



QUEENSLAND
FUTURES INSTITUTE



QLD POLICY LEADERS' FORUM

**ENERGY & RESOURCES:
POWERING STATE GROWTH**

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ENERGY & RESOURCES: POWERING STATE GROWTH

PANELISTS:



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Snapshot

The Queensland Futures Institute's Forum – *Energy and Resources: Powering State Growth* – outlined Queensland's ambitious plans to integrate renewable energy, focusing on the Queensland Energy and Jobs Plan. The discussion underscored the importance of collaboration between industry and government to achieve emissions reduction targets and maintain economic prosperity during the transition.

Summary of Panel Comments

- Queensland's energy transition will require significant infrastructure development – including up to 6 gigawatts of long-duration pumped hydro storage and 25 gigawatts of wind and solar resources.
- Delivering this transition will create opportunities for the Queensland economy across the energy and resources sectors. The state will play a significant role in delivering reliable, affordable and low emissions energy to support decarbonisation efforts of Queensland industry, communities, the rest of Australia and our energy export partners.
- However, there are significant challenges in achieving the pace of the transition required and reaching a high penetration of renewables.
- Innovative solutions will be required to deliver the significant projects – including pumped hydro – to operate the system and support the decarbonisation of remote mines and communities across Queensland.
- Long-duration storage – as well as sustainable fuels – will also play a critical role in supporting high penetration of renewables.
- This will require a supportive policy environment and collaboration between government and industry to effectively deliver these projects.

Panel Comments

How is Queensland Hydro planning to integrate the pumped hydro energy storage with renewable energy resources to provide the electricity supply for the State?



Keiran Cusack

- The Queensland Energy and Jobs Plan will require 6 gigawatts of long-duration pumped hydro storage, 25 gigawatts of wind and solar resources and a transmission super grid.
- Queensland Hydro already has two projects underway: Borumba – which is in EIS phase, with exploratory works to start after approvals – and Pioneer Burdekin, the business case for which is to be delivered to the government shortly.
- Pumped hydro is fast, flexible and reliable, providing secure power 24/7. This reliability is crucial to the renewable energy transition as variable renewable sources like wind and solar are deployed.
- Uruguay is an excellent example to illustrate how renewable energy targets can be achieved, given its population of 4 million and its history of oil and gas. The country has successfully integrated 100% of renewable energy into the system in only 10 months – utilising pumped hydro, wind and solar, as well as a carbon tax.
- This level of renewable penetration requires a system with deep storage, variable renewable sources, and an efficient grid.

How is your organisation preparing to handle this integration of diverse renewable energy resources and new loads like green hydrogen while maintaining grid stability?



Prof. Paul Simshauser AM

- Queensland has the world's longest and stringiest grid – which makes integration complex.
- To maximise power system availability, Powerlink has the ability to work on live substations – a globally unique operational decision shared only with Electricité de France.
- The Queensland network was originally built to support 11 generating sites (coal and hydro), but now has over 74 generators across the state. This is a significant operational challenge.
- In its role, Powerlink has adopted innovative operational strategies, such as the Wide Area Monitoring and Protection Control (WAMPAC) system, to manage the grid more effectively. This allows circuits to be run at higher utilisation through credible contingent events such as lightning storms, switching in less than 160 milliseconds in order to maintain stability if a lightning strike occurs. Powerlink is again one of the first two operators globally to utilise this innovation – the other being Southern California Edison.
- Innovations like this help manage the grid's increasing complexity and maintain stability.
- Powerlink has done well to enable renewables – exemplified by the state's northern grid (above Mackay) having the highest renewable share globally – higher than Denmark.
- Given this high level of renewable market share, Powerlink has had to address new challenges in operating the grid due to complexities with inverter-based systems. This has led to innovations in system strength and system operations.

Panel Comments

- Generators are also dealing with these challenges. For example, Vestas – a leading turbine manufacturer – pioneered a wind farm control solution for system strength with a Queensland wind farm, applying it across its global fleet. This demonstrates Queensland’s role in pioneering solutions for system management.
- Queensland also has the highest rooftop solar PV take-up rate in the world, which also presents network challenges.
- Powerlink engineers are continuously solving these complex problems, ensuring grid stability and enabling the integration of diverse renewable resources and new loads like green hydrogen.

With the growing demand for critical minerals, are the current policy reforms and initiatives adequate to drive the necessary investment into the sector? Is the market well placed to deliver the necessary supply?



Janette Hewson

- The resource sector will play a key role in this transition. Gas is currently needed for manufacturing – which will continue to be important given the Future Made in Australia initiatives – and steelmaking coal is used in electric vehicle production. We must ensure public understanding of the necessity of these existing commodities, as well as critical minerals, to reach net zero.
- Queensland is well positioned for critical minerals due to our existing resource sector, a skilled and highly paid workforce, and strong ESG criteria met by the state. Our state has strong mining and energy sectors and stringent environmental regulations, which boosts confidence in our ability to benefit from these opportunities and become a critical minerals leader.
- To meet global demand, 230 new critical minerals mines are needed by 2030. It currently takes 16 years on average from exploration to production, indicating we’re behind in starting critical mineral operations.
- Ensuring investment confidence is a key challenge to unlocking Queensland’s opportunities not only in traditional mining, but also in advanced processing to add value along the supply chain.
- Reliable, affordable, and sustainable energy is also critical for these ventures. For example, existing mines are major energy users who are demanding clean energy as they pursue decarbonisation. This is being met through electrification on site and through renewable energy agreements.
- Additionally, we must streamline project approvals to reduce the 16-year wait and enhance investor confidence.
- The development of the resource sector is vital for Queensland’s economy, government revenue, and employment – directly and indirectly supporting over half a million Queenslanders.
- The Queensland Resources Council emphasises policy stability to maintain investor confidence and capitalise on opportunities. Policy certainty and stability are critical for long-term investments; sudden changes without consultation deter investors.
- The right policy settings are critical to ensuring Queensland capitalises on the opportunities in the critical minerals sector.

Panel Comments

There is a clear need for affordable, reliable, sustainable energy for Queensland's mining sector. What is the role of off-grid hybrid renewable energy systems in being able to deliver this energy?



James Harman

- The transition to sustainable energy is challenging, but Queensland is well placed to contribute to the global effort.
- One key challenge is providing renewable energy to those far from the grid, which includes many remote areas in Queensland. Traditionally, these off-grid areas have relied on unreliable diesel generators.
- EDL has played a key role in delivering hybrid renewable energy alternatives to remote communities and mine sites.
- When these projects were first started, this resulted in about 10-15% renewable energy for a mine site or remote community. Cannington mine was an early example of this, with the conversion of a diesel-fired power station to gas, and then the addition of a solar farm.
- In 2020, EDL developed the Agnew microgrid in Western Australia for a Gold Fields mine – integrating wind, solar, battery, and thermal backup to deliver more than 50% renewables. This was also the first mine in Australia to be powered by large-scale wind.
- As technology and EDL's solutions have developed, and come down in cost, it has become possible to deliver projects that are over 80% renewables – while ensuring the lowest cost for new mining projects anywhere in Australia.
- This is enabling a different approach to managing electricity supply and demand, moving from a centralised model towards decentralised energy for communities and customers located away from the main grid via microgrids. These can deliver 75-80% renewables and can be more reliable than the grid.
- Policy change is critical to continuing to support these innovative solutions.
- These solutions are case studies for microgrids which should be considered in policy development in order to supply remote power across Queensland.
- Broader decarbonisation policy is critical to achieve 100% renewables; while we can get to about 90% renewables through solar, wind, battery, and some thermal backup, renewable gas or fuels can enable the final 10% for remote energy applications in communities and mines.
- As another example of innovation helping with the global transitions, EDL is also a producer of renewable natural gas – biomethane – in the US, where we have up to seven petajoules of capacity.
- Considering the difficulty in decarbonising and electrifying industrial processes, having an alternate to fossil fuel gas is critical. The use of renewable natural gas is widespread in Europe and North America, but not in Australia – given the supportive policy environment in these regions. This includes the Inflation Reduction Act and Renewable Fuel Standard – which has resulted in 70% of the gas used in transport in the US being renewable, compared to zero in Australia.
- Greater policy support will be required to unlock the bioenergy sources in Queensland, which could supply more than half of the domestic demand for gas in the state.

Panel Comments

There is going to be a large build of pumped hydro energy storage to enable renewable energy resources, and off-grid systems to supply our remote mining operations – which unlock \$500 billion of critical minerals and power remote communities across the state. Are we ready for the significant construction that will be required?



Mark Scott

- Hastings Deering has a 92-year history in Queensland, working in construction, resources and energy sectors.
- As an industry, we are ready for the ramp-up in construction needed for pumped hydro energy storage and renewable integration. This major opportunity for the construction industry should focus on long-term benefits for Queensland and the country, not just immediate needs.
- To achieve this, these projects require planning, coordination, resourcing and the right funding models to achieve success.
- Certainty and planning are critical for long-term investment and infrastructure development. To achieve this, we must ensure a well-planned pipeline of opportunities and secure our supply chains.
- Collaboration across the value chain is necessary to achieve the construction goals and unlock the state's potential.
- Another critical enabler of this development will be continuous investment in skills to overcome ongoing skill shortages.



Keiran Cusack

- Queensland Hydro have launched a new campaign focused on education and awareness. This was in response to low levels of knowledge about Queensland Hydro and how hydroelectricity works in areas outside of those directly impacted by development.
- Queensland Hydro is also spreading information via a website to address this gap, providing more information about the Pioneer Burdekin project – including how hydro works and how it integrates into the system.



James Harman

- The Queensland Government's decarbonisation initiatives are significantly contributing to this area.
- One notable initiative is the Queensland Decarbonisation Hub, launched in collaboration with universities, industry, government and communities. This hub promotes a collaborative approach to decarbonising the state, ensuring community involvement in projects like wind farms, solar farms, and hydro projects.
- Another significant policy is the Low Emission Investment Partnership, aimed at supporting mining, particularly metallurgical coal. This partnership invites industry collaboration to help mines decarbonise.
- For over 20 years, EDL has been converting waste gases from underground coal mines in Queensland into power.
- With government support, this fund will enable major miners in Queensland to undertake similar initiatives and advance their decarbonisation efforts.

Audience Questions

There is a clear shift from just addressing emissions towards thinking more broadly about nature-based impacts and solutions. Given the environmental impacts of pumped hydro, how can we implement the environmental policy required while maintaining a timely energy transition?



Keiran Cusack

- Queensland Hydro considers how to achieve nature-positive outcomes, beyond just the immediate benefits from hydro. For example, we are looking for opportunities to exceed our base offset requirements and increase the protected area of national parks.
- While hydro has obvious benefits for decarbonisation and the reef in particular, we have an obligation to further contribute to ensuring positive local impacts as much as we contribute to the global impacts of decarbonisation.

How is Queensland Hydro addressing challenges around constructability, which have previously contributed to delays and cost over-runs for pumped hydro?



Keiran Cusack

- Our project is quite distinct to Snowy Two, which has 27 kilometres of tunnels connecting two reservoirs, given our tunnels will be about three kilometres.
- The selected site is geographically advantageous for having very short tunnels, providing an advantage in reduced impacts and reduced risk for the projects.
- In terms of constructability, we are bringing in a highly skilled and talented team. To do this, we have established partnerships with Landsverkjun Power from Iceland, a state-owned operator of hydro that has been building them since 1939. We have also formed a relationship with Verbund, the Austrian generation entity with 8,000 megawatts of generating capacity.
- This highlights how we are bringing significant expertise to help us craft the best plans to mitigate risk and overcome the types of challenges seen with Snowy Two.

Audience Questions

What is the role of innovative technologies – such as different forms of long-duration storage such as sodium-ion batteries – in the transition and for the grid?



Prof. Paul Simshauser AM

- Operating a power system with high levels of renewables without storage is complex. Given intermittency, this will involve some level of over-capacity – resulting in spilled output - to meet demand and State targets.
- As such, there is a clear role for storage, including batteries, to support the system. Batteries are currently economical for short durations – around two to four hours – while long duration storage solutions need further development and support.
- A key challenge is that we need to make storage decisions now, despite the uncertainty around potential future technological advancements. Operating in this environment will see those technologies which deliver the best economic and technical outcomes come out on top.
- Solar energy is rapidly increasing in the market, competing with coal-fired power generation. By the 2030s, this solar influx will require some coal generators to shut down due to material oversupply during daylight hours.
- As such, enhancing our ability to shift renewable energy through space (via Powerlink's networks) and through time (via long duration storage) will be critical.
- Pumped hydro is currently the most cost-effective long duration storage solution. However, future options might include innovative technologies such as compressed air, various battery technologies, and flexible loads.



James Harman

- In deploying microgrid solutions, EDL is considering four-hour duration batteries, given significantly decreasing costs.
- For example, a few years ago, we replaced an old diesel-fired power station at Jabiru in Kakadu National Park, which supplied the Ranger uranium mine and the town of Jabiru.
- Our energy solution delivered 50% renewable energy to Jabiru, using solar, battery and diesel backup.
- If we delivered the same project now, we could deliver around 70% renewables at the same cost due to the reduced cost of storage. The battery cost curve is on a downward slope – and this is supporting innovative projects such as our microgrid solutions.

Audience Questions

What is the role of distributed energy resources – such as residential home batteries – to support the transition and the grid?



Prof. Paul Simshauser AM

- Any storage – including household batteries – is beneficial for the power system. Household batteries can help move solar power around, which has positive impacts for the local grid.
- However, household batteries need coordination, which can be challenging. This is exacerbated given the increasing average installation size of rooftop solar in Queensland – which is now 9.9 kilowatts.
- With these installations, a household battery – like a Powerwall – would likely fill up by 10:30 AM and be depleted by 7:30 PM. There is clearly further coordination required to better shift this energy throughout the day – but this may not suit the household.
- Larger batteries in electric vehicles may also contribute in this area. However, coordination implies some level of control by electricity utilities and this is, understandably, likely to be met with resistance by households.
- So for these reasons, and given the scale of the storage needed, both household and utility-scale batteries and other long duration storage assets such as pumped hydro will be essential to meet this need, both shifting power and also providing services like frequency control and system strength.
- We must deliver storage – no matter the scale – at an efficient price in order to effectively manage Queensland’s abundant solar resources.

As we undertake decarbonisation and the energy transition, how do we ensure we don’t miss out on the economic prosperity previously delivered by a strong resources sector?



Janette Hewson

- Queensland has long relied on energy – including coal and gas, as well as exports to New South Wales and overseas – for its economic prosperity. As we transition away from these traditional energy sources, we must retain this prosperity in the decarbonised future.
- Last year, \$18 billion in royalties came to the Queensland Government and to Queenslanders – highlighting the significance of this revenue source for the economy.
- Queensland is fortunate to have various energy options, unlike some of our Asian export partners who are also aiming for net zero emissions.
- From a geopolitical perspective, we need to ensure energy security. But we must also consider our role beyond our state in supporting a safe, reliable and prosperous region and world.
- The whole world is facing net zero challenges, and each country will approach this in different ways. Some countries rely on our exports to keep their lights on, especially those with populations much larger than ours.
- Queensland will therefore likely play a role in supporting decarbonisation across other economies. We must consider how to best leverage this opportunity as we pivot our own economy.

Audience Questions

The mining sector has often led innovative technology development. What changes around transport has decarbonisation of the sector seen?



Mark Scott

- Mining operations have pioneered cutting-edge technology. For example, autonomous vehicles are being developed by companies like Caterpillar for the industry, before being considered for public roads.
- There will still be a role for diesel engines for some time, with ongoing development to improve their efficiency. However, battery electric and alternate fuel technologies are currently being developed and advanced – which may eventually support transition.
- Large mining companies globally are starting to trial and publicly announce these new technologies. We are likely to see the results of these technological developments in the next few years once they are proven and adopted.

As leaders in the energy and resources industry, what coordination is needed to achieve the state's emissions reduction targets?



Prof. Paul Simshauser AM

- As leaders in the energy and resources industry, we have a long history of coordination, though it hasn't always been seamless.
- The power sector and resources sector are closely linked - historically, one doesn't function well without the other. This interdependence provides practical evidence of the coordination required and our ability to work together.
- Given this relationship, Queensland is well placed to coordinate effectively in achieving the state's emission reduction targets.



James Harman

- There's been a long history of cooperation and collaboration between the energy and resources sector.
- For example, the resources sector wants reliable, sustainable and cheap energy – and is now seeking sustainable energy to achieve this given renewable solutions are now cheaper than the old thermal solutions. This is a win-win situation as we can deploy renewables to help the resources sector decarbonise.
- However, beyond the electricity needs, there is a significant amount of work required to decarbonise transport and deliver broader electrification of processes at mines.
- The energy demand for this electricity is going to be very large – and will require solutions to produce and manage the energy required to supply this demand.
- Collaboration between the private and public sector will be required to achieve this.



Janette Hewson

- Collaboration within industry is a critical enabler of the transition.
- However, it is also critical for government to work with industry to overcome the challenges faced by the resources and energy sectors that have been discussed.
- Given the capability of businesses to solve problems, and set and achieve targets, the more we can leverage this knowledge through collaboration with governments at a federal and state level, the better.

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