



Customer Panel Update Supergrid Strategy

16 February 2023 - circulated



Acknowledgement

Powerlink acknowledges the Traditional Owners and their custodianship of the lands and waters of Queensland and in particular, the lands on which we operate. We pay our respect to their Ancestors, Elders and knowledge holders and recognise their deep history and ongoing connection to Country.

What are we here for?

- Provide an update on QEJP progress and associated legislation
- Introduce at a high level Powerlink's Supergrid Strategy:
 - Why it is needed?
 - What options have we looked at?
 - What economic, technical and operational factors we have considered

Why out of session?

- Draft Supergrid Strategy will be discussed by Powerlink Board at February meeting
- Timeframes associated with transmission connection for Borumba Pumped Hydro Project

Outcome

- Set the scene for a more detailed discussion at March Customer Panel meeting



70%
Renewable
Energy by
2032



QUEENSLAND ENERGY AND JOBS PLAN

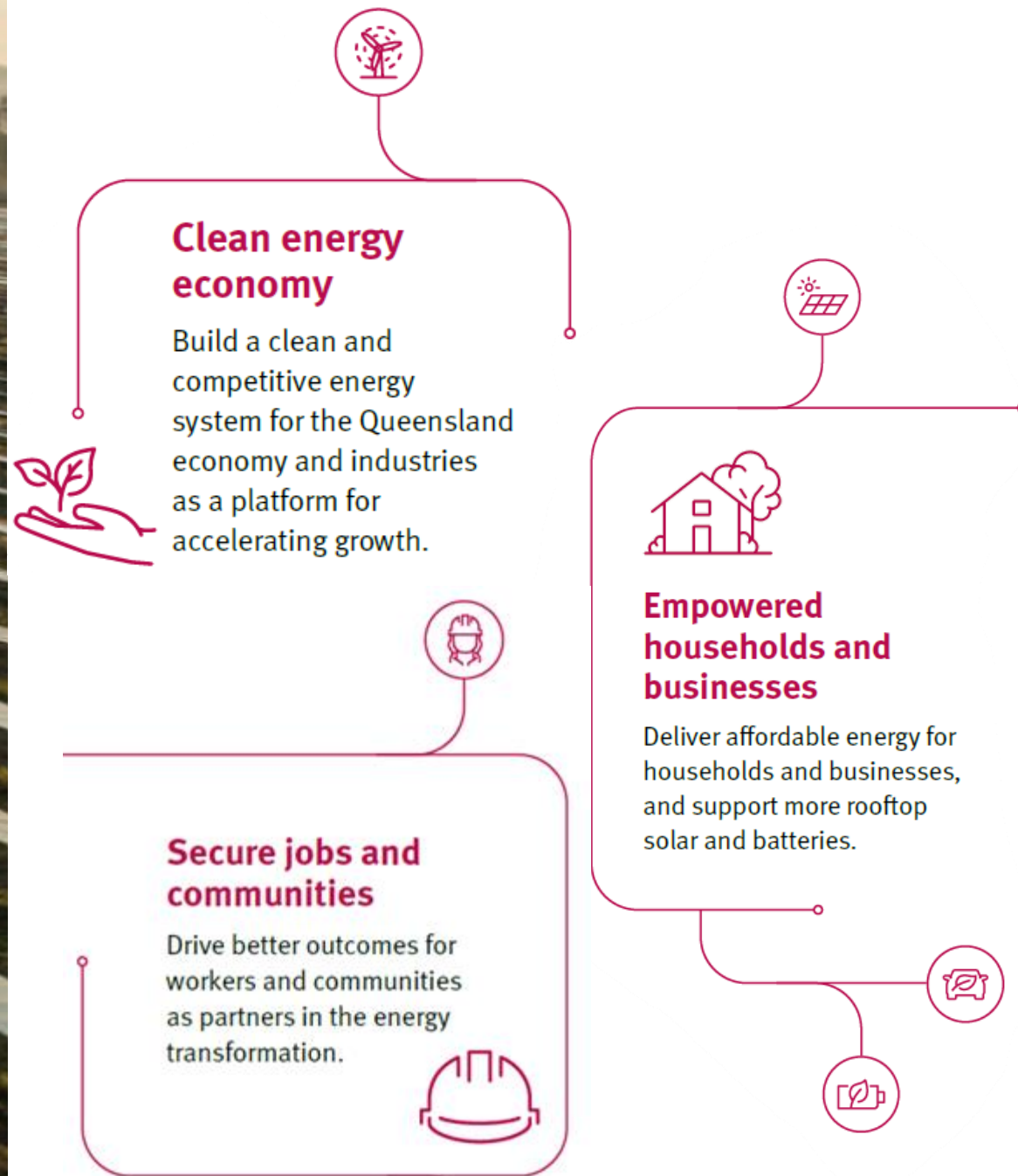
Power for **generations**



Queensland
Government

Vision

Clean, reliable and affordable energy providing power for generations.



Overview of the Plan



\$4 billion down payment

SuperGrid Infrastructure Blueprint

- Optimal infrastructure pathway to transform Queensland's electricity system, based on a least cost approach
- Investment in 4 key large-scale infrastructure areas
 - Renewables
 - Storage and firming
 - Transmission and system strength
 - Clean Energy Hubs
- Framework to manage risk and uncertainty

Queensland's SuperGrid

In 2015 almost no large-scale renewables

Currently 3GW wind and solar (21% renewables)

More public and private renewable development

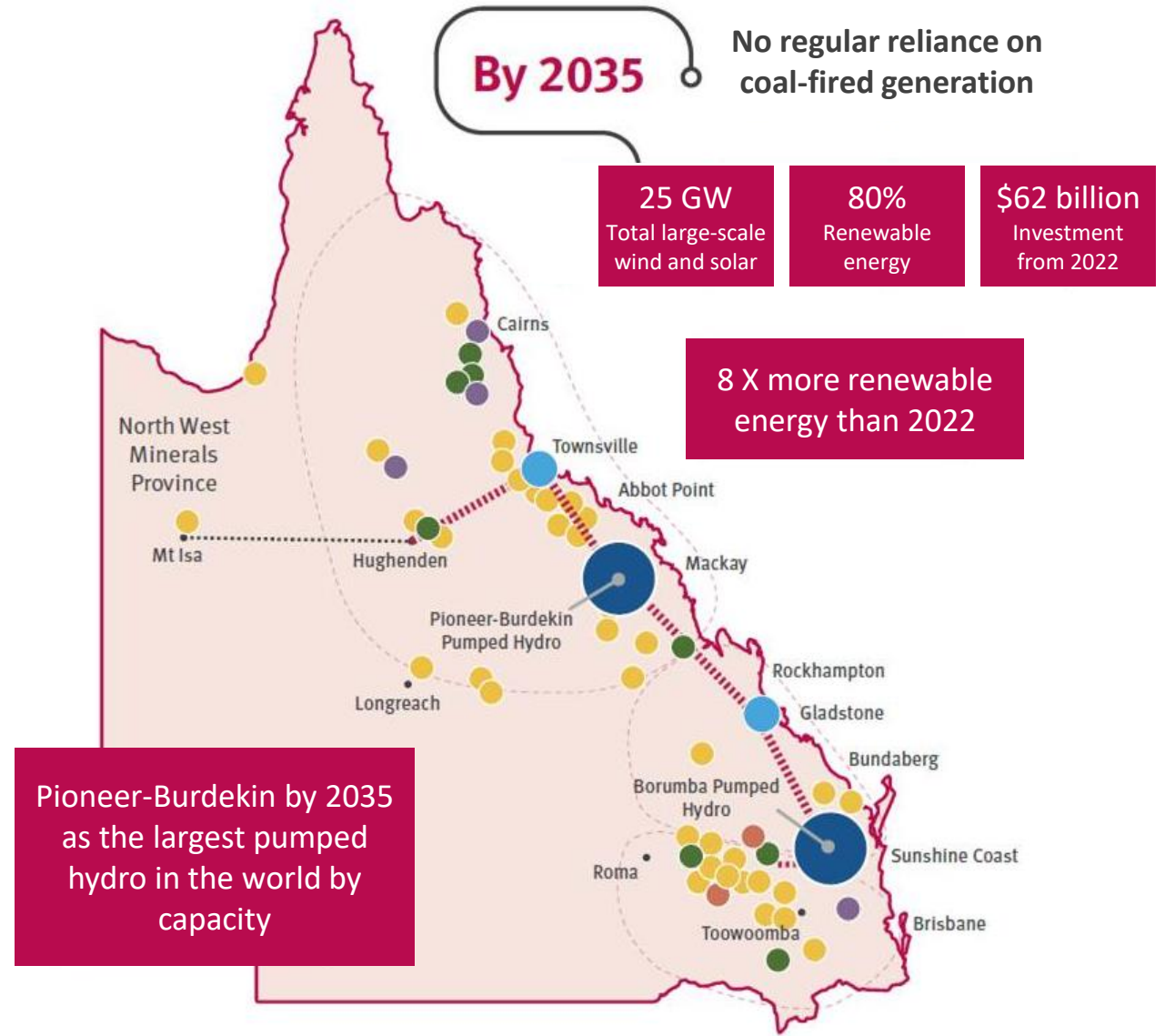
Borumba Pumped Hydro planned for 2030

New transmission connecting southern and central

Pioneer-Burdekin planned for 2035 (stage 1 - 2032)

New transmission to connect in Pioneer-Burdekin

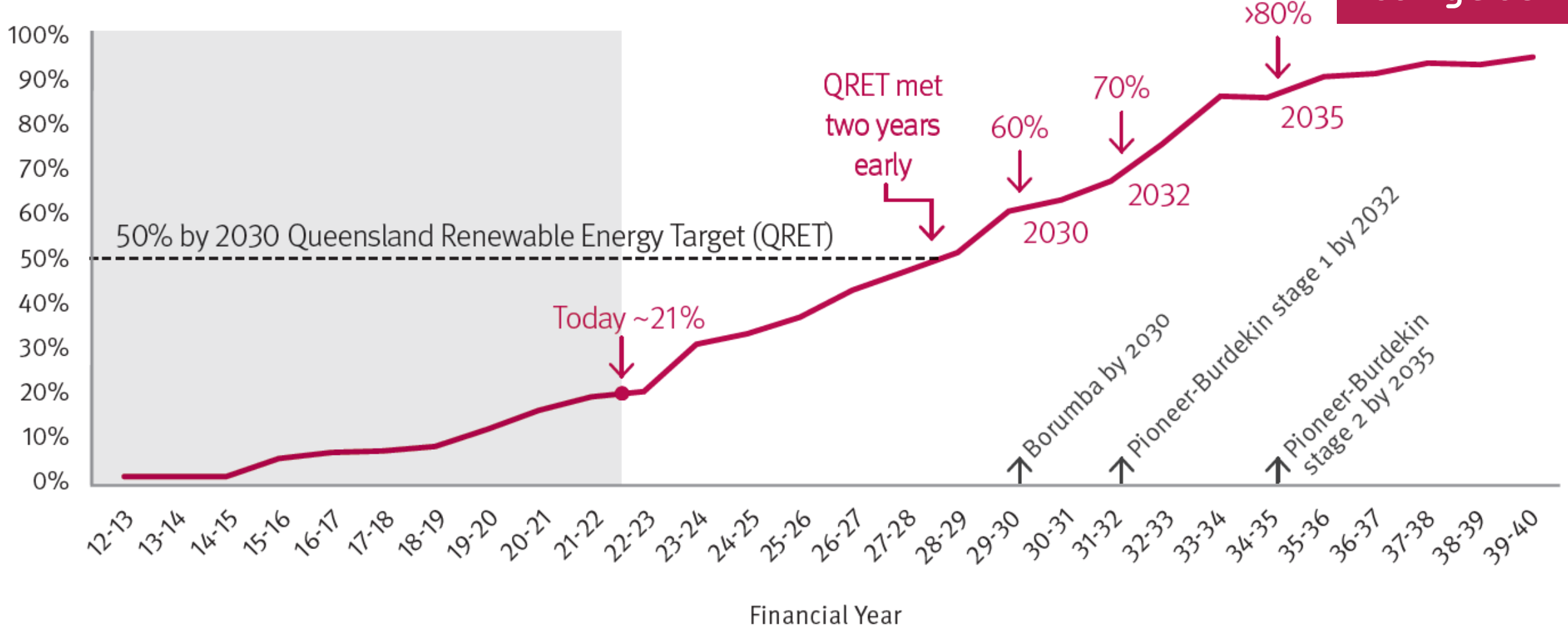
25GW total new and existing wind and solar by 2035



Beating our 50 per cent renewable energy target

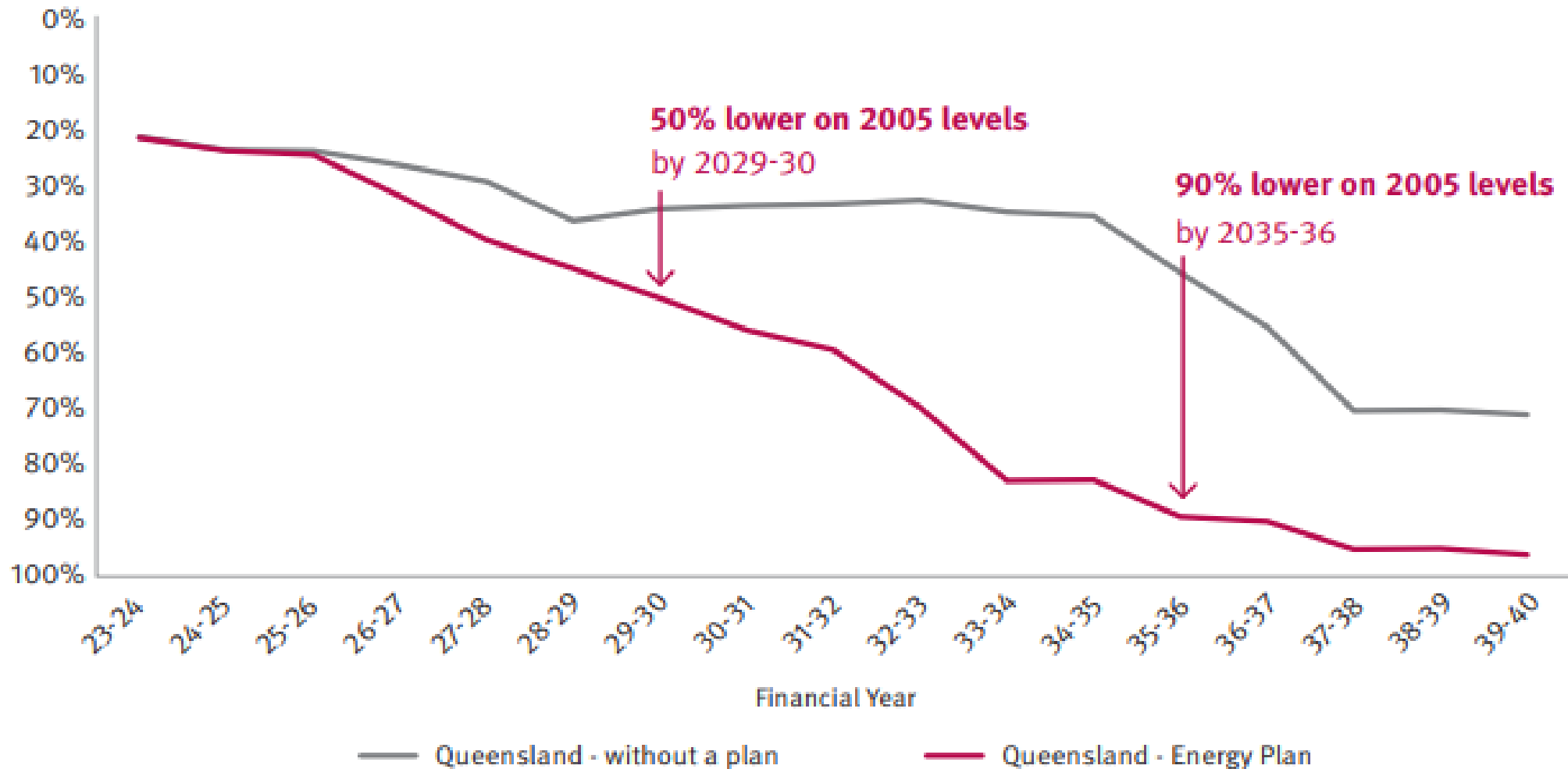
Renewable energy percentage under the Queensland Energy and Jobs Plan

New targets



Delivering substantial emissions reductions

Electricity emissions (reduction on 2005 levels)



A coordinated energy transformation



Checkpoints
every 2 years
from 2025



Renewable **Transformation Bill**

To be prepared in 2023 to legislate the new renewable energy targets, governance framework, the Job Security Guarantee and key enabling mechanisms like the Queensland Renewable Energy Zones framework.



Queensland Energy System **Advisory Board**

To provide technical advice to Government on updates to the Infrastructure Blueprint every two years starting from 2025, including on how to accelerate the transformation, and for an annual market snapshot to ensure Queensland continues to achieve the National Electricity Objectives.



Energy Industry **Council**

To provide advice to Government on a smooth transformation for workers and their communities. This Council will also provide input to key actions under the Plan including the Future Energy Workforce Roadmap and the Job Security Guarantee.

Legislative Package

Commitment to transition	
Renewable Energy Targets	NEW “Queensland Energy and Jobs” Act
Job Security Guarantee	NEW “Queensland Energy and Jobs” Act
Delivery of required infrastructure	
Delivering our SuperGrid	NEW “Queensland Energy and Jobs” Act
Advice and governance	
Queensland Energy System Advisory Board (QESAB)	NEW “Queensland Energy and Jobs” Act
Energy Industry Council (EIC)	NEW “Queensland Energy and Jobs” Act
Queensland Renewable Energy Jobs Advocate (Jobs Advocate)	NEW “Queensland Energy and Jobs” Act
Job Security Guarantee Fund	NEW “Queensland Energy and Jobs” Act

Commitment to Transformation

Queensland Renewable Energy Targets: *Certainty to investors, drive investment in renewables*

Enshrine three targets:



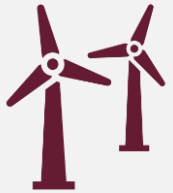
- 50% of Qld electricity generated sourced from renewables by 2030
- 70% of Qld electricity generated sourced from renewables by 2032
- 80% of Qld electricity generated sourced from renewables by 2035

Job Security Guarantee: *Guarantee to give affected workers in publicly owned coal fired power stations choice, opportunities and certain over their future.*



Legislate a statement of commitment to the Job Security Guarantee in the publicly owned energy sector

Delivering Transformational Energy Infrastructure



Delivering our SuperGrid: *Coordinated, efficient development of new transmission to connect renewable generators, storage and demand centres.*

New legislative framework to support delivery of our renewable energy zones and backbone transmission outlined in the SuperGrid Blueprint

Advice and Governance



QESAB: *Technical advice to government to remain on optimal pathway.*

Establishment and remit (advice to Minister to inform updates to Infrastructure Blueprint from 2025 and produce annual market snapshot on progress towards targets)



EIC: *Advice to government on opportunities and pathways for workers*

Establishment and remit (advice and recommendation to the Minister on smooth workforce transformation for coal fired power station workers)



Jobs Advocate: *Advice to government to champion jobs in the renewables energy sector*

Establishment and remit (advice to the Minister on workforce development including strategies for employment, education, and skills training with a regional focus)



Job Security Guarantee Fund: *Financially implement the Job Security Guarantee.*

Establishment and governance of fund (guidelines will be developed for dispersing funds)

Timeframes for Delivery

**New legislation
enacted by the end of
2023**

Development of
the exposure Draft
Bill



Refine Bill based
on consultation



Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec



Consultation on
the exposure Draft
Bill



Regional Energy Transformation Partnerships Framework

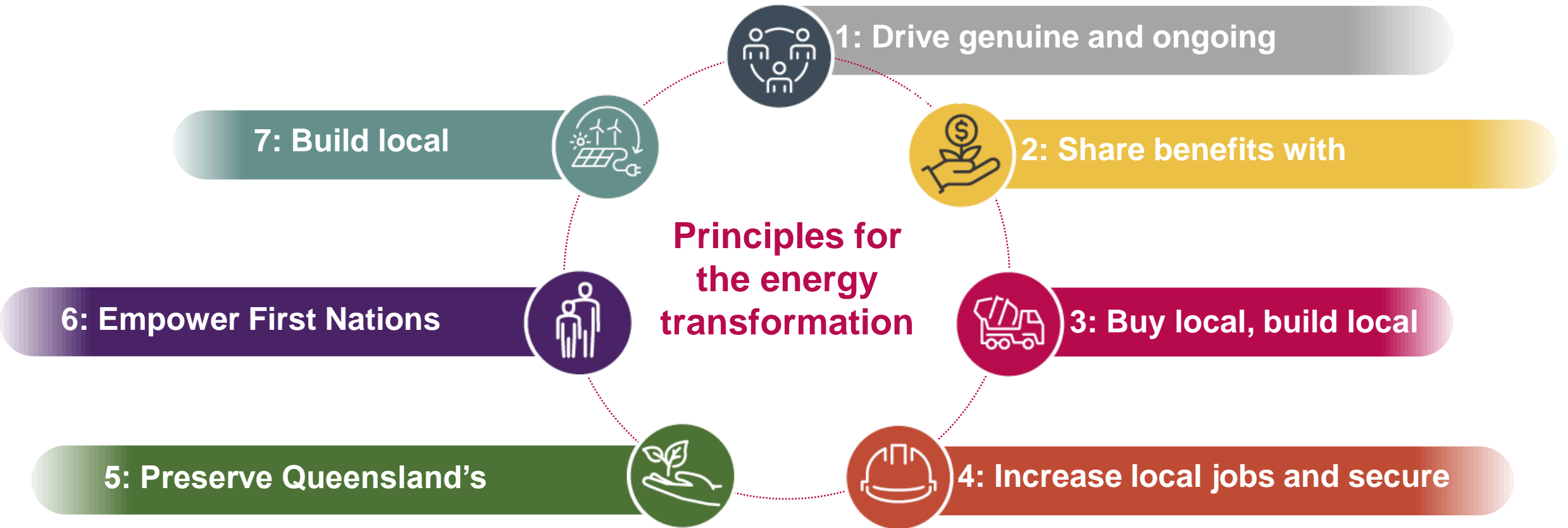


Our approach to:

- partnering with community, local government, First Nations people and industry
- delivering improved community outcomes from government initiatives and investment
- encouraging best practice from private investment into clean energy infrastructure
- **requires actions across government to deliver**

Consultation: late 2022 to mid-2023

Driving better social outcomes



Engagement Opportunities



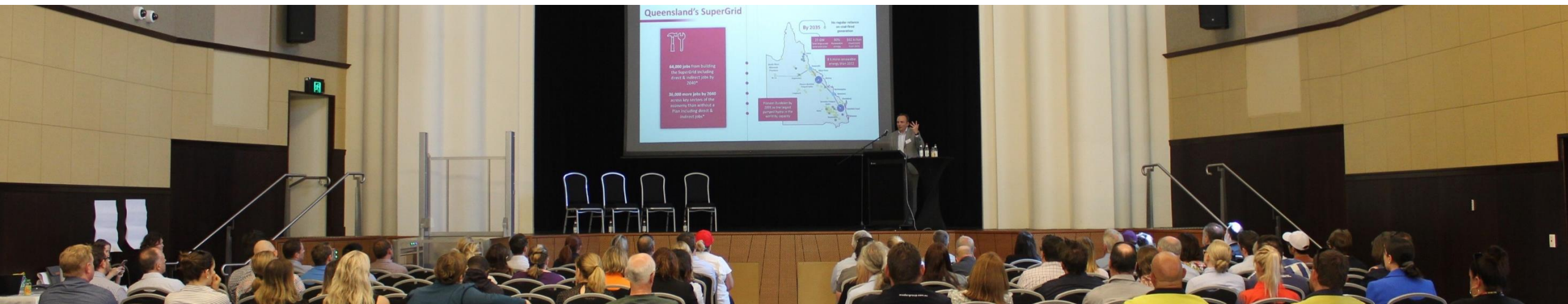
Targeted consultation across the state to give Queenslanders and industry more information about the plan and seek input for key implementation activities



Consultation on the **draft Regional Energy Transformation Partnerships Framework** is currently open. To identify further actions and help shape the Framework an online survey can be completed at qld.gov.au/energyandjobsplan



Community information sessions will help Queenslanders find out more about the plan and have their say. Upcoming sessions will be held in:
Cairns, Townsville, Mount Isa, Mackay, Emerald, Kingaroy, Rockhampton, Gladstone, Biloela, Thursday Island, Gympie, Brisbane and Gold Coast.



Powerlink's Supergrid Strategy



The QEJP and Infrastructure Blueprint



2022



2035

3GW transmission-connected wind & solar generation

8.1GW coal generation

Firming & storage mainly comes from coal & gas

Low demand growth

High amount of rooftop solar

25GW wind & solar generation

Some coal-fired generation remains, repurposed for system strength & inertia

Firmed by at least **6GW** of long-duration storage, **3GW** of utility-scale batteries, **3GW** of hydrogen-ready gas-fuelled plant

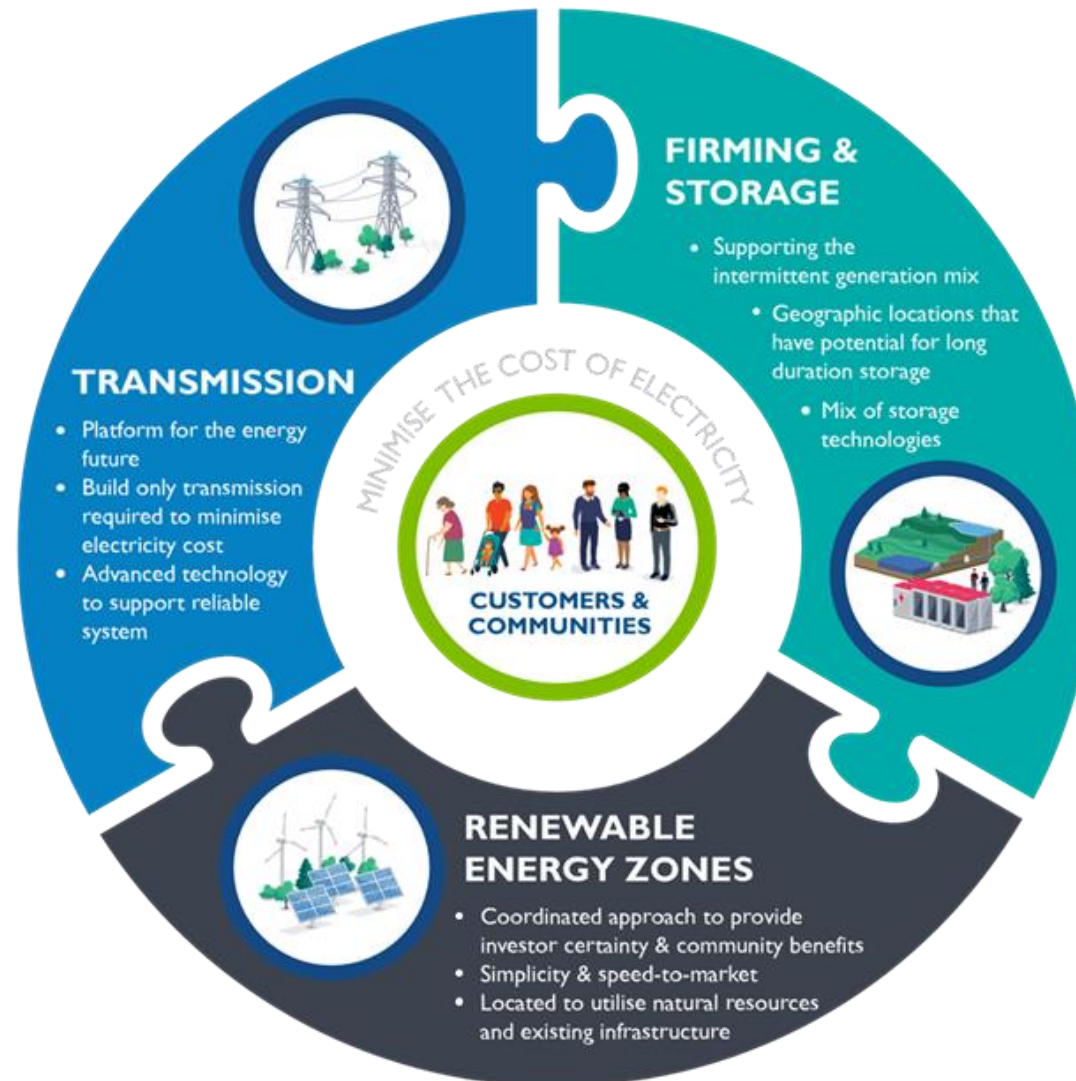
Electrification of heavy industry

Opportunities for greater flexibility on the demand side

Continued rooftop solar growth

Three Interdependent Elements

- Three interdependent elements to achieve the targets set out in the QEJP
- To progress the backbone transmission element we are developing a Supergrid strategy
- By 2035, expect power flows of 15GW to meet a 10GW demand due to need to charge batteries and PHES pumping loads.

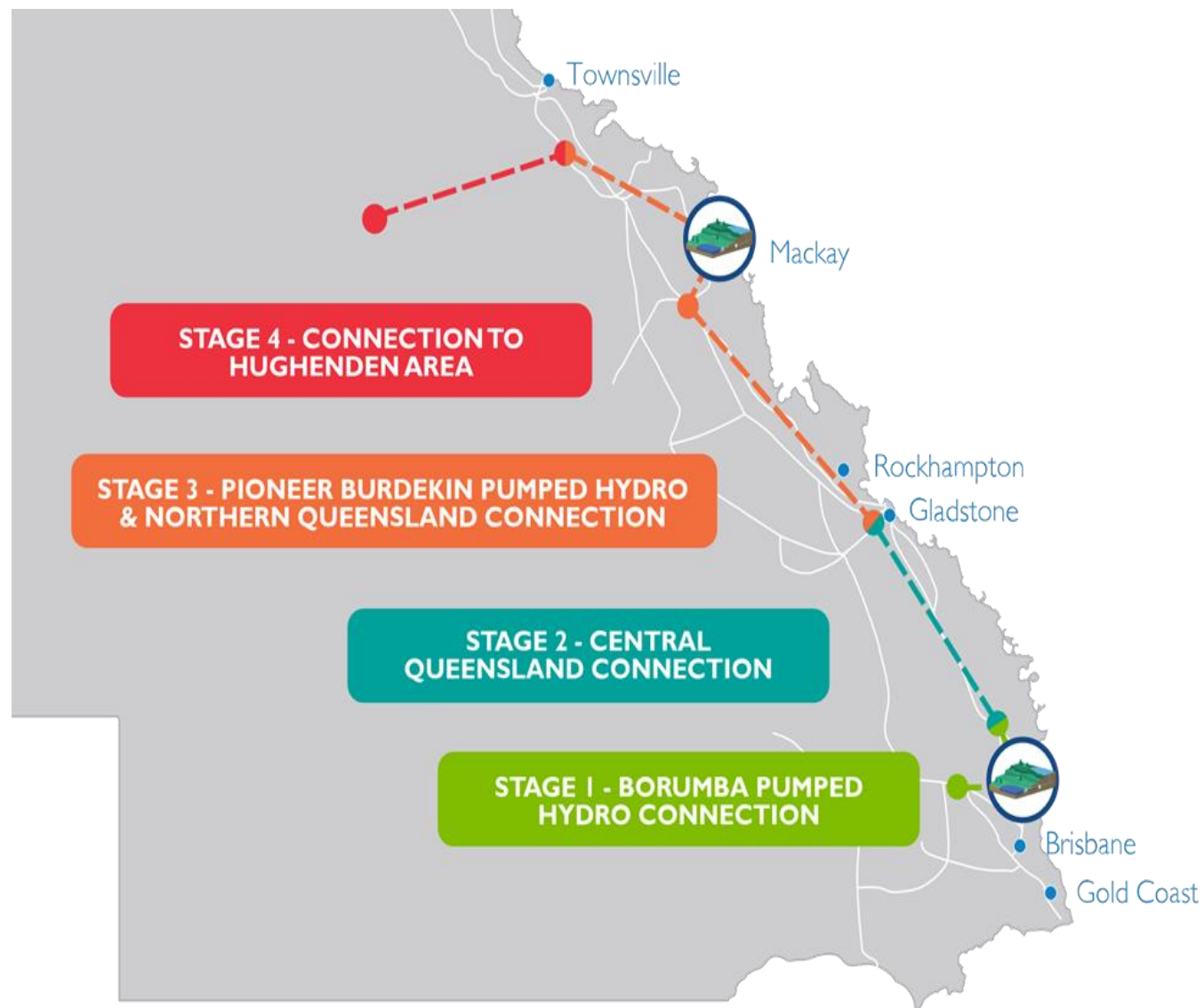




Powerlink's Supergrid Strategy

- Powerlink has developed its Supergrid Strategy to support
 - the objectives and timeframes of the QEJP and Infrastructure Blueprint
 - our planning and investment decision making processes for the establishment of the backbone infrastructure
- The Supergrid strategy
 - is based on original EY modelling for QEJP, plus subsequent additional modelling (including sensitivities)
 - presents options that support the network transfers required for the optimal generation development in QEJP
 - applies a whole-of-system planning lens to determine the most cost effective development path
 - presents the rationale and preliminary economic assessment in establishing a preferred development path
 - leveraging existing RIT-T processes
 - considers alternative variants (underground/overhead, AC/DC transmission, etc.)
 - provides the strategic foundation for individual, staged decisions for sections of the backbone infrastructure
 - which can be advanced within this whole-of-system plan.

Transmission Backbone Development





Options Considered

- Base case
 - incremental expansion of the existing transmission network at 275kV in line with the need timing of increased capacity
- Option 1 – 500kV
 - coordinated and staged development of an AC high capacity backbone supergrid at **500kV** (as outlined in QEJP)
- Option 2 – 275kV
 - coordinated and staged development of an AC high capacity backbone supergrid at **275kV** and **330kV**
- Option 3 - Hybrid
 - coordinated and staged development of a “hybrid” AC high capacity backbone supergrid at **275kV** and **500kV** (combines 500kV development north of Gladstone and 275kV development south of Gladstone).

Overview of Base Case and Options

	Base Case	Option 1 – 500kV	Option 2 – 275kV	Option 3 - Hybrid
New transmission lines (km)	3,585	1,550	4,200	2,390
New substations ¹	10	8	21	12
Expected Cost (\$m)	11,080	7,200	13,740	9,370

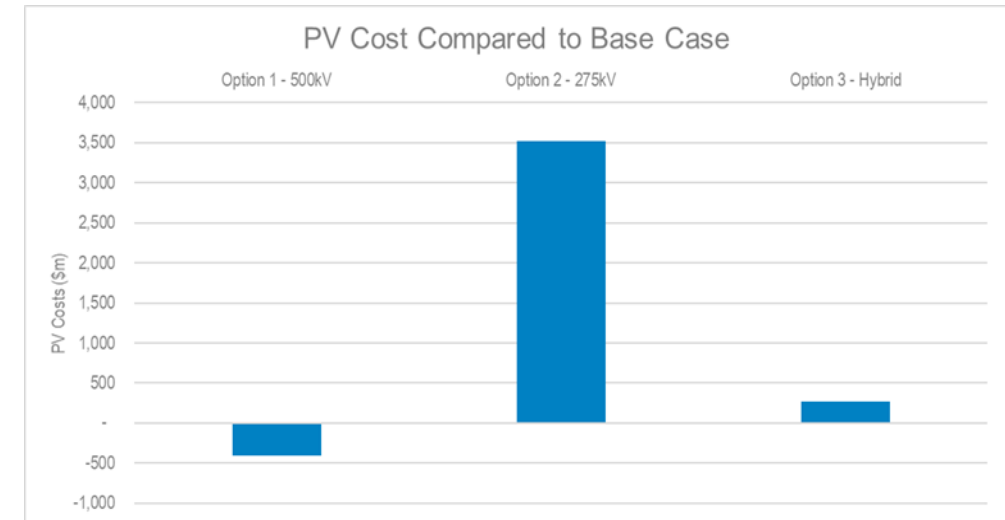
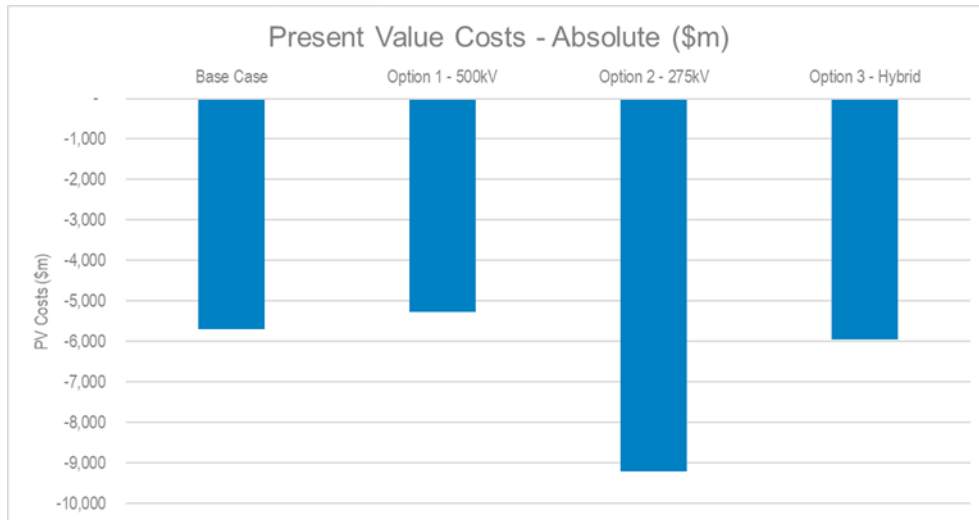
¹ New substations or substations requiring significant expansion (i.e. more than inclusion of switching bays for new feeders)



Conclusions

- The 500kV development path presents the least cost option in net present terms and also the least regret approach, as it:
 - is expected to result in lower transmission losses
 - requires fewer easement corridors (and hence least disruption in terms of community and landholder impact)
 - is more readily expandable for future development
- The 500kV development path is deliverable in the required timeframes based on expected transmission line construction capability in Queensland
- The Supergrid Strategy is also staged with individual investment decisions being made with the best available information at the time.

Present Cost Analysis



- 500kV option is the least cost in present terms
 - results in a total investment of around \$400 million (7%) less than the counter-factual base case
- The assessment will continue to be updated and refined and benefits will be considered as well as costs
 - losses will be modelled (relatively inexpensive) – expected to favour 500kV option
 - additional benefit assessment (such as fuel cost savings) will be considered with respect to both the expected materiality of the benefit and the expected cost to model that benefit effectively for all options
 - sensitivity and scenario analysis will also be developed to improve the credibility and confidence in the assessment outcomes

Considerations of Options

Consideration	Commentary
Constructability	Construction of around 1,500km of new transmission lines by 2035 considered challenging but achievable
Power transfer	Higher transfer capability per circuit at 500kV (up to three times more power per circuit than 275kV)
Transmission losses	Power transferred at higher voltages incurs lower network losses
Cost efficiency	Lower ongoing operational and maintenance costs (function of number of structures and transmission lines)
Easements	One 500kV double circuit line requires an easement (70m) half as wide as three 275kV double circuit lines
Future expansion	A second 500kV double circuit line would increase power transfer capability by up to 4,500MW – three times the capability of an additional 275kV. This would meet 2035 QEJP targets, and allow for additional capacity beyond these.
Operating contingency	Larger contingency size for 500kV when operating with only one circuit, e.g. under a planned or unplanned outage Larger consequence from a 'non-credible' trip of the double circuit (new technologies, e.g. WAMPAC, may reduce this limitation)
Lightning performance	May need to be de-rated when lightning is in the vicinity of any given transmission line (installation of surge arrestors may reduce this limitation)
Maintenance and spares	New standards and processes for system design and maintenance required Additional equipment and components will be required to be held as 'system spares'
Other	System strength benefits could arise through stronger coupling of the network provided by 500kV Enables a higher capacity QNI and facilitates a common voltage with NSW and Victorian 500kV systems



Considerations of Variants

- Underground cable elements to be considered for specific locations and informed by community engagement
 - UQ study (in conjunction with Curtin University) commenced into comparative assessment of underground and overhead transmission to inform approach
- HVDC construction limits flexibility to establish new substations along route to accommodate future connections direct to backbone transmission
 - trade-off lower cost of construction of lines (incl. underground) with significant increase in terminal station cost (and size)
 - will continue to explore this option to better understand benefits and limitations
- 330kV not considered suitable due to its relative high cost for minor capacity increase compared to 275kV transmission.

Regret Analysis

275kV	500kV
<p>Inability to deliver to the QEJP timelines:</p> <ul style="list-style-type: none">• significant reputational damage to Powerlink• targets for renewables unachievable – consequential impact to some \$55 billion of investments• lack of capacity to support decarbonisation of Queensland economy	<p>In the event of the failure of a PHES to commit:</p> <ul style="list-style-type: none">• need to re-evaluate the strategy based on the alternatives to the PHES development that is being pursued• potential under-utilised / stranded 500kV assets• reputational damage to Powerlink
<p>If 500kV required at later stage to support decarbonisation of Queensland economy:</p> <ul style="list-style-type: none">• under-utilised / stranded 275kV transmission line assets• reputational damage to Powerlink	<p>Double circuit 500kV could result in reduced resilience in the operability of the Queensland system</p>

- Based on this analysis the path of least regrets is the commitment to a staged 500kV development



Proposed Next Steps

- Continue to review and develop preliminary economic assessment to reflect forecast transmission losses and updated cost estimates for each option
- Work with AEMO to align future versions of the Integrated System Plan more closely with the QEJP, where possible under the National Electricity Rules
- Engage with the Customer Panel:
 - 16 Feb – this webinar to provide overview of Supergrid Strategy
 - 30 Mar – scheduled Panel Meeting to deep dive on supergrid approvals and consultation processes
- Submit approval requests for individual transmission development stages of work:
 - Feb – Board approval of ‘draft’ Supergrid Strategy and high level investment framework
 - Apr – Board approval for the Borumba PHES 500kV Connection (incl. phase 1 of 500kV Supergrid)
 - Jun – Board approval of ‘final’ Supergrid Strategy and investment framework





Discussion Points

Approach

- Your feedback now will guide preparation for the March panel meeting
- There may be merit in convening over and above the 30 March and 8 June meetings (between April-June)
- Please send Wendy an email if you want to be involved in additional sessions, or to share any thoughts you have subsequent to this session.
- We will be able to make the best decision on the need and nature of any additional engagements after the March 30 panel meeting

Discussion:

- Your initial questions and feedback?
- What are the areas that you feel we need to focus on with you in March?