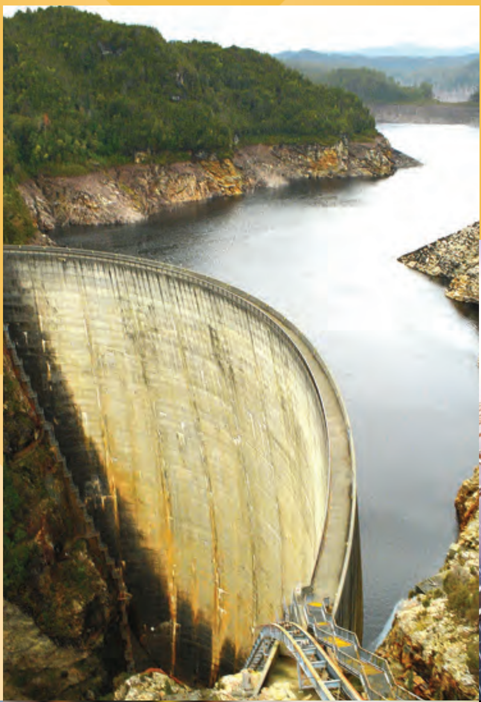





Tasmanian Energy Security Taskforce

Final Report | June 2017

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Glossary

Acronym	Meaning
ACCC	Australian Competition and Consumer Commission
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
BCG	Boston Consulting Group
BPL	Basslink Pty Ltd
CCGT	Combined cycle gas turbine
CCI	Cable Consulting International
CO_2-e	Carbon dioxide equivalent
COAG	Council of Australian Governments
DEP	Director of Energy Planning
EERZ	Extreme Environmental Risk Zone
EIS	Energy in storage
ENA	Energy Networks Australia
EV	Electric vehicle
FCAS	Frequency Controlled Ancillary Services
GJ	Gigajoule
GWh	Gigawatt hours
GSOO	Gas Statement of Opportunities
HRL	High Reliability Level
HVDC	High voltage direct current
JSSC	Jurisdictional System Security Coordinator
kWh	Kilowatt hour
LCOE	Levelised cost of energy
LGC	Large-scale generation certificate

Acronym	Meaning
LNG	Liquefied natural gas
LOS	Loss of service
MW	Megawatt
MWh	Megawatt hour
NEFR	National Electricity Forecast Report
NEM	National Electricity Market
NPV	Net present value
NTNDP	National Transmission Network Development Plan
OCGT	Open cycle gas turbine
OTTER	Office of the Tasmanian Economic Regulator
PSL	Prudent Storage Level
PV	Photovoltaic
RET	Renewable Energy Target
RO	Responsible Officer
TEIS	Total energy in storage
TER	Tasmanian Economic Regulator
TGP	Tasmanian Gas Pipeline
TJ	Terajoule
TVPS	Tamar Valley Power Station
USE	Unserved energy

Foreword

Across Australia, the ability of consumers to expect adequate, reliable and affordable energy, now and into the future, has recently come into sharp focus. Governments are rightly perceived as having the responsibility for energy security and consequently the actions required to ensure energy security is maintained.

During 2015-16, Tasmania experienced its own unique energy security challenges, with the combined impact of two extreme events – record low rainfall during spring, combined with the Basslink interconnector being out of service – resulting in Hydro Tasmania's water storage levels falling to historically low levels. The Tasmanian Government took action to slow the decline of water storages through an Energy Supply Plan, which included voluntary large user demand reduction and the installation of temporary diesel generation. While energy in storage reached a record low of 12.5 per cent in late April 2016, a combination of heavy winter rains in 2016, Basslink being back in operation and the operation of the Tamar Valley Power Station during summer, has seen energy in storage at above 35 per cent at the end of April 2017.

In response to the 2015-16 energy supply security challenges, the Tasmanian Energy Security Taskforce (the Taskforce) was established to advise Government on how it can better prepare for, and mitigate against, the risk of future energy security events.

The Taskforce released a Consultation Paper on 3 August 2016, and this was followed by the Taskforce's Interim Report, released on 21 December 2016. The Interim Report presented the Taskforce's assessment of Tasmania's energy security risks, and identified strengths and areas which require action to improve Tasmania's energy security, with a particular focus on the short-term future. A number of recommendations were made that focussed on ensuring Tasmanians can have confidence that their demand for energy is secure and, importantly, that there is a robust framework for monitoring and responding to risks.

For the Final Report, the Taskforce has continued with an evidence-based approach to undertaking its energy security risk assessment, with the findings and recommendations contained within being developed on the basis of information sought by the Taskforce, together with its own modelling of options for addressing Tasmania's energy security. The Final Report reflects updates made to recommendations proposed as part of the evidence-based assessments made in the Interim Report.

Throughout its work, the Taskforce has actively engaged with relevant stakeholders (including industry participants and customers or their representative organisations) and this has provided important information to support the preparation of the Final Report. The Taskforce is grateful to all stakeholders who took the time to prepare a submission or engage directly on matters pertinent to the Taskforce's Terms of Reference.

As required under its Terms of Reference, the Taskforce has provided this Final Report to the Minister for Energy. It contains the Taskforce's full 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 findings and recommendations to the Tasmanian Government for actions to support Tasmania's energy security both now and in the medium to long term.

Executive Summary

The Taskforce has undertaken its work during a time of considerable uncertainty and national debate around energy security and energy market issues. The number of reviews and announcements relevant to energy security that have occurred over the past 12 months has reinforced the importance of undertaking an assessment of Tasmania's energy security situation.

The energy security issues facing the mainland states are different to those facing Tasmania. Nationally, the central energy security risk is ensuring that there is sufficient energy capacity to meet peak demand. The Taskforce's assessment is that Tasmania's capacity to meet peak demand is strong. However, due to the dominance of hydro-electricity generation in Tasmania and the observed variability of rainfall, the volume of energy supply in Tasmania's water storages prevails as the most important factor in setting Tasmania's energy security. This difference is important in identifying solutions.

It remains the responsibility of the Tasmanian Government for maintaining energy security for the Tasmanian community. This responsibility includes ensuring that the State is prepared for both emergency energy capacity constraints and 'pre-emergency' energy supply shortages. It also extends to the clear communication of risk and mitigation measures to the public to support confidence in the timeliness and appropriateness of responses to energy security challenges.

In this Final Report, the Taskforce sets out a series of recommendations which will improve the Tasmanian Government's oversight of energy security. It outlines the manner in which these improvements can be introduced at a relatively low cost and be operational before the commencement of the dry season at the end of October 2017.

The Taskforce's consultation processes and the mid-term release of its Interim Report have revealed heightened community concern and an appetite for a higher level of insurance to improve the security of energy supply in Tasmania.

As a consequence of higher than average inflows over the past year, the Taskforce's assessment is that Tasmania's electricity energy security is currently 'Managed' and there are no immediate threats to energy security.[1] Hydro-electric water storages remain in the mid-30 per cent range at the end of the dry season, the gas fired Tamar Valley Power Station (TVPS) is available on standby and the Basslink interconnector is back in service.

However, the Taskforce assesses that gas energy security remains 'Susceptible' with a tightening supply of gas on the eastern seaboard and a Tasmanian gas transportation agreement beyond 2017 still subject to protracted negotiations. If satisfactory arrangements are not in place by year end, then higher levels of energy in storage may be required to mitigate against the energy security risk.

In the medium term, the Taskforce has assessed that both retaining the TVPS on standby and maintaining higher water storages are important strategies for managing Tasmania's energy security. While adoption of this approach to energy security does come with a financial cost, this cost is considered to be low relative to the energy security that it provides.

Over the medium to long term, Tasmania has the opportunity to build on its already enviable position for a low emissions future, based on its diverse array of hydro-electric power stations and the potential for further renewable energy development. Higher National Electricity Market (NEM) pricing is likely to encourage further on-island development in Tasmania, whilst over the longer term the significant strengths of Tasmania's hydro-electric based system will become an increasingly important part of a low carbon future for the nation.

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1 The Taskforce's energy security assessment ratings are defined in Chapter 15.

The energy landscape is changing rapidly in Australia and this will impact on energy policy and developments in Tasmania. Recent trends in mainland energy pricing, coal-fired generating plant closures and gas availability could impact on Tasmania's energy security in the medium to long term, to the extent that Tasmania remains dependent on energy imports. However, the State is well placed to build on its current energy security position so that the economic and social activities of Tasmanians are supported and resilience to a potential shock to the energy system is strong. Resilience would be increased by additional on-island renewable energy developments and this is consistent with the outcome that would be expected in a competitive market. It would also be consistent with the Tasmanian brand, of which Tasmanians are justifiably proud.

Modelling and analysis undertaken by the Taskforce reinforces that the following five priority actions identified in the Taskforce's Interim Report should be acted upon by the Tasmanian Government.

1. **Define energy security and responsibilities.**
    - The Taskforce has defined energy security for Tasmania as "*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*".
    - Additional recommendations are made to ensure roles and responsibilities are 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 considers that the Tasmanian Economic Regulator (TER) has appropriate credentials to undertake this independent 'Monitor and Assessor' role.
    - If water storages are near or below an identified energy security level, an 'Energy Security Coordinator' should coordinate responses across market participants to manage energy supply risks. The Taskforce considers that the Director of Energy Planning would be well placed to take on the Energy Security Coordinator role when resourced appropriately, including external technical capability.
    - The Taskforce expects that these roles could be implemented with a modest cost impost on the sector with no material pass-through to customer prices.
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 recommends the immediate introduction of an Energy Security Risk Response Framework as depicted in Figure 1.1.
    - This framework makes it clear when Hydro Tasmania can operate freely within its commercial interests and those occasions where it needs to take increasing steps to redress/avoid energy security risks.
    - The Taskforce has developed and modelled specific High Reliability Level (HRL) and Prudent Storage Level (PSL) profiles. These are based on more conservative assumptions for rainfall variability and Basslink availability, and provide the starting point for the Energy Security Risk Response Framework.

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. Figure 1.2 illustrates the comparative risk implications of various future scenarios considered by the Taskforce.
   - 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 and a timely resolution is urged, whether by commercial agreement or by using proposed national gas arbitration reforms.[2]
   - Whilst it is possible that the proposed arbitration process, if invoked, would preserve the status quo from the time of invocation until the time of determination, there is a residual risk that this may not be the case. In that event, energy in storage profiles should be temporarily adjusted upward from the beginning of the dry season (i.e. from the start of November 2017) until the arbitration process is finalised to mitigate against any increased energy security risk from not having the TVPS available.
   - Natural gas is an important energy diversification today that holds important optionality for the future. Retention of the TVPS supports ongoing supply and transportation of gas in Tasmania.
   - The long-term energy security need for the TVPS is less certain if new generation is introduced, a second electricity interconnector is built, or there is a major downturn in demand.

5. **Support new on-island generation and customer innovation.**

   - Tasmania has an annual deficit of on-island hydro-electric and wind generation to on-island consumption of between 700 GWh to 1 000 GWh (approximately seven per cent to 10 per cent per annum) 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. Promoting new renewable energy development of 700 GWh to 1 000 GWh per annum would improve Tasmania's energy security and reduce reliance on Basslink imports, thus mitigating against the risk of high priced imported energy from the rest of the NEM.
   - The Taskforce considers that Tasmania's features make it desirable for private sector interests to partner with local businesses and researchers to trial new products and services, such as storage integration and electric vehicles. The piloting of fast moving consumer-led technologies and other innovations would be positive for business sentiment.

This Final Report provides a series of recommendations that support these priority actions and which are designed to improve the resilience of Tasmania's energy security across the short, medium and long term. The Taskforce commends them to the Tasmanian Government for their earliest implementation.

[2] Vertigan M, 2016, *Examination of the current test for the regulation of gas pipelines.*

Figure 1.1 Proposed Energy Security Risk Response Framework

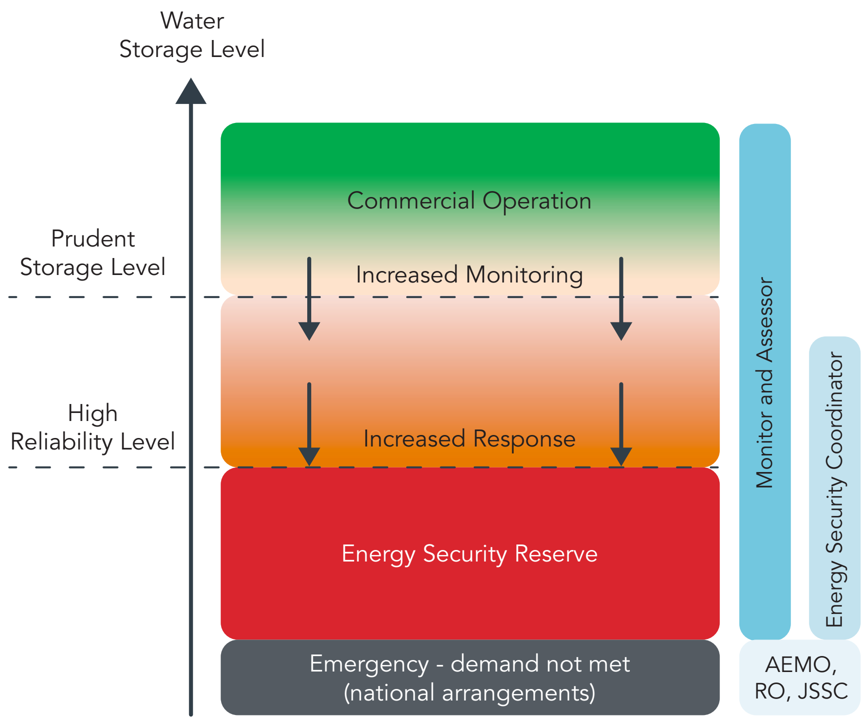
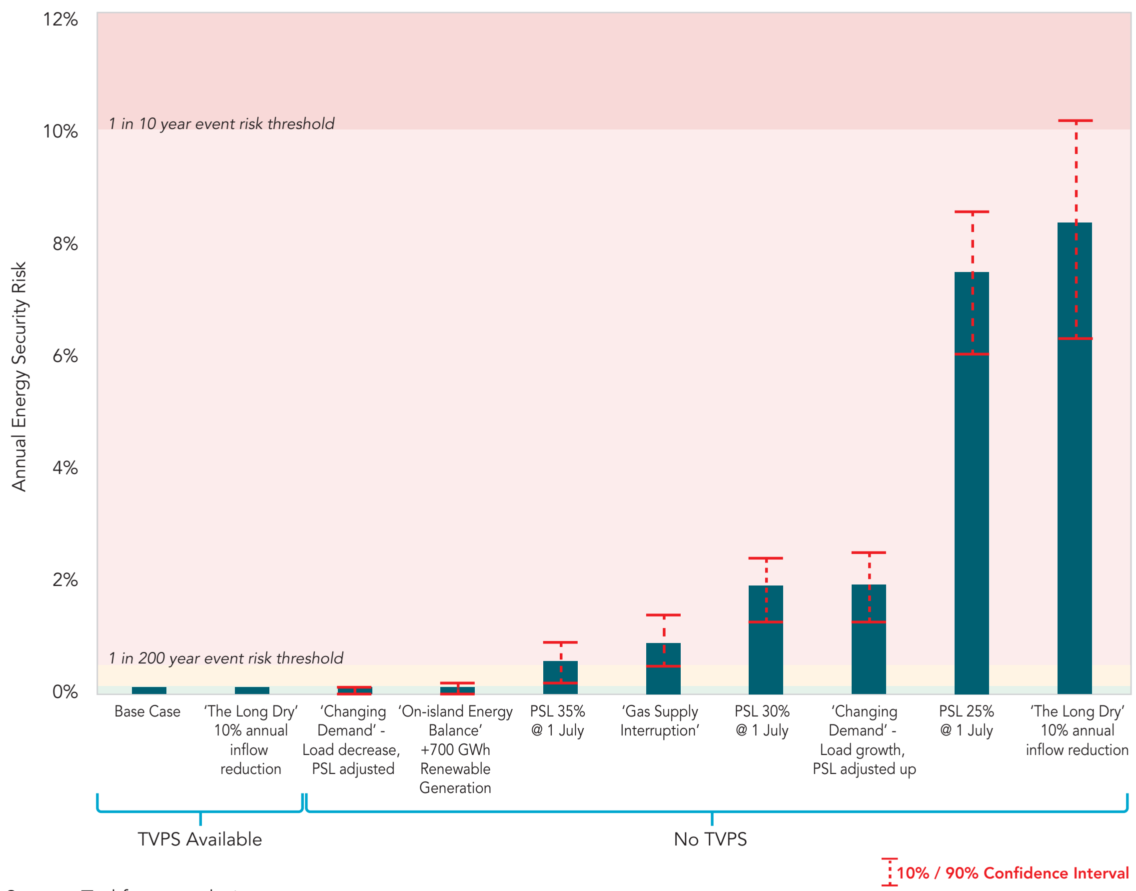


Figure 1.2 Risk of an energy security event across scenarios modelled by the Taskforce



Source: Taskforce analysis

Key Findings and Recommendations

Key findings

The Taskforce's key findings are summarised below. This summary lists findings arising from the Taskforce's Interim Report (some of which have been updated based on Final Report analysis) and highlights additional new findings that the Taskforce has identified in the Final Report.

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 annual electricity load.
- Because of the importance of energy security to households and businesses, the responsibility for energy security ultimately rests with the Tasmanian 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.

Additional findings:

- There have been significant events in 2016-17 affecting both electricity and gas markets across Australia. Growth in intermittent renewable energy generation, reducing energy demand, concern over future gas scarcity and an increase in energy security events all combine to increase uncertainty in the energy sector.
- Despite these events, future forecasts for energy supply and demand remain largely as expected. Tasmanian energy demand is projected to remain flat or increase only moderately. While emerging technologies are advancing, they are yet to have a material impact on supply or demand.

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 generating capacity 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 adverse 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 being Managed.[3] 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 gas energy security in the short term is assessed as being Susceptible.

Additional findings:

- Whilst in the past 12 months there have been significant events affecting both electricity and gas markets across Australia, the implications for Tasmania are not as heightened and consequently have not materially changed the energy security risk assessment for Tasmania outlined in the Interim Report.
- Retention of the TVPS on standby and the implementation of a new Energy Security Oversight Framework would, all other things being equal, result in Tasmania's electricity energy security adequacy and overall ratings in the short term improving to Resilient.
- Tasmania's electricity energy security in the medium and long term is 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.
- If gas transportation arrangements are not recontracted soon, this will directly impact the availability and price of gas for Tasmanian users.
- Tasmania's gas energy security in the medium and long term is 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 are not 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

[3] The Taskforce's energy security assessment ratings are defined in Chapter 15.

is a need for a clear authority in the State to coordinate and manage the situation from a State perspective (an Energy Security Coordinator role).

- 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 through a new and independent Monitor and Assessor role would enhance public confidence.

Additional findings:

- While Tasmania's energy security is assessed as being Managed in the short term, formalisation and implementation of the Energy Security Risk Response Framework, including the Monitor and Assessor and Energy Security Coordinator roles, would likely result in a Resilient assessment.
- Whether through laws, rules and/or licence conditions, it is important that the Energy Security Risk Response Framework is embedded as a sustainable operating model that will persist over years, if not decades, regardless of changes in board compositions, corporate strategies or government ownership structures.
- The Energy Security Risk Response Framework must be fully resourced, preferably with dedicated allocations, to ensure it is sustainable and supported.
- Any extended delays to the implementation of the Monitor and Assessor and Energy Security Coordinator roles may risk implementation not eventuating due to perceived lack of necessity or relevance.
- While Government is ultimately responsible for energy security, it does not require the explicit control of all energy security levers and tools to be retained within the immediate control of the Minister. The expertise and experience of Tasmania's energy businesses can be utilised to maintain energy security in a pre-emergency situation.
- During the course of the year, the actions of the Monitor and Assessor will differ according to the energy in storage relative to its prudent benchmark, forecasts of the upcoming months of inflows and the availability of Basslink.
- The successful operation of the Monitor and Assessor role relies on the free flow of information from Hydro Tasmania and a high level of analytical capability to use this information to assess the prevailing level of energy security of Tasmania.

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 independently scrutinised and above which would allow Hydro Tasmania the freedom to operate commercially, would clearly articulate the Tasmanian Government's risk appetite to Hydro Tasmania.
- The use of extreme low inflow sequences in modelling and planning will result in improved prudent planning for energy supply risks.

- 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 risk level and the actions being taken to mitigate these risks.

Additional findings:

- A High Reliability Level (HRL) profile for energy in storage applies the national concept of unserved energy (USE) to the energy constrained Tasmanian system. This allows comparison to a national standard that is accepted and well understood in the energy industry.
- The HRL profile should reflect the capability of energy in storage to meet demand over a six month period without Basslink support.
- The PSL profile should reflect an operational energy in storage profile under average supply and demand conditions. The PSL profile should also allow for a historically low three month inflow sequence and still remain at or above the HRL profile.
- As energy security is ultimately the responsibility of the Tasmanian Government, it is appropriate for the Minister for Energy to approve the proposed HRL and PSL profiles and any future variation of these. Initially these benchmarks could be established by adopting the recommendations of the Taskforce and then only varied following consideration of advice from the Monitor and Assessor.
- A material change in either supply or demand would need to occur before undertaking a reassessment of the HRL and PSL profiles.
- Energy security issues created by capacity constraints (rather than energy constraints), if they were to occur, are managed through existing national arrangements and would most likely happen in the early wet season as a result of a delay in wet season inflows. The expertise of Hydro Tasmania in managing capacity of the hydro-electric generation network need not be duplicated by the Monitor and Assessor as it is a complex task that requires a high level of modelling expertise.

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 10-20 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 backup 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.

Additional findings:

- Until additional generation to address Tasmania's annual on-island energy deficit is proven reliable and adequate, gas generation will continue to serve as the primary backup energy generation source for the Tasmanian energy sector.
- There may be value in running the TVPS at select times, to address low inflows, to ensure operational effectiveness and/or to take advantage of imbalances between gas and electricity markets.
- Gas market regulatory reforms are seeking to bring greater efficiency and competitiveness into national legislation by introducing new mechanisms such as binding arbitration to resolve disputes or inability to reach agreement between pipeline operators and shippers. From a Tasmanian perspective, these regulatory reforms should strengthen gas energy security.

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.
- 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 through Basslink imports alone without there being a challenge to energy security. 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.
- Interconnection with the NEM is a 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.

Additional findings:

- Based on the limited evidence available to it, the Taskforce is unable to reach a conclusion as to whether Basslink will be more or less reliable in the future than it has been in the past.
- There is insufficient evidence to suggest that a longer outage of 12 months or more is a plausible scenario that should be specifically planned for at this time. However, the risk of a subsea Basslink outage extending beyond six months appears to be greater until all ordered spares are delivered in early 2019.
- An independent and publicly communicated review of Basslink's asset management and compliance plans would provide greater public confidence as to their adequacy.
- A second Bass Strait electricity interconnector would enhance Tasmania's energy security and provide wider benefits. However, its development is not required to ensure Tasmania's long-term energy security if the Energy Security Risk Response Framework is adopted and new on-island generation is supported.

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 and peak

demand reduction when embedded storage technologies are combined with new products and services (e.g. time-of-use tariffs and 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.

Additional findings:

- Much of the progression of solar PV, battery storage and EVs depends on a range of factors that are largely beyond the control of the Tasmanian Government. The ability for Tasmania to significantly influence or control these factors creates uncertainty over their value to, and impact on, the energy security of the stationary energy sector.
- Over the long term, the energy security impact from EVs is expected to be low and focussed on network infrastructure.
- The need for demand-side management measures is limited due to Tasmania's excess generation capacity, although the unique characteristics of the State ensure that some locations will benefit from measures to reduce peak demand.
- The highest value in voluntary demand reductions to ease concerns during an energy supply security event in Tasmania come from major industrial energy consumers.

Additional findings – assessment of energy security options

- With the TVPS on standby and the adoption of the HRL and PSL profiles from 1 July 2017, the Tasmanian electricity energy security situation can be considered Resilient in the short term, as it would take multiple adverse events before electricity energy supply security was threatened.
- If the situation arose whereby the TVPS was temporarily unavailable, but it was considered that the TVPS could return to service in a reasonable timeframe if required to support energy security, then the HRL and PSL profiles would not necessarily require adjustment.
- If the situation arose whereby the TVPS was permanently unavailable and energy storage levels were not adjusted to reflect this loss of generation potential, then the electricity energy security situation would be assessed as Susceptible.
- However, if the TVPS was permanently unavailable and the HRL and PSL profiles were adjusted upwards to reflect that loss of generation potential, then the electricity energy security situation would be assessed as being Managed, but would not be considered as robust as with the TVPS on standby.
- While retaining the TVPS on standby and increasing energy in storage does have a financial cost, the cost is low for the energy security it provides.
- Medium-term scenario analysis indicates that:
  - The TVPS is important in reducing energy security risk in the event of a prolonged reduction in inflows. With a 10 per cent reduction in long-term average inflows, the TVPS changes from a source of backup generation to a source of baseload generation.
  - In the event of a significant reduction in long-term average inflows, new (non-hydro) generation should be developed in Tasmania in order to support Resilient electricity energy security.

- The TVPS is important in reducing the energy security risk in the event of an increase in demand.
    - In the event of a material increase in demand in Tasmania, it would be prudent to accompany the demand increase with additional generation development to ensure the on-island energy balance remains in a manageable state.
    - A significant demand reduction would result in an on-island surplus of energy generation and would alleviate energy security concerns in Tasmania. In scenarios of a very large demand reduction, this could result in stranded assets with adverse implications for generating asset owners.
    - There is an increased energy security risk if gas is unavailable to operate the TVPS. In the event of a long-term interruption to gas supply in Tasmania, adjustments would need to be made to the HRL and PSL profiles that only partially offset this risk.
    - Increasing non-hydro renewable energy generation would increase on-island self-sufficiency and is likely to provide a net benefit to Tasmania.
    - Operation of the TVPS to meet the on-island generation deficit is not preferred unless its operating costs reduce or market prices for electricity significantly increase.
    - Tasmania's energy security is not materially impacted by a carbon price. Tasmania would be in a better position to adjust to a price on carbon if it were a net exporter of energy sourced from renewable energy generation.
- The approach of adopting a PSL of around 30 per cent at 1 July each year (and 40 per cent at the end of October) and the retention of the TVPS provides a Resilient level of electricity energy security in the short term, as well as other benefits, at a cost that is low relative to the energy security that it provides.
- The development of additional Tasmanian renewable energy generation would provide a Resilient electricity energy security rating in the medium to long term and is assessed as being the most cost-effective option for reducing the on-island generation deficit in the medium term.

Priority actions and recommendations

Table 1.1 presents the Taskforce's five priority actions and its final 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. Each recommendation is identified with a prefix to indicate whether it was made in the context of the Interim Report ('IR') or the Final Report ('FR'). Recommendations from the Interim Report that have been changed in the Final Report are identified with the prefix 'FR*' to indicate that they have been updated. Readers should refer to the recommendations where they appear in the chapters of either the Interim Report or the Final Report to understand the context in which they have been made.

Table 1.1 Priority actions and final Taskforce recommendations

Recommendations	No. in Interim Report or Final Report[4]
Priority Action 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.*	IR-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.	IR-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) should undertake the Monitor and Assessor role.	FR*-2
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. The Director of Energy Planning (DEP) / Department of State Growth should undertake the Energy Security Coordinator role provided that the following necessary prerequisites are in place: • external technical and analytical capability is contracted on an ongoing basis, with TasNetworks contracted to undertake this role in the first instance; and • the Energy Security Coordinator function is provided with an explicit State Growth budget allocation.	FR*-3
Where necessary, legislation must 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.	IR-7
New oversight roles proposed as part of the Energy Security Response Framework should be implemented as soon as practicable, with interim measures/directives in place by 1 July 2017 where possible, and no later than the end of October 2017 to enable the first annual energy security assessment to be undertaken at the commencement of the 2017-18 dry season.	FR-6
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.	IR-8
The Monitor and Assessor role should consider 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.	IR-10
The Department of State Growth should review the emergency management requirements for natural gas emergencies to ensure there are clear lines of accountability between the Director of Gas Safety and the Energy Security Coordinator.	FR*-5
Priority Action 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.	IR-4
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.	IR-9

[4] IR = recommendation made in the Interim Report; FR = recommendation made in the Final Report; FR* = recommendation made in the Interim Report that has been substantially updated or changed in the Final Report. The wording of some Interim Report recommendations has been altered slightly to make actions more definitive (e.g. 'should' instead or 'could').

<table>
<tr><th>Recommendations</th><th>No. in Interim Report or Final Report[4]</th></tr>
<tr><td>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.</td><td>IR-18</td></tr>
<tr><td colspan="2">Priority Action 3: Establish a more rigorous and more widely understood framework for the management of water storages</td></tr>
<tr><td>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.</td><td>IR-12</td></tr>
<tr><td>The HRL profile should be set at the following levels at the beginning of each month:
<table>
<tr><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>28.0%</td><td>24.0%</td><td>19.0%</td><td>18.0%</td><td>16.0%</td><td>17.0%</td><td>22.0%</td><td>24.0%</td><td>29.0%</td><td>30.0%</td><td>30.0%</td><td>31.0%</td></tr>
</table></td><td>FR-7</td></tr>
<tr><td>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.</td><td>IR-13</td></tr>
<tr><td>The PSL profile should reflect an operational energy in storage profile under average supply and demand conditions and be set such that storages remain at or above the HRL profile following an historically low three month inflow sequence.</td><td>FR-8</td></tr>
<tr><td>The PSL profile should be set at the following levels at the beginning of each month:
<table>
<tr><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>38.0%</td><td>35.2%</td><td>32.4%</td><td>29.9%</td><td>29.2%</td><td>28.8%</td><td>29.4%</td><td>31.4%.</td><td>35.4%</td><td>38.7%</td><td>40.1%</td><td>39.3%</td></tr>
</table></td><td>FR-9</td></tr>
<tr><td>The Minister for Energy should be responsible for final approval of the HRL and PSL profiles and any future changes to these.</td><td>FR-10</td></tr>
<tr><td>Future changes to the HRL and PSL profiles should be based upon advice from the Monitor and Assessor and should only be made when there are material changes to supply and/or demand.</td><td>FR*-11</td></tr>
<tr><td>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.</td><td>IR-17</td></tr>
<tr><td>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.</td><td>IR-19</td></tr>
<tr><td>Hydro Tasmania must submit a robust HRL Recovery Plan to the Energy Security Coordinator for approval prior to accessing the energy security reserve.</td><td>FR*-4</td></tr>
<tr><td>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.</td><td>IR-21</td></tr>
</table>

Recommendations	No. in Interim Report or Final Report[4]
The Energy Security Coordinator should design (in consultation with key stakeholders) a pre-planned scheme for large customer demand-side responses or provision of additional generation in response to energy security threats.	FR-14
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.	IR-20
The Energy Security Coordinator should request that Hydro Tasmania provides early notice to major industrial users if energy in storage stays below the HRL and that potential buyback arrangements or additional generation may be required.	FR-15
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.	IR-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-electric system and any increased dependence on one (particularly Lake Gordon) or more storages.	IR-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.	IR-24
The TER should, to the extent possible and as soon as practicable, undertake its independent appraisal of Basslink's compliance and asset management plans and publicly report on their adequacy.	FR*-1
Energy security planning should include planning for at least a six month Basslink outage.	IR-29
Priority Action 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.	IR-25
Commercial negotiations currently underway to resolve the gas commodity and transportation arrangements to support the TVPS should be resolved in a timely manner that allows for certainty for all gas market participants to secure gas supply beyond 2017.	FR-12
Should an arbitration process be invoked for gas transportation arrangements, and should the process not provide for preservation of existing arrangements pending determination of the arbitration, then the HRL and PSL profiles should be temporarily adjusted upward from the beginning of the dry season at 1 November 2017 until the arbitration process is finalised to mitigate against the increased energy security risk of not having the TVPS available.	FR-13
Priority Action 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 in a competitive market.	IR-30
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, improving competitiveness for consumers and positioning Tasmania as open to innovation.	IR-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 returned to much higher levels than they have been in recent years by the start of the dry period in November 2016. The adoption of higher interim energy in storage targets by Hydro Tasmania, together with operation of the Tamar Valley Power Station (TVPS) combined cycle gas turbine (CCGT) during early 2017, has resulted in storages being at around the 35 per cent level as at mid-May 2017.

As a result of the 2015-16 energy security event, 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 Coordination 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 of its establishment. The Taskforce provided its Interim Report to the Minister for Energy on 12 December 2016. The Terms of Reference also require a final report to be provided within 12 months, which is to include recommendations to the Tasmanian Government on appropriate energy security risk mitigation measures. This Final Report has been prepared in response to that requirement.

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 has been a non-executive director of the Australian Energy Market Operator since November 2013.

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. He was appointed as a non-executive director of the Australian Energy Market Operator in May 2017.

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;
- 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 has been 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 has been 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 has included 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 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 was provided in the Interim Report and reinforced in the Final Report may be adaptable to transport fuels.

The Taskforce publicly released its Interim Report on 21 December 2016. The Interim Report sets out the Taskforce's assessment of Tasmania's energy security risks and identifies strengths and areas which require action to improve Tasmania's energy security. The Interim Report concentrated on the short term to ensure Tasmanians could be confident that, following the events of 2015-16, their energy needs can be met.

The Taskforce has focused its attention in the Final Report more to the medium and long term, including evaluating options that can address some of the issues and challenges that were identified in the Interim Report.

The Taskforce has been supported by a five person Secretariat seconded from within State Government and the energy sector. Boston Consulting Group (BCG) was engaged as a strategic advisor to help the Taskforce frame how it would undertake its assessments and to provide additional insight into how the energy sector could change over the next 10-20 years. Other independent expert consultants engaged by the Taskforce included Oakley Greenwood (to assist the Taskforce to work through the challenges facing the Tasmanian gas market in the context of overall energy security), Marchment Hill Consulting (to independently review the Taskforce's 'Energy Security Cost Model') and Goanna Energy Consulting Pty Ltd (to independently and rigorously assess the assumptions used in the Taskforce's modelling).

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. Thirty two submissions were received from large and small customer representatives, industry bodies and key energy sector participants, which provided useful insights and consistent messages against the Taskforce's Terms of Reference that the Taskforce has taken into consideration when developing its views.

Following its release, the Taskforce invited feedback on the Interim Report and the proposed direction for the Final Report. Eleven submissions were received which again provided informative feedback that was taken into consideration by the Taskforce in preparing its Final Report.

Throughout its work program, the Taskforce has actively engaged 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 and feedback received on the Interim Report. The Taskforce has also consulted with the secretariats supporting a number of national reviews being undertaken, including the Independent Review into the Future Security of the National Electricity Market (led by Dr Alan Finkel), the Australian and Tasmanian Governments' Joint Feasibility Study into a second Bass Strait interconnector (undertaken by Dr John Tamblyn) and the Gas Market Reform Group (chaired by Dr Michael Vertigan). The Taskforce has also engaged with the Australian Energy Market Operator (AEMO), the Australian Energy Market Commission (AEMC) and the Australian Energy Regulator (AER) to ensure that its findings and recommendations in relation to energy security oversight were workable in the national context.

The Taskforce has adopted an evidence-based approach to undertaking its energy security risk assessment. The findings and recommendations contained within this Final 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. The Taskforce is grateful to all who have taken the time to prepare a submission and/or meet with the Taskforce to share their views and insights on matters relevant to Tasmania's future energy security. A full list of stakeholders with which the Taskforce and its Secretariat has been engaged with (either through submissions or meetings) is provided at Appendix 1.

As required under its Terms of Reference, this Final Report includes recommendations to the Tasmanian Government on actions to support Tasmania's energy security. It contains the Taskforce's assessment of short (1-5 years), 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.

The Taskforce finalised the Final Report on 19 May 2017 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 Final Report.

1.5 Structure of Final Report

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

The body of the Final 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 focuses on evaluating options that can address some of the issues and challenges that were identified in the Interim Report. It focuses on medium-term prospective opportunities and scenarios that Tasmania should position and plan for to ensure its energy security is sustainable. The Final Report then assesses the Taskforce's recommendations and other options against a robust assessment criteria framework. Part A also presents an analysis of the role of interconnection, including an assessment of Basslink's future reliability and the potential role of a second Bass Strait electricity interconnector. The potential for consumer participation to facilitate energy security is also discussed.

Part B further progresses the priority actions and recommendations made in the Interim Report in relation to the proposed Energy Security Risk Response Framework. It presents the Taskforce's assessment of the preferred entities to undertake new energy security oversight roles and provides further guidance as to how these roles are expected to operate. Proposed energy in storage thresholds to be endorsed by the Minister for Energy and adopted by Hydro Tasmania are presented, as well as an analysis of how these would interact with the communication and response frameworks presented in the Interim Report. Part B also confirms the Taskforce's recommendations in relation to the TVPS and provides an update on gas commodity and transportation contract arrangements in the short term.

Part C presents the Taskforce's assessment at this time of Tasmania's electricity and gas energy security against the framework developed in the Interim Report to assess Tasmania's energy security.

Appendices provide more detailed information on the Taskforce's modelling approach and assumptions, the assessment criteria framework, the set of performance indicators and measures which the Taskforce has used to support its energy security assessments, and a summary of stakeholder engagement.

The Taskforce's Final Report is supported by the detailed information and analysis it presented in the Interim Report. In this context, the Interim Report provides necessary background to the scenario analysis, discussion, priority actions, findings and recommendations that are contained within the Final Report. Readers are directed to relevant chapters within the Interim Report where background evidence will assist with understanding the Taskforce's conclusions.

Part A

Options for Addressing Tasmania's Energy Security

2. Recap of Interim Report Recommendations

Based on the evidence outlined in Chapter 4 of the Interim Report, the Taskforce recommends the adoption of the following definition for energy security in 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 also proposes a framework to assess energy security in Tasmania that is clearly linked to the definition of energy security. The framework, which is outlined in Chapter 5 of the Interim Report, 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). In this context, an energy security rating is given to each criteria and by each timeframe.

The energy security assessment 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.

The Taskforce has continued to adopt the Interim Report's definition of energy security and the energy security assessment framework in the context of its Final Report.

In the Interim Report, the Taskforce concentrated most closely on measures that could be adopted in the short term (1-5 years) to ensure confidence that Tasmania's energy security needs could be met following the 2015-16 energy security event. Specifically, the Taskforce recommended:

- the establishment of an 'Energy Security Risk Response Framework' (refer Figure 2.1), supported by strengthened independent energy security monitoring and assessment;[5]
- the adoption of the following water storage management thresholds:
  - a High Reliability Level (HRL) – 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 low inflow sequence, and avoid extreme environmental risk in Great Lake;
  - a Prudent Storage Level (PSL) – a storage buffer from the HRL that is sufficiently conservative that the likelihood of storages falling below the HRL is low; and
- the retention of the Tamar Valley Power Station (TVPS), particularly the combined cycle gas turbine (CCGT), for the present, and at least until there is a reliable alternative in place to mitigate against hydrological and Basslink failure risk.

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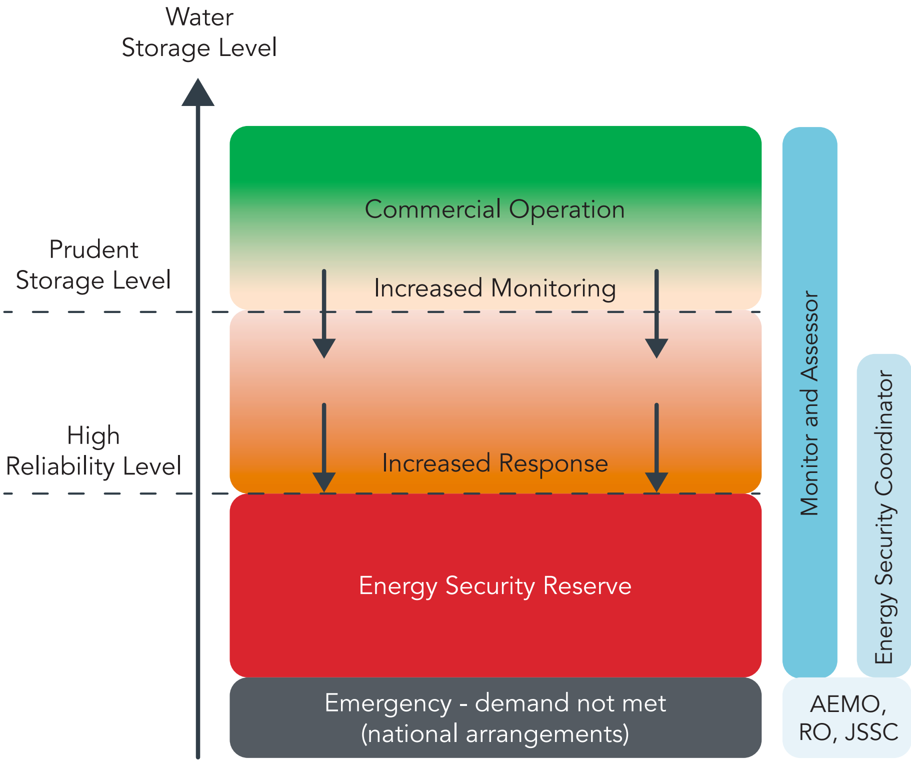
[5] The Energy Security Risk Response Framework represents the Taskforce's view of the interaction between energy supply security risk response thresholds and two new proposed energy security oversight roles (a Monitor and Assessor role and an Energy Security Oversight role).

Figure 2.1 Proposed Energy Security Risk Response Framework



The Interim Report also found 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. While Tasmania currently relies on interconnection with the mainland to address this annual deficit, the Taskforce identified that there may be opportunities to reduce this dependence through the development of additional and diversified on-island generation sources.

In the Final Report, the Taskforce has turned its attention to evaluating options for addressing Tasmania's energy security (particularly from a supply perspective) more to the medium and long term. The remainder of Part A discusses the current national context for energy security, provides an overview of the Taskforce's modelling and scenario approach, and presents the outcomes of the Taskforce's assessment of energy security options and the implications of these for Tasmania's ongoing energy security.

3. Current National Context for Energy Security

KEY FINDINGS

- There have been significant events in 2016-17 affecting both electricity and gas markets across Australia. Growth in intermittent renewable energy generation, reducing energy demand, concern over future gas scarcity and an increase in energy security events all combine to increase uncertainty in the energy sector.
- Despite these events, future forecasts for energy supply and demand remain largely as expected. Tasmanian energy demand is projected to remain flat or increase only moderately. While emerging technologies are advancing, they are yet to have a material impact on supply or demand.

The work of the Taskforce has been undertaken during a time of significant transformation and uncertainty in Australia's energy markets, most notably within the National Electricity Market (NEM) but also within in the gas energy sector. Increases in intermittent renewable generation, technological innovation, closure of coal-fired generators, reducing energy demand, an increase in emergency energy security events and concern over the future scarcity of gas supply have all combined to increase energy sector uncertainty.

Figure 3.1 provides a high level summary of energy market events, announcements and reviews that have occurred or been announced since the Taskforce was established.

Figure 3.1 Key national energy market events, announcements and reviews that have occurred or been announced since June 2016

Recent energy security events	Energy security announcements	Energy market reviews
South Australia • Extreme weather event resulted in a state-wide blackout • Heatwave conditions caused load shedding of residential homes, Pelican Point Power Station could not respond fast enough to prevent load shedding New South Wales • Heatwave conditions drove record demand • Tomago aluminium smelter asked to reduce demand for a four hour period during the peak • Mass load shedding avoided • Announcement of the NSW Energy Security Taskforce	Hazelwood Power Station closure • Removal of 1 600 MW of generation capacity from the Victorian region of the NEM SA Government Energy Plan • New state owned and privately owned gas fired generation • Grid scale battery support • Gas exploration and extraction • Ministerial powers over the national market Snowy Hydro expansion • Expansion of Snowy Hydro scheme to increase capacity by 2 000 MW Tasmanian pumped hydro • ARENA assessing Hydro Tasmania applications for significant pumped hydro capacity in Tasmania Tasmania wholesale price cap • Tasmanian Government to introduce a cap on residential wholesale electricity price • Hydro Tasmania to cap wholesale electricity prices for unregulated large customers	• Independent Review into the Future Security of the National Electricity Market • Feasibility of a second Tasmanian interconnector • AEMO National Transmission Network Development Plan • AEMO Gas Statement of Opportunities • Examination of the current test for the regulation of gas pipelines • ENA and CSIRO Network Transformation Roadmap • ACCC investigation into Australian gas markets and transparency

Note: As at 19 May 2017

This chapter presents an overview of these developments and the implications of these matters for the Taskforce's assessment of Tasmania's energy security, having regard to the specific issues identified in the Taskforce's Terms of Reference.

3.1 National Electricity Market (NEM) energy security events

Since the Taskforce was established in June 2016 there have been three significant energy security events in the NEM - two in South Australia and one in New South Wales.

The first energy security event experienced in South Australia on 28 September 2016 occurred when extreme weather events led to a total system blackout in the State. According to the Australian Energy Market Operator (AEMO) investigation into the event, severe storms resulted in five system faults on the South Australian transmission system in 87 seconds.[6] At the time of the event, wind generation was supplying 48 per cent of the local demand. AEMO found that the transmission faults caused system instability which caused a large proportion of the wind generation to be removed from the system. This, in turn, placed a high degree of stress on the Heywood interconnector between Victoria and South Australia. Once the load on the Heywood interconnector reached unsafe levels, the AEMO report states that protection equipment on the interconnector removed the interconnector from service and supply to the South Australian region was lost. AEMO concluded that the protection settings of the wind farms were too sensitive and not consistent with connection agreements.

A second energy security event occurred in South Australia on 8 February 2017 when heatwave conditions resulted in a shortfall of supply during a period of peak demand. According to its investigation into the event, AEMO directed the interruption of supply to 100 MW of customer load in South Australia.[7] However, SA Power Networks implemented load shedding in response to AEMO's direction resulting in an excess demand reduction of 300 MW, with approximately 90 000 properties being affected for a 30 minute period. AEMO's report states that the gas-fired Pelican Point Power Station in South Australia was unavailable for dispatch at that time as there was insufficient advance notice for the power station to reach an operational state in time to meet system security requirements.

In New South Wales, an energy security event was experienced on 10 February 2017 also as a result of heatwave conditions. During this event, AEMO reports that it directed the reduction of consumption from the Tomago aluminium smelter for a four hour period as a result of a forecast shortfall of supply of 189 MW during a near record high peak in demand.[8] This load reduction was accompanied by the New South Wales Government publicly encouraging customers to restrict their energy consumption during the peak to help avoid any loss of supply.

These three energy security events occurred as a result of capacity failures, whereby there was a lack of available generation capacity to meet demand. This type of emergency energy security situation can be described as a 'capacity constrained' emergency energy security event. Where a loss of demand occurs through a capacity constraint, the energy security event will last as long as the capacity to supply is absent or demand remains high. For example, in the South Australian energy security event in September 2016, supply was slowly restored over a number of hours as part of system restart protocols. In New South Wales, the demand peak which necessitated a controlled reduction in industrial demand in February 2017 lasted for around four hours.

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 such as in South Australia and New South Wales.

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6 AEMO, 2016, *Black System South Australia 28 September 2016 – Final Report.*
7 AEMO, 2017, *System Event Report South Australia, 8 February 2017.*
8 AEMO, 2016, *System Event Report New South Wales, 10 February 2017.*

As outlined in the Interim Report, the number and diversity of the State's hydro-electric power stations, combined with wind generators, the 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 peak demand. However, if the amount of water to supply Tasmania's hydro-electric generation system becomes constrained, then the corresponding energy supply shortfall from that generation source would last until the next significant rainfall event, which could take anywhere from a single day up to several months.

In this context, a key finding of the Taskforce's Interim Report was that "*Tasmania's electrical energy system is energy constrained rather than capacity constrained, meaning 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.*"

Similarly, emergency disruptions to the transmission network are usually localised and not long lasting. As found in the Interim Report, State and national arrangements for managing energy emergency situations in Tasmania are well understood, practiced and implemented when necessary, in particular in relation to capacity risks arising from sudden weather events.[9]

For these reasons, and in the context of its Terms of Reference, the Taskforce has concentrated on identifying measures that can be implemented to avoid, where possible, a supply driven emergency situation from occurring. These include 'pre-emergency' actions that can be implemented early to prevent a looming energy supply constraint event from occurring. However, in light of the recent events interstate, the Taskforce has engaged further with Hydro Tasmania to more fully understand how capacity is managed in the context of the Tasmanian hydro-electric system. This is explored further in Chapter 11.

3.2 Energy security related announcements

A number of national and interstate energy security announcements have been made since the Taskforce's Interim Report was finalised for publication in November 2016. The Taskforce has examined these announcements with a view to understanding their relevance in the Tasmanian energy security context.

In response to the state-wide blackout event of September 2016 and heatwave load shedding event of February 2017, the South Australian Government announced on 14 March 2017 an energy plan that includes a range of measures aimed at addressing a future emergency energy capacity constraint event.[10] These measures include: construction of a State-owned emergency fast-start gas-fired power station; interim installation of temporary diesel generation capacity; support for grid-scale battery support; gas exploration and extraction incentives; additional State powers in an emergency event; and an energy security target for baseload generation. The implications of the proposed South Australian energy plan on the NEM will be reported at the July 2017 meeting of the Council of Australian Governments (COAG) Energy Council.[11]

On 19 May 2017, AEMO and the Australian Renewable Energy Agency (ARENA) jointly announced plans to pilot a demand response initiative in South Australia and Victoria to manage electricity supply during extreme summer peaks through securing 100 MW of demand response capacity.[12]

9 Interim Report, page 15.
10 http://ourenergyplan.sa.gov.au/
11 COAG Energy Council Meeting Communique, 10 April 2017.
12 https://www.aemo.com.au/Media-Centre/ARENA-and-AEMO-join-forces-to-pilot-demand-response-to-manage-extreme-peaks-this-summer

The Taskforce notes that, as discussed previously, these measures have been implemented in response to emergency energy capacity failures, whereby there is a lack of available generation capacity to meet demand. It is, however, of note that the gas-fired backup generation and temporary diesel generation responses announced are comparable to those responses that were used as pre-emergency responses in the 2015-16 energy supply security event in Tasmania.

On 15 March 2017, the Federal Government announced a $2 billion expansion of the Snowy Hydro scheme which would add 2 000 MW of energy capacity to the NEM through increasing the scheme's pumped hydro capability.[13] Subsequent to this announcement, the Australian and Tasmanian Governments announced on 20 April 2017 that ARENA was assessing applications from Hydro Tasmania to support feasibility work into several new projects to enhance opportunities from Hydro Tasmania's generation assets in the context of supporting capacity constraints in the NEM.[14] Potential projects include redeveloping the Tarraleah scheme to increase production by up to 210 GWh per year, enhancing production from Gordon Power Station and exploring the potential of several new pumped hydro energy storage schemes that could deliver up to 2 500 MW of pumped hydro capacity.

While these feasibility studies are largely focused on increasing the capacity of the Tasmanian system to support the NEM, the Taskforce notes that some of these potential enhancements to the Tasmanian system (if found to be feasible) have the potential to reduce the State's annual on-island energy deficit. These projects are most likely to be realised in the medium to long term. In this context, the potential contribution of additional annual energy generation through enhancements to Tasmania's hydro-electric system has been considered in the assessment of medium to long-term measures in Chapter 7.

3.3 Other energy market developments

A key energy market development since the establishment of the Taskforce is the closure on 31 March 2017 of the coal-fired Hazelwood Power Station in Victoria, resulting in the reduction of Victorian generation baseload generation capacity by 1 600 MW. [15] This significant reduction of supply is likely to result in higher forward wholesale electricity prices. For example, the Australian Energy Market Commission (AEMC) has projected that prices in Victoria, South Australia and Tasmania will increase by around 20 to 40 per cent from 2016-17 to 2017-18 following the retirement, before decreasing by around 10 per cent in 2018-19.[16] At the same time as this increase in electricity prices, the Taskforce notes that there has been a further increase in wholesale gas prices.[17] The Taskforce has taken into consideration these potential increases in forward electricity and gas prices when undertaking its cost modelling and scenario analysis of energy security options for Tasmania.

The Hazelwood Power Station closure is the largest closure of a coal-fired power station in Australia but continues a recent trend of retirement of black and brown coal power stations totalling 5 160 MW since 2012 (refer Table 3.1). This trend could be expected to continue as Australia introduces measures aimed at meeting its international emissions reduction commitments.

At the same time as the Hazelwood closure, the development of renewable energy is quickly increasing across Australia. According to the Clean Energy Council, more than 3 300 MW of new renewable energy capacity will be under construction or completed in 2017 representing around $7.4 billion in investment.[18]

13 https://www.pm.gov.au/media/2017-03-16/securing-australias-energy-future-snowy-mountains-20
14 https://www.hydro.com.au/about-us/news/2017-04/supporting-australia%E2%80%99s-energy-transition
15 http://www.gdfsuezau.com/hazelwood-closure/Announcement
16 AEMC, 2016, *2016 Residential Electricity Price Trends.*
17 AEMO, 2017, *Gas Statement of Opportunities.*
18 Clean Energy Council, 2017, *Another $2 billion of Renewable Energy Investment in Unprecedented Year.*

Table 3.1 Australia's decommissioned coal-fired power stations

State	Power Station	Primary Fuel	Year of commissioning	Date of closure	Age (Years)	Capacity (MW)
NSW	Munmorah	Black Coal	1969	Jul-12	43	600
NSW	Redbank	Black Coal	2001	Aug-14	13	144
NSW	Wallerawang C	Black Coal	1976-80	Nov-14	38	1 000
VIC	Morwell	Brown Coal	1958-62	Aug-14	52-56	189
VIC	Anglesea	Brown Coal	1969	Aug-15	46	160
VIC	Hazelwood	Brown Coal	1964-71	Mar-17	45-52	1 600
QLD	Collinsville	Black Coal	1968-98	Dec-12	14-44	180
QLD	Swanbank B	Black Coal	1970-73	May-12	42	500
SA	Northern	Brown Coal	1985	May-16	31	546
SA	Playford	Brown Coal	1960	May-16	56	240

Source: Senate Standing Committee on Environment and Communications, 2017, *Retirement of Coal Fired Power Stations – Final Report.*

This development 'flurry' can be attributed partly to the certainty provided by the Renewable Energy Target (RET) to 2030, as well to the recent increases in wholesale electricity prices. A state by state breakdown of this development is provided in Table 3.2.

Table 3.2 Large-scale renewable energy projects under construction or completed in Australia in 2017 (as at 2 May 2017)

State	Projects	Capacity (MW)	Investment (A$million)	Jobs
Queensland	15	963	2 224	1 680
New South Wales	8	1 017	2 140	1 170
Victoria	5	685	1 295	535
South Australia	6	863	1 737	620
Western Australia	1	20	50	100
Tasmania	0	0	0	0

Source: Clean Energy Council, 2017, *Another $2 billion of Renewable Energy Investment in Unprecedented Year.*

The Taskforce has observed that while the scale of development is increasing at a national level, no new largescale renewable energy projects have been announced in Tasmania. This is despite Tasmania having some of the best wind resources in the nation and the recent increase in wholesale electricity prices which, all other things being equal, should make new development attractive in Tasmania. This may in part be attributed to Tasmania's market structure, as outlined in the Interim Report.[19]

In the Interim Report, the Taskforce recommended that "*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.*" The Taskforce considers that this recommendation remains appropriate in the current investment climate.

[19] Interim Report, section 14.2.

3.4 Energy market reviews

Since the commencement of the Taskforce's work in June 2016, a number of significant national energy market reviews have been announced, with several not due for completion until after the Taskforce is required to deliver its Final Report in June 2017. These reviews include:

- AEMO's 2016 National Transmission Network Development Plan (completed December 2016) and Gas Statement of Opportunities (completed March 2017);[20, 21]
- the COAG Energy Council's examination of the current test for the regulation of gas pipelines (completed December 2016);[22]
- the Australian and Tasmanian Governments' Joint Feasibility Study on a second Tasmanian interconnector (completed April 2017);[23]
- the Energy Networks Australia (ENA) and Commonwealth Scientific and Industrial Organisation (CSIRO) Electricity Network Transformation Roadmap Final Report (released April 2017);[24]
- the Independent Review into the Future Security of the National Electricity Market (due for completion in mid-2017);[25]
- the AEMC and Climate Change Authority joint report on policy or policies to enhance power system security and to reduce energy prices (report due mid-June 2017);[26]
- the New South Wales Energy Security Taskforce review of how New South Wales manages energy security and resilience, including readiness, planning, preparation and response capability to extreme events such as weather (final report due end 2017);[27] and
- the Tasmanian Parliamentary Standing Committee of Public Accounts Inquiry into the Financial Position and Performance of Government Owned Energy Entities (released date unknown).[28]

The Taskforce has been mindful of these reviews and has taken the findings and recommendations of those that have been released into consideration in the context of its own review of Tasmania's future energy security.[29] In particular, this contemporary policy and regulatory environment has been taken into consideration when the Taskforce has undertaken its modelling and scenario analysis work.

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20 AEMO, 2016, *National Transmission Network Development Plan.*
21 AEMO, 2017, *Gas Statement of Opportunities.*
22 http://www.coagenergycouncil.gov.au/publications/examination-current-test-regulation-gas-pipelines-consultation-paper
23 http://www.environment.gov.au/energy/tasmanian-energy-taskforce
24 http://www.energynetworks.com.au/electricity-network-transformation-roadmap
25 http://www.environment.gov.au/energy/national-electricity-market-review
26 http://climatechangeauthority.gov.au/
27 http://www.chiefscientist.nsw.gov.au/reports/nsw-energy-security-taskforce
28 http://www.parliament.tas.gov.au/ctee/Joint/pacc.htm
29 It should be noted that the Taskforce finalised the Final Report on 19 May 2017 in readiness for publication, and therefore any reviews or reports relevent to the Taskforce's Terms of Reference that may have been released since that date have not been considered.

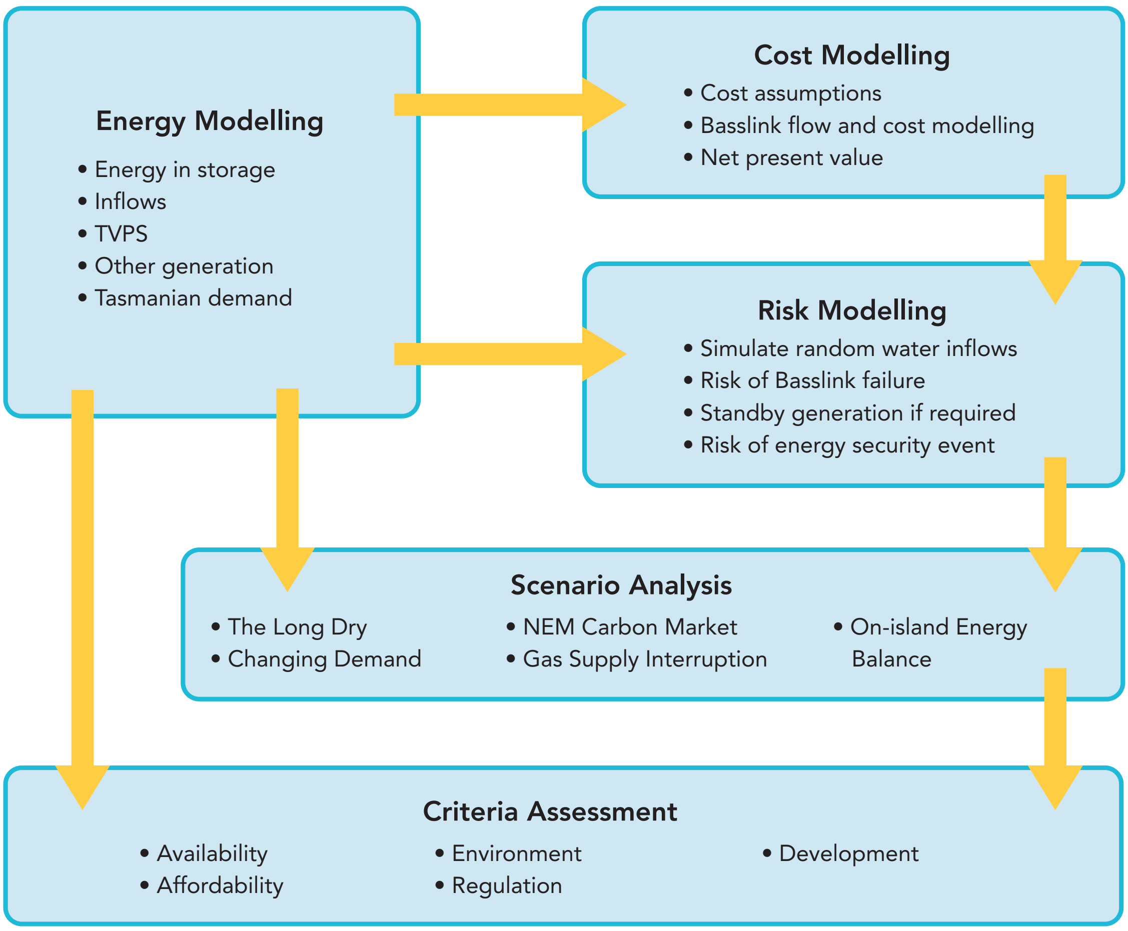
4. Modelling and Scenario Approach

This chapter provides an overview of the Taskforce's modelling and scenario approach as a precursor to the ensuing chapters detailing the outcomes of the Taskforce's assessment of energy security options.

The Taskforce has developed, with the assistance of Boston Consulting Group (BCG), a robust modelling methodology and assessment framework to evaluate options that can address some of the issues and challenges identified in the Interim Report. The approach adopted by the Taskforce utilises energy, cost and risk modelling to inform five 'big picture' scenarios that the Taskforce has identified could present in Tasmania in the short to medium term, and assesses the Taskforce's recommendations against other options through a set of common assessment criteria.

Figure 4.1 illustrates the process and linkages between the Taskforce's energy and cost modelling, scenario analysis and assessment of options against five overarching assessment criteria.

Figure 4.1 Taskforce modelling, scenario and criteria assessment process



The Taskforce's 'Energy Security Cost Model' is designed to provide a high level assessment of the relative costs and energy security risk implications of different options to address Tasmania's energy security (i.e. it is not a detailed economic evaluation of each potential option).

The modelling is conducted over a 10 year period to reflect the medium-term timeframe (2017-18 to 2026-27). Beyond around 2030 there is even greater uncertainty than exists in the 10 year period with regard to future energy related policies and energy market prices. Due to this inherent uncertainty, the Taskforce has assessed that modelling beyond this timeframe would not produce meaningful results.

KEY MODELLING PRINCIPLES ADOPTED BY THE TASKFORCE

At the outset, the Taskforce agreed upon a set of high level principles to guide its modelling, scenario and criteria assessment process. These principles were developed by the Taskforce with the assistance of BCG.

- The primary objective of modelling is to estimate and compare the cost of actions to be recommended by the Taskforce against other options for improving Tasmania's energy security.
- Modelling focuses on the incremental costs, revenue or cost savings of actions.
- Modelling addresses electricity generation and energy security monitoring costs, not broader economic impacts.
- Modelling tests the sensitivity of costs to uncontrollable variables (e.g. changes in NEM/gas/carbon prices, demand and long-term average inflows).
- Modelling includes analysis of some actions that were considered by the Taskforce but were not recommended.
- Cost/benefit modelling is from the 'Tasmanian system' perspective, not 'whole of NEM'.

The model created by the Taskforce operates on a financial year basis and assumes a base case whereby the Taskforce's Interim Report recommended short-term actions are implemented from 1 July 2017; i.e. the PSL and HRL profiles recommended by the Taskforce (refer Chapter 11) are adopted and the TVPS remains available on standby. The Taskforce has adopted this base case as it reflects the current situation in Tasmania, being that the TVPS remains on standby and the projected energy in storage target for 1 July 2017 is currently higher than the proposed PSL.[30] The annualised cost and risk of an energy security event occurring is assessed relative to this base case for alternative options under a range of scenarios.

The Taskforce has observed that over the last two decades Tasmania has had a one in 10 year rate of an energy security event occurring. Based on the Taskforce's assessment of energy security, and consistent with feedback it has received, the likelihood of an energy security event occurring needs to be improved by an order of magnitude to a one in 100 year risk, or a one per cent chance of an energy security event occurring in any given year.

There are two types of inflow risk which interact together to influence energy security risk exposure in Tasmania: medium-term inflow risk and short-term inflow risk.

- Medium-term inflow risk is observed through historical data as a sequence of low inflow for two to three years in succession. Recent examples of these medium-term inflow risks were observed in the 2006 to 2008 calendar years, and also in the 2014 to 2015 calendar years. Both of these examples resulted in the one in 10 year observation of energy security events mentioned above.
- Short-term inflow risk relates to intra-year periods of very low inflows. Short-term inflow risks can dramatically alter the pre-existing energy security situation in a short space of time. The very low inflows experienced in September and October in 2015 greatly contributed to the energy security event of 2015-16.

The modelling presented in the Final Report is conducted on an annual basis and captures the medium-term inflow risk, but it is unable to reflect the short-term intra-annual variability of inflows and the energy security risk associated with these. In order to take this into account when interpreting the modelling, the Taskforce considers that a one in 200 year event (or an annual risk of 0.5 per cent) from the modelling output more accurately represents the potential inflow risks associated with a one in 100 year event in reality.

30 The current level of energy in storage means that there will be no direct cost in adopting the PSL profile from 1 July 2017 and managing storages to that profile. However, the Taskforce recognises that there is an opportunity cost going forward from maintaining higher energy in storage through reduced exports over Basslink.

DEFINITION OF AN ENERGY SECURITY EVENT

A key focus of the Taskforce's modelling is assessing how each option presents the risk of an energy supply security event occurring per annum (i.e. an event similar to that which occurred in 2015-16, where low energy in storage combined with an extended Basslink outage requires the implementation of pre-emergency temporary generation measures and/or voluntary major industrial customer demand reduction).

Energy security risks have been assessed in the model by utilising a randomised annual inflow assumption and a randomised six month Basslink outage with a one in 10 year probability of occurrence. Where the randomised inflows result in energy in storage falling below the HRL and a Basslink outage has occurred during the year, this is classified in the model as an energy security event. An energy security event is also identified if pre-emergency temporary diesel generation is required to maintain storage levels at or above the minimum point of the HRL profile (16 per cent at the start of May). Further detail on the workings of the model is provided in Appendix 2.

This energy security risk estimation for modelling purposes should not be confused with the unserved energy (USE) metric used in the calculation of the HRL profile and commonly used throughout the NEM. Under the definition of an energy security event used for the Taskforce's modelling, an energy security event is recognised well before the USE threshold is triggered. In the Taskforce's modelling, the USE threshold represents the level of total energy in storage whereby it is no longer possible to meet Tasmanian demand, and it is only passed in the most extreme supply and demand circumstances (i.e. a combination of multiple very low inflow years, no TVPS support and high demand).

Further detail behind operation of the model and its assumptions is provided in Appendix 2 and Appendix 3. As described in these appendices, both the model and its assumptions have been independently verified by external consultants as being reasonable for the purpose of assessing the relative impacts of the costs and risks of different energy security options for Tasmania.

5. Modelling of Short-term Energy Security Options

KEY FINDINGS

- With the TVPS on standby and the adoption of the HRL and PSL profiles from 1 July 2017, the Tasmanian electricity energy security situation can be considered Resilient in the short term, as it would take multiple adverse events before electricity energy supply security was threatened.
- If the situation arose whereby the TVPS was temporarily unavailable, but it was considered that the TVPS could return to service in a reasonable timeframe if required to support electricity energy security, then the HRL and PSL profiles would not necessarily require adjustment.
- If the situation arose whereby the TVPS was permanently unavailable and energy storage levels were not adjusted to reflect this loss of generation potential, then the electricity energy security situation would be assessed as Susceptible.
- However, if the TVPS was permanently unavailable and the HRL and PSL profiles were adjusted upwards to reflect that loss of generation potential, then the electricity energy security situation would be assessed as being Managed, but would not be considered as robust as with the TVPS on standby.
- While retaining the TVPS on standby and increasing energy in storage does have a financial cost, the cost is low for the energy security it provides.

The Taskforce identified in the Interim Report that the primary role of the TVPS is to provide a backup energy generation source for the Tasmanian energy sector in the event of low inflows and an extended outage of Basslink. However, the need for the TVPS to play this role may diminish if significantly higher levels of water storages were to be permanently held.

This chapter explores the medium-term (5-10 years) cost and the likelihood of an energy security event occurring under various energy in storage targets and either with or without the TVPS being available on standby. An overview of the Taskforce's modelling approach is provided in Chapter 4, with further details around the model and its assumptions provided in Appendix 2 and Appendix 3 respectively.

5.1 Tamar Valley Power Station (TVPS) availability

A key question the Taskforce has sought to address is how retaining the TVPS on standby impacts on Tasmania's energy security in the medium term.[31] In this context, the Taskforce has assessed the cost of managing energy security without the TVPS being available relative to the potential risk of an energy security event occurring.[32]

In an environment where the TVPS is permanently unavailable to the Tasmanian energy market, the Taskforce's Energy Security Risk Response Framework identifies that total energy in storage across Tasmania's hydro-electric system would need to be increased to adjust for the loss of generation capacity from the TVPS.[33] As part of this assessment, the Taskforce has also examined the impacts on energy security of not adjusting energy in storage targets in the absence of the TVPS.

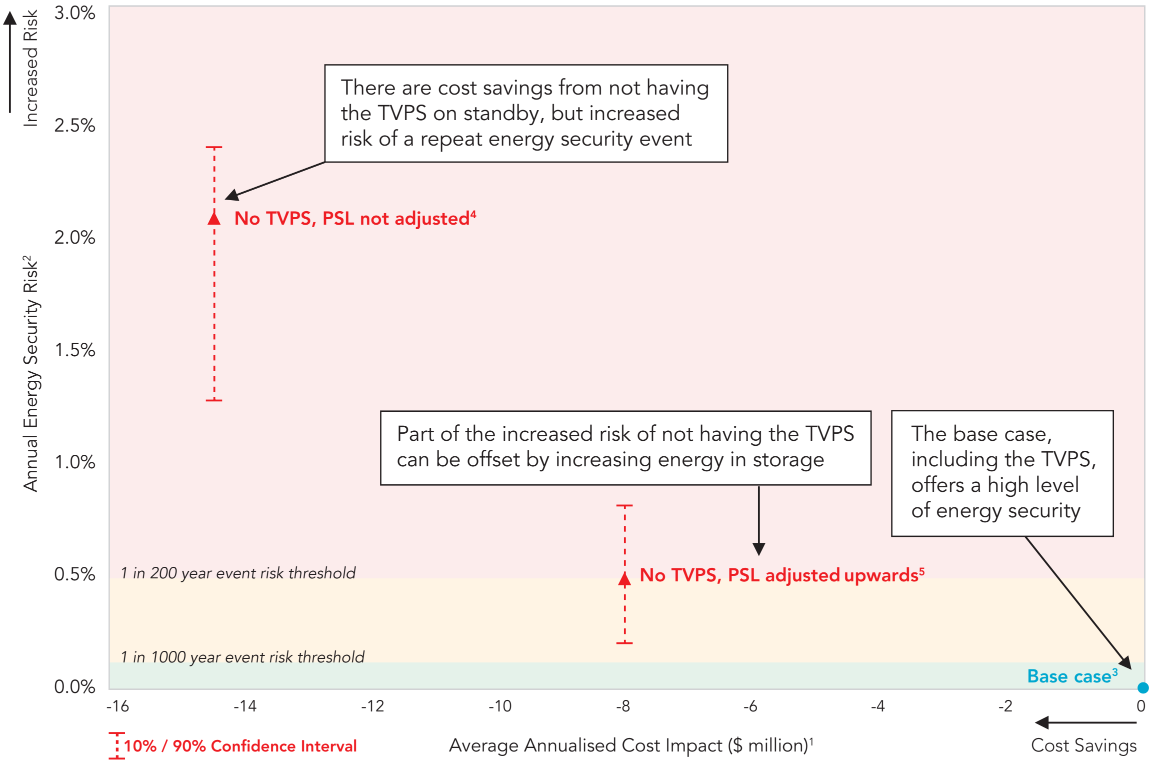
Figure 5.1 illustrates the Taskforce modelling of cost savings versus the risk of an energy security event in the situation where the TVPS is unavailable and energy in storage profiles are not adjusted accordingly.

[31] An assessment of the option of operating the TVPS on an annual basis is presented in Chapter 6.

[32] For the purposes of modelling, and as discussed in Chapter 4, an energy security event is an event similar to that which occurred in 2015-16, whereby low energy in storage combined with an extended Basslink outage requires the installation of temporary diesel generation and voluntary major industrial customer demand reduction.

[33] Noting that if the TVPS were only temporarily unavailable, the PSL profile would not necessarily require adjustment if the TVPS could return to service in a reasonable timeframe if required to support energy security.

Figure 5.1 Annualised cost savings versus annual risk of an energy security event with the TVPS unavailable and with/without adjustment of energy storage levels



Source: Taskforce analysis

Notes:
1. Average annualised cost savings averaged over 10 year period from 1 July 2017 and 5 000 Monte Carlo simulations.
2. Annual Energy Security Risk is the risk of an energy security event in a year, based on 5 000 Monte Carlo simulations of random inflows and Basslink failure, with an energy security event defined in relation to energy storage levels and Basslink failure (refer definition presented in Chapter 4). 10 per cent and 90 per cent confidence intervals are based on 100 simulation sub-samples.
3. Base case set at zero in accordance with modelling principles, including random inflow cost adjustment; TVPS on standby and PSL target 30 per cent at 1 July each year.
4. PSL target 30 per cent at 1 July each year.
5. PSL increased from 30 per cent to 36.1 per cent at I July each year in response to removal of TVPS.

Key outcomes from the Taskforce's analysis presented in Figure 5.1 are as follows.

- The cost of retaining the TVPS on standby is estimated to be around $14.6 million per annum which would prima facie be saved if the TVPS was not retained.[34]
- If the TVPS is removed, but storage levels are adjusted upwards (from around 30 per cent to around 36 per cent at 1 July), the Taskforce's modelling indicates that this would cost around an additional $6-7 million per annum, such that the net cost of no TVPS and higher storages is estimated to be approximately $8 million per annum. The Taskforce's modelling includes the cost of pre-emergency temporary diesel generation if required.
- The risk of an energy security event in a given year is shown to be less than 0.1 per cent with the TVPS available on standby and storages operated to the PSL (presented as the base case in Figure 5.1).

[34] The cost of holding the TVPS on standby has been modelled based on a Taskforce estimate of $14.6 million per annum (refer Appendix 3). The cost of the TVPS on standby is significantly determined by the cost of gas transportation arrangements, which are currently under negotiation between Hydro Tasmania and Palisade Investment Partners.

- If the TVPS is unavailable to the Tasmanian energy system over the short to medium term (i.e. 10 year timeframe), the risk increases to around a two per cent chance of an energy security event occurring each year if the PSL is not adjusted to reflect this loss of generation potential.[35] If the PSL is increased to account for the TVPS being unavailable, then the risk of an energy security event is around 0.5 per cent each year. Based on this analysis, it can be seen that the proposed PSL profile approach works to dynamically reduce the risk of an energy supply security event occurring as the State's annual on-island supply/demand balance changes.

The Taskforce assesses that a risk of an energy security event of two per cent each year is too high, and that an annual risk of 0.5 per cent (i.e. a modelled one in 200 year event) is higher than desirable, depending on cost. In this situation, it is considered unlikely that a new power station (costing around $400 million) would be built to reduce this risk. However, having the TVPS available and energy in storage being managed according to the PSL profile means that Resilient energy security can be achieved at an estimated annualised cost of around $8 million each year overall, and is therefore the recommended option.

5.2 Energy in storage targets

Energy held in Hydro Tasmania's storages is a critical component of Tasmania's energy supply. Holding additional energy in storage comes with an opportunity cost, as that energy is unavailable to be exported across Basslink. The absence of the TVPS reduces overall cost as the opportunity cost of holding higher levels of energy in storage is lower than the annual costs of maintaining the TVPS on standby. Conversely, with the absence of the TVPS and a reduction in energy in storage, annual costs actually increase as a result of higher import and pre-emergency temporary generation costs.

In this context, the Taskforce has explored the energy security risk implications of changing energy in storage targets with and without the TVPS available on standby, as illustrated in Figure 5.2. The red dashed line in Figure 5.2 shows the relationship between various energy storage levels and the risk of an energy security event occurring in the absence of the TVPS. It shows that the risk is very sensitive to the level of energy in storage at 1 July each year. The risk increases as energy in storage falls below 35 per cent at I July, becoming increasingly risky at 30 per cent at 1 July and unacceptably high when energy in storage is 25 per cent at 1 July.

Where the TVPS has been assumed to be removed, the modelling also assumes that the associated operating costs of the TVPS would be saved. This cost saving may be offset by the cost of building energy storage levels where higher targets have been identified, as well as by the cost of temporary diesel generation if required during an energy security event. The Taskforce's modelling shows that cost savings (annualised over 10 years) from the absence of TVPS range from around $14.6 million with a 1 July PSL of 30 per cent to $2.1 million with a 1 July PSL of 40 per cent.[36]

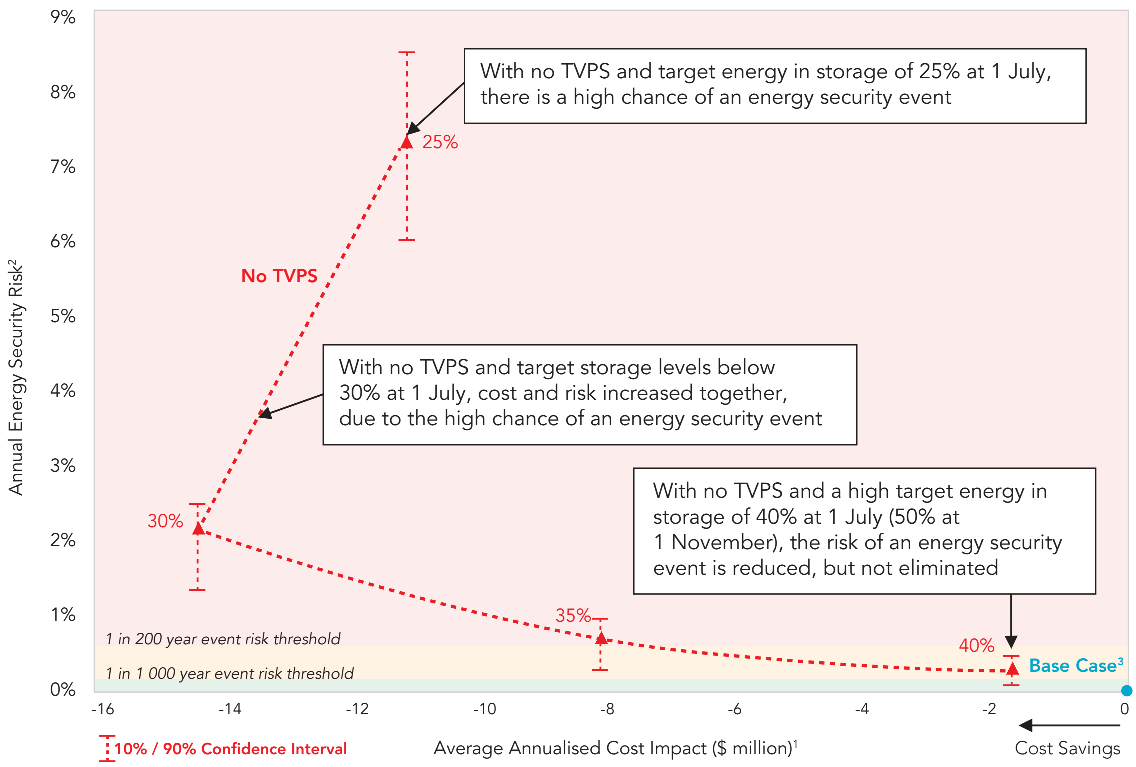
In a scenario where the TVPS is available to support low inflow periods (base case in Figure 5.2), the risk of an energy security event is less than 0.5 per cent. In this situation, the most important energy security concern is significant intra-year variation in inflows, the impact of which is not assessed in the model.[37]

[35] As described in Chapter 4, under the Taskforce's model an order of magnitude improvement in energy security is represented by a one in 200 year event, or a 0.5 per cent chance of an energy security event occurring per annum.

[36] There is a significant range of estimated net costs depending on random inflows, Basslink failure and the cost of energy security events. The modelled 10 per cent/90 per cent confidence interval is around +/- $50 million per annum across most scenarios. The alignment of the average savings from removal of the TVPS and the modelled cost estimate of the TVPS indicates that the costs of operating the TVPS, including gas costs, the cost of imported energy over Basslink and the cost of pre-emergency temporary diesel generation, if and when required, are approximately balanced.

[37] The model created by the Taskforce operates on a financial year basis and as such utilises the PSL at I July each year as communicated in Chapter 11. The Taskforce has used the annual cost model to evaluate the cost of different PSL profiles and associated exposure to energy risk. It is important to note that the PSL and HRL profiles have been developed to mitigate against intra-year inflow variation. This intra-year variation is not reflected in the cost modelling so energy security assessments evaluated with this model only reflect a very high level assessment of energy security with regard to energy in storage measures.

Figure 5.2 Annualised cost savings versus annual risk of an energy security event with TVPS unavailable and various energy storage levels at 1 July



Source: Taskforce analysis

Notes:

1. Average annualised cost savings over 10 years from 1 July 2017 based on 5 000 Monte Carlo simulations.
2. Annual Energy Security Risk is the risk of an energy security event in a year, based on 5 000 Monte Carlo simulations of random inflows and Basslink failure, with an energy security event defined in relation to energy storage levels and Basslink failure (refer to the definition presented in Chapter 4). Ten per cent and 90 per cent confidence intervals are based on 100 simulation sub-samples.
3. Base case set at zero in accordance with modelling principles, including random inflow cost adjustment; TVPS on standby and PSL target 30 per cent at 1 July each year.

The management of intra-year inflow variation is addressed through the calculation of the HRL and PSL profiles outlined in Chapter 11.

Without the TVPS, the Taskforce's modelling shows that the annual risk of an energy security event occurring ranges from 7.5 per cent to 0.2 per cent (for a 1 July PSL of 30 per cent and 40 per cent respectively). It is in this context, together with the proposed calculation of the HRL and PSL profiles, that the Taskforce assesses that the HRL and PSL profiles would need to be adjusted higher in the absence of the TVPS to mitigate against the chance of an energy security event occurring.

Overall, the Taskforce assesses that with the TVPS available on standby and the adoption of the HRL and PSL profiles presented in Chapter 11, the short-term Tasmanian energy security situation is Resilient, as it would take multiple adverse events before energy supply security was threatened. If the situation arose where the TVPS was permanently unavailable and the energy in storage profiles were not adjusted to reflect the loss of this generation potential, then the energy security situation would be assessed as Susceptible.

However, if the TVPS was unavailable and the HRL/PSL profiles were adjusted upwards, then the energy security situation would be assessed as being Managed – but would not be considered as resilient as with the TVPS on standby.

On this basis, the Taskforce considers that its Interim Report recommendation that "*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*" (recommendation 24) remains appropriate.

The Taskforce is cognisant that the analysis presented in this chapter is based on a modelled assessment of cost versus the annual risk of an energy security event occurring. In Chapter 7, the Taskforce presents an assessment of its recommended option against other possible options to improve Tasmania's energy security using an assessment framework that expands consideration beyond cost and risk assessment.

6. Medium-term Scenario Analysis

KEY FINDINGS

Medium-term scenario analysis indicates the following.

- The TVPS is important in reducing energy security risk in the event of a prolonged reduction in inflows. With a 10 per cent reduction in long-term average inflows, the TVPS changes from a source of backup generation to a source of baseload generation.
- In the event of a significant reduction in long-term average inflows, new (non-hydro) generation should be developed in Tasmania in order to support Resilient electricity energy security.
- The TVPS is important in reducing the energy security risk in the event of an increase in demand.
- In the event of a material increase in demand in Tasmania, it would be prudent to accompany the demand increase with additional generation development to ensure the on-island energy balance remains in a manageable state.
- A significant demand reduction would result in an on-island surplus of energy generation and would alleviate energy security concerns in Tasmania. In scenarios of a very large demand reduction, this could result in stranded assets with adverse implications for generating asset owners.
- There is an increased energy security risk if gas is unavailable to operate the TVPS. In the event of a long-term interruption to gas supply in Tasmania, adjustments would need to be made to the HRL and PSL profiles that only partially offset this risk.
- Increasing non-hydro renewable energy generation would increase on-island self-sufficiency and is likely to provide a net benefit to Tasmania.
- Operation of the TVPS to meet the on-island generation deficit is not preferred unless its operating costs reduce or market prices for electricity significantly increase.
- Tasmania's energy security is not materially impacted by a carbon price. Tasmania would be in a better position to adjust to a price on carbon if it were a net exporter of energy sourced from renewable energy generation.

The future is highly uncertain, particularly due to the pace of change in the national energy context, climate change and emerging technologies. The Taskforce has undertaken 'big picture' scenario analysis of potential future energy situations for Tasmania in the medium term (i.e. the next 10 years). Due to this inherent uncertainty in making assumptions beyond 2030, the Taskforce has assessed that modelling beyond this timeframe would not produce useful insights for energy security or cost.

This chapter presents the outcomes of the Taskforce's analysis. An overview of the Taskforce's modelling approach is provided in Chapter 4, with further details around the model and its assumptions provided in Appendix 2 and Appendix 3 respectively.

6.1 Description of scenarios

The scenarios the Taskforce has chosen to examine are summarised in Table 6.1. The scenarios modelled by the Taskforce are multidimensional, combining variable inflows, the chance of Basslink failure and the availability of the TVPS to test the high-level robustness of the Tasmanian energy system under each scenario. Under each scenario, there is a chance that Basslink will fail in conjunction with low inflows. In this case supplementary generation, including gas if available, is assumed to activate to maintain energy supply at acceptable levels.

Table 6.1 Description of scenarios modelled by the Taskforce

Scenario	Description
The Long Dry	Long-term average inflows are assumed to be 9 000 GWh, but what might be the impact for Tasmania's energy security in the event of an ongoing drying trend? The Long Dry scenario considers the energy security impact of reduced long-term average water inflows of up to 10 per cent, both with and without the TVPS on standby.[38]
Changing Demand	Significant changes in Tasmania's electricity demand have implications for Tasmania's on-island supply/demand balance. The loss of one or more major industrial consumers would significantly decrease the on-island generation gap; conversely a sustained growth in load would increase the on-island generation gap. The Changing Demand scenario explores the energy security impact of a change in demand with and without the TVPS on standby.
Gas Supply Interruption	There are potential scenarios in which gas supply could be interrupted in Tasmania, whether through a gas shortage or plant/pipeline failure or due to a combination of factors that make it uneconomic to continue to safely supply gas to Tasmania. The Gas Supply Interruption scenario examines the energy security impact of gas not being available for electricity generation or other uses in Tasmania.
On-island Energy Balance	The On-island Energy Balance scenario examines three different ways that Tasmania's non-hydro energy generation could increase by 700 GWh per annum so that in an average year on-island energy supply is equal to energy demand.[39] These approaches are: • operation of the 200 MW TVPS CCGT for five months each year; • installation of two additional wind farms with 266 MW combined capacity and a 30 per cent capacity factor; or • installation of a combination of 'mixed' renewables (wind, solar and biomass).
NEM Carbon Market	With the Australian Government committing to reducing national greenhouse gas emissions by 26 to 28 per cent below 2005 levels by 2030, it is likely that some form of a price on carbon will be required during the period 2020-2030 in order to achieve that target. The NEM Carbon Market scenario assesses the energy security impact of an increase in the Victorian NEM energy price reflecting the imposition of a cost of carbon around $25 per tonne.[40]

The outcomes of the scenario modelling are presented in section 6.2 to section 6.6. Appendix 3 details the scenario modelling assumptions. Unless otherwise indicated, scenarios draw on base case assumptions, including HRL and PSL profiles that vary with changes in demand and on-island generation. Where appropriate, scenario analysis includes analysis of variables such as the standby operation of the TVPS and additional wind generation.

38 Projections presented in Chapter 10 of the Interim Report show that climate change could reduce inflows to Tasmania's hydro-electric catchments by up to eight per cent by the end of the 21st century (Interim Report, page 83).

39 Chapter 3 of the Interim Report found 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 current and potential future long-term inflow averages of 9 000 and 8 700 GWh respectively. The Taskforce has chosen to use the current long-term average inflow assumption for its modelling, hence this scenario examines how the 700 GWh on-island generation gap could be addressed.

40 Following AEMO's 2016 National Transmission Network Development Plan.

6.2 'The Long Dry' scenario

THE LONG DRY

What would Tasmania's energy security look like if long-term inflows were permanently reduced?

Any reduction in long-term average inflows will further exacerbate the current deficit in on-island energy supply balance. This loss of energy must be replaced in order for energy supply to meet demand. Without the development of additional (non-hydro) generation in Tasmania, the first source of generation used to replace the lost energy from low inflows will be Basslink import. If inflows are sufficiently low, Basslink import will be maximised to the point of exhaustion and the remainder of the energy deficit will need to be supplied by the TVPS.

The Taskforce has modelled the impact of a reduction of long-term average inflows of up to 10 per cent of the current long-term average (9 000 GWh).[41] Under the worst long-term average inflow studied, there is an increased reliance on the TVPS for year round generation in order to maintain energy security in Tasmania. This situation would result in the TVPS becoming a fundamental generation source rather than a reliable backup. Tasmania's energy system would trend toward a reliance on constant Basslink import and TVPS generation, with no source of backup generation available to prevent future challenges to energy security.

Figure 6.2 illustrates the modelled energy security risk associated with the absence of TVPS and reduced inflows. Without the TVPS, Tasmania's energy security would be significantly compromised with a 10 per cent reduction in long-term average inflows. There would also be a significant increase in costs because of the need to increase Basslink imports and an increased reliance on pre-emergency temporary diesel generation. In this situation, the Taskforce's modelling shows that there is an eight per cent chance of an energy security event in any given year.

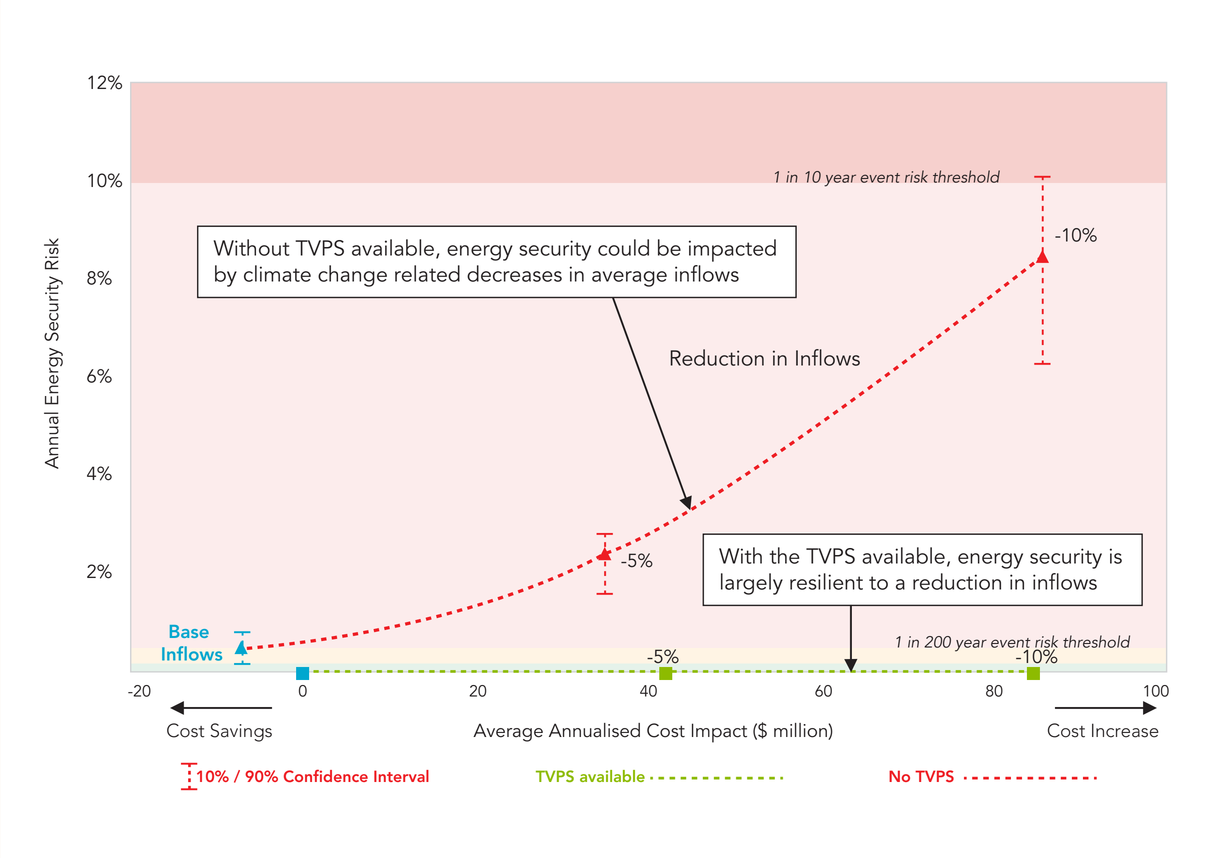
This also provides insight into the energy security value of the TVPS to support energy security in Tasmania in an environment with reduced long term average inflows. The reason that the risk of an energy security event remains so low with the TVPS available is because it ceases to be a source of backup generation and becomes a fundamental part of meeting every day supply and demand.

Conclusion:

- The TVPS is important in reducing energy security risk in the event of a prolonged reduction in inflows. With a 10 per cent reduction in long-term average inflows, the TVPS changes from a source of backup generation to a source of baseload generation.
- In the event of a significant reduction in long-term average inflows, new (non-hydro) generation should be developed in Tasmania in order to support Resilient electricity energy security.

[41] Forecasts presented in Chapter 10 of the Interim Report shows that climate change could reduce inflows to Tasmania's hydro-electric catchments by up to eight per cent by the end of the 21st century (Interim Report, page 83).

Figure 6.2 Annualised cost impact versus annual risk of an energy security event with reduced long-term average inflows



Source: Taskforce analysis

6.3 'Changing Demand' scenario

HIGHER DEMAND

What would Tasmania's energy security look like if energy consumption increased above its current level?

Any increase in energy consumption in Tasmania will further exacerbate the current deficit in on-island energy supply. The Taskforce has chosen to align its demand assumptions with that of the 2016 AEMO National Electricity Forecast Report (NEFR) which indicates an increase of 2 270 GWh from 2016-2036 under a high demand scenario. Without any other changes in the Tasmanian energy system, this would represent an annual on-island energy generation deficit of around 3 000 GWh.

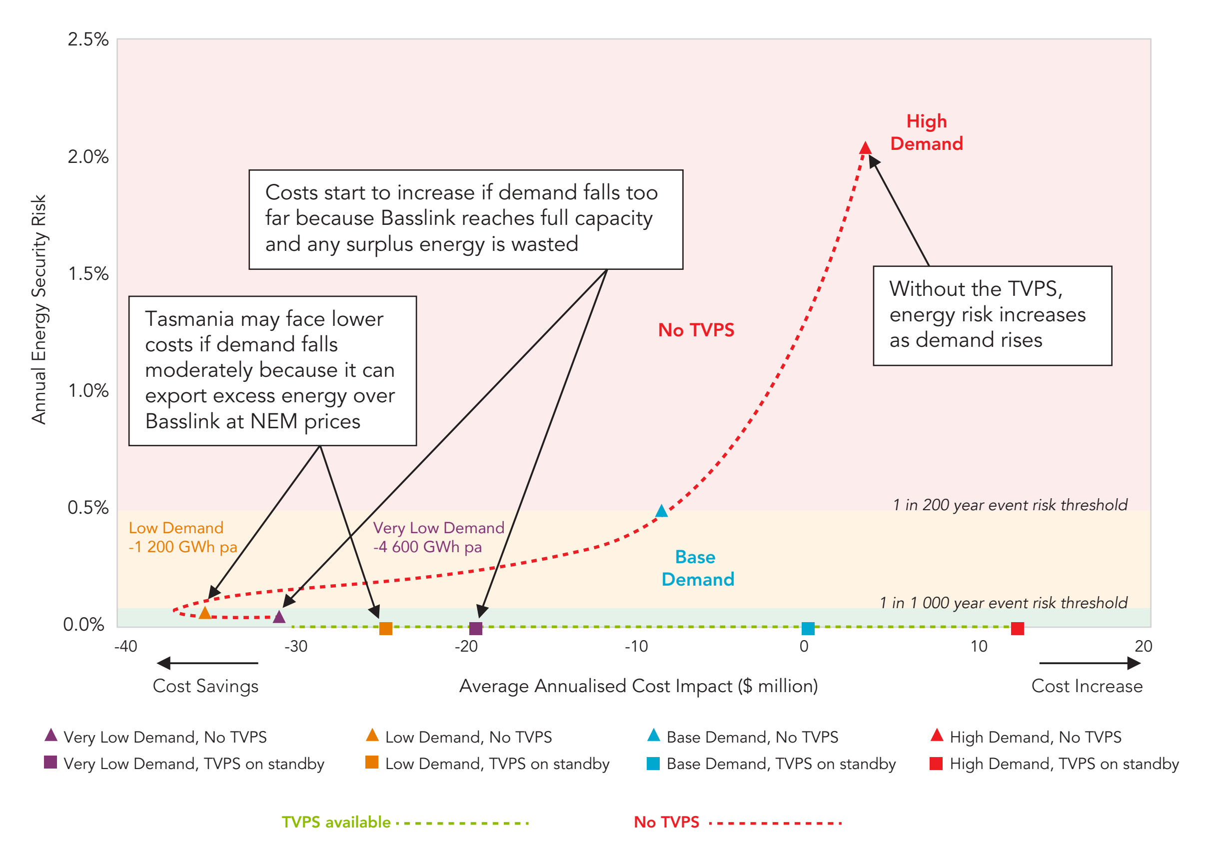
Any material increase in Tasmanian energy demand should be sourced from the cheapest available energy source. In the present system this source is Basslink import. In the event of demand growth at the magnitude suggested by AEMO, there is additional importance placed on the TVPS for its energy security value. Figure 6.3 indicates that with high demand, without the TVPS, there would be around a two per cent risk of an energy security event occurring in any given year. As discussed in Chapter 4, the Taskforce assesses that the risk of an energy security event of two per cent is too high.

If the on-island supply deficit were to significantly increase, the TVPS becomes increasingly important for maintaining energy security in Tasmania.

Conclusion:

- The TVPS is important in reducing the energy security risk in the event of an increase in demand.
- In the event of a material increase in demand in Tasmania, it would be prudent to accompany the demand increase with additional on-island generation development to ensure the on-island energy balance remains in a manageable state.

Figure 6.3 Annualised cost impact versus annual risk of an energy security event with changing demand



Source: Taskforce analysis

LOWER DEMAND

What would Tasmania's energy security look like if energy consumption decreased below its current level?

Any decrease in demand in Tasmania would alleviate the current deficit in on-island energy supply. The Taskforce has chosen to align its demand assumptions with that of the 2016 AEMO NEFR which indicates a reduction to 6 000 GWh per annum in 2036 under a weak demand scenario. The Taskforce has implemented this weak demand scenario in two low demand scenarios reflecting reductions of 100 MW and 400 MW blocks of demand.[42] This approach accounts for the degree of change possible in the Tasmanian energy system with the dominance of industrial load. Without any other changes in the Tasmanian energy system, these scenarios result in an on-island energy surplus of around 500 GWh for the 100 MW scenario and a 3 900 GWh surplus for the 400 MW scenario.

A surplus in the on-island energy balance results in a very strong energy security position for Tasmania. Table 6.2 shows that in both of these scenarios, the reliance on the TVPS for energy security is significantly reduced compared to the Higher Demand scenario. This is also illustrated in Figure 6.3 in the Higher Demand scenario. The retention of the TVPS could be re-evaluated under these circumstances.

A large (400 MW) reduction of energy demand in Tasmania would result in such a large surplus of energy in Tasmania that it would exceed Basslink's maximum export capacity, potentially resulting in stranded generation assets. This is why the annualised cost savings of the Low Demand scenario are larger than the Very Low Demand scenario. Under this circumstance a second Bass Strait electricity interconnector would enable this excess energy to be exported to the NEM. This finding is consistent with the outcomes of the Joint Feasibility Study into a second Bass Strait interconnector.[43] It may also be a catalyst for the State Government to attract other industrial demand to Tasmania to utilise the surplus low cost energy.

Conclusion:

- A significant demand reduction would result in an on-island surplus of energy generation and would alleviate energy security concerns in Tasmania. In scenarios of a very large demand reduction, this could result in stranded assets with adverse implications for generating asset owners.

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42 These blocks align with the 2015 AEMO NEFR.

43 Tamblyn J, 2017, *Feasibility of a Second Tasmanian Interconnector.*

Table 6.2 Cost impact and annual risk of an energy security event with changing Tasmanian demand

Scenario	TVPS available		No TVPS	
	Annualised Average Cost Impact ($ million)	Annual risk of an Energy Security Event (%)	Annualised Average Cost Impact ($ million)	Annual risk of an Energy Security Event (%)
High Demand	12.3	<0.1	4.2	2.1
Base	-	<0.1	- 8.1	0.5
Low Demand (-1 200 GWh p.a.)	- 24.2	<0.1	- 35.6	<0.1
Very Low Demand (-4 600 GWh p.a.)	- 19.7	<0.1	- 32.0	<0.1

6.4 'Gas Supply Interruption' scenario

GAS SUPPLY INTERRUPTION

What would Tasmania's energy security look like if gas was not available as a fuel source for industry, commercial, residential and power generation purposes?

There are potential (although unlikely) scenarios in which gas supply could be interrupted in Tasmania, whether through a gas shortage or plant/pipeline failure or due to a combination of factors that make it uneconomic to continue to safely supply gas to Tasmania.

These scenarios could include:

- a shortage of gas in eastern Australia driven by liquefied natural gas (LNG) exports and depleting sources;
- a failure of the Longford plant or Tasmanian Gas Pipeline;
- a substantial increase in prices that encouraged customers to switch to other energy sources; and/or
- a combination of factors that made it uneconomic to continue to safely supply gas to Tasmanian customers.

The impact of a gas supply interruption would include the loss of the TVPS as a source of generation and the potential conversion from gas to electricity of existing gas users (estimated demand increase of around 167 GWh per annum).

If gas were permanently unavailable in Tasmania, Taskforce modelling shows that there would be between $3-5 million average net cost savings per annum, representing the removal of the costs of maintaining and operating the TVPS, offset by higher energy in storage and the cost of importing over Basslink to meet these higher energy in storage requirements. Table 6.3 shows the amount by which the HRL and PSL profiles (refer Chapter 11) would need to be increased to account for the permanent absence of the TVPS as a source of generation.

Table 6.3 Change in energy in storage measures at the beginning of each month in a system without the TVPS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HRL	+5.3%	+5.2%	+4.6%	+5.5%	+7.3%	+7.4%	+6.8%	+2.6%	+3.1%	+5.5%	+3.9%	+2.0%
PSL	+5.1%	+5.0%	+4.9%	+4.9%	+5.0%	+5.7%	+6.1%	+6.1%	+5.8%	+5.4%	+5.1%	+5.1%

These higher energy in storage targets would only partially offset the risk of an energy security event. As shown in Chapter 5, having the TVPS available with a PSL of 30 per cent at 1 July is more effective as an energy security measure than holding higher energy storage levels in isolation.

The energy security benefits of the TVPS have been well documented in Chapter 5 and other scenarios presented in this chapter. A Tasmanian energy system without the TVPS is at a greatly increased chance of experiencing an energy security event without the presence of this readily available backup generation

In the event of a gas supply interruption, without an adjustment of the HRL and PSL profiles, Tasmania's gas energy security would be assessed as Impacted until gas supply was restored or alternative sources of energy were available. A loss of gas for an extended period could potentially increase the likelihood of a Tasmanian major industrial consumer that is reliant on gas for energy ceasing its operations. While this would potentially ameliorate the risk to energy security, it would amplify the negative consequences on the economy and employment. Overall, a total loss of gas supply would increase Tasmania's energy security risk.

Conclusion:

- There is an increased energy security risk if gas is unavailable to operate the TVPS. In the event of a long-term interruption to gas supply in Tasmania, adjustments would need to be made to the HRL and PSL profiles that only partially offset this risk.

6.5 'On-island Energy Balance' scenario

ON-ISLAND ENERGY BALANCE

What would Tasmania's energy security look like if there was on-island energy balance between supply and demand?

In the Interim Report the Taskforce identified that Tasmania has an average annual on-island energy supply deficit of 700 GWh to 1 000 GWh. The Taskforce assessed that energy security in Tasmania would be more resilient if this deficit were reduced or eliminated. To investigate this, the Taskforce has examined three options available to Tasmania to meet the deficit:

- 'TVPS 700 GWh' – operation of the 200 MW TVPS CCGT for five months each year;
- 'Wind' – installation of two additional wind farms with 266 MW combined capacity operating with a 30 per cent capacity factor; or
- 'Mixed Renewables' – installation of a combination of renewables (wind, solar and biomass).

Figure 6.4 represents the costs and revenues associated with each option investigated by the Taskforce. The data above the horizontal axis shows the estimated cost savings and revenue associated with each option, and the data below the axis shows the estimated additional costs. The net result is represented by the dashed line.

As illustrated in Figure 6.4, Taskforce modelling shows that the option of operating the TVPS to produce 700 GWh per annum presents an annual net cost as the cost of gas generation is forecast to exceed the corresponding value of the reduced amount of energy imported over Basslink.

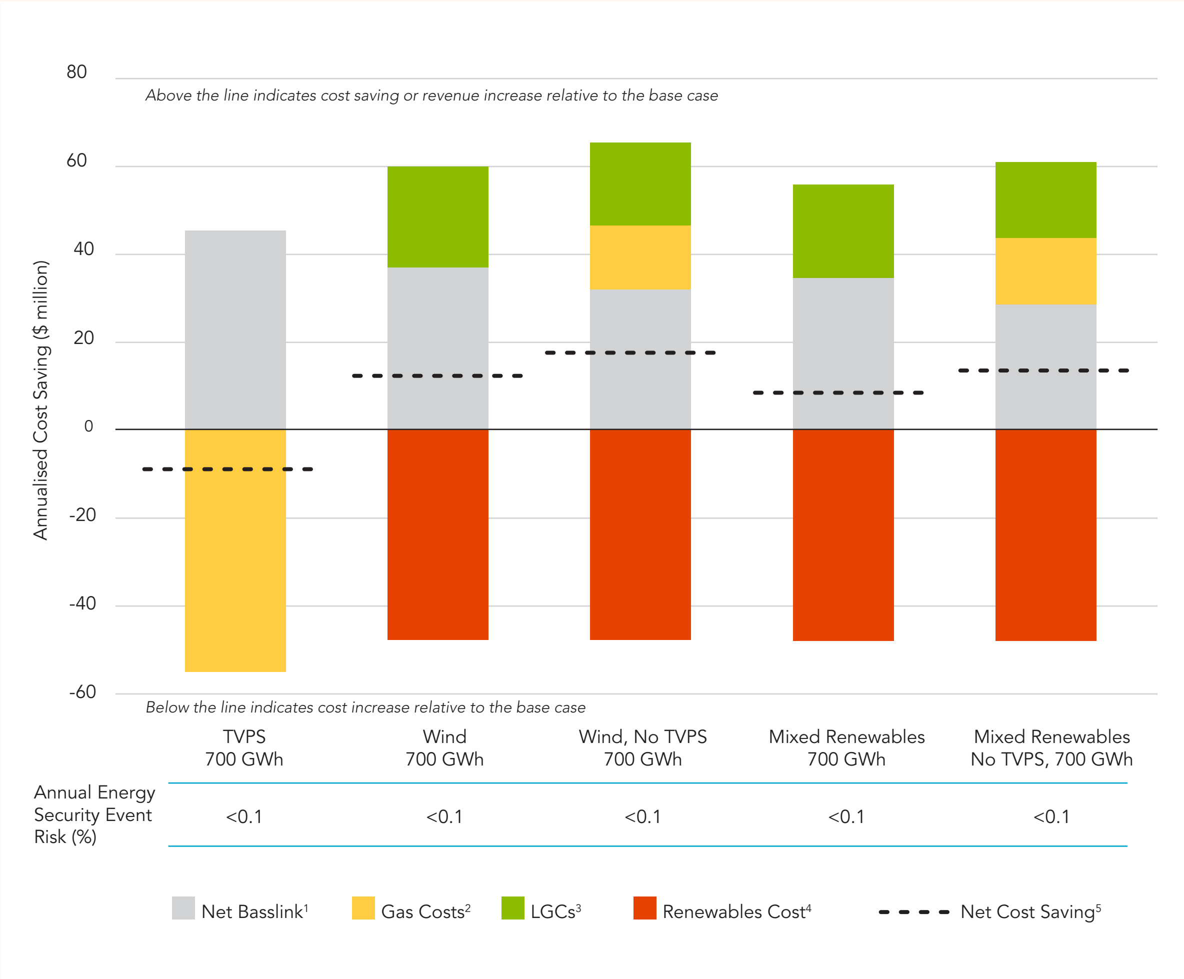
Conversely, the option of developing new renewable energy generation to produce 700 GWh per annum presents an annualised cost saving (compared to the base case), largely as a result of the value of large-scale generation certificates (LGCs) generated. The Mixed Renewables option presents a slightly lower cost saving compared to the Wind option as biomass and solar are assumed to be marginally more expensive and are also expected to take longer to develop, resulting in lower net revenues. The value of both renewable energy options would be further enhanced if energy prices continue to increase and/or if their development creates a sufficiently robust energy system to support the closure of the TVPS without impacting energy security.

Options for addressing the on-island supply balance are assessed further against the Taskforce's assessment criteria in Chapter 7.

Conclusion:

- Increasing non-hydro renewables would increase on-island self-sufficiency and is likely to provide a net benefit to Tasmania.
- Operation of the TVPS to meet the on-island generation deficit is not preferred unless its operating costs reduce or market prices significantly increase.

Figure 6.4 Annualised cost savings and annual risk of an energy security event with various options to achieve on-island energy balance in Tasmania



Source: Taskforce analysis

Notes:

1. Net Basslink – Savings in reduced Basslink energy imports.
2. Gas Costs – Increased/decreased cost of gas generation, or savings from removal of TVPS.
3. LGCs – Large-scale generation certificate revenue from renewable energy generation.
4. Renewables Cost – Additional cost of renewable generation.
5. Net Cost Saving – Net Cost Saving (above the line is net cost saving, below the line is net cost increase).

6.6 'NEM Carbon Market' scenario

NEM CARBON MARKET

What would Tasmania's energy security look like if there was a price on carbon in the NEM?

This scenario examines the impact of a price on carbon on Tasmania's energy security over the period 2020-2030 in the generation options explored in the On-island Energy Balance scenario. Under this scenario, the Taskforce has also explored an option of building two additional wind farms beyond that required to achieve on-island energy balance (four wind farms in total). The assumed carbon price is \$25/tCO_2-e rising linearly to \$50/tCO_2-e in 2030.[44]

The introduction of a price on carbon emissions would result in a significant increase in wholesale prices in the NEM. This price increase would be driven by an increase in the cost of production of carbon intensive generation. While these costs would not be incurred in the production of hydro-electricity, Tasmania would still experience an increase in the wholesale price due to its connection to the NEM. Higher wholesale prices would represent both a significant increase in the cost of Basslink imports and a significant increase in the value of Basslink exports. As Tasmania is a net importer of energy over Basslink (a result of the deficit in on-island energy generation) this would represent a net cost to Tasmania.

Figure 6.5 is presented in a similar manner to the data presented in the On-island Energy Balance scenario. Data above the horizontal axis shows the estimated cost savings and revenue associated with each option, and the data below the axis shows the estimated additional costs. The net result is represented by the dashed line.

Without a change in generation in Tasmania, there is a cost impact from a carbon price (shown in black). As the cost of energy imports increases, so does the cost of maintaining the current energy supply mix in Tasmania. This cost is eliminated when there is on-island energy balance achieved through installing an additional 700 GWh of renewable energy generation in Tasmania.

A further benefit is realised when a surplus of on-island energy generation is available for export. This surplus has been modelled by the Taskforce using four wind farms, however a similar result could be expected if a surplus were achieved through the development of a mixture of renewables.

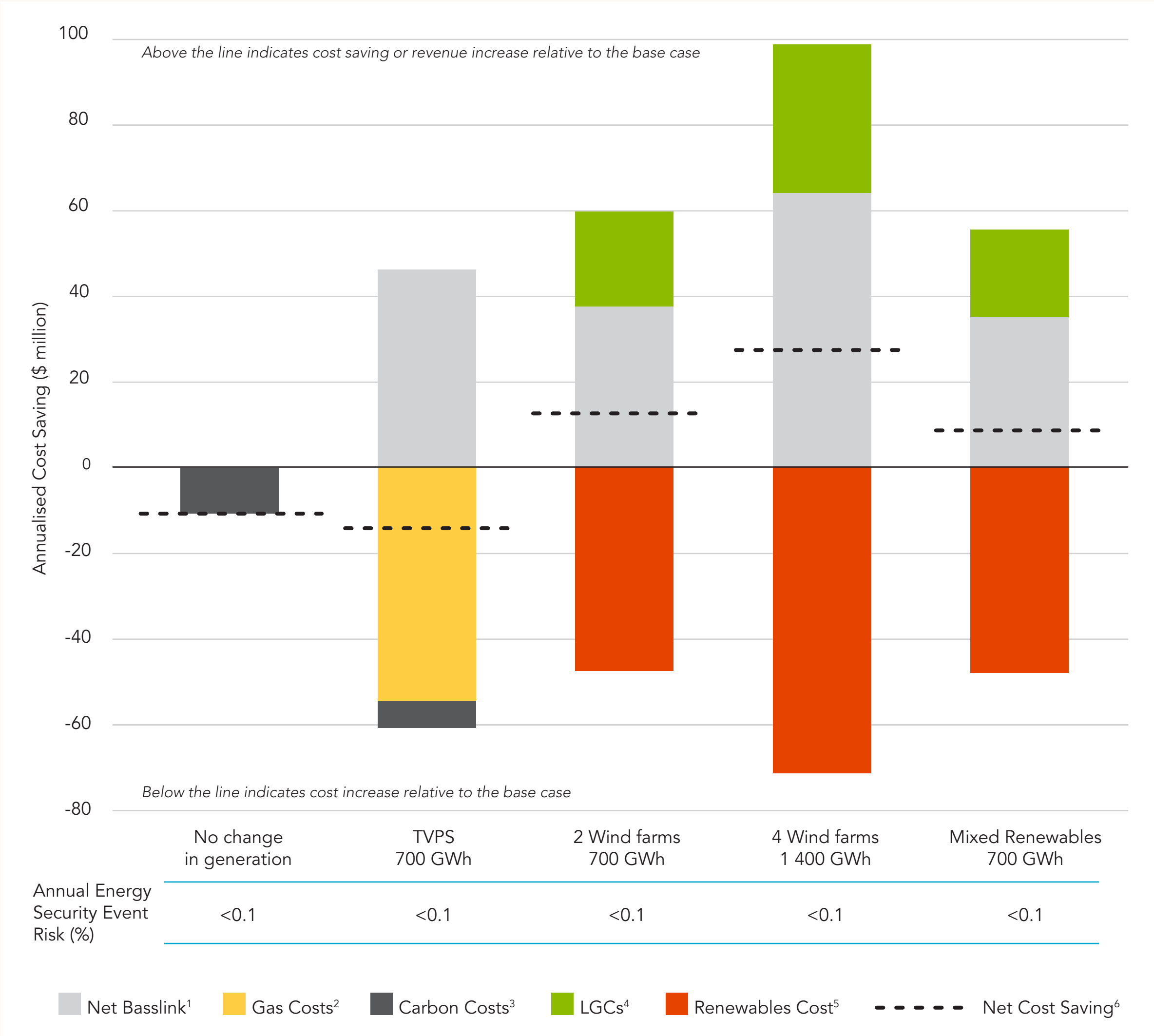
Running the TVPS for five months a year costs more under this scenario than under the On-island Energy Balance scenario due to the cost associated with its carbon emissions. However, the net cost is reduced as gas has a lower carbon intensity than the base load coal-fired generation that dominates the NEM. This suggest that at higher electricity prices, even with higher gas prices, the TVPS may become more competitive under a carbon price.

Conclusion:

Tasmania's energy security is not materially impacted by a carbon price. Tasmania would be in a better position to avoid the costs of a carbon price if it were a net exporter of energy sourced from renewable generation.

44 Following the AEMO 2016 National Transmission Network Development Plan.

Figure 6.5 Annualised cost saving and annual risk of an energy security event with various options to achieve on-island energy balance in Tasmania with a price on carbon



Source: Taskforce analysis

Notes:

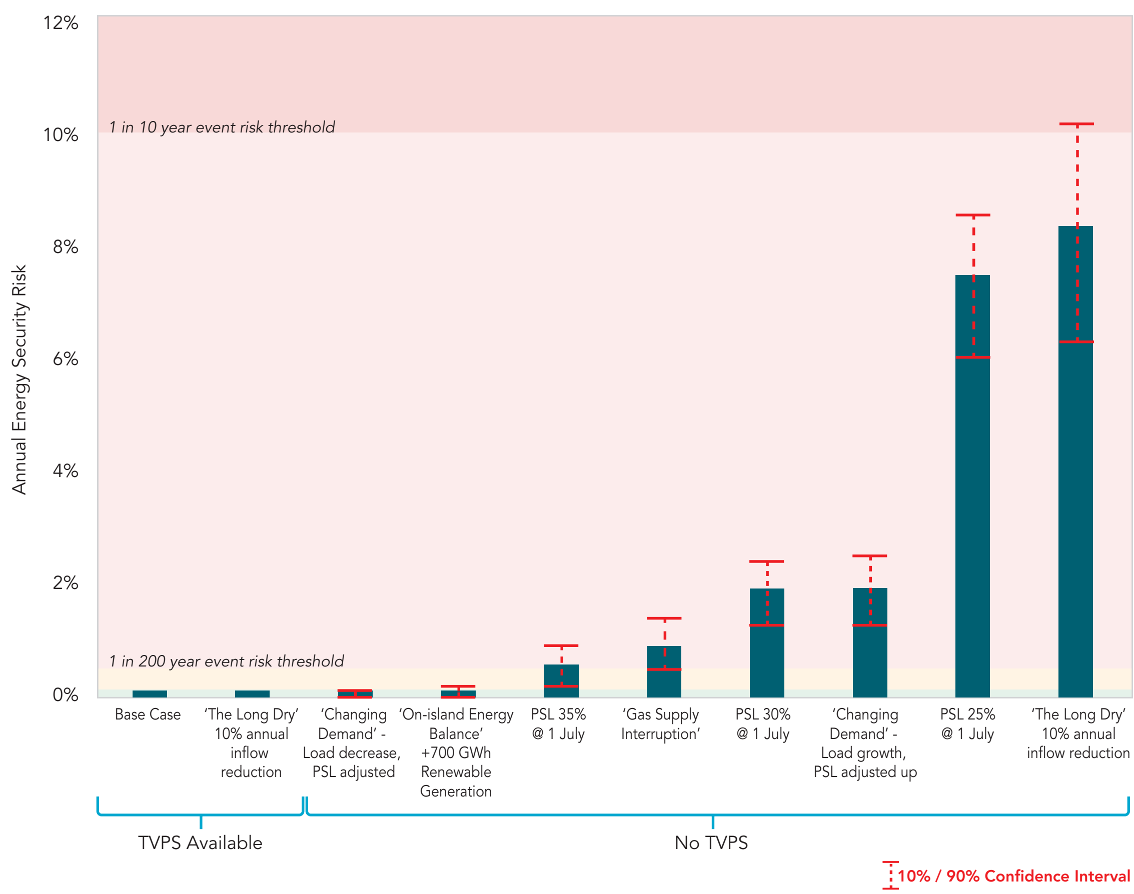
1. Net Basslink – Savings in reduced Basslink energy imports.
2. Gas Costs – Increased/decreased cost of gas generation, or savings from removal of TVPS.
3. Carbon Cost – Direct cost of increased Tasmanian carbon emissions, or indirect cost of carbon price from NEM price increase.
4. LGCs – Large-scale generation certificate revenue from renewable energy generation.
5. Renewables Cost – Additional cost of renewable generation.
6. Net Cost Saving – Net Cost Saving (above the line is net cost saving, below the line is net cost increase).

6.7 Risk of an energy security event across modelled scenarios

The outcomes of the scenarios discussed in this paper have a wide range of energy security risks associated with their modelling. As discussed in Chapter 4, energy security risks have been assessed in the model by utilising a randomised annual inflow assumption and a randomised six month Basslink outage with a one in 10 year probability of occurrence. Where the randomised inflows result in energy in storage below the HRL on 1 July and a Basslink outage has occurred in that year, this is classified by the model as an energy security event. An energy security event is also identified if pre-emergency temporary generation is required to maintain storage levels at or above the minimum HRL for the year (16 per cent in May). Further details on the workings of the model and the assumptions behind it are provided in Appendix 2 and Appendix 3.

Figure 6.6 shows the comparative risks of an energy security event occurring across the scenarios modelled by the Taskforce. The importance of TVPS support, combined with the Taskforce's recommended PSL profile, in ensuring energy security in Tasmania is evident. All scenario outcomes with annual energy security risks higher than one per cent are representative of analyses without TVPS availability. When the TVPS is available (and utilised) for support when total energy in storage is low, the risk of an energy security event occurring in a given year is very low.

Figure 6.6 Risk of an energy security event across modelled scenarios



Source: Taskforce analysis

7. Assessment of Energy Security Options

KEY FINDINGS

- The approach of adopting a PSL of around 30 per cent at 1 July each year (and 40 per cent at the end of October) and the retention of the TVPS provides a Resilient level of electricity energy security in the short term, as well as other benefits, at a cost that is low relative to the energy security that it provides.
- The development of additional Tasmanian renewable energy generation would provide a Resilient electricity energy security rating in the medium to long term and is assessed as being the most cost-effective option for reducing the on-island energy deficit in the medium term.

As summarised in Chapter 2, the key short-term Taskforce recommendations arising from the Interim Report include the establishment of more prudent energy in storage targets (i.e. a PSL of around 30 per cent at 1 July each year and 40 per cent at the end of October), the retention of the TVPS as a standby generator and the establishment of an Energy Security Risk Response Framework supported by two new energy security oversight roles.

This chapter presents the Taskforce's assessment of its recommendations against other possible options to improve Tasmania's energy security in the short term (i.e. over the next 1-5 years) using an assessment framework that expands consideration beyond cost and risk assessments. An assessment of options to address Tasmania's on-island generation deficit in the medium to long term is also provided.

7.1 Assessment criteria and measures

The Taskforce has developed, with the assistance of Boston Consulting Group (BCG), an assessment framework to compare energy security options. Using this framework, the Taskforce has assessed each option against 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 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.

For each criteria, the Taskforce has developed a set of quantitative and qualitative measures against which each option is assessed. These measures, which are described in detail in Appendix 4, have been developed with the assistance of BCG, and have been chosen to enable an objective comparison of options. While the Taskforce recognises that choosing the 'right' set of measures for each criteria is open to interpretation, and is to some extent subjective, the Taskforce considers that the set of measures it has adopted is appropriate for undertaking a high level comparison of different energy security options.

The Taskforce has applied a balanced approach to the application criteria to develop a 'holistic view' of its preferred option against others, noting that the use of some judgement has been required regarding the trade-off between options that satisfy different criteria to varying degrees.

7.2 Short-term energy security options

The Taskforce has evaluated its recommendations against other possible options to improve Tasmania's energy security in the short term (i.e. next 1-5 years), including retaining the TVPS and reducing the PSL to 25 per cent at 1 July (as was the situation during the 2015-16 energy security event) or raising it to 35 per cent at 1 July. An alternative option of not retaining the TVPS and not implementing the PSL methodology is also considered, whereby there is reliance on pre-emergency measures such as demand reduction and temporary diesel generation if an energy supply shortfall event is looming.

The assessment of each option against the five assessment criteria is presented in Table 7.1. A full description of Taskforce's reasoning behind its assessment of each option is presented in Appendix 4.

7.2.1 Options with the TVPS available on standby

As shown in Table 7.1, the Taskforce's recommended option provides a very low chance of an energy security event occurring in a given year and is considered robust to the range of scenarios presented in Chapter 6 (although not as robust as if an even higher PSL profile were to be adopted at 1 July). While adoption of the Taskforce's recommendations does come at a cost over a 10 year period relative to some alternative options, this cost is considered to be low relative to the energy security that it provides.

The availability of the TVPS supports the broader economic outcomes of Tasmania through creating ongoing employment and improving wider business confidence, although its use when required does have an impact on Tasmania's carbon emissions.

The Taskforce has observed that its recommended option provides a strong robustness to a range of energy security scenarios, and considers that Tasmania's electricity energy security can be assessed as Resilient in the short term. An increase in the PSL profile at 1 July each year to 35 per cent is considered to provide even greater robustness to future scenarios if the TVPS is available, and also provides other benefits (including greater energy availability and lower carbon emissions). However, the Taskforce considers that this alternative option is not required to maintain a Resilient short-term electricity energy security rating for Tasmania.

The Taskforce has explored the option of maintaining the TVPS on standby and adopting a lower PSL of 25 per cent at 1 July each year, which is effectively the situation that was in place prior to the 2015-16 energy security event. Table 7.1 shows that the lower PSL profile would result in a lower overall cost over 10 years (due to increased energy available for Basslink exports) whilst still maintaining a very low risk (less than 0.1 per cent or 1 in 100 year chance) of an energy security event occurring each year. However, this risk likelihood is a product of the annual basis of the Taskforce's model, and does not account for intra-year inflow variability that makes operating at this level more risky than operating with a PSL of 30 per cent at 1 July each year (i.e. the ability to maintain energy security through low intra-year inflow sequences is not shown). While a Managed energy security assessment is considered appropriate in this situation, this option is assessed as being less robust to future scenarios than operating with a PSL of 30 per cent at 1 July each year and the TVPS on standby.

An energy in storage target of 25 per cent at 1 July would also not give business confidence in energy security management as it represents a similar targeted level of energy in storage that was in place prior to the energy security event of 2015-16.

Table 7.1 Assessment of short term energy security options for Tasmania

Measure[1]	Taskforce recommendations:	Alternative options considered:			
	TVPS on standby, PSL 30% at 1 July	TVPS on standby		No TVPS	
		Reduce PSL to 25% at 1 July	Increase PSL to 35% at 1 July	Increase PSL to 35% at 1 July	Rely on emergency measures (no PSL)
Availability - solutions that improve Tasmania's resilience to shocks					
Energy availability (over year, GWh)	Base	-724	+724	-1 028	-2 476
Likelihood of energy security event (% chance per annum)	< 0.1	< 0.1[2]	< 0.1	~0.5	~8
Vulnerability to intra-year inflow risk	Low	High	Very Low	Moderate	Very High
Robustness to Taskforce scenarios	4	3	5 (most robust)	2	1 (least robust)
Short-term electricity energy security rating	Resilient	Managed	Resilient	Managed	Susceptible
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups					
Net cost (annualised, $ million)	Base	-6	+7	-8	-11
Impact on wholesale electricity price ($/MWh)	Base	-0.57	+0.65	-0.77	-1.05
Impact on wholesale electricity price (%)	Base	-0.8	+0.9	-1.1	-1.5
Impact on typical retail bills (%)	Base	-0.2	0.3	-0.3	-0.4
Environmental sustainability - solutions that have low impact on land, water and air quality					
On-island/total carbon emissions (000' t CO_2-e pa)	Base	+46/-78	-18/+90	-49/+58	-17/-45
Regulation – solutions that are consistent with energy policies and energy security objectives					
Government budget impact	Base	Favourable	Unfavourable	Favourable	Variable
New policy, regulation or legislation	Energy security oversight regulation	Energy security oversight regulation	Energy security oversight regulation	Energy security oversight regulation	No new regulation, but policy risk
Economic development – solutions that support the sustainability of the Tasmanian economy					
Support ongoing economic activity and employment	✓	✓	✓	×	×
Impact on confidence and investment	↑	↓	↑	↓	↓

Notes:
1. Description of Measures is included in Appendix 4.
2. This risk likelihood is a product of the annual basis of the Taskforce's model, and does not account for intra-year inflow variability that makes operating at this level more risky than operating with a PSL of 30 per cent at 1 July each year.

7.2.2 Options where the TVPS is not present

The Taskforce has also examined the option of the TVPS being permanently unavailable in Tasmania. In the absence of the TVPS, but maintaining the PSL profile, the required energy in storage would increase to around 35 per cent at 1 July each year. While Taskforce modelling shows that this option costs less over 10 years than the Taskforce's recommended option, and there is only a marginal increase in the risk of an energy security event occurring, this option appears less robust to the future scenarios examined in Chapter 6, particularly under modelled low inflow scenarios or if there is an increase in Tasmanian demand. As the TVPS currently underpins the Tasmanian gas market, the reduced gas supply may also negatively impact gas availability and affordability for other consumers, with a potentially negative impact on economic activity.[45]

If the TVPS was not retained on standby and storage levels were not managed according to a PSL profile, a reliance on standby pre-emergency measures (such as negotiated voluntary load reductions or temporary generation) would be required to keep energy in storage at or around the HRL profile. Such an approach significantly increases the chance of an energy security event in a given year, and it is assessed as being less robust under future scenarios, in particular a scenario of extreme low inflows. The energy security rating in this situation would be Susceptible, as resilience to a major shock would be low. Given the historical incidence of low probability energy security events in Tasmania, together with recent history showing that two or more separate low probability events can occur within a short period, the Taskforce has concluded that a greater level of insurance is required than this option provides.

The cost of reliance on standby pre-emergency measures is highly variable – it may be zero if no combination of low inflows and Basslink outages occurs in a particular decade, or it may be several hundreds of millions of dollars if events occur (or even recur). While the annual cost of emergency generation on average is likely to be less than the cost of the Taskforce's recommendations, it would likely result in variable and potentially significant budget impacts when an energy security event does occur, and would likely reduce public and business confidence in the reliability of Tasmania's energy security.

7.2.3 Taskforce recommendation

Based on the above assessment, the Taskforce concludes that its recommended approach of a PSL profile of around 30 per cent at 1 July each year (and 40 per cent at the end of October) and the retention of the TVPS provides a Resilient level of energy security in the short term, as well as other benefits, at a cost that is low relative to the energy security that it provides.

The Taskforce's recommendations are consistent with a policy intention to reduce the risk of an energy supply security event occurring. The PSL profile provides a strong level of energy security that is robust to different scenarios. However, its successful operation requires the implementation of the Monitor and Assessor and Energy Security Coordinator roles outlined further in Chapter 10. These are a key aspect of the energy security enhancements proposed by the Taskforce. While the establishment of these roles comes at a small cost (estimated to be approximately $0.5 million per annum), the implementation of these roles will provide robustness to adverse energy security scenarios and market sensitivities and will increase confidence of Tasmanian energy consumers that energy security is being managed well.

[45] Interim Report, section 11.8.

7.3 Options for addressing on-island energy balance

The Interim Report found that, all other things being equal, a more secure setting for Tasmania would be created if the average deficit of 700 GWh to 1 000 GWh of on-island generation were reduced or eliminated. The On-island Energy Balance scenario presented in Chapter 6 presents three possible approaches that could increase Tasmania's annual non-hydro on-island generation by 700 GWh in an average rainfall year.

Table 7.2 presents an assessment of each of these options against the five assessment criteria. For consistency with section 7.2, each option is compared against the Taskforce's recommended option.

Table 7.2 Assessment of options for addressing on-island energy balance

Measure[1]	New Generation – Wind	New generation – Mixed Renewables	TVPS running for five months
Availability - solutions that improve Tasmania's resilience to shocks			
Change in energy supply (GWh)[2]	+700	+700	+700
Energy security rating	Resilient	Resilient	Resilient
On-island coverage	Yes	Yes	Yes
Energy supply diversity	Good	Strong	Good
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups			
Net cost (annualised, $ million)	-12	-9	9
Impact on wholesale electricity price ($/MWh)	-1.16	-0.81	+0.85
Impact on wholesale electricity price (%)	- 1.7	- 1.2	+ 1.2
Impact on typical retail bills (%)	- 0.5	- 0.3	+ 0.3
Sensitivity to uncontrollable market variables	Good (once developed)	Good (once developed)	Susceptible
Environmental sustainability - solutions that have low impact on land, water and air quality			
On-island/total carbon emissions (000' t CO_2-e pa)	-51/-413	-48/-383	+244/-245
Regulation – solutions that are consistent with energy policies and energy security objectives			
Government budget impact	Favourable	Mixed	Unfavourable
Compatibility with existing policy	Compatible	May require change	Compatible
New regulation or legislation	No	No	No
Economic development – solutions that support the sustainability of the Tasmanian economy			
Support ongoing economic activity and employment	✓✓	✓✓	✓
Indirect support to confidence and investment	↑	↑	-

Notes:
1. Description of Measures is set out in detail in Appendix 4.
2. Change in energy supply reflects availability of additional energy imports if required.

Each option is considered to provide a Resilient energy security rating in the medium to long term, as the risk of a prolonged Basslink outage is mitigated by the presence of sufficient on-island energy generation (based on long-term average inflows of 9 000 GWh).

The development of new on-island renewable energy generation is assessed as being the most cost-effective of these options. Taskforce modelling shows that there should be a reduction in total annual energy costs to consumers from increasing renewable energy generation.[46] This recognises that the cost of renewable energy generation is falling (as outlined in Chapter 14 of the Interim Report) and that the alternative cost of importing energy over Basslink is rising. This annualised cost saving contrasts with the increased annual cost that would be incurred if the TVPS was run annually for five months. As evidence presented in the Interim Report suggests, large-scale solar and biomass energy generation are likely to be more expensive to implement than wind energy in Tasmania in the short to medium term.[47]

The development of additional renewable energy projects, whether it be purely wind generation or a mixed portfolio of renewables, also has a direct and ongoing economic benefit through the creation of construction and ongoing jobs. However, transmission stability issues will need to be considered and any associated costs applied appropriately to new developments.

It is noted that a greater energy output from on-island generation would enable greater flexibility in the use of Hydro Tasmania's storages, allowing a reduction in targeted energy storage levels whilst maintaining and improving energy security. This is further discussed in Chapter 11. The role of the TVPS could also be reconsidered if there was sufficient confidence that on-island energy security could be maintained at a Resilient level based on an assessment of the capacity of on-island renewable energy generation sources to meet demand during an extended Basslink outage under a range of future scenarios.

One of the options identified by the Taskforce for achieving on-island energy balance is to operate the TVPS CCGT for five months in the dry season each year. This option is assessed as being relatively high cost due to the energy and gas cost assumptions used in the Taskforce's modelling. As the 'spark spread' of gas electricity generation changes over time this assessment may change.[48] This option is therefore susceptible to uncontrollable market forces. Uncertain financial impacts aside, running the TVPS enhances Tasmania's energy security under scenarios such as sustained low inflows. Through increasing the scale of gas consumption, it may also facilitate better access to gas by other energy users and provide indirect economic benefits. While this option has a higher carbon emissions intensity than the renewable alternatives, overall emissions are substantially lower than importing higher carbon intensity energy over Basslink from the NEM.

A second electricity Bass Strait interconnector is not directly assessed in Table 7.2, but would provide a significant increase in energy security by offering redundancy against any future extended outage or permanent loss of Basslink. Modelling undertaken by the Joint Feasibility Study into a second Bass Strait electricity interconnector estimated that the net cost of a second interconnector was $346 million.[49] This is a significantly higher net cost than the medium-term measures assessed in Table 7.2. A second electricity interconnector may reduce the need in the long term for the Taskforce's recommended short-term energy security measures of operating storages to a PSL profile and retention of the TVPS on standby (although the recent Joint Feasibility Study identified that the TVPS may have additional commercial benefits under a second electricity interconnector scenario). However, as outlined in the Interim Report, energy security

[46] While Taskforce modelling shows that the development of a portfolio of wind farms presents a favourable net present cost over 10 years, there are some conditions in the sensitivity analysis that could reduce this benefit (such as a lower than anticipated return from LGCs).

[47] Interim Report, Chapter 14.

[48] The 'spark spread' is the theoretical gross margin of a gas-fired power plant from selling a unit of electricity, having bought the fuel required to produce this unit of electricity. All other costs (operation and maintenance, capital and other financial costs) must be covered from the spark spread. Also called 'spark arbitrage'.

[49] Ernst & Young, 2017, *Market Dispatch Cost Benefit Modelling of a Second Bass Strait Interconnector.*

attributes are unlikely to be a major commercial driver for a second electricity interconnector and other options to achieve enhanced energy security are available that are significantly less expensive. The role of a second electricity interconnector for Tasmania's energy security is further discussed in Chapter 8.

A further option for reducing the on-island generation deficit, which is not assessed in Table 7.2, is the potential for augmentation of the Tasmanian hydro-electric system. For example, as outlined in Chapter 3, Hydro Tasmania has developed a proposal to investigate the potential to gain an additional 800 GWh energy per annum through a combination of efficiency upgrades and new pumped storage projects. At an estimated capital cost of $500 million, the total cost of these projects is comparable to the expected investment required to provide on-island balance through wind generation. However, given that these projects are only at the feasibility stage, this option may not be completed until the latter medium term to long term. The Taskforce assesses that diversification through new non-hydro renewables can address on-island coverage of energy supply sooner.

8. Role of Interconnection

KEY FINDINGS

- Based on the limited evidence available to it, the Taskforce is unable to reach a conclusion as to whether Basslink will be more or less reliable in the future than it has been in the past.
- There is sufficient evidence to consider a six month outage of Basslink to be a scenario that should be planned for.
- There is insufficient evidence to suggest that a longer outage of 12 months or more is a plausible scenario that should be specifically planned for at this time. However, the risk of a subsea Basslink outage extending beyond six months appears to be greater until all ordered spares are delivered in early 2019.
- An independent and publicly communicated review of Basslink's asset management and compliance plans would provide greater public confidence as to their adequacy.
- A second Bass Strait electricity interconnector would enhance Tasmania's energy security and provide wider benefits. However, its development is not required to ensure Tasmania's long-term energy security if the Energy Security Risk Response Framework is adopted and new on island generation is supported.

This Chapter provides the Taskforce's final assessment of Basslink's future reliability, and an assessment of the robustness of the Taskforce's key assumption arising from the Interim Report that a six month outage should be included as a plausible scenario in energy security planning assumptions. It also provides an overview of recent reports that have assessed the costs and benefits of a second Bass Strait electricity interconnector, and presents the Taskforce's final assessment of a second interconnector's value to Tasmania from an energy security perspective.

8.1 Basslink

8.1.1 Performance of Basslink

Chapter 12 of the Interim Report provides an overview of Basslink's past reliability and outages prior to the December 2015 fault.

As required under the conditions of Basslink's transmission licence, Basslink Pty Ltd (BPL) provides annual performance information to the Tasmanian Economic Regulator (TER). Since the Taskforce's Interim Report was finalised, BPL has reported that Basslink was available for 99.6 per cent of the time during 2015-16, although in reporting this figure BPL excluded the 20 December 2015 to 14 June 2016 outage.[50] This exceeds the Basslink Operations Agreement (BOA) performance requirement for a minimum availability of 97 per cent and a performance target of 97.5 per cent (excluding force majeure events). This is despite a separate unplanned outage of just under 36 hours occurring on 22 June 2016, which BPL has stated was caused by a protection trip at the Victorian Loy Yang convertor station and was unrelated to the subsea cable fault.[51]

As at 19 May 2017, there have been no unplanned outages of Basslink reported in 2016-17.

50 Office of the Tasmanian Economic Regulator (OTTER) 2016, *2015-16 Energy in Tasmania Report*.
51 http://www.basslink.com.au/wp-content/uploads/2016/06/Media-statement-23-June-.pdf

8.1.2 Future reliability

Since the Taskforce's Interim Report was finalised, BPL has publicly communicated the outcome of an investigation it commissioned into the 2015 Basslink cable fault. The investigation was undertaken for BPL by the United Kingdom-based firm, Cable Consulting International (CCI). BPL's position is that the exact cause of the subsea cable fault that led to the extended outage could not be determined, being described as a 'cause unknown' by CCI.[52] While the fault was determined to have occurred within the cable, BPL has reported that the investigation found that the location was not at a joint or lead sheath to armour bond, there was no evidence of pre-existing mechanical damage and the cable had been operating within its thermal rating at the time the fault occurred.[53] According to BPL, the investigation finding was that the cable itself was in sound condition, based on a sample remote from the fault location.

Based on the limited evidence available to it, the Taskforce is currently unable to verify the accuracy of the statements made by BPL or reach a conclusion as to whether Basslink will be more or less reliable in the future than it has been in the past.

A key recommendation of the Interim Report was that energy security planning should include planning for at least a six month Basslink outage. This was based on how subsea interconnectors have performed historically in other jurisdictions and the fact that Basslink has now experienced an outage of this duration. Based on this assessment, the ability to withstand a six month Basslink outage forms a key assumption in setting the HRL profile under the Energy Security Risk Response Framework. Due to the importance of this assumption in underpinning the HRL and PSL profiles, the Taskforce has sought further evidence as to whether a longer outage of 12 months or more could be considered plausible.

Apart from the time it takes to locate a subsea cable fault, there are a number of factors that are critical to the repair time of a subsea interconnector.[54]

- Availability of a repair vessel – submarine fibre-optic cable repair vessels are placed at strategic locations worldwide, called zonal agreements, and some cable system owners contract with these vessels to guarantee access to them. These vessels can normally mobilise for a cable repair within 24 hours. The availability of a suitable repair ship and its proximity to the fault location can critically impact the length of time to repair a cable fault. According to BPL, Basslink is currently the only high voltage direct current (HVDC) submarine power cable system that is party to one of these zonal agreements.
- Modification of the repair vessel – a cable repair vessel may require modification with extra cable handling equipment (e.g. chutes, roller guides etc.) before it can be used to carry and repair a length of cable at sea.
- Availability of a specialist cable jointer crew – subsea cable manufacturers generally have their own specialist teams to undertake repairs of cables they have manufactured. Without a standing contract for these jointer teams, the repair time of a cable fault is dependent on the availability of the manufacturer's jointing team to undertake the repair.
- Availability of spare equipment – spare cable and jointing kits are required to repair a cable fault, as the length of cable containing the fault must be removed and a new length of cable jointed to the cut ends to replace the cut length. Procurement of new cable can take up to three years, depending on availability of manufacturing windows, and can substantially delay the repair timeframe.
- Weather conditions – the damaged cable must be cut on the sea bed, brought to the surface safely, cut and rejointed, which is difficult to undertake safely in rough seas when the vessel is moving around strongly. Ongoing adverse weather conditions can substantially delay the length of time it takes to repair a cable fault.

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52 http://www.basslink.com.au/wp-content/uploads/2016/12/161205-Media-statement.pdf
53 Ibid.
54 Worzyk T, 2011, *Submarine Power Cables: Design, Installation, Repair, Environmental Aspects.*

While there is no indication to suggest that another Basslink fault will occur in the future, the Taskforce has engaged with BPL to better understand its preparedness for such an event and the implications of this for the six month Basslink outage assumption. In this context, BPL has provided verbal advice to the Taskforce regarding the measures it has in place to respond to a potential future Basslink cable fault. The Taskforce has also visited BPL's spares facility to view the equipment available to repair the cable should a fault occur. The Taskforce welcomes the fact that BPL has been prepared to engage with the Taskforce in this manner.

BPL has advised the Taskforce of the following arrangements it has in place.

- Cable repair ship contract – BPL continues to maintain a standing contract with a cable repair ship based in Noumea, which can be called upon if needed. This cable ship is shared between 20 other subsea fibre optic and power cable operators on a first come first served basis. Hence if a Basslink fault occurs, and the ship is already working on another cable, a delay will necessarily occur until work to repair that other cable is complete. This delay may be compounded if more than one cable operator has called upon the cable ship and there is a 'waiting list'.
- Cable ship modifications – the vessel contracted by BPL is an optic cable repair vessel that does not have cable sheaves or cable chutes for handling power cables. Cable sheaves and chutes were specifically manufactured by BPL in 2008 as part of its Marine Disaster Recovery Plan and stored in Melbourne. These are being refurbished in 2017 so that they may be redeployed if needed. BPL has advised that the plans for these can be adapted to an alternative ship, and that the experience of the 2016 repair means that they are better prepared for the processes required to make the necessary modifications to the vessel.
- Cable jointers – BPL has advised that Prysmian (the manufacturer of the Basslink cable) does not offer a standing contract for its cable jointer team.
- Strategic spares – while BPL does have a length of cable in storage and available for immediate use, an extra length of cable has been ordered to replace that used in the 2016 repair. Due to long lead times, this spare cable is due for delivery during the first quarter of 2019. BPL has replaced the jointing kits used in the 2016 repair and, as a prudent precaution until the spare cable has been delivered, BPL has ordered additional jointing kits which are due for delivery in mid-2017.
- Experienced team – BPL has advised that its employees have significant specialised HVDC power cable engineering skills and experience that would be utilised in any future outage.

While the refinements BPL has made to its emergency response process and strategic spares supply go some way towards shortening the repair time for a subsea Basslink fault, there are several uncontrollable factors that could extend the repair timeframe beyond six months (including the 'first come first serve' basis of the vessel contract, the inability to pre-contract cable jointers and weather delays in Bass Strait). The fact that these are uncontrollable means that the Taskforce is not in a position to estimate the likely time impact of these events occurring either individually or in combination. However, the Taskforce assesses that the risk of a subsea Basslink outage extending beyond six months appears to be greater until all ordered spares are delivered in early 2019.

A subsea fault is not the only technical issue that could cause an extended failure of Basslink. In 2008, a transformer failure at Loy Yang in Victoria caused an unplanned Basslink outage for eight days while a replacement transformer was installed.[55] BPL has advised the Taskforce that it has a spare transformer for both the Tasmanian (George Town) and Loy Yang ends of the cable. According to BPL, if either spare transformer is called upon and another operational transformer fails prematurely, the typical lead time for delivery of a replacement is at least 18-24 months. However, the Taskforce considers that there is insufficient evidence to suggest that a longer outage of 12 months or more is a plausible scenario that should be

55 http://www.abc.net.au/news/2008-01-11/investigation-into-basslink-failure/1008990

specifically planned for at this time.[56] Furthermore, as noted in the Interim Report, Hydro Tasmania has advised the Taskforce 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 should one occur.

In this context, the Taskforce assesses that the Interim Report recommendation that "*energy security planning should include planning for at least a six month Basslink outage*" (recommendation 29) remains valid, and should be used in setting the HRL profile under the Energy Security Risk Response Framework.

In the Interim Report, the Taskforce recommended that "*(t)he TER should seek an independent appraisal of Basslink's asset management plans (including its Marine Disaster Recovery Plan) as soon as possible*" (recommendation 28). This recommendation was made in the context of providing some assurance to stakeholders following the 2015-16 energy security event as to BPL's ability to respond to similar circumstances to the December 2015 outage.[57] At that time, the TER had advised the Taskforce that it would not be undertaking an independent appraisal of BPL's compliance and asset management plans (as required every three years under Basslink's licence conditions) until 2017-18. The Taskforce concluded that an earlier appraisal of these plans would be desirable to provide assurance to stakeholders, and should include in its scope Basslink's Marine Disaster Recovery Plan, which was included in the previous independent appraisal undertaken in 2014.[58]

The Taskforce has since learned that there is a legal limitation to the TER reviewing Basslink's Marine Disaster Recovery Plan, as BPL's licence only requires it to develop and submit to the TER an asset management plan that covers those parts of Basslink within the Tasmanian jurisdiction.[59] Hence BPL is not required under its licence conditions to provide the TER with its undersea management plans for the portion of Basslink extending beyond three miles from the high water mark at the Tasmanian coast.

The Taskforce considers that a key element of energy security extends to the clear communication to the public of the risk and mitigation measures to support public confidence in the timeliness and appropriateness of responses to energy security challenges. Compliance and asset management plans are a key risk mitigator, and are an integral part. Accordingly, the TER should undertake its independent appraisal of BPL's compliance and asset management plans as soon as possible with a view to informing the public to the extent possible as to their adequacy.

RECOMMENDATION

1. The TER should, to the extent possible and as soon as practicable, undertake its independent appraisal of Basslink's compliance and asset management plans and publicly report on their adequacy.

[56] 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.

[57] Interim Report, page 108.

[58] Interim Report, pages 107-8.

[59] Basslink Pty Ltd Tasmanian Electricity Transmission Licence version 2.

8.2 Second Bass Strait electricity interconnector

8.2.1 The case for a second interconnector

Chapter 13 of the Interim Report discussed the Taskforce's initial assessment of the energy security value of a second electricity interconnector between Tasmania and Victoria. Since that time, several studies have been completed that assess the costs and benefits of a second Bass Strait interconnector. The Taskforce has assessed these studies in the context of Tasmania's energy security.

The Australian and Tasmanian Governments' Joint Feasibility Study of whether a second electricity interconnector between Tasmania and Victoria would help to address long-term energy security issues and facilitate investment in renewable energy was released on 13 April 2017.[60] It provides an assessment of whether a second electricity interconnector is likely to be an economically efficient investment which could support energy security and reliability in the NEM and the efficient transition of the NEM to a lower emissions generation mix.[61]

AUSTRALIAN AND TASMANIAN GOVERNMENTS' JOINT FEASIBILITY STUDY OUTCOMES

The Joint Feasibility Study assessed the economic efficiency and financeability of a second electricity interconnector under a range of plausible scenarios for the future development of the NEM, including neutral and weak economic growth, a reduction in Tasmanian demand, the concurrent development of a second electricity interconnector and 1 200 MW of additional wind generation in Tasmania, low Tasmanian rainfall, and 45 per cent emissions reductions. To gain an understanding of these issues, power system and market dispatch modelling and analysis was commissioned from AEMO and Ernst & Young, including modelling of energy market responses to different combinations of Basslink and a second electricity interconnector operating as regulated or merchant assets.

The study recommended that the Tasmanian Government should develop a detailed business case when one or more of the following preconditions are realised:

- AEMO concludes in a future National Transmission Network Development Plan (NTNDP) that a second electricity interconnector would provide significant positive net market benefits under most plausible scenarios;
- additional interconnection is approved for construction between South Australia and the eastern states; and/or
- there is a material reduction in Tasmanian electricity demand.

From a Tasmanian energy security perspective, the Joint Feasibility Study concluded that a second electricity interconnector could provide some power system security and reliability benefits in Tasmania and a redundancy option against any future loss of Basslink, noting that the benefits of investing in a second electricity interconnector may increase if there is a reason for regarding it as a replacement asset for Basslink at some point during its economic life. However, the study also commented that the incremental energy security benefits from a second electricity interconnector in the long term may be significantly reduced due to the Taskforce's recommendations for the short term and medium term being implemented well before a second electricity interconnector could be completed.

60 Tamblyn J, 2017, *Feasibility of a Second Tasmanian Interconnector*.

61 In the study, the term 'economically efficient' refers to an investment which, if made, would be efficient in the long-term interests of electricity consumers in the NEM, meaning that its expected benefits to consumers would outweigh its expected costs.

A second electricity interconnector could operate to provide additional frequency control ancillary services (FCAS) in Tasmania thus reducing the cost of operating Hydro Tasmania's power stations for this purpose. However, the study also found that there is also some risk that some existing power system security challenges associated with the Tasmanian transmission network could increase with a second interconnector, with implications for system strength, inertia and voltage control.

The implications of a second electricity interconnector for the development of large-scale renewable energy generation in Tasmania was also considered by the Joint Feasibility Study. Under a neutral economic growth scenario, modelling showed that the development of up to 730 MW of new wind capacity could be developed by 2026 without a second interconnector, and that a second electricity interconnector would enable an additional 365 MW of generation capacity to be developed over the same period.

Further to the Joint Feasibility Study, other reports that consider the potential for a second Bass Strait electricity interconnector have been released since the Taskforce's Interim Report was finalised for publication. In December 2016, AEMO published its annual NTNDP, which found that a second Bass Strait electricity interconnector had greatest market benefit when combined with additional interconnection between other NEM regions (particularly interconnectors from the South Australian region) and that a more interconnected NEM can also improve system resilience and security.[62] The NTNDP found that a second electricity interconnector had marginal net market benefits under a neutral economic growth scenario ($20 million over a 20 year period) if built by 2025. AEMO's modelling was sensitive to assumptions on future grid demand, climate change policy and the uptake of large-scale battery storage facilities, with negative market benefits being observed under scenarios of low grid demand or a 45 per cent reduction in national emissions.

Work by Jacobs Consultancy for the Clean Energy Finance Corporation in late November 2016 examined the potential role that interregional transmission could play in a transformed electricity sector under various emissions reductions targets ranging from 28 per cent to 45 per cent by 2030.[63] The report found that up to 3 500 MW of additional interregional capacity would be required by 2030 across the NEM to allow the exploitation of available renewable energy resources to replace the substantial coal fleet retirement, and that under most emission reduction targets a second electricity link between Victoria and Tasmania was required by 2025 to export Tasmania's lower cost wind generation to the mainland and provide backup services to higher levels of intermittent generation in Victoria. This finding is in line with the timing indicated by AEMO's NTNDP. In contrast to the NTNDP, the Jacobs Consultancy report found that a second Bass Strait electricity interconnector was only marginally affected by a change in assumptions of demand growth.

The Jacobs Consultancy report also highlights a risk of stranded transmission assets if transmission infrastructure is developed to support additional renewable generation connections and those generation projects do not proceed.

8.2.2 Value of a second electricity interconnector to Tasmania's energy security

As noted in the Interim Report, a second electricity interconnector would provide energy security and other benefits both in Tasmania and the rest of the NEM. The Taskforce has focused its assessment of the value of a second electricity interconnector to the outcomes for Tasmania's energy security, in line with its Terms of Reference.

From a Tasmanian energy supply security perspective, a second Bass Strait electricity interconnector would provide a significant increase in energy security by offering redundancy against any future extended outage or permanent loss of Basslink. In addition, a second electricity interconnector would enable increased import capacity during times of low inflows and allow for a greater level of imported energy when market

62 AEMO, 2016, *National Transmission Network Development Plan.*
63 Jacobs, 2016, *Benefits of Transmission Upgrades in a Transforming Electricity Sector.*

prices are low. However, a higher level of import capacity is not without risks. For example, AEMO identifies that high imports into Tasmania could result in reduced system inertia, lower availability of FCAS and weaken the system strength in Tasmania. These risks would need to be addressed in any development proposal for a second interconnector.

AEMO modelling suggests that by 2036-37 a second electricity interconnector would enable the development of an additional 365 MW of wind generation capacity in Tasmania beyond that which could be developed with Basslink alone. A second electricity interconnector could therefore encourage additional wind generation to be developed in Tasmania (to take advantage of the quality of Tasmania's wind resource) and could lead to an on-island surplus of generation under average annual inflow conditions, thus strengthening further the Tasmanian energy security outlook. In this context, a second electricity interconnector could also negate the need to retain the TVPS on standby for energy security purposes and enable a reduction in water storage levels, with considerable cost savings. For example, if a second electricity interconnector negated the need to retain the TVPS on standby and enabled a reduction in the PSL profile, the Taskforce's modelling shows that the potential cost savings would be around $140 million over 10 years.[64]

The Taskforce has concluded that, due to significant development lead times, a second electricity interconnector is unlikely to be built in the medium term (next 5-10 years) unless a firm commitment is made by governments now. This appears unlikely given that a robust economic case has not yet been made for a second Bass Strait electricity interconnector and there are a number of significant technical, regulatory and other challenges that must be overcome. In this context, the Taskforce makes the assessment that while a second electricity interconnector would greatly enhance Tasmania's energy security and provide other benefits, its development is not required to enhance Tasmania's energy security if the Taskforce's Energy Security Risk Response Framework is adopted by Government now, the TVPS is retained and new on-island renewable energy generation is supported.

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64 While the TVPS would no longer be required for energy security purposes, the Joint Feasibility Study found that the market benefits of a second electricity interconnector would improve by around $200 million in net present value (NPV) if the TVPS CCGT remained operational and supplied energy into the NEM.

9. Impact of Emerging Technologies

KEY FINDINGS

- Much of the progression of solar PV, battery storage and electric vehicles (EVs) depends on a range of factors that are largely beyond the control of the Tasmanian Government. The ability for Tasmania to significantly influence or control these factors creates uncertainty over their value to, and impact on, the energy security of the stationary energy sector.
- Over the long term, the energy security impact from EVs is expected to be low and focussed on network infrastructure.

In Chapter 15 of the Interim Report, the Taskforce presented a detailed examination of emerging technologies and consumer participation initiatives that could influence Tasmania's energy security. Accordingly, the Taskforce provided a recommendation that:

"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."

This recommendation remains valid and reflects the progression of emerging technologies whilst indicating their potential impacts are yet to clearly materialise as energy security opportunities or threats.

For the Final Report, the Taskforce has examined how Tasmania can position itself for the uptake of emerging technologies in the context of energy security across the medium to long term. Based on the findings of the Interim Report, the principal technologies addressed in this chapter are refined to solar PV, battery storage and EVs.

9.1 Consumer impacts on energy consumption

AEMO's 2016 NEFR details the expected long-term contribution of a number of consumer-led energy management opportunities.[65] By 2036, Tasmania's annual electricity consumption is forecast to be greater than 12 000 GWh, some 1 400 GWh more than the State's current average annual consumption. However, AEMO's forecast suggests that this additional annual consumption will be offset by additional small-scale generation and a number of consumer related actions, such as energy efficiency improvements, technological developments and customer uptake of behind the grid renewable energy systems (refer Figure 9.1).

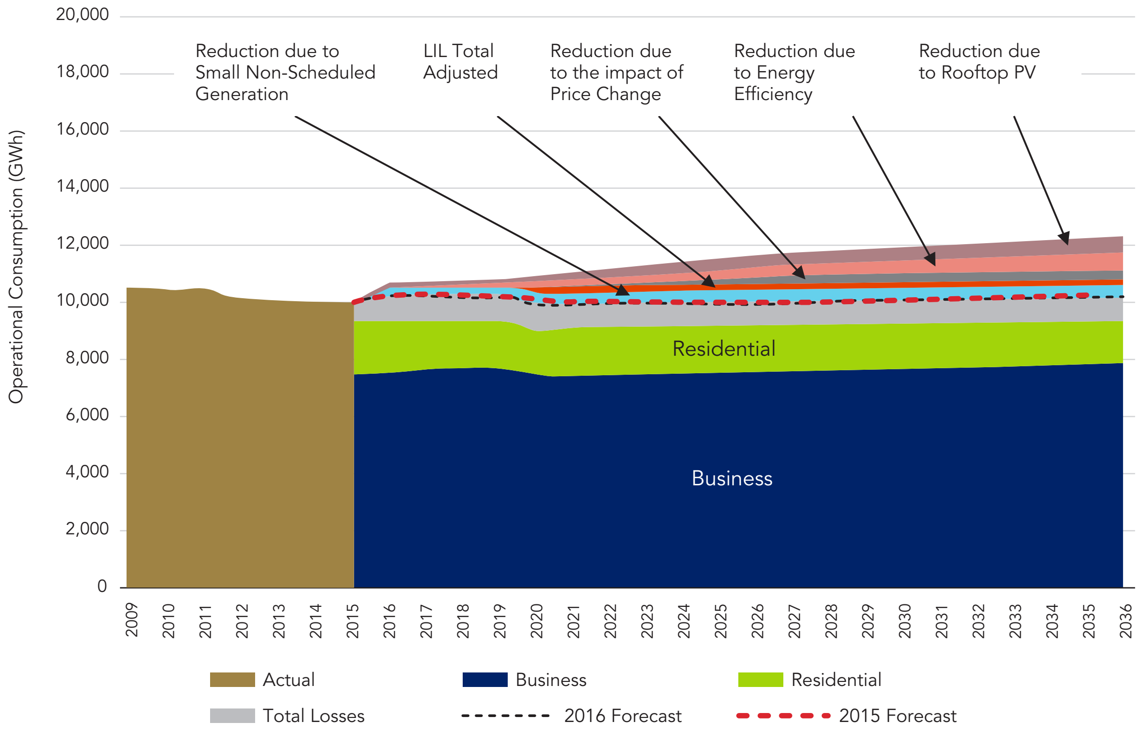
9.2 Small-scale renewable energy generation

Across small-scale renewable energy generation technologies, solar PV systems are the most likely to influence Tasmanian energy security. Small-scale wind and hydro are, to date, providing negligible additional generation into the Tasmania system.[66] At the end of 2015-16, there were 24 867 Tasmanian consumers with an installed solar PV system with a total generating capacity of 87.5 MW.[67] For this period 72.8 GWh were supplied to the Tasmanian grid, representing 0.69 per cent of the Taskforce's assumption for annual consumption of 10 600 GWh.

In the long term, rooftop solar PV generation is predicted to rise to six per cent of annual consumption (629 GWh) and will be a major contributor to ensuring a static level of consumption in Tasmania out to 2036 (refer Table 9.1).[68]

[65] AEMO, 2016, *National Electricity Forecasting Report.*
[66] OTTER's *Energy in Tasmania – Performance Report 2014-15* reports that mini-hydro contributed 9.4 MW and small wind 0.45 MW.
[67] OTTER, *Energy in Tasmania Report 2015-16.*
[68] AEMO, 2016, *National Electricity Forecasting Report.*

Figure 9.1 Annual operating consumption to 2036 for Tasmania – neutral case[69]



Source: AEMO, 2016, *National Electricity Forecasting Report, chart pack - slide 19*

Table 9.1 Forecast Tasmanian rooftop PV generation (GWh)

Year	GWh
2016-17	111
2020-21	213
2025-26	346
2030-31	499
2035-36	629

Source: AEMO 2016 NEFR

The AEMO 2016 NEFR forecast for the contribution of solar PV in 2036 is close to the current deficit of annual on-island generation for Tasmania. However, because the contribution of solar acts as an offset for consumption growth predicted by AEMO, this in effect means that there is no impact on the deficit. This is also an extended time period, being nearly 20 years away, during which additional generation is likely to be realised.

Figure 9.2 illustrates the historical residential solar PV installation by calendar year and projected installations required to meet the AEMO forecast of 629 GWh by 2036.[70] Taking into account projected reductions in system costs it can be seen that the robust level of installations of around 3 000 each year inferred by the AEMO forecast appears reasonable.

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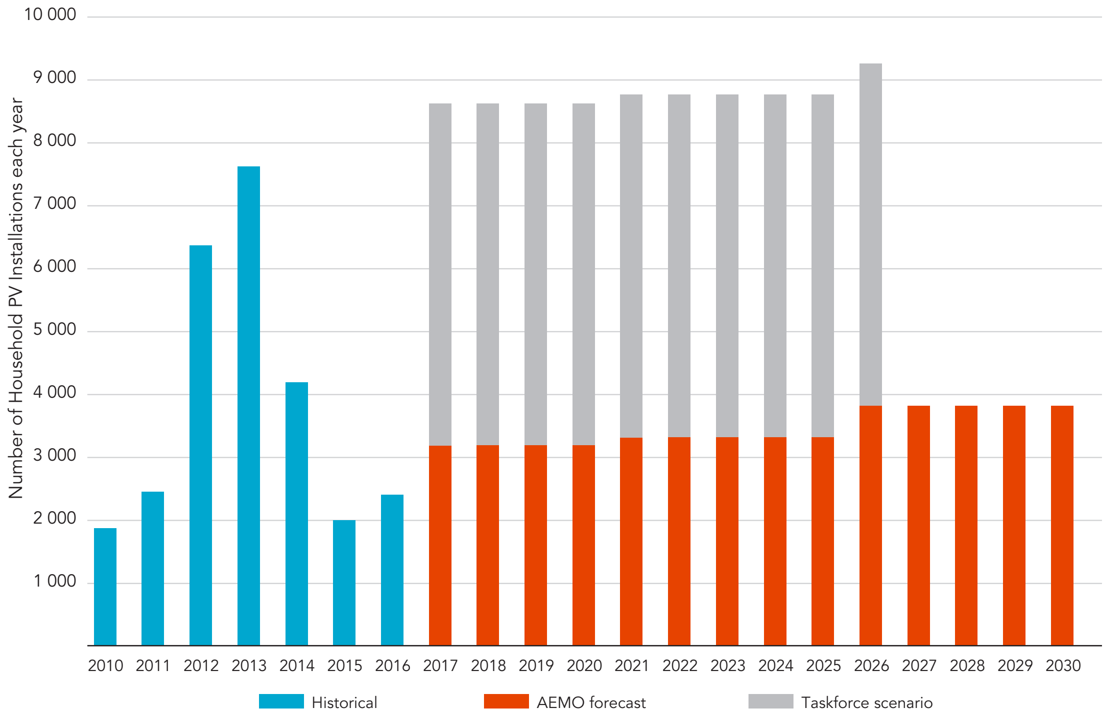
69 According to AEMO's 2016 National Electricity Forecasting Report, 'annual operating consumption' is defined as "*the electricity used by residential, commercial, and large industrial consumers, drawn from the grid and supplied by scheduled, semi-scheduled, and significant non-scheduled generating units (excluding rooftop PV generation and small non-scheduled generation)*".

70 Based on 5 kW system size and 4.4 average hours of solar radiation per day.

Figure 9.2 Accelerated installation rates required to generate 700 GWh per annum



Source: Taskforce analysis, based on 5 kW average installation size

Further to the AEMO forecast, the Taskforce has assessed the number of installations required for residential solar PV to influence the on-island energy deficit of around 700 GWh per annum. The Taskforce has chosen to undertake this analysis in response to feedback received during its consultation regarding the capacity for residential solar PV to contribute to on-island energy security. As illustrated in Figure 9.2, this would collectively require over 8 500 installations per annum, which is around 10 per cent higher than the historical peak of 7 659 installations that occurred in 2013 (when it was announced that the then one-for-one feed-in tariff would be grandfathered).

While this rate of installation is feasible, for residential solar PV to provide a significant contribution to meeting the 700 GWh deficit beyond AEMO forecasts, additional actions beyond current incentives would be required to promote a greater uptake of solar PV in Tasmania. This could be achieved through greater levels of post installation incentives (e.g. feed-in tariffs) or increased levels of support pre-installation (e.g. renewable energy certificates).

The Taskforce has also explored the relative costs of increasing solar PV installations to achieve 700 GWh average annual generation compared with the cost of installing additional on-island wind generation. The analysis found there is a significantly greater net present value (around $90 million over 10 years) from generating an additional 700 GWh energy per annum through new wind developments as opposed to accelerated residential solar PV.[71]

This analysis should not be taken as implying that residential solar does not have an important role in supporting Tasmania's energy security, particularly noting that a significant number of installations are part of AEMO's base forecast. However, the Taskforce does not propose that additional policy measures be initiated to support residential solar PV installations as a mechanism for bridging the on-island energy gap. In this context the Taskforce considers that the Interim Report's recommendation to prudently "*facilitate,*

[71] This is compared to the base case presented in Appendix 3 which includes an average net import over Basslink of 700 GWh per annum, the TVPS being on standby and the HRL/PSL profiles and methodology proposed in Chapter 11.

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" remains appropriate.

A sustained increase in wholesale energy prices in the NEM could be reasonably expected to have a positive impact on the uptake of small-scale renewable energy by households and businesses. Along with falling costs for solar PV installations, higher energy tariffs and feed-in tariffs will substantially improve the economics of new energy installations and support new investment. An increase in installations has already occurred in Queensland, South Australia, New South Wales and Victoria.[72]

The Taskforce has also investigated the potential uptake and benefits associated with household battery storage. It appears that at current prices, adding a battery system represents a significant additional cost to the household that is not offset by reducing the cost of peak electricity. Most battery systems have a limited lifespan that is measured in the number of cycles or kWh of energy that are expected to be able to cycle through the battery before it deteriorates. The Tesla Powerwall 2.0 has a storage of around 13.2 kWh and a warranted cycle life of 37 000 kWh.[73] Based on Taskforce modelling, and at a list price of $10 500, the price of sending energy through a Tesla Powerwall 2.0 is at least 28 cents per kWh excluding finance costs.[74] The cost of other deep cycle battery technologies, while often with lower upfront costs, is often higher given the shorter life spans.

The Taskforce concludes that until there are significant decreases in battery costs and technology, or significant changes to current electricity pricing, adding a battery system represents a significant additional cost to the household that is not offset by reducing the cost of peak electricity. This partly reflects the unique aspects of Tasmania's electricity situation, in that Tasmania is generally not capacity constrained (except for some remote locations).

9.3 Electric vehicles (EVs)

Based on the analysis presented in the Interim Report, the penetration of EVs in Tasmania has been low to date and is expected to remain so over the short to medium term.[75] AEMO projections show that over the longer term (up to 2030), EVs will begin to have some impact on electrical load and the operation of network infrastructure as a result of predicted significant drops in battery and technology costs.[76] The total expected consumption from EVs for Australia is forecast to be 6 941 GWh by 2036,[77] while in Tasmania the forecast additional consumption from EVs is expected to be negligible over the next 10 years reaching 30 GWh by 2026 and an estimated 171 GWh in 2036.[78]

From an energy security perspective, the most significant impact of EVs appears to be related to changed approaches to electricity usage, specifically as it relates to the existing electricity network. A future state of increased penetration of EVs can bring benefits to the network by increasing the utilisation of the grid at off-peak times given the preference of most EV owners to charge during off-peak periods. Some studies suggest the future electrification of transport out to 2050 could also result in lower residential electricity bills, particularly if fast charging stations are introduced to enhance capacity utilisation of the network.[79] As noted in the Interim Report, EVs may assist in reducing Tasmania's dependence on liquid fuels, lower its carbon emissions and provide network optimisation benefits.

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72 http://www.abc.net.au/news/2017-04-14/solar-panel-installations-skyrocket-in-australia/8443550
73 Tesla Powerwall warranty – refer https://www.tesla.com/sites/default/files/pdfs/powerwall/Powerwall_2_AC_Warranty_AUS-NZ_1-0.pdf
74 $10 500 is an average cost obtained from a number of quotes for battery costs investigated by the Taskforce.
75 Interim Report, page 146.
76 Interim Report, page 147.
77 AEMO, 2016, *AEMO Insights - Electric Vehicles.*
78 EV forecasts for all jurisdictions show a higher uptake rate after 2026 as a result of predicted significant drops in battery and other technology costs - AEMO, August 2016, *AEMO Insights – Electric Vehicles.*
79 Energy Networks Australia and CSIRO, 2016, *Electricity Network Transformation Roadmap: Key Concepts Report.*

The Taskforce has heard from a number of stakeholders that Tasmania can position itself for the uptake of EVs in the medium and long term by ensuring pathways are established that enable EVs to enhance the energy sector, not disrupt it.

KEY BARRIERS TO ELECTRIC VEHICLE (EV) UPTAKE

Multiple industry and peak body groups have identified numerous barriers to the progression of EVs.[80,81]

These include a number of technical barriers such as the high cost of vehicles, charging time, lack of range ('range anxiety'), battery efficiency and choice of models.

A number of institutional barriers also exists with regulatory impediments, including: consumer protections and tax concessions, national standards, appropriate charging structures (electricity tariffs) and lack of information to inform governments and consumers.

Much of the uptake of EVs depends on factors external to Tasmania, particularly those associated with cost and choice of models. Furthermore, frameworks for electricity regulation and standardisation for vehicles are predominantly overseen at a national level with benefits from standardisation occurring when applied consistently across all Australian jurisdictions.[82]

The Taskforce also recognises a preference amongst policy makers for a 'market led' approach that is better suited to addressing technical barriers. Under this approach, cooperation across all elements of a supply chain can enable a more efficient delivery of alternative transport technologies and is considered optimal for its ability to respond quickly to rapidly changing technologies.[83] However, there is some obligation on governments to address barriers that are within their scope of influence.

The Tasmanian Government has taken initial steps to address barriers to EV uptake such as the examination of the case for deploying EVs in State Government fleets and work being progressed by the Tasmanian Climate Change Office related to EVs. Importantly, the Tasmanian Energy Strategy has a commitment to review policy and regulatory settings for an effective market led rollout of EVs by the close of 2016-17.

The volume and type of charging stations within Tasmania is a consistently raised concern by EV peak body representatives. The Tasmanian Branch of the Australian Electric Vehicle Association has advised the Taskforce that Tasmania does have a number of 'slow charge' stations located around the State, however there are no 'fast charge' stations.[84] The introduction of any coordinated fast charge network should take into account the impacts on local network infrastructure and reliability. The Taskforce considers this area a barrier to EV uptake that warrants further investigation by network operators, Government and EV peak body representatives.

Discussions with key industry EV stakeholders have also highlighted the value provided from the presence of recently introduced time-of-use tariffs and off-peak rates as new charging structures being utilised by EV owners. At the present time these structures appear adequate with the majority of EV owners charging their vehicles at home or at low-cost slow charge stations located at small business sites around the State. In the event that the Tasmanian charging stations network grows and becomes commercialised, there will be an imperative on Government and electricity entities to review tariff structures and connection requirements placed on customers to ensure an appropriate level of suitability, safety and affordability.

Given the expected low impacts of EVs into the medium and long term on energy security, the Taskforce considers the above initiatives are aligned with the current rate of EV uptake and likely benefits.

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80 Dunstan C, Usher J, Ross K, Christie L, Paevere P, 2011. *Supporting Electric Vehicle Adoption in Australia: Barriers and Policy Solutions (an Electric Driveway Project Report).*

81 AEMO, August 2016, *AEMO Insights – Electric Vehicles.*

82 AEMC, 2012, *Energy Market Arrangements for Electric and Natural Gas Vehicles, Final Advice.*

83 Department of Premier and Cabinet, 2015, *Embracing the climate challenge: Tasmania's Draft Climate Change Action Plan 2016-2021.*

84 'Slow charging' is typically associated with overnight recharging of the EV battery over six to eight hours. Slow charging is relatively low cost and can be integrated more easily into networks. 'Fast charging' is typically associated with charging EVs in 10 minutes to one hour, and requires consideration of network capacity.

Part B

Recommended Energy Security Measures

10. Energy Security Oversight

KEY FINDINGS

- While Tasmania's energy security is assessed as being Managed in the short term, formalisation and implementation of the Energy Security Risk Response Framework, including the Monitor and Assessor and Energy Security Coordinator roles, would likely result in a Resilient assessment.
- Whether through laws, rules and/or licence conditions, it is important that the Energy Security Risk Response Framework is embedded as a sustainable operating model that will persist over years, if not decades, regardless of changes in board compositions, corporate strategies or government ownership structures.
- The Energy Security Risk Response Framework must be fully resourced, preferably with dedicated allocations, to ensure it is sustainable and supported.
- Any extended delays to the implementation of the Monitor and Assessor and Energy Security Coordinator roles may risk implementation not eventuating due to perceived lack of necessity or relevance.
- While Government is ultimately responsible for energy security, it does not require the explicit control of all energy security levers and tools to be retained within the immediate control of the Minister. The expertise and experience of Tasmania's energy businesses can be utilised to maintain energy security in a pre-emergency situation.
- During the course of the year, the actions of the Monitor and Assessor will differ according to the energy in storage relative to its prudent benchmark, forecasts of the upcoming months of inflows and the availability of Basslink.
- The successful operation of the Monitor and Assessor role relies on the free flow of information from Hydro Tasmania and a high level of analytical capability to use this information to assess the prevailing level of energy security of Tasmania

As part of its Interim Report, the Taskforce identified a need for significant structural changes to governance frameworks supporting energy security oversight. In support of the overarching position that government is responsible for energy security, the Taskforce made 10 oversight recommendations pertaining to energy security oversight including specific recommendations for new roles and responsibilities. The Taskforce recommended the establishment of two new roles:

- a Monitor and Assessor role to 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; and
- an Energy Security Coordinator role to coordinate responses across market participants to manage electricity supply risks when water storages are at or below an 'energy security reserve' level.

Both roles are intended to work within the proposed Energy Security Risk Response Framework outlined in the Interim Report.[85]

Since the Interim Report was completed, the Taskforce has undertaken further work to progress the design of the Energy Security Risk Response Framework and identify the most suitable entities to undertake the Monitor and Assessor role and the Energy Security Coordinator role. This Chapter provides an update on this work, in particular:

- further detail on how the Taskforce conceives that the Energy Security Risk Response Framework should work in practice through the actions of the Monitor and Assessor and the Energy Security Coordinator; and

85 Interim Report, page 71.

- final recommendations for entities to undertake the Monitor and Assessor and the Energy Security Coordinator roles, including a set of guiding principles for implementation by the Tasmanian Government.

10.1 Energy Security Risk Response Framework

The Taskforce recommends the adoption of an Energy Security Risk Response Framework, which was formulated in the Interim Report and is presented Figure 2.1 in Chapter 2 of the Final Report. This framework represents the Taskforce's view of the interaction between energy security risk response thresholds and the proposed energy security oversight roles, and identifies two key energy in storage profiles to be maintained across a rolling 12 month period.

- High Reliability Level (HRL) – 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.
- Prudent Storage Level (PSL) – set to create a storage buffer from the HRL that is sufficiently conservative that the likelihood of energy in storage falling below the HRL is low under normal operational conditions. Above the PSL, it is expected that Hydro Tasmania would have the freedom to operate commercially.

The Monitor and Assessor and Energy Security Coordinator roles within this Framework are discussed in detail throughout the remainder of this chapter. Further discussion and analysis around the HRL and PSL profiles recommended by the Taskforce are presented in Chapter 11.

To assist with its assessment of the capacity for entities to work within the framework, the Taskforce has liaised with each of the entities identified as potentially undertaking one or both of the roles, as well as with Hydro Tasmania and Aurora Energy. As part of this process, the Taskforce prepared 'functional specifications' for each role, which provided a description of what was intended by the Taskforce's recommendations, articulated anticipated work flows and suggested other operational details concerning enabling frameworks and communication responsibilities. These functional specifications have been provided to the Department of State Growth (State Growth) to facilitate the prompt implementation of the new roles and the legal frameworks governing energy security oversight. They are summarised in section 10.2 and section 10.3 below.

Feedback provided to the Taskforce on the effective operation of each role has been instrumental in the Taskforce reaching its final recommendations, and the Taskforce is grateful to each entity for their engagement throughout this process.

10.2 Monitor and Assessor

10.2.1 Key functions

As highlighted in section 10.1, the Taskforce has prepared a functional specification to detail the activities the Monitor and Assessor role could be expected to undertake. A summary of these activities is provided in Table 10.1 to convey the key functions of this new oversight role. The summary is provided noting that the entity ultimately established as the Monitor and Assessor may seek to add or amend functions or details to ensure the intent of the Monitor and Assessor role is effectively realised within their organisation.

Table 10.1 Key functions of the Monitor and Assessor

Core function	• Provide independent oversight and transparent public reporting of energy security.
Function context	• The Monitor and Assessor role is intended to provide an additional layer of public reporting on energy security levels in addition to the publicly available reporting currently conducted by Hydro Tasmania. • Energy in storage levels will be regularly assessed against pre-determined communication and response thresholds. When these thresholds are passed, or are forecast to be passed, the Monitor and Assessor and/or the Energy Security Coordinator will initiate escalating communication and response actions. • Whilst there is a high focus on electricity, the impact of gas on energy security will also be monitored. Principally this will be done through information provided on the TVPS and availability of gas to the broader Tasmanian gas market.
Expected outputs	• An annual energy security review released in early November, after the completion of the wet season, that examines forecast energy storage levels and forecast demand, providing commentary on whether energy in storage may drop below the PSL and/or HRL. • A monthly energy in storage 'dashboard' reporting on a standard set of energy security parameters.[86] • Public communications during an energy security event specifically related to energy shortfalls. • Advice to the Energy Security Coordinator on the suitability and effectiveness of the HRL Recovery Plans to support the Energy Security Coordinator's process towards approval of the HRL Recovery Plans. • Advice to the Minister when supply/demand balance changes to the extent that a revision to the HRL and PSL profiles should be considered.

In order to optimally undertake its role, the Monitor and Assessor will need a range of information sources, particularly data from Hydro Tasmania.

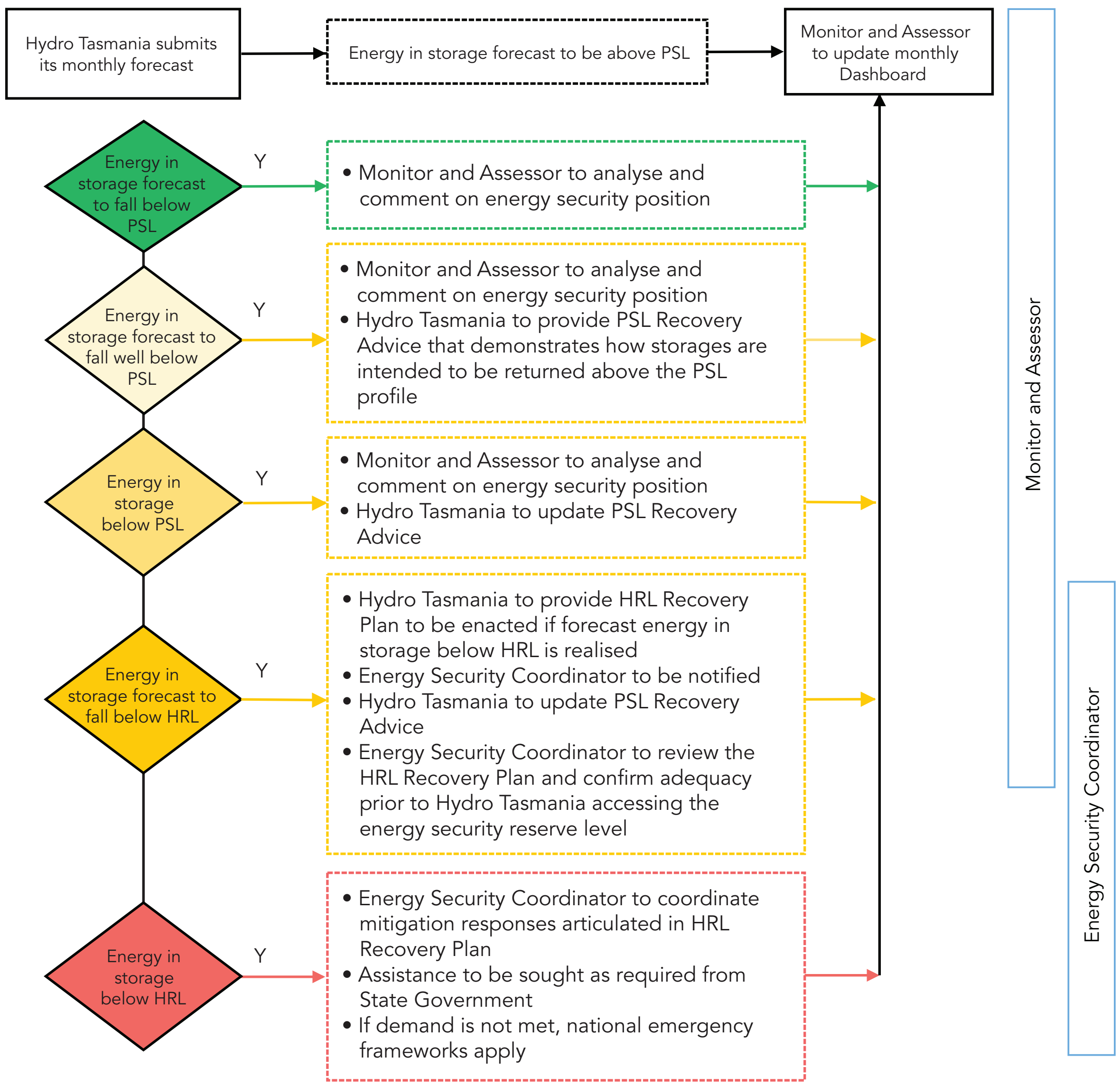
As the Taskforce's Terms of Reference do not include consideration of liquid fuels and focus on gas pricing effects on energy security, the Monitor and Assessor role is not proposed to review liquid fuel energy security nor undertake broad scanning of the Tasmanian gas market outside of price and supply pressures that may be applied to the TVPS. However, in the implementation of the Monitor and Assessor role the Taskforce sees no reason why these points of review may not be included in the future.

The Taskforce envisages that Hydro Tasmania will provide 12 month rolling energy in storage forecasts on a monthly basis to the Monitor and Assessor, with a particular focus on the immediate three months. In the event that Hydro Tasmania's forecasts indicate plausible scenarios of energy in storage falling below the PSL or HRL profiles there would be a number of actions triggered depending on the forecast energy in storage position. Figure 10.1 below shows the potential workflow for the Monitor and Assessor and Energy Security Coordinator. These actions are focussed around the provision of advice and actions by Hydro Tasmania including:

- PSL Recovery Advice from Hydro Tasmania that demonstrates how energy in storage will be returned above the PSL; and
- HRL Recovery Plans from Hydro Tasmania that demonstrate how energy in storage will be returned above the HRL once the energy security reserve is accessed.

86 An example of the dashboard was provided in Figure 9.3 of the Interim Report.

Figure 10.1 Work flow for the Monitor and Assessor and Energy Security Coordinator roles

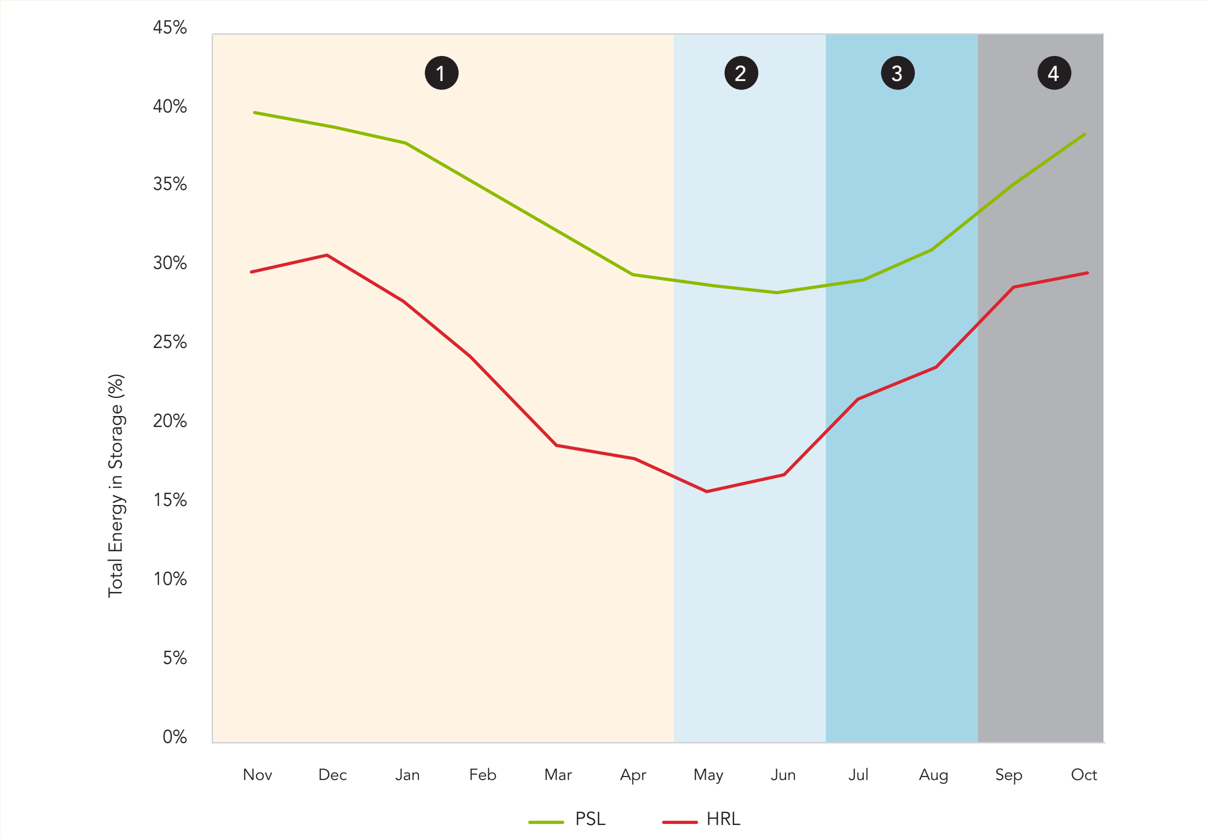


The Taskforce notes that in rare events where there are multiple asset failures, regional inflow variation and/or a Basslink failure, there could be a lack of available supplementary generation, resulting in a capacity management problem whereby local demand might not be met. In most circumstances, these are unpredictable and national market arrangements under the Power System Emergency Management Plan would be expected to be activated to address the supply shortfall triggered by the loss of capacity. Capacity challenges as a result of low energy in storage, and the response to these, are discussed in further detail in section 11.6.

IMPACT OF SEASONALITY ON THE ACTIONS OF THE MONITOR AND ASSESSOR

The potential actions of the Monitor and Assessor under a range of energy in storage positions relative to the PSL and HRL profiles should vary depending on the time of the year. The Taskforce has categorised the year into four seasonal periods based on expected rainfall (refer Figure 10.2).

Figure 10.2 PSL and HRL profiles grouped to four distinct seasonal periods



Source: Taskforce analysis

Notes:

1. Dry season (from November to April) – low probability of any significant inflows over this period.
2. Early wet season (from May to June) – high chance of significant inflows over this period with a potential for delay until the midwet season.
3. Mid-wet season (from July to August) – significant inflows expected.
4. End-wet season (from September to October) – critical time of year to assess water storage position with a chance of significant inflows.

It is expected that the Monitor and Assessor will account for the following factors when evaluating the energy security risk of the energy in storage on a monthly basis:

- time until the next expected high inflow sequence;
- likelihood of inflows in the month (or two) ahead; and
- Hydro Tasmania's 12 month total energy in storage forecast (specifically the chance of entering into the energy security reserve).

Further detail on how the Taskforce's envisages the Monitor and Assessor would undertake the seasonal evaluation of energy in storage in its monthly assessment is provided in Appendix 5.

10.2.2 Recommended entity

Based on discussions with all stakeholders and consideration of operational and legislative frameworks, the Taskforce has assessed that the TER should undertake the role of Monitor and Assessor.

The TER already undertakes a range of operational, analytical and reporting functions (including data analysis) and is in regular communication with the Tasmanian energy sector. The TER has well established relationships with entities across the Tasmanian energy sector and is highly experienced in working with complex market data sets. Whilst some additional capability will be required to undertake the Monitor and Assessor role, feedback from the TER is that this role is not expected to be onerous and where necessary consultants can supplement the TER's resources. The TER also has funding options available for independent cost recovery, principally through licence fees. Importantly, the TER itself has indicated that it would be willing and able to undertake the Monitor and Assessor role.

The Taskforce recognises that to formalise the TER as the Monitor and Assessor, legislative amendments will likely be required to ensure it has a head of power to operate correctly. However, prior to legislative changes being implemented, the Taskforce has been advised that interim measures can be introduced to enable the TER to effectively operate in the Monitor and Assessor role. There may also be amendments required to the legislative frameworks and directives overseeing key market participants such as Hydro Tasmania in order to compel the provision of information to the TER.

RECOMMENDATION

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 TER should undertake the Monitor and Assessor role.

10.3 Energy Security Coordinator

10.3.1 Key functions

As per the Monitor and Assessor role, the Taskforce has prepared a functional specification to detail the activities and requirements of the Energy Security Coordinator role. Table 10.2 summarises the key functions of the role.

The Taskforce considers it essential that Hydro Tasmania provides a robust HRL Recovery Plan before accessing the energy security reserve. This step will demonstrate that an immediate, pre-planned course of action will be applied to restore energy in storage to above the energy security reserve and engender community confidence regarding the management of Tasmania's energy supply security. Based on rolling monthly forecasting, Hydro Tasmania should have advance notice that energy in storage may drop below the HRL and this will allow the submission of a robust HRL Recovery Plan prior to accessing the energy security reserve. Taking this early and robust step will give the Energy Security Coordinator time to review the adequacy of the submitted plan (including seeking advice from the Monitor and Assessor), and request further information and advice from Hydro Tasmania if deemed necessary.

The Energy Security Coordinator should not be afforded powers to mandate load reduction or compel network providers to switch off load. In the event that the situation changes from a pre-emergency situation to a level 4 or level 5 emergency, then the current NEM emergency management provisions would be triggered.[87]

[87] Interim Report, Figure 6.1, page 39.

Table 10.2 Key functions of the Energy Security Coordinator

Core function	• To coordinate responses across market participants in order to manage electricity supply risks when energy in storage is at or below an energy security reserve level.
Function context	• The Energy Security Coordinator will play an important role when energy in storage drops below the HRL and there is a need for a coordinated response by all market participants. • When energy in storage is forecast to fall below the HRL, the Monitor and Assessor will notify the Energy Security Coordinator and an HRL Recovery plan will be requested from Hydro Tasmania. • The Energy Security Coordinator will review the HRL Recovery Plan to provide a point of independent oversight and also ensure it can assist with any coordination activities. • The Energy Security Coordinator will be required to coordinate activities outside of Hydro Tasmania's control, including coordinating other generation sources and demand reduction activities (if required).
Expected outputs	• An annual report on the activities of the Energy Security Coordinator role, regardless of whether or not energy in storage has fallen below the HRL during the past 12 months. This could be provided to the Monitor and Assessor and released alongside the Monitor and Assessor's annual energy security review. • In consultation with Hydro Tasmania and other market participants, development of potential mitigation responses to potential future energy security supply shortfall events, including testing of responses that could be included in an HRL Recovery Plan. • Information to the Monitor and Assessor in response to notifications that energy in storage has fallen below the HRL, such as confirmation of approval of HRL Recovery Plans and details on HRL Recovery Plans and outcomes (where commercial confidentiality allows) to ensure greater community confidence.

Figure 10.3 illustrates the broad categories of actions that the Taskforce envisages should be undertaken by the Energy Security Coordinator. It should be noted that every instance of energy security may be different and Figure 10.3 is intended as a guide to steps that may be enacted.

As illustrated in Figure 10.3, the following escalation of activities is envisaged to occur depending on the level of incursion into the energy security reserve.

1. Once the Energy Security Coordinator has been notified by the Monitor and Assessor, the Energy Security Coordinator would seek confirmation from market participants that actions contained within the HRL Recovery Plan have been triggered. At this early stage, mitigation actions are likely to solely extend to Hydro Tasmania increasing generation from non-hydro sources (e.g. running the TVPS, increasing Basslink imports). The Energy Security Coordinator would also inform the Minister for Energy of the current situation.
2. If storages fall below the HRL but a future loss of supply is not forecast, the Energy Security Coordinator would continue to coordinate the HRL Recovery Plan, including checking that mitigation actions outside the direct remit of Hydro Tasmania can be accessed, such as arrangements that may be required to install temporary generation. The Minister for Energy would continue to be kept informed about the situation by the Energy Security Coordinator, but would not be required to make decisions regarding mitigation actions.
3. If storages fall below the HRL and a future loss of supply is a plausible scenario, mitigation actions may include the connection of temporary generation and major industrial demand management. At this stage, it is envisaged that the Energy Security Coordinator would inform the Minister for Energy that a shortfall of supply could occur, and the Energy Security Cabinet Sub-committee (or equivalent) would be convened by the Minister and briefed by the Energy Security Coordinator.

   In this situation, the responsibility for directing Hydro Tasmania to undertake certain actions to avoid a shortfall of supply should be made by the Minister for Energy and the Treasurer under section 65 of the *Government Business Enterprise Act 1995*.[88] As some of these actions may be in conflict with the business' commercial imperatives, any direction made to Hydro Tasmania should be based upon advice from the Energy Security Coordinator, the Monitor and Assessor and the Energy Security Cabinet Sub-committee (or equivalent). Once a direction has been received, the Energy Security Coordinator would remain responsible for coordinating the HRL Recovery Plan (including any actions Hydro Tasmania has been directed to undertake), working with all market participants to return energy supplies to a point at which they are no longer a trigger for statutory emergency management and load-shedding roles.

4. In the event that the situation changes from a pre-emergency situation to a situation where supply becomes so constrained that it becomes unreliable and unavailable (i.e. a level 4 or 5 emergency), then the current NEM emergency management provisions would be triggered. As a result of these existing provisions, the Energy Security Coordinator should not be afforded powers to mandate load reduction or compel network providers to switch off load.

Figure 10.3 Actions of Energy Security Coordinator in response to passing below the HRL

	Event	Actions	Key Participants	Demand Management
Prudent Storage Level (PSL)				
	Energy in storage well below PSL; energy in storage forecast to fall below the HRL	• Energy Security Coordinator notified and provided the HRL Recovery Plan for review in case of storages dropping below the HRL • Energy Security Coordinator to review the HRL Recovery Plan and confirm adequacy prior to Hydro Tasmania accessing the energy security reserve level	Hydro Tasmania	None required
High Reliability Level (HRL)				
Energy Security Reserve	Energy in storage below the HRL	• Energy Security Reserve level accessed subject to adequate HRL Recovery Plan • Energy Security Coordinator to seek confirmation from Hydro Tasmania whether mitigation responses have been implemented • Responses may include greater utilisation of gas generation or Basslink imports	Hydro Tasmania	None required
Energy Security Reserve	Energy in storage well below HRL but not forecast to result in supply shortfall	• As above • Major industrial customers notified of Tasmanian energy security status • Mitigation responses outside of Hydro Tasmania's sources to be checked and confirmed, including temporary generation availability	Hydro Tasmania Major industrials	None required
Energy Security Reserve	Energy in storage well below HRL and likely to progress towards shortfall of supply	• As above. • Temporary generation connected and major industrial demand management sought, no other load reductions • Cabinet Sub-committee convened and briefed by Energy Security Coordinator • Minister for Energy/Treasurer direct Hydro Tasmania to take actions, if required	Major industrials Hydro Tasmania Minister for Energy	Major industrial load reduction may be sought
Emergency – demand not met				
	Supply not met	• National reliability and emergency arrangements apply with load-shedding guided by Jurisdictional System Security Coordinator (JSSC) and Responsible Officer (RO) • HRL Recovery Plan to continue as above • Cabinet Sub-committee continue to convene	Hydro Tasmania State Growth (JSSC) TasNetworks (RO) AEMO Minister for Energy	Load shedding as per exisiting state schedules

Some supplementary points to guide the above are:

- streamlining existing roles in the context of the new framework (such as the Water Storage Advisory Committee or Minister's powers for load shedding etc.) will bring clarity to questions of when a committee or other agency should be involved in emergency processes from an energy security perspective; and

88 Section 65 of the *Government Business Enterprise Act 1995* allows for the Minister for Energy and the Treasurer to jointly give a direction to a Government Business Enterprise to "*perform, provide or allow a function, service or concession that they are satisfied would not be performed, provided or allowed if the Government Business Enterprise were a business in the private sector acting in accordance with sound commercial practice.*"

- before major industrial load reductions are required (as a mitigation option), the intent is that some notice be given to these customers to ensure their readiness if asked to undertake load reductions, most likely by Hydro Tasmania. This function needs to be considered at some point during implementation of the new oversight roles as an operational task.

Throughout a 12 month period, it is envisaged that the Energy Security Coordinator would review planned mitigation responses that could be included in an HRL Recovery Plan. This could include testing the availability of gas generation, voluntary demand side management and temporary generation. Actions could extend to gathering knowledge of temporary generation cost and timeframes for installation or connection, confirming voluntary demand management capacity and maintaining an up-to-date understanding of the availability of gas generation.

A contingency plan for responses to events could also be maintained by the Energy Security Coordinator and reviewed periodically. Further, the Energy Security Coordinator should work with the Monitor and Assessor to ensure simulation exercises for energy supply situations are conducted, including testing potential energy supply security events ensure Hydro Tasmania and other industry and customer participants are able to respond.

10.3.2 Recommended entity

Based on discussions with all stakeholders and consideration of the application of operational and legislative frameworks, the Taskforce has assessed that the Director of Energy Planning (DEP) should undertake the role of Energy Security Coordinator, supported by the Department of State Growth (State Growth), provided that the following necessary prerequisites are in place:

- external technical and analytical capability is contracted on an ongoing basis, with TasNetworks contracted to undertake this role in the first instance; and
- the Energy Security Coordinator function is provided with an explicit State Growth budget allocation.

As acknowledged in the Interim Report, the 2015-16 energy security event was managed by the DEP/State Growth. It did not result in loss of supply and national market emergency management structures were not required to be utilised. The Taskforce did note that the performance of the DEP in managing the event was inhibited by resource constraints, a lack of role clarity and outdated emergency committee structures.[89] However, with the implementation of a number of key actions the DEP would be in a better position to manage a future energy security event.

The implementation of the Taskforce's proposed Energy Security Risk Response Framework will provide a greater level of role clarity and structure. The DEP/State Growth would also require additional resources to reach an acceptable level of capability to support its ongoing responsibilities of the role. If sustained resourcing and focus does not occur, there is a distinct possibility that the standby Energy Security Coordinator's capabilities will not be maintained and resources will be subsumed within current policy functions, with the inherent risk that this may not necessarily become apparent until an energy security event occurs. The Taskforce therefore assesses that an explicit State Growth budget allocation is a necessary prerequisite for the DEP/State Growth to take on the Energy Security Coordinator role.

Without appropriate technical expertise, there is a risk that the role would not be able to operate effectively in an energy security event or effectively plan energy security mitigation strategy options. To address this gap, the Taskforce assesses that ongoing technical expertise and advice should be contracted to help fulfil those functions. TasNetworks is ideally suited to supply this expertise and advice as it has strong modelling expertise, it already performs a range of system security functions for Tasmania under national and State

89 Interim Report, page 40.

laws, and it is well practiced in terms of emergency preparedness and response for capacity situations. The contractual arrangement should have sufficient flexibility to enable another suitably qualified external body to be engaged if circumstances change in the future.

In arriving at the conclusion that the DEP is best placed to undertake the Energy Security Coordinator role, the Taskforce took into account the following.

- AEMO indicated that it did not wish to be considered for the Energy Security Coordinator role due to a potential conflict with its core functions.
- Other concerns were raised over likely tensions if TasNetworks were given powers to compel other energy sector entities to undertake key energy security mitigation actions. In this context it appears more suitable that TasNetworks provide the DEP and State Growth with technical support in executing the Energy Security Coordinator role.
- The Taskforce assesses that there should be a separation of the roles of the Energy Security Coordinator and the Monitor and Assessor. It would be inappropriate for the DEP/State Growth to act in the Monitor and Assessor role in the interim as it would then be effectively undertaking both roles. The Taskforce considers that this could result in a weakening of the independence and accountability of each role, including the responsibility of the Monitor and Assessor to provide independent advice to the Energy Security Coordinator.

For an interim period, it appears that the current legislative structures are broad enough to accommodate the new roles, meaning rapid implementation could occur. However, this should not distract from the observation that existing frameworks for responding to energy security threats are decades old and have not been updated despite major changes in the energy market. As recommended in the Interim Report, a review of the DEP's role should be undertaken to modernise and streamline its functions in line with the Taskforce's recommendations and other reform considerations.[90]

RECOMMENDATION

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. The DEP/State Growth should undertake the Energy Security Coordinator role provided that the following necessary prerequisites are in place:
   - external technical and analytical capability is contracted on an ongoing basis, with TasNetworks contracted to undertake this role in the first instance; and
   - the Energy Security Coordinator function is provided with an explicit State Growth budget allocation.
4. Hydro Tasmania must submit a robust HRL Recovery Plan to the Energy Security Coordinator for approval prior to accessing the energy security reserve.

10.4 Management of natural gas emergencies

In the Interim Report, the Taskforce suggested (in recommendation 10) that "*the Department of State Growth should limit itself to a policy role with respect to gas energy security*" and that "*the Director of Gas Safety should be responsible for engaging and coordinating responses with industry and gas customers on*

[90] Interim Report, page 46.

potential or actual emergency gas supply risks as they emerge".[91] This recommendation was made prior to the DEP/State Growth being assessed as being suitable for the Energy Security Coordinator role.

The Taskforce considers that the Energy Security Coordinator has the potential to examine forward gas supply and demand risks as part of its consideration of energy supply contingency options. In this context, there appears to be merit in State Growth reviewing the emergency management requirements for natural gas emergencies. It is important that State Growth ensures there are clear lines of accountability between the Director of Gas Safety and the Energy Security Coordinator role in order to maintain effectiveness of energy security management during gas energy supply emergencies. This aligns with a key finding from the Interim Report that gas oversight arrangements could be strengthened through greater clarity between State Growth and the Director of Gas Safety.

RECOMMENDATION

5. The Department of State Growth should review the emergency management requirements for natural gas emergencies to ensure there are clear lines of accountability between the Director of Gas Safety and the Energy Security Coordinator.

10.5 Implementation principles

Based on a number of key points of feedback provided to the Taskforce the following are recommended as key principles to ensure a successful and effective new oversight framework:

- the framework should be implemented as soon as practicable, with interim measures/directives in place by 1 July 2017 where possible, and no later than the end of October 2017 to enable the first annual energy security assessment to be undertaken;
- the framework must be fully resourced with dedicated allocations to ensure it is not subsumed within present functions; and
- whether through laws, rules and/or licence conditions, it is important that the Energy Security Risk Response Framework is embedded as a sustainable operating model that will persist over years, if not decades, regardless of changes in board compositions, corporate strategies or government ownership structures.

Any extended delays to the implementation of the Monitor and Assessor and Energy Security Coordinator roles may risk implementation not eventuating due to perceived lack of necessity or relevance. The Taskforce also notes that while Government is ultimately responsible for energy security, it does not require the explicit control of all energy security levers and tools to be retained within the immediate control of the Minister.

RECOMMENDATION

6. New oversight roles proposed as part of the Energy Security Response Framework should be implemented as soon as practicable, with interim measures/directives in place by 1 July 2017 where possible, and no later than the end of October 2017 to enable the first annual energy security assessment to be undertaken at the commencement of the 2017-18 dry season.

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[91] Interim Report, section 6.5.

11. Management of Hydro-electric Storages

KEY FINDINGS

- An HRL profile for energy in storage applies the national concept of unserved energy (USE) to the energy constrained Tasmanian system. This allows comparison to a national standard that is accepted and well understood in the energy industry.
- The HRL profile should reflect the capability of energy in storage to meet demand over a six month period without Basslink support.
- The PSL profile should reflect an operational energy in storage profile under average supply and demand conditions. The PSL should also allow for a historically low three month inflow sequence and still remain at or above the HRL profile.
- As energy security is ultimately the responsibility of the Tasmanian Government, it is appropriate for the Minister for Energy to approve the proposed HRL and PSL profiles and any future variation of these. Initially these benchmarks could be established by adopting the recommendations of the Taskforce and then only varied following consideration of advice from the Monitor and Assessor.
- A material change in either supply or demand would need to occur before undertaking a reassessment of the HRL and PSL profiles.
- Energy security issues created by capacity constraints (rather than energy constraints), if they were to occur, are managed through existing national arrangements and would most likely happen in the early wet season as a result of a delay in wet season inflows. The expertise of Hydro Tasmania in managing capacity of the hydro-electric generation network need not be duplicated by the Monitor and Assessor as it is a complex task that requires a high level of modelling expertise.

This chapter presents the Taskforce's recommended HRL and PSL profiles. It also provides commentary regarding management of the capacity of Tasmania's hydro-electric system.

11.1 High Reliability Level (HRL) profile

The HRL was introduced in the Interim Report as a means of communicating 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 low inflow sequence, assuming 200 MW (876 GWh) of generation from the TVPS is utilised and there is no incursion into the Great Lake Extreme Environmental Risk Zone (EERZ). The HRL is an adaptation of the USE measure and has been designed for use in the energy constrained Tasmanian hydro-electric system. The Interim Report refers to the energy in storage below the HRL as the 'energy security reserve', which should only be accessed in exceptional circumstances such as an extreme period of low inflows, an extended Basslink outage or an extended unplanned outage to the full output of Gordon Power Station or Poatina Power Station (the largest hydro-electric power stations in the Tasmanian generation system).

The HRL is not a storage trajectory; rather it is a set of individual monthly storage levels required to meet the NEM reliability standard should a six month Basslink outage occur in a given month.

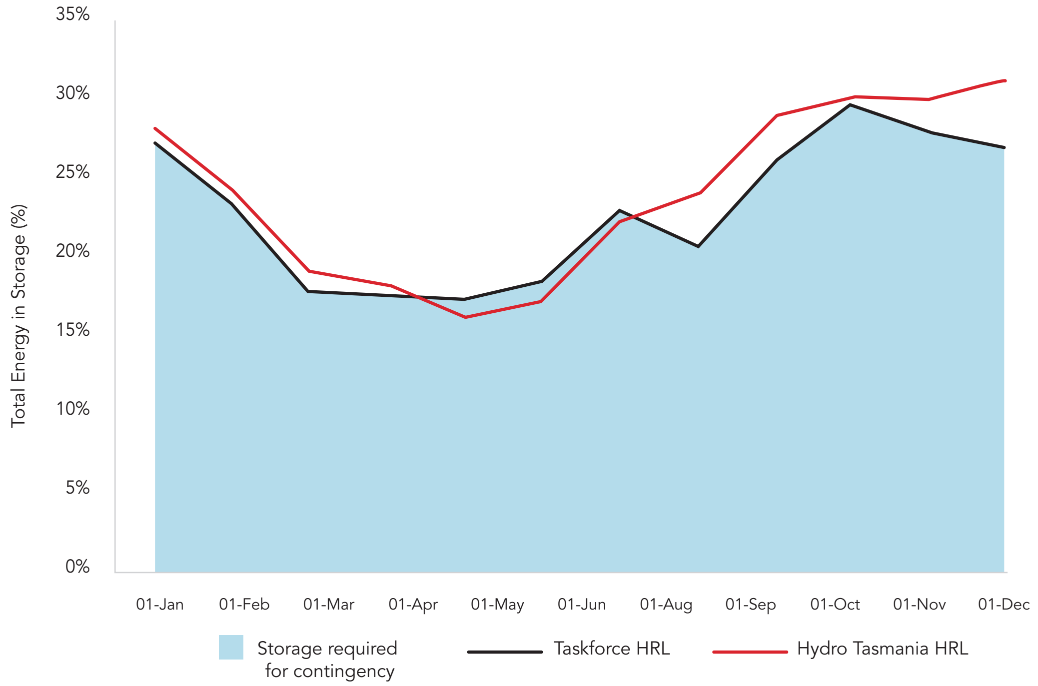
The Taskforce has tested Hydro Tasmania's calculation of the HRL for suitability and robustness by calculating the amount of energy needed to meet demand under the following conditions:

- Basslink unavailable for six months;
- Tasmanian demand equivalent to 10 600 GWh per annum (profiled monthly);
- lowest six monthly inflow sequences from Hydro Tasmania modelled inflow data;

- wind generation of 900 GWh per annum; and
- gas generation of 876 GWh, reflecting TVPS operation during the six month Basslink outage.

The output of this analysis is the amount of energy in storage required each month in the event of an extended Basslink outage. This calculated storage requirement is then added to the theoretical 'floor' of the energy supply from Tasmania's hydro-electric system (referred to as the USE threshold) at which point Hydro Tasmania has indicated that all demand may not be met. This can then be used to form an HRL profile based on readily available data independently of Hydro Tasmania's calculations. The results of this analysis are presented in Figure 11.1.

Figure 11.1 High Reliability Level (HRL) profile analysis



Source: Taskforce analysis

Figure 11.1 shows that the Taskforce's calculation of the HRL profile (and hence the minimum required amount of energy in storage each month) broadly supports Hydro Tasmania's calculation of the HRL profile. Overall Hydro Tasmania's HRL profile is more conservative than that calculated by the Taskforce, including during the drier months of the year between November and April. For this reason, as well as for ease of implementation and future reference, the Taskforce recommends that the HRL profile should be initially set based on Hydro Tasmania's more conservative calculation.

Any future revision of the HRL profile would require Hydro Tasmania to submit its own calculation for review by the Monitor and Assessor, who would undertake its own independent assessment as to its appropriateness using the calculation methodology provided to it by the Taskforce. This is further discussed in section 11.4.

It should be emphasised that the HRL represents a warning level rather than a storage target. Regular operation of water storages at HRL levels would represent a high risk position. Operation in this manner would see any below average inflow month resulting in the operation of the system at levels which would be susceptible to the loss of load during an extended Basslink outage. The safe level of operation above the HRL is represented by the PSL.

RECOMMENDATION

7. The HRL profile should be set at the following levels at the beginning of each month:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
28.0%	24.0%	19.0%	18.0%	16.0%	17.0%	22.0%	24.0%	29.0%	30.0%	30.0%	31.0%

11.2 Prudent Storage Level (PSL) profile

The PSL profile is a set of monthly storage targets that provide an allowance for three months of low inflows above the HRL profile to ensure the low risk operation of the hydro-electric system in Tasmania. The PSL profile is fundamentally different to the HRL profile in that it represents an annual storage profile (under average inflow conditions and an average Basslink import/export profile), whereas the HRL profile is a sequence of monthly indicators.

The Taskforce has developed a PSL methodology that involves calculating an annual profile to represent the movement of energy in storage in a 12 month period under average inflow conditions. The annual profile of the PSL is generated from average monthly supply and demand conditions consistent with prior Taskforce modelling parameters identified in the Interim Report. This annual profile is then applied to ensure that the most vulnerable monthly position of the PSL maintains a buffer above the HRL profile equivalent to an historic dry three month sequence with Basslink and TVPS support. This monthly minimum position is calculated using the following assumptions:

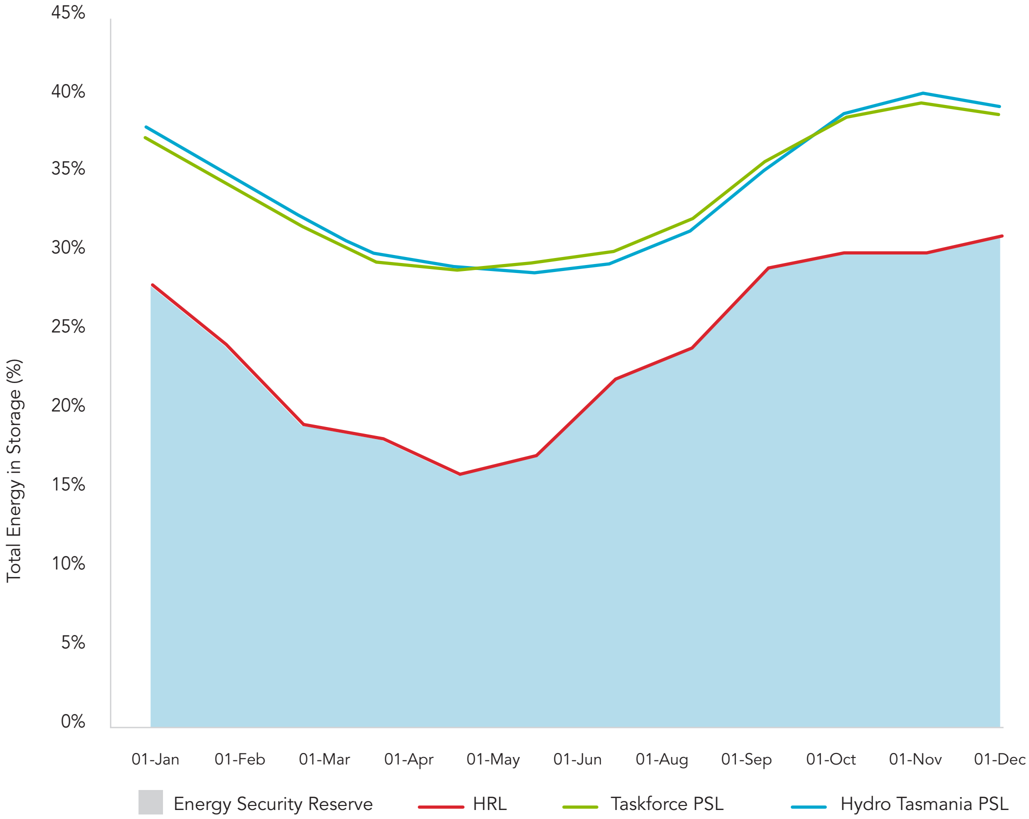
- Tasmanian demand (monthly profile of 10 600 GWh per annum);
- historically low monthly inflow sequences;
- wind generation of 225 GWh for any three month period (900 GWh per annum, evenly distributed across the year);
- gas generation of 219 GWh for any three month period (1.5 months of 200 MW flat generation); and
- Basslink import of 657 GWh for any three month period (equivalent to 300 MW flat import).[92]

The Taskforce requested that Hydro Tasmania provide its own calculation of the PSL profile based on the Taskforce's proposed methodology. Hydro Tasmania submitted a PSL profile using the Taskforce's PSL methodology and its own inflow assumptions.

A comparison between Hydro Tasmania's PSL profile and the Taskforce's PSL profile is illustrated in Figure 11.2, which shows there is little variation between the two profiles. At the start of July, Hydro Tasmania's PSL is 29.4 per cent total energy in storage. By the start of November, the PSL is 40.1 per cent total energy in storage. The proposed PSL profile is consistent with the Interim Report recommendations of 30 per cent at 1 July and 40 per cent at the end of October. For this reason, as well as for ease of implementation and future reference, the Taskforce recommends that the PSL profile should be initially set based on Hydro Tasmania's calculation.

[92] The Basslink import assumptions reflect the historical operation of Basslink in times of low inflow and low storage levels.

Figure 11.2 Comparison of the Taskforce and Hydro Tasmania PSL profiles



Source: Taskforce analysis

Any future revision of the PSL profile would require Hydro Tasmania to submit its own calculation for review by the Monitor and Assessor, which would undertake its own independent assessment as to its appropriateness using the calculation methodology provided to it by the Taskforce. This is further discussed in section 11.4.

As at 1 May 2017, total energy in storage was 36.2 per cent. This is around six per cent above the Taskforce's calculation of the PSL profile for the beginning of May. Assuming average inflows, it is unlikely that operation below the PSL profile will occur in the 2017 calendar year with levels so much higher than the PSL target. However this still remains a possibility under some low inflow scenarios.

RECOMMENDATIONS

8. The PSL profile should reflect an operational energy in storage profile under average supply and demand conditions and be set such that storages remain at or above the HRL profile following an historically low three month inflow sequence.
9. The PSL profile should be set at the following levels at the beginning of each month:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
38.0%	35.2%	32.4%	29.9%	29.2%	28.8%	29.4%	31.4%	35.4%	38.7%	40.1%	39.3%

11.3 Operation below the PSL and HRL profiles

From an energy security perspective, the probability of remaining above the PSL and HRL profiles should be a key driver of Hydro Tasmania's future water storage management. Under the Energy Security Risk Response Framework, as the probability of dipping below the PSL and/or HRL increases, Hydro Tasmania would be required to commence and communicate additional measures to increase energy supply security. The triggers for escalation and interaction with the Monitor and Assessor and Energy Security Coordinator under this framework are set out in Chapter 10.

As discussed above, the PSL represents both a safe operating level above the HRL and a profile which could realistically be achieved with average inflow conditions. Despite the name, average inflow conditions are not actually common on a monthly basis. It is more realistic to expect that, over an average inflow year, monthly inflows will occur both above and below historic monthly averages. In such situations, it is realistic to expect that storage levels below the PSL may occur for short periods on a fairly regular basis.

In the event of storages dropping below the PSL, it is expected that the Monitor and Assessor would observe that the current level of energy in storage is below the PSL and note the reasons why this may have occurred. Reasons may include low monthly inflows, higher than anticipated demand and variations in Basslink flows based on Victorian energy market conditions.

Operation of water storages significantly below PSL could be caused by very low inflows in a historically high inflow month or a combination of a string of lower than average inflow months. Operation at this level will be accompanied by PSL Recovery Advice from Hydro Tasmania regarding how it intends to return energy in storage back toward the PSL over time.

The level of response to operation below the PSL would differ according to the time of year and the extent that the water is below the PSL. Operating significantly below PSL in the early wet season is likely to cause less concern than being significantly below PSL at the beginning of the dry season. The reason the 2015-16 energy security event was such a cause for concern was because the extreme dry period occurred at the end of the wet season and beginning of the dry season, allowing very little scope for a natural recovery of storage position through rainfall.

11.4 Process for establishing and re-evaluating the HRL and PSL profiles

The Taskforce noted in the Interim Report that energy security is ultimately the responsibility of the Tasmanian Government. The Taskforce considers it appropriate that the Minister for Energy should be responsible for establishing the initial HRL and PSL profiles, and the Taskforce has provided the recommended levels. The Minister for Energy should also be responsible for approval of any future variation of the energy in storage measures. The Taskforce proposes that the process for establishing and re-evaluating the energy in storage measures is as follows.

1. A material change in the input assumptions is identified by the Monitor and Assessor and/or Hydro Tasmania.
2. The Monitor and Assessor requests Hydro Tasmania to re-calculate the HRL and PSL profiles to take into account the observed changes.
3. Hydro Tasmania submits new HRL and PSL profiles for consideration by the Monitor and Assessor.
4. The Monitor and Assessor evaluates the new HRL and PSL profiles using the calculation methodology developed and provided to it by the Taskforce.[93]

[93] The Taskforce intends to provide to the Monitor and Assessor the calculation methodology it has used to evaluate Hydro Tasmania's HRL and PSL profiles.

5. The Monitor and Assessor recommends new HRL and PSL profiles. This could be the exact version as submitted by Hydro Tasmania or it could be a variation based on the Monitor and Assessor's analysis.
6. The new HRL and PSL profiles are submitted with advice to the Minister for Energy for approval.

The Taskforce considers that one or more of the following conditions, or combinations thereof, would need to be met before the Monitor and Assessor would undertake a reassessment of the HRL and PSL profiles:

- the connection of material new generation source(s) in the Tasmanian region of the NEM equivalent to two per cent (around 300 GWh) of total energy in storage or greater;
- the material reduction or increase (+/- 500 GWh)[94] of the current Tasmanian demand forecast (10 600 GWh average) as communicated in the AEMO NEFR;
- a material permanent change in interconnector import capacity (+/- 100 MW); or
- a long-term (six months or greater) unplanned outage of the entirety of Gordon or Poatina Power Stations.

RECOMMENDATION

10. The Minister for Energy should be responsible for final approval of the HRL and PSL profiles and any future changes to these.
11. Future changes to the HRL and PSL profiles should be based upon advice from the Monitor and Assessor and should only be made when there are material changes to supply and/or demand.

The current structure of the Energy Security Risk Response Framework relies upon the existence of the PSL and HRL profiles in order to determine communication requirements and levels of risk. As reported in the Interim Report, Hydro Tasmania has proposed to the Taskforce that in the future the PSL profile could be replaced by a mechanism whereby the total energy in storage is evaluated by the probability of entry into the energy security reserve.[95] This mechanism would require independent analysis by the Monitor and Assessor of Hydro Tasmania's total energy in storage forecast. The Taskforce does not consider that this option should be considered at this time because it has not yet been tested and there is little external visibility or independent assessment of Hydro Tasmania's total energy in storage forecasts. However, the appropriateness of a probability approach could be tested in conjunction with the PSL profile over time by the Monitor and Assessor.

As described in Chapter 10, the Monitor and Assessor will have access to regular information regarding the probability of entry into the energy security reserve. It may be possible for the Monitor and Assessor to gain confidence in Hydro Tasmania's forecasts over time with regular analysis of its monthly forecast submissions. As noted in the Interim Report, this is likely to be highly useful to the Monitor and Assessor in determining its own assessment of risks. However, it is important that such an approach is not adopted unless the Monitor and Assessor has the ability to provide assurance on Hydro Tasmania's forecasts.

11.5 Taskforce modelling of energy in storage

The Taskforce has undertaken modelling of options for improving energy security in Tasmania and presented its approach and findings in Chapter 4 to Chapter 6. One of the key inputs to the Taskforce's model is the adoption of the HRL and PSL profiles outlined in section 11.1 and section 11.2 respectively. While the HRL and PSL are monthly energy in storage profiles, the Taskforce's modelling was conducted on a financial year basis, and hence uses only the 1 July HRL and PSL targets.

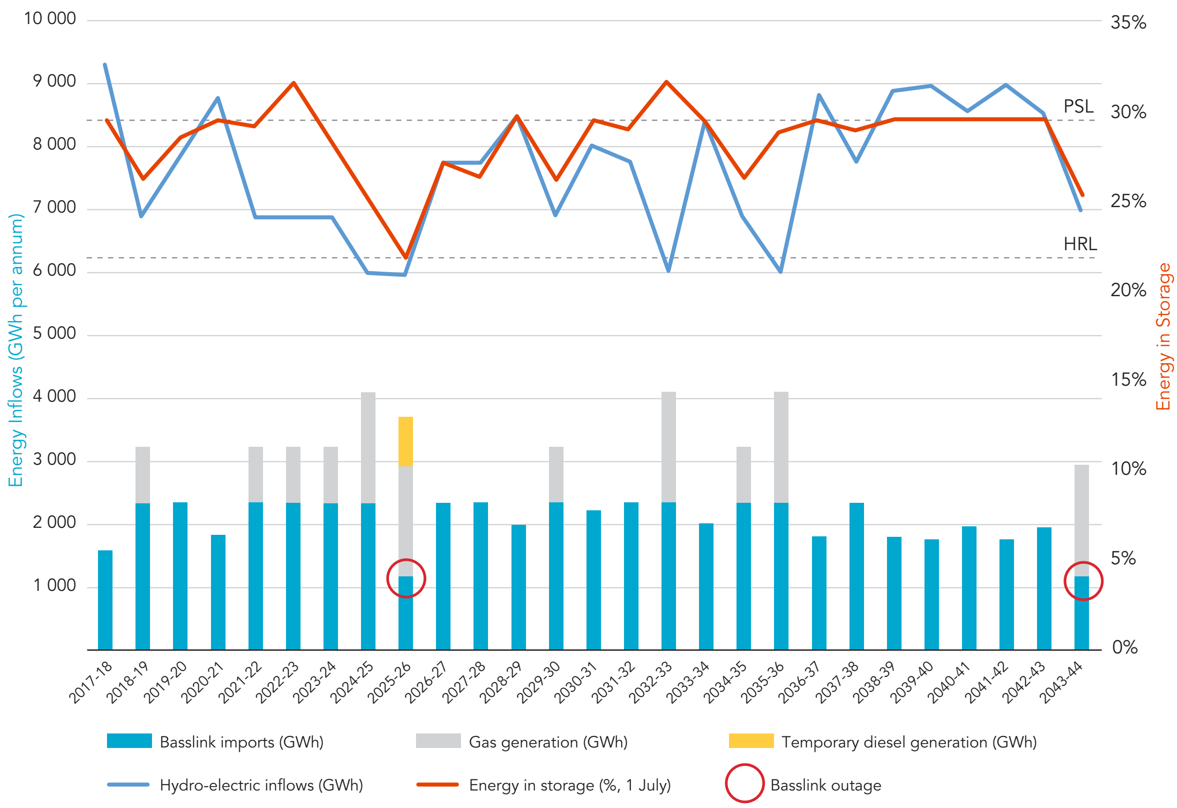
94 This figure is higher than the generation equivalent as a result of the inherent uncertainty of demand forecasting.
95 Interim Report, page 66.

As outlined in Appendix 2, the Taskforce's model utilises a Monte Carlo simulation approach to inflow variability. This has resulted in the following principles of operation surrounding the HRL and PSL profiles:

1. If energy in storage is less than the half way mark between HRL and PSL profiles, then at least six months of TVPS generation is introduced into the modelled year.
2. If energy in storage is less than the HRL profile, then 12 months of TVPS generation is introduced into the modelled year.
3. If the energy in storage is less than the HRL profile (even after 12 months of TVPS operation) and a Basslink failure is modelled to occur, then supplementary generation and/or negotiated demand reductions are introduced into the modelled year.
4. If the energy in storage is less than 16 per cent (i.e. the lowest point in the full HRL profile) then supplementary generation and/or negotiated demand reductions are introduced into the modelled year regardless of Basslink operational status.

Figure 11.3 shows the modelling interaction of a single Monte Carlo iteration between annual inflows, energy in storage at the start of a financial year, Basslink import, TVPS generation and supplementary diesel generation.

Figure 11.3 Single Monte Carlo iteration of the Taskforce energy in storage modelling



Source: Taskforce analysis

11.6 Capacity management of energy in storage

The Taskforce's work has focused on management of energy supply constraints rather than capacity constraints. Although capacity constraints are unlikely to occur in Tasmania because there is a large excess of generation capacity in the State, there exist certain conditions under which a capacity constraint could occur.

Hydro-electric power stations in Tasmania can be separated 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 smaller, lower 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. The total 2 281 MW of hydro generation capacity in Tasmania comes from the output of 30 individual power stations. Lake Gordon and Great Lake have very large storages that make up 78 per cent of the total energy in storage capacity. In order to meet Tasmanian demand at any given time a balance between power stations with small, moderate and very large storages must be planned. This balance must also account for Basslink flow, wind generation and the option of gas generation.

The balancing of Tasmania's hydro-electric storages for the purposes of managing capacity is particularly important if total energy in storage reaches low levels and Hydro Tasmania is unable to utilise some of its power stations. Hydro Tasmania has advised the Taskforce that it manages this risk through:

- adhering to a set of operational rules that govern the energy in storage balance between Lake Gordon and Great Lake in order to mitigate the system impact of a major contingency event reducing access at either; and
- reprioritising the operation of power stations with a moderate level of storage (John Butters Power Station) and headwater storages at the top of the run-of-river systems (Lake Echo / King William) to conserve their energy in storage for use only during high demand periods. Together with operation of the TVPS, this approach is considered by Hydro Tasmania to be able to provide significant energy and capacity even if a major double contingency were to eventuate (e.g. a Basslink outage and the loss of a major storage).

Balancing power station operation for the purposes of capacity management requires a great deal of expertise in hydrology and intimate knowledge of the Tasmanian energy system as a whole. The Taskforce considers that it is appropriate that Hydro Tasmania undertakes this capacity management of the system as it has the expertise and systems in place to do so. This was demonstrated during the 2015-16 energy security event, during which Hydro Tasmania was able to manage capacity with storages as low as 12.5 per cent. In this context, the Taskforce considers that that it would not be practical or useful for the expertise of Hydro Tasmania in managing capacity of the network to be duplicated by the Monitor and Assessor.

Capacity challenges as a result of low energy in storage are most likely to occur in the early wet season as a result of a delay in wet season inflows. The HRL has been defined to enable sufficient energy in storage to meet demand in the event that a six month Basslink outage coincides with an extremely low inflow sequence, with the lowest point of the HRL coinciding with the end of the dry season and beginning of the wet season. This reflects the need to have room in the head storages to capture the inflows of the upcoming wet season as well as the need to draw down larger storages over the dry season in order to maintain supply in Tasmania. If the wet season were delayed, the act of balancing the system becomes more difficult as storages are already at their lowest annual position and Tasmanian maximum daily demand is increasing with the colder weather.

Capacity issues are unlikely to occur if storages are operated above the HRL unless a series of contingent events occurs (e.g. Basslink failure and the failure of a major storage). As discussed above, in the event of this occurring Hydro Tasmania has considerable flexibility in management of system capacity and in most foreseeable circumstances can do so without compromising energy security.

In the unlikely event of a specific sequence of concurrent events (such as a combination of asset failures, regional inflow variation, Basslink failure and a lack of available supplementary generation) causing a capacity management problem whereby there is a risk that local demand might not be met, then national emergency management arrangements set down under AEMO's Power System Emergency Management Plan for an incident categorised as Level 4 would apply. Such an incident would trigger local emergency management roles as well as AEMO's emergency management teams.

12. Tasmanian Gas Market

KEY FINDINGS

- Until additional generation to address Tasmania's annual on-island deficit is proven reliable and adequate, gas generation will continue to serve as the primary backup energy generation source for the Tasmanian energy sector.
- There may be value in running the TVPS at select times, to address low inflows, to ensure operational effectiveness and/or to take advantage of imbalances between gas and electricity markets.
- Gas market regulatory reforms are seeking to bring greater efficiency and competitiveness into national legislation by introducing new mechanisms such as binding arbitration to resolve disputes or inability to reach agreement between pipeline operators and shippers. From a Tasmanian perspective, these regulatory reforms should strengthen gas energy security.

Modelling and scenario analysis presented in Chapter 5 and Chapter 6 (together with Taskforce analysis in the Interim Report) show that, in any future scenario of low water inflows to hydro catchment areas and an extended Basslink outage, gas generation remains important to Tasmanian energy security in the absence of other supply or demand changes.

A key requirement for sustainable gas generation is the need for gas commodity and transportation arrangements that ensure continuity of supply over the longer term. To date, transportation arrangements beyond December 2017 remain uncertain. Predominantly, the resolution to the uncertainty is at a commercial level. However, reforms to the national gas market regulatory arrangements are set to introduce a new framework to resolve disputes (including inability to reach agreement) between pipeline operators and shippers over the terms of gas transportation agreements. It is likely that the reforms will include provision for the status quo to be preserved from the invocation of the arbitration provisions until the determination of the dispute or inability to agree.

Following on from the scenario analysis contained in Part A of this report, the role of gas generation in the medium and longer term is considered in this chapter, as is the current status of gas transportation agreements for Tasmania.

12.1 Retention of the TVPS

In the Interim Report, the Taskforce examined the role of gas generation in the Tasmanian electricity market and found that the primary function of the TVPS is to serve as a backup energy generation source. A number of factors supported this position including:

- the demonstration by the TVPS during the 2015-16 energy security event 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;
- the TVPS is the only controllable base load generation for Tasmania outside of hydro-electric power stations;
- the TVPS is a firm alternative energy supply source when compared to wind or temporary generation such as diesel; and
- the TVPS can assist in maintaining the strength of the network.

These factors led to the Interim Report recommendation (recommendation 25) that "*(t)he 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.*" The Taskforce also observed that the need for the TVPS to provide backup generation may diminish if additional on-island energy supply is developed (or significantly higher levels of water storages are permanently held).

Part A of this Final Report confirms the importance of the TVPS for Tasmania's energy security under a range of scenarios, particularly under scenarios in which there is a decrease in long-term average inflows. Part A also investigated the medium and long-term future of different forms of on-island supply that may provide a reliable alternative that displaces gas generation as the primary source of backup energy generation. Renewable energy generation is identified as a cost effective solution to achieve on-island energy balance compared to gas generation. However, it will be some time before the cumulative value of new renewable energy projects can surpass the supply able to be provided by the TVPS when needed.

As such, before a position can be formed that the TVPS is no longer required, there must be clear and sustained evidence of an excess of generation compared to demand in the Tasmanian energy market. At this point, consideration of secondary drivers (such as provision of excess energy to address mainland energy constraints) should be undertaken prior to making a decision to remove the TVPS from operation.

Whilst the TVPS is retained, there may be value in running it at certain times during a year beyond its role as a backup generator. When there has been an extended period of low inflows, the TVPS will be needed to help restore energy in storage to an acceptable level. There may also be annual periods when running the TVPS is undertaken as a long-term prudent water storage management action. For example, in January 2017, Hydro Tasmania began to run the TVPS to support increasing storages during the drier summer months as well as to keep the TVPS equipment in optimal condition.[96]

The ability for gas generation to support the Tasmanian energy market can change if the key supply inputs of commodity and transportation are disturbed to a point that they become cost-prohibitive or unavailable through physical or market constraints. This circumstance is considered in the local context further in section 12.2. Conversely, if there are points at which gas prices are highly favourable compared to electricity prices then opportunities to operate the TVPS competitively against other forms of generation may result in its dispatch into the NEM solely for commercial reasons. This option value may partially offset some of the costs associated with maintaining the TVPS on standby.

The Taskforce is of the view that the factors driving the need to retain the TVPS have not altered since its Interim Report. The TVPS currently plays a highly important role in maintaining Tasmania's energy security as it is a firm and dependable alternative to other forms of generation and is a proven mitigation option for times of low in-flows. While new renewable energy developments can be expected to occur in the medium to long term to help address the on-island deficit, this will take some time to realise.

12.2 Gas commodity and transportation contracts

Since the release of the Interim Report, the Australian gas market has come under rising pressure in terms of both gas availability and price. The extreme heatwave in South Australia on 8 February 2017 and the lack of a supply contract for the second generation unit at Pelican Point Power Station provided a tangible example of a constrained gas market in which the viability of gas generation is challenged by the growth of other forms of generation. The 2017 AEMO Gas Statement of Opportunities (GSOO) gave further detail to this challenge in its forecast of a gas supply shortage in 2018.[97]

Concurrently, gas commodity costs have continued to rise under the pressure of a constrained Australian east coast gas market that is increasingly being relied upon to address issues of intermittency and supply short falls during extreme weather events.[98] Since July 2016, gas prices have fluctuated between $5-15 per GJ, with pricing forecasts suggesting up to $10 per GJ for long-term wholesale contracts.[99, 100]

96 https://www.hydro.com.au/about-us/news/2017-01/routine-ccgt-operation
97 AEMO, 2017, *Gas Statement of Opportunities.*
98 Ibid.
99 Ibid.
100 National Australia Bank, 2017, *Gas and LNG Market Outlook: January 2017*.

Based on a Tasmanian commodity cost of $6 per GJ, customers could incur an increase of over 50 per cent.[101]

For Tasmania, these national market challenges have been amplified due to the commercial impasse between the operators of the Tasmanian Gas Pipeline, Palisade Investment Partners Limited (Palisade), and Hydro Tasmania over the transportation of gas to Tasmania, most notably an agreement to supply the TVPS beyond December 2017. The lack of a transportation agreement led to the Taskforce's interim assessment that Tasmania's gas energy security is Susceptible, as well as two key recommendations in the Interim Report (recommendations 26 and 27 respectively) that:

- *"(c)ommercial 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"*; and
- *"(a)greed 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."*

While the Taskforce has heard from both parties that they seek to enter into an agreement post 2017, at the time of writing there has been no resolution to the commercial impasse over gas transportation agreements. Neither has there been a communication to the Tasmanian gas market as to the features of any contract between Hydro Tasmania and Palisade. This means that Tasmanian customers, including the TVPS, are exposed to risk if they buy the gas commodity without having firm transportation arrangements in place.

The Taskforce notes that as at 1 May 2017, energy in storage is six per cent higher than the PSL target for the start of May. As presented in the Gas Supply Interruption scenario in Chapter 6, Taskforce modelling suggests that this is the right order of magnitude to reasonably offset the lack of availability of the TVPS without substantially increasing energy security risk. However, even if intended that this level of buffer be retained, the Taskforce's assessment of gas energy security would remain Susceptible until there is certainty around future gas arrangements.

In light of the commercial impasse between Hydro Tasmania and Palisade, the Taskforce has investigated recent gas market reform initiatives that may assist the gas security challenges faced by Tasmania. The regulatory reform program commenced in response to the AEMC Eastern Australian Wholesale Gas Market and Pipelines Framework Review and the Australian Competition & Consumer Commission's Inquiry into the East Coast Gas Market is laying the foundations for new regulatory levers to introduce greater efficiency and competitiveness into national legislation that has relevance for Tasmania.

During the latter part of 2016, extensive consultation was undertaken by the Gas Market Reform Group, chaired by Dr Michael Vertigan AC, on the current test for the regulation of gas pipelines ('the Vertigan Report'). A key finding from Dr Vertigan concerns the role of gas transmission network operators:

"It is clear that pipeline owners do have market power and, based on submissions by, and discussions with, pipeline customers on their experiences in negotiations, the examination concludes that the existing regulatory arrangements require modification."[102]

The Vertigan Report outlines a number of recommendations to introduce greater transparency of gas pipeline availability, pricing and terms, and a new national framework to support a binding arbitration framework. In response to the Vertigan Report, the COAG Energy Council agreed to implement a commercial arbitration framework for pipeline access disputes in the National Gas Law in January 2017 with the aim of there being a binding arbitration framework in place by mid-2017.[103]

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101 An independent assessment of Taskforce modelling assumptions suggested a gas price sensitivity of up to $16 per GJ.
102 Vertigan M, 2016, *Examination of the Current Test for the Regulation of Gas Pipelines.*
103 COAG, 2017, *Gas Market Reform Bulletin.*

The implication of this regulatory change is that if the commercial impasse over Tasmanian gas transportation arrangements is still unresolved, there will be a legislated arbitration framework available to address this dispute (or any future dispute). At a minimum, it is clear that the broader gas market is coming under increased scrutiny from market operators and regulators.

It is also anticipated that the new regulatory change may provide for the continuation of the status quo from the invocation of the arbitration process until the arbitrator's determination. If this is the case, then the pressure and uncertainty on Tasmanian gas consumers would be alleviated provided that the new arbitration process is invoked before 31 December 2017.

If gas transportation arrangements are not resolved commercially and arbitration is invoked, but that new arbitration regime does not include provision for the continuation of the status quo, then Hydro Tasmania will need to maintain higher levels of energy in storage to compensate for the residual energy security risk of there being no gas available to supply the TVPS. The Taskforce recommends that, in these circumstances, the HRL and PSL profiles should be temporarily adjusted upward from the beginning of the dry season at 1 November 2017 to mitigate against this increased energy security risk until the pipeline capacity arbitration is finalised. The proposed level of adjustment based on the Taskforce's PSL profile calculation methodology is presented in the Gas Supply Interruption Scenario (refer section 6.4).

Accordingly, the Taskforce has amended its recommendations from the Interim Report to reflect the level of progress in resolving the commercial impasse over gas transportation contracts for Tasmania.

RECOMMENDATION

12. Commercial negotiations currently underway to resolve the gas commodity and transportation arrangements to support the TVPS should be resolved in a timely manner that allows certainty for all gas market participants to secure gas supply beyond 2017.
13. Should an arbitration process be invoked for gas transportation arrangements, and should the process not provide for preservation of existing arrangements pending determination of the arbitration, then the HRL and PSL profiles should be temporarily adjusted upward from the beginning of the dry season at 1 November 2017 until the arbitration process is finalised to mitigate against the increased energy security risk of not having the TVPS available.

13. Demand-side Responses

KEY FINDINGS

- The need for demand-side management measures is limited due to Tasmania's excess generation capacity, although the unique characteristics of the State ensure that some locations will benefit from measures to reduce peak demand.
- The highest value in voluntary demand reductions to ease concerns during an energy supply security event in Tasmania come from major industrial energy consumers.

Demand-side management actions have the potential to assist during a supply-driven energy security event, and were used as a mechanism during the 2015-16 energy security event. This chapter explores initiatives that could be adopted in a pre-emergency energy supply situation to reduce consumption in line with an expected shortfall created by either low levels of energy in storage or an extended outage of Basslink.

For demand actions that are specifically targeted at energy supply security events, the Taskforce has focussed solely on voluntary demand reduction initiatives that are delivered as a pre-emergency response, i.e. at a point prior to nationally mandated reliability and load controls being activated. In this context, the Taskforce is not proposing any changes to national reliability roles such as the Jurisdictional System Security Coordinator (JSSC) or the Responsible Officer (RO), nor is it seeking to broaden the application of load shedding schedules for Tasmania. Neither is the Taskforce considering load reductions that can potentially be required under the Frequency Control System Projection Scheme that is in place to rapidly disconnect either generation or load immediately following the unexpected loss of Basslink.[104]

13.1 Tasmania's load profile

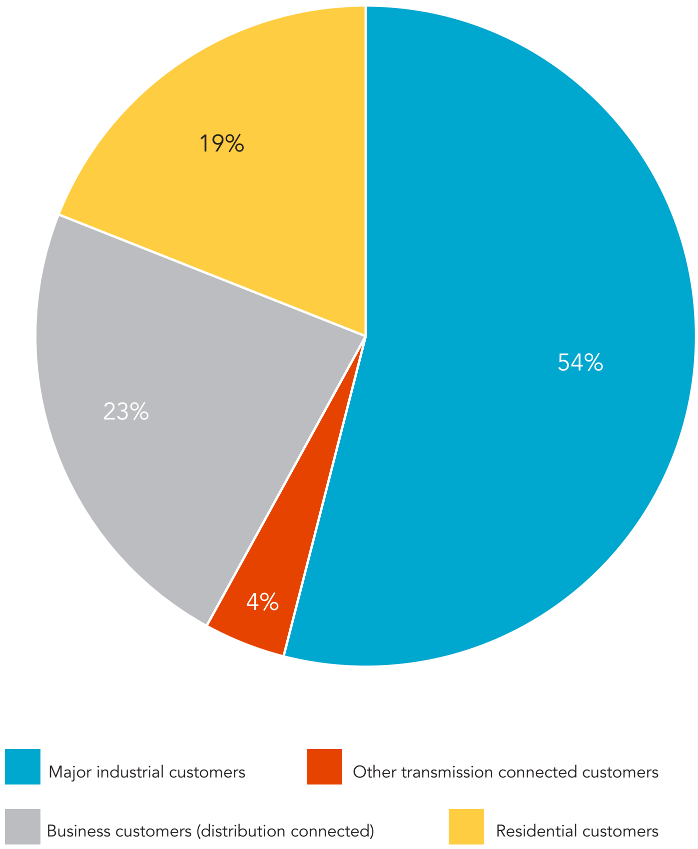
As highlighted in the Interim Report, Tasmania is unique in that four large major industrial customers account for 54 per cent of the State's electricity load.[105] A further four per cent of load comes from transmission connected customers.[106] Residential and business customers connected to the distribution network represent 19 per cent and 23 per cent of Tasmania's load respectively (refer Figure 13.1).

Based on a total annual consumption value of 10 430 GWh for all Tasmanian businesses and customers, the major industrial users consume 5 668 GWh per annum.[107] A 12 per cent reduction in their consumption would reduce annual consumption by nearly 700 GWh, nearly equivalent to the average annual on-island electricity supply/demand imbalance. To reach a similar level of reduction, residential customers would have to reduce their consumption by 34 per cent.

Consequently, major industrial load reduction is considered the most likely customer class in which actions to reduce Tasmanian electricity demand to address supply-driven energy security concerns can be sought, although some benefit can still be obtained from smaller consumers in certain circumstances.

[104] Electricity Supply Industry Expert Panel, 2011, *Technical Parameters of the Tasmanian Electricity Supply System.*
[105] Interim Report, page 8.
[106] TasNetworks, 2016, *Annual Planning Report 2016.*
[107] Ibid.

Figure 13.1 Customer load base by consumption for Tasmania



Source: Taskforce analysis

13.2 Small customer demand-side management actions

In the Interim Report, the Taskforce investigated a number of small customer technologies and initiatives that have the capacity to mitigate threats to energy security including:

- demand aggregation services;
- the rollout of advanced metering infrastructure; and
- enhanced network management services that enable the shifting of demand.

Until 2025, even under high growth scenarios, Tasmania as a whole is predicted to have ample generating capacity.[108] This largely removes the need for a State-wide approach to reducing consumption during peak periods. However, there are instances across the Tasmanian jurisdiction where capacity constraints can be identified at a localised level, whether at the feeder level or below. One such example is the Consumer Energy Systems Providing Cost-effective Grid Support (CONSORT) project that commenced on Bruny Island in late 2016. This local project is targeted at relieving stress on the undersea cable to the island through use of an automated control system, new payment structures and solar systems equipped with batteries.[109]

The Taskforce has observed that, whilst the circumstances on Bruny Island are unique, there are likely to be other scenarios of constraint across Tasmania that over time may be better suited to non-network solutions,

[108] TasNetworks, 2016, *Annual Planning Report 2016.*
[109] Further details on this project are provided in the Taskforce's Interim Report, page 140.

whether battery storage or other similar technologies. These could be rural and regional areas that are dependent on single point inputs from the distribution network and are exposed to swings in peak demand that may place pressure on existing networks. These areas may position Tasmania as a good test bed for consumer driven demand-side management measures.

The transformational nature of technologies such as batteries, digital meters and EVs will see an increasingly active role of consumers in supporting energy security and power system affordability.[110] In this context, consumers are essential to determining and influencing energy security. The Taskforce encourages the State Government, in consultation with TasNetworks, to identify the characteristics of locations that may benefit from non-network solutions. Projects with high potential to benefit from demand-side management can ensure Tasmania is optimising new technologies that are transforming the electricity sector in unprecedented ways.

13.3 Pre-emergency voluntary demand reduction initiatives

The buying back of load from major industrial Tasmanian consumers to avoid energy supply shortfall has occurred on two occasions, most notably in 2005 and in the 2015-16 energy security event.[111] Recent instances in the national market have also shown the use of demand reductions to provide energy security. To mitigate constraints caused by the heatwave across mainland states in February 2017, both South Australia and New South Wales utilised buyback agreements in an attempt to avoid loss of supply (refer Chapter 3).

Despite the recognised value provided from this mitigation option, Tasmanian major industrial users highlighted some concerns with participating in the 2015-16 commercial voluntary demand reduction process, including:

- challenges from managing disruptions to standard operations;
- the short notice period before commercial buybacks were sought (i.e. major industrial users would have preferred to have been advised at an earlier stage); and
- a lack of information on the energy security event as it unfolded.

The Interim Report highlighted that a market bidding process could potentially select the most cost effective options for considering supply and demand opportunities to be used during an energy security event.[112] There are a number of variations on this option that could be adopted, including the following:

- a market based process that secures supply and demand options during times when there is low risk, with a retainer fee paid to successful bidders as part of a firm contractual obligation for those bidders to provide the load reduction or supply if called upon;
- a bilateral pre-agreement directly agreed during times of low risk between generators and customers for the reduction of load to address energy security concerns; and/or
- a process similar to what has occurred in recent supply-driven energy security events, whereby demand reductions and supply options are sought in response to looming shortfalls of supply in a relatively ad-hoc manner.

The Taskforce considers that some level of pre-organisation would not only enhance energy security and consumer confidence but also remove any misinterpretation that voluntary load reductions are reactionary, involuntary or non-commercial. Given that there are differences in the production processes of major

110 Finkel A, Moses K, Munroe C, Effeney T, O'Kane M, 2016, *Preliminary Report of the Independent Review into the Future Security of the National Electricity Market.*

111 Across the first six months of 2016 the Taskforce estimates that avoided consumption by three major industrial users resulted in a 337 GW load reduction.

112 Interim Report, page 72.

industrial users and that not all consumers can 'switch off' at the same time, a pre-planned approach may facilitate a greater number of large customer contributions to managing demand during a period of energy supply constraint.

By their nature, emergency and pre-emergency events can be difficult to predict and are unlikely to unfold in patterns consistent with previous events. There is some risk that a pre-organised buyback approach that attempts to predict the requirements for an energy security event may not produce the correct mitigation response to a future event. The Taskforce also recognises the development of a pre-planned approach or system for buying back load is expected to be a complex and time consuming task. It will require the detailing of a number of potential energy security challenges that may require different responses such as varying load reductions at different times during a day, week or longer period.

For these reasons, and in light of the energy security benefit associated with voluntary demand reduction by large customers in Tasmania, the Taskforce considers that the Energy Security Coordinator should be tasked with developing a pre-planned and agreed approach to the buying back of customer load during a pre-emergency, supply-driven energy security event. Such a scheme may take various forms, from a set of agreed triggers and timings for commencement of commercial negotiations to a detailed scheme comprising products or services that multiple market participants may choose to 'bid-in' as mitigation responses to an energy supply shortfall.

To address concerns of timeliness and information provision in the event of a looming threat to energy supply security, the Energy Security Coordinator should request that Hydro Tasmania provides early notice to, and commences early negotiation with, major industrial users to ensure their readiness to participate in any buyback arrangements. Furthermore, as part of its annual energy security assessment, the Monitor and Assessor should undertake an assessment of the potential need for a major industrial buyback process each October as an additional form of early notification.

The Taskforce is mindful that as a first priority the State Government must implement the Energy Security Risk Response Framework, with the proposed oversight roles fully established. Once established, in considering energy security mitigation options, the Energy Security Coordinator should commence work on the development of the pre-planned approach to the buying back of customer load from major industrial users.

RECOMMENDATIONS

14. The Energy Security Coordinator should design (in consultation with key stakeholders) a pre-planned scheme for large customer demand-side responses or provision of additional generation in response to energy security threats.
15. The Energy Security Coordinator should request that Hydro Tasmania provides early notice to major industrial users if water storages stay below the HRL and that potential buyback arrangements or additional generation may be required.

14. Changes to Interim Report Recommendations

The Interim Report presented the Taskforce's five priority actions and its 32 interim recommendations to the Tasmanian Government that supported these actions. Based on the work it has undertaken for the Final Report, the Taskforce has assessed that the following five priority actions described in the Interim Report remain appropriate for addressing Tasmania's ongoing energy security.

1. Define energy security and responsibilities.
2. Strengthen independent energy security monitoring and assessment.
3. Establish a more rigorous and more widely understood framework for the management of water storages.
4. Retain the TVPS as a backup power station for the present and provide clarity to the Tasmanian gas market.
5. Support new on-island generation and customer innovation.

In this context, and in light of recent developments both at a State and national level, the Taskforce has reviewed the recommendations that were outlined in the Interim Report with a view to updating them to ensure they are consistent with the findings of the Final Report and remain appropriate in the current environment. Table 14.1 presents the Interim Report recommendations and identifies those that have been changed since the Interim Report was released in December 2016. It should be noted that some new recommendations made in the Final Report are additional to those presented in Table 14.1. Readers should refer to the recommendations in the Final Report chapters to locate them and understand the context in which they have been made.

A summary of the Taskforce's final set of recommendations to the Tasmanian Government is presented in Table 1 of the Executive Summary of this Final Report.

Table 14.1 – Changes made to Interim Report recommendations

Interim Report Recommendations	No. in Interim Report	Final Report Update	No. in Final Report
Priority Action 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	No change	N/A
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	No change	N/A
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	Amended as follows: 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) should undertake the Monitor and Assessor role.**	2
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	Amended as follows: 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. **The Director of Energy Planning (DEP) / Department of State Growth should undertake the Energy Security Coordinator role provided that the following necessary prerequisites are in place:** • **external technical and analytical capability is contracted on an ongoing basis, with TasNetworks contracted to undertake this role in the first instance; and** • **the Energy Security Coordinator function is provided with an explicit State Growth budget allocation.**	3

Interim Report Recommendations	No. in Interim Report	Final Report Update	No. in Final Report
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	Amended as follows: Where necessary, legislation **must** 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.	N/A
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	No change	N/A
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	Amended as follows: **The Monitor and Assessor role should consider** 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.	N/A
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	Removed (based on stakeholder feedback received on the Interim Report)	N/A
Priority Action 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	No change	N/A
The Monitor and Assessor role should utilise existing expertise where possible, such as within TasNetworks (particularly its modelling capacity).	5	Removed (this is captured/implied in the Monitor and Assessor role)	N/A

Interim Report Recommendations	No. in Interim Report	Final Report Update	No. in Final Report
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	No change	N/A
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	No change	N/A
Priority Action 3: Establish a more rigorous and more 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	No change	N/A
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	No change	N/A
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	Removed (this recommendation is redundant now that the PSL and HRL have been determined)	N/A
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	Amended as follows: Future changes to the HRL and PSL **profiles** should **be based upon advice from the Monitor and Assessor and** should only be **made** when there are material changes to supply and/or demand.	11
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	No change	N/A

Interim Report Recommendations	No. in Interim Report	Final Report Update	No. in Final 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	No change	N/A
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	Amended as follows: **Hydro Tasmania must submit a robust HRL Recovery Plan to the Energy Security Coordinator for approval prior to accessing the energy security reserve.**	4
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	No change	N/A
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	No change	N/A

Interim Report Recommendations	No. in Interim Report	Final Report Update	No. in Final Report
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	No change	N/A
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-electric system and any increased dependence on one (particularly Lake Gordon) or more storages.	23	No change	N/A
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	No change	N/A
The TER should seek an independent appraisal of Basslink's asset management plans (including its Marine Disaster Recovery Plan) as soon as possible.	28	Amended as follows: The TER should, **to the extent possible and as soon as practicable, undertake its** independent appraisal of Basslink's **compliance and** asset management plans **and publicly report on their adequacy.**	1
Energy security planning should include planning for at least a six month Basslink outage.	29	No change	N/A
Priority Action 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	No change	N/A
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	Amended as follows: Commercial negotiations currently underway to resolve the gas commodity and transportation arrangements to support the TVPS should be **resolved in a timely manner that allows certainty for all gas market participants to secure gas supply beyond 2017.**	12
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	Removed (this recommendation is redundant now that end of March as passed)	N/A

Interim Report Recommendations	No. in Interim Report	Final Report Update	No. in Final Report
Priority Action 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	No change	N/A
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	Remove (redundant upon release of the Final Report)	N/A
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	Amended as follows: 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, improving competitiveness for consumers **and positioning Tasmania as open to innovation.**	N/A

Part C

Energy Security Assessment

15. Energy Security Assessment for Tasmania

KEY FINDINGS

- Whilst in the past 12 months there have been significant events affecting both electricity and gas markets across Australia, the implications for Tasmania are not as heightened and consequently have not materially changed the energy security risk assessment for Tasmania outlined in the Interim Report.
- Retention of the TVPS on standby and the implementation of a new Energy Security Oversight Framework would, all other things being equal, result in Tasmania's electricity energy security adequacy and overall ratings in the short term improving to Resilient.
- Tasmania's electricity energy security in the medium and long term is 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.
- If gas transportation arrangements are not recontracted soon, this will directly impact the availability and price of gas for Tasmanian users.
- Tasmania's gas energy security in the medium and long term is assessed as being Susceptible, based on the current outlook for gas prices and supply.

The Interim Report outlined the recommended framework for assessing energy security in Tasmania and presented the Taskforce's assessment of the State's energy security as at mid-November 2016.[113] This chapter presents the Taskforce's assessment of Tasmania's energy security as of mid-May 2017.

15.1 Framework for assessing energy security in Tasmania

As described in the Interim Report, the Taskforce has adopted a framework to assess energy security in Tasmania that is clearly linked to the Taskforce's definition of energy security:

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 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.

113 Interim Report, Chapter 5.

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 strong.

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 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. It is envisaged that as part of the proposed enhancements to energy security oversight, specifically, the Energy Security Risk Response Framework, that the risk assessment approach undertaken by the Taskforce will be used by the Monitor and Assessor role when undertaking its annual assessment of Tasmania's energy security at the beginning of November each year with the first assessment to occur in November 2017.

15.2 Energy security assessment

The following section presents the Taskforce's energy security assessment for electricity and gas in Tasmania. Assessments of risk over the medium and long term presented indicatively in the Interim Report have now been assessed in the context of the findings of the Final Report.

Table 15.1 presents the Taskforce's energy security assessment for electricity in Tasmania as at mid-May 2017. 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 15.2 to Table 15.4 present in more detail the basis for the individual criteria ratings for adequacy, reliability and competitiveness.

Table 15.5 to Table 15.8 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 Final Report and the indicative performance indicators presented in Appendix 6. The rating of Resilient, Managed, Susceptible or Impacted energy security is a qualitative assessment inferred from the quantitative information and analysis contained in both the Interim Report and Final Report.

15.2.1 Electricity energy security assessment

Table 15.1 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 through the retention of the TVPS and the implementation of a new Energy Security Oversight Framework. Upon adoption of these recommendations, Tasmania's electricity energy security adequacy and overall ratings would likely improve to Resilient.
	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.
	Reliability	Managed		
	Competitiveness	Managed		
Long Term	Adequacy	Managed	Managed	Tasmania's electricity energy security in the long term is highly dependent on the interaction between market developments, consumer choices and strategic decisions made by governments. The potential impact of climate change on long-term average inflows is also uncertain. A Managed assessment is appropriate at this time.
	Reliability	Managed		
	Competitiveness	Managed		

Table 15.2 Electricity adequacy assessment for Tasmania

<table>
<tr><th colspan="2">ELECTRICITY ADEQUACY</th></tr>
<tr><td colspan="2">Supplies of energy are adequate to meet the efficient use needs of Tasmanian consumers over time</td></tr>
<tr><td rowspan="2">Short Term</td><td>Managed</td></tr>
<tr><td>Water storages at the middle of May 2017 are at significantly higher levels than they were at the same time of year in 2014 to 2016, being in the mid 30 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. The on-island energy deficit and the closure of the Hazelwood Power Station in Victoria is already seeing some tightening on the supply side, with cost rather than energy security implications.
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. However, energy in storage is currently tracking well above the proposed HRL and PSL profiles.
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 until the new Energy Security Oversight Framework (particularly operation of Hydro Tasmania's storages to the HRL and PSL profiles) is implemented. Once implemented, and with the retention of the TVPS, the assessment of Tasmania's electricity energy security would improve to Resilient in light of the Taskforce's analysis.</td></tr>
<tr><td rowspan="2">Medium Term</td><td>Managed</td></tr>
<tr><td>Unless there is additional on-island generation 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.
If found to be feasible, Hydro Tasmania's proposal to redevelop the Tarraleah scheme and develop new pumped hydro storage schemes could be completed by the end of this timeframe, with a potential increase in on-island generation.
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 much 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 price 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 it proceeds, 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. In the medium term, Tasmania would be Resilient if it was a net energy exporter.</td></tr>
</table>

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. If found to be feasible, Hydro Tasmania's proposal to redevelop the Tarraleah scheme and develop new pumped hydro storage schemes are likely to be completed by this time frame, with a potential increase in on-island generation. Gas generation for energy security purposes (if still present in Tasmania by this period) may be unnecessary if there were a second electricity interconnector, and even without it remains uncertain and dependent on its competitiveness with other alternatives. With additional on-island generation and/or load loss, Basslink may on average 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.

Table 15.3 Electricity reliability assessment for Tasmania

ELECTRICITY RELIABILITY	
The supply of energy to consumers is reliable	
Short Term	**Resilient**
	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. While the Taskforce is unable to reach a conclusion as to its ongoing reliability, 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.
Medium Term	**Managed**
	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 or 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.

Long Term	Managed
	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. The initial term for Basslink's contract for service expires in 2031 but there are provisions to extend the term for a further 15 years 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 or 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.

Table 15.4 Electricity competitiveness assessment for Tasmania

ELECTRICITY 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	**Managed**
	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 and/or desire for consumers to choose or engage in supply and demand management. 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.
Medium Term	**Managed**
	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 dependent businesses 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.
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.

15.2.2 Gas energy security assessment

Table 15.5 Gas energy security assessment for Tasmania

Timeframe	Criteria	Rating	Overall Rating	Comment
Short Term	Adequacy	Susceptible	Susceptible	Over the short term, energy security for gas users is assessed as Susceptible due to significant uncertainty with gas commodity and transportation prices. If transportation arrangements are not recontracted soon, then this may directly impact the availability and price of gas for Tasmanian users. 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.
	Reliability	Managed		
	Competitiveness	Susceptible		
Medium Term	Adequacy	Susceptible	Susceptible	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 mediumterm energy security for gas customers being Susceptible.
	Reliability	Managed		
	Competitiveness	Susceptible		
Long Term	Adequacy	Susceptible	Susceptible	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.
	Reliability	Managed		
	Competitiveness	Susceptible		

Table 15.6 Gas adequacy assessment for Tasmania

<table>
<tr><th colspan="2">GAS ADEQUACY</th></tr>
<tr><td colspan="2">Supplies of energy are adequate to meet the efficient use needs of Tasmanian consumers over time</td></tr>
<tr><td rowspan="2">Short Term</td><td>Susceptible</td></tr>
<tr><td>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. The 2017 AEMO Gas Statement of Opportunities has also forecast a shortfall of gas to the east coast gas market in 2019. Whilst the Australian Government is considering measures to ensure gas supply availability in response to market constraints, the price of gas and transportation arrangements is expected to remain high.
It is for these reasons that the adequacy of gas supply to meet demand from Tasmanian gas consumers is assessed as Susceptible at this time. However, if ongoing gas transportation arrangements are unable to be resolved soon, then this may influence the availability of gas for Tasmanian users.</td></tr>
<tr><td rowspan="2">Medium Term</td><td>Susceptible</td></tr>
<tr><td>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.</td></tr>
<tr><td rowspan="2">Long Term</td><td>Susceptible</td></tr>
<tr><td>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.</td></tr>
</table>

Table 15.7 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 in good physical condition and be 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.

Table 15.8 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 Australia 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 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. However, if ongoing gas transportation arrangements are unable to be resolved soon, there may be further negative impacts on the ability of gas users to contract future gas supply.
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, 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.

Appendices

16. Appendix 1: Stakeholder Engagement

Throughout its work program, the Taskforce has taken a consultative approach to collating evidence and analysing issues that were relevant to its Terms of Reference. Essential to this process has been the contribution provided by a wide range of energy sector and other stakeholders. Whether through direct liaison or written submissions to the Taskforce, the contribution from stakeholders has been invaluable.

The Taskforce is grateful to the following organisations and individuals who have taken the time to prepare a submission and/or meet with the Taskforce to share their views and insights on matters relevant to Tasmania's future energy security.

Antarctic Climate and Ecosystems Cooperative Research Centre
Australian Electric Vehicle Association
Australian Energy Council
Australian Energy Market Commission
Australian Energy Market Operator
Australian Energy Regulator
AusNet Services
Aurora Energy
Basslink Pty Ltd
Bell Bay Aluminum
Bureau of Meteorology
BOC Ltd and LNG Refuellers Pty Ltd
Clean Energy Council
Clean Energy Finance Corporation
Climate Tasmania
CWP Renewables Pty Ltd
Department of State Growth
Department of Primary Industry, Parks, Water and Environment
Department of Industry (Commonwealth)
Doctors for the Environment Australia
Energy Networks Association
Engineers Australia
Estelle Ross (private)
Gas Energy Australia
Gas Market Reform Group
Goanna Energy Consulting Pty Ltd
Goldwind Australia
Hydro Tasmania
Ian Howard (private)

Inland Fisheries Advisory Council
John Bishop (private)
Lee Dyson (private)
Minerals Resources Tasmania
National Electricity Market Security Review Taskforce
New South Wales Energy Security Taskforce
Office of the Tasmanian Economic Regulator
Pavel Ruzicka (private)
Steel Wave Power
TasGas Network
TasGas Retail
Tasmanian Climate Change Office
Tasmanian Council of Social Service
Tasmanian Energy Taskforce and Dr John Tamblyn
Tasmanian Gas Pipeline (Palisade Investment Partners Limited)
Tasmanian Greens
Tasmanian Minerals and Energy Council
Tasmanian Renewable Energy Alliance Inc.
Tasmanian Small Business Council
TasNetworks Pty Ltd
Trout Guides & Lodges Tasmania Inc.
University of Tasmania
Value Advisor Associates Pty Ltd

17. Appendix 2: Scope of the Energy Security Cost Model

17.1 Overview

As outlined in Chapter 4, the Taskforce developed a modelling methodology and assessment framework to evaluate options that can address some of the issues and challenges identified in the Interim Report.

The approach adopted by the Taskforce utilises energy, cost and risk modelling to inform five big picture scenarios that could present in Tasmania in the short to medium term, and assesses the Taskforce's recommendations against other options through a set of common assessment criteria (refer Figure 4.1 in Chapter 4).

This appendix provides an overview of the modelling principles and approach to modelling energy security responses. Appendix 3 outlines the cost and energy assumptions used in the modelling.

17.2 Independent review

The Taskforce engaged Marchment Hill Consulting to independently review the Energy Security Cost Model. The model was independently verified as being reasonable for the purpose of assessing the impacts of the costs and risks of different energy security options for Tasmania.

17.3 Modelling principles

Chapter 4 provides a high level overview of the modelling principles adopted by the Taskforce. Additional detail around those principles is as follows.

- Modelling is focussed on incremental electricity generation and energy security costs. It does not seek to replicate full system analysis undertaken by AEMO or other organisations. An adjustment factor is used to set the cost of the base case to zero.
- The key Taskforce recommendations are included in the base case for analysis. This includes a PSL of 30 per cent on 1 July each year, an HRL of 22 per cent on 1 July each year and retaining the TVPS on standby.[114] The cost and energy security benefits of these recommendations form part of the base case.
- Cost and risk modelling is undertaken from the Tasmanian system perspective and examines a 10 year time horizon. A longer time period was considered inappropriate due to the increasing uncertainty as to how Australia's energy system will evolve. Modelling is annual, on the basis of financial years starting 1 July.
- A discount rate of seven per cent is used for cost modelling. This corresponds to the lower rate used by Ernst & Young in its market dispatch cost benefit modelling of a second Bass Strait Interconnector.[115] This discount rate is higher than the government cost of capital (long-term bond rates), but lower than the cost of capital for new renewable energy projects.
- Risk analysis models two main risks using Monte Carlo simulation.[116] These risks are variable inflows to the Tasmanian hydro-electric system and a repeat Basslink outage. Other risks are assessed through scenario analysis. Scenarios analysed were:
    - 'The Long Dry' - changes in average rainfall and inflows;
    - 'Changing Demand' - changes in Tasmanian electricity demand;
    - 'Gas Supply Interruption' - unavailability of gas;

[114] The Taskforce has presented modelling results based on the Interim Report recommended PSL of 30 per cent at 1 July. The Taskforce has verified that adjusting the final recommended PSL to 29.4 per cent at 1 July (as described in Chapter 11) has no material impact on modelling outcomes.
[115] Ernst & Young, 2017, *Market Dispatch Cost Benefit Modelling of a Second Bass Strait Interconnector.*
[116] Monte Carlo simulation is a method of deriving numerical results based on repeated random sampling from a distribution.

- 'On-island Energy Balance' - additional on-island generation, including renewables; and
- 'NEM Carbon Market' - introduction of a price on carbon.

- The model dynamically adjusts to ensure energy balance in Tasmania and that demand is met. The modelled sources of energy are:
  - hydro-electric generation (subject to maintaining storage levels);
  - existing wind generation;
  - Basslink imports (and exports) to maintain storages at the PSL profile;
  - the TVPS (as required);
  - pre-emergency temporary diesel generation (as required); and
  - new renewable energy sources (wind, solar PV and biomass, depending on the scenario).

  More information on these sources is provided in the overview of assumptions provided in Appendix 3.
- The cost of different sources of electricity is the main driver of costs in the model. High value energy exports over Basslink offset the cost of energy imports. Changes in energy in storage impact the generation available for export and the need for imports. Revenue from large-scale generation certificates (LGCs) also offsets costs in the model.
- The model identifies when an energy security event may occur, based on a combination of low energy in storage (below the HRL profile) and a Basslink outage, or very low energy in storage without a Basslink outage.[117]

17.4 Modelling energy security responses

The Energy Security Cost Model developed by the Taskforce links energy demand, (randomised) inflows, energy in storage, Basslink flows and supplementary generation to the Energy Security Risk Response Framework, as illustrated in Figure 17.1.

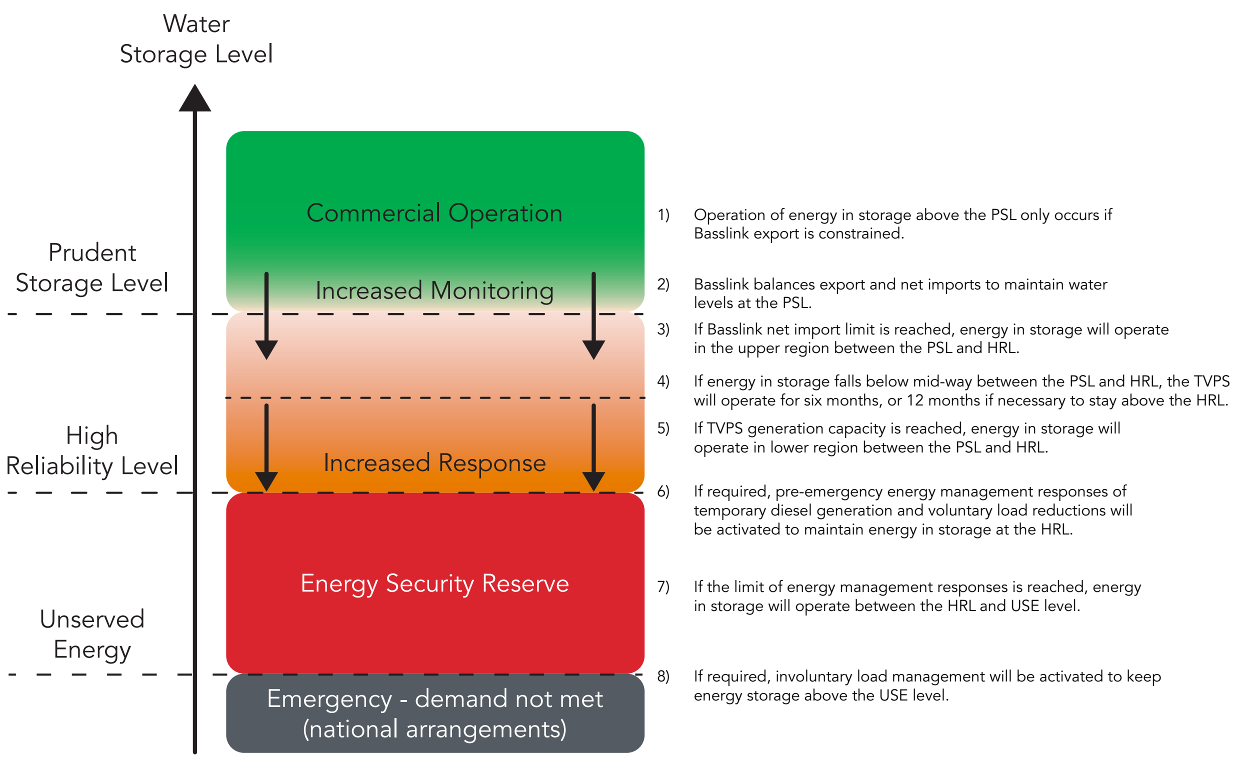
Figure 17.1 describes how, as water storages (and consequently energy in storage) fall, different responses are activated to maintain energy security.

- Under the PSL methodology recommended by the Taskforce in Chapter 11, with water levels at or above the PSL, Hydro Tasmania is assumed to manage electricity generation and energy storage on a fully commercial basis. In the Energy Security Cost Model, it is assumed that energy available above the PSL profile is exported over Basslink, resulting in energy in storage only rising above the PSL when Basslink is export constrained.
- It is assumed that Hydro Tasmania will use Basslink to manage energy in storage to the PSL. Basslink imports and exports are therefore determined so that net energy imports (or exports) are consistent with energy in storage being at the PSL at the start of each financial year.
- If Basslink is importing to the maximum capacity (after accounting for some exports associated with spill events and limited high demand exports) then, assuming that there is insufficient energy available to maintain energy in storage to the PSL, energy in storage will fall below the PSL. This reflects that Hydro Tasmania has some flexibility before initiating higher cost generation sources to maintain energy security.
- If energy in storage falls substantially below the PSL (modelled as midway between the PSL and HRL profiles) then, if available on standby, the TVPS will commence generating to maintain energy in storage levels.

[117] An energy security event is defined in Chapter 4.

- If the TVPS's generation capacity is fully utilised then, in the model, energy in storage may fall below the mid-PSL level.
- Once energy in storage reaches the HRL then an energy security event may be identified by the model under two circumstances:
  - energy in storage falls below the HRL and there is a Basslink outage; and/or
  - energy in storage would otherwise fall below the minimum point of the HRL profile (16 per cent at the start of May).
- In an energy security event, pre-emergency energy security responses (voluntary demand responses and temporary diesel generation) will be implemented to maintain energy in storage at the HRL.
- If the capacity of pre-emergency energy security responses is fully utilised, and there is still insufficient energy available, energy in storage may continue to fall below the HRL.
- The model incorporates an unserved energy (USE) storage level. At the USE storage level, demand is involuntarily constrained to maintain minimal storage levels (including the Great Lake EERZ). USE events are identified by the model in the rare cases when this occurs.

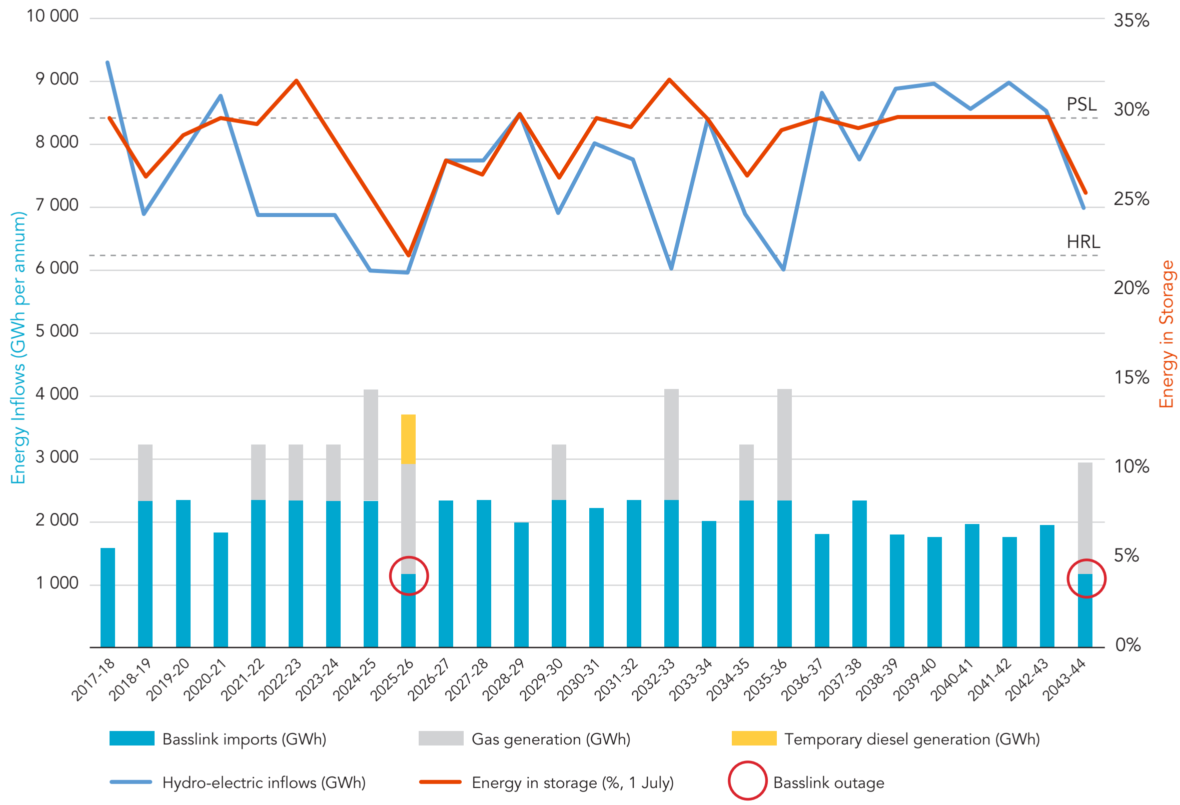
Figure 17.1 Supplementary energy generation modelling approach



The manner in which the relationship between energy storage levels, inflows and the activation of additional generation options is simulated within the model is demonstrated in Figure 17.2. The model settings for the demonstration have an extreme low inflow sensitivity 15 per cent below the base case projection. This analysis is also presented in Chapter 11 of the Final Report.

Figure 17.2 is based on a single Monte Carlo simulation, with both random inflows and a random chance of Basslink failure over 26 years from 2017-18 to 2043-44. It does not represent analysis from the material presented in the Final Report; rather it is provided to illustrate the manner in which the model operates in different (relatively extreme) circumstances.

Figure 17.2 Energy Security Cost Model output of inflows, energy in storage management and standby generation options (with TVPS available, a PSL of 30 per cent at I July each year and a reduction in long-term average inflows of 15 per cent)



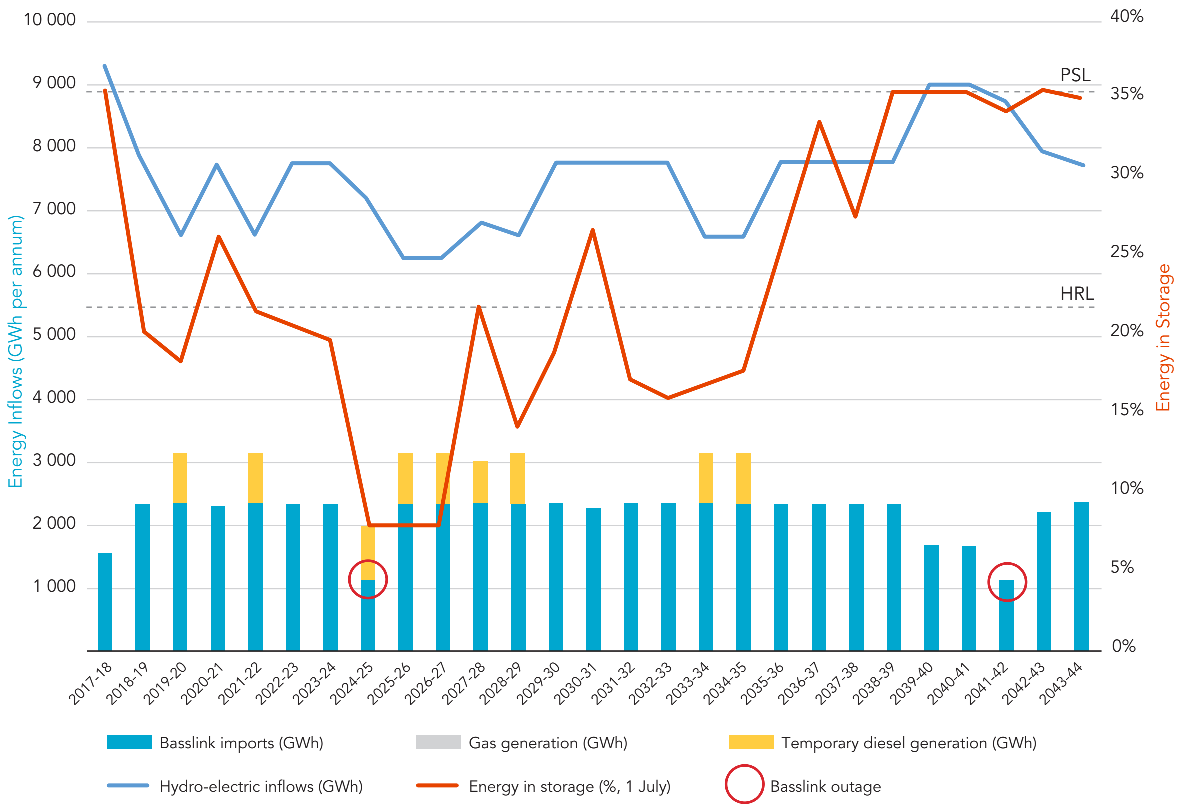
Source: Taskforce analysis

The following key observations can be made from the demonstration in Figure 17.2.

- At the PSL, Basslink is used to balance energy inflows and consumption, with the expectation of energy imports around 700 GWh per annum, potentially increasing to around 2 000 GWh if required. The blue bars at the bottom show Basslink net imports. In 2025-26 and 2043-44 a Basslink failure is simulated, resulting in half the normal energy being able to be imported.
- The TVPS is assumed to be available on standby. This is activated for half a year in 2018-19 when inflows are around 7 000 GWh and again in 2021-22 and several years to follow. It is activated for a full year in 2024-25 when energy in storage is otherwise anticipated to be below midway between the HRL and PSL profiles and again in 2025-26 when inflows are similarly very low around 6 000 GWh.
- Temporary diesel generation is activated when there is a Basslink failure such that, without supplementary generation or voluntary load management, storage levels would fall significantly below the HRL. In the simulation in Figure 17.2, this occurs only in 2025-26 and with the supplementary generation, energy in storage is maintained at the HRL at the end of the year. This coincides with two consecutive years of very low inflows and a Basslink outage. This is a key point illustrated by the demonstration, as temporary diesel generation is unlikely to occur unless these two events occur together.
- In the later 2030s, inflows recover, gas generation is rarely used and energy in storage is maintained around the PSL profile. The gas generation is again used in 2043-44, coinciding with low inflows and a Basslink outage, but due to high energy storage levels temporary diesel generation is not required.

A second simulation demonstrates how the model behaves with different underlying assumptions of the level of energy in storage and the availability of gas (refer Figure 17.3). In this simulation, the TVPS is assumed to be unavailable. As in the previous example, the model settings for the demonstration have an extreme low inflow sensitivity of 15 per cent below the base case projection. As the TVPS is not available, the PSL is adjusted higher at around 35 per cent at 1 July each year. Similar to Figure 17.2, this simulation reflects an extreme 'stress test' of the model and is an outlier event. It demonstrates how the model responds to extreme circumstances, in this instance a combination of a 15 per cent reduction in average inflows, a random sequence of low inflows, a Basslink outage and the absence of the TVPS.

Figure 17.3 Energy Security Cost Model simulation of inflows, storage management and demand management options (with the TVPS unavailable, PSL at 35 per cent at 1 July each year and a reduction in long-term average inflows of 15 per cent)



Source: Taskforce analysis

The following key observations can be made from the demonstration in Figure 17.3.

- In 2017-18, with relatively high inflows and energy in storage, Basslink is a net importer of energy, but not at full capacity. However, lower inflows in the 2020s result in energy in storage falling towards the HRL and Basslink operating at full import capacity and recovery actions being periodically activated when inflows fall below 7 000 GWh per annum (this occurs quickly due to the absence of gas generation). Storage levels are unable to recover with inflows below 8 000 GWh per annum.

- If the assumed available temporary diesel generation and voluntary load management were exhausted, then energy in storage could fall below the HRL in the simulation. Involuntary load demand management is assumed to be implemented as required to keep energy in storage at or above the USE minimum.
- There is a Basslink failure simulated in 2024-25, such that additional temporary diesel generation is required. Supplementary generation occurs on an ongoing basis after Basslink is restored, until higher inflows result in energy in storage returning to the PSL in the late 2030s.
- A Basslink outage in 2041-42 is absorbed with only a brief reduction in storage levels below the PSL due to relatively high inflows.

In the context of climate change increasing the potential for low inflows, comparing Figure 17.2 and Figure 17.3 illustrate how the TVPS provides important energy security against this eventuality.

18. Appendix 3: Energy and Cost Modelling Assumptions

The Taskforce's energy and cost modelling is intended, at a high level, to model the supply and demand for energy in Tasmania to provide insights in how key decisions impact energy security. The make-up of the supply/demand balance can vary significantly in any given year, so the model must also make realistic assumptions about how standby generation may change with circumstances.

The baseline for the model represent the average state of the Tasmanian energy supply/demand balance over the medium term, while risk modelling looks at the cost and energy security impact of movement away from this baseline.

This appendix presents the baseline assumptions, scenario assumptions and cost assumptions applied in the modelling in Chapter 5 and Chapter 6.

18.1 Independent review

The Taskforce engaged Goanna Energy Consulting Pty Ltd to independently and rigorously assess the assumptions used in the Taskforce's modelling. The model assumptions were independently verified as being reasonable for the purpose of assessing the impacts of the costs and risks of different energy security options for Tasmania, subject to a number of refinements which have been adopted by the Taskforce.

18.2 Baseline energy assumptions

Consistent with the Interim Report, the baseline energy assumptions listed below form the base case against which energy security options (emergency and long term) are assessed and costed.

- Inflows: 9 000 GWh per annum (based on post 1996 average annual inflows).
- Targeted energy in storage: 30 per cent at 1 July of each year.[118]
- Wind generation: 900 GWh per annum.
- Basslink energy flow: net annual import 700 GWh.
- TVPS: 0 GWh per annum (TVPS not utilised in an average inflow year).
- Tasmanian demand: 10 600 GWh per annum (as per AEMO's 2016 NEFR).

18.3 Inflows into hydro storages

Baseline: 9 000 GWh per annum

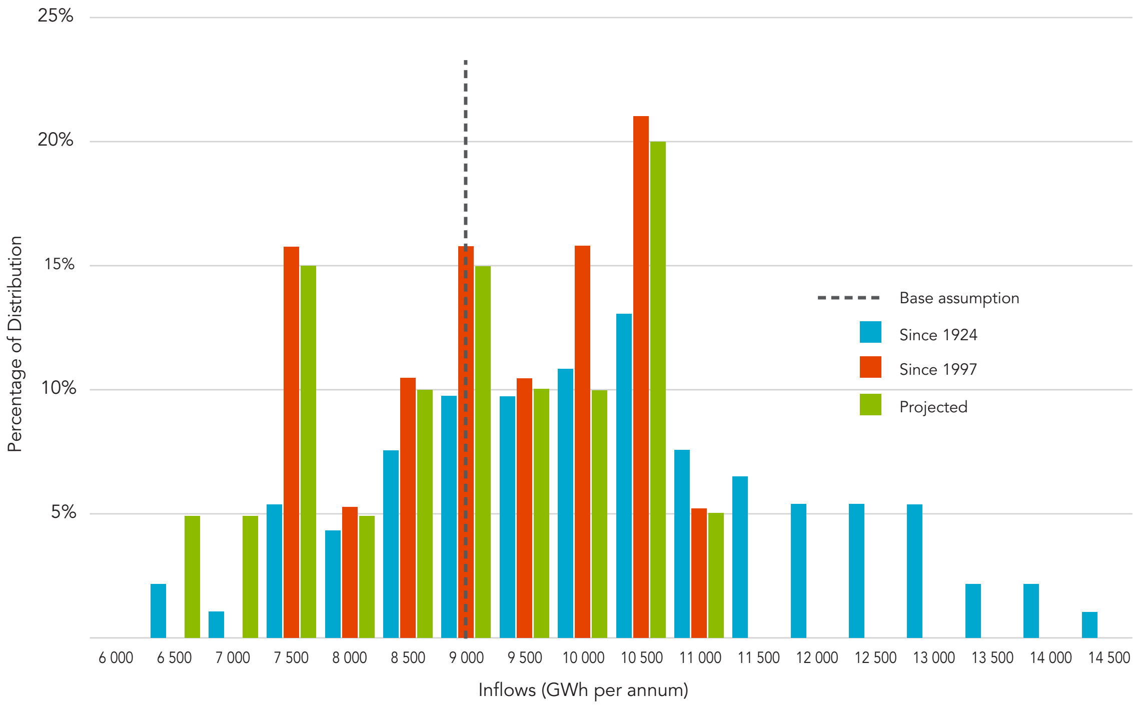
Since 1997 there has been a clear shift downwards in annual average inflows into Tasmania's hydro-electric catchments. As presented in the Interim Report, the assumed average annual inflow is currently 9 000 GWh, which is a reduction from previous historical assumptions of around 10 000 GWh each year.[119] For the baseline, inflows are fixed at 9 000 GWh each year, while for risk modelling a distribution of inflows is assumed.

Figure 18.1 illustrates the distribution of historical inflows from 1924 to 2016 and demonstrates the variability in inflows over time. The Monte Carlo simulation used in the modelling takes the recorded inflow distribution since 1996 and adds the two lowest observations (rounded to the nearest 500 GWh) from the historical series. The average of the result of the Monte Carlo simulation is 9 000 GWh per annum.

118 The Taskforce has presented its modelling results based on the Interim Report recommended energy in storage target of 30 per cent at 1 July each year. The Taskforce has verified that adjusting the final recommended PSL to 29.4 per cent at 1 July each year (as presented in Chapter 11) has no material impact on the modelling outcomes.

119 Interim Report, page 80.

Figure 18.1 Hydro-electric inflows yield histogram - historial and projected



Source: Taskforce analysis

Scenarios:

'The Long Dry' scenario examines a reduction in projected average annual inflows of up to 10 per cent.

18.4 Targeted energy in storage

Baseline: PSL of 30 per cent at 1 July each year

The PSL profile is a targeted energy storage level designed to provide a sufficient buffer such that a three month sequence of low inflows combined with Basslink being available for import would keep energy in storage above the HRL profile. The HRL profile is a warning level whereby if storages are allowed to go lower, a six month Basslink outage and low inflow sequence would place the Tasmanian system at risk of unserved energy before Basslink could be repaired.

The implementation cost of managing storages to the PSL and HRL profiles are accounted for in the analysis by restricting the level of exports and requiring increased imports or alternative generation to maintain energy in storage at or around the PSL profile.

Scenarios:

The PSL calculation methodology presented in Chapter 11 proposes that energy storage levels are dynamic to changes in the Tasmanian demand and supply situation, including the availability of TVPS on standby. Under most scenario modelling, changes in supply or demand automatically result in a change in the targeted energy in storage.

The impact of energy storage levels on energy security is examined through changing the PSL at 1 July each year from 30 per cent to 25 per cent, or 35 per cent and 40 per cent in the absence of the TVPS.

The Taskforce has verified that there is no material impact on the modelling from adjusting the PSL at 1 July each year from 30 per cent to 29.4 per cent (which is the 1 July PSL presented in the Taskforce's recommendations in Chapter 11).

Cost Assumptions:

The assumed costs associated with changing energy storage levels have been developed in consultation with Hydro Tasmania. There are three direct impacts of changes in energy in storage on energy costs:

- reduce energy exports, or increased energy imports, over Basslink, at expected NEM prices;
- sales of LGCs associated with increased or reduced generation; and
- increased generation from higher storage levels due to increased efficiency at Lake Gordon.

Higher energy storage levels generally have a net cost, but reduce the likelihood that higher cost generation is required. The current level of energy in storage means that there will be no direct cost in adopting the PSL profile from 1 July 2017 and managing storages to that profile. However, the Taskforce recognises that there is an opportunity cost going forward from maintaining higher energy in storage through reduced exports over Basslink.

18.5 Wind generation

Baseline: Annual wind output of 900 GWh

The Taskforce has adopted a conservative approach to the assumed generation from existing wind farms in Tasmania. This conservative approach takes into account the small sample size from the existing installed wind capacity and reduces reliance on volatile wind resources.

Hydro Tasmania has indicated that the annual output of installed wind generation in Tasmanian varies from 900 GWh to 1 100 GWh under low to high scenarios. The Taskforce's independent consultant has advised that the Taskforce estimate is below their central estimate of 950 GWh, but within the reasonable range.

Scenarios: Up to four wind farms (700 GWh to 1 400 GWh per annum)

The On-island Energy Balance scenario includes an option considering two wind farms collectively generating 700 GWh per annum, and an option for one additional wind farm as part of a mixed renewables scenario.

The NEM Carbon Market scenario analyses the impact of either two or four wind farms producing 700 GWh and 1 400 GWh respectively.

Cost Assumptions:

No net cost is associated with existing wind farms as they are part of the baseline.

Based on advice from the independent consultant, the levelised cost of energy for new wind generation developed in 2019 is assumed to be $91.10 per MWh for 700 GWh per annum of capacity (two wind farms), falling to $84.10 per MWh for a wind farm developed in 2021 and $74.80 per MWh for a wind farm developed in 2023. This reduction reflects ongoing cost improvements for wind generation as outlined in the Interim Report and also includes adjustment for higher transmission losses or higher transmission costs for remote locations for later wind farms.

18.6 Basslink energy transfer

18.6.1 Basslink energy flow

Baseline: 2 665 GWh total energy flow, 700 GWh net import per annum

In terms of Tasmania's supply demand balance, Basslink provides 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. The data used to calculate the total flow is shown in Table 18.1 of the Interim Report.

The Taskforce has not attempted to model the maximum possible impact of full import or full export on the system. For the baseline, it is assumed that Basslink is able to transfer a combined import/export volume of 2 665 GWh in a 12 month period. The baseline also assumes that a net 700 GWh import will be used to make up the annual shortfall between on-island generation and Tasmanian consumption.

Scenarios:

Modelling of variability in Basslink flow is focussed around two aspects:

- the net import/export outcome of the 2 665 GWh transferred over Basslink; and
- the availability of Basslink where there is assumed to be a 10 per cent probability of a Basslink outage occurring in any year with a six month outage duration. This reduces the available total energy flow by half.

The determination of exports and imports identifies the net flow required based on on-island demand and generation and then sets exports and imports to meet total flow.

Imports and exports are calculated as follows:

$$I = \frac{TF + NF}{2} \qquad X = \frac{TF - NF}{2}$$

where:

I = Imports, X = Exports, TF = Total Flow = I + X, NF = Net Flow = I – X

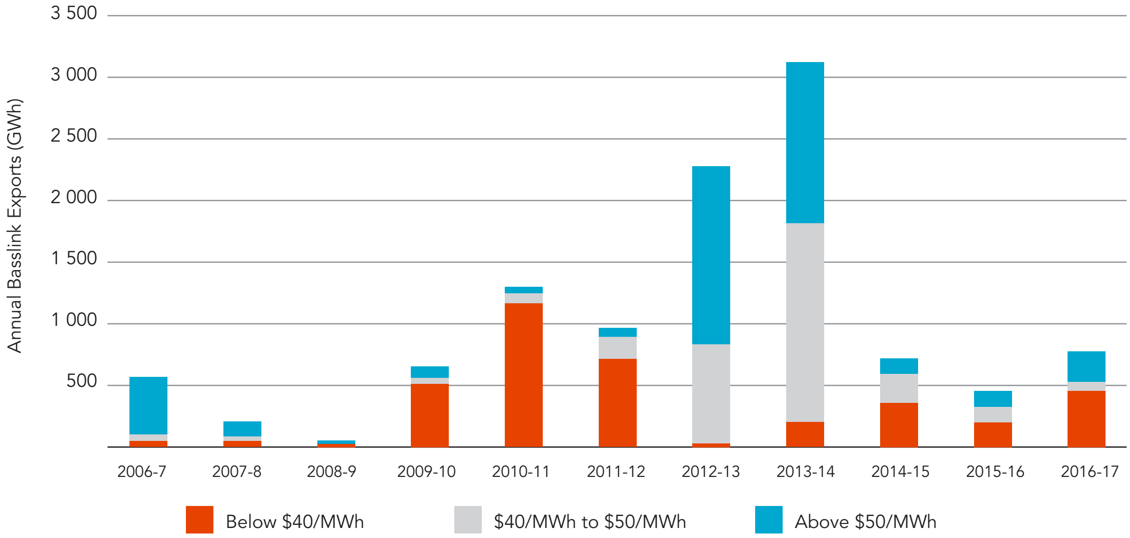
Cost Assumptions:

The net cost impact of Basslink is modelled on the net cost of energy imports and exports over Basslink, estimated with reference to NEM electricity prices.

18.6.2 Basslink export prices

It is assumed that there is a minimum 350 GWh exported at low prices each year. This reflects spill from dams that reach full capacity during winter, where energy not exported would be lost. It is assumed that these exports cannot be avoided. It is also assumed that there will be around 300 GWh exported at high prices each year. This reflects meeting peak periods in Victorian demand. High priced exports could be avoided if necessary, which is modelled by allowing a negative mid-price export volume up to the quantity of high-priced exports. Figure 18.2 shows the historical pattern of low, middle and high priced energy exports. Mid-priced exports are flexible to meet the overall balance.

Figure 18.2 Historical annual Basslink exports by price



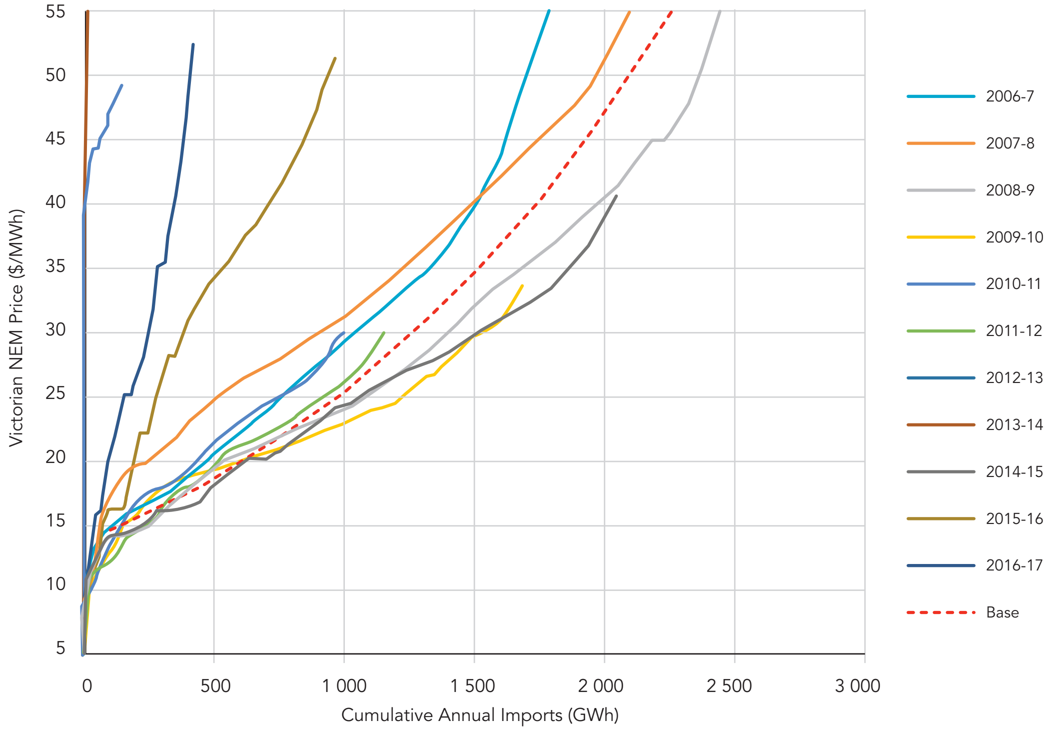
Source: Taskforce analysis

Based on advice from the independent consultant, historic price estimates have been adjusted upwards by $28.80 per MWh to take into account structural changes in energy markets affecting both gas and electricity prices, including the recent closure of the Hazelwood Power Station.

18.6.3 Basslink import prices

Basslink import prices are set based on the historical data on the relationship between cumulative annual imports and the price of imports over the NEM, as illustrated in Figure 18.3. When only a low level of import is required, energy will be imported at times of the day and year when Victorian prices are at their lowest. As the cumulative import requirement rises, energy will necessarily be imported at times of the day and year when prices are higher. While some years are outliers (for example during the carbon tax period), there is fairly consistent relationship where price rises with cumulative imports.

Figure 18.3 Victorian NEM price and cumulative imports over Basslink



Source: Taskforce analysis

The red Base line is a smoothed median of the curves (reducing the influence of outliers). It is applied as the marginal cost curve for Basslink imports.

Based on advice from the independent consultant, historic price estimates have been adjusted upwards in the model by $28.80 per MWh to take into account structural changes in energy markets affecting both gas and electricity prices, including the recent closure of the Hazelwood Power Station.

18.7 TVPS

Baseline: TVPS available on standby

For the purposes of maintaining energy security, it is assumed that a flat output of 200 MW of gas generation is available from continuous operation of the CCGT when required. This translates to 1 752 GWh per annum of available energy. 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 open cycle gas turbines (OCGT) can be conservatively assumed to offset any actual difference.

For the purposes of modelling energy security options, the TVPS is assumed to be on standby in the base case. This assumption is tested in relation to different scenario options and storage levels. While on standby, if energy in storage would fall to below the mid-point between the PSL and HRL profiles, the TVPS will operate in the model to keep the storage levels above the mid-point. This will generally occur if there is a Basslink outage, but also in response to prolonged periods of low inflows.

Scenarios:

In most scenarios, the impact of the availability of standby generation from TVPS on cost and risk is examined. The following options are examined further as part of scenarios:

- The Long Dry - gas operating on standby is likely to become a regular contributor to energy supply;
- Gas Supply Interruption - no TVPS availability; and
- On-island Energy Balance and NEM Carbon Market scenarios - operation of the TVPS for five months to generate 700 GWh per annum to bridge the on-island supply deficit.

Cost Assumptions:

An estimated cost of holding the TVPS on standby has been made based on advice provided by Hydro Tasmania to the Parliamentary Standing Committee of Public Accounts[120] and confidential advice provided by the owner of the Tasmanian Gas Pipeline (Palisade Investment Partners Ltd) to the Taskforce. This estimate is $14.6 million per annum.

The assumption used by the Taskforce was assessed as reasonable by the independent consultant.

For modelling purposes, and taking into account advice from the independent consultant, the cost of operating the TVPS assumes a gas heat rate (the amount of gas required to generate electricity) of 7.5 GJ per MWh, a gas price of $9.50 per GJ and a variable operating cost component for maintenance and other costs of $10 per MWh.

There is an option value from having the TVPS on standby when gas and electricity prices vary in the market. This option value would partially offset the fixed standby cost.

18.8 Demand

Baseline: 10 600 GWh per annum

In the base case, demand is held constant around 10 600 GWh per annum, as per AEMO's 2016 NEFR. This implicitly assumes that factors driving increased consumption (including population and economic growth, and the impact of new technologies such as EVs) are offset by improved energy efficiency and household solar PV installations.

Scenarios:

AEMO's 2016 NEFR Tasmanian demand forecast also includes 'Strong' and 'Weak' scenarios which are adapted for the Taskforce's scenario purposes. In the Taskforce's Changing Demand scenario, a high forecast, a low forecast, and a very low forecast are used. The Gas Supply Interruption scenario also includes a demand change.

- In the high forecast, demand grows steadily to 12 000 GWh by 2036. This implicitly assumes that while there are no significant changes, forces driving increased demand exceed efficiency and other offsets.
- Two demand reduction scenarios reflect the loss of one or more major energy users. The Taskforce has modelled a low forecast with a 1 200 GWh load reduction (around 100 MW), and a very low forecast with a 4 600 GWh load reduction (around 400 MW). The low and very low forecasts are modelled as 'block' reductions consistent with the AEMO 2015 'Low' forecast.[121]

[120] http://www.parliament.tas.gov.au/ctee/Joint/pacc.htm
[121] AEMO, 2016, *National Electricity Forecasting Report*, chart pack – slide 20.

- A Gas Supply Interruption scenario is also considered. The unavailability of natural gas supply to Tasmania would have a major impact on Tasmanian energy users. The majority of industrial customers would need to convert to oil, coal or liquefied natural gas as an alternative. The Taskforce's external consultant has advised the Taskforce that a loss of gas would increase electricity demand by around 600 TJ or 167 GWh, mainly from residential and small business customers, food processing and hospitals.

Cost Assumptions:

The Energy Security Cost Model ensures that supply is matched to demand from the sources available, subject to maintaining appropriate energy in storage (as described in Chapter 17). The costs of increased demand therefore reflect the costs of increased supply options including Basslink and the TVPS.

An economic contribution from demand to network and generation costs is assumed to be around $40 per MWh. This contribution does not incorporate any broader economic contribution that energy consumption makes, and does not infer any expected negotiating outcome on the part of energy or transmission prices. The Taskforce considered it necessary to ensure that modelling of demand changes does not lead to misleading inferences in the cost modelling. The contribution applies to both demand increases and decreases and mirrors the historic mid-range export price for energy over Basslink.

18.9 Other generation sources

18.9.1 Supplementary generation

Based on the 2015-16 energy security event, temporary diesel generation is used as a contingency generation source. Under the modelling approach, supplementary generation is used to keep energy in storage above the lowest point of the HRL profile (16 per cent at the beginning of May), subject to available generation capacity. Cost assumptions pertaining to temporary diesel generation are summarised in Table 18.1. Fixed set-up costs are assumed to be around $5 million lower than the cost associated with standby generation for the 2015-16 energy security event,[122] reflecting the benefits of site identification and preparation from that event.

Table 18.1 Temporary diesel generation cost assumptions

Cost Component	Cost	Comment
Fixed set-up cost	$45.5 million	For six months leas and mobilisation
Generation cost	$245 per MWh	264 litres per MWh x $0.85 per litre + $20 per MWh[123]
Generation capacity	855 GWh	220 MW installed capacity could generate 855 GWh over six months if run at full capacity (220 MW x 24 hours x 180 days x 90 per cent availability)

The Taskforce's independent consultant has advised that there is a risk that temporary diesel generation sets may not be available to be sourced, installed and operating within a short window of time. The 2015-16 energy security event occurred during a mining and construction downturn which meant that unused temporary diesel generation capacity was able to be sourced in a short timeframe. In the event that temporary diesel generation is not readily available, an alternative pre-emergency generation source may be required that could prove more expensive.

[122] http://www.parliament.tas.gov.au/ctee/Joint/pacc.htm
[123] Maintenance cost and heat rate based on analysis of Lazard LCOE 10.0; diesel cost based on wholesale pricing, less excise ($0.401 per litre). https://www.unitedpetroleum.com.au/wholesale/list-pricing/

Model simulations indicate that temporary diesel generation is only likely to be activated when low inflows and a Basslink failure coincide (refer Figure 17.3).

18.9.2 Additional renewable energy generation

Under the On-island Energy Balance and NEM Carbon Market scenarios, the option of increasing Tasmania's generating capacity with a portfolio of renewable energy sources is considered.

In addition to wind generation considered in section 18.5, the Taskforce has also modelled Tasmania's energy generation being supplemented by a combination of wind, biomass and commercial solar PV.

For modelling purposes, commercial solar PV is assumed to have a levelised cost of $100 per MWh in 2018 falling to $85 per MWh in 2020. Tasmanian solar has an estimated availability of 18 per cent, which is lower than mainland Australian sites and results in a higher cost of generation. For modelling purposes, two 50 MW projects are assumed, each producing around 80 GWh per annum.

For modelling purposes, biomass is assumed to have a levelised cost of $120 per MWh in 2020 with 170 GWh per annum available. Biomass estimates are derived by the Taskforce using the Lazard Levelised Cost of Energy (LCOE) methodology but applying assumptions for a Tasmanian biomass generator from the Indufor Forest Residues Stage 2 Analysis Final Report.[124, 125] There is significant variability in biomass costs due to the cost and quality of feedstock, transportation costs, seasonality and other factors. The cost is indicative and not site specific.

Estimates have been reviewed and assessed as reasonable by the independent consultant.

18.10 Carbon price / large-scale generation certificates (LGCs)

18.10.1 LGCs

LGCs provide additional revenue to renewable energy generators as part of Australia's Renewable Energy Target (RET) scheme. LGCs are available for new renewable energy projects and a proportion of incremental energy production from hydro-electric generation.

In the short term, the LGC market faces a supply shortfall as political uncertainty over the scheme reduced investment confidence. The scheme is scheduled to end in 2030. For modelling purposes an LGC price of $80 per MWh is assumed for 2017-18 to 2019-21 and an LGC price of $41 per MWh is assumed for the remaining period of the scheme.

18.10.2 Carbon prices

Carbon prices are applied in the NEM Carbon Market scenario. A carbon price is assumed to increase the price of energy in the NEM based on the average carbon intensity of NEM electricity production and also apply to natural gas and diesel generation (if required) and partially to biomass.

The carbon price assumed for modelling purposes is based on AEMO's 2016 NTNDP assumption for the carbon price required for Australia to meet its international carbon emissions reduction commitments. This is a price of $25 per tonne CO_2-e in 2020 rising to $50 per tonne CO_2-e in 2030.

It is assumed that the RET scheme is maintained during the carbon price period and LGCs maintain their value as occurred during the 2012 to 2014 carbon price period.

While a carbon price will reduce the carbon intensity of NEM generation over time, this will also result in higher underlying generation costs.

124 https://www.lazard.com/perspective/levelized-cost-of-energy-analysis-100/

125 http://www.stategrowth.tas.gov.au/__data/assets/pdf_file/0015/135321/Residues_Solutions_Study_Stage_2_Report_final.pdf Note there were some inconsistencies between the financing assumptions used in Lazard's analysis and this report. A mid-estimate between the two sets of assumptions was applied, i.e. 60 per cent debt financing and eight per cent debt finance cost.

19. Appendix 4: Assessment of Energy Security Options – Additional Information

This appendix presents background commentary and reasoning for the Taskforce's assessment of energy security options.

Table 19.1 presents a description of the measures that the Taskforce has chosen to assess and compare short term energy security options for Tasmania. The measures have been developed with the assistance of Boston Consulting Group (BCG), and have been chosen to enable an objective comparison of options.

Table 19.2 to Table 19.6 provides the Taskforce's reasoning behind its assessment of each of the short-term energy security options presented in Chapter 7.

Table 19.7 presents a description of the measures that the Taskforce has chosen to assess and compare medium to long-term options identified for achieving on-island energy security.

Table 19.8 to Table 19.10 provides the Taskforce's reasoning behind its assessment of each of the options presented in Chapter 7.

Table 19.1 Descriptions of measures used to assess energy security options

Measure	Description
Availability - solutions that improve Tasmania's resilience to shocks	
Energy availability (GWh)	The additional energy available from standby measures or energy in storage to provide energy security. Standby generation is measured over a 12 month period, with the TVPS able to provide 1 752 GWh per annum.
Energy security event (% chance per annum)	Consistent with the energy modelling, an energy security event is identified in the Energy Security Cost Model through Monte Carlo simulation (based on 5 000, 10 year simulations of random annual inflows and risk of Basslink failure) where energy in storage is below the HRL on 1 July and a Basslink failure occurs or, without pre-emergency measures, energy in storage would otherwise fall below 16.0 per cent (the lowest monthly HRL). The modelling does not include risks associated with low intra-year inflow sequences or other un-modelled events. To reflect this uncertainty the minimum risk has been identified as less than 0.1 per cent each year (rather than zero).
Vulnerability to intra-year inflow risk	A qualitative assessment on the vulnerability of the energy security option to low inflow sequences of less than 12 months.
Robustness to Taskforce scenarios	An assessment against the five big picture scenarios presented in Chapter 6, ranked out of 5, where the most robust option is ranked 5 and the least robust option is ranked 1.
Energy security rating	Energy security rating assessed using the ratings presented in the Interim Report (and described in Chapter 15 of the Final Report).
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups	
Net cost (annualised $ million)	The average annual cost calculated using the Energy Security Cost Model, as presented in Chapter 5. It calculates the annual equivalent sum of the 10 year net present value (NPV) of the costs of the option at a discount rate of seven per cent. The base case is set to zero in accordance with the modelling principles. The net cost is an average across 5 000 Monte Carlo simulations.
Impact on wholesale electricity price ($/MWh)	The estimated net price impact per MWh supplied to Tasmanian consumers if all costs and benefits are passed through. It is derived by dividing the annualised net cost by total annual consumption (10 600 GWh).
Impact on wholesale electricity price (%)	The expected percentage change in the wholesale price if all net costs and benefits are passed through to consumers. It is derived based on the wholesale price impact per MWh divide by the modelled Basslink export mid-price assumption of $68.80 per MWh.
Impact on typical retail bills (%)	The estimated impact on wholesale prices ($/MWh) relative to the 'Typical Retail Bill' of 8.31 MWh per annum and $2 064 per annum. Typical Retail Bill is based on the TER's Typical Customer Methodology released May 2014 (medium scenario, Tariff 31 and Tariff 41), updated for 2016-17 prices.
Environmental sustainability - solutions that have low impact on land, water and air quality	
On-island / total carbon emissions (000' t CO_2-e pa)	An assessment of the average annual carbon emissions based on energy model simulations using the carbon intensity of different energy sources. Assessment is both on-island and total to take into account the impact of higher emission intensity energy imported over Basslink. Carbon emissions reflect both an environmental impact and the exposure to carbon price imposts.
Regulation – solutions that are consistent with energy policies and energy security objectives	
Government budget impact	An assessment of whether there will be a significant positive or negative impact on the Budget, taking into account the results of the cost analysis.
New policy, regulation or legislation	An assessment as to whether new policy, regulation or legislation is likely to be required to implement the proposed option. In general, options that do not require additional regulation or legislation are preferred.
Economic development – solutions that support the sustainability of the Tasmanian economy	
Support ongoing economic activity	An assessment of whether the option would have direct or indirect impacts on other parts of the economy or employment.
Impact on confidence and investment	An assessment of whether the option would increase confidence in the economy, energy security and/or have an impact on private sector investment.

Table 19.2 Assessment of Taskforce recommended option - TVPS on standby, PSL 30 per cent at 1 July

Measure	Assessment	Commentary
Availability - solutions that improve Tasmania's resilience to shocks		
Energy availability (GWh)	Base	Under the base case, for a pre-emergency situation such as Basslink failure and low inflows, energy available over a 12 month period includes the energy in storage (4 345 GWh at 30 per cent TEIS, 4 258 GWh at 29.4 per cent PSL), and the standby TVPS able to produce 1 752 GWh each year.
Energy security event (% chance per annum)	< 0.1	Monte Carlo modelling indicates that, based on 5 000 10-year simulations of annual inflows and risk of Basslink failure, there is no likelihood of an energy security event with the Taskforce recommendations being implemented. The modelling does not include risks associated with low intrayear inflow sequences or other un-modelled events. Therefore the risk is assessed as being less than 0.1 per cent per annum.
Vulnerability to intra-year inflow risk	Low	Intra-year low inflows are mitigated by the implementation of the HRL and PSL profiles.
Robustness to Taskforce scenarios	4	The recommended option is ranked the second most robust of the options to the Taskforce's scenarios, and is therefore ranked 4 for this criteria. The Taskforce's recommendations are considered less robust than the option with TVPS available and a PSL target of 35 per cent at 1 July each year in the Gas Supply Interruption scenario. Retention of TVPS is assessed as critical in The Long Dry scenario.
Energy security rating	Resilient	Given the high level of robustness against scenarios, and the very low chance of energy security event, this option is considered Resilient.
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups		
Net cost (annualised $ million)	Base	The annualised net cost is calculated using the Energy Security Cost Model. The base case is set to zero in accordance with the modelling principles.
Impact on wholesale electricity price ($/MWh)	Base	The base case is set to zero in accordance with the modelling principles.
Impact on wholesale electricity price (%)	Base	As above
Impact on typical retail bills (%)	Base	As above
Environmental sustainability - solutions that have low impact on land, water and air quality		
On-island / total carbon emissions (000' t CO_2-e pa)	Base	The base case is set to zero in accordance with the modelling principles. Modelling indicates that with the TVPS on standby and variable inflows, emissions of 51 kt CO_2-e pa would be expected on island and 481 kt CO_2-e pa in total (including mainland NEM emissions associated with Basslink imports).
Regulation – solutions that are consistent with energy policies and energy security objectives		
Government budget impact	Base	The base case is set to zero in accordance with the modelling principles. A small budget impact may be associated with implementing the energy oversight framework.
New policy, regulation or legislation	Energy security oversight regulation	Amendment to energy security oversight regulation is required to implement the Taskforce recommendations. The Taskforce recommendations are consistent with Government policy to substantially reduce the risk of any repeat energy security event.
Economic development – solutions that support the sustainability of the Tasmanian economy		
Support ongoing economic activity	✓	The recommendations will support ongoing economic activity by maintaining confidence in energy security and supporting the ongoing viability of Tasmanian gas market arrangements. While no additional employment is anticipated, the recommendation to retain the TVPS on standby will require the maintenance of 10-20 jobs.
Impact on confidence and investment	↑	Adoption of the recommendations is likely to increase investment confidence following the 2015-16 energy security event.

Table 19.3 Assessment of alternative option - TVPS on standby, reduce PSL to 25 per cent at 1 July

Measure	Assessment	Commentary
Availability - solutions that improve Tasmania's resilience to shocks		
Energy availability (GWh)	-724	Reduction in energy in storage (- 724 GWh)
Energy security event (% chance per annum)	< 0.1	Monte Carlo modelling indicates that, based on 5 000 10-year simulations of annual inflows and risk of Basslink failure, there is no likelihood of an energy security event under this option. This risk likelihood is a product of the annual basis of the Taskforce's model, and does not account for intra-year inflow variability that makes operating at this level more risky than operating with a PSL of 30 per cent at 1 July each year. The risk of a 25 per cent PSL at 1 July is therefore considered higher than a 30 per cent PSL at 1 July on the basis of intra-year flows.
Vulnerability to intra-year inflow risk	High	A PSL profile with a 1 July target of 25 per cent violates the methodology used to calculate the PSL profile.
Robustness to Taskforce scenarios	3	This option is ranked third in robustness and therefore given a ranking of 3. This option is considered to be vulnerable to the Gas Supply Interruption scenario.
Energy security rating	Susceptible	With an annual risk of less than 0.1 per cent, the energy security situation could be considered Managed, however it would be vulnerable to significant reductions in inflows, any loss of availability of the TVPS as well as intra-year inflow variability.
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups		
Net cost (annualised $ million)	-6 (gain)	Taskforce modelling shows that there would be a net cost saving relative to the base case, due to the reduced opportunity cost associated with lower energy in storage partially offset by the costs of increased operation of the TVPS.
Impact on wholesale electricity price ($/MWh)	-0.57	Potential for small reduction in costs (if there was pass through of savings from having less energy in storage).
Impact on wholesale electricity price (%)	-0.8	Potential for small reduction in costs.
Impact on typical retail bills (%)	-0.2	Insignificant.
Environmental sustainability - solutions that have low impact on land, water and air quality		
On-island / total carbon emissions (000' t CO_2-e pa)	+46 / -78	The increase in on-island emissions reflects the increase use of the TVPS associated with maintaining lower energy in storage. The reduction in overall emissions reflects increased exports and reduced imports over Basslink (due to both lower energy storage levels and greater use of the TVPS).
Regulation – solutions that are consistent with energy policies and energy security objectives		
Government budget impact	Favourable	Cost reduction could be shared with government as higher dividends.
New policy, regulation or legislation	Energy security oversight regulation	Lower energy in storage would continue to require oversight.
Economic development – solutions that support the sustainability of the Tasmanian economy		
Support ongoing economic activity and employment	✓	Maintaining the TVPS will support the ongoing viability of Tasmanian gas market arrangements. Overall employment would be the same as the recommended base case as changes in energy storage levels do not directly impact employment.
Impact on confidence and investment	↓	The (slightly higher) risk of an energy security events could have a negative impact on confidence, as this was similar to the situation in place prior to the 2015-16 energy security event.

Table 19.4 Assessment of alternative option - TVPS on standby, increase PSL to 35 per cent at 1 July

Measure	Assessment	Commentary
Availability - solutions that improve Tasmania's resilience to shocks		
Energy availability (GWh)	+724	Increase in energy in storage (+ 724 GWh)
Energy security event (% chance per annum)	< 0.1	Monte Carlo modelling indicates that, based on 5 000 10-year simulations of annual inflows and risk of Basslink failure, there is no likelihood of an energy security event under this option. The modelling does not include risks associated with low intra-year inflow sequences or other un-modelled events. Therefore the risk is assessed as being less than 0.1 per cent per annum.
Vulnerability to intra-year inflow risk	Very Low	A PSL profile with a 1 July target of 35 per cent adds a 'premium' to the calculated PSL profile and provides a very strong resistance to low inflow sequences of less than 12 months.
Robustness to Taskforce scenarios	5 (most robust)	This option is ranked the most robust to the scenarios examined (rating 5). This option is considered to be robust to the Gas Supply Interruption scenario, and retention of the TVPS provides significant protection in The Long Dry scenario and the Higher Demand scenario.
Energy security rating	Resilient	As it is assessed as the most robust option with the lowest chance of an energy security event, this scenario would provide a Resilient level of energy security.
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups		
Net cost (annualised $ million)	+7 (loss)	Taskforce modelling shows that there would be an increase in net cost relative to the base case, due to the increased opportunity costs of holding higher energy in storage partially offset by the cost savings of reduced operation of the TVPS.
Impact on wholesale electricity price ($/MWh)	+0.65	Potential for small increase in costs (if there was pass through of cost from having the TVPS on standby and the increased opportunity costs of holding a higher level of energy in storage).
Impact on wholesale electricity price (%)	+0.9	Potential for small increase in costs.
Impact on typical retail bills (%)	0.3	Insignificant.
Environmental sustainability - solutions that have low impact on land, water and air quality		
On-island / total carbon emissions (000' t CO_2-e pa)	-18 / +90	The decrease in on-island emissions reflects that the TVPS will be operated less often with higher energy in storage targets. The increase in overall emissions reflects reduced exports and increased imports over Basslink (due to both higher storage levels and lower use of the TVPS).
Regulation – solutions that are consistent with energy policies and energy security objectives		
Government budget impact	Unfavourable	Cost increases could be shared with Government through lower dividends.
New policy, regulation or legislation	Energy security oversight regulation	Higher energy storage levels would continue to require oversight.
Economic development – solutions that support the sustainability of the Tasmanian economy		
Support ongoing economic activity and employment	✓	Maintaining the TVPS will support the ongoing viability of Tasmanian gas market arrangements. Overall employment would be the same as the recommended base case as changes in energy storage levels do not directly impact employment.
Impact on confidence and investment	↑	Adoption and strengthening of the Taskforce recommendations would be expected to have a positive impact on confidence.

Table 19.5 Assessment of alternative option - No TVPS, increase PSL to 35 per cent at 1 July

Measure	Assessment	Commentary
Availability - solutions that improve Tasmania's resilience to shocks		
Energy availability (GWh)	-1 028	Loss of the TVPS (-1 752 GWh) offset by increase in energy in storage (+724 GWh)
Energy security event (% chance per annum)	~0.5	Monte Carlo simulation indicates a 0.56 per cent chance each year of an energy security event.
Vulnerability to intra-year inflow risk	Moderate	A system without the TVPS is more vulnerable to low intra-year inflow sequences than the Taskforce's recommended option.
Robustness to Taskforce scenarios	2	This option is considered to be the second least robust and is therefore ranked 2. While this option is relatively robust to the Gas Supply Interruption scenario, the Lower Demand scenario and scenarios that include additional renewable generation, retention of the TVPS is considered to be critical in The Long Dry scenario and important in the Higher Demand scenario.
Energy security rating	Managed	With an annual risk of less than one per cent, the energy security situation could be considered Managed, however it would be vulnerable to significant reductions in inflows.
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups		
Net cost (annualised $ million)	-8 (gain)	Taskforce modelling shows that there would be a net cost saving relative to the base case, due to cost savings from reduced operation of the TVPS offset by the opportunity cost of holding higher levels of energy in storage and occasional pre-emergency responses to low energy storage levels.
Impact on wholesale electricity price ($/MWh)	-0.77	Potential for a small decrease in energy costs (if there was pass through of savings from not having the TVPS on standby, offset by increased costs of holding higher energy in storage).
Impact on wholesale price (%)	-1.1	Small reduction in costs, offset by slightly higher energy security risk.
Impact on typical retail bills (%)	-0.3	Insignificant.
Environmental sustainability - solutions that have low impact on land, water and air quality		
On-island / total carbon emissions (000' t CO_2-e pa)	-49 / +58	The decrease in on-island emissions reflects removal of the TVPS offset by occasional uses of emergency generation (averaging 3 kt CO_2-e pa). There is an increase in overall emissions due to higher energy in storage and no TVPS requiring additional imports over Basslink.
Regulation – solutions that are consistent with energy policies and energy security objectives		
Government budget impact	Favourable	Cost reduction could be shared with government as higher dividends.
New policy, regulation or legislation	Energy security oversight regulation	Higher energy storage levels would continue to require oversight, which would be relatively more important for energy security in the absence of the TVPS.
Economic development – solutions that support the sustainability of the Tasmanian economy		
Support ongoing economic activity	×	The reduced gas supply may have negative impacts on gas availability and affordability on other consumers, with a potentially negative impact on economic activity. Overall employment could be lower.
Impact on confidence and investment	↓	The higher risk of an energy security event could have a negative impact on confidence.

Table 19.6 Assessment of alternative option - No TVPS, reliance on emergency measures (no PSL)

Measure	Assessment	Commentary
Availability - solutions that improve Tasmania's resilience to shocks		
Energy availability (GWh)	-2 476	Loss of TVPS (-1 752 GWh) and assumed reduction in energy in storage to pre-2015 levels (724 GWh)
Energy security event (% chance per annum)	~8	Monte Carlo simulation indicated a 7.8 per cent chance each year of an energy security event.
Vulnerability to intra-year inflow risk	Very High	A system without the TVPS and lower energy in storage levels is farmore vulnerable to low intra-year inflow sequences than the Taskforce recommended option.
Robustness to Taskforce scenarios	1 (least robust)	This option is considered the least robust, and is therefore given a ranking of 1 in terms of its robustness to scenarios. The option is vulnerable in the Gas Supply Interruption, The Long Dry scenario and the Higher Demand scenario due to the lower energy in storage and the TVPS being unavailable. This option could be feasible (but not robust) with sufficient increased on-island generation, or a significant reduction in demand.
Energy security rating	Susceptible	With an annual risk of an energy security event of around seven per cent, the energy security situation could be considered Susceptible as any significant reductions in inflows and/or Basslink failure would cause significant energy security concerns.
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups		
Net cost (annualised $ million)	-11 (gain)	Taskforce modelling shows that there would be a net cost saving relative to the base case, driven significantly by savings from not having the TVPS on standby. However, long-term savings would be significantly affected by the prevalence of high cost energy security events. Potential additional costs of up to $335 million in a year in response to low inflows and Basslink failure are estimated due to the need to implement temporary generation and major industrial demand reductions.
Impact on wholesale electricity price ($/MWh)	-1.05	Potential for a decrease in energy costs (if there was pass through of savings from not having the TVPS on standby). However, this may present as a net cost if pre-emergency measures are required.
Impact on wholesale price (%)	-1.5	Reduction in costs, offset by significantly higher energy security risk.
Impact on typical retail bills (%)	-0.4	Low significance.
Environmental sustainability - solutions that have low impact on land, water and air quality		
On-island / total carbon emissions (000' t CO_2-e pa)	-17 / -45	The decrease in on-island emissions reflects removal of the TVPS offset by regular use of emergency generation (averaging 35 kt CO_2-e pa). There is also a decrease in overall emissions due to lower energy in storages and reduced imports/greater exports over Basslink.
Regulation – solutions that are consistent with energy policies and energy security objectives		
Government budget impact	Variable	The Government Budget impact would be highly variable, with a potential for higher dividends when energy security events did not occur, but very significant costs when they did.
New policy, regulation or legislation	No regulation, but policy risk	No energy security oversight regulation is required under this option.
Economic development – solutions that support the sustainability of the Tasmanian economy		
Support ongoing economic activity and employment	×	The reduced gas supply may have negative impacts on gas availability and affordability for other consumers, with a potentially negative impact on economic activity. Overall employment would be lower with a reduction in staff for the TVPS and likely reduction in investment. Some temporary employment may be required to establish short-term responses.
Impact on confidence and investment	↓	The higher risk of an energy security event is likely to have a significant impact on confidence.

Table 19.7 Criteria descriptions for assessment of options addressing on-island energy balance

Measure	Description
Availability - solutions that improve Tasmania's resilience to shocks	
Change in energy supply (GWh)	This is the additional energy available from additional generation.
Energy security rating	As per Table 19.1
On-island coverage	An assessment of whether the option provides Tasmania with supply/demand balance in an average inflow/demand year.
Energy supply diversity	An assessment of how well the option improves the diversity of Tasmanian energy supply.
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups	
Net cost (annualised $ million)	As per Table 19.1
Impact on wholesale electricity price ($/MWh)	As per Table 19.1
Impact on wholesale electricity price (%)	As per Table 19.1
Impact on typical retail bills (%)	As per Table 19.1
Sensitivity to uncontrollable market variables	An assessment of how sensitive the ongoing economic viability of the option is to uncontrollable market variables (such as gas and energy prices) once developed.
Environmental sustainability - solutions that have low impact on land, water and air quality	
On-island / total carbon emissions (000' t CO_2-e pa)	As per Table 19.1
Regulation – solutions that are consistent with energy policies and energy security objectives	
Government budget impact	As per Table 19.1
Compatibility with existing policy	An assessment of whether the option is consistent with existing policy positions.
New regulation or legislation	An assessment as to whether new regulation or legislation is likely to be required to implement the proposed option. In general, options that do not require additional regulation or legislation are preferred.
Economic development – solutions that support the sustainability of the Tasmanian economy	
Support ongoing economic activity	As per Table 19.1
Impact on confidence and investment	As per Table 19.1

Table 19.8 On-island energy balance option - New Generation - Wind

Measure	Assessment	Commentary
Availability - solutions that improve Tasmania's resilience to shocks		
Change in energy supply (GWh)	+700	This option would increase energy availability by 700 GWh, all other things being equal. This may be offset by reductions in energy in storage, or removal of the TVPS and upward adjustment of energy in storage.
Energy security rating	Resilient	With additional wind generation, all other things being equal, the energy security rating would be considered Resilient as annual on-island supply would on average be in balance with consumption.
On-island coverage	Yes	This option would provide on-island energy balance.
Energy supply diversity	Good	This option would increase on-island energy supply diversity and reduce the dependency on hydro-electric generation.
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups		
Net cost (annualised $ million)	-12 (gain)	Taskforce modelling shows that there would be a net cost reduction relative to the base case, driven by the levelised cost of wind energy being less than the expected combined revenue from LGCs and reduced imports over Basslink.
Impact on wholesale electricity price ($/MWh)	-1.16	Potential for a decrease in energy costs.
Impact on wholesale electricity price (%)	-1.7	Reduction in costs.
Impact on typical retail bills (%)	-0.5	Low significance.
Sensitivity to uncontrollable market variables	Good (once developed)	Wind power, once developed will continue to produce energy largely independently of market energy prices or other input costs.
Environmental sustainability - solutions that have low impact on land, water and air quality		
On-island / total carbon emissions (000' t CO_2-e pa)	-51 / -413	The decrease in on-island emissions reflects reduced use of the TVPS. There is also a decrease in overall emissions due to reduced imports/greater exports over basslink.
Regulation – solutions that are consistent with energy policies and energy security objectives		
Government budget impact	Favourable	Cost reduction (through reduced energy in storage) could be shared with government as higher dividends.
Compatibility with existing policy	Compatible	State government policy currently supports new renewable energy developments.
New regulation or legislation	No	No regulatory or legislative changes will be required if new wind projects can establish without further assistance.
Economic development – solutions that support the sustainability of the Tasmanian economy		
Support ongoing economic activity	✓	The development of new wind farms will provide positive economic and employment benefits, particularly during the construction phase.
Impact on confidence and investment	↑	A decision by private investors to develop new renewable energy projects will likely increase confidence by other investors in the Tasmanian economy.

Table 19.9 On-island energy balance option - New Generation – Mixed Renewables

Measure	Assessment	Commentary
Availability - solutions that improve Tasmania's resilience to shocks		
Change in energy supply (GWh)	+700	The option would increase energy availability by 700 GWh, all other things being equal. This may be offset by reductions in energy in storage, or removal of the TVPS and upward adjustment of energy in storage.
Energy security rating	Resilient	With additional renewable energy generation, all other things being equal, the energy security rating would be considered Resilient as annual on-island energy supply would on average be in balance with consumption.
On-island coverage	Yes	This option would provide on-island energy balance.
Energy supply diversity	Strong	This option would provide strong on-island energy supply diversity, as it would increase generation by multiple diverse sources that would provide energy at different times and with different sensitivity to uncontrollable factors.
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups		
Net cost (annualised $ million)	-9 (gain)	Taskforce modelling shows that there would be a reduction in net cost relative to the base case. This is based on higher energy prices and the cost competitive nature of wind and to a lesser extent solar PV generation.
Impact on wholesale electricity price ($/MWh)	-0.72	Potential for a decrease in energy costs if the cost of generating energy through wind farms is lower than the alternative cost of importing energy over Basslink (as is expected). Wind farms will bid whatever power is generated, potentially putting downward pressure on electricity pool prices.
Impact on wholesale electricity price (%)	- 1.1	Reduction in costs reflecting lower cost generation sources and cross-subsidy through RET scheme.
Impact on typical retail bills (%)	- 0.3	Low significance.
Sensitivity to uncontrollable market variables	Good (once developed)	Once established wind and solar projects have low marginal costs and are likely to keep operating irrespective of changes in market conditions. Biomass plants may be subject to uncontrolled variables (particularly resource security, cutting and transportation costs) but are only one component.
Environmental sustainability - solutions that have low impact on land, water and air quality		
On-island / total carbon emissions (000' t CO_2-e pa)	-48 / -383	The decrease in on-island emissions reflects reduced use of the TVPS. There is also a decrease in overall emissions due to reduced imports/greater exports over Basslink. A small CO_2-e component is associated with biomass.
Regulation – solutions that are consistent with energy policies and energy security objectives		
Government budget impact	Potentially Unfavourable	While wind projects are likely to be able to proceed without additional subsidy, and the mixed renewables are NPV positive overall, solar and biomass are not as competitive. Seeking a broad mix of renewable options may therefore require subsidies (for example assistance for transporting biomass).
Compatibility with existing policy	May require change	Biomass projects may require resource security or other policy assistance to establish.
New regulation or legislation	No	No regulatory or legislative changes will be required if new renewable energy projects can establish without further assistance.
Economic development – solutions that support the sustainability of the Tasmanian economy		
Support ongoing economic activity	✓	The development of a range of renewable options will provide economic stimulus, particularly in regional areas. The development of new mixed renewable energy projects will provide additional employment, particularly during the construction phase. Ongoing employment is likely to be higher than the development of wind farms alone due to higher employment associated with biomass.
Impact on confidence and investment	↑	A decision by private investors to develop new renewable energy projects will likely increase confidence by other investors in the Tasmanian economy.

Table 19.10 On-island security option – TVPS running for five months per annum

Measure	Assessment	Commentary
Availability - solutions that improve Tasmania's resilience to shocks		
Change in energy supply (GWh)	+700	Using the TVPS to bridge the on-island generation deficit would not increase availability compared to the base case in which the TVPS is held on standby. However there would be an increase in 700 GWh in energy generated in Tasmania.
Energy security rating	Resilient	Ensuring that the TVPS is available, when combined with the HRL/PSL methodology, provides a Resilient energy security situation.
On-island coverage	Yes	Running the TVPS for five months would bridge the on-island generation deficit.
Energy supply diversity	Good	By using additional gas, the dependency on hydro-electric generation is reduced.
Affordability - solutions that are low in expected system costs, are viable under a range of future price scenarios and do not unfairly impact particular user groups		
Net cost (annualised $ million)	+9 (loss)	Taskforce modelling shows that there is a net cost compared to the base case, driven by the greater cost of gas than the alternative cost of importing energy over Basslink.
Impact on wholesale electricity price ($/MWh)	+0.85	Potential for increased cost as the cost of gas and the TVPS operation are higher than the alternative forecast NEM import price over Basslink.
Impact on wholesale electricity price (%)	+ 1.2	Increase in costs due to higher cost of generating electricity using the TVPS.
Impact on typical retail bills (%)	+ 0.3	Low significance
Sensitivity to uncontrollable market variables	Susceptible	Utilisation of the TVPS is highly dependent on the spark spread – the difference between the energy price ($/MWh) and the cost of gas for generation ($/GJ x GJ/MWh) multiplied by the heat rate.
Environmental sustainability - solutions that have low impact on land, water and air quality		
On-island / total carbon emissions (000' t CO_2-e pa)	+244 / -245	While utilising the TVPS will increase emissions, this is offset by reduced imports over Basslink. The emissions intensity of the TVPS (0.42) is approximately half that of the NEM as a whole (0.83) so that there is a significant net reduction, even if Tasmanian emissions increase.
Regulation – solutions that are consistent with energy policies and energy security objectives		
Government budget impact	Unfavourable	As the TVPS is a relatively high cost source of energy, greater utilisation of the TVPS (when not driven by market conditions) may reduce dividends available to Government.
Compatibility with existing policy	Compatible	
New regulation or legislation	No	
Economic development – solutions that support the sustainability of the Tasmanian economy		
Support ongoing economic activity	✓	Utilisation of the TVPS may support greater gas availability to other Tasmanian gas users. TVPS utilisation will support employment at the TVPS site.
Impact on confidence and investment	-	No net impact on investment is anticipated.

20. Appendix 5: Actions of the Monitor and Assessor

The potential actions of the Monitor and Assessor, under a range of total energy in storage (TEIS) positions relative to the PSL and HRL profiles, should vary depending on the time of the year. The Taskforce has categorised the year into four seasonal periods based on expected rainfall (refer Figure 20.1). This appendix provides an overview of how the Taskforce envisages the Monitor and Assessor would undertake the seasonal evaluation of energy in storage in its monthly assessment.

Figure 20.1 PSL and HRL grouped to four distinct seasonal periods

Source: Taskforce analysis.

Notes:

1. Dry season (from November to April) – low probability of any significant inflows over this period.
2. Early wet season (from May to June) – high chance of significant inflows over this period with a potential for delay until the mid-wet season
3. Mid-wet season (from July to August) – significant inflows expected
4. End wet season (from September to October – critical time of year to assess water storage position with a chance of significant inflows)

20.1 Operation of storages below PSL

TEIS marginally below the PSL – any time of year (i.e. seasonal period 1, 2, 3, 4)

A TEIS which is marginally below the PSL is likely the result of periodic low monthly inflows. It is expected that the Monitor and Assessor would consider the situation as normal operation. The monthly dashboard would include commentary that the current status as below the PSL and will mention the reason for the reduced TEIS. No advice from Hydro Tasmania on a plan to return above the PSL would be required in this situation. It is expected that the Energy Security Coordinator would keep a keen interest in the monthly dashboard updates.

TEIS well below the PSL – dry season (1)

If the TEIS is significantly below the PSL at the beginning of the dry season, it is likely that it will be in the same position relative to the PSL at the end of the dry season due to there being a low probability of any significant inflows over this period. In this situation, the Monitor and Assessor would require the PSL Recovery Advice from Hydro Tasmania to clearly articulate how it intends to return storages to the PSL. This advice will most likely indicate greater utilisation of Basslink imports or gas generation to provide support in the lead up to the next wet season inflow. Forecasts from the Bureau of Meteorology (BOM) are focussed on shorter term outcomes (three months or less) and are unlikely to predict anything other than average inflows for the upcoming wet season.

Action: It is envisaged that the Monitor and Assessor's monthly dashboard update would include commentary that the current TEIS is below the PSL and current TEIS forecasts predict this will be the situation until the early wet season at earliest. The commentary will also mention that PSL Recovery Advice for returning to the PSL had been provided to the Monitor and Assessor by Hydro Tasmania. If applicable, the Monitor and Assessor could mention the probability (per cent chance) of needing to access the energy security reserve. It is unlikely that this situation would require the notification of the Energy Security Coordinator.

TEIS well below PSL – early wet season (2)

A TEIS well below the PSL in the early wet season is a cause for concern for a number of reasons. Firstly, at this time of year Tasmanian demand is starting to increase towards its peak maximum demand on cold winter days, resulting in an increase in the amount of hydro-electric generation required to meet this rising demand. Secondly, there is a risk that wet season inflows will not occur early in the season and that this high demand period may not be supported by high inflows. This situation should have been relatively easy to foresee as the preceding dry season had a low chance of significant inflows and Hydro Tasmania forecasts would likely have been predicting this level of TEIS well in advance.

A TEIS well below the PSL in the early wet season indicates that the mitigation plan detailed in the previous PSL Recovery Advice has not functioned as desired. In this situation, the Monitor and Assessor will seek updated PSL Recovery Advice from Hydro Tasmania. This advice would most likely include increased Basslink imports (if possible) and gas generation.

Action: It is envisaged that the Monitor and Assessor's monthly dashboard update would include commentary that the current TEIS is well below the PSL and indicate the current probability of entering into the energy security reserve based on Hydro Tasmania's TEIS forecast. It would also indicate that it has received updated PSL Recovery Advice from Hydro Tasmania. It is not anticipated that the details of this advice would be publicly communicated. Any forecast entry into the energy security reserve will still be heavily influenced by inflows in the next few months. It is unlikely that this situation would require the notification of the Energy Security Coordinator unless there was a forecast of energy in storage falling below the HRL.

TEIS well below PSL – mid-wet season (3)

A TEIS well below the PSL in the middle of the wet season could be the result of a single abnormally dry month in the wet season to date, or the result of a string of below average inflow months. In this situation, it is critical that the BOM's weather forecast is examined closely in order to ascertain the likelihood of low inflows for the remainder of the wet season. The Monitor and Assessor will be seeking an updated PSL Recovery Advice from Hydro Tasmania which states how it plans to recover from this position and identify whether it is relying on the rainfall for the rest of the wet season or escalating Basslink imports or gas generation support. It is important to note that gas generation is unlikely to be operational in ordinary circumstances at this time of year due to the minimisation of risk of spill from any rainfall event that may occur.

Action: It is envisaged that the Monitor and Assessor's monthly dashboard update would include commentary that the current TEIS is well below the PSL and that an updated PSL Recovery Advice has been received from Hydro Tasmania. It is not anticipated that the details of this advice would be publicly communicated. If storages are projected to fall below the HRL, the Monitor and Assessor would notify the Energy Security Coordinator and highlight the potential risk of operation below the HRL through the upcoming dry season. Hydro Tasmania would be requested to provide an HRL Recovery Plan for approval by the Energy Security Coordinator prior to entering the energy security reserve. The Monitor and Assessor would review the HRL Recovery Plan and provide advice on its adequacy to the Energy Security Coordinator.

TEIS well below PSL – end wet season (4)

A TEIS well below PSL at the end of the wet season is a sign of an inflow year which is below average. As the prospect of future inflows really only covers two months, it is highly likely that the upcoming dry period will also be well below the PSL. The upcoming weather forecast should be able to inform the Monitor and Assessor as to the likelihood of any late season inflows and will be a key input into the evaluation of any PSL Recovery Advice from Hydro Tasmania. At this stage, preparation for the annual energy security assessment will include a plan for the upcoming dry season, including planning to import over Basslink and ensuring that the gas generation assets at the TVPS are working towards full availability for the dry season.

Action: It is envisaged that the Monitor and Assessor's monthly dashboard update would include commentary that the current TEIS is well below the PSL and that updated PSL Recovery Advice has been received from Hydro Tasmania. It is not anticipated that the details of this advice would be publicly communicated. If storages are projected to fall below the HRL, the Monitor and Assessor would notify the Energy Security Coordinator and highlight the potential risk of operation below the HRL through the upcoming dry season. Hydro Tasmania would be required to provide an HRL Recovery Plan for approval by the Energy Security Coordinator prior to entering the energy security reserve. The Monitor and Assessor would review the HRL Recovery Plan and provide advice on its adequacy to the Energy Security Coordinator.

20.2 Operation of storages below HRL

TEIS marginally below HRL – any time of year (1, 2, 3, 4)

A TEIS marginally below the HRL may not necessarily require the Energy Security Coordinator to coordinate actions of market participants. In the event that TEIS is only forecast to remain marginally below the HRL for less than two months then it would not be necessary for the Energy Security Coordinator to become heavily involved. However, if there is a Basslink failure during operation of TEIS at any time when storages are below the HRL then the Energy Security Coordinator should become involved immediately.

Action: It is envisaged that the Monitor and Assessor would continue to provide monthly dashboard updates and commentary on the situation, including an estimate on the period of time that TEIS is expected to be below the HRL (based on Hydro Tasmania's TEIS forecast and its own analysis). The Monitor and Assessor would communicate that the Energy Security Coordinator has been notified and that the HRL Recovery Plan is being implemented. Depending on the commercial sensitivity of the mitigating actions in the HRL Recovery Plan, the Monitor and Assessor may disclose some or all of these actions.

TEIS well below HRL – any time of year (1, 2, 3, 4)

If projections show that TEIS will fall significantly below the HRL then the Energy Security Coordinator should be involved as soon as possible. A TEIS well below the HRL would require the Energy Security Coordinator to coordinate actions of market participants, including actions within the HRL Recovery Plan.

Action: It is envisaged that the Monitor and Assessor would continue to provide monthly dashboard updates and commentary on the situation, including an estimate on the period of time that TEIS is expected to be below the HRL (based on Hydro Tasmania's TEIS forecast and its own analysis). The Monitor and Assessor would communicate that the Energy Security Coordinator has been notified and that the HRL Recovery Plan is being implemented. Depending on the commercial sensitivity of the mitigating actions in the HRL Recovery Plan, the Monitor and Assessor may disclose some or all of these actions.

20.3 Basslink operation

Basslink outages

If the TEIS is above the HRL and an unplanned Basslink outage occurs, then no further actions would be required outside those already discussed. In this situation, Basslink imports would no longer be available as a PSL recovery option and so greater reliance would be placed on other methods (primarily gas generation at the TVPS).

If the TEIS is below the HRL and an unplanned Basslink outage occurs, then an HRL Recovery Plan will be executed in order to replace the energy represented by the absent Basslink imports. This scenario demonstrates that it would be highly advantageous if the HRL Recovery Plan's mitigation responses included potential actions that would be taken in the event of a Basslink outage when operating below the HRL.

Basslink exports

With Basslink operational, exports may occur at any time during the events described in section 20.1 and section 20.2. For example, this could occur during times of high inflow when small run-of-river dams are spilling or during times of very high spot prices in Victoria when importing energy is simply uneconomical. This would need to be managed by Hydro Tasmania. An HRL Recovery Plan would be expected to outline the likely extent and circumstances of Basslink imports when storages are projected to fall below the HRL.

21. Appendix 6: 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 21.1 and Table 21.2, are intended to support (through the use of quantitative data) the Taskforce's Energy Security Assessment for Tasmania presented in Part C.

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 and Final 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 21.1 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	38.1% at 3 April 2017, 8.2% above the PSL	Hydro Tasmania
	Basslink availability	Basslink availability compared with performance of the time (on a rolling 12 month average)	5 year average availability: 99.13% 2015-16: 99.60%[126] 5 year average outages: 3 2015-16: 1	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)[127]	Low: 4 years or 40% High : 2 years or 20%[128]	Hydro Tasmania
	Long-term average inflows	Rolling average annual inflows over 10, 20 and 40 years (to 2015-16)	10 year average : 8 698 GWh[129] 20 year average : 9 232 GWh[130] 40 year average: 9 468 GWh[131]	Hydro Tasmania
	Net electricity import dependence	Percentage of on-island consumption met by hydro and wind generation, over most recent year, five 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 average and low assumptions) relative to forecast consumption for the next 12 months[132]	Average inflows: 16 months Low inflows: 13 months	TER, Hydro Tasmania
	Total available energy supplies (including imports)	As above but including assumed available Basslink imports and gas generation[133]	Average inflows: 21 months Low inflows: 18 months	TER, Hydro Tasmania
	Diversity of supply	Percentage of consumption met by non-hydro generation and number of non-hydro sources (greater than five per cent of Tasmanian consumption), assessed over most recent year, five 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

126 Six month Basslink outage excluded from calculation.
127 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.
128 Calendar year (to 2016): 3 years or 30 per cent.
129 10 calendar years (2007 – 2016): 9 195 GWh.
130 20 calendar years (1997 – 2016): 9 171 GWh.
131 40 calendar years (1977 – 2016): 9 546 GWh.
132 All time low annual inflows assumed at 6 434 GWh. Average inflows assumed as 9 000 GWh. Wind generation assumed at 900 GWh.
133 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 (USE) (generation and transmission)	USE compared to NEM standard of 0.002 per cent. (2015-16), five year average and 10 year average	1 year: 0.0000% 5 year: 0.0000% 10 year: 0.0000%	AEMC
	Unplanned outages (transmission)	Number of loss of service (LOS) events >0.1 system minute Target: ≤15, most recent year (2015-16), five year average Number of LOS events >1.0 system minute Target: ≤2, most recent year (2015-16), five year average	LOS events >0.1 system minute 1 year: 0 5 year: 7 LOS events >1.0 syst 1 year: 0 5 year: 1	TER
	Distribution network reliability	System average interruption frequency Index (SAIFI) and System average interruption duration Index (SAIDI) for 2015-16[134] Measure - number of communities inside SAIFI and SAIDI limits for 101 communities	SAIFI – 93 compliant communities SAIDI – 77 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 forcast maximum demand	TER

[134] 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[135]	TER
	Small business customer costs	Comparison of Tasmanian small business electricity costs with national average	Tas < national average[136]	TER
	Small customer price volatility	Annual change in electricity prices relative to changes in CPI, most recent year and seven year average	7 year average = +2.63[137] 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 three year average[138]	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[139]		
	Availability of consumer choices	Effective competition[140]	Effective competition yet to emerge	AEMC
	Energy efficiency	To be developed[141]		
	Electricity sector carbon emissions	Per capita electricity sector carbon emissions in Tasmania compared with Australia 2014	Tasmania: 818 CO_2-e per captia Australia: 7 652 CO_2-e per capita	Commonwealth Department of the Environment and Energy / ABS

[135] OTTER, 2017, *Comparison of Australian Standing Offer Energy Prices* as at 1 February 2017. Tasmanian residential costs compared with around 60 tariff offerings nationally, based on certain assumptions.

[136] OTTER, 2017, *Comparison of Australian Standing Offer Energy Prices* as at 1 February 2017. Tasmanian small business costs compared with around 30 tariff offerings nationally, based on certain assumptions.

[137] 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.

[138] AER reporting on energy affordability for Tasmania commenced in 2012-13 when the National Energy Retail Law was applied to the Tasmanian jurisdiction.

[139] 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.

[140] 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.

[141] The Taskforce is not aware of available data to holistically measure the energy efficiency of business and residential sectors. However, the Taskforce considers that developing a measure would be desirable and hence has included the performance indicator as a placeholder.

Table 21.2 Tasmanian energy security performance indicators, performance measures and actual performance against each measure for gas[142]

Criteria	Performance Indicators	Performance Measures	Actual performance	Data source
Adequacy	Available capacity of Tasmanian Gas Pipeline (TPG)	Percentage yearly average of daily flows of TGP capacity not utilised (129 TJ),[143] 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 (2015-16) and five year average	1 year: 2[144] 5 year: 0.4	TER
		Maintenance plan compliance – target: 90% Most recent year (2015-16) and five year average	1 year: 96%[145] 5 year: 99.55%	TER
	Distribution reliability	Total Interruptions, most recent year (2015-16) and five year average	I year: 280 5 year: 340	TER
		Average interruption minutes, most recent year (2015-16) and five year average	I year: 58 minutes 5 year: 70 minutes	TER
Competitiveness	Residential customer costs	Comparison of Tasmanian residential gas costs with national average	Tas < national average[146]	TER
	Small business customer costs	Comparison of Tasmanian small business gas costs with national average	Tas > national average[147]	TER
	Distribution and transmission utilisation of gas	Percentage split of total gas utilisation between distribution and transmission customers, most recent year (2015-16) and five year average	I year: Distribution - 17% Transmission – 83% 5 year: Distribution - 16% Transmission – 84%	
	Total distribution customers	Customers connected compared to previous year	2015-16 change – increase of 4% (12 699 to 13 246)	TER

142 Broader energy market performance indicators concerning the environment and energy efficiency are to be included within electricity indicator measures.
143 Based on financial year and data taken from TGP's website tracking daily flows. TGP total daily available capacity 129 TJ.
144 TGP has reported two interruptions to supply in past five years, in 2015-16.
145 TGP five year average maintenance plan compliance sits at close to 100 per cent.
146 OTTER, 2017, *Comparison of Australian Standing Offer Energy Prices as at 1 February 2017*. Tasmanian residential costs compared with around 50 tariff offerings nationally, based on certain assumptions.
147 OTTER, 2017, *Comparison of Australian Standing Offer Energy Prices as at 1 February 2017*. Tasmanian small business costs compared with around 60 tariff offerings nationally, based on certain assumptions.