Our Conversation

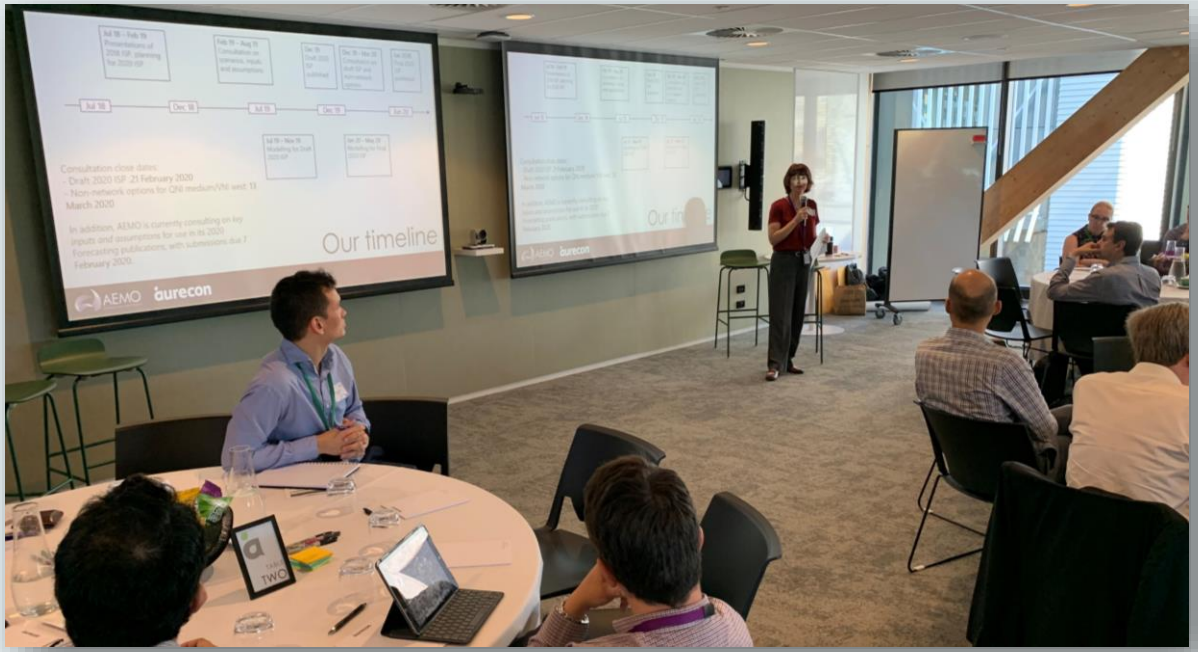
Integrated System Plan

Stakeholder Workshop | 3-5th February 2020

Contents

Following the release of the Draft 2020 Integrated System Plan in late 2019, AMEO ran a series of stakeholder engagement workshops across Brisbane, Sydney and Melbourne to foster industry engagement, gather industry feedback and to help shape the areas that could be further explored ahead of the final release.

These notes capture the conversation from the three days, the team output and the key themes that became apparent.



Welcome

Natasha Sinclair
Principal Analyst / ISP Stakeholder Engagement

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I would like to acknowledge that this meeting is being held on Aboriginal land.

I pay my respects to their Elders past, present and future.

Acknowledgement of Country

Natasha Sinclair,
Principal Analyst / ISP Stakeholder Engagement

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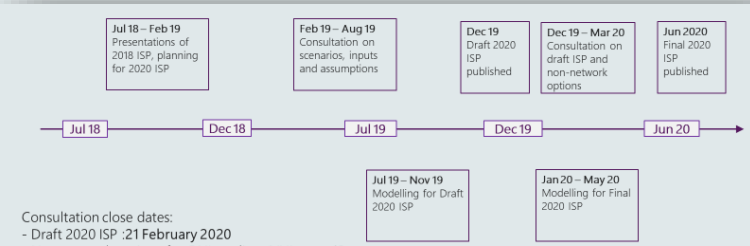

Consultation close dates:
- Draft 2020 ISP :**21 February 2020**
- Non-network options for QNI medium/VNI west: **13 March 2020**

In addition, AEMO is currently consulting on *key inputs and assumptions* for use in its 2020 Forecasting publications, with submissions due **7 February 2020.**

Our timeline

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- Provide an opportunity to ask questions and improve your understanding of the ISP process and outcomes
- Involve participants in the ISP process by requesting feedback and input to prioritisation of workscope for the Final 2020 ISP

Objectives of today

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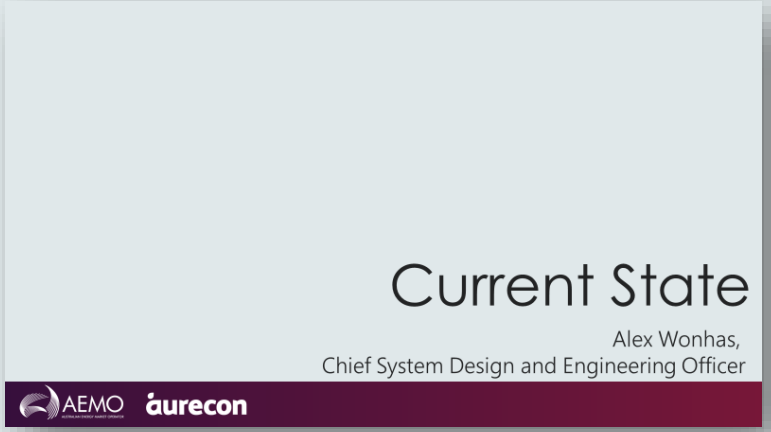

Current State

Alex Wonhas
Chief System Design and Engineering Officer

Today

Matt Roskam
Aurecon

- In case of emergency…
- Ground rules
- Our set up
- Photos
- Social Media
- Media

Today

- Reviewing the roadmap
- Understanding the details
- What else…

Agenda

At your table…

- Introduce yourself - name, company

then…

- What are you most excited about for the future?

Let's get
to know each other

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Introducing…the ISP

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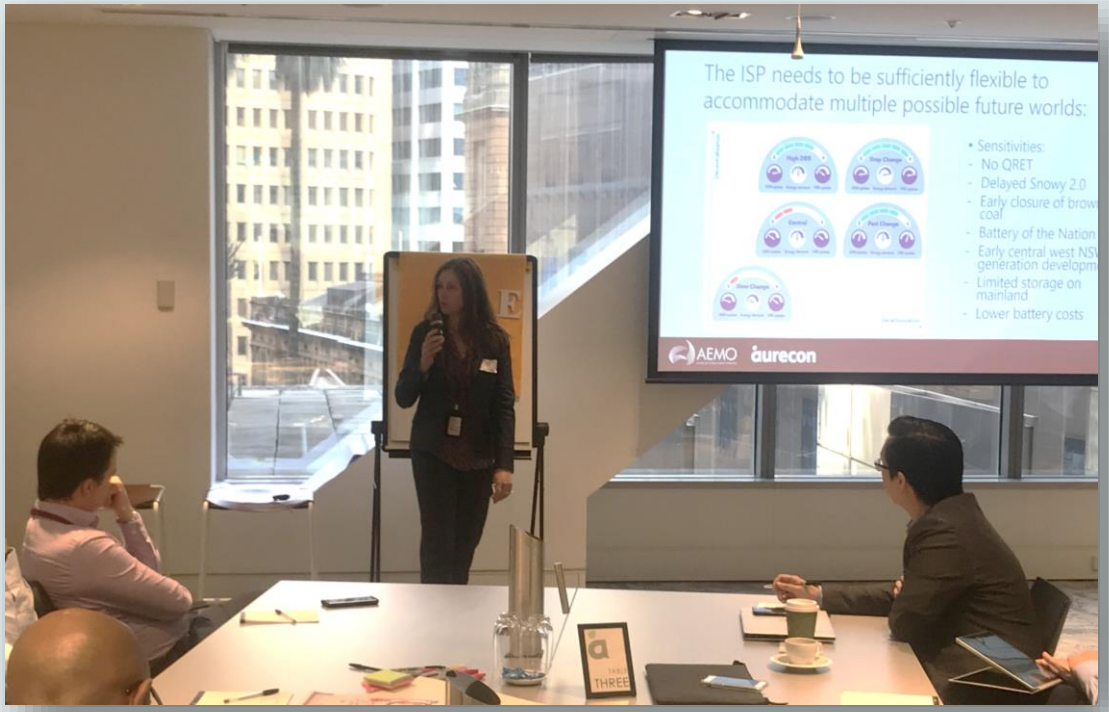

The ISP process

Nicola Falcon
GM Forecasting

Introducing…the ISP

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The ISP needs to be sufficiently flexible to accommodate multiple possible future worlds:

- Sensitivities:
  - No QRET
  - Delayed Snowy 2.0
  - Early closure of brown coal
  - Battery of the Nation
  - Early central west NSW generation development
  - Limited storage on mainland
  - Lower battery costs

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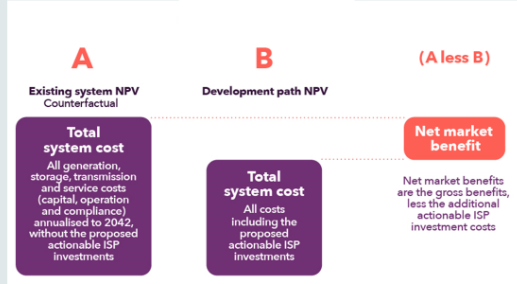
..with the recommended actionable ISP being one that delivers positive net market benefits while retaining flexibility



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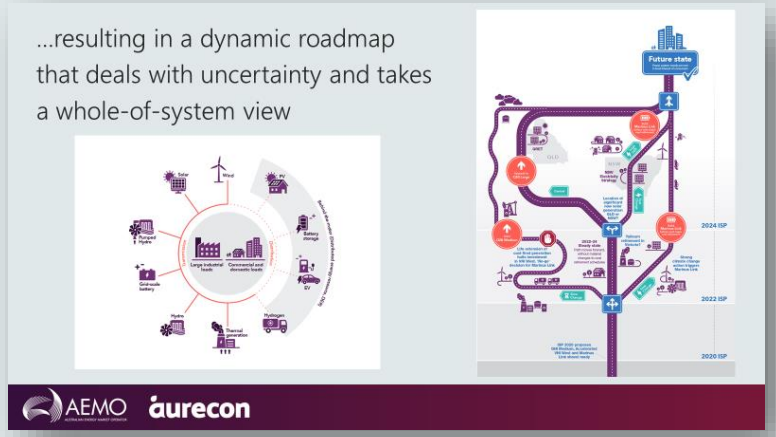
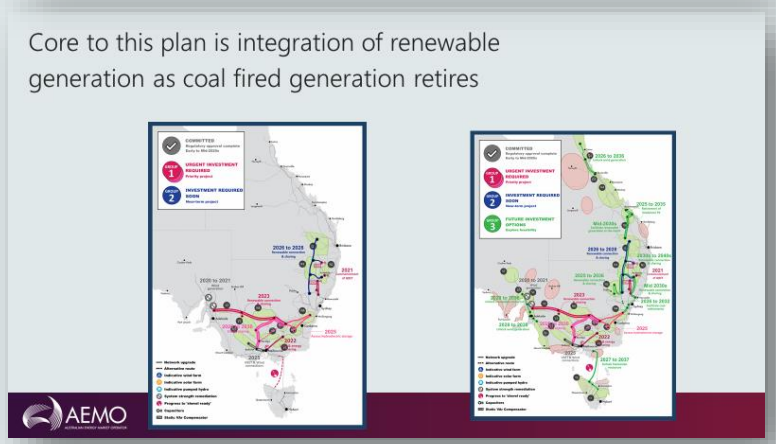
A dynamic roadmap

Craig Price
GM System Planning





- Further validation of the plan through detailed hourly simulations
- Resilience to climate change – we will be including a chapter on this in the Final ISP
- Central West NSW REZ – other sensitivities with generation development in this zone
- Choice of route selection for VNI West
- In step change scenario, are we confident the system is operable in 2040?
- Cost increases on interconnectors or generators (capex generally)
- Projections of Marginal Loss Factors (MLFs)

Prioritisation for final ISP

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At your tables, read and discuss the roadmap. We'd like you to have a conversation within your group to help each other make the 2020 ISP as robust as we can.

We'll capture some of your thoughts as we go

I like the ISP, it's good to have and communicates some pretty complicated modelling

It isn't clear what the process is from ISP to action? Who makes the decision about which transmission is built?

Here are some of the common themes and insights we heard at all three locations.

If you're looking for all of the output, take a look here

I like

- That AEMO are accepting feedback
- I like the staged development approach
- Engagement with industry
- Coordinated view, thinking across state lines
- Quality of data inputs
- Fast change scenario
- Clear definition of REZs
- Great intro for someone new
- Highlights we have a world of building in contingencies
- Focus on flex & adaptability
- Range of scenarios considered especially use of step-change
- That there is now a plan that looks to the future

I think a gap is…

- What if VRE & DER are even higher?
- Climate impact risks/ sensitivities
- Will it lock out new technologies?
- Where is firming coming from?
- A scenario without policy overlays
- Plan for system security
- Ability to physically deliver the assumptions in the scenarios e.g. DER investment
- Alternative capabilities of batteries in delivering system services
- Estimate consumer costs by scenario
- Who is paying for it?
- Resilience
- Politics
- Are there other smaller options that will create benefit for lower cost?

It isn't clear…

- Where did REZs build limit come from?
- What is the best way to allocate cost that ensures equity & risk?
- What is the best system for greater resilience?
- Timing & national coordination
- What is different now that the ISP is "actionable"
- What's the process from ISP to it being actioned? Who makes the decision about which transmission is built?
- Priorities of projects
- Assumptions that go into ISP – more transparency
- Adaptability to change when ISP final
- Limited discussions on battery
- No mention on system strength & inertia

Session 1 – The Roadmap
Summary

Understanding the details

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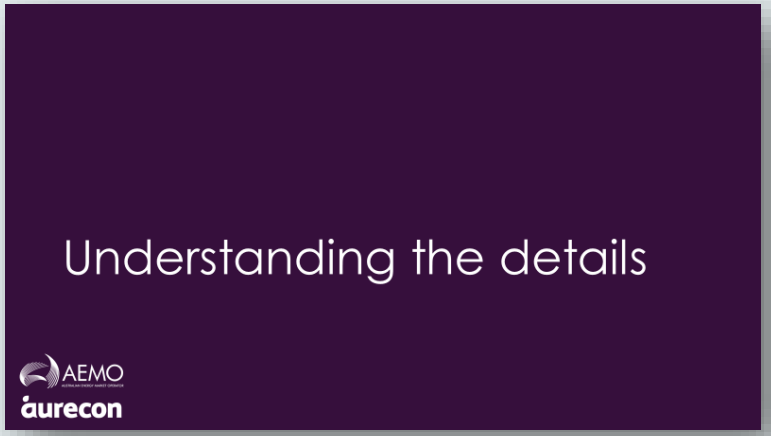
In the lead up to today's session, we asked you to submit any questions you might have after reviewing the ISP.

We've themed the questions and picked out a couple that popped up consistently that we'll ask our panellists to answer.



How was the dispatch order of the various energy storages (batteries, PHES of varying durations, DR etc) determined?

How do consumers get confidence that this investment is a “no regrets” when net benefits in all of the above scenarios are only between 1-2.5% of “total system costs with projects”?

Your modelling for each scenario was based on a mix of generation and transmission that achieves lowest system cost. You've said that the "Step Change" incurs higher costs due to closing existing coal-fired generators early. How much more costly is "Step Change" than Central? Would consumers see significant cost increases?

Could you explain how the ISP has considered non network options?

Would the optimal development path be affected by more build of local generation and storage?

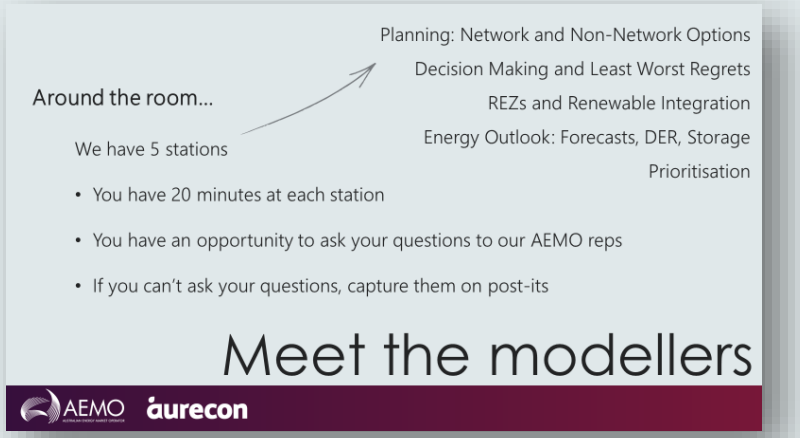
How is the Renewable Potential and Hosting Capacity in the score cards specifically determined, and what are the underlying assumptions for each Loss Factor Robustness forecasts in REZ score cards ?

We've grouped some of the content and early feedback into 5 key topic areas.

You now have a chance to have a deeper conversation about these topics with the modellers and ask them any questions that you may have had while reviewing the ISP.

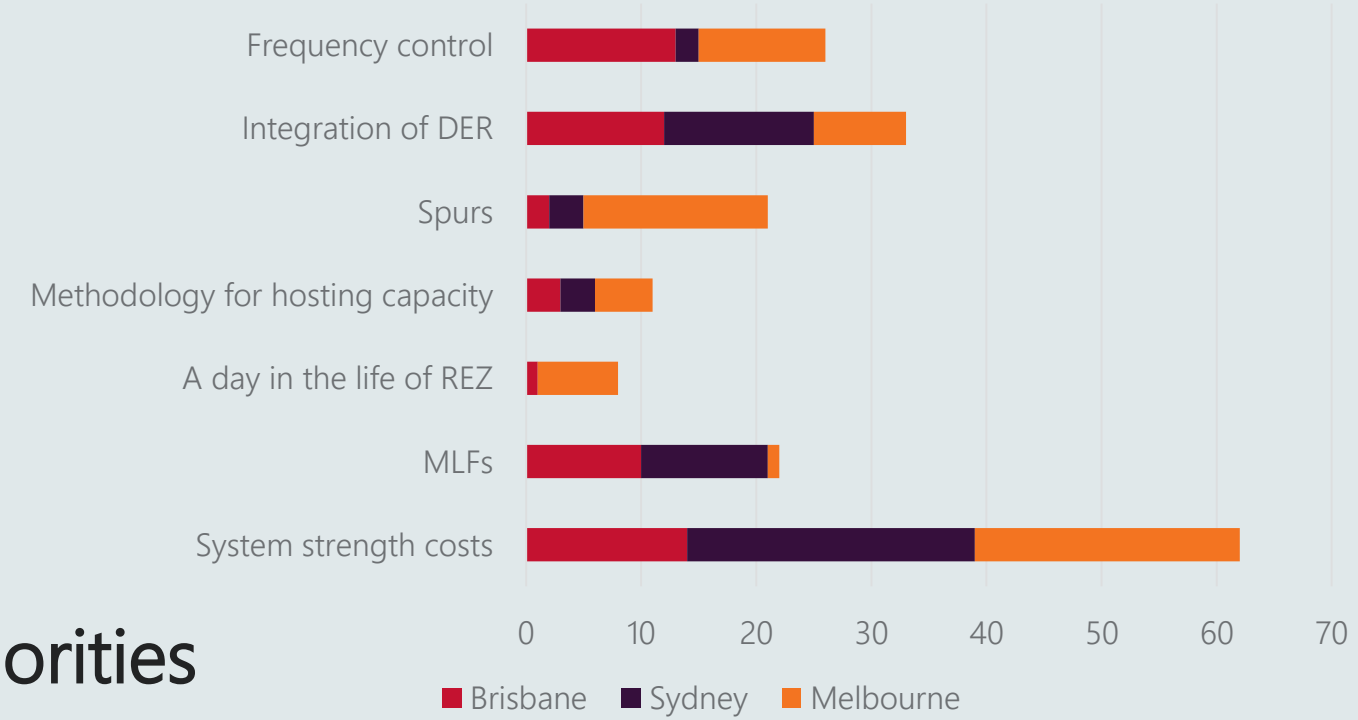
There are also a number of areas that we'd like you to vote on, to help us prioritise what further work AEMO could do over the next 3 months, ahead of the final release. You'll be given a number of stars at each of the stations and asked to vote on which is important to you, and/or add other suggestions.

You'll have 20 minutes at each stage and then we'll rotate. You'll have a chance to spend time at each of the five stations.



Other suggestions from the group…

- In a REZ can provision of energy be decoupled from system services?



REZs & Renewable Integration Priorities

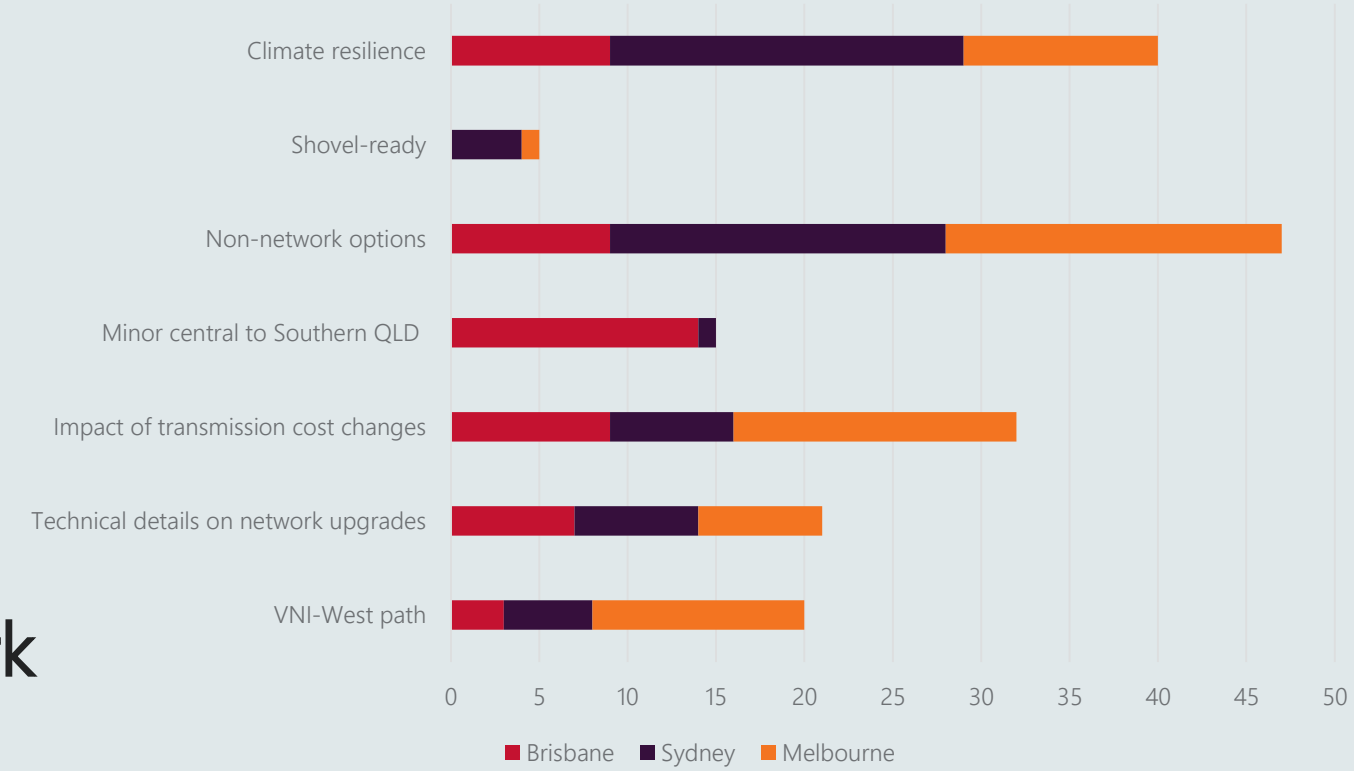
Station 1 Cumulative votes

Planning - Network & Non-network Options Priorities

Station 2 Cumulative votes

Other suggestions from the group...

- Sensitivity analysis on 'QNI Medium'
- Is Marinus a key step in resilience of NEM
- What if the ISP ignored the RIT-/+ limitation on net benefits
- Sensitivity to network timing to zonal non-network options by scenario to supplement value analysis

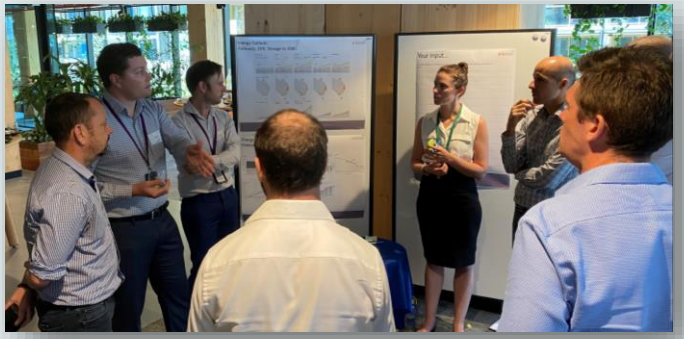


Other suggestions from the group...

- Improved transparency on max demand forecast
- Clarification on storage & PHES
- What's the spillage assumed in the modelling
- What's driving the scale of behind the meta story? How is it so large when compared to large scale battery?
- Can you consider a scenario without snowy 2.0?
- Potential disconnect between battery assumptions (large scale) VS observations - what about new value in a 5 min market
- Do you include microgrids in modelling?
- Does wind input include offshore?
- Is this a scenario for breakthrough technology?
- Would change of economics of solar/wind affect selection of REZ
- Can you publish typical day or worst day scenarios?
- Can you model a high load/low DER scenario?
- Stability and reliability of demand forecasts (look at 2018 vs 2019 peak for Vic)(No overlap of range)
- Coincident peaks - NSW/VIC (Friday, Jan 30)
- POE IO (Peak demand) demand occurring routinely - climate rebated
- High demand with low DER
- High electrification
- Low DER control
- Faster regional pricing

Energy Outlook

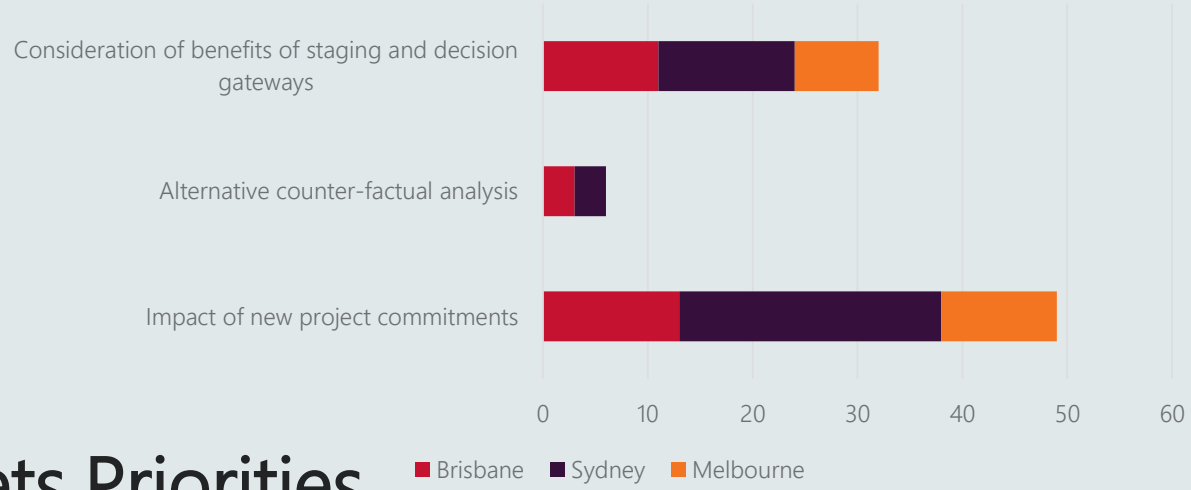
Station 3



- Validity of weather data - diversity, capacity factor
- Interaction of emission constraints and retirements
- Different storage tech and their utilisation
- Breaking out storage options (including non-pumped hydro)
- Value proposition to customers (market structures, commoditised, situational changes)
- Connecting customers to the market signals
- Minimum demand study
- Energy efficiency and demand management as a pathway to least cost and verification
- Implications for market reform
- Utility scaled battery sensitive
- Concept 5min data in 5min period
- More info about the drivers for taking out coal fire stations
- Consequences (and probability) of sustained wind/water/solar drought (resilience)
- Pumped hydro is far more problematic than batteries
- 2040 be less specific for storage type
- Don't assume perfect foresight for BESS - will need more and it will be less economic
- Impact of seasonal advantage on snowy 2.0
- Add state schemes as an input (i.e. BESS programs)
- Industrial load retirements (smelter impacts)
- Commercial viability of PHES on mainland. No developed even though there are sites
- NWTAS REZ wind capacity! Factors are low given plants are now 10-15 years old. New plants are more efficient!
- Interactions of AEMO trials including VPP & system strength investigation
- Let this market decide on grid scale storage (sets the scene) BESS
- Sensitivities on PHES Capex assumptions
- Sensitivities to gas price?
- High consumption: hydrogen, EV, low AUD
- Demand destruction under step change scenario sensitivity

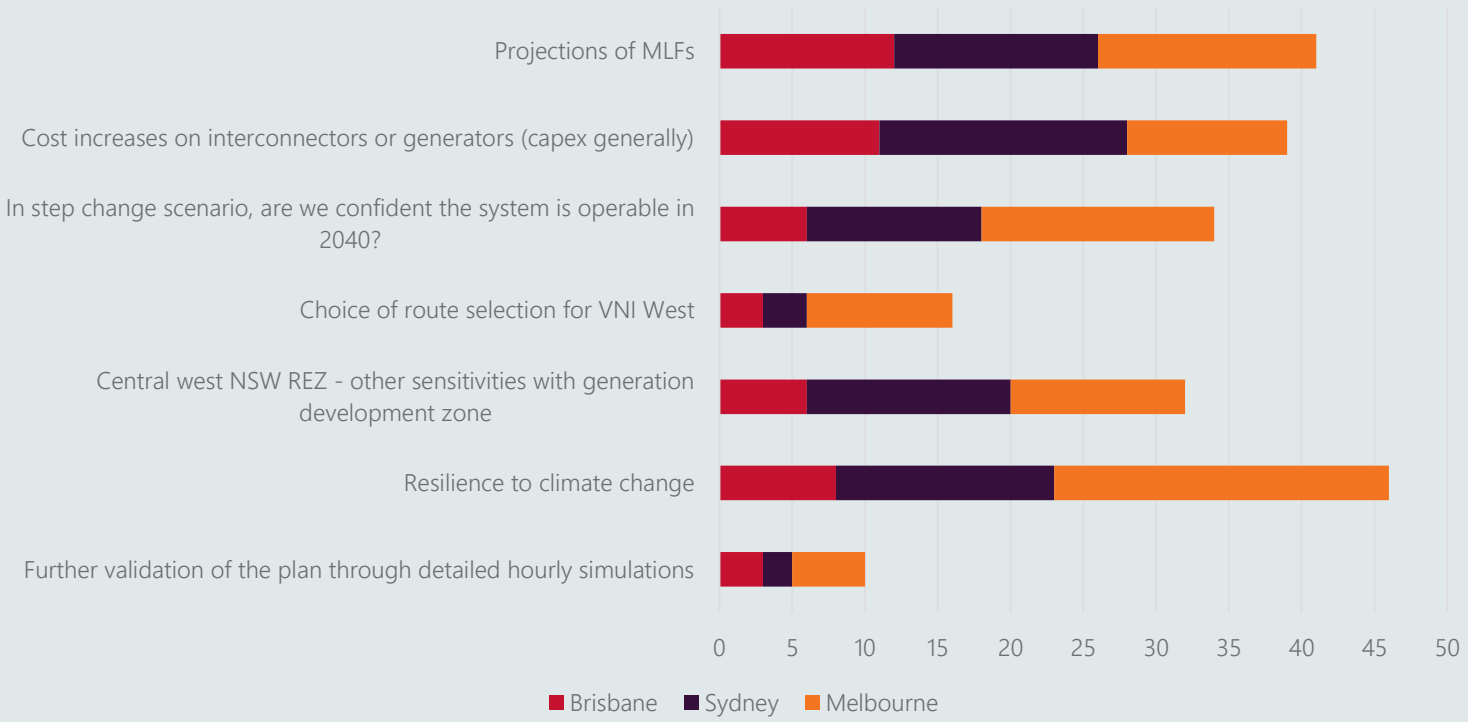
Other suggestions from the group…

- How will different scenarios lead to project commitments?
- Managing risk: What options have other 'future-proofing- benefits? (e.g. resilience)
- Policy commitments
- Alternative technologies for early retirement
- Increased incidence of non-credible events
- "True" least cost modelling scenario (e.g. without policy overlaps)
- Shovel ready transmission projects?



Decision Making & Least Worst Regrets Priorities

Station 4 Cumulative votes

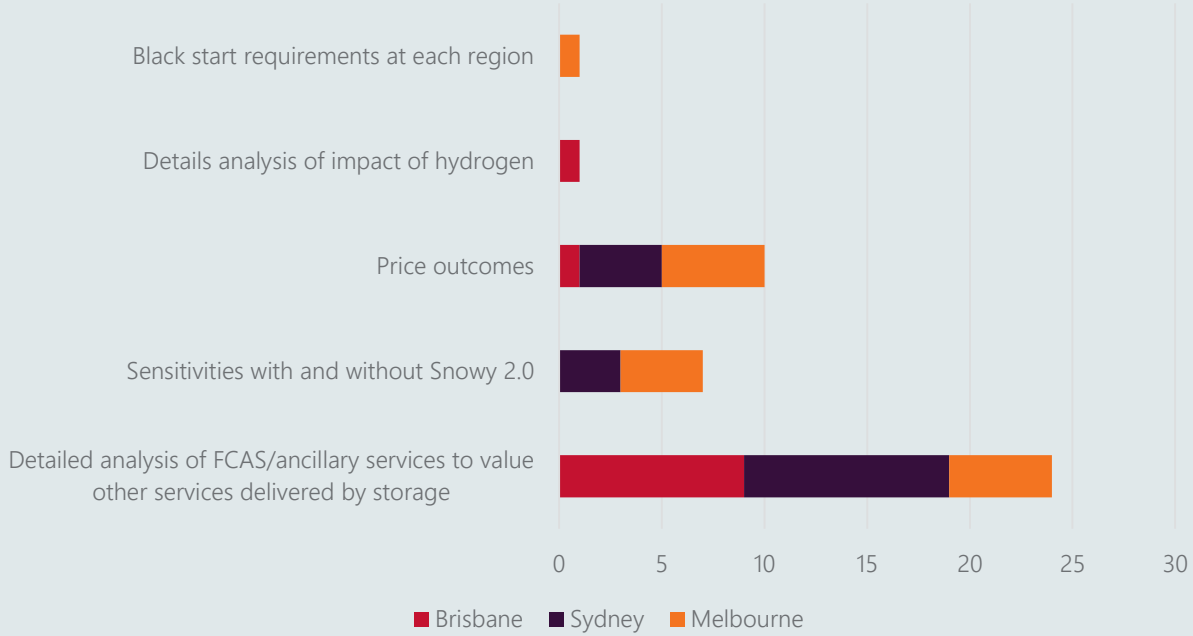


Prioritisation for Final ISP

Station 5 Cumulative votes

Other suggestions from the group…

- System strength
- Step Change sensitivity
- Risk of "baking in" risk - renewables in one node, customer in another node
- Keep grid scale storage - open market decides
- Market benefits on a project basis & impact on actionable path
- Buildability and build rates
- Quantum shift - faster or further than step
- Sensitivity analysis on EV uptake. Remove choice of route VNI WEST



In prioritising the most important aspects to analyse, it has been necessary to identify items that are "nice to have" but may be unable to be delivered in time for this ISP

Please add a star on anything you feel should be prioritised ahead of the other items we've discussed

Suggested workscope areas that have been screened out

Station 5

Given that you've been in your groups having some very detailed conversations, we thought it would be worthwhile hearing from our AEMO reps about what they heard.

Energy Outlook

Behind the meter, VPPs, battery storage and uptake of EVs
Storage, value to system and the different types
Connection between revenue maximisation and cost minimisation
Operability of system, e.g. wind farms
What about pumped hydro and lithium
Have you considered market reform
Retirements – emissions and least cost

Prioritisation for Final ISP

MLFs
Capex increases
Resilience to climate (bushfires / extreme heat)
FCAS
Central West NSW REZ

Decision and Least Worst Regrets

Robustness of plan and input assumptions
Appropriateness of scenarios, do they need more weighting?
Benefits identified
Project and policy commitments
Do projects and policy define pathways

REZ & Renewable Integration

DER controllability
When will the RIS study be released?
What about frequency control?
Have you looked at system strength
Who is responsible for the cost?
Can this be treated as an input not just an output
Methods and approach to solving MLF issues

Network & Non-Network Options

Climate resilience, in particular bushfire considerations and space between transmission lines
Economics of non-network options such as FCAS
Interconnector individual modelling
Route selection, spoken about generally
What is the system strength at each REZ

At the stations, our modellers had some great conversations and heard some strong reoccurring themes

Here's what we heard...

What else…

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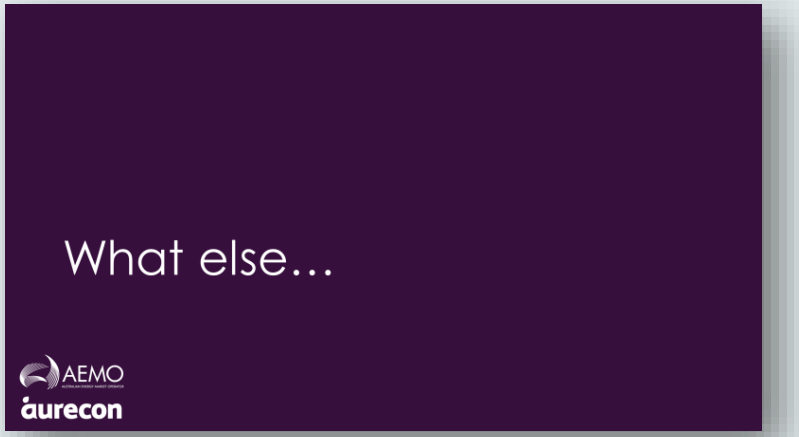
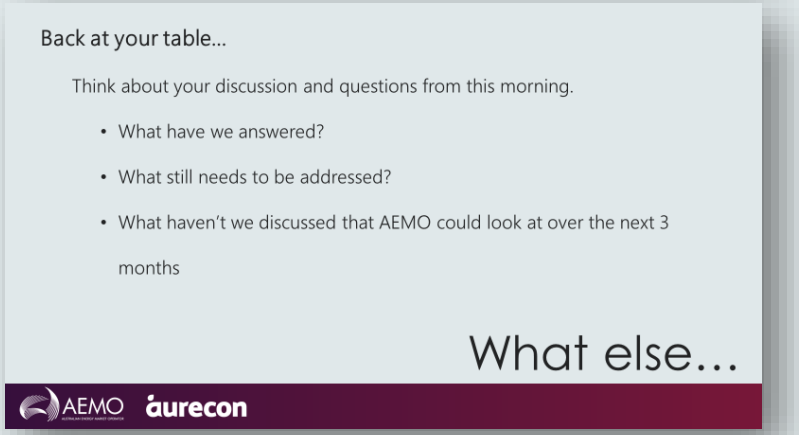
Through the course of the morning, you've helped us to start prioritising things we could look at. Lets build on this and make sure this plan is robust.

Think about your discussions this morning and questions you've asked.

What haven't we discussed that AEMO could look at over the next 3 months? What still needs to be addressed?





How to execute the plan

Timing of delivery

EVs

Commentary on FCAS markets

Battery Options

Navigating politics

Pumped Hydro

Total System costs for each scenario

Sensitivities

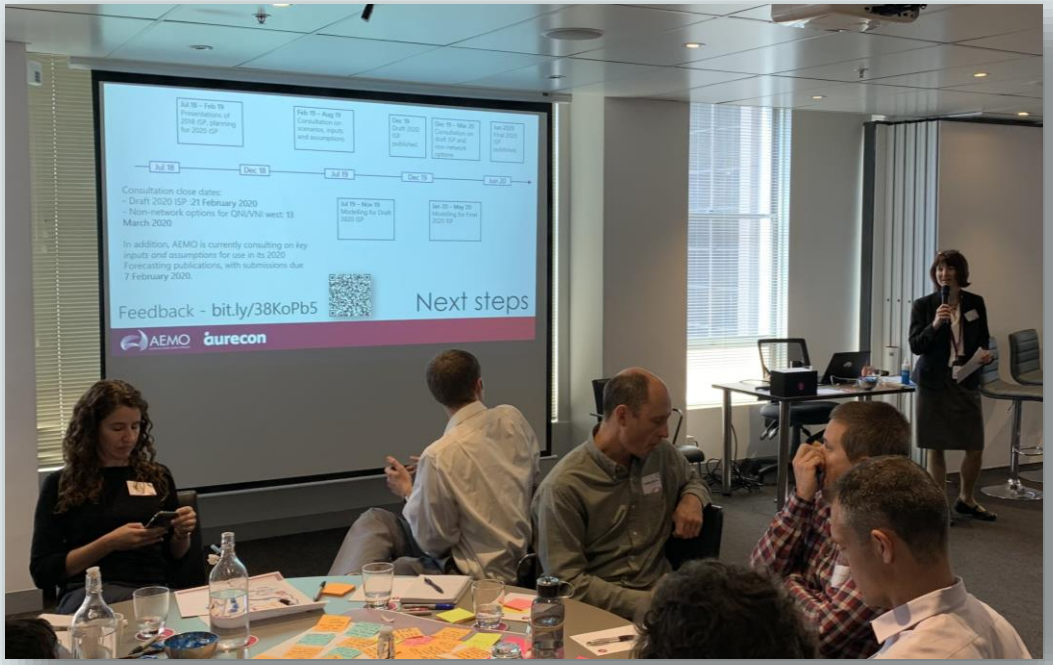
Flexibility or ability to change optimal paths

Allocation of Costs

What else?

Here are some of the common themes and insights we heard at all three locations

If you're looking for all of the output, take a look here



Next Steps

Natasha Sinclair
Principal Analyst / ISP Stakeholder Engagement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Thank you!

Appendices

We had some great conversations and heard some important things when we were in Brisbane, Sydney and Melbourne…

We've captured the raw notes and conversations from our sessions, here in the following appendices.

Table output

Introducing…the ISP

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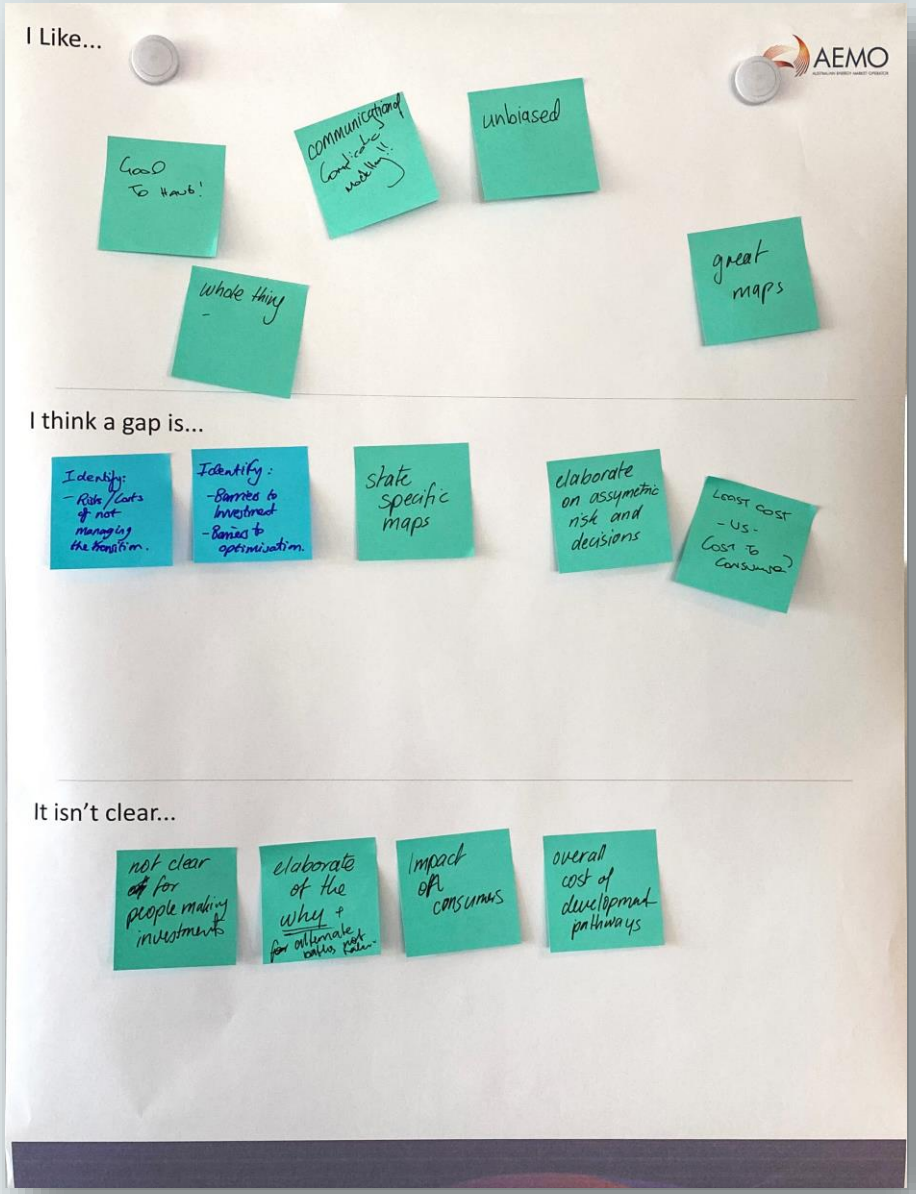


I like

- Good to have!
- Whole thing
- Communication of complicated modelling
- Unbiased
- Great maps

I think a gap is...

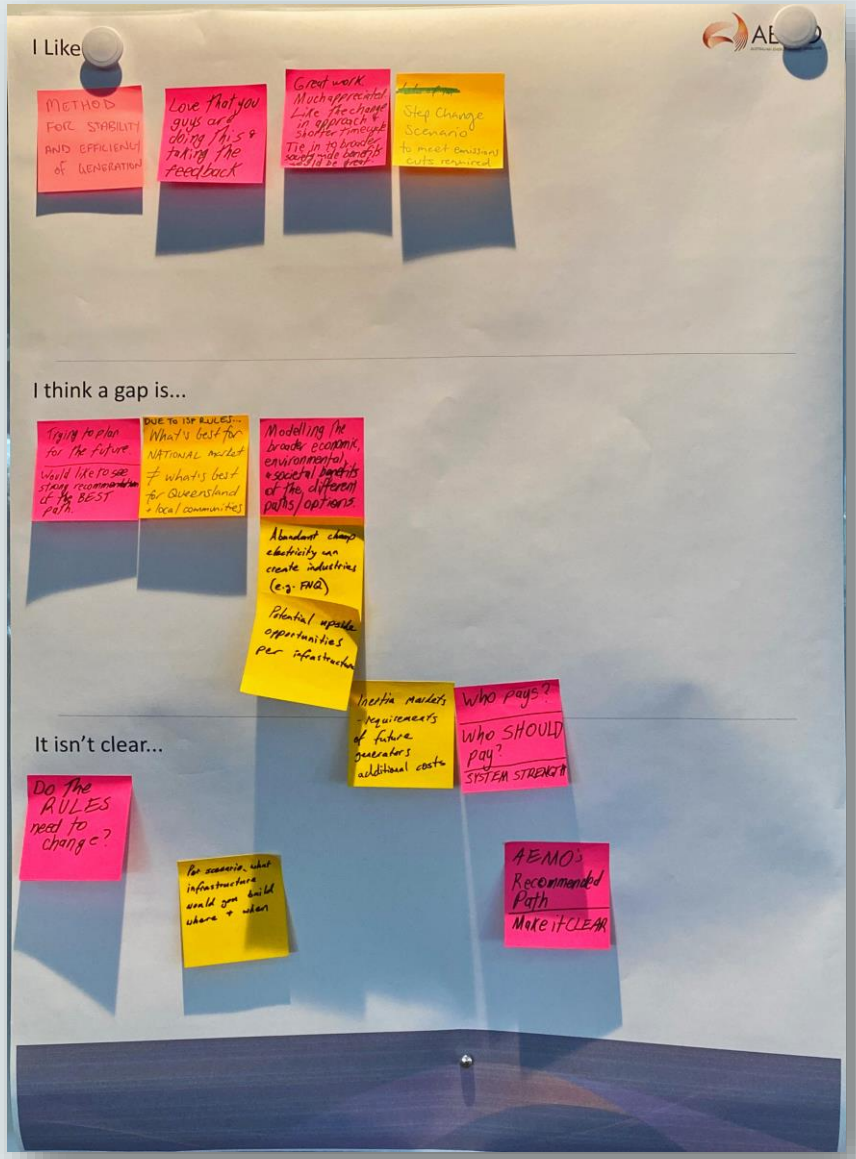
- Identify:
  - Risks/ costs of not managing the transition
  - Barriers to investment
  - Barriers to optimisation
- State specific maps
- Elaborate on asymmetric risk and decisions
- Least cost vs cost to consume?

It isn't clear...

- Not clear for people making investments
- Elaborate of the why & for alternative paths not taken
- Impact of consumers
- Overall cost of development pathways

Table 1

Brisbane



I like

- Method for stability and efficiency of generation
- That AEMO are accepting feedback
- The change in approach & shorter time scale. Tie into broader society wide benefits would be great
- Step change scenario to meet emissions cuts required

I think a gap is…

- Trying to plan for the future – would like to see strong recommendation of the BEST path
- Due to ISP rules… What's the best for national market doesn't equal what's best for QLD and local communities
- Modelling the broader economic, environmental and societal benefits of the different paths/options
- Abundant cheap electricity can create industries (e.g. FNQ)
- Potential upside opportunities per infrastructure
- Inertia markets – requirements of future generators and additional costs
- Who pays? Who should pay? System strength?

It isn't clear…

- Do the rules need to change?
- Per scenario, what infrastructure would you build where + when
- AEMO's recommended path

Table 2

Brisbane

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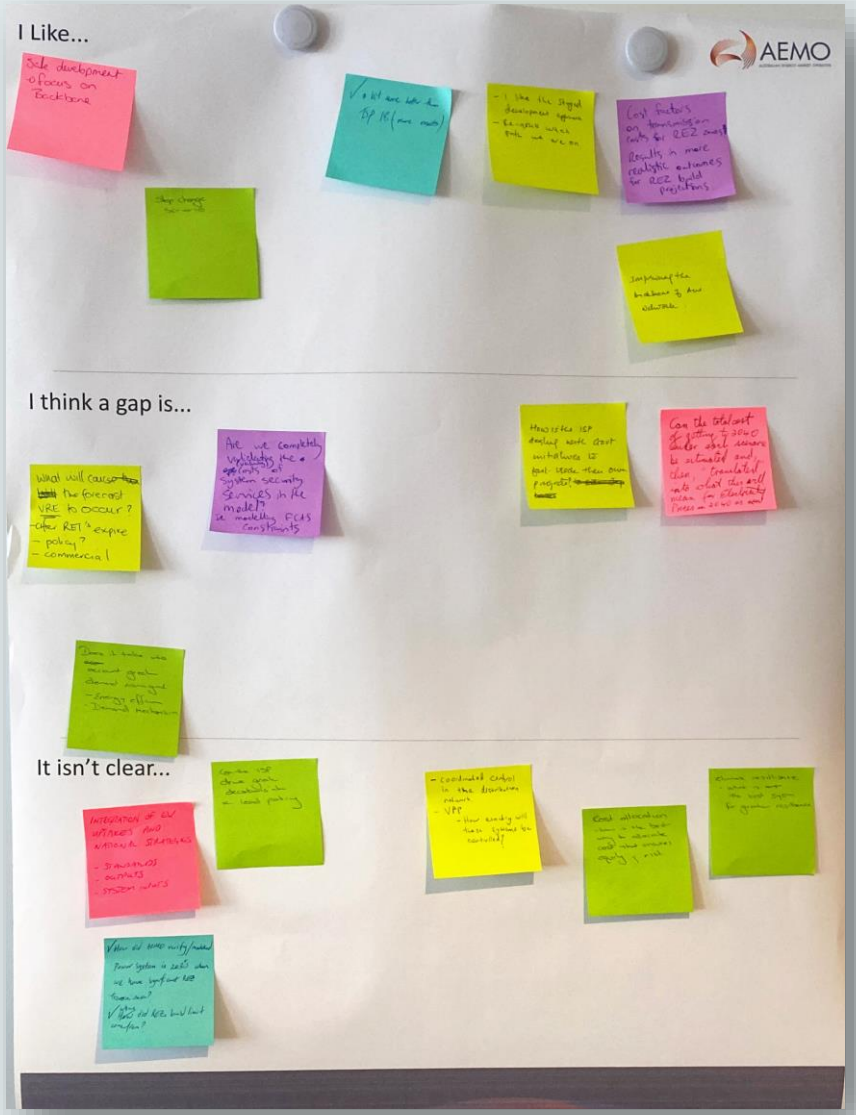


I like

- Safe development
  - Focus on Backbone
- Step change scenario
- A bit more better than ISP 18 (more results)
- I like the staged development approach
  - Re-assess which path we are on
- Cost factors on transmission costs for REZ zones
  - Results in more realistic outcomes for REZ build projections
- Improving the backbone for Aus network

I think a gap is...

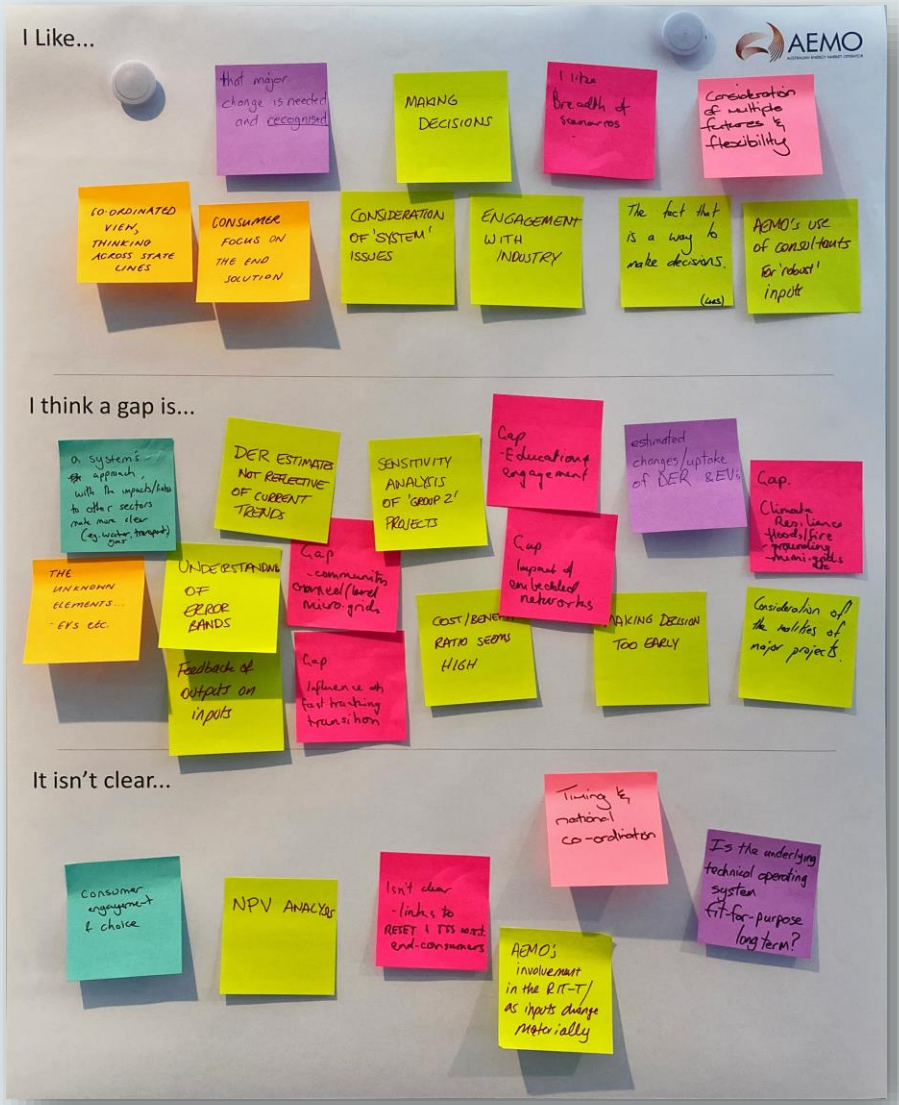
- What will cause the forecast VRE to occur?
  - After RET's expire?
  - Policy?
  - Commercial
- Does it take into account who great demand management?
  - Energy efficient
  - Demand mechanism
- Are we completely validating the costs of a system security services in the model?
  - i.e. modelling FCAS constraints
- How is the ISP dealing with Govt initiatives & goals à lead their own projects?
- Can the total cost of getting to 2040 under each scenario be satisfied and then, "translated" into what this will mean for electricity prices in 2040 vs now?

It isn't clear...

- Integration of EV uptakes and national strategies
  - Standards
  - Outputs
  - System inputs
- How did AEMO verify/ modelled power system in 2030's when we have significant REZ transmission?
- Where did REZs build limit come from?
- Can the ISP drive great decarbonisation i.e. lead policy?
- Coordinated control in the distribution network
- VPP
- How exactly will these systems be controlled?
- Cost allocation
- How is the best way to allocate cost that ensures equity & risk?
- Climate resilience
- What is the best system for greater resilience?

Table 3

Brisbane



I like

- That major change is needed and recognised
- Making decisions
- Breadth of scenarios
- Considerations of multiple futures & flexibility
- Coordinated view, thinking across state lines
- Consumer focus on the end solution
- Consideration of 'System' issues
- Engagement with industry
- The fact that is a way to make decisions
- AEMO's use of consultants for 'robust' inputs

I think a gap is...

- A systems approach, with the impacts/links to other sectors. Make more clear (e.g. water, transport, gas)
- The unknown elements – Evs, etc
- DER estimates not reflective of current trends
- Understanding of error bands
- Feedback of outputs on inputs
- Sensitivity analysis of 'Group 2' projects
- Community owned/level microgrids
- Cost/Benefit ratio seems high
- Education and engagement
- Gap impact of embedded networks
- Estimated changes/uptake of DER & EVs
- Making decision too early
- Climate resilience, floors & fire, grounding, mini grids etc
- Consideration of the realities of major projects

It isn't clear...

- Consumer engagement and choice
- NPV analysis
- Links to RESET + TSS with respect to end consumers
- Timing & national coordination
- AEMO's involvement in the RIT-T/as inputs change materially
- Is the underlying technical operating system fit-for-purpose long term?

Table 4

Brisbane

I like

- Facilities discussion
- Data availability and usefulness
- The plan has been done!
- Improvements
  - Solar
- Wind

I think a gap is...

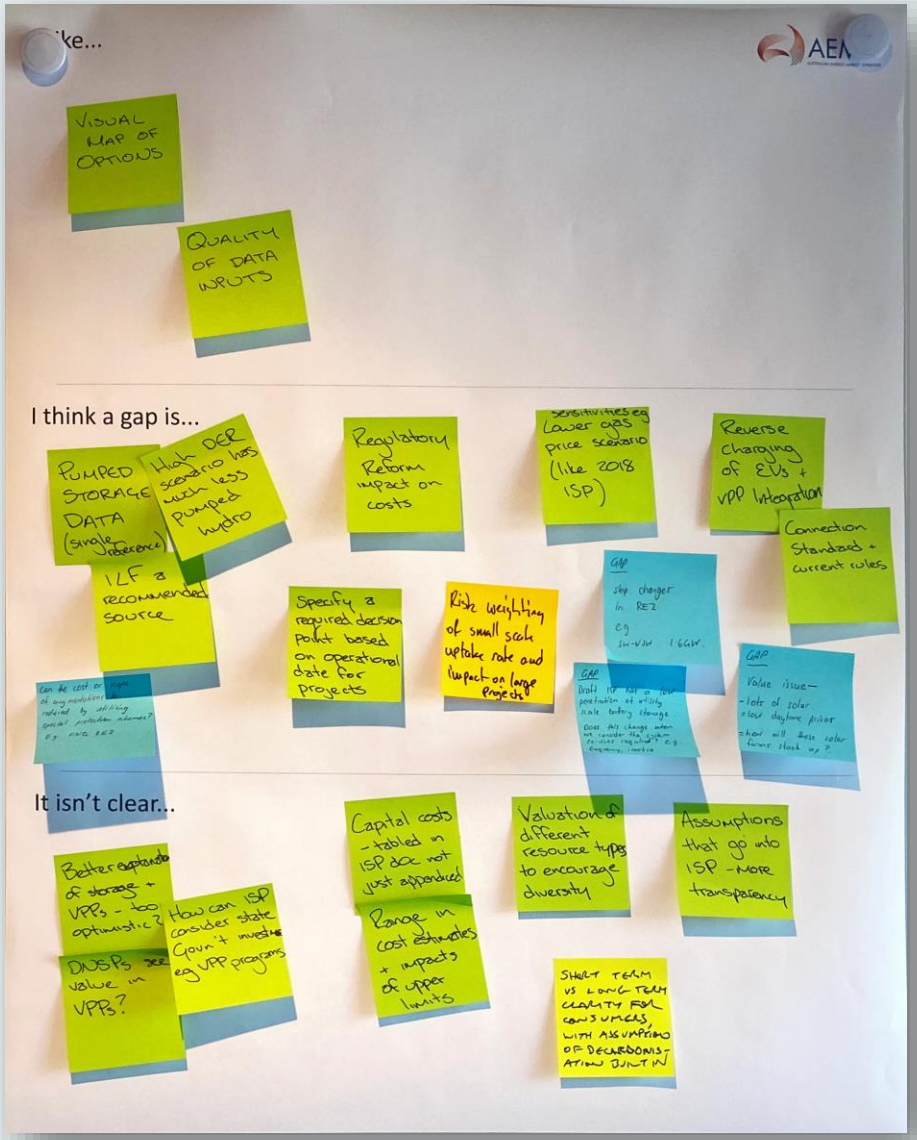
- More discussion around <u>all</u> fuel sources
  - Discussion implies renewables are the answer, but are they?
- If all the suggested groups of transmission are built, will that unlock REZs? Or is still more needed?
- Connecting NEM to:
  - WA
  - Sun cable RE Hub
  - Copper strip
-
- Granularity around data provided. e.g. Wind traces Hydr. Location
- Renewables firming
- Detail around hydro
- Storage solutions
- Where are we citing renewables?
- Losses

It isn't clear...

- Commercial considerations (e.g. how generation will use capacity in their portfolios, firming etc.)
- By including specific projects (e.g. Marinus) these lead reader to put that project first & implies that should occur, but where is analysis to support
- What's the process from ISP to it being actioned? Who makes the decision about which transmission is built?
- Encouragement for next renewable projects (policy)
- Least cost externalities
  - "Consumers" – who are they?
- Modelling around electrification of industry/ mineral processing
- Modelling around generation at load rather than REZ that are remote
  - Where is modelling supporting one over the other?
- Priorities of projects
- Assumes transmission is the answer but is it?
  - Amalgamate other lines, new technology
- Link between Central QLD with North QLD

Table 5

Brisbane



I like

- Visual map of options
- Quality of data inputs

I think a gap is...

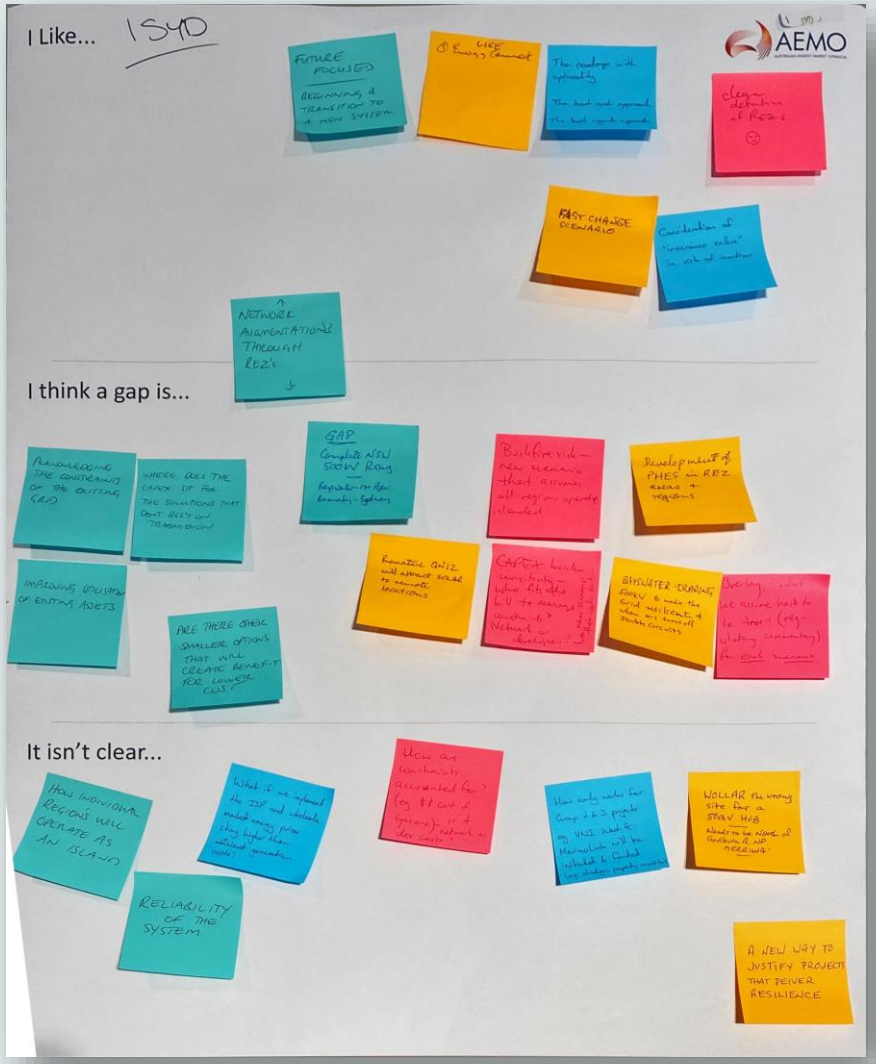
- Pumped storage data (single reference)
- High DER scenario has much less pumped hydro
- ILF a recommended source
- Can the cost or scope of augmentations be reduced by utilising special protection schemes? E.g. FNQ REZ
- Specify a required decision point based on operational date for projects
- Regulatory reform impact on costs
- Risk weighting of small scale uptake rate and impact on large projects
- Sensitivities e.g. Lower gas price scenario (like 2018 ISP)
- Step changes in REZ e.g. SW-NSW 1.6GW
- Draft ISP has a low penetration of utility scale battery storage. Does this change when we consider the system services required? E.g. frequency, inertia
- Reverse charging of EVs + VPP integration
- Connection standard + current rules
- Value issue. Lots of solar = low daytime prices = how will these solar farms stack up?

It isn't clear...

- Better explanation of storage + VPPs – too optimistic?
- DNSPs see value in VPPs?
- How can ISP consider state government investment e.g. VPP programs
- Capital costs – tabled in ISP doc not just approved
- Range in cost estimates + impacts of upper limits
- Valuation of different resource types to encourage diversity
- Assumptions that go into ISP – more transparency
- Short term VS long term clarity for consumers, with assumption of decarbonisation built in

Table 6

Brisbane



I like

- FUTURE FOCUSED
  - Beginning a transition to a new system
- Energy Connect
- The roadmap with optionality
  - The least cost approach
  - The least agenda approach
- FAST CHANGE SCENARIO
- Clear definition of REZs
- Consideration of "insurance value" i.e. risk of inaction
- Network augmentation through REZs *[also a gap]*

I think a gap is...

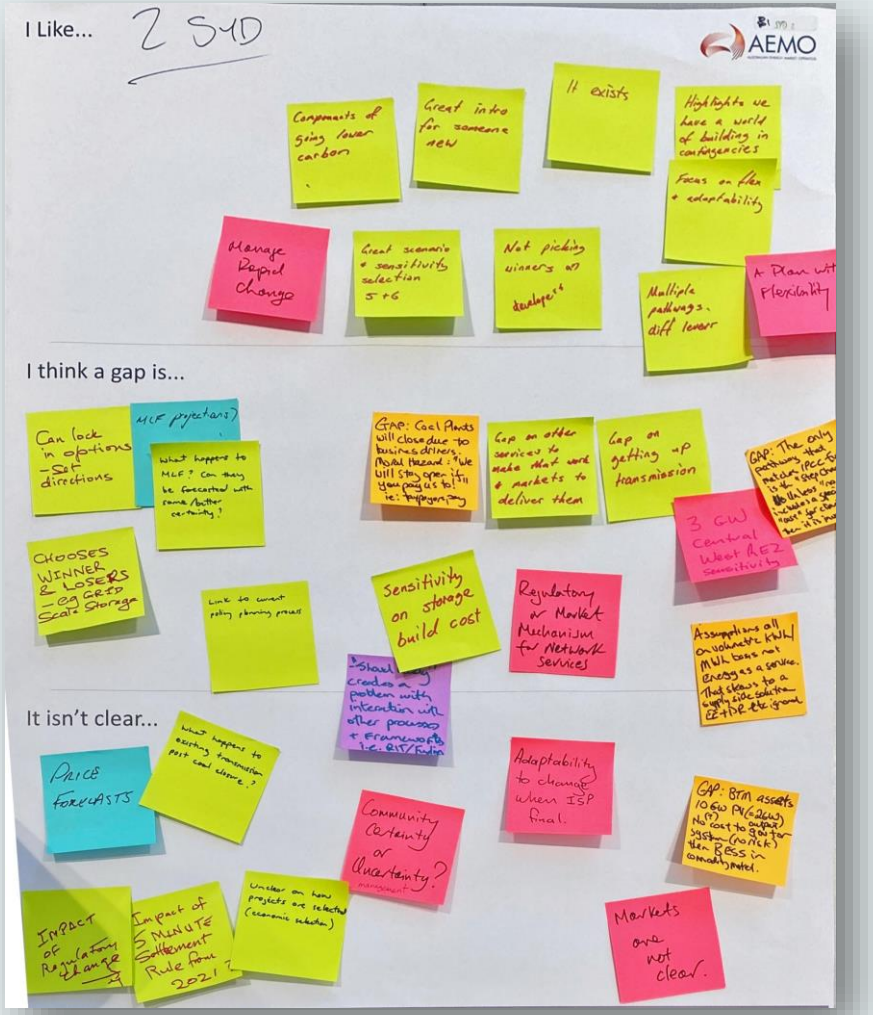
- Acknowledging the constraints of the existing grid
- Improving utilisation of existing assets
- Where does the CAPEX sit for the solutions that don't rely on transmission?
- Are there other smaller options that will create benefit for lower cost?
- Complete NSW 500kW ring
  - Bayswater – Mt Piper
  - Bannaby – Sydney
- Premature QNI2 will attract SOLAR to remote locations
- Bushfire risk – new scenario that assumes all regions operate islanded
- CAPEX burden sensitivity – who foots the bill to manage constraints?
  - Network or developer?
  - New scenario that puts control
- Development of PHES in REZ areas & regions
- BAYSWATER – ERARING 500kW to make the grid resilient & when No1 turns off Double Circuits
- Overlay, "what we assume has to be true" (regulatory commentary for each scenario)

It isn't clear...

- How individual regions will operate as an island
- Reliability of the system
- What if we implement the ISP and wholesale market energy prices stay higher than efficient generation costs?
- How are constraints accounted for?
  - E.g. $$ cost of syncons)
  - Is it network or dev costs?
- How early works for Group 2 & 3 projects e.g. VNI West & Marinus Link will be initated & funded (e.g. strategic property acquisition)
- WOLLAR the hitching site for a 500kW HUB
  - Needs to be north of Goulburn R.NP. MERRIWA
- A new way to justify projects that deliver resilience

Table 1

Sydney



I like

- Components of going lower carbon
- Manage rapid change
- Great intro for someone new
- Great scenario & sensitivity selection 5 & 6
- It exists
- Not picking winners as developers
- Highlights we have a world of building in contingencies
- Focus on flex & adaptability
- Multiple pathways, diff levels
- A plan with flexibility

I think a gap is...

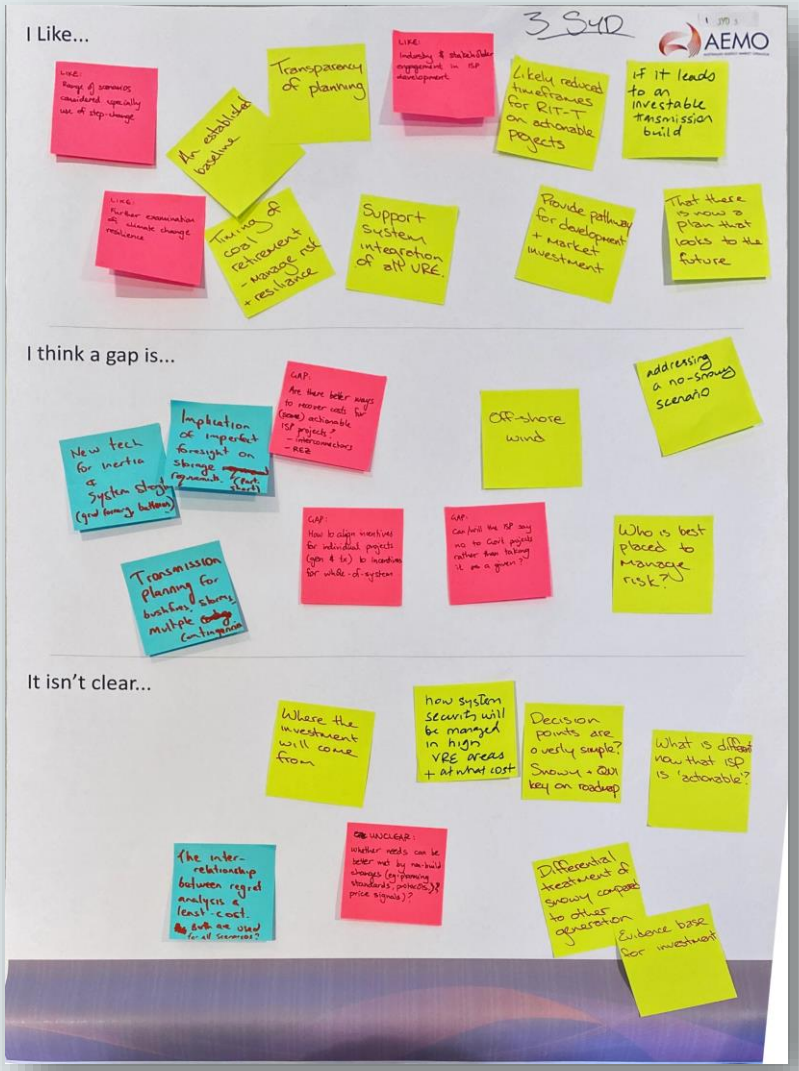
- Can lock in options
- Set directions
- MLF projections? What happens to MLF? Can they be forecasted with same/ better certainty?
- Chooses winners & losers e.g. grid scale storage
- Link to current policy planning process
- Coal Plants will close due to business drivers
- Moral hazard: "We will stay open if you pay us to!" i.e. taxpayers pay
- Sensitivity on storage build cost
- "Shovel Ready" creates a problem with interaction with other processes & frameworks i.e. RIT/ Funding
- Other services to make that work & markets to deliver them
- Regulatory or market mechanism for network services
- Getting up transmission
- 3GW central West REZ sensitivity
- The only pathway that matches IPCC 1.5C path is the "Step Change". Unless "no regrets" includes a specific "cost" for climate change – then it is invalid
- Assumptions all on volumetric kWh/ MWh basis not energy as a service. That skews to a supply side solution EE + PR etc ignored

It isn't clear...

- Price forecasts
- Impact of regulatory change
- Impact of 5 minute Settlement Rule from 2021?
- What happens to existing transmission post coal closure?
- Unclear on how projects are selected (economic selection)
- Community certainty or uncertainty?
- Management
- Adaptability to change when ISP final
- Markets are not clear
- BTM assets 10GW PV (=2GW output)
    - No (?) cost to govt or system (no risk) then BESS in commodity market

Table 2

Sydney



I like

- Range of scenarios considered especially use of step-change
- Further examination of climate change resilience
- An established baseline
- Timing of coal retirement
  - Manage risk & resilience
- Transparency of planning
- Support system integration of all VRE
- Industry & stakeholder engagement in ISP development
- Likely reduced timeframes for RIT-T on actionable projects
- Provide pathway for development & market investment
- If it leads to an investable transmission build
- That there is now a plan that looks to the future

I think a gap is...

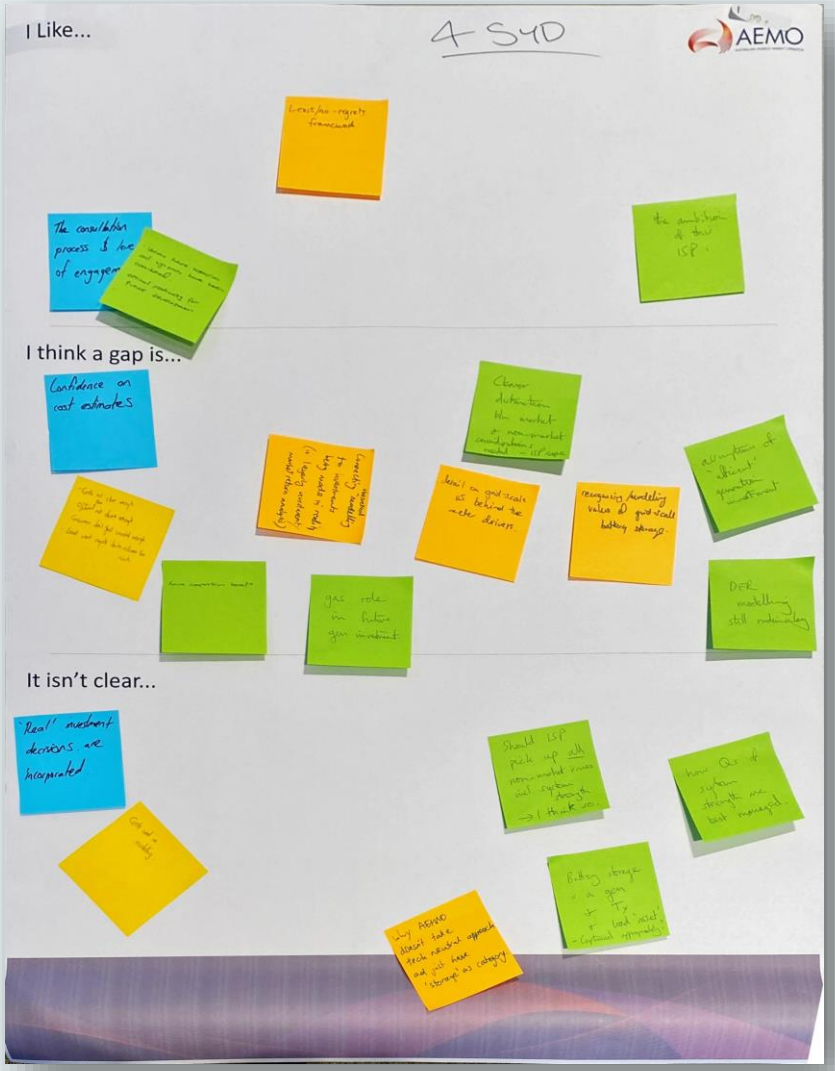
- New tech for inertia & system strength (grid forming, batteries)
- Transmission planning for bushfires, storms, multiple contingencies
- Implication of imperfect foresight on storage requirements (particularly short)
- Are there better ways to recover costs for (some) actionable ISP projects?
  - Interconnectors
  - REZ
- How to align incentives for individual projects (gen & tx) to incentives for whole-of-system
- Off-shore wind
- Can/ will the ISP say no to govt projects rather than taking it as a given?
- Addressing a no-snowy scenario
- Who is best placed to manage risk?

It isn't clear...

- Where the investment will come from
- The inter-relationship between regret analysis of least-cost
  - Both are used for all scenarios?
- Whether needs can be better met by in-build changes (e.g. planning standards, protocols, price signals)
- How system security will be managed in high VRE areas & at what cost
- Decision points are overly simple?
  - Snowy + QNI key on roadmap
- Differential treatment of snowy compared to other generation
- What is different now that the ISP is "actionable"
- Evidence base for investment

Table 3

Sydney



I like

- The consultation process & level of engagement
- Least/ no-regrets framework
- Various future scenarios and signposts have been considered
- Optimal pathway for future development
- The ambition of this ISP

I think a gap is...

- Confidence on cost estimates
- Costs not clear enough
- Other plans not clear enough
- Consumers don't feel included enough
- Least cost regrets claim outcomes too much
- Future competition benefit
- Gas role in future gen investment
- Detail in grid-scale is behind the meter drivers
- Clearer distinction between market & non-market considerations needed
    - ISP scope
- Recognising/ modelling value of grid-scale battery storage
- Assumption of "efficient" generation investment
- DER modelling still rudimentary
- Connecting theoretical modelling to investments being made in reality (i.e. layering investment/ market return analysis)

It isn't clear...

- "Real" investment decisions are incorporated
- Costs used in modelling
- Should ISP pick up all non-market issues incl. system strength
    - I think so
- Why AEMO doesn't take tech neutral approach and just have "storage" as category
- Battery storage is a gen & Tx & good "asset"
    - Captured appropriately?
- How Qs of system strength are best managed?

Table 4

Sydney

I like

- Improved backbone
- Expandable
- Whole of system plan that considers best outcomes for consumers
- In doing so, it provides additional market signals to drive investment in the right areas for consumers
- Resilience
- Extra attention to immediate issues – e.g. issues in NW Vic/ SW NSW (NTNDP)

I think a gap is...

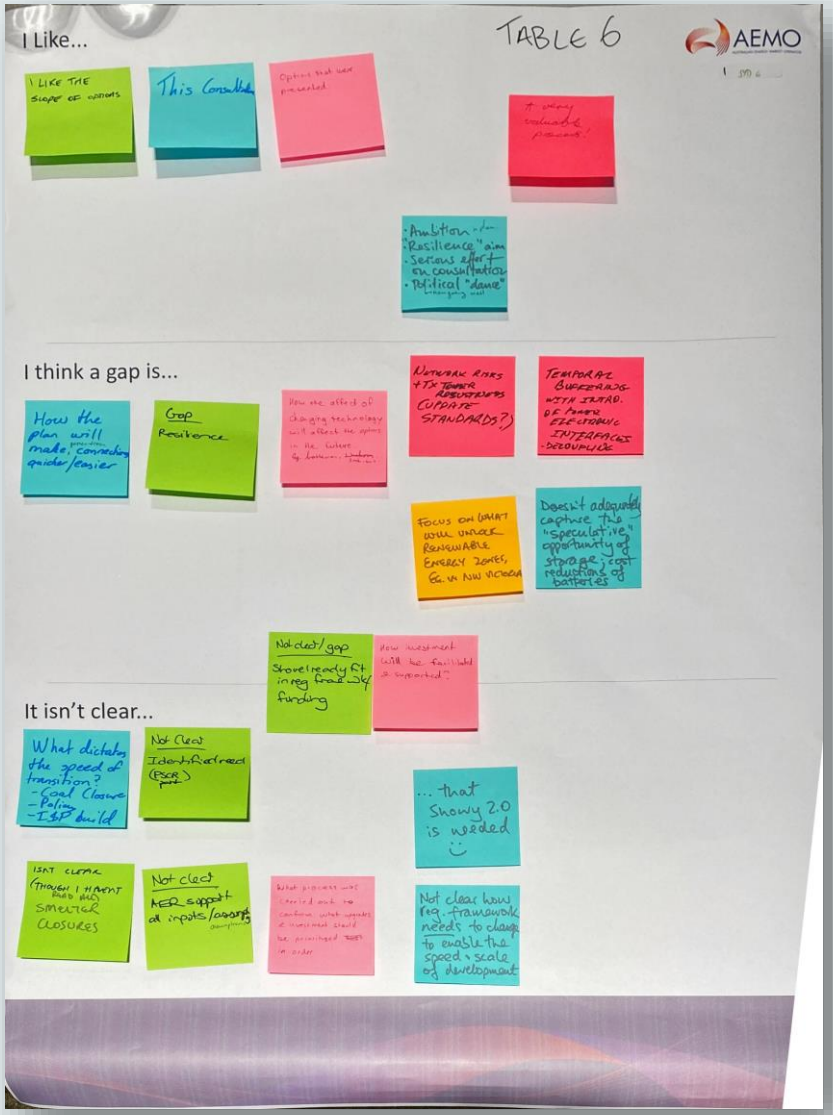
- It concentrates assets around nodes
- Eroding market
- Inter-regional & settlement impact on PPA
- Politics
- Lived experience
- ISP should drive PI Policies
- 5 minute data for a 5 minute market
- Short-term projects bailout for investments in the wrong areas?
- Not all electrons are the same
  - "Green demand"
  - Long duration storage demand
- Assumes indifference to inter-regional settlement/ node risk

It isn't clear...

- How are future inputs going to shape the ISP?
- Comms?
- Timing
- Trig Dev
- Rename central scenario to something like "current" scenario

Table 5

Sydney



I like

- The scope of options
- This consultation
- Options that were presented
- Ambition in plan
- "Resilience"aim
- Serious effort on consultation
- Political "dance" -navigating well
- A very valuable process

I think a gap is...

- How the plan will make generation connections quicker/ easier
- Resilience
- How the effect of changing technology will affect the options in the future e.g. batteries, sync-ons
- Network risks & Tx tower robustness (update standards?)
- Temporal buffering with intro of power electronic interfaces – decoupling
- Doesn't adequately capture the "speculative" opportunity of storage; cost reductions of batteries

It isn't clear...

- Shovel ready fit in reg. framework/ funding
- How investment will be facilitated & supported
- What dictates the speed of transition?
  - Coal closure
  - Policy
  - ISP build
- Identified need (PSCR part)
- AER support all inputs/ assumptions
- Smelter closures
- What process was carried out to confirm what upgrades & investment should be prioritised in order
- How reg. framework needs to change to enable the speed & scale of development
- ... That Snowy 2.0 is needed 😊

Table 6

Sydney

I like

- Least worst regrets
- Honesty of short comings
- Roadmap visual + clarity
- Provides a good start point for discussion
- Has vision
- That brings energy needs together
- Seemingly impartial, based on consultation based on facts & modelling
    - Is a national plan
    - Is generally seen as a source that can be trusted
- The passion
- Good consultation
- Access to discuss & consult
- Independent source for rigorous assessments
- Consolidates multiple stakeholders, jurisdictions & objectives
- Representation of different scenarios & timing
    - Is there only 1 future state?
- Agreed framework with new ways of presenting information
- Clarity of developments required
    - Show in ① ② ③ on map
- Brings together diverse ideas/ assumptions into one vision
- "NO REGRETS" method

Table 1

Melbourne

I think a gap is...

- Show HOW 90% RE copes with a "bad week"
- Clarity on degree of uncertainty vs optimisation
- Incorporating electrification & everything, including ...
- Breadth of scenarios & sensitivities
- Temporal understanding (ST) driving TX decisions (LT)
- ... NEO to consider broader economic outcomes
- Investment thresholds (drives delay in investment)
- The assumption of increased gas access
- Estimate consumer costs by scenario
- Attraction of new loads
- Cost of lack of competition to consumers (same cost, different price)
- Low DER scenario
- → Resist control or feel it is not needed if the system is responding
- Social constraints will be material
- Investment needed for:
    - System strength
    - **Etc**
- Hydrogen + renewable metal smelting
- ... foresight
- Credibility of real options:
    - QLD wind?
    - Vic pumped hydro?
    - (Build what is real first)
- Projects required for system stability, strength, control & management
- > 90% RE: more wind in QLD + TAS
    - REGRET?
- Technical control parameters
- The concurrent build rates are unrealistic
    - Look at solar
        - Which should be easy
- Consumer behaviour & the impact on DER pace & quantity
- How the network is going to evolve?
- Who is paying for it?
- ISP graphic identifies one "future state" however any of the identified paths could lead to a different future

Table 1

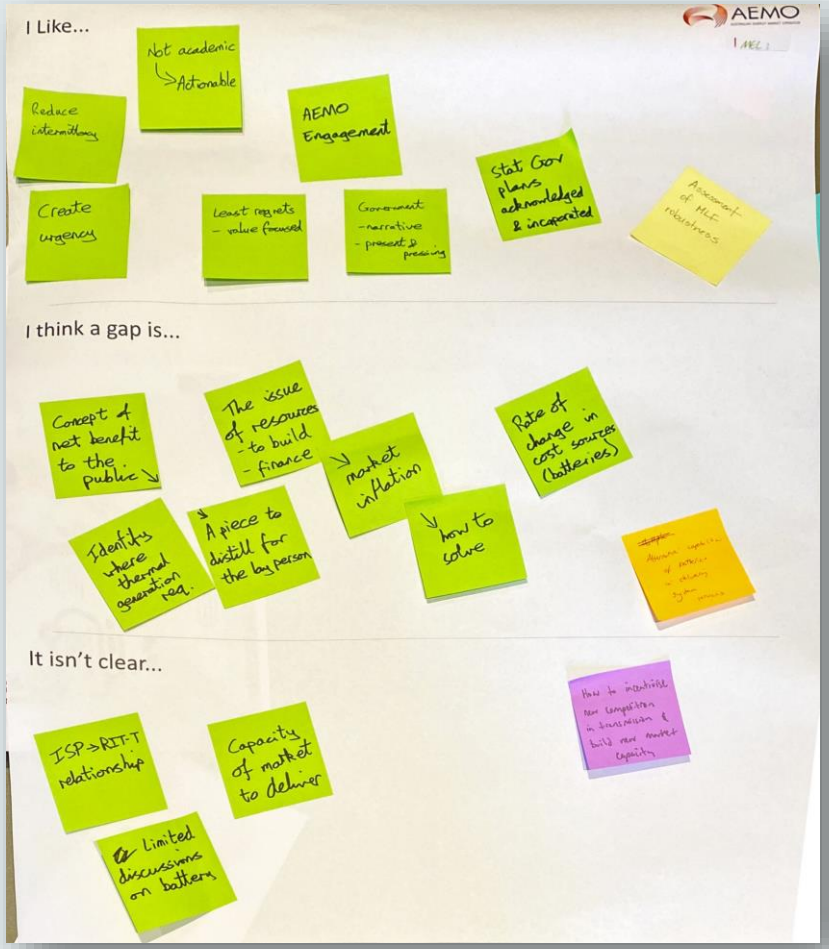
Melbourne

It isn't clear...

- DER is an assumption but communication as an outcome
- Analysis of security and reliability post coal retirement and how ISP projects can replace whilst possible as urban growth may produce smoke solutions later
- System degradation via retirements
    - Inertia
    - Strength
- Why does LYA retire so late?
- How the resources are determined
    - I have not found one developer or weather expert who believes wind in N.Q.
- How forecasting is done for things like future-DER uptake
- Why is there a 56:44 solar to wind ratio?
    - Other analysis shows a very different preference
- treatment of physical constraints in existing Snowy Hydro tunnels
- Why is VNI West a Group 1 for a similar timing to Marinus
- Greater clarity around assumptions in REZ scenario
- Is the ISP already too late to cover coal closure?
- "..." definition:
    - How far does shovel ready go with project prep?
- How AEMO decided what feedback to accept & what to address later/ ignore?
- REZ development
    - What does this look like?
    - How to build network to accommodate multiple new generators?
- Why the standard capacity in Tasmania is less valuable than other options?
- Changes in regulation might affect the ISP
- Degree of diversity assumed
    - Load
    - Wind Solar
    - How is this defended?
- How much flexibility does TNSP have to determine details e.g. route of new interconnectors in RIT process?
- REZ report cards could have more info/ background context

Table 1

Melbourne



I like

- Reduce intermittency
- Create urgency
- Not academic
- Actionable
- Least regrets
  - Value focused
- AEMO engagement
- Government
  - Narrative
  - Present & pressing
- State Gov plans acknowledged & incorporated
- Assessment of MLF robustness

I think a gap is…

- Concept of net benefit to the public
  - A piece to distil for the lay person
- Identify where thermal generation req.
- The issue of resources
  - To build
  - Finance
- Market inflation
- How to solve
- Rate of change in cost sources (batteries)
- Alternative capabilities of batteries in delivering system services

It isn't clear…

- ISP RIT-T relationship
- Limited discussions on battery
- Capacity of market to deliver
- How to incentivise new competition in transmission & build new market capacity

Table 2

Melbourne

I like

- Help through transition & reduce $ impact on consumers
- Managing shift from coal to VRE
- Signpost for generation
- Enabler to help the market improve
- Minimises risk (hopefully?)
- Filling policy vacuum
- Taking market along on the journey
- Centralised planning to indicate grid spending

I think a gap is...

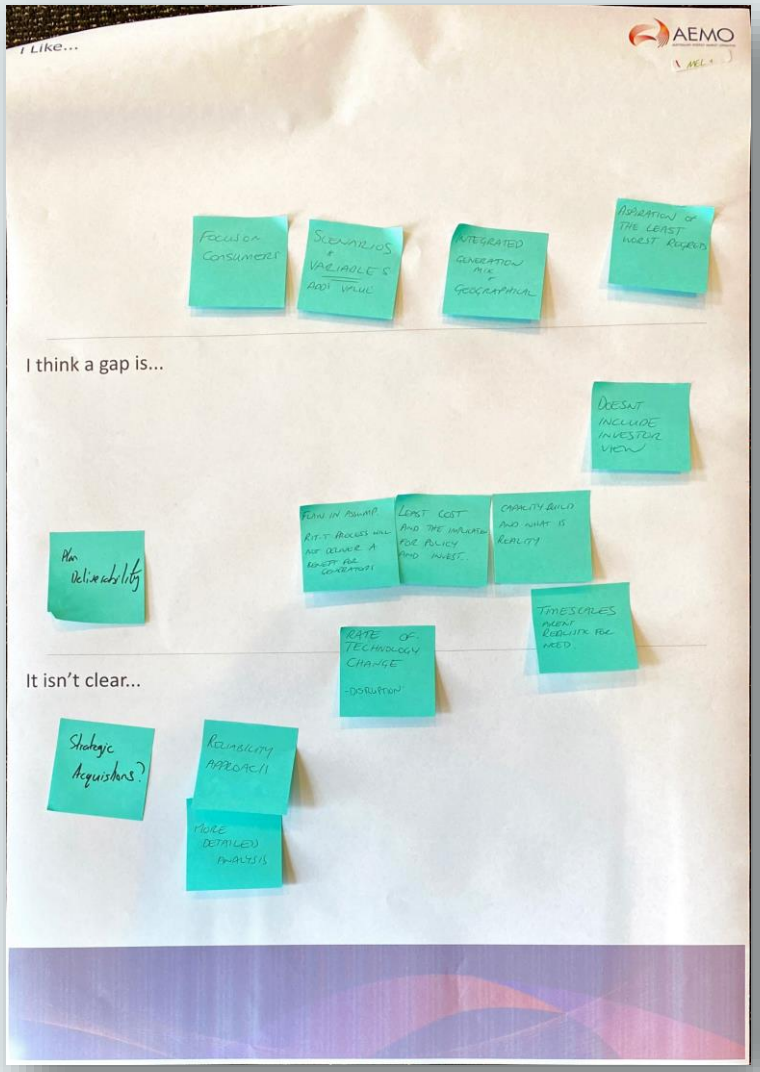
- Mismatch of lead time between generation T & D
- A scenario without policy overlays
- Plan for system security
- Avoid issues being seen in Western Vic currently
- State policy should not dictate ISP
- Ability to physically deliver the assumptions in the scenarios e.g. DER investment
- Least cost vs reality
- E.g. Pumped hydro in VIC: Model outcomes have significant build of PH where currently there is no interest
- Structure of current markets
  - New services E.g. Inertia
- CAPEX analysis

It isn't clear...

- Convert concept into action
- What kind of investment?
  - Private equity?
  - Govt funding?
- Why lowest Lcoe wind is not developed earlier?
- What unexpected changes might threaten network investment value
  - E.g. cost sensitivity around batteries, pumped hydro, VRE, etc.
  - How does this influence viability of interconnectors?
- Must be converted into spending
- There could be multiple futures, not just one "future state"
- More explanation how least cost results have been arrived
- Benefit of each interconnector project on its own

Table 3

Melbourne



I like

- Focused on consumers
- Scenarios & VARIABLES add value
- Integrated generation mix & geographical
- Aspiration of the least worst regrets

I think a gap is…

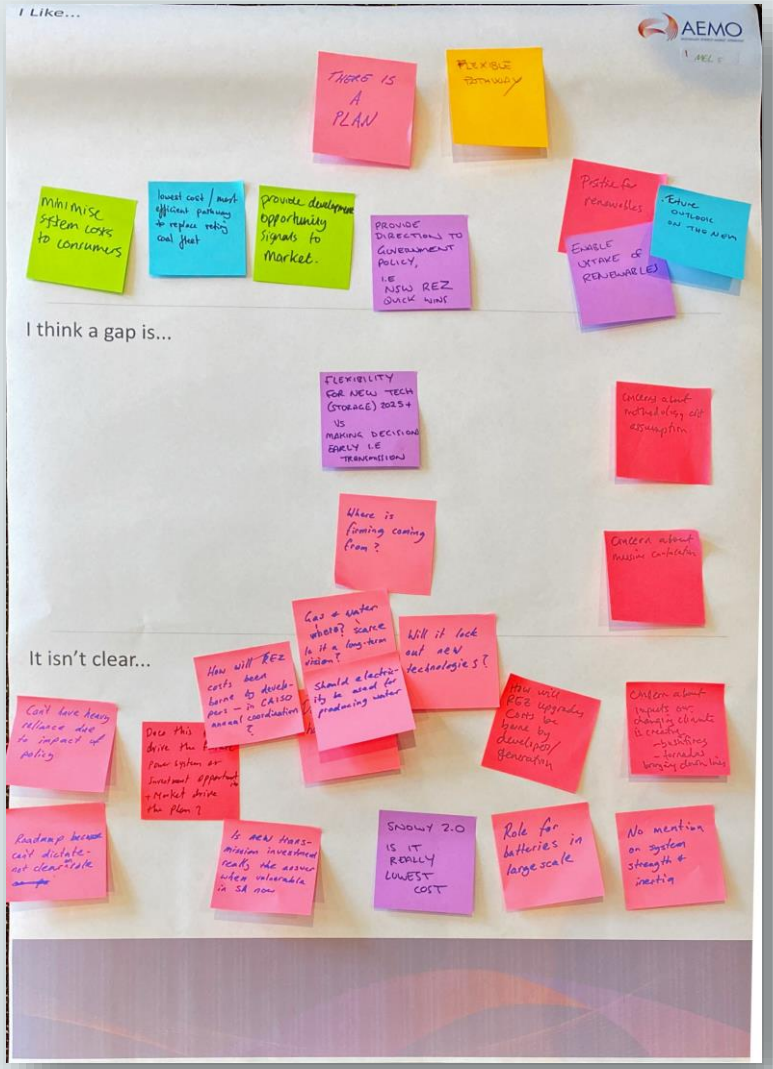
- Plan deliverability
- Flaw in assumption.
  - RIT-T process will not deliver a benefit for generators
- Least cost and the implication for policy and invest.
- Capacity build and what is reality
- Rate of technology change
  - Disruption
- Timescales aren't realistic for need
- Doesn't include investor view

It isn't clear…

- Strategic acquisitions?
- Reliability approach
- More detailed analysis

Table 4

Melbourne



I like

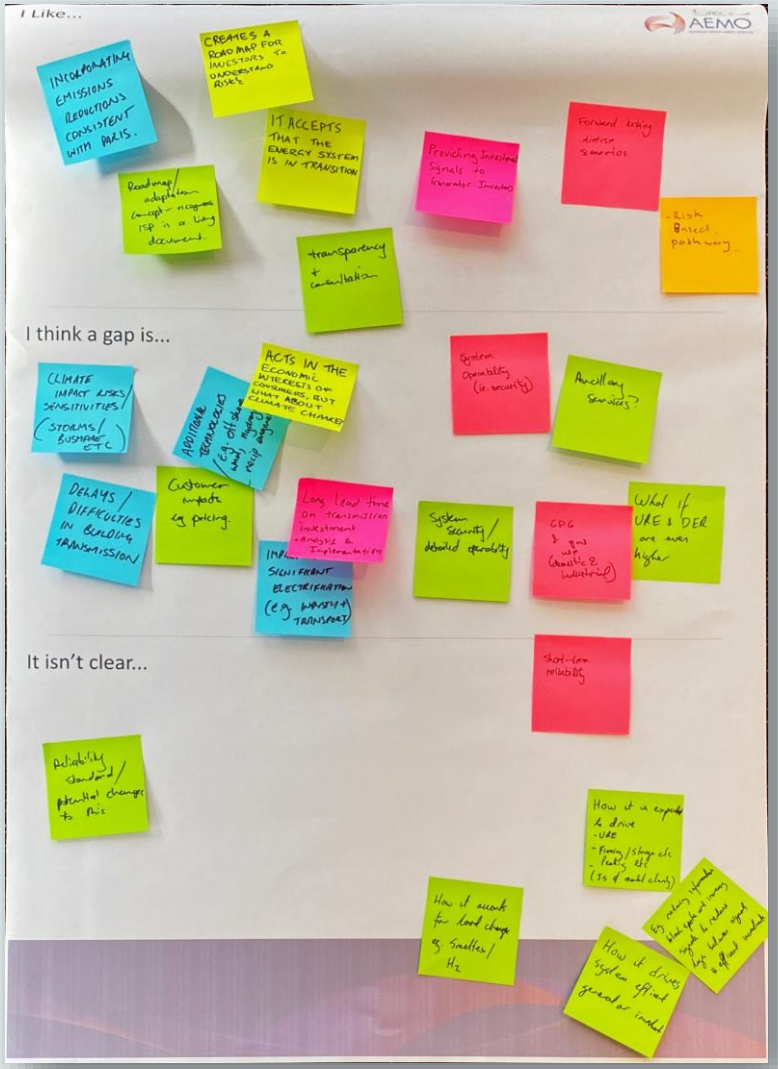
- Minimise system costs to consumers
- Lowest cost/ most efficient pathway to replace retiring coal fleet
- Provide development opportunity signals to market
- There is a plan
- Flexible pathway
- Provide direction to government policy, i.e. NSW REZ quick wins
- Positive renewables
- Enable uptake of renewables
- Future outlook on the NEM

I think a gap is...

- Flexibility for new tech (storage) 2025 + vs making decisions early i.e. transmission
- Where is firming coming from?
- Will it lock out new technologies? [also in unclear]
- Gas & water [also in unclear]
    - Scarce
    - Where?
    - Is it a long-term vision?
- Concerns about methodology cost assumptions
- Concern about massive co-location

It isn't clear...

- Can't have heavy reliance due to impact of policy
- Roadmap because can't dictate not clear on role
- Does this ... drive the future power system or investment opportunities & market drive the plan?
- How will REZ upgrade costs be borne by developers/generators?
- Should electricity be used for producing water?
- Concern about impacts our changing climate is creating
    - Bushfires
    - Tornados bring down lines
- Is new transmission investment really the answer when vulnerable ie. SA now?
- Snowy 2.0 – is it really lowest cost
- Role for batteries in large scale
- No mention on system strength & inertia



I like

- Incorporating emissions reductions consistent with Paris
- Creates a roadmap for investors to understand risks
- Roadmap/ adaption concept – recognises ISP is a living document
- It accepts that the energy system is in transition
- Transparency & consultation
- Providing investment signals to Generator Investors
- Forward looking diverse scenarios
- Risk based pathway

I think a gap is...

- Climate impact risks/ sensitivities (storms/ bushfire/ etc)
- Delays/ difficulties in building transmission
- Additional technologies
  - E.g. offshore wind, hydrogen, recip. Engines
- Customer impacts e.g. pricing
- Acts in the economic interests of consumers, but what about climate change?
- Long lead time on transmission investment
  - Analysis & implementation
- Impact of significant electrification
  - E.g. … & Transport
- System operability (i.e. security)
- System security/ detailed operability
- Ancillary services?
- GPG & gas use
  - Domestic & industrial
- What if VRE & DER are even higher?

It isn't clear...

- Reliability standard/ political changes to Ris
- How it accounts for load changes
  - Smelters/ H2
- How is it expected to drive
  - VRE
  - Firming/ storage/ etc
  - Peaking/ etc
  - (market clarity)
- How it drives system efficient generator investment
- E.g. Redoing information black spots and investment signals to reduce lags between signals & efficient investments

Table 6

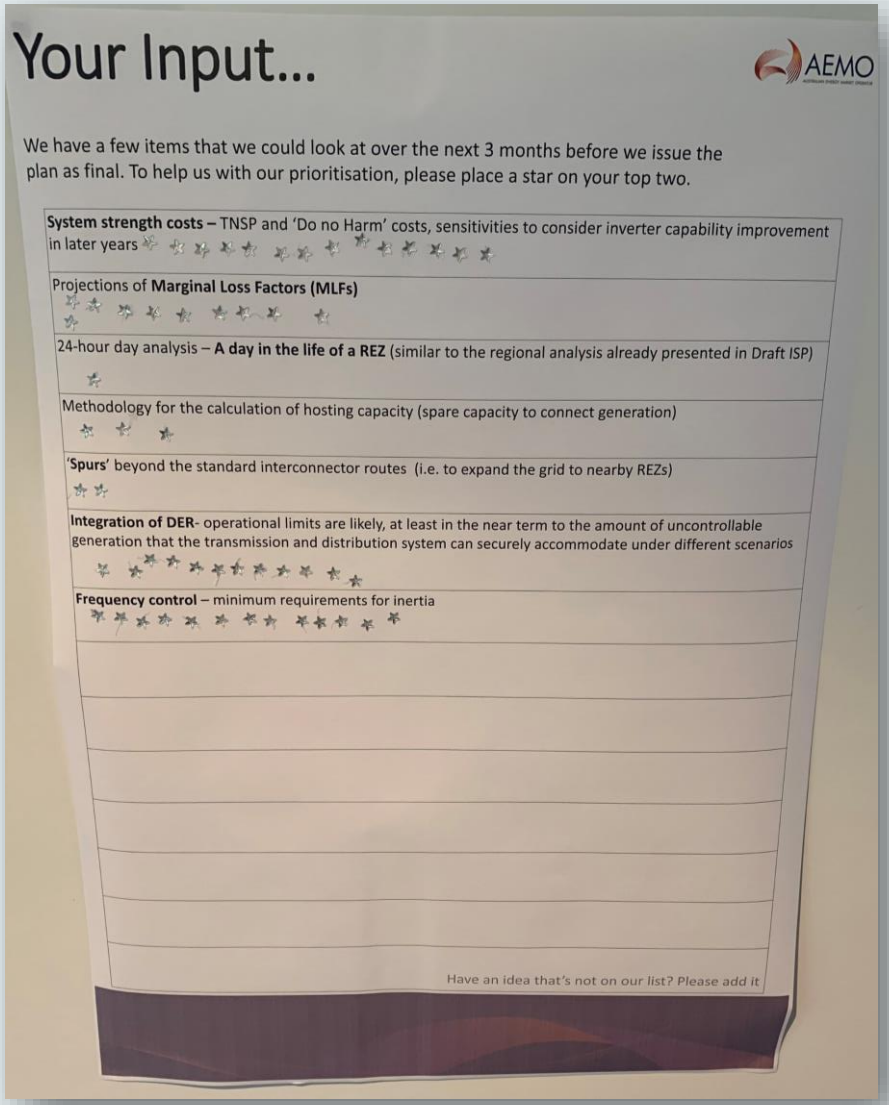
Melbourne

Station output

Understanding the details

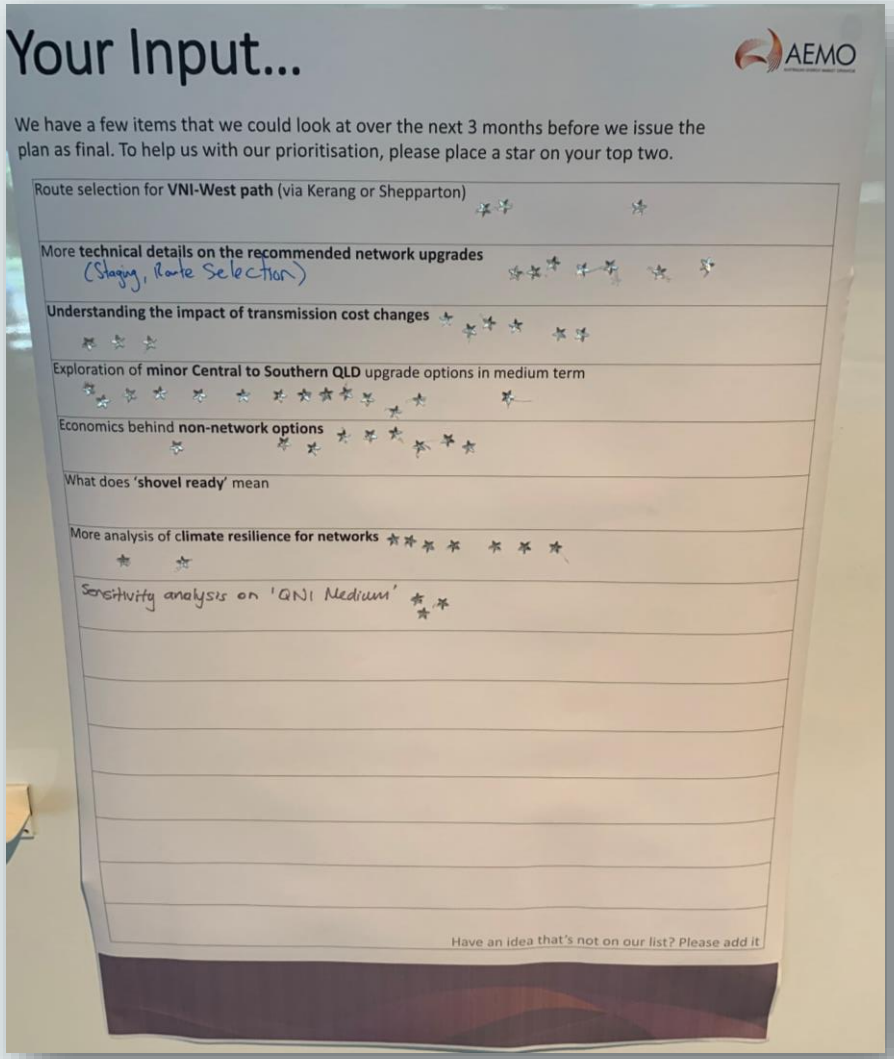
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

aurecon



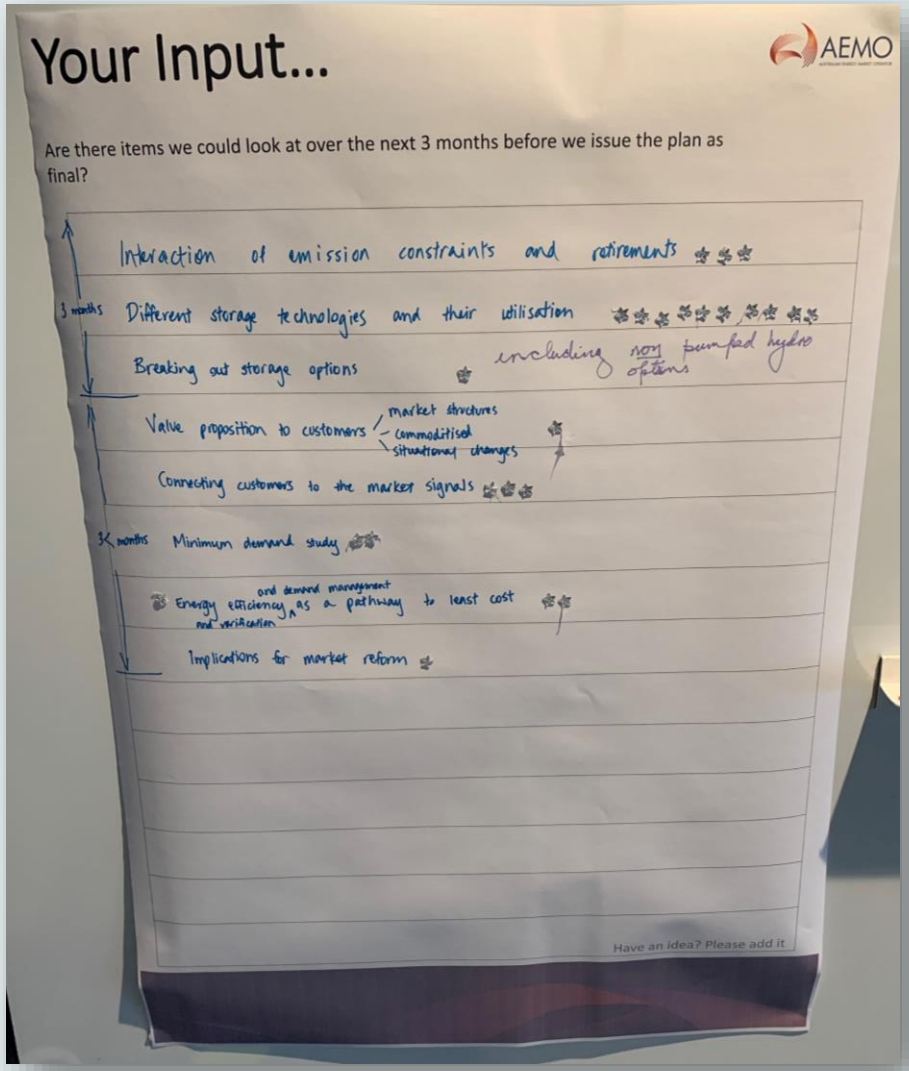
Themes/Questions/Insights/Comments

- Greater understanding of integration between the DER report 2019 and the ISP
- Can you implement a greater level of controllability on a highly uncontrollable system?
- Assumption of integration of DER (noting controllability above), what does that actually mean in practice.
- What will it take, and who wears the cost?
- Potential rule change for Frequency Control MW requirements. Will that change the Modelling?
- Challenges to supplying load during minimum demand periods
- Is there movement to look at MLFs as an input.
- More thorough modelling is needed
- Essential to get right to provide certainty for investment, greater detail.
- Increasing major weather events and high demand days coupled with overreliance on intermittent generation may make increasingly difficult to manage.
- Is there an overreliance on Hydro? Is hydro actually feasible, cost effective and rational?
- Greater understanding of the role of pumped hydro – energy production vs system inertia
- Concern about the rapid change from synchronous generation to solar and wind.
- Is there an overreliance on FNQ, the constraints, risks and costs seem prohibitive.
- REZ capacity vs transmission limits: where do the upgrade costs come from?
- Do we need to be looking at more synchronous generation (gas) as a system support and backup.



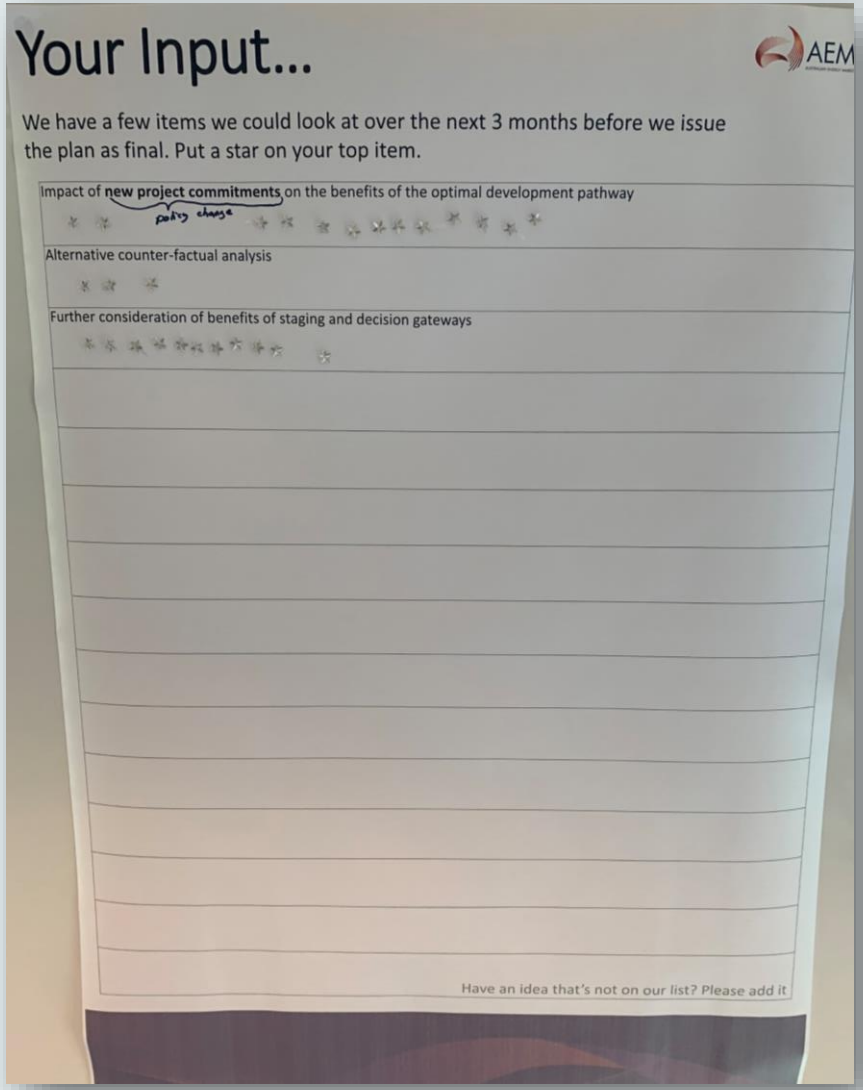
Themes/Questions/Insights/Comments

- What is the difference in cost between the fast and slow change models? Is it similar but with different distribution of cost over time?
- Would like more assistance to understand the location considerations of the network and how the right geographic mix is determined and how prioritisation is determined
- Asked how much is influenced by State policy – transparency about how much is within AEMO's total control
- Request for more detailed information on timeframes
- A lot of discussion on what level of technical detail is necessary to determine the route and also request for more technical detail to undertake own modelling
- How does decision making work?
    - What factors are taken into consideration?
    - What are the economic considerations?
    - Geographic considerations?
- How is the feasibility of different storage options assessed?
- Does the model change according to the quality of the sites being modelled? Eg. does the model change according to average windspeed at a site?
- Questions driving at robustness of modelling
- What does climate resilience look like for AEMO?
- What level of technical detail is required for certainty on decision making?
- Discussion on cost of mitigation v cost of adaptation
    - How does this interact with the timeframe of the ISP?



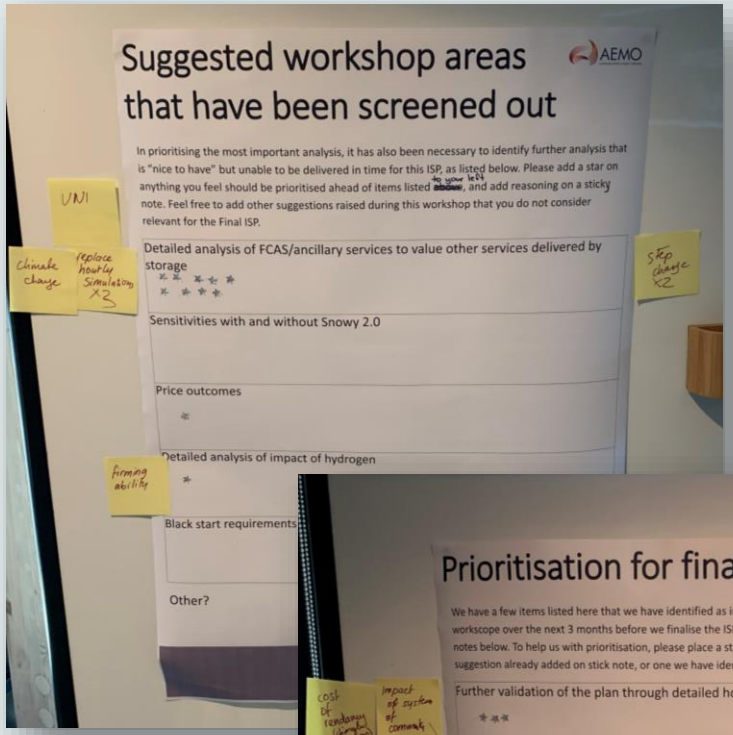
Themes/Questions/Insights/Comments

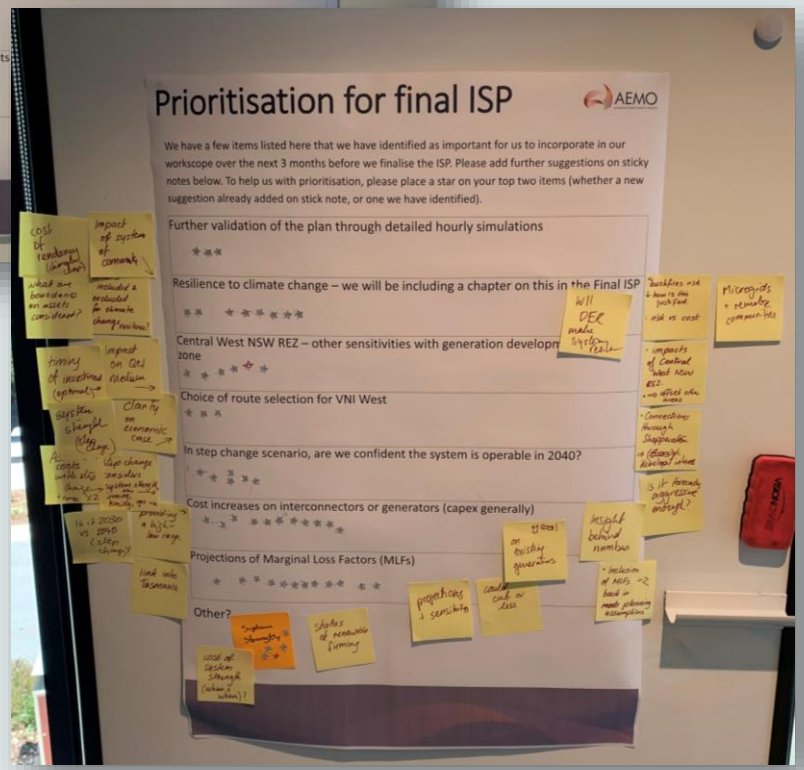
- Energy efficiency
- The input data for retirement of assets
- Minimising the total system cost
  - The relationship between total system cost and individual site cost
- Emission constraints
- Systems emission budget
- Electric vehicles.
- Interaction of emission constraints and retirements (3 votes)
- Different storage technologies and their utilisation, including non-pumped hydro options (10 votes)
- Breaking out storage options (1 vote)
- Value proposition to customers (1 vote)
  - Market structure
  - Commoditised
  - Situational changes
- Connecting customers to the market signals (3 votes)
- Minimum demand study (2 votes)
- Energy efficiency and verification, and demand management, as a pathway to least cost (2 votes)
- Implications for market reform (1 vote)



Themes/Questions/Insights/Comments

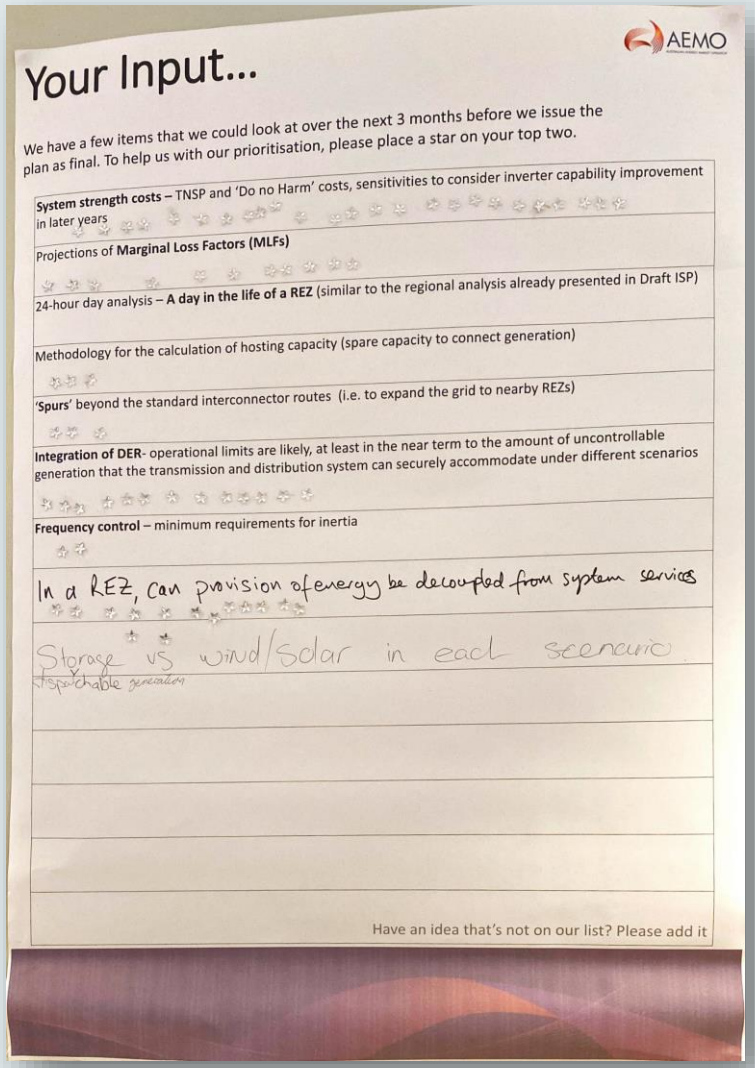
- What does option 5 mean?
- With shovel ready Marinus would it enable earlier deployment?
- Does shovel ready include regulatory process or just project development costs (e.g.) feasibility, holding queue on equipment procurement?
- Do you see this aligning with the ESP (?) framework?
- Overview of what numbers mean and include?
    - Struggled with it in the report
- Counterfactual is a do nothing case? $240M less than counterfactual
- Why use least worst regret rather than weighting more likely (e.g.) central pathway over step change?
- Qualitative risk factors can override least worst regrets?
- Who wears the $240M cost?
- Is it fair to say, the $470M vulnerability is flexibility with DER?
    - Drawing out the fact costs relate to acting early/late would help
- With current state politics (e.g.) sensitivity of building gas peakers, it would reassure stakeholders they are considered in sensitivity.
- Have you modelled gas generation that could solve this?
- Your saying you modelled transmission, then generation?
- The reason you can get clarity on these (no regret projects) are because of Latrobe valley retirements?
- What if you question the common development pathways to start off with?
- What if EnergyConnect does not occur?
- Is there a matrix over time if scenarios change?
- Does the sensitivity (bottom) add on top of others (rows above)?
- Are the costs borne out over time?
- Why sensitivity on early retirement, when Victoria has 5 year notice on retirement?
- Understanding min and max on timeframes (on transmission implementation) for a dynamic view
- Communication of costs in a way that government understands (this was in relation to retrospectively looking at potential cost savings being meaningless)
- Not clear why those 5 candidate pathways were selected? What are the costs and consequences?





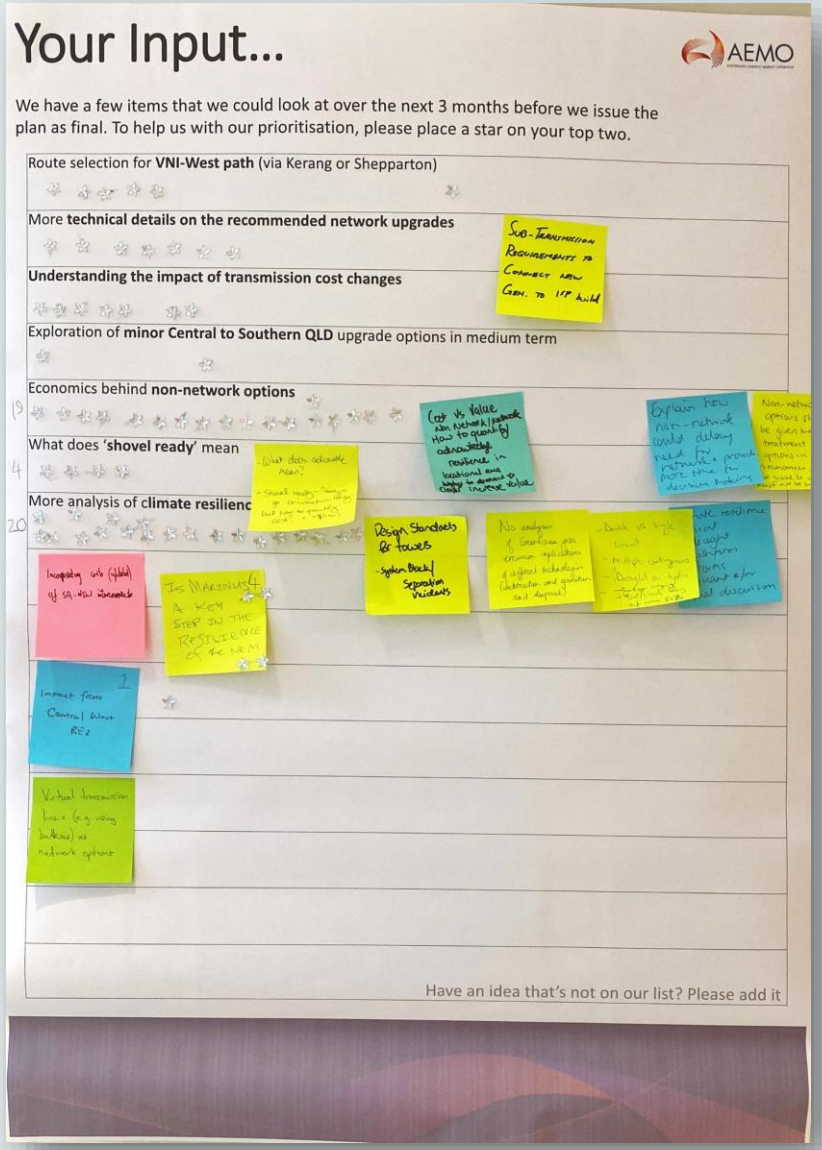
Themes/Questions/Insights/Comments

- Projections on marginal loss factors
  - What information can you provide around MLFs and their inclusion in planning assumptions including projections and sensitivities and link into Tasmania
- Cost increases on interconnectors or generators:
  - Increased insight behind the numbers – why have the costs increased (is it equipment cost or development/installation costs)
  - Provision of low and high side cost ranges
- Resilience to climate change
  - Many questions about what this actually meant?
  - Will be an increase in microgrids in remote communities?
  - Will DERs make the system resilient?
  - What is the cost of redundancy for being resilient to climate change?
  - How will this resilience impact communities?
- Central West NSW REZ
  - Impact on QNI medium
  - What is the optimal timing for investment?
  - What are the impacts of Central West REZ on other REZ sites?
- In the step change scenario, what is the confidence level of the system's operational level in 2040:
  - What is the assurance that the step change forecast is aggressive enough?
  - What is evaluated in terms of system's operational level in 2040 – is it more than system strength?
- Hourly simulation
- Choice of route selection for VNI West



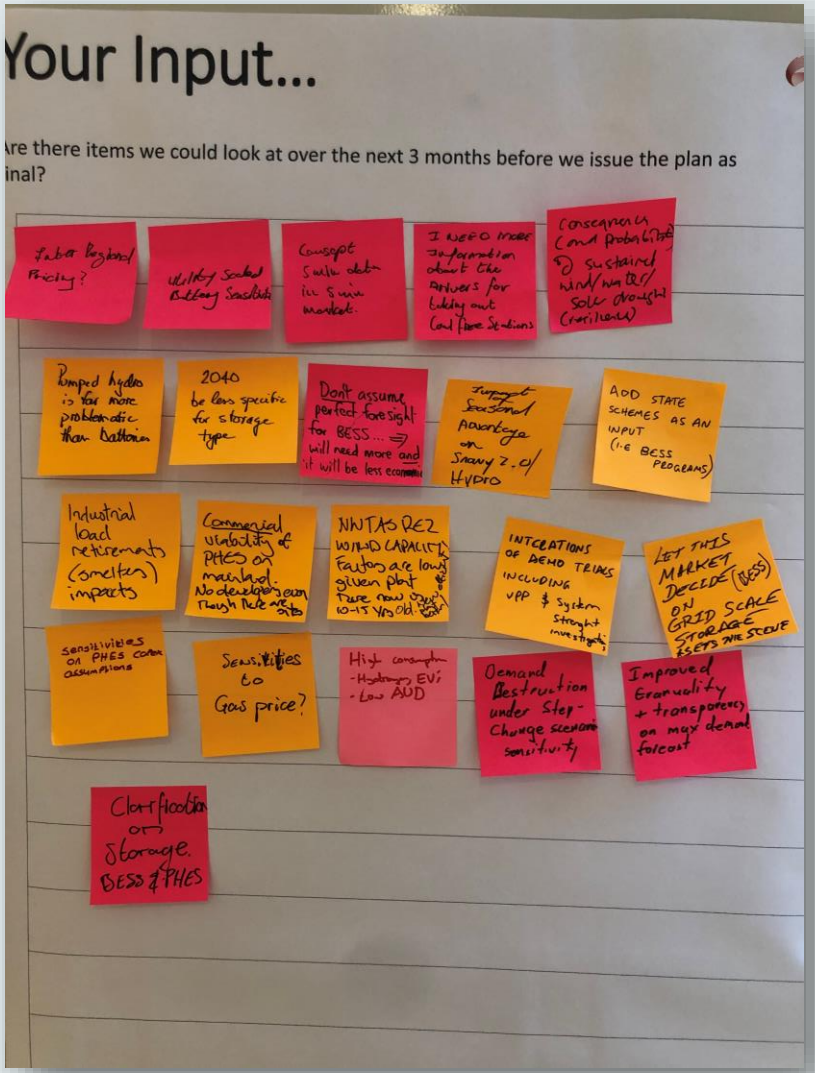
Themes/Questions/Insights/Comments

- Have the capacity factors taken into account 10-15 year old plant?
- Why would or wouldn't you put system strength requirements on generator or system? Rationale for putting it on VRE (variable renewable energy) or market mechanisms?
- Why are you phasing out grid scale storage (batteries)?
- Can the system services and energy provided by technologies be decoupled?
- Has the modelling looked at increasing correlation (VRE in REZs) – benefits of dispersing versus concentration?
- Lines only linking up REZs aren't actionable and require further work – do you expected these to be finished in the final?
- Do you pick up intra-regional constraints in your modelling? Do you have hard limits?
- How is inertia being modelled in Plexos?
- Are you including integration cost into the REZs – synchronous condensers and batteries?
- Are you considering grid forming inverters?
- How have you considered system strength? Are you considering doing further analysis just for the central scenario or all scenarios?
- Does MLF (further work area) mean whole region?
- Have you included constraints in the modelling? Have you considered how a synchronous condenser in one zone can impact another?
- Have you developed a storage curve with the corresponding increasing VRE penetration it enables? A curve to understand the relationship would be really useful across the scenarios.
- Methodology around system strength, voltage and considering hosting capacity if QNI comes in?
- How do you consider increasing suite of solutions to solve services?



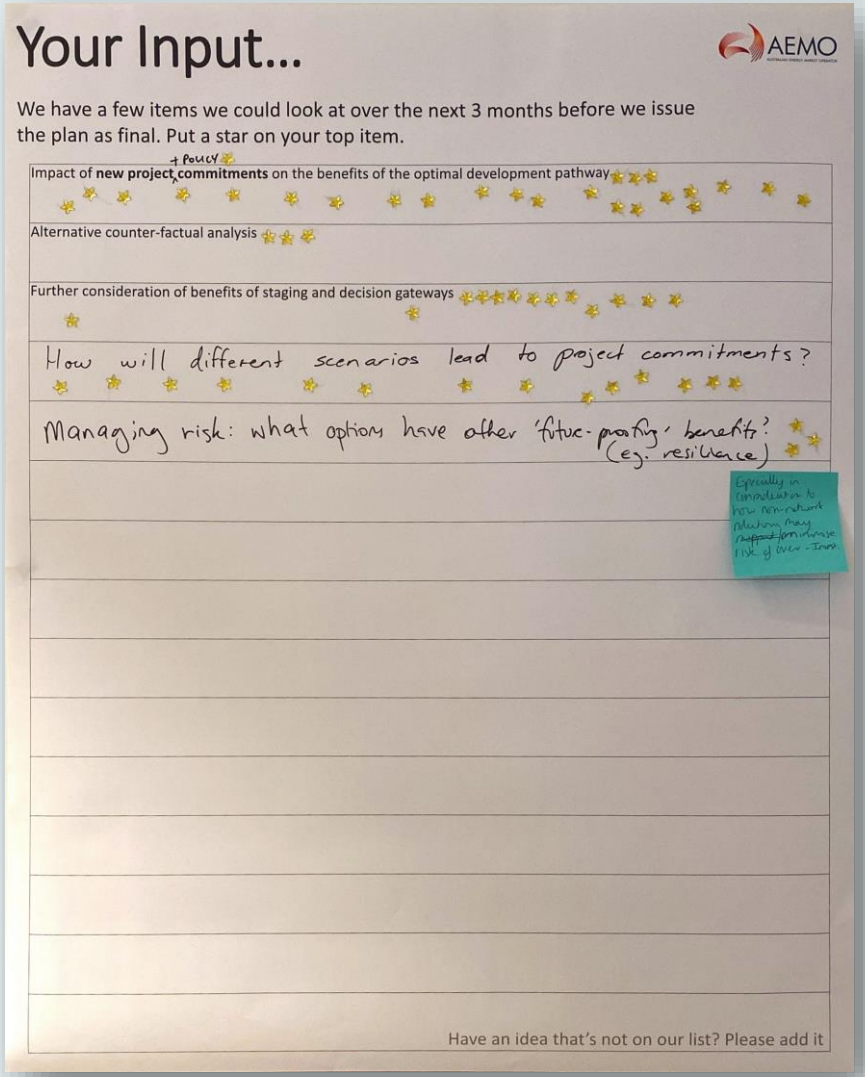
Themes/Questions/Insights/Comments

- If the costs of the interconnector changes, how does this impact the ISP, what is the deadline by which the ISP team will need to know exact pricing?
- Route selection was a key area of interest, especially given the different risk profiles of proposed routs
- Climate resilience was a strong theme with all groups, this played into the need for route diversity
- Questions around the impact of COGATI on the ISP
- Questions whether adding additional substations has been considered
- Australia not having done transmission in a long time may lead to additional constraints
- Many groups wanted a greater consideration of non-network options, felt that currently these are not sufficiently emphasised. Wanted the ISP to recommend non-network solutions.
- Interest in understanding how one interconnector is prioritised vs another.
- Some of the locations of pumped hydro on the map were questioned or considered inaccurate.
- Where the prep. Work for a major project is greater than $6M, does that prep work in itself require a RIT-T?
- Shovel ready definition: all approvals, finance, planning complete
- Clarify the differing cost impacts of different non-network options in the report.
- Participants want clarity on which "unknowns" are left that could impact the ISP, want these specifically called out.
- How responsive are they to new disruptive tech coming in that may impact the ISP?



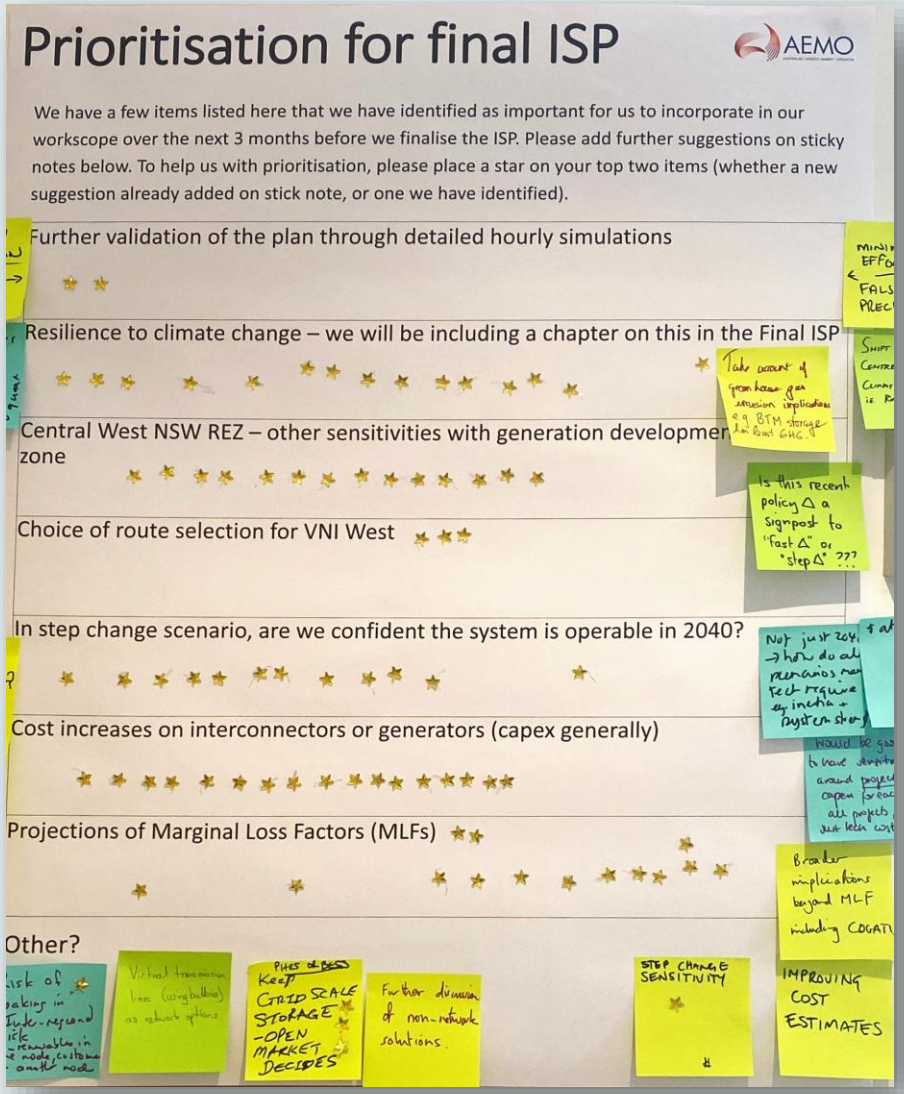
Themes/Questions/Insights/Comments

- There were a lot of questions on how the retirement of coal fire power stations where modelled, namely
  - What are the drivers?
  - Does it consider emissions?
- It was unclear within the ISP how loads where modelled
  - Load Growth
  - Impact of EV
- Storage
  - more clarity is required on the need for storage and a more general discussion on the solution instead of referencing to hydro or batteries e.g. deep 6-12hr storage solutions
- Where there any consideration for curtailments and the impact on the grid
- There were a couple of questions regarding the market modelling and the impact of nodal and inter regional impact on the cost of energy and as a result the impact on generators



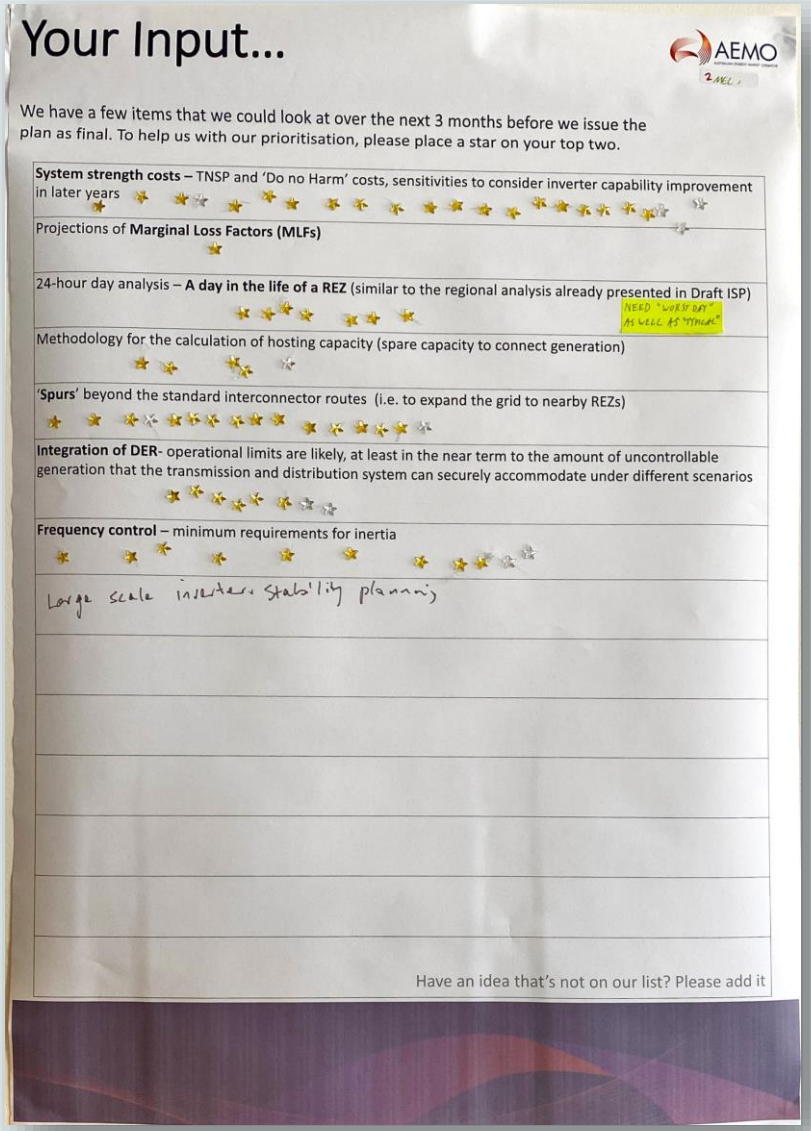
Themes/Questions/Insights/Comments

- Alternative approach could have used a decision tree with probability rates
- Are scenarios listed all equally likely to occur?
- What is alternative counter-factual analysis?
- Is cost capital an important element in this equation, i.e. does it change conclusions?
- Do you take into account who bears the cost of the least-worst regret, or are you agnostic on who pays?
- Regret cost – how is it formed? (Confused about counter-factual element)
- Seek to understand the regret methodology details / philosophy of the equation
- Why is Snowy Hydro not included in the scenarios list? (Is there a chance it won't go ahead?)
- What are the benefits you're accounting for?
- How would this analysis change with pre-commitment projects?
- How do you account for projects not yet funded that may have significant impact?
- Seek analysis of how these pathways link with project commitment
- Are scenarios weighted?
- How does time sensitivity work with notice required to be given?
- AER is writing guidelines for cost/benefit analysis focussing more on net-market benefits (not least-worst regrets) – concerned that focusing on least worst outcome versus net market best outcome leads to different outcomes for decision-making
- Strong support for the least/worst approach, noting the net market benefit has downsides
- How do non-network options fit into the framework? Can these be added as a pathway?
- Why is shovel ready Marinus Link included?
- What happens if we do a step change option and demand reduces? Then how do we account for the least regrets? (E.g. load changing in VIC last year)
- Capital cost – key driver that needs to be stress tested
- Alternative counter-factual analysis – what is this?
- We should be focusing on decommitments in scenario projects as well as commitments
- The challenge is this doesn't showcase benefits, only negatives
- Is EnergyConnect factored in?



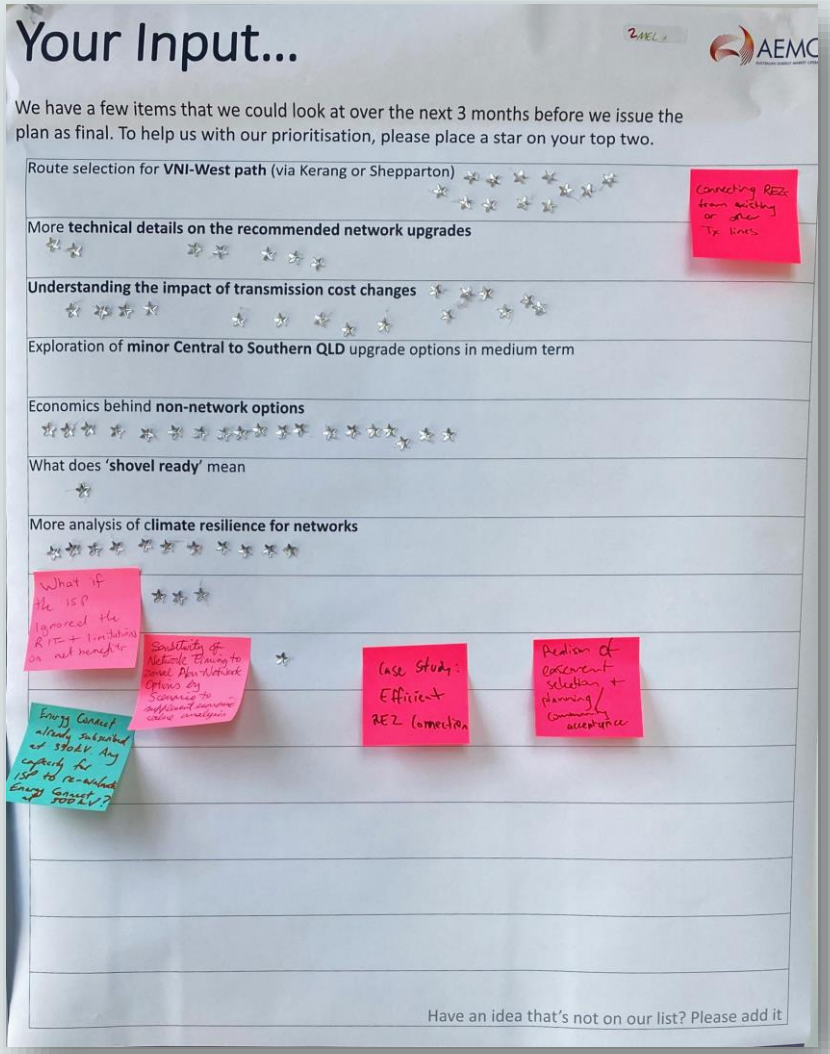
Themes/Questions/Insights/Comments

- Is there an overconfidence that Snowy2.0 will proceed?
- The plan is heavily reliant on transmission and pumped hydro for success, but these are both heavily susceptible to bushfires and drought which are likely to increase in frequency and intensity.
- What about changing settlement patterns and moving load centres as a result of climate change (rising sea levels)
- Much discussion around how "are we confident the system is operable in 2040?"
    - It is not a yes or no questions, need to know how the system is operable
- Plan seems to have completely written battery storage off, what makes hydro the preferred solution across the board.
    - What do we need to do to get there and at what cost, need to clearly define the technical solution
    - More thorough costings need to be acknowledged not just cost of tech, look at sensitivities for each project.
- MLF changes impacted a lot of developments, needs to be unpacked in much higher detail



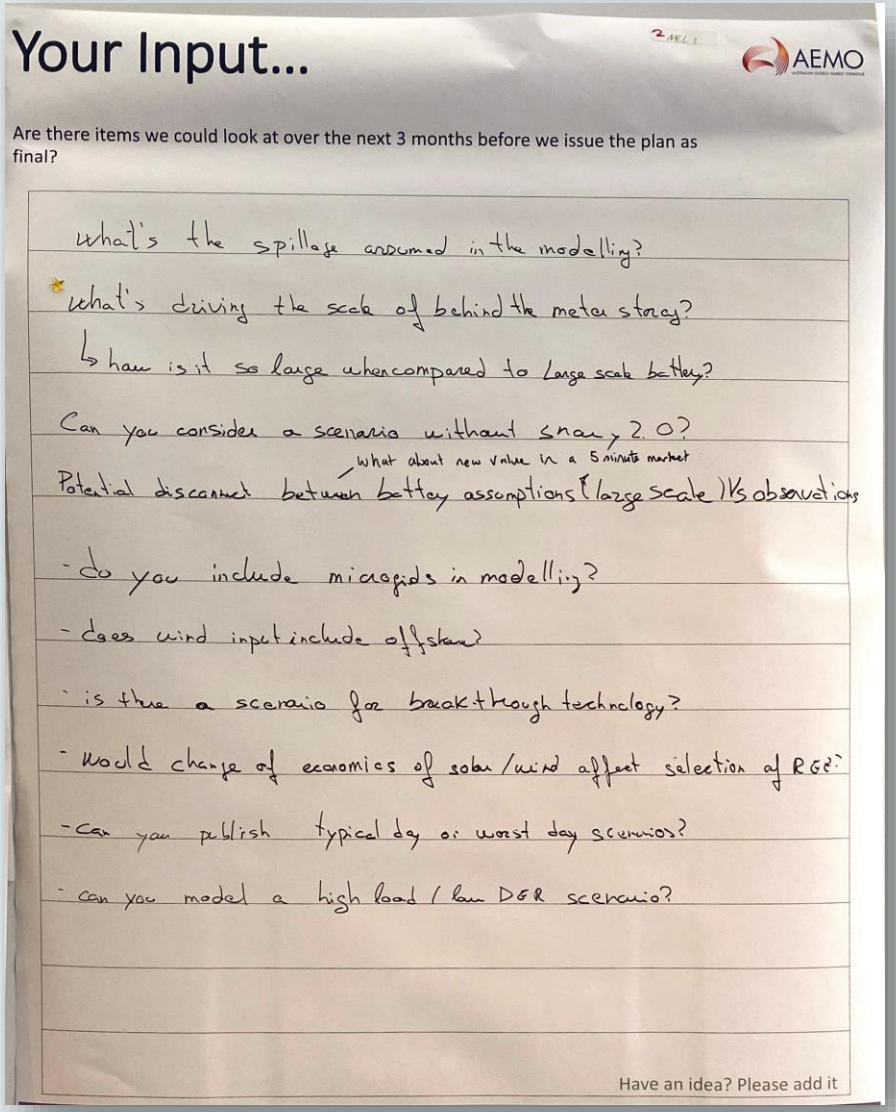
Themes/Questions/Insights/Comments

- What is deep storage? 6hrs+?
- What quantities (MW) of pumped hydro in each zone? No way to work out amount. How is pumped hydro incorporated into constraints?
- Concern of renewable developers in NW VIC – will transmission solve the system strength issues?
- Where do you see system strength coming from: generators, at the hub?
- REZs with more wind make them more valuable, when prices are going to zero with solar, is this being taken into account? (Energy outlook question)
- 330kV double circuit EnergyConnect will be picking up lots of solar with the potential for 800 MW going each way – is there an integration problem?
- What does 24hr load analysis mean (on the prioritisation list)?
- Hosting capacity when building an interconnector – QNI is 800 MW but releases 1000 MW of renewables – how does this work?
- To what extent does hosting capacity factor in storage?
- REZ well defined – disconnect is where we bring in storage – particularly with storage and REZs being in different spots
- Where is the wind in FNQ and how is it being validated?
- Commentary around optionality for spurs in VNI west would be very useful
- System strength is the most important
- In your modelling, is there a period where there is insufficient power during droughts? (energy outlook question)
- How do you take into account the loss factors from wake loss factors in REZs with wind? How do you determine the generation (MW of wind and solar) that can be built for the hosting capacity?
- Does the model take physical land constraints?
- Have you considered where the economics decline on solar?
- Being just outside of a REZ boundary, would it still be considered inside it?
- Noticed some were out of scope - as the technology progresses will these be taken into account?
- Is there a phase 2 REZ in TAS, is that dependent on Marinus, does this impact the modelling?
- How does RIS get integrated within the ISP?
- What does 24hr mean?
- Where does min system strength values come from?
- Is there consideration for offshore wind?
- When higher penetration of renewable, system strength won't be there compared to old days. Is it looking at a different way to operate the grid entirely – is that part of the scope?
- Is there testing of coincidental maximum demand across regions?
- Demand – are you looking at demand at a more granular level than regions?
- Resource traces – are there assumptions around types of tech (e.g.) PV single axis tracking and wind?
- Pumped hydro cost sensitivity has changed from inputs
- Current problem in NW VIC is inverter based – does this come under system strength issue?
- Should inverter instability be something that should be considered?
- Are insight (from RIS study) influencing standards for non-controllable generation? Nothing being put in place for standards.



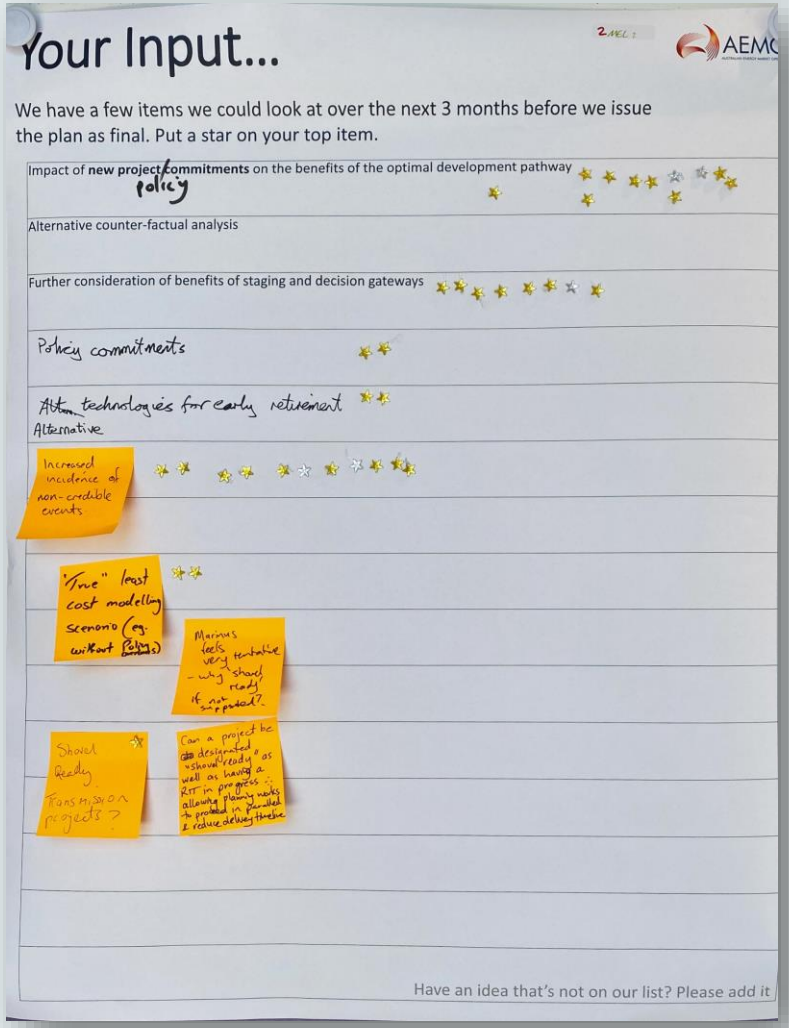
Themes/Questions/Insights/Comments

- Concerns about the volume of prime agricultural land along both Shepparton and Kerang link, both likely to cause local tension
- More thorough understanding of transmission cost changes, particularly given that Australia hasn't built one in a long time
- Given the local events that have affected the transmission network this summer, greater investigation of non-network options should be investigated
- Could be a more thorough investigation of the most efficient way to connect REZs
- Discussion around the need to reform the RIT-T process, and work with other agencies and departments to refine development pathways
- Climate change resilience, particularly given the limitations of the network and existing infrastructure to withstand heat and bushfire events.



Themes/Questions/Insights/Comments

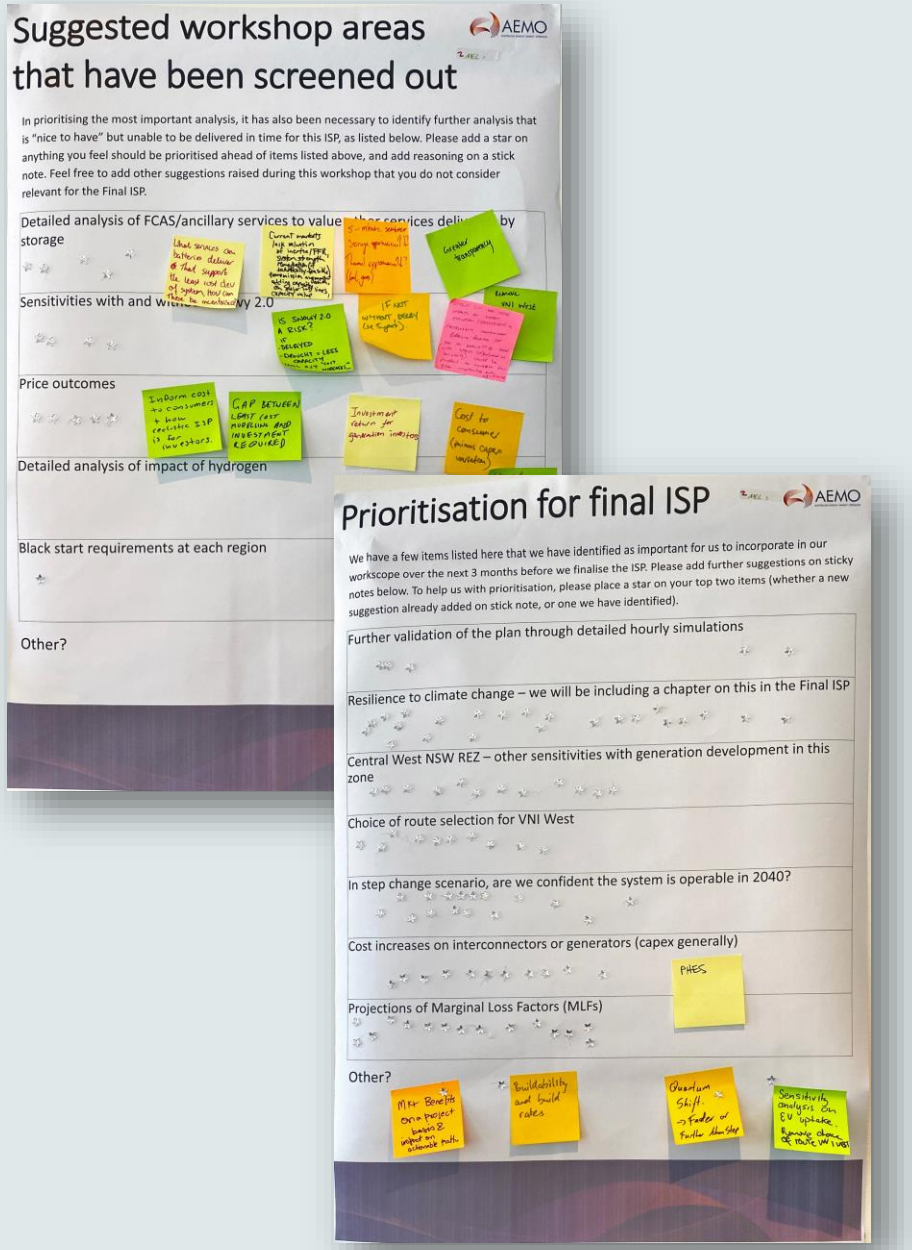
- Why there are not so many large-scale batteries in any of the scenarios? Particularly in high DER where there are a lot of behind the meter?
- Where does pump hydro go in the map?
- What assumptions go into electrification of gas network or other networks (e.g. EV)?
- Should benefit be better MLF rather than lower spot pricing?
- Can you model a scenario without snowy 2.0?
- What are the non-negotiable assumptions in the modelling, e.g. snowy 2.0?
- What if coal retirement happens earlier?
- why is there a reduction of storage from 2018 to 2020 ISP?
- Does modelling consider sensitivity on reliability of grid?
- Does ISP take into account capacity required from short periods of no RE (e.g. drought, smoke haze, no wind)? Is there a focus on reliability? Is there a factor of safety?
- What's the least cost scenario based on? NPV?
- What cost is included in generation? Opex, capex, fuel?
- Is the costing looking at individual projects or whole system cost? If second, How does this ensure individual projects would happen?
- Can AEMO inform market on cost modelling gaps or inputs to the modelling? It would assist investors.
- is potential curtailment on plant (e.g. solar) being considered in the modelling. It would good to understand what the potential spillage is in the scenarios
- How is government investment being considered?
- Are you capturing latest solar rooftop uptake position and changes in legislations, incentives?
- What's driving the scale of behind the meter model? Is behind the meter input an assumption?
- What are the assumptions on large scale battery?
- In the step change, why wouldn't you consider sensitivity on other technologies, geographically diverse from hydro?
- Wouldn't step change have EVs, hydrogen?
- would modelling consider a technology breakthrough scenario?
- What uncertainties are more important for the general outcome?
- Wouldn't you model a steeper step change scenario?
- Where does the firming for all projects come from?
- Does High DER scenario consider EVs?
- does wind development includes offshore wind?
- does ISP consider individual RE projects or hybrid solar, wind, battery projects?
- are microgrids included in the modelling?
- Is it 2050 NEM net zero input considered in the modelling?
- What is the scenario that considers EV uptake?
- How much was energy efficiency forecast? Is it included in ISP?
- Why is major load retirement looked at only in Vic?
- Key question: how much fuel switching have you built in the modelling (from gas to elec)?
- Have you considered scenarios that switch in between them (e.g. from high DER to step change)
- it would be good to see a high load growth and low DER uptake scenario
- What's the time resolution of the modelling?



Themes/Questions/Insights/Comments

- What is the process? And How does this work?
- Sensitivities
  - How did AEMO consider cost sensitivities?
  - "How is this sensitive to renewable penetration?
  - Step-change is tilting the scales – is / should this be weighted?
  - What was used for the Early Retirement Sensitivity?
- Change and probability
  - How do / will AEMO react if there is a sudden change?
    - Federal policy change
    - Deal-making between Federal Gov and the states.
  - How do you reassess as things change?
  - What are the probabilities of each of these scenarios occurring?
  - Increased frequency of non-credible events is quite important (note star count)
  - If you make a plan that is based on certain events being rare then what do you do when they become common?
- Into the detail…
  - For Scenario […] were diesel generators required?…
  - Which version of the VNI (Victoria to New South Wales Interconnector) did you use for your cost basis? There is a $200M difference between them…"
- The ISP tone on cost suggests $100M-400M is a major cost – they're not! Why not do it all?!

D - Least Worst Regrets Melbourne



Themes/Questions/Insights/Comments

- How much confidence do we have in defining demand?
- It is highly likely that Snowy 2.0 will be delayed so we need to plan appropriately to have a contingency plan, including what other projects can be started in the meantime.
- Want to understand what the domino effect of the Central West NSW REZ will have on the market and other activities.
- Are the costs stated in the ISP relative to the International market? Want to benchmark Australia's activities with other countries for reference.
- Storage has been considered and the ISP assumes locations in the grid however the plan is vulnerable to decisions made by the market and regulators, such as location and duration of storage.
- Want to explore all of the benefits of storage.
- Central West NSW REZ timing of development and location differs slightly to what was proposed in the 2018 ISP. The updated information provided by the NSW Government will impact the market and 2020 ISP – stakeholders want more investigations to unpack impact.
- Want price outcome certainty and how policy makers can have a framework that sets and adapts to changes. Price outcome certainty between what is predicted in the plan and what occurs.
- MLF report in conjunction with an insights / constraints report, separate to the ISP.

Table output

What else…

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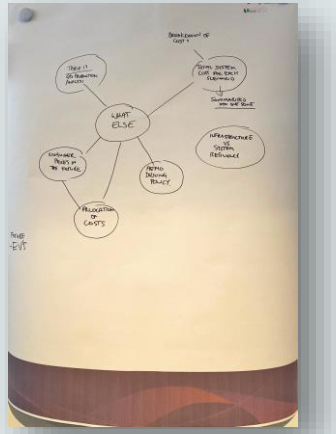
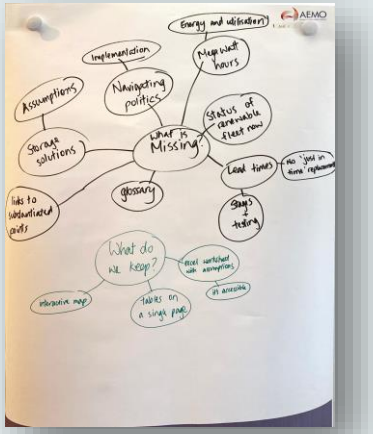
What else?

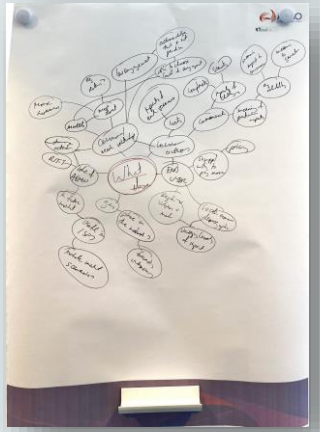
- Commentary on FCAS markets
- Likelihood of Scenarios
- Impact of least pathway of regret
  - How chosen and why
  - Sensitivities
- Reserve margins
- Addition QNI options
- Impact of NSW REZ
- Battery Options
- MLF Resistance
- Finalisation of methodology
- Feedback loops
  - Short term impacts
- How was this developed through the process and where it ends up
- Storage Solutions
  - Assumptions
- Links to substantiated points
- Glossary
- Navigating politics
  - Implementation
- Megawatt hours
  - Energy and distribution
  - Status of renewable fleet now
  - Lead-times
    - No just in time replacement
    - Stages and testing
- Driver for transmission
  - Wind resource
  - Solar resource constant geography
- Table 17 - Gas production analysis
- Consumer prices in the Future
- Allocation of Costs

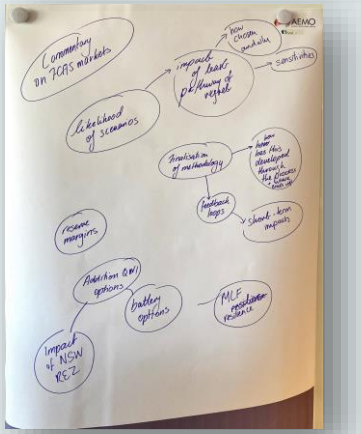
What else?

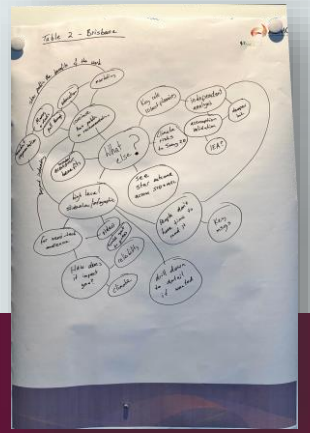
- Lead time for assets
  - BESS vs Pumped hydro
  - Gen costs
  - Firm CAPEX costs
  - How to assess non-network options if $$ not firm?
- Technology development
  - Storage minimisation
- NSW Announcement
  - Gas price
    - Sensitivities
    - Impact on business case?
- Pumped Hydro
  - Sensitivities
    - Cost Variances
    - Impact on Wind and Solar
- AEMO driving policy
- Total System costs for each scenario
  - Summarised into one point
- Infrastructure vs system resilience

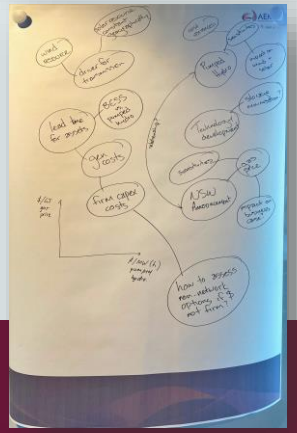












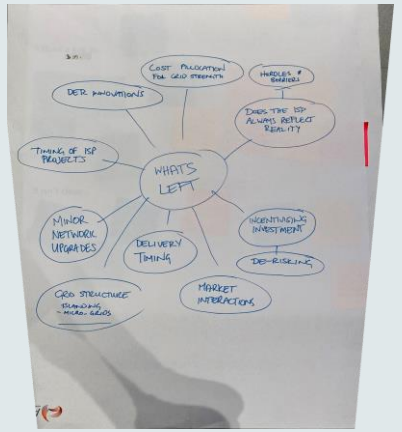
Brisbane

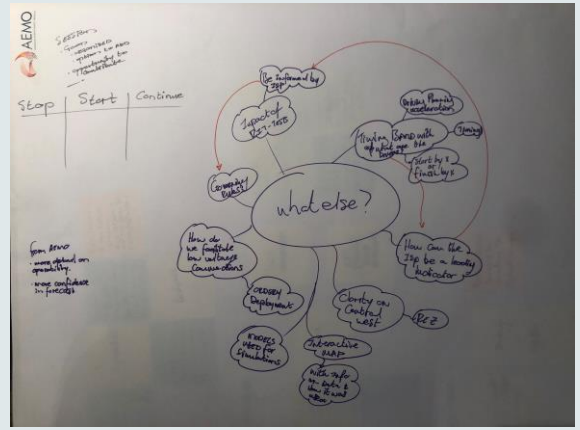
What else?

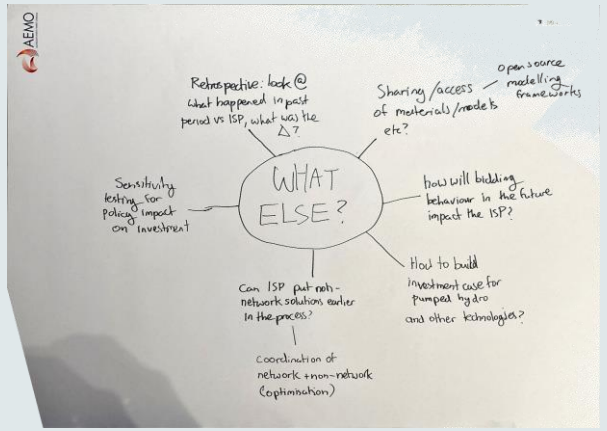
- Will this be extended to distribution?
  - Method?
  - Pace
- Business model for generation
  - How?
  - Market signals
  - Pumped hydro viability on mainland
    - Resources and skills
- Degree policy drives scenario vs scenario driving policy
- Sensitivities
  - Ensuring confidence
  - Test externally
    - Collaboration
- How does the grid handle EVs?
  - Concentration of charging
  - Load management
- How to execute the plan
  - Deliverability
    - Network
    - Generation
  - Cost
- Resource constraints (on team)
  - Stakeholder inputs
  - Data
    - Crowdsourced?
  - A bigger computer!
- Greenhouse gas emissions
  - Construction impact
    - Transmission lines
  - Operations
- Consistency with global chances and COGATI
- Interconnecting Bayswater w Eraring

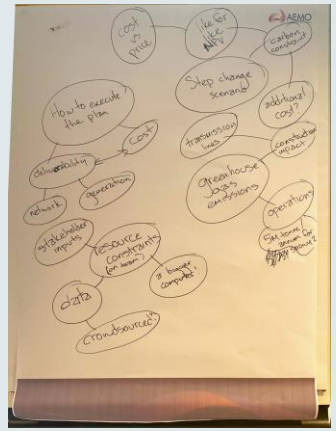
What else?

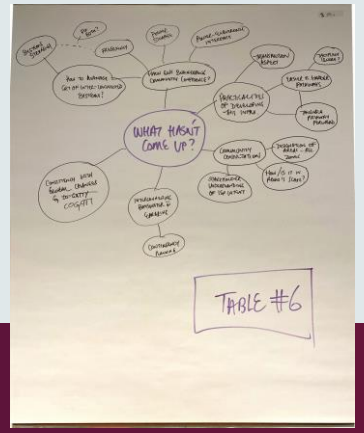
- Contingency planning
- How might we give Kerang community confidence?
  - How to manage set of interconnected systems
  - Frequency
  - Power storage
- Community consultation
  - Designation of areas (REZ)
  - Is it in AEMO's scope?
  - Stakeholder understanding of ISP intent
- Practicalities of developing this infrastructure
  - Transmission aspect
  - Easier vs harder pathways
- Clarity on REZ
- Interactive map
  - With info on data and how it was used
- Models used for simulations
- How do we facilitate low voltage connections
  - Orderly development
- Contingency Rules
- Impact of RIT-Tests
- Timing band with what are the drivers
- How can the ISP be a leading indicator
- Retrospective look at what happened in past period vs ISP – what was the delta?
- Sensitivity testing for policy impact on investment
- Can ISP Put Non Network Solutions earlier in the process?
- How to build investment case for pumped hydro and other technologies
- How will bidding behaviour in the future impact the ISP?
- Sharing/access of materials/models
  - Open source modelling frameworks

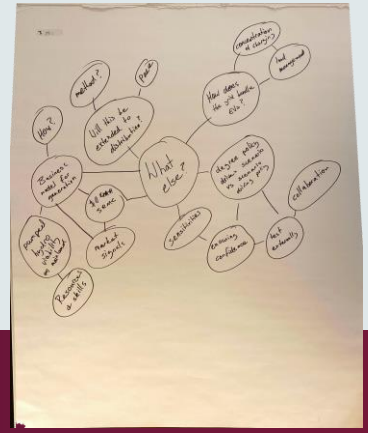












Sydney

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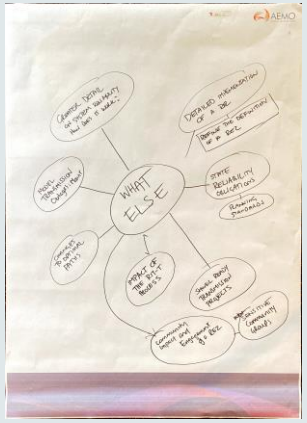
What else?

- Understand how the scenarios are being used
- Renewable metal refining
  - Market in Europe
- Need for 5% more capacity
  - Allow for more uncertainty
- Degree of materiality
  - Uncertainty in assumptions
- Lack of funding
  - Comparative funding with other industries
- Transmission availability
- Buildability limits
- Timing of delivery
- Capacity for operational and maintenance
  - Jurisdictional planning
  - Planned and non-planned
- Benefits of making things more certain
- The ISP could be used as a measure of plants in the future connection applications planning
  - Central scenario or multiple
- Gas/fuel switching
- Cost of generation and distribution
  - What is the most economic
- Reduce complexity
- System Strength and inertia
  - Changing system
  - +120% renewable
- Key messages
  - Future investment
  - Future growth
  - A core that doesn't change
  - What are the trigger points

What else?

- Water
  - Reliance
  - Drinking or Pumped hydro
  - Cooling for thermal generation
- Cost of DER
- Market transparency decisions
  - COGATI
  - Competition impacts
  - Gas availability
- Government intervention
  - Demand side opportunities
- Storage to avoid transmission
- Unforeseen factors
  - Environmental, innovation, public
- Modelling Coal
- Failure combinations
  - EVs, batteries, interconnectors
- Tasmania as a holistic project
  - Hydro is cheaper than VIC
  - Model it as a REZ?
  - CAPEX certainty
- In 20 years are we competitive
- Confidence in government commitments
- Investment vs technical drivers
- Managing market dynamics
- Capacity value of different storage
- Greater detail on system reliability
- Detailed implementation of a REZ
- Changes to optimal paths
- Impact of the RIT-T process
- Shovel ready transmission projects



Melbourne

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Collated Feedback

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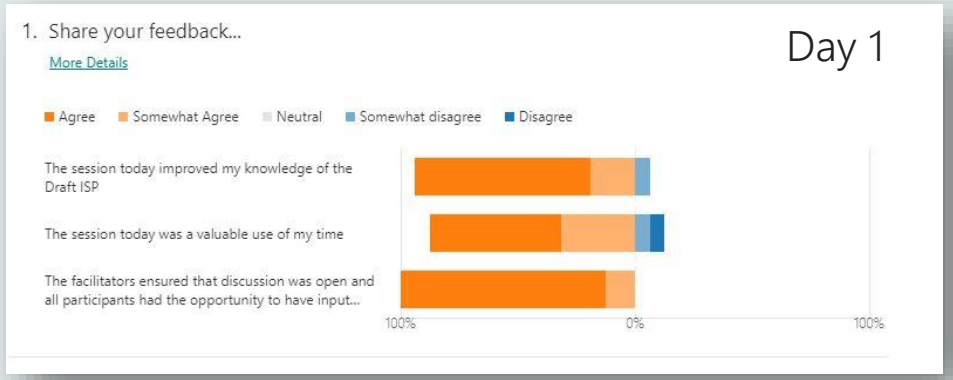

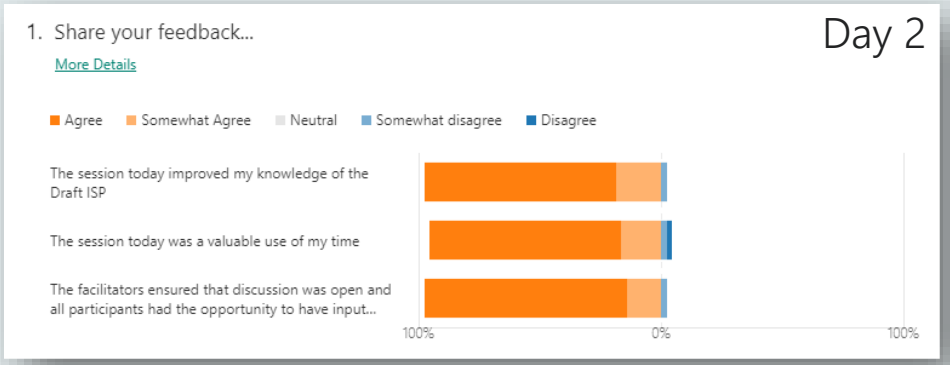

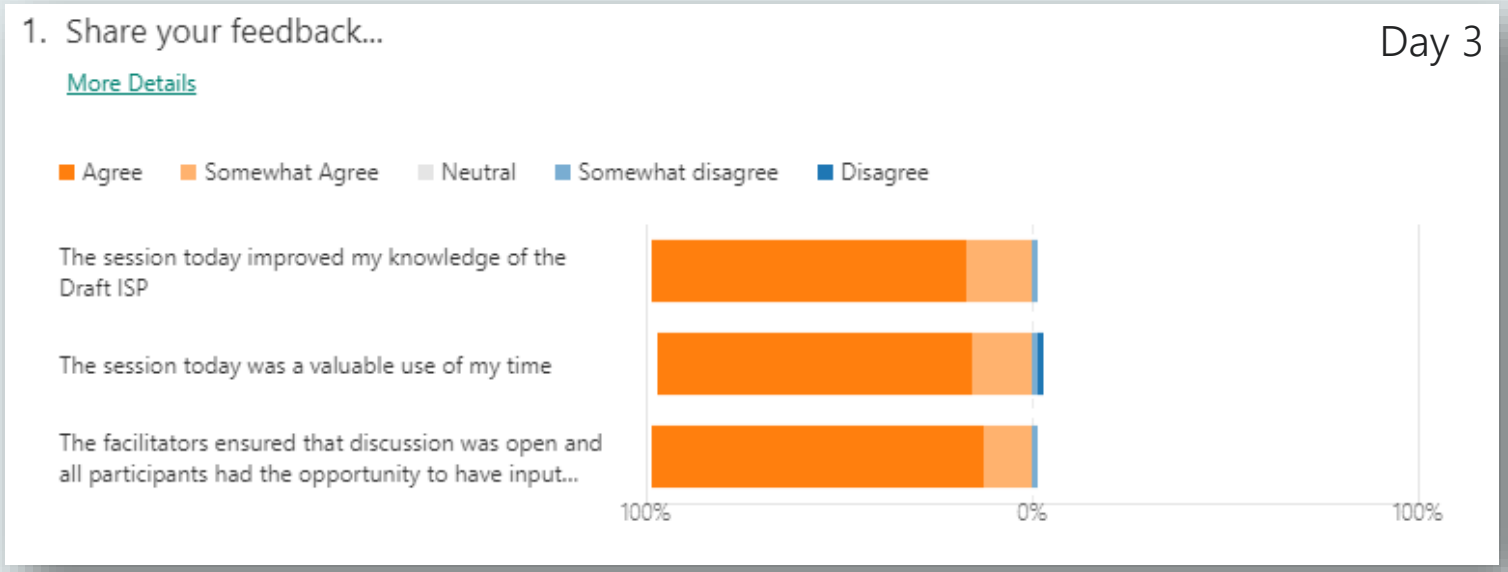

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Share your feedback

- Interactive nature with SMEs
- Format was good and a lot of willingness to listen
- The first session (I like, the gap, it isn't clear…)
- The opportunity to ask questions to clarify my understanding of AEMO's approach - will help a lot as I develop my submission
- the workshop was very interactive.
- I love that you are doing this. Format was good. Host was very good. I liked the open minded non defensive way that the AEMO people interacted and took feedback.
- Everything
- Working with different stakeholders to diversify my perspective. How key AEMO staff are travelling to each city.
- Hearing the concerns and questions of others in industry
- The ideas that AEMO are thinking about for modelling system security services
- Access to the modellers
- The openness and honesty of the experts.
- How open and collaborative the session was
- The 5 specific stations for issue deep dives.
- The way the workshop was structured to get as wide a range of feedback as possible
- Being to chat directly to the modellers/AEMO staff.

- Interactive discussion about ISP details
- Open and transparent conversation.
- Having the opportunity to determine AEMO priorities
- Facilitation, exploration and openness to feedback
- Well run, efficient, good discussion, everyone was encouraged to contribute.
- "Facilitation by proper facilitators kept the conversation moving and no one from dominating. Spending time with the modellers. "
- The ability to add ideas to the predetermined.
- Collaborative approach with all parties involved
- The coordination of the sessions. Splitting to 5 areas and provide the ability to discuss details with modellers is very good
- Moving around the room, visual thought provoking content, chance to talk with AEMO frequently
- Mix of presentation, table discussion and whiteboard Q&A
- Timings and variations of sessions plus mixing people up
- The format and flow of the forum. There was sufficient time for robust discussion and I left with a better understanding of the ISP design process.
- Discussion with AEMO team
- "Facilitator. Openness from team about things they didn't know / didn't have time to do."
- The discussion stations and opportunities to give input.
- Open ended nature it the discussion

I liked… (2)

- Isp gaps analysis
- I liked the fact there was a workshop which allowed the opportunity, although limited, to interact with AEMO staff and with other attendees
- The opportunity to contribute
- The whole thing - subject matter and mode of engagement
- The broad views are f the participants
- The structured facilitation
- Opportunity to ask questions
- The format
- The format and dialogue
- Combination of presentations and working group discussion. Rotation to new topics and presenters.
- Strong representation from key AEMO modellers
- AEMO is trying their best to answer as many questions as possible. Open, frank and transparent discussion.
- Open access to key members of the development team
- Structure and engagement levels
- Structured and guided discussions
- The breadth of relevant topics

I liked…(3)

- Openness, transparency and access to staff
- The facilitation and discussions, top notch engagement!
- Particular liked the 2nd half (1st half also good)
- Hearing the perspectives of other participants. The opportunity to speak with the modellers.
- That this was a genuine consultation
- Direct discussions with the modelling team, with 20 min per session enables really good discussions and learning opportunities
- The detailed discussion around the stations
- The facilitation, the break out sessions.
- The arrangement for circulating from one discussion to the other
- The 5 white board session discussions and the what else discussion
- network investment is being reaffirmed and providing confidence to investors at the least cost to consumers
- The access to the experts who were almost entirely very open to feedback.

I liked…(4)

- That AEMO was willing to change their ways of doing things
- We had a bit more tune to ask questions if the modellers before moving to the A - E workshop session
- Nothing really.
- There wasn't always people who think renewable technology can't replace coal and gas always over contribute
- We had slightly more time
- Explained more on the next steps following final ISP publication, and distinguished between what TNSPs will achieve in line with ISP process, such that the ISP itself doesn't need to focus on these specific areas (e.g. detailed design)
- There was more time for broader Q&A across the entire group
- There was an overview of methodology and outcomes at start
- There were separate sessions for different groups of participants. Discussion was too broad.
- There was some clarification of the ISP purpose and the difference between this and market reform
- There was more time to talk to specific assumptions.
- This happened earlier
- There was greater understanding of how this interacts with how energy markets work in the future, and how the private sector will be able to underwrite investments

- There was more information in the introductory slide pack and that the pack was distributed to attendees.
- Industry grouped questioning of the modellers to situate the discussion.
- More explanation of transmission options considered
- A bit more discussion on network options
- The groups had the opportunity for more mixing, rather than having the exact same group of people for 4 hrs (allows for more cross pollination of ideas across the industry, and less time with very vocal ranters)
- "There was time for quiet preparation by yourself before opening to table discussion to allow time for ideas and thoughts to be formulated. Otherwise discussion can be dominated by a few loud voices and we miss quieter people with good ideas and insight. The previous ISP workshop did this well"
- Clear pragmatic isp rules and streamlined approach into tnsp rits
- There was more detail on how the ISP interacts with the current rules and rules planning processes.
- Some more case studies from participants and their issues
- some Of the priorities could be easily voted on by industry who aren't in the room (busy developing projects) - not just those who have time to attend/vote
- The ISP considered nuclear power.
- More on what happens to the outcome from the ISP
- For better evaluation of PHES sites to focus on the most viable

- "There had been more feedback from the original break out session, 2 only was not enough. The five different station sessions could have been a bit longer. Feedback and questions from other attendees is as important as information from AEMO staff, this could have been facilitated better"
- The AEMC would engage as well as you guys!
- To come next time!
- More high level discussions around the role of the ISP and AEMO
- We had more time - this could easily have been a full day session, with the afternoon building on priority areas identified in the morning.
- Some more colour and movement at the break out space. Some had lots of charts, some were text only.
- It was a larger room, quieter, less chilly
- "Time to join other groups of attendees. Better visibility of who was attending. "
- There were responses to queries re why so little generation and utility batteries are in the capacity outlook
- We had time for more technical discussions. A lot of items in ISP do not make sense.
- There was more discussion on the scenarios and triggers. The ISP has to predict the future yet the ISP contains limited prediction on that future
- There is more participants from consumer groups, and regulators
- It was longer
- Facilitators took a speaking list or something, to make sure everyone got a chance to speak.
- There was more detail provided on the content of the ISP (having only read the exec summary!)
- I had more stars

I wish…(3)

- This was an annual event
- I had been able to read more beforehand
- I'd had a chance to hear the views of people from other tables more.
- "Understand more on modelling view of correlation of wind resources across the nemISP modelled Tasmania as a integrated REZ/ project including wind/phes and marinus link"
- to understand the modelling methodology and working on cost benefit analysis
- That there was a follow-up that provided a reflection from AEMO. Also, to get a full response there should have been sessions in SA and TAS. The rallies are less relevant without that. It also would have been good to have better understanding of the inputs consequences in earlier consultations. Some of the clarity on assumptions (scale, application, etc) came late.

- All started working together?
- Took follow up comments and questions after the day
- Use marketing and PR tools and devices to get this message at a higher level out to a broader audience so the tax payer can see the value and importance of your work.
- Did the step change!
- Discussed the options in more detail
- Explained more on the next steps following final ISP publication
- AEMO follows up with a summary and feedback for clarity on future work they will do based on today's discussions
- Could change the policy space around the ISP more quickly so it supported the development of the power system rather than hindered it.
- "There was time for quiet preparation by yourself before opening to table discussion to allow time for ideas and thoughts to be formulated. Otherwise discussion can be dominated by a few loud voices and we miss quieter people with good ideas and insight. The previous ISP workshop did this well"
- Did a sense check of draft to realities of market investment

- Do this every year, please :)
- Had slightly longer time for more discussion in a less structured and controlled format. Some control and structure is good, but from a downside perspective it can prevent the free exchange of thoughts and concepts
- Just build the infrastructure
- The last session of discussion on everything else was led by AEMO rather than Aurecon. Take some of our technical questions on notice.
- Accept a great deal of uncertainty in a wide variety of assumptions and build room as insurance for large impacts…
- Provided a probability that each scenario eventuates
- Remove the cow bell. ISP is looking forward, why has Matt brought along old technology;-), will he bring out a slide rule next? Ha ha. All good
- Could use this work to better inform our politicians
- Broke people into their key interest areas to spend more time (rather than everyone spending equal time at each station)
- Called on the views of parties the table facilitators found particularly interesting.
- Considers the potential for ancillary devices to drive development that could influence the ISP decisions.
- Considered uncertainty more explicitly.

What if we…(2)