are not expected to have a significant impact on energy consumption over the next 20 years (Figure 15.5b).

Depending on the extent to which electricity imports from Victoria would be required to support extra load associated with EVs, there would still be emissions from EV use in Tasmania. However, this would reduce over time as Victoria transitions to renewable generation sources, and if Tasmania addresses its on-island energy deficit and no longer relies (on average) on imports.

EVs may also provide an opportunity to optimise the network. With the right tariff incentives in place, recharging could predominantly occur during off peak times (i.e. overnight), which would help to flatten Tasmanian demand and encourage use of the network at times when it is currently underutilised. This would therefore also decrease fixed costs as a proportion of energy use.

[126] Australian Electric Vehicle Association Tasmania Branch submission to Tasmania's draft climate action plan, *Embracing the Climate Challenge.*

Figure 15.5 Projected EV (a) uptake and (b) consumption in Australia by region



Source: AEMO, (2016), *AEMO insights: electric vehicles*

Since June 2015, the Tasmanian Government's Smarter Fleets pilot program has worked with six participating vehicle fleets (a mix of Tasmanian Government, local government, private and Government Business Enterprises) to build a business case for deploying EVs in State Government and private vehicle fleets as a mechanism for transitioning towards wider uptake. The Taskforce intends to further examine how Tasmania can position itself in the medium and long term for the uptake of EVs (in the context of energy security) in the Final Report.

Appendices

16. Appendix 1: Energy Security Performance Indicators

The Taskforce has developed an initial set of quantitative performance indicators and measures. These indicators and measures, which are detailed in Table 16.1 and Table 16.2, are intended to support (through the use of quantitative data) the Taskforce's Energy Security Assessment for Tasmania presented in Chapter 5.

An assessment of 'actual performance' against each measure is also provided, which mostly supports the Short Term assessment of energy security (given that they are based on recent data). However, some also have value in examining changes over time that may indicate longer term trends.

These data, when read together with the information and analysis presented throughout the Interim Report, support the qualitative commentary in the Energy Security Assessment for Tasmania.

The Taskforce recognises that identifying and developing performance indicators and measures is generally a difficult and complex task, as choosing the 'right' ones is to some extent subjective, reliant on available data and can be interpreted in different ways. It is for this reason that the Taskforce considers that this initial set of indicators and measures should be treated as indicative. The Taskforce considers that the use of such metrics could be a feature of the reporting to be done by the Monitor and Assessor, and that this initial set could be improved upon through that process.

Table 16.1 Tasmanian energy security performance indicators, performance measures and actual performance against each measure for electricity.

Criteria	Performance Indicators	Performance Measures	Actual performance	Data source
Adequacy	Total hydro energy in storage	Storage position relative to minimum level	46.1% at 21 November 2016 (interim level is at least 40% by end of spring)	Hydro Tasmania
	Basslink availability	Basslink availability compared with performance requirement of 97 % of the time (on a rolling 12 month average)	5 year average availability: 99.13% 2014-15: 98.71%[127] 5 year average outages: 3 2014-15: 2	Tasmanian Economic Regulator (TER)
	Volatility of inflows	Number of years and percentage of annual inflow observations outside one standard deviation of historical average (low and high) in the last 10 years (to 2015-16)[128]	Low: 4 years or 40% High: 2 years or 20%	Hydro Tasmania
	Long-term average inflows	Rolling average annual inflows over 10, 20 and 40 years (to 2015-16)	10 year average: 8 698GWh 20 year average: 9 232GWh 40 year average: 9 468GWh	Hydro Tasmania
	Net electricity import dependence	Percentage of on-island consumption met by hydro and wind generation, over most recent year, 5 year average and 10 year average (to 2015-16)	1 year: 77% 5 year: 96% 10 year: data unavailable at time of publication	TER
	Total available on-island energy supplies	Estimated months of supply (available storages, wind generation and inflows – average and low assumptions) relative to forecast consumption for the next 12 months[129]	Average inflows: 17months Low inflows: 14months	TER, Hydro Tasmania,
	Total available energy supplies (including imports)	As above but including assumed available Basslink imports and gas generation[130]	Average inflows: 22months Low inflows: 19months	TER, Hydro Tasmania
	Diversity of supply	Percentage of consumption met by non-hydro generation and number of non-hydro sources (greater than 5% of Tasmanian consumption), assessed over most recent year, 5 year average and 10 year average (to 2015-16)	1 year: 25% and 3 non-hydro sources 5 year: 23% and 3 non-hydro sources 10 year: data unavailable at time of publication	TER

127 Published data for 2015-16, the year in which the 6 month Basslink outage occurred, is not yet available.
128 Historical data since 1997 inclusive. One standard deviation below mean is between 7 930 GWh and 9 023 GWh. One standard deviation above mean is between 9 023 GWh and 10 115 GWh.
129 All time low annual inflows assumed at 6 434 GWh. Average inflows assumed as 9 000 GWh. Wind generation assumed at 900 GWh.
130 Gas generation assumed at 1 752 GWh. Basslink import assumed at 2 628 GWh.

Criteria	Performance Indicators	Performance Measures	Actual performance	Data source
Reliability	Unserved energy (generation and transmission)	Unserved energy (USE) compared to NEM standard of 0.002 per cent. Most recent year (2014-15), 5 year average and 10 year average	1 year: 0.0000% 5 year: 0.0000% 10 year: 0.0000%	AEMC
	Unplanned outages (transmission)	Number of LOS events >0.1 system minute Target: ≤15; Most recent year (2014-15), 5 year average Number of LOS events >1.0 system minute Target: ≤2; Most recent year (2014-15), 5 year average	LOS events >0.1 system minute 1 year: 5 5 year: 9 LOS events >1.0 system minute 1 year: 0 5 year: 2	TER
	Distribution Network Reliability	System average interruption frequency Index (SAIFI) and System average interruption duration Index (SAIDI) for 2014-15[131] Measure - number of communities inside SAIFI and SAIDI limits for 101 communities	SAIFI – 93 compliant communities SAIDI – 62 compliant communities	TER
	Asset Management	Generation and transmission asset management plans independently assessed	Basslink – last completed November 2014 Hydro Tasmania – last completed November 2015 TasNetworks – last completed (Transend 2012, Aurora Distribution 2011)	TER
	Installed capacity	Reserve Plant margin	3 453 MW installed capacity 1 787 MW reserve capacity above forecast maximum demand	TER

[131] SAIFI measures how often a customer can expect to experience an outage. SAIDI measures average outage duration per customer (planned and unplanned). The reliability of the Tasmanian distribution network is based on the performance of 101 geographical communities which are grouped into five supply reliability categories.

Criteria	Performance Indicators	Performance Measures	Actual performance	Data source
Competitiveness	Residential customer costs	Comparison of Tasmanian residential electricity costs with national average	Tas < national average[132]	TER
	Small business customer costs	Comparison of Tasmanian small business electricity costs with national average	Tas < national average[133]	TER
	Small customer price volatility	Annual change in electricity prices relative to changes in CPI, most recent year and 7 year average.	7-year average = +2.63[134] percentage points July 2016 = +2.13 percentage points	TER, Australian Bureau of Statistics (ABS)
	Vulnerable customers	Number of customers per 100 on hardship programs (compared to available jurisdictional data) as at 30 June 2016	TAS - 0.87 SA - 1.8 ACT - 0.37 NSW - 0.79 QLD - 0.97	Australian Energy Regulator (AER)
	Tasmanian energy affordability	Annual electricity bills as a share of disposable income for a benchmark low income household (6 500 kWh), with and without concession, most recent year (2015-16) and 3 year average.[135]	1 year: Without concession – 8.5% With concession – 6.4% 3 year: Without concession – 8.7% With concession – 6.6%	AER
	Commercial and industrial prices	To be developed[136]		
	Availability of consumer choices	Effective competition[137]	Effective competition yet to emerge.	AEMC
	Energy efficiency	To be developed[138]		
	Electricity sector carbon emissions	Per capita electricity sector carbon emissions in Tasmania compared with Australia 2014	Tasmania: 818 $CO_{2\text{-e}}$ per capita Australia: 7 652 $CO_{2\text{-e}}$ per capita	Cth Department of the Environment and Energy / ABS

[132] OTTER, 2016, *Comparison of Australian Standing Offer Energy Prices as at 1 August 2016*. Tasmanian residential costs compared with around 60 tariff offerings nationally, based on certain assumptions.

[133] OTTER, 2016, *Comparison of Australian Standing Offer Energy Prices as at 1 August 2016*. Tasmanian small business costs compared with around 30 tariff offerings nationally, based on certain assumptions.

[134] Seven year average chosen due to change in structure standing offer tariffs 2009 onwards to flat rate for Tariff 31 Light & Power. A positive number indicates that small customer electricity prices increased by more than CPI.

[135] Australian Energy Regulator reporting on energy affordability for Tasmania commenced in 2012-13 when the National Energy Retail Law was applied to the Tasmanian jurisdiction.

[136] The Taskforce is not aware of available data to measure commercial and industrial prices, given most price are commercially negotiated and are confidential. The Taskforce considers however, that developing a measure would be desirable and hence has included the performance indicator as a placeholder.

[137] A performance measure for consumer choice availability would ideally capture a broad range of options for consumers to manage their demand and supply. However, the Taskforce is not aware of such a measure at this time. Hence, the Taskforce has used a performance measure focussing only on retail competition, as assessed by the AEMC in its 2016 Retail Competition Review.

[138] The Taskforce is not aware of available data to holistically measure the energy efficiency of business and residential sectors. The Taskforce considers however, that developing a measure would be desirable and hence has included the performance indicator as a placeholder.

Table 16.2 Tasmanian energy security performance indicators, performance measures and actual performance against each measure for gas[139]

Criteria	Performance Indicators	Performance Measures	Actual performance	Data source
Adequacy	Available capacity of Tasmanian Gas Pipeline	% yearly average of daily flows of TGP capacity not utilised (129 TJ)[140], most recent year (2015-16) and five year average	1 year: 72% not utilised 5 year: 70.5% not utilised	TGP
Reliability	Transmission reliability	Interruptions to supply, most recent year (2014-15) and five year average	1 year: 0[141] 5 year: 0.2	TER
		Maintenance plan compliance – target: 90% most recent year (2014-15) and five year average	1 year: 99.7%[142] 5 year: 99.46	TER
	Distribution reliability	Total Interruptions, most recent year (2014-15) and five year average	I year: 265 5 year: 327	TER
		Average interruption minutes, most recent year (2014-15) and five year average	I year: 78 5 year: 70	TER
Competitiveness	Residential customer costs	Comparison of Tasmanian residential gas costs with national average	Tas < national average[143]	TER
	Small business customer costs	Comparison of Tasmanian small business gas costs with national average	Tas > national average[144]	TER
	Distribution and Transmission utilisation of gas	Percentage split of total gas utilisation between distribution (Dx) and transmission (Tx) customers, most recent year (2014-15) and five year average	I year: Dx - 29% Tx – 71% 5 year: Dx - 15% Tx – 85%	
	Total distribution customers	Customers connected compared to previous year.	2014-15 change – increase of 6% (11 978 to 12 699)	TER

139 Broader energy market performance indicators concerning the environment and energy efficiency are to be included within electricity indicator measures.
140 Based on financial year and data taken from Tasmanian Gas Pipelines website tracking daily flows. TGP total daily available capacity 129 TJ.
141 TGP has reported one interruption to supply in past five years, in 2010-11.
142 TGP five year average maintenance plan compliance sits at close to 100%
143 OTTER, 2016, *Comparison of Australian Standing Offer Energy Prices as at 1 August 2016.* Tasmanian residential costs compared with around 50 tariff offerings nationally, based on certain assumptions.
144 OTTER, 2016, *Comparison of Australian Standing Offer Energy Prices as at 1 August 2016.* Tasmanian small business costs compared with around 60 tariff offerings nationally, based on certain assumptions.

17. Appendix 2: Current Energy Security Oversight Arrangements

The present energy security oversight framework for Tasmania is a mixture of:

- state-based laws, rules and regulatory functions that provide specific provisions to address matters of supply security;
- oversight mechanisms such as government committees, prudent water storage management directives and annual network planning statements; and
- national market architecture in the form of market operator powers, national rules, and prescribed functions to be undertaken within the Tasmanian energy market.

These areas define the energy security oversight roles and responsibilities for key sector participants as well as the emergency management plans set to be enacted under an energy emergency event.

17.1 National energy market architecture

17.1.1 The Australian Energy Market Operator (AEMO)

AEMO is responsible for maintaining energy security in the NEM under a national legislative framework, principally the NEL and National Gas Law (NGL). Underneath the NEL, the NER prescribes all procedures and processes for market operations including, amongst other matters, power system security.

In order to model the risks associated with hydro-electric power in the NEM, AEMO conducts the Energy Adequacy Assessment Projection. This modelling determines the risk of breaching unserved energy reliability standards using a range of rainfall scenarios.

AEMO exercises its emergency management responsibilities under an agreed framework in all NEM jurisdictions (Tasmania, Victoria, South Australia, ACT, New South Wales and Queensland) known as the PSEMP.

17.1.2 Prescribed roles for Tasmanian officers

AEMO, Tasmanian Government officers and TasNetworks also have prescribed regulatory roles and responsibilities to manage energy security threats under national arrangements, though these tend to be organised mostly around 'capacity' emergencies that arise from sudden events, rather than a deficit in available energy sources.

The JSSC is appointed by the Tasmanian Minister for Energy in accordance with Section 110 of the NEL. The JSSC has the key responsibility to prepare load shedding priorities and sensitive loads for Tasmania and arrange their authorisation.

The RO for each jurisdiction is provided for in the NEM Memorandum of Understanding (MOU) on the use of Emergency Powers and associated NEM Emergency Protocol. The RO is the key jurisdiction operations contact for AEMO and for Tasmania is the General Manager Customer Engagement from TasNetworks. The RO for Tasmania has the key responsibility to enact load shedding directed by AEMO, or the jurisdiction, as part of an emergency response.

17.2 Tasmanian laws, rules and regulatory functions

Across the Tasmanian electricity and gas legislative framework there are a number of provisions and requirements placed upon State Government officers and energy sector participants that can be considered part of the energy security oversight framework.

17.2.1 Electricity legislation

For electricity entities with key roles in energy security, namely generators and transmission/distribution operators, the *Electricity Supply Industry Act 1995* (the ESI Act) includes provisions relating to the management of energy security events. Part 6 of the ESI Act details 'emergency restriction orders' that can be enacted by the Minister for Energy to restrict electricity use to the level of available or sustainable supply. This can be done if an electricity entity can satisfy the Minister that:

- it is presently unable to meet the demands for electricity from its customers because of failure of, or damage to, its electricity infrastructure or for any other reason; or
- it may not be able to sustain hydro-electric electricity generation at the level of current demand because of depletion of water supplies.

Before making an emergency restriction order because of the depletion of water supplies available for hydro-electric generation, the Minister must consider the advice of an advisory committee established to monitor and advise the Minister on the adequacy of the available water supplies (see the Water Storage Advisory Committee below).

The *Energy Co-ordination and Planning Act 1995* (the EC&P Act) establishes the role of Director of Energy Planning (Director). This role has a number of functions and powers to assist and advise the Minister for Energy on all aspects of energy policy. In the context of energy security, the Director has requirements to:

- advise the Minister on the energy needs of the State and any factors which might put the supply of electrical energy at risk;
- monitor the operation of the State's energy industry and participants in consultation with interested groups and persons;
- examine and monitor the factors affecting the supply and demand for energy in Tasmania;
- coordinate activities to ensure that adequate arrangements are in place for the planning of the State's electrical system; and
- produce and publish information and reports on energy related matters.[145]

To support these functions, the Director has information gathering powers and is to be assisted by appropriate staff as appointed under the *State Service Act 2000*. The Director must report to the Minister for Energy annually on the performance of the Director's functions and exercise of the Director's powers. This report covers all aspects of the Director's functions and powers and is not limited to matters of energy security.

17.2.2 Gas legislation

In Tasmania, the legislative instruments governing the gas industry are the *Gas Act 2000* (the Gas Act) and the *Gas Pipelines Act 2000*. Both Acts are assigned to the Minister for Energy for the most part, and to the Minister for Justice and Workplace Relations in so far as they relate to the appointment, functions, powers, and duties of the Director of Gas Safety.

The *Gas Act 2000* provides that the Minister for Energy may direct customers connected to the distribution network not to use gas during certain energy supply emergency events to ensure the most efficient and appropriate use of the available gas or to ensure no gas is drawn from the system except for allowed purposes.

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145 *Energy Co-ordination and Planning Act 1995*, section 5(1).

17.2.3 Liquid fuels/petroleum

In Tasmania, petroleum products supply incident management responsibilities are identified in the *Petroleum Products Emergency Act 1994*. This Act provides the Tasmanian Governor with the power to declare a period of emergency restriction and/or rationing as a means of managing supply constraints. This power has not been used to date as the industry has managed (mostly localised) supply issues without significant impact on consumers.

17.2.4 Department of State Growth

State Growth's Industry Policy Branch provides policy advice on energy issues to the Minister for Energy in regards to his portfolio responsibilities relating to the Tasmanian and national energy sector. This includes implementing the Tasmanian Government's Energy Strategy and ensuring arrangements are in place to respond to any major disruption to supplies in Tasmanian electricity, gas or petroleum products.

State Growth also has had historical responsibility under the Tasmanian Emergency Management Plan to be the main advisory and management authority for hazards of an energy supply security nature and to support prescribed statutory roles of the Director and the JSSC. [146]

17.2.5 Department of Treasury and Finance

The Department of Treasury and Finance's (Treasury) responsibilities includes monitoring and the provision of strategic advice to Shareholding Ministers (currently the Minister for Energy and the Treasurer) on the performance and management of all Tasmanian Government businesses. This includes the three Tasmanian Government owned energy entities – Aurora Energy, Hydro Tasmania and TasNetworks. Treasury does not have formal responsibility for energy policy or energy security, although it may provide advice on these matters from a whole of State financial perspective if required. In practice, Treasury has had a lead role in most of the major energy sector structural reforms in Tasmania since at least the mid 1990s.

17.2.6 Tasmanian Economic Regulator (TER)

The TER has an objective set in the ESI Act to "*establish and enforce proper standards of safety, security, reliability and quality in the electricity supply industry.*"[147] This is primarily conducted through the powers provided to the TER to administer gas and electricity licences for generators and distributors. Compliance with obligations under a licence are periodically tested by the TER as part of independent appraisals required to be undertaken approximately every two years.

As part of licence conditions, both generators and distributors of electricity and gas must maintain an emergency management plan in accordance with a guideline currently issued by the JSSC.

For gas, emergency management plans are reviewed and approved by the Director of Gas Safety.

The TER also conducts annual reliability reviews.

17.2.7 Government owned businesses

The overall treatment of a Government Business Enterprise (GBE) and State Owned Company (SOC) are similar with the reporting requirements and overall commercial expectations the same for both types of entities. Of the three government owned businesses, Hydro Tasmania is a GBE while Aurora Energy and TasNetworks are SOCs.

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[146] Department of Police and Emergency Management, 2015, *Tasmanian Emergency Management Plan*.
[147] *Electricity Supply Industry Act 1995*, section 6(2)(c).

Through their respective frameworks, all three entities must abide by the strategic requirements provided to them by their Shareholder Ministers. Treasury prepares and administers a range of governance documents to guide the government businesses and to ensure that the Shareholding Ministers' expectations for the specific businesses are met. These include Treasurer's Instructions and Guidelines for Government businesses, such as the preparation of Corporate Plans. Specific energy policy objectives of Government are also communicated to the businesses through appropriate governance instruments, such as Ministerial Charters or Statements of Expectation.

17.3 Energy security oversight mechanisms

17.3.1 Hydro Tasmania's Ministerial Charter

The obligation on Hydro Tasmania to ensure the prudent management of its water storages is currently imposed by the Tasmanian Government through Hydro Tasmania's Ministerial Charter. In 2006, to give effect to the obligations, Hydro Tasmania established a set of prudent water storage management guidelines that were designed to ensure that water storages were being managed sustainably such that there was sufficient water in reserve to ensure the short and long term reliability of electricity supply.

The Ministerial Charter outlines the 'Principal Purpose' of Hydro Tasmania to: "*efficiently generate, trade and sell electricity in the National Electricity Market.*" Underneath this purpose there is a 'Principal Objective' to "*achieve a sustainable commercial rate of return in accordance with its corporate plan, having regard to the social and economic objectives of the State, as agreed in writing with the Portfolio Minister and the Treasurer.*" [148]

With regard to water storage management, the Ministerial Charter details the 'Strategic Expectation' that Hydro Tasmania will "*prudently manage its water resources consistent with the long run energy capability of its system.*"[149]

Hydro Tasmania's Ministerial Charter is a publicly available document that is tabled in the Tasmanian Parliament (including when it is revised).

17.3.2 Reliability standards and reviews

TasNetworks has a number of transmission and distribution planning requirements, set at both a national and State level.

- Under the requirements of the NER, TasNetworks must publish an Annual Planning Report to provide information on the planning activities undertaken in the previous year and to consider future requirements to accommodate changes to load and generation.
- Under the Tasmanian Annual Planning Statement, TasNetworks is required as part of its licence conditions to assess the adequacy of electrical energy availability for low, medium and high rainfall scenarios and is also required to assess significant risks to the security of Tasmania's energy supply from extreme events.
- Under its transmission licence, TasNetworks is required to plan, procure and progress augmentations that are necessary to meet service obligations, including transmission planning and security criteria. These criteria are mandated through the *Electricity Supply Industry (Network Planning Requirements) Regulations 2007*.

148 Hydro Tasmania Ministerial Charter, November 2012.
149 Ibid.

The Annual Planning Report from TasNetworks covers both its transmission and distribution functions under the NER and meets its requirements to prepare a Tasmanian Annual Planning Statement.

Under its licence and in accordance with the TER's Electricity Supply Industry Information and Performance Reporting Guideline, Basslink is also required to report annually on its performance to the TER.

17.3.3 Committees

The WSAC is established by the Minister for Energy under section 67 of the ESI Act. The WSAC is chaired by the Director of Energy Planning, and includes senior representatives from the Department of Premier and Cabinet, Treasury and the Department of Primary Industries, Parks, Water and Environment. Non-members (including Hydro Tasmania) attend as required to brief the WSAC on matters relevant to its function. Under its Terms of Reference, the WSAC is required to meet annually, but meets more frequently when water storages fall below certain levels, or as determined by the Chair.

The WSAC's single role is to advise the Minister for Energy on whether there are adequate available water supplies to sustain hydro-electric electricity generation at the level of current demand. Specifically, the Minister for Energy's power to invoke mandatory restrictions on the basis of water shortages may only be exercised after consideration of advice from the WSAC. However the WSAC does not itself advise on the restrictions, but provides information that must be taken into account by the Minister for Energy.

In the past, other management committees relating to emergency or energy security issues have been established. However, the Taskforce understands these have since been suspended due to a review of their legal authority and consideration of appropriate committee structures.

17.3.4 Emergency management framework and plans

The emergency management arrangements for the broader NEM are embodied in a common framework for an integrated response by all participants. This framework includes:

- the NEM MOU between the States and AEMO on the Use of Emergency Powers;
- the NEM Emergency Protocol; and
- AEMO's PSEMP.

Tasmania is a signatory to the NEM emergency management framework for electricity, gas and liquid fuels purposes.

Additionally, the Tasmanian *Emergency Management Act 2006* provides a head of power for the Energy Supply Emergency Plan. This Act allows for emergency powers under Schedule 1(1)(i) to: "*turn off, block, take possession of or restore the supply of electricity, liquids, gas or any other substance.*"

For gas, there are national plans in relation to emergency management:

- the National Gas Emergency Response Protocol; and
- the National Liquid Fuel Emergency Response Plan.

18. Appendix 3: Modelling Assumptions

The make-up of the supply demand balance in Tasmania can vary greatly in any given year. The baseline model represents that average state of the Tasmanian energy supply demand balance in the short term. For the purpose of establishing a baseline on which to evaluate a variety of risk scenarios the following assumptions have been made:

- average inflow of 9 000 GWh;
- annual wind output of 900 GWh;
- Basslink net energy capability of 2 665 GWh;
- thermal generation capability of 1 752 GWh; and
- annual Tasmanian energy consumption of 10 600 GWh.

18.1 Average inflow into hydro storages

There is a clear variability in inflows over time which has resulted in the downward revision of annual average inflows at Hydro Tasmania. In summary, the historical assumption of 10 000 GWh average inflows into the system has been replaced by the existing assumption of 9 000 GWh, as a result of a clear shift in observed yield since 1997. The assumed average inflow for the baseline scenario model is 9 000 GWh for the modelling undertaken by the Taskforce. However, there is evidence to suggest the long-term average could be reduced to 8 700 GWh. While the Taskforce has not used this figure in its modelling, it has reflected this possibility in identifying Tasmania's on-island energy deficit as being between 700 GWh and 1 000 GWh.

18.2 Wind generation

In order to obtain a full understanding regarding the annual generation in Tasmania, an assessment must be made on the annual output of wind generation. It is inappropriate to use an average output of historical generation data as a basis for the modelling assumptions because the addition of new wind generation in recent years has resulted in the sample size for the wind generation from the existing installed capacity being too small. To this end the assumption made for the modelling relates to the wind generation output of the most recently reported year of 2014-15.[150] This assumption is an output of 898 GWh per annum. Hydro Tasmania has indicated that the annual output of installed wind generation in Tasmania varies from 900 GWh to 1 100 GWh in the low to high scenarios. Hence the Taskforce's analysis is based on a conservative assumption.

18.3 Basslink energy transfer

In terms of Tasmania's supply demand balance, Basslink can present as both supply and demand depending on the direction of energy flow. In order to incorporate Basslink flow into the modelling an assessment has been made of the total net energy flow over Basslink (refer Table 18.1).

Table 18.1 Historical Basslink energy flows

Basslink Direction	2010-11	2011-12	2012-13	2013-14	2014-15	Average
Tasmania to Victoria (GWh)	1 320	989	2 294	3 131	728	1 692
Victoria to Tasmania (GWh)	1 108	1 280	253	20	2 200	972
Total (GWh)	2 428	2 269	2 547	3 151	2 928	2 665

150 OTTER, 2016, *Energy in Tasmania – performance report 2014-15.*

This net energy flow takes into account the average energy outcome of Basslink flow over the past five years. The Taskforce has not attempted to model the maximum possible impact of full import or full export will have on the system. Rather, the Taskforce has decided to represent the net energy flow at varying levels of import or export that have been observed in recent years. This avoids the difficulties involved in modelling spot price variations between Victoria and Tasmania while keeping the assumptions simple and easily scrutinised. For the modelling, it is assumed that Basslink is able to transfer a combined import/export volume of 2 665 GWh in a 12 month period.

18.4 Thermal generation capacity

The TVPS comprises of three peaking units (known as Bell Bay Three in the NEM), an OCGT and a CCGT. For the purposes of generation it is assumed that the peaking units and the OCGT are primarily used for peaking purposes caused by times of very high demand and/or very high prices in the Victorian spot market. For the purposes of building or maintaining total energy in storage of the hydro system, it is assumed that efficient operation of the CCGT is the most likely way that the TVPS would be used to support energy security. In the assumptions used in the modelling, a flat output of 200 MW has been used to estimate the capacity for thermal generation to contribute to energy security. This translates to 1 752 GWh per annum. While this may overstate the capacity of the CCGT over a longer period of time (given maintenance periods and outage risks), the availability of the OCGTs can be conservatively assumed to offset any actual difference.

18.5 Tasmanian energy consumption

Tasmanian energy consumption has been in decline since its peak in around 2008. AEMO provides an energy consumption forecast for Tasmania as part of its National Energy Forecast Report (2016) (NEFR) performed on an annual basis. The 2016 NEFR has been used to guide the modelling assumptions of the Taskforce. The current outlook for Tasmanian annual energy consumption is relatively flat until the end of the forecast period in 2035. As a result, the assumption used for the modelling presented is an average of the forecasted energy consumption of the NEFR for Tasmania. The results in an assumption of 10 600 GWh per annum, which is comparable to assumptions made by Hydro Tasmania in its modelling.

19. Appendix 4: Low Inflow Scenarios – Additional Information

19.1 One year record low inflow

This scenario outlines the extent to which existing generation sources, other than hydro and wind, would be required in order to maintain total energy in storage at the levels observed at the beginning of the year under record low annual inflows of 6 434 GWh (the lowest actual year on record). This scenario is shown in the first column of Figure 7.3 in Chapter 7. Assumptions on Tasmanian energy consumption, wind generation, Basslink annual energy transfer capacity and available contribution of thermal generation are provided at Appendix 3.

This scenario illustrates that if a record low inflow year (6 434 GWh) were to occur today, the combination of hydro-electric generation, wind generation and the assumed annual Basslink energy transfer fully importing into the State over the course of the year would not be sufficient to meet Tasmanian consumption without reducing the stock of storage. In this scenario a drawdown of energy in storage of 4.2 per cent would be required in order to meet Tasmanian consumption (refer Table 7.1 in Chapter 7). However, if thermal generation of 603 GWh is added the 12 month period, there would be no requirement for a drawdown of energy in storage.

If this record low scenario was to occur without the availability of Basslink the result would be an annual energy in storage drawdown of around 10 per cent if thermal generation was operating on the baseline assumption (refer Table 7.1). In reality the drawdown would be less than this as it is assumed that such a low inflow year would result in maximum operation of all thermal generation assets. The 24 hour operation of the full capacity of thermal generation (387 MW or 3 390 GWh per annum at full output) would be enough to bring the annual storage position back to equilibrium in this scenario. Operation in this manner is unlikely to occur in a full 12 month period due to maintenance requirements and poor fuel efficiency when operating at maximum output.

19.2 Three year record low inflow sequence

This scenario outlines the extent to which existing generation sources, other than hydro and wind, would be required in order to maintain total energy in storage at the levels observed at the beginning of the lowest three year sequence of inflows on record (22 590 GWh between 2006-08, or on average 7 530 GWh per annum). This scenario is represented in the second column in Figure 7.3 in Chapter 7 on a per annum basis. Assumptions on Tasmanian energy consumption, wind generation, Basslink annual energy transfer capacity and available contribution of thermal generation are as per the baseline assumptions listed in Appendix 3.

If the lowest three year sequence of inflows were to repeat itself, hydro and wind generation would need to be supplemented by a Basslink energy flow requirement of 91 per cent import and nine per cent export to enable total energy in storage to be maintained over the three years. With the addition of thermal generation base load over that time, the Basslink energy flow requirement would reduce to 58 per cent import and 42 per cent export in order to maintain total energy in storage.

19.3 Five year record low inflow sequence

This scenario outlines the extent to which existing generation sources, other than hydro and wind, would be required in order to maintain total energy in storage at the levels observed at the beginning of the lowest five year sequence of inflows on record (42 566 GWh between 2006-10, or on average 8 513 GWh per annum). This scenario is represented in the third column in Figure 7.3 in Chapter 7 in a per annum basis. Assumptions on Tasmanian energy consumption, wind generation, Basslink annual energy transfer capacity and available contribution of thermal generation are as per the baseline assumptions listed in Appendix 3 for each year of the five years represented in this scenario.

If the record low five year sequence of inflows were to repeat itself, hydro and wind generation would need to be supplemented by a Basslink energy flow requirement of 72 per cent import and 28 per cent export to enable total energy in storage to be maintained over the five year period. With the addition of thermal generation base load over that time, the Basslink energy flow requirement would fall to 39 per cent import and 61 per cent export in order to maintain total energy in storage.

19.4 Ten year record low inflow sequence

This scenario outlines the extent to which generation sources, other than hydro and wind, would be required in order to maintain total energy in storage at the levels observed at the beginning of the lowest 10 year sequence of inflows on record (86 980 GWh between 2006-15, or on average 8 698 GWh per annum). This scenario is represented in the fourth column in Figure 7.3 in Chapter 7 in a per annum basis. Assumptions on Tasmanian energy consumption, wind generation, Basslink annual energy transfer capacity and available contribution of thermal generation are as per the baseline assumptions listed in Appendix 3 for each year of the 10 years represented in this scenario.

This scenario illustrates that if the record low 10 year sequence of inflows were to repeat itself, hydro and wind generation would need to be supplemented by a Basslink energy flow requirement of 69 per cent import and 31 per cent export to enable total energy in storage to be maintained over the three year period. With the addition of thermal generation base load over that time, the Basslink energy flow requirement would fall to 36 per cent import and 64 per cent export in order to maintain total energy in storage.

20. Appendix 5: Examples of hydro-electric water storage management

This section outlines learnings from other hydropower systems. The Taskforce has reviewed literature on several hydropower systems, been provided with case studies and the Taskforce Chair visited Norway and met with key stakeholders involved in Norway's energy system.[151]

Table 20.1 provides an overview of relevant details of jurisdictions where hydropower generation is the dominant form of generation. The information in this table is compared and contrasted to the Tasmanian situation in order to provide context for what can be learnt from the jurisdictional water storage management practices that would improve the energy security situation in Tasmania.

Table 20.1 Jurisdictions with dominant hydro-electric generation

	Norway	New Zealand	Manitoba (Canada)	Iceland	Tasmania
Annual demand	109.3 TWh	42.9 TWh	26 TWh	18.1 TWh	10.6 TWh
Typical generation mix	Hydro 96.1% Thermal 2.5% Wind 1.4%	Hydro 56.7% Geothermal17.3% Thermal 15.0% Wind 5.4% Coal 4.1% Other 1.5%	Hydro 87% Thermal 9% Wind 4%	Hydro 71% Geothermal29%	Hydro 90% Wind 10% Thermal 0%[152]
Annual inflows	131.4 TWh	24 TWh[153]	36 TWh[154]	13.4-18.6TWh	9 TWh
Hydro storage capacity	85 TWh	3.8 TWh[155]	Data unavailable	Data unavailable	14.5 TWh
Interconnection	High levels of interconnection with further interconnection planned. Net exporter of energy.	South Island exports energy to the North island via two HVDC submarine cables	Capacity to export into the US (2 300 MW) Import capacity 760 MW Planned increase to both import and export capacities	None	Basslink
Energy security oversight responsibility	Regulatory body (NVE)	Transmission system operator, Transpower	Regulation exists for upper and lower levels of Lake Winnipeg.	Regulator (NEA) advises government on energy issues	Government authorities and generator – Hydro Tasmania
Impact of climate change	Higher average inflows (snowmelt) and higher variability	unknown	Higher average inflows (snowmelt)	unknown	Increased variability in total quantity and geographic location

151 The Chair's visit to Norway was as an adjunct to a privately organised and paid for holiday in Europe.
152 Based on profile of 2014-15 generation.
153 Estimated value.
154 Estimated value.
155 Estimated value.

20.1 Norway

The energy system in Norway is dominated by hydropower generation and is heavily interconnected with neighbouring countries. Norway has a number of generation companies of various sizes, all of which are state-owned either in full or in part. Norway's annual inflow is greater than the annual energy consumption, leading to an excess of energy in the system. This excess can be stored in long-term storage lakes up to 85 TWh and is also regularly exported to neighbouring countries. Norway has such a large energy surplus that more interconnectors are being built despite the existing high interconnection capacity. These new interconnectors will connect to the UK and Germany and have been justified on economic terms. Norway is moving towards its vision for being the battery of Europe.

Energy security challenges have been rare for Norway but despite this the regulatory body, the Norwegian Water Resource and Energy Directorate (NVE), has significant capacity to analyse and model the hydrological and energy security aspects of operating hydro power stations. This capacity was developed in 2002 when the largest generation company, Statkraft, spent time upskilling the regulatory body in order to provide this function to the Norwegian energy system.

The NVE has powers to segment and control the energy market in times of dry inflow sequences. The NVE can also escalate communications when energy security risks increase to such a degree that public awareness and response is necessary. These measures ensure that low inflow sequences do not result in energy shortfalls, however, they are understood to have never been used. Instead, Norway allows the market to resolve demand and supply for as long as possible. Small customers in Norway are exposed to some spot price volatility in their energy bills and this appears to be accepted, just as Australians accept that petrol prices vary regularly over time and between locations.

Current inflow assumptions for planning purposes are based on historically low inflow outcomes. The energy entities are able to fully utilise this assumption as a result of a system whereby average inflow outcomes far exceed annual local consumption.

Norway is in the process of decommissioning and selling its thermal power stations as a result of the interconnection capacity in place and being constructed.

It is anticipated that temperature increases driven by climate change will result in a higher degree of snowmelt and increase inflows into dams overall. The Taskforce has been advised that climate change will also increase inflow variability in Norway, leading to longer dry periods between the heavy inflows.

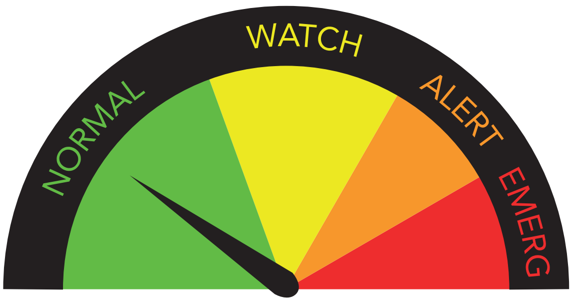
20.2 New Zealand

The energy system in New Zealand is characterised by a majority of hydropower generation supported by a combination of geothermal, thermal, wind and coal fired generation. There are multiple, privately-owned and majority government owned generators in New Zealand. New Zealand has interconnection between the South and North Islands in order to transfer energy from the generation dominated South Island to the demand dominated North Island. New Zealand has a low volume of storage capacity compared to the annual inflows received, meaning that generation must be available during times of high inflow in order to capture the full value of the inflows. This also represents an increased risk to energy security if low inflow sequences are experienced. New Zealand is more diversified than the Tasmanian system although it is still heavily reliant on hydro-electric generation.

Energy security is maintained by the transmission system operator, Transpower. Transpower regularly publishes a wide variety of hydrological information including forecasts which clearly show the range of potential outcomes resulting from the current energy in storage position and historical inflow sequences.[156] Transpower also maintains a weekly security of supply newsletter to effectively communicate the energy security risks of the existing storage position. This newsletter communicates the risks of the current energy in storage outlook using a dashboard approach as shown in Figure 20.1. The newsletter communicates the current storage position as a percentage of the long-term average storage position, allowing interested parties to quickly determine the relative strength of the current energy in storage relative to the long-term average. The security of supply newsletter also contains other communications regarding the generation mix, energy demand, transmission and wholesale prices.

Figure 20.1 Transpower security of supply outlook

OUTLOOK



Over the next 8-10 weeks we expect the risk of shortage due to hydro storage to remain low (though, in the unlikely event of multiple equipment failures the situation could deteriorate.

The risk of shortage in the following 2-3 months is largely dependent on hydro catchment inflows.

The Risk Meter above is currently set to normal.

The energy in storage in New Zealand is split into controlled storage and contingent storage. Controlled storage is the water available for energy generation purposes and the contingent storage is only made available for the generation of electricity under emergency conditions or specifically to mitigate a risk of shortage. The information presented in Figure 20.1 refers to controlled storage only.

In addition to the weekly newsletter, Transpower is required under the *Electricity Industry Participation Code 2010* to publish a security of supply annual assessment in order to provide a set of metrics with which to gauge the security of supply outlook in the medium term.

The Transpower example shows the benefit of transparency with regard to publishing forecast energy in storage position and communicating the range of possibilities to the public.

Transpower also has an emergency management policy which outlines the steps taken during an energy security emergency caused by energy shortfalls rather than short-term capacity issues. The plan includes the following measures:

- providing information and forecasts to market participants;
- requesting urgent temporary grid reconfigurations;
- commencing an official conservation campaign; and
- making a supply shortage declaration and giving directions to specified participants under a predefined rolling outage plan.

A pre-determined emergency management plan with this level of specificity is not something that Tasmania currently has in place.

156 https://www.transpower.co.nz/system-operator/security-supply

The Taskforce does not currently have advice on the impact of climate change on the New Zealand hydropower system.

20.3 Manitoba (Canada)

The energy system in Manitoba, Canada, is dominated by hydropower generation and has a single interconnection with Minnesota, in the United States of America (USA). Manitoba Hydro is the state-owned energy utility that generates, transports and retails electricity (and it distributes gas). Manitoba has inflows which greatly exceed the local demand and is a net exporter over the interconnector. Manitoba appears to have significant storage capacity in Lake Winnipeg although the exact quantum of storage capacity does not appear to be publicly available. Manitoba is currently in the process of expanding the export capacity of the system with an additional interconnector into Minnesota. As a result of the abundant inflows into the system, Manitoba has very cheap energy prices and passes these low prices on to customers in order to attract additional industrial and commercial loads.

It is anticipated that climate change will increase inflows into the system over the long term as an increase in snowmelt is the projected result of the changing weather patterns in the region.[157] Like Norway, current inflow assumptions for planning purposes are based on historically low inflow sequences. Manitoba Hydro is able to fully utilise this assumption as a result of a system whereby average inflow outcomes far exceed annual local consumption.

There are upper and lower regulations on the main storage at Lake Winnipeg and these are controlled by Manitoba Hydro under the *Manitoba Water Power Act*. Although there are few direct correlations with the Tasmanian energy system it is again important to note the involvement of regulation with regard to water storages.

20.4 Iceland

The energy system in Iceland is dominated by hydropower generation and has no interconnection with any other jurisdictions. Inflows into the energy system in Iceland are more variable than the situation in Tasmania but the system is supported by a significant geothermal energy capacity. During low inflow sequences the Icelandic energy system relies heavily on demand management of large industrial loads in order to maintain energy security for other customers. The industrial load in Iceland is proportionally greater than in Tasmania, consuming around 76 per cent of the country's electricity generation in 2015.[158]

Iceland is another jurisdiction with an extensive involvement of the local energy regulator for oversight of energy security. The regulator (National Energy Authority, Orkustofnun) has responsibilities to: advise the Government of Iceland on energy issues and related topics; license and monitor the development and exploitation of energy and mineral resources; regulate the operation of the electrical transmission and distribution system; and promote energy research.

20.5 Snowy Hydro

Snowy Hydro (not listed in Table 20.1) acts as a peaking station within the NEM rather than a baseload power station and hence is fundamentally different to the energy system in Tasmania.

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157 https://www.hydro.mb.ca/environment/pdf/climate_change_report_2014_15.pdf.
158 ORKUSTOFNUN, 2016, *Energy Statistics in Iceland 2015.*

Snowy Hydro is operated according to two main principles: commercial operating outcomes, and ensuring enough water is released downstream to meet water supply requirements for downstream users. Snowy Hydro has annual targets for downstream release as dictated by the Snowy Water Licence but is free to manage the intra year profile of this water release as it determines commercially appropriate.

Snowy Hydro produces an annual report titled Snowy Hydro Water Report.[159] This report contains useful background information on the Snowy Hydro system and also give a concise overview of the inflows and operating conditions of the completed year. The report is not a legal or regulatory requirement on Snowy Hydro but is part of an effort by the organisation to remain open and transparent in the area of water storage management

[159] http://www.snowyhydro.com.au/waterenvironment/water-operations-report/

21. Appendix 6: State and Territory Renewable Energy Targets and Policies

State/Territory	Target	Current supporting policies / mechanisms[160]
Australian Capital Territory	100 per cent renewable energy by 2020 (NEM-wide projects; additional to national RET)[161]	• Staged, reverse-auction process for feed-in tariff (FiT) entitlements for large scale (200-550 MW) renewable energy developments (e.g. wind farms, large scale solar)[162] • Renewable Energy Industry Development Strategy contains 14 actions related to renewable energy investment, battery storage and research & development[163] • $12 million Renewable Energy Innovation Fund
New South Wales	No target	• New South Wales Renewable Energy Action Plan contains 24 actions related to renewable energy investment, community support and research & development[164]
Northern Territory	50 per cent renewable energy by 2030	• A Road Map to Renewables report is planned to assess the pathway to achieving the target[165]
Queensland	50 per cent renewable energy by 2030 3 000 MW rooftop solar PVs by 2020	• Queensland Renewable Energy Expert Panel currently assessing the pathway to achieving the target[166] • Solar 150 program supporting up to 150 MW of large-scale solar energy projects[167]
South Australia	50 per cent renewable energy by 2025 $10 billion investment in low carbon technologies by 2025	• Low Carbon Investment Plan sets out four key strategies towards achieving these targets, including actions related to policy and regulation, investment information, government procurement and facilitating projects to leverage funding [168] • Legislation introduced to make Crown land holdings as accessible to wind and solar investors as freehold land
Tasmania	No target	• The Tasmanian Energy Strategy and draft Climate Change Action Plan contain actions that support renewable energy development.
Victoria	25 per cent renewable energy by 2020 and 40percent by 2025 (Victorian projects only)	• Competitive auction scheme to allow companies to bid for long-term contracts (currently being consulted upon)[169] • $20 million for New Energy Jobs Fund to support new energy technology projects[170] • Renewable Energy Action Plan will set long-term actions to drive renewable energy investment in Victoria (to be released in late 2016)[171]
Western Australia	No target	• Low Emissions Energy Development Fund supports demonstration and commercialisation of innovative low emission energy technologies[172]

160 This is not an exhaustive list but provides an overview of key policies and measures currently in place.
161 http://www.environment.act.gov.au/energy/cleaner-energy/renewable-energy-target,-legislation-and-reporting
162 The FiT, which is levied on electricity users, is the difference between the wholesale price of electricity generated and the FiT price bid by the proponent.
163 ACT Government, 2015, *2015 Renewable energy industry development strategy.*
164 NSW Government, 2013, *NSW Renewable Energy Action Plan.*
165 Territory Labor, 2015, *Roadmap to Renewables.*
166 http://www.qldrepanel.com.au/
167 https://www.business.qld.gov.au/industry/energy/renewable-energy/solar-150
168 Government of South Australia, 2015, *A low carbon investment plan for South Australia.*
169 http://www.delwp.vic.gov.au/news-and-announcements/victoria-targets-climate-change
170 http://www.business.vic.gov.au/support-for-your-business/future-industries/new-energy-technologies
171 Victoria State Government, 2015, *Victoria's Renewable Energy Roadmap.*
172 https://www.der.wa.gov.au/your-environment/climate-change/256-low-emission-industry-and-technology-in-wa