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Energy Policy Evidence
Environmental Effects Statement – WORM Pipeline Project

Jim Snow

Executive Director

Adjunct Professor University of Queensland

Expert Witness Instructions – Jim Snow - Final Report, 22 September 2021

- *Prepare an expert witness statement that summarises your opinion and analysis regarding the consistency of the Project with State and Federal energy policy;*
- *Review and respond to relevant submissions filed by third parties and Authorities.*

In preparing this evidence I have drawn from the APA EES the Project Rationale, from my work related to the Victorian Transmission System Demand and Supply analysis being also undertaken for APA, and from other market knowledge acquired across recent projects related to gas supply in Victoria and South Australia, nationally and projects in Victoria looking at the production of, and markets for, zero emission gases. These include hydrogen, biomethane and zero emission methane.

The WORM has been already factored into meeting peak gas load for winter heating in Victoria and fits within net zero transitional approaches.

PROJECT RATIONALE

The WORM is already factored into delivering peak gas heating demand

The WORM is already factored into the system planning to meet the peak gas heating demand in Victoria and has Regulatory Approvals

- AEMO – the market operator has factored in the WORM to its Victorian Gas Planning (GSOO, VGPR) to meet peak demand – needed by 2023 – still problems after that date – even with the WORM.
- AER – the Energy Regulator has approved its construction and costs – to be paid for by all customers – stringent prudency tests are applied – these are very exacting economic tests

Without the WORM concerns that consumers will get enough gas in peak winter periods by 2023, and for the security of gas supply at that time.

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

AER AUSTRALIAN ENERGY REGULATOR

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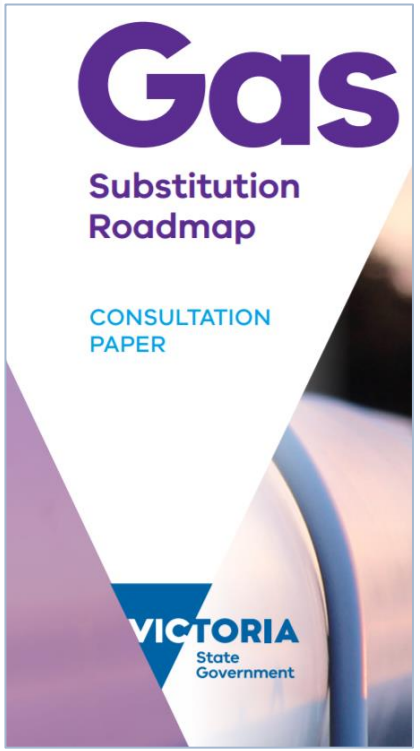
The WORM is supported by Government Policy positions

The WORM is seen by the Commonwealth Government as Critical Gas Infrastructure

It also fits with the Victorian Government Energy Policy

- Commonwealth Government National Gas Infrastructure Plan – Interim Report, and other gas and renewable gas policies.
- Victorian Government Gas Substitution Roadmap Consultation paper - "*Given the reliance on gas in Victoria, gas will continue to play a role in meeting Victoria's energy needs for years to come. Until such time as renewable and zero emissions alternatives become available at scale and are embraced by the market, it is important to maintain a reliable supply of affordable gas.*"



Recognition that in the transition to net zero, gas will be needed in the short to medium term as this transition occurs – but natural gas use will likely be very limited by 2050

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Victorian and Commonwealth gas and climate change policies.

RELEVANT POLICIES

Relevant Policies – Victorian Government Policy Objectives

- The Victorian Government in terms of energy policy states:

  *We strive for all Victorians to be able to access energy that is **affordable, reliable and more sustainable**. We work to keep the lights on, at an affordable price for most people, while also looking for ways to minimise the impact of our energy use on the environment.*

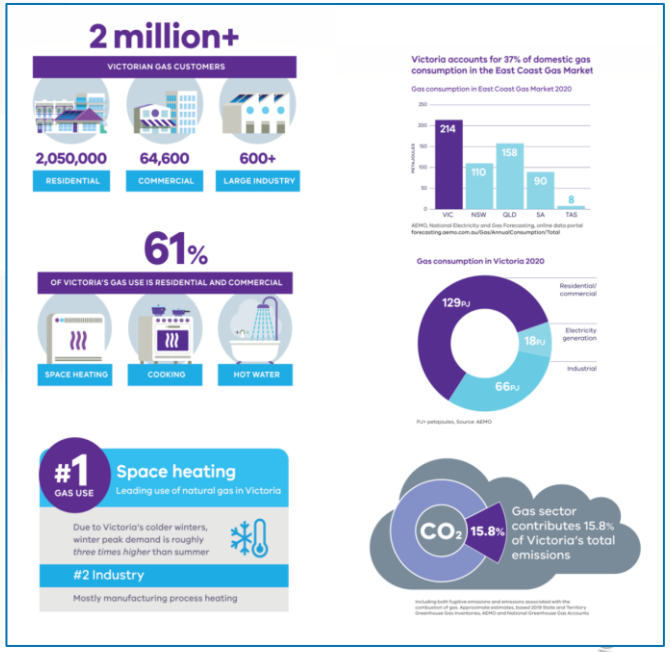
  The four key objectives of Victoria's energy policy are:

  - *An **efficient and secure** energy system.*
  - *That energy supplies are delivered **reliably and safely**.*
  - *That consumers can access energy at **affordable** prices.*
  - *That energy supplies and the way we use them are **environmentally sustainable and less greenhouse intensive**.*

- There is a focus on ensuring gas is available in the short/medium term on the journey to net zero – the WORM fits with this policy.

  Given the reliance on gas in Victoria, gas will continue to play a role in meeting Victoria's energy needs for years to come. Until such time as renewable and zero emissions alternatives become available at scale and are embraced by the market, it is important to maintain a reliable supply of affordable gas.

VICTORIA State Government | Environment, Land, Water and Planning



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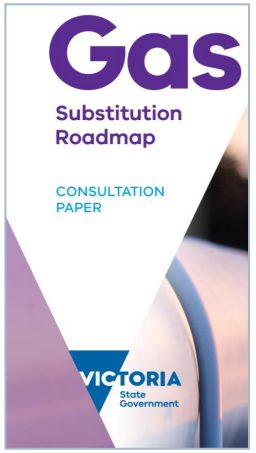
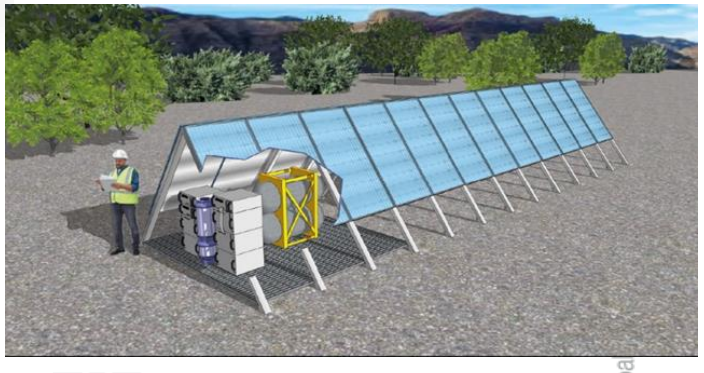
Relevant Policies - Victoria

- Victorian Climate Change Act 2017 and related targets
  - Legislated net zero greenhouse emissions, long-term target, by 2050
  - Reduce emissions by 28-33% by 2025, and 40-5% by 2030
- Gas Substitution Roadmap – Consultation Paper
  - Seeking feedback on key questions.
  - “Deep Dive” Investigations
    - Victorian gas sector decarbonisation pathways studies
    - Policies to support renewable/zero emission gas substitution for natural gas
    - H2, biomethane, zero emission methane (Southern Green Gas)
- Transitional issues and challenges – 6 Key Issues identified
  - Electricity supply issues, end user disruption, reliable and affordable energy for consumers and businesses in the transition, skills development, managing uncertainty in the transition, equity



Southern Green Gas Renewable Methane - Qld



Relevant Policies - Victoria

- Infrastructure Victoria - Interim Report – July 2021 - four scenarios to achieve net zero emissions for gas use in Victoria by 2050.
  - *Scenario A: full electrification, no natural gas (by 2050), no CCS.*
  - *Scenario B: partial electrification, limited natural gas use (in 2050), limited CCS.*
  - *Scenario C: green and blue hydrogen with carbon offsets, electrification, no natural gas (by 2050), no CCS.*
  - *Scenario D: large-scale brown hydrogen, large-scale CCS, no natural gas (by 2050).*
- Recognises that:
  - *Need to scale up proven, reliable and relatively low-cost solutions including energy efficiency, electrification and biogas* – did not examine zero emissions methane – and *long term use or repurposing of gas infrastructure* issues.
  - May need to keep some natural gas for certain industrial uses which cannot yet move to other energy sources or chemical inputs.
  - Need to ***…keep Victoria's options open rather than locking in a single approach which may not turn out to be the best course of action***.

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Commonwealth Gas Policies – very active on supply side and GPG

- The Commonwealth is focused on trying to ensure near term supplies of gas at affordable prices to meet east coast gas market demand, and
- Have published the National Gas Infrastructure Plan (**which sees the WORM as critical infrastructure**) as well as the ambition to have a *gas-fired* recovery from Covid for the economy (Prime Minister), and
- Are focused on ensuring **sufficient gas power generation** is available in the NEM to support the NEM shift to more intermittent renewable energy generation.
- This is also a focus of the **Energy Security Board** and its advice on a new market design for the National Electricity Market – the 2025 Project - keeping the lights on.
- ESB is working with the key energy market bodies (AEMC, AEMO, AER) and has run an extensive stakeholder consultation process across Australia with consumer and industry representatives (issues papers, public consultation sessions, submissions, directions paper, consultation paper, expert reports and advice, multiple ESB papers (30 odd).

AEMC AUSTRALIAN ENERGY MARKET COMMISSION AEMO AER AUSTRALIAN ENERGY REGULATOR

FINAL ADVICE JULY 2021

- Electricity market redesign advice released 26 August 2021
- Making way for new large-scale generation
- Recommendations
- Connecting renewables to the grid
- People's generation – rooftop solar and other distributed energy resources
- Strengthening the power system

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Energy Security Board – The 2025 Project

This work was requested by the nation's energy ministers in March 2019.

It is all about resetting the national electricity market so consumers can benefit from rapidly changing technologies in our power system.

- *…unlocking the value of flexible demand and distributed energy resources.*
- *…working alongside government schemes which are delivering on their policy commitments including emissions reduction*
- *…clear signals for timely and efficient investment to deliver reliable, secure and affordable electricity for consumers.*

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Commonwealth Gas Policies – very active on supply side and GPG

- The Commonwealth also have developed (with the States) a large scale hydrogen development plan (National Hydrogen Strategy) - and are actively looking at other zero emission gases (biomethane and zero emission methane).
- Renewable Energy Target Scheme, Emissions Reduction Fund and Climate Safeguard Scheme, Clean Energy Regulator, ARENA, CEFC, etc.
- Also working with the States on funding packages to support gas and renewables mix – Bilateral Sate Energy Deals (NSW, SA, Tasmania)
- Gas Acceleration Program, Australian Domestic Gas Security Mechanism, AEMO Gas Supply Guarantee (for GPG), Part 23, ACCC Gas Inquiry 2019-2025, LNG Netback series, PCTP CTP and DAA, Prospective National Gas Reservation Scheme (Paper)….

Australian Government
Department of Industry, Science, Energy and Resources

COAG Energy Council
AUSTRALIA'S NATIONAL HYDROGEN STRATEGY

Bilateral energy and emissions reduction agreements

Australian Domestic Gas Security Mechanism

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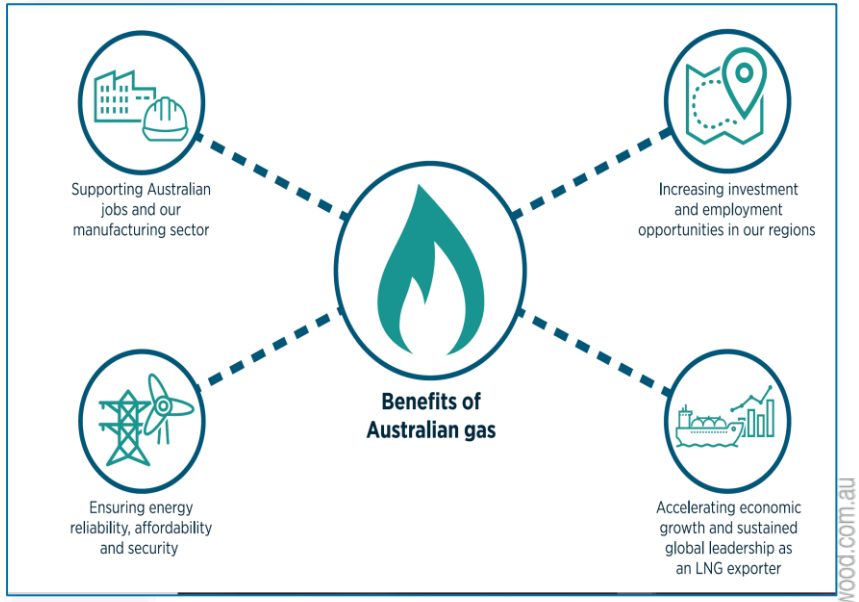
Commonwealth Gas Policies – WORM

National Gas Infrastructure Plan: Interim Report (May 2021)

- Identifies the priority infrastructure developments required to alleviate forecast southern gas supply shortfalls in the near-term.
  - This included the WORM among others (e.g., Golden Beach & Iona gas storage developments in Victoria) being recognised as a Critical Infrastructure project:

    Upgrades to the South West Pipeline (SWP) are equally critical in order to unlock the additional storage potential of the Iona facility and could support additional production from new fields in the Otway Basin. The business case for further SWP expansion, beyond that already committed as part of the Western Outer Ring Main (WORM) project, warrants examination to assist in meeting peak demand.

- Also identifies the critical role in complementing increased uptake of renewable energy technologies that gas is playing.



Massive task, major timing issues with investments, and customer fuel choice.

THE VICTORIAN DECARBONISATION CHALLENGE

Understanding the decarbonisation challenge in Victoria

- Gas use in Victoria is 200 to 230 PJ/year = 55 TWh/year (plus)
  - Electricity use in Victoria is 44.3 TWh/year (80% of the gas use)
  - Has Iona gas storage circa 7,200 GWh = 20 x Snowy 2.0 – WORM role.
- 55 TWh is the same electricity load as all of Queensland.
  - So total energy equivalent to 100 TWh – 50% of current total east coast electricity use (NEM).
- Victorian Generation – 12,000 MW – 4,750 of renewable generation including 2,292 of Snowy – 7,250 MW of coal and gas
  - AEMO ISP - 13,200 needed to get to 50% renewable energy by 2030.
  - Double this to get to 100% by 2050 presumably – 26,000 to 30,000 MW
  - Double again to add gas load (direct and/or zero emission gases H2 and CH4).
  - Circa 50,000 to 60,000 MW needed by 2050 – but would also need firming
- Zero emission gases could be best way for Victoria to firm generation.

Gas Substitution Roadmap: Electrification will likely play a significant role in decarbonising gas in Victoria. But this will increase electricity demand, including at peak times, and so may place additional stress on the electricity grid. Decarbonising the energy sector tests the capability of the electricity networks to accommodate the increase in demand if gas load is converted to electrical load through electrification or hydrogen production.

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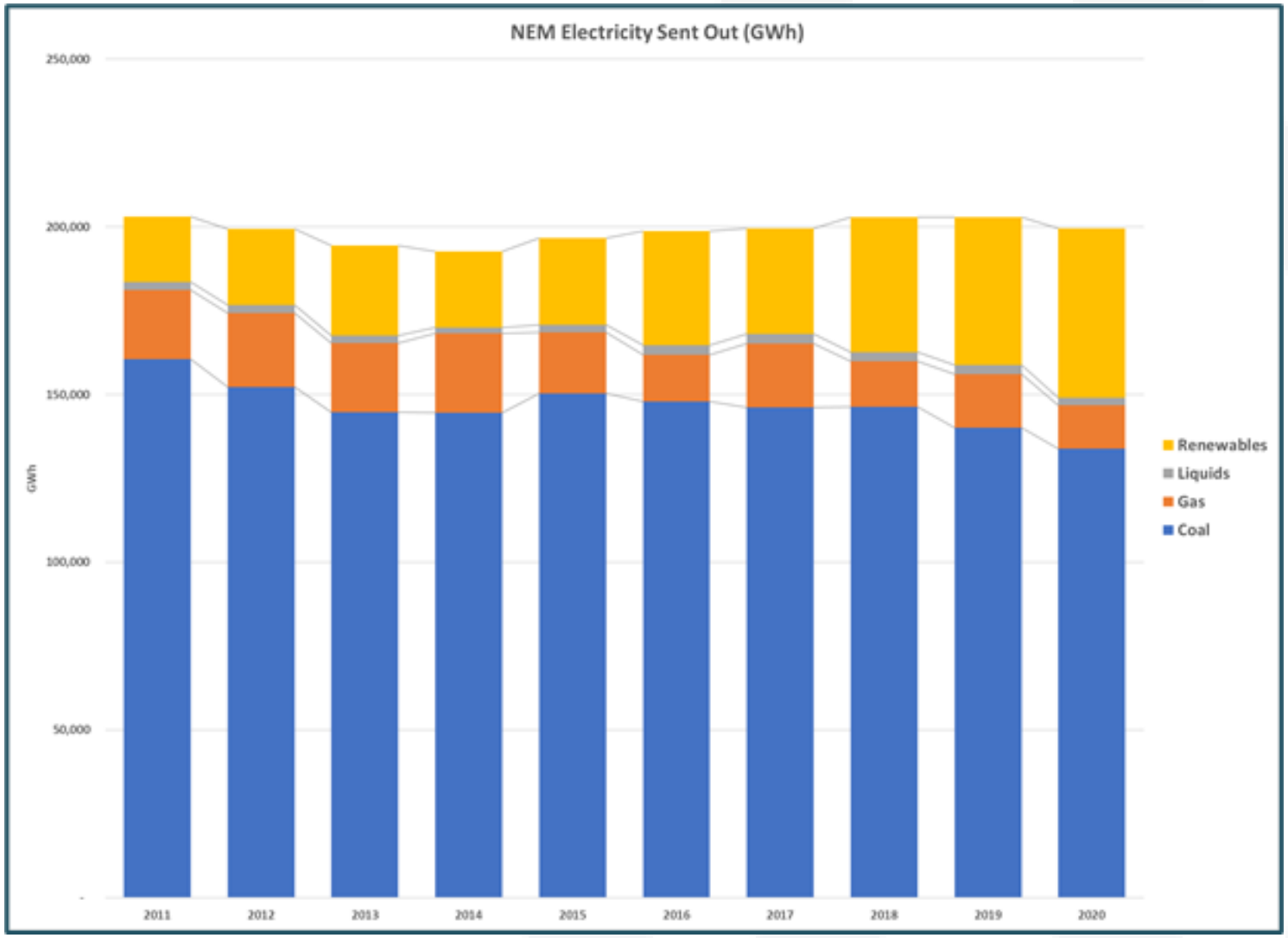
Understanding the decarbonisation challenge in Victoria



- <u>Timing</u> of such major investment is clearly a key issue.
- 75% of electricity generated in the NEM is still from gas and coal – but this is changing.
- In 10 years added 15% - but in last 3 years added 5,000 GWh new each year.
- To get to 200,000 GWh = 30 years – circa 2050-2055.
- To add gas though would take another 30 years at current rates (maybe 15 years additional at best).
- This is also a massive investment and build rate across the NEM – and does not account for firming…which will also be huge investment…or electric vehicles which may double it all again.

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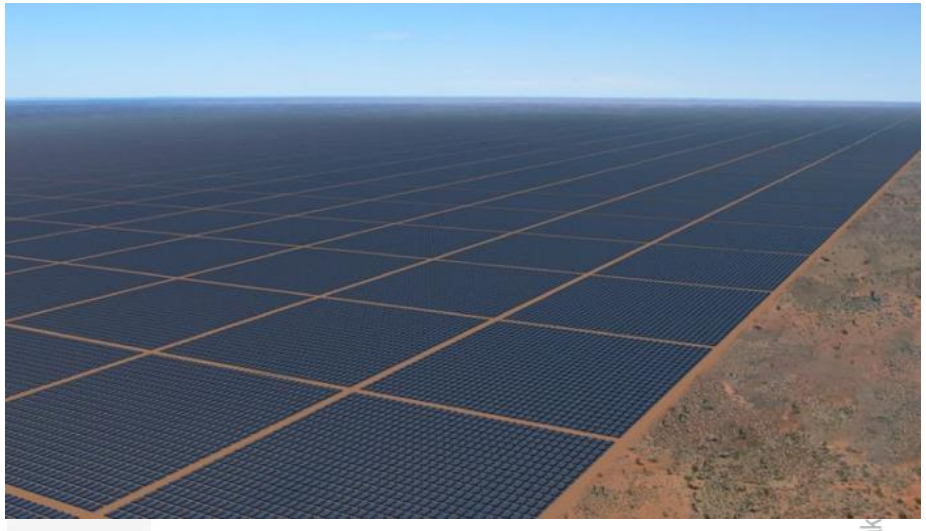
Understanding the decarbonisation challenge in Victoria

- There are 2.2 million households using gas in Victoria – consuming 61% of the gas
- Most use gas for heating, hot water and cooking
- They will need to make decisions about appliance fuels in the timeframe to 2050
- If they electrify too early in any volume greenhouse gas emissions will increase from electricity production – lower if they stay on gas
- There is a critical timing issue – electrification will need to be staged with renewable electricity generation or production and use of zero emission gases.
- Same issues facing many businesses, and
- Some can not use electricity and will need to have a viable energy source – hard to abate industries – they use 31% of the gas, which is 65% of total industrial energy use – this is a major issue for the Victorian economy.



The critical role of gas, and then forms of renewable electricity storage (including zero emission gases and existing gas infrastructure) to firm renewable generation.

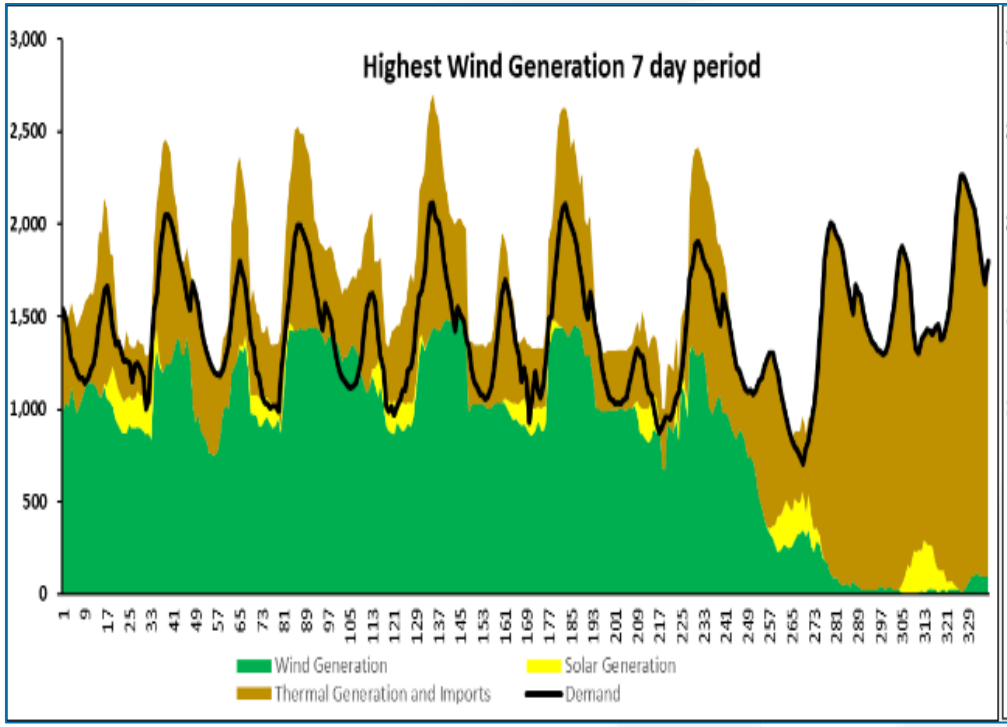
THE SOUTH AUSTRALIAN CASE STUDY

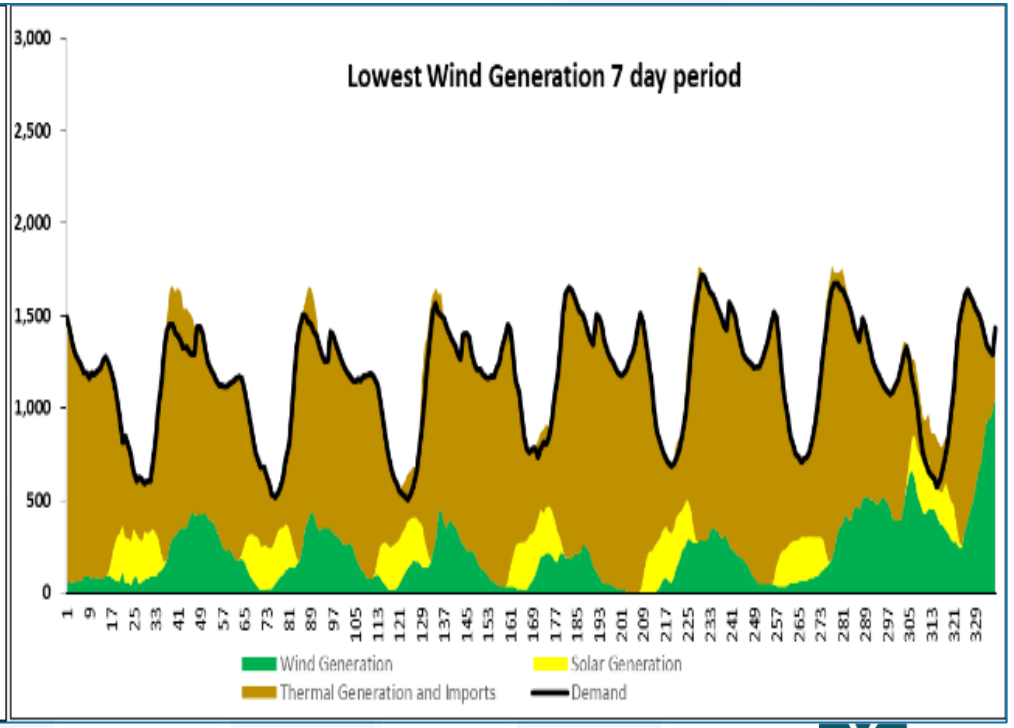
South Australia is an excellent case study for net zero future in the NEM

- Has very high wind capacity and solar capacity (when rooftop solar is counted) – no coal fired generation - but does have interconnector with Victoria
- Has 98% of its peak demand in dispatchable generation (mainly gas).
- Has 64% of its peak demand in solar generation capacity
- Has 71% of its peak demand in wind generation.
- Has the first large battery installed in Australia – now 150MW/195 MWh.
- AEMO 2040 projections (ODP) would see more solar and battery storage added - so progressing toward even high utilization of renewable generation.
- In 2019-20 wind was 40% of energy generated, solar 5% (15% with rooftop PV) and gas was 43% (net imports are about 8.5% - rest is some diesel).
- The State though has extended "***wind droughts***".

Wind droughts and renewable generation support

- South Australia has periods of high and low wind generation – low often coincides with very hot weather…
- In the last 2 years there were 292 out of 730 days where wind generation was less than 20% (40% of the time).
- Consecutively: 40 x 3 days, 18 x 4 days, 9 x 5 days, 1 x 14 days – a month where 20 days – this is when dispatchable generation/very high levels of storage are essential.





Green is wind, yellow is solar, brown is gas/diesel and imports, black line is demand

High wind vs low wind = 6 x the wind generated

Low wind days support generation is very high

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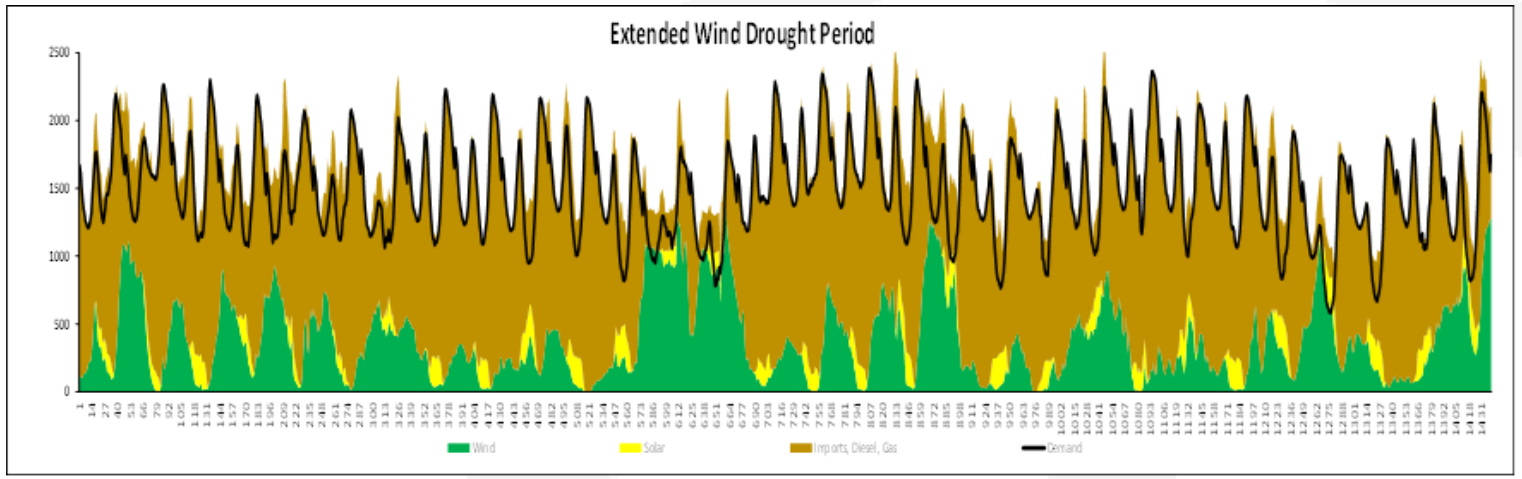
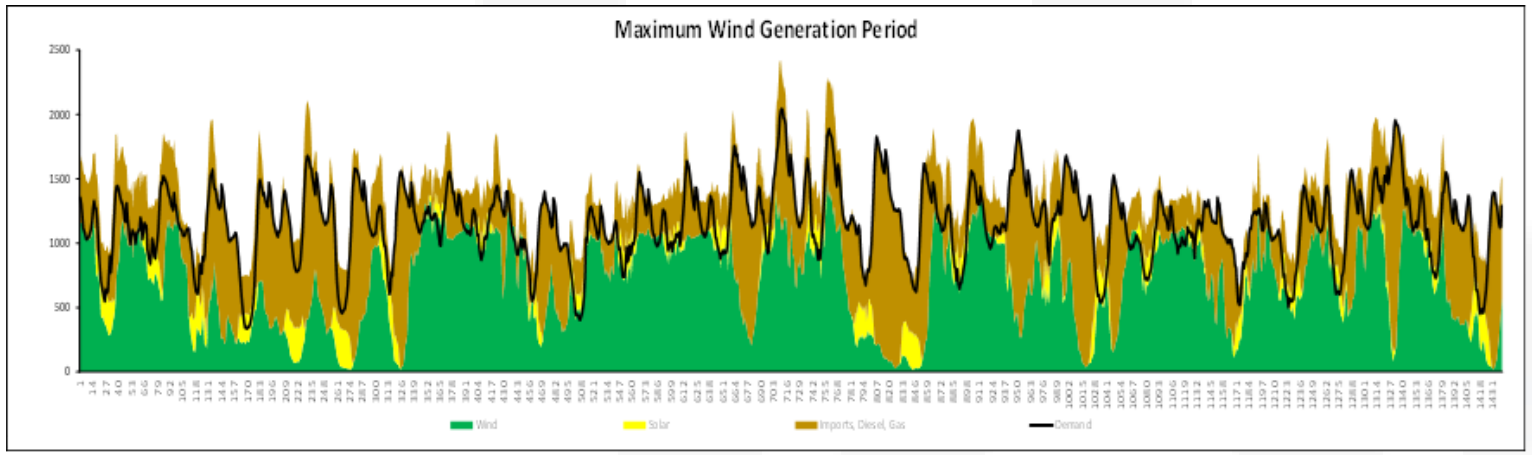
Extended Wind Lows & Highs – over a 30 day period

- Extended wind drought - 20 days wind was less than 20% - 71% of the generation was SA thermal and imports – (gas/diesel/imports).
- Maximum wind period – 32% of the generation was SA thermal and imports – (gas/diesel/imports)





Green is wind, yellow is solar, brown is gas/diesel and imports, black line is demand

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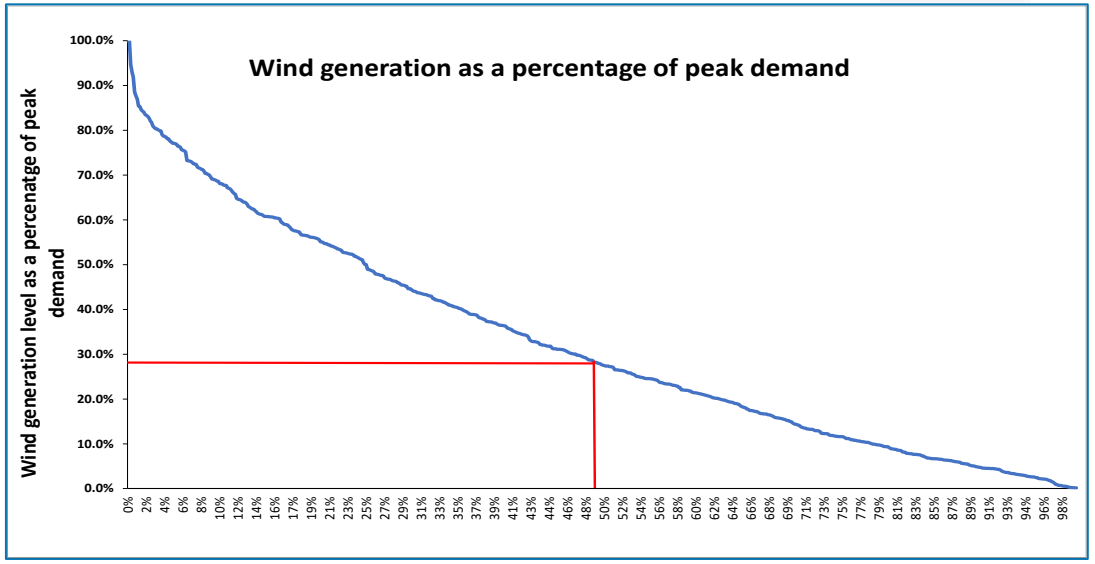
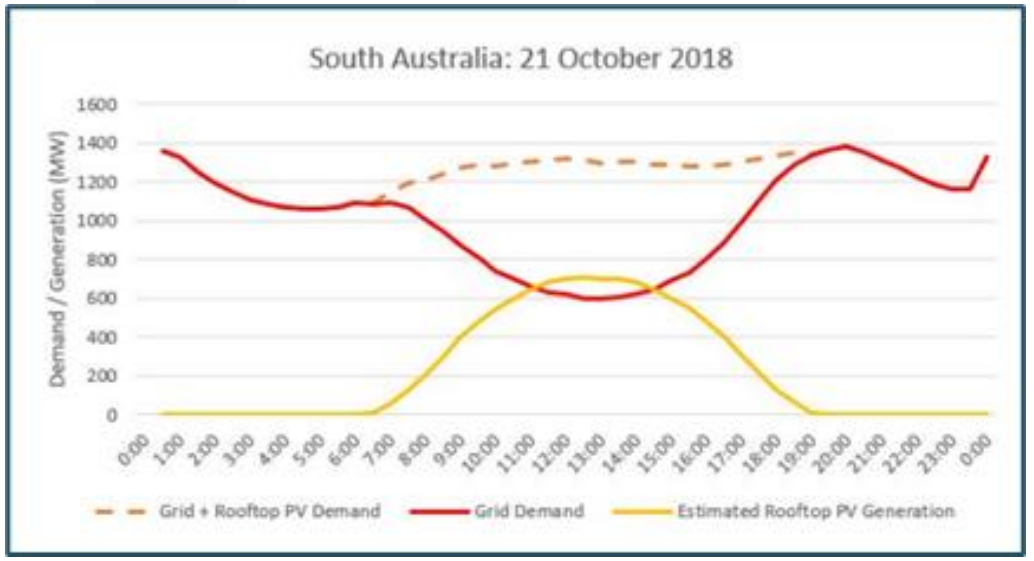
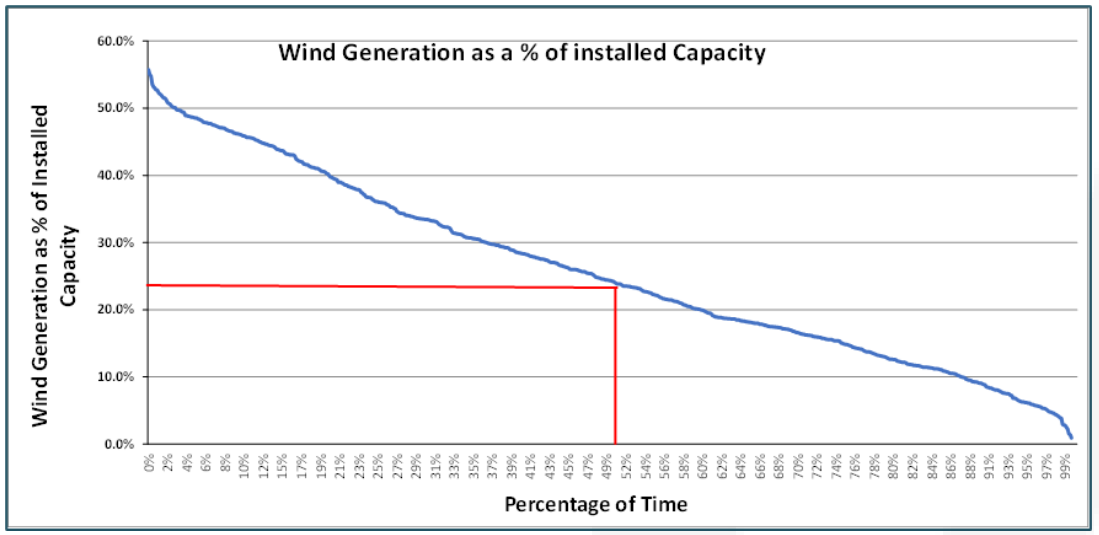
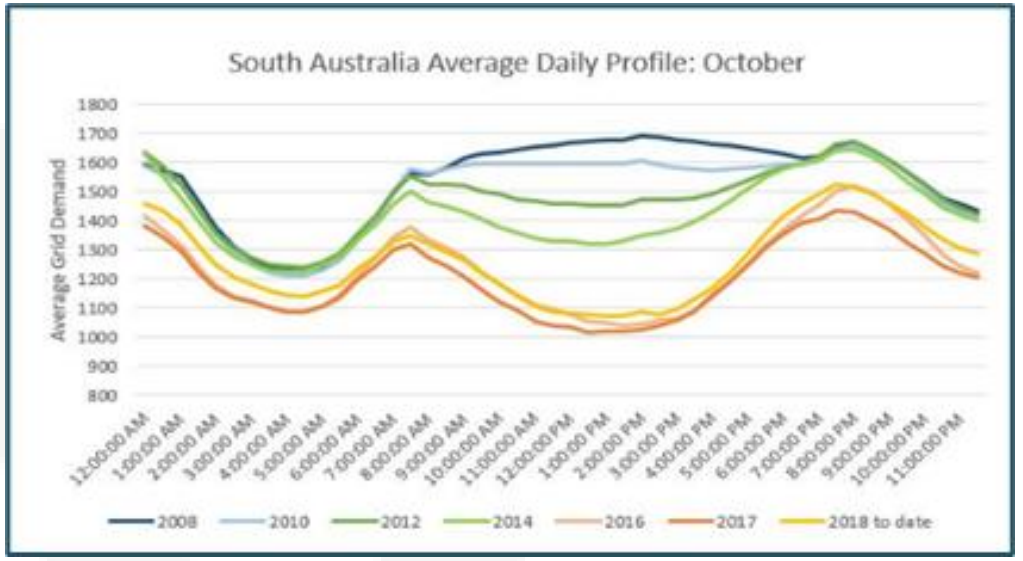
Major issue is that wind and solar have (natural) utilization limits and need firming









Average wind output is 26% of capacity, solar is 17% - this is normal (wind patterns, daylight, etc.) – solar creates new “peak periods”

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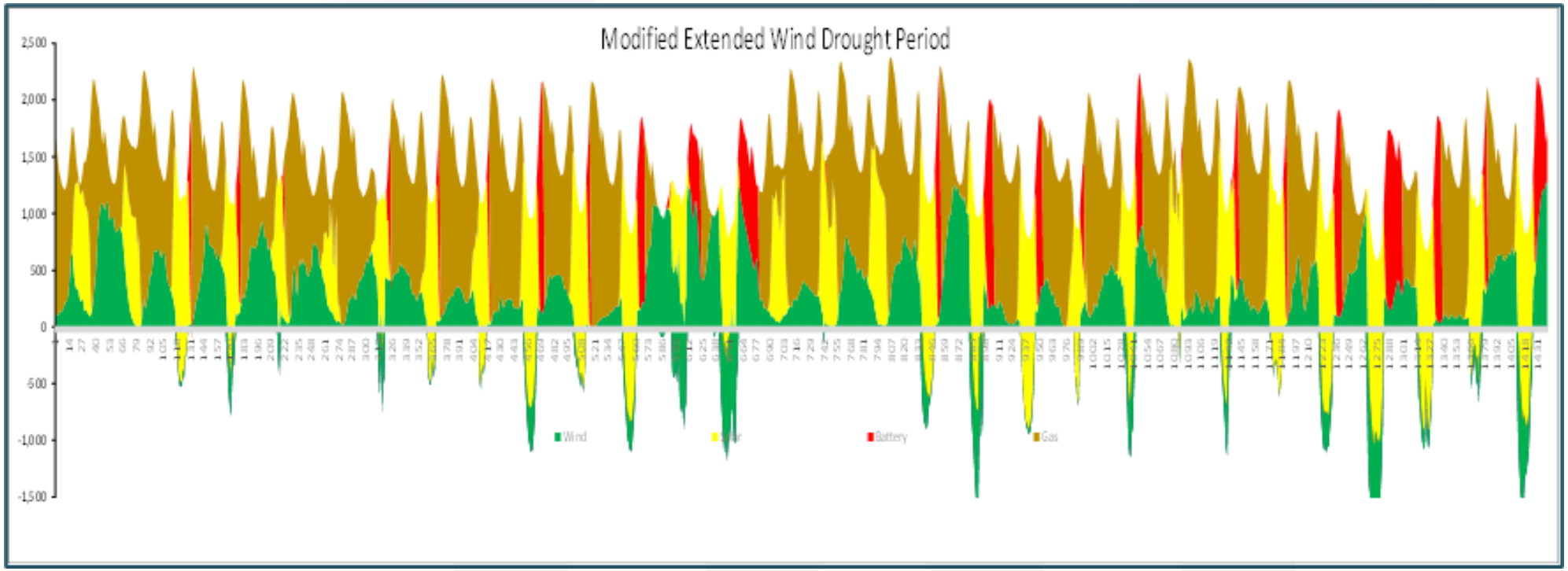
Simple example of pushing SA to very high levels of renewables (ODP AEMO)

- Same wind resource, 7 x solar (grid based) and unlimited “battery” – excess renewable electricity stored in the “battery” and returned when no wind or solar
- In extended wind drought case still need 48% gas generation – simply not enough excess renewables
- In the maximum wind case though no gas is needed – battery works fine.



Green is wind, yellow is solar, brown is gas and red is battery

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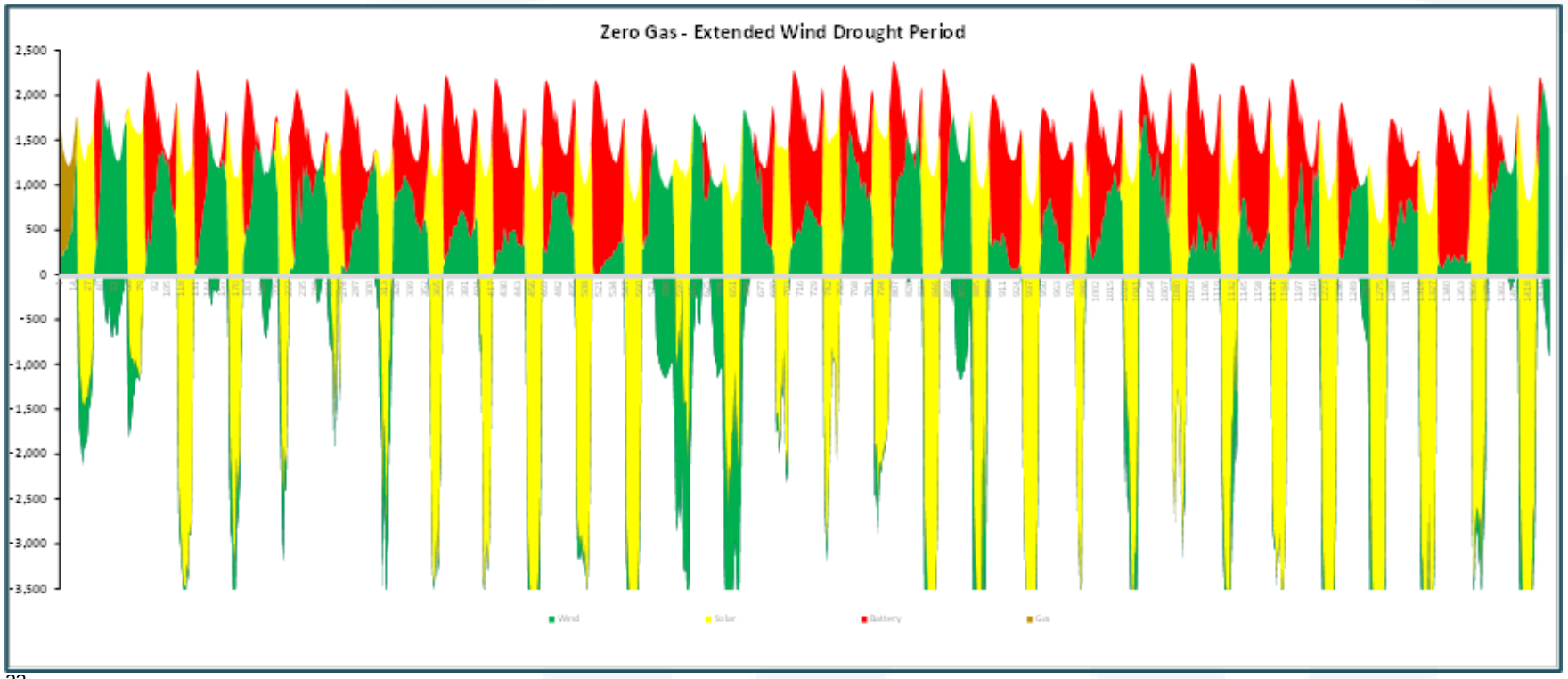
Simple example of No Gas Generation in extended wind drought

- To do this requires = 2 x the wind capacity and 18 x the solar (grid based) capacity to be built – in order to generate sufficient excess renewable electricity to be “stored”.
- This case requires 215 GWh of renewable energy storage to support the “droughts” – this is for example 60% of Snowy 2.0 – batteries at $135k/MWh = $30 billion – 1,100 x Hornsdale battery.
- But could also be done with zero emissions gases using existing infrastructure (and maybe more gas storage) - especially if zero emission methane sources.



Green is wind, yellow is solar, brown is gas and red is battery

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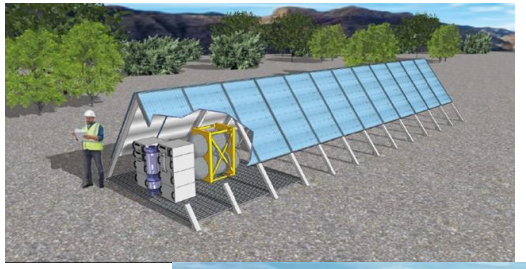
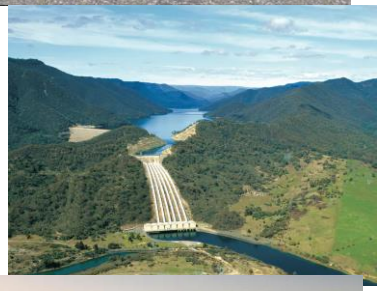
SA Case Study – what does it show, WORM?

- Large scale renewable energy storage will be needed to support the development and final operation of electricity systems with high levels of renewable power generation – net zero world.
- This could be pumped hydro, batteries and/or zero emission gases – the economics of these will decide on which is preferred, in which location and state – it is a market investment matter – **private capital** needed to make this occur.
  - And we are seeing this right now with gas for example – LNG imports, Queensland supply enhancement, Iona enhancements, Golden Beach storage, compression enhancements, etc. etc. – all market solutions with some needing VTS enhancements (that has the safe guard of the AER prudency process) – lot of private capital involved
- Only the gas system has existing infrastructure that can be repurposed – and in Victoria it is world class with large scale gas storage already available and good transmission feeder network – the WORM adds to that capability
  - If the zero emission gas is methane based it will already be pipeline quality
  - If SA had such gas production it would be game over.





Need to separate the type of gas from the gas infrastructure (WORM) use – it is proving to be vital for the transition to net zero emissions – do not foreclose major options, especially with sunk infrastructure

KEY ISSUE RAISED IN THE SUBMISSIONS

Key Issues Raised in Submissions

- “Gas” versus “Renewable Electricity”
- “Gas” Type and Gas Infrastructure
- Economics of Gas versus Electricity
- Gas Power Generation Issues

Gas versus Renewable Electricity

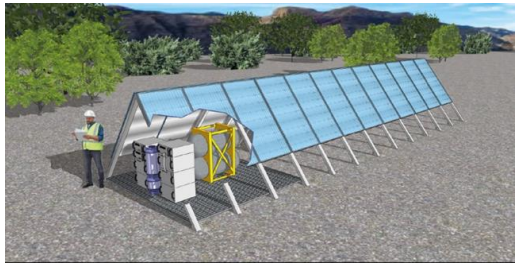
Natural gas will certainly need to be scaled back significantly to reach net zero – this is not the issue – it is about investments in infrastructure.

- Lowers emissions if this can be achieved and is an option over time for Victoria to electrify some or a lot of the gas demand.
- As outlined though this has major investment ramifications – renewable generation and dispatchable generation/storage – even if zero emission gases play a major role – which they can.
- The issue is (investment) timing – done now will increase emissions, and
- The competition between pumped hydro, batteries and zero emission gases to provide the support role – directly or indirectly
- The gas infrastructure is a critical asset to repurpose in this regard.
- The WORM in particular adds to the ability to store zero emission gases - storage that already exists and is massive in energy terms and well located with new developments coming online that could support renewable generation.
- South Australia also shows the critical role gas will play in developing the renewable electricity generation systems – but in the end it has to be decarbonised as well.

Gas Type and Gas Infrastructure

The gas infrastructure is a key energy deliver system in Victoria – in fact the dominant system and it could just as easily transport zero emission methane based gases – with no changes to infrastructure or market design.

- Hydrogen at scale could also repurpose a lot of the system – more than most think and this needs to play out technically.
- Huge storage of renewable energy will be needed when we achieve net zero in the energy sector and zero emission gases produced from renewable electricity can play this role – as can pumped hydro and batteries – and biomethane can also provide this critical support.
- Infrastructure Victoria were right – do not foreclose now on options for Victoria – as they are highly likely to be essential in making the transition to net zero emission in the energy (and maybe transport) sectors.
- The WORM is need in the short term, the mid term on the journey to net zero and likely could be a key asset come 2050 in support zero emission gas storage.



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Economics of Gas versus Electricity use

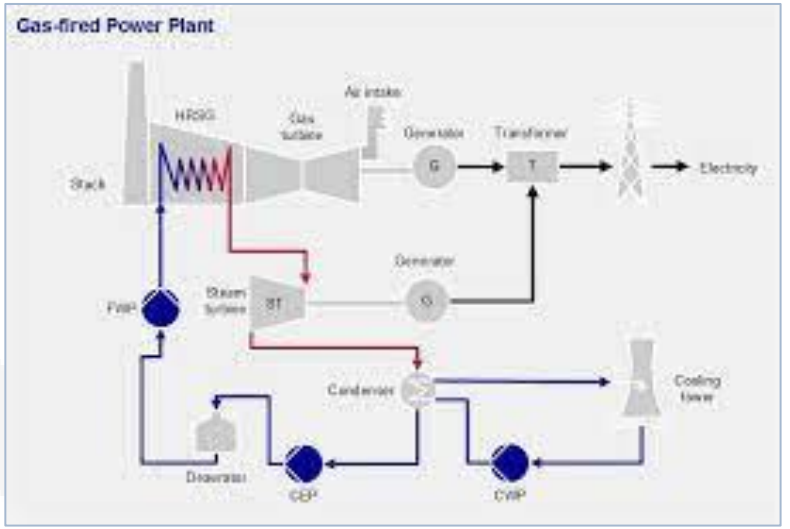
Use of reverse cycle air conditioning instead of gas for heating – relative consumer economics, solar PV rooftop assist to some degree.

- Already available to Victorian consumers (very high penetrations of air conditioning and gas heating) – but only so far a small drift that way – that is competition.
- Can it be relied on though to displace winter heating peaks?
- Only if it is mandated – which brings with it major risks for investment, and greenhouse gas emissions growth if the renewable electricity sector is not ready – and it is clear this will take a lot of time to be the case.
- Let this play out in the market – the customers willingness to pay will be key (and their inevitable appliance choices).
- Focus on supply competing zero emission gas options as much as electrification (and the Victoria Government is taking this policy approach).
- The transition has to be affordable for customers and deliver lower greenhouse gas emissions (and customer choice).

Gas Power Generation issues

Is gas generation needed for the transition to renewable electricity – can it be done using batteries for example?

- I have covered this off in the SA Cas Study so will not labour it here other than to say this was the least commented on issue in the submissions, but
- Yet is the most significant issue in moving toward a net zero emissions energy system, and
- This fact appears to not be not lost on either the Victorian Government or Commonwealth Government and is central to the ESB market redesign advice.



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Project consistency

The WORM project is currently consistent with the policy developments at both the State and Commonwealth level.

- It is also seen in the AEMO analysis that the WORM construction is a given in that analysis, a base line assumption, and the Australian Energy Regulator has approved its construction after a rigorous review of its prudency.
- While the approval of gas infrastructure may seem at odds with a policy goal of decarbonisation there are good reasons what this is not the case and it may be a major support, and
- Whilst the transition to a net zero emissions energy system in Victoria is in progress there is a critical need to maintain a reliable supply of both electricity and natural gas (as recognised by the Victorian Government). This is even more critical for business consumers, and hard to abate industries that operate in Victoria.
- It is also very important given the options for decarbonisation involve significant renewable electricity generation and a critical need for effective very deep storage of renewable electricity not to foreclose too early on any of those options.
- The WORM expansion would materially assist for example, in most cases, a zero emission gas solution, which is still very much in contention competitively and being actively supported by all policy makers at this time.

Questions?

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This report is referenced in several submissions so interesting to see what it says and how that relates to Australian energy markets.

IEA NET ZERO BY 2050, A ROADMAP FOR THE GLOBAL ENERGY SECTOR REPORT (JULY 2021)

IEA Net Zero by 2050, A Roadmap for the Global Energy Sector Report (July 2021)

- Was a view that this report said there was no gas needed – but it was a bit more specific than this

  *Beyond projects already committed as of 2021, there are **no new oil and gas fields approved for development in our pathway, and no new coal mines or mine extensions are required**. The unwavering policy focus on climate change in the net zero pathway results in a sharp decline in fossil fuel demand, meaning that the focus for oil and gas producers switches entirely to output – and emissions reductions – from the operation of existing assets. Unabated coal demand declines by 98% to just less than 1% of total energy use in 2050. **Gas demand declines by 55% to 1,750 billion cubic metres** and oil declines by 75% to 24 million barrels per day (mb/d), from around 90 mb/d in 2020. [page 21]*

  *The rapid electrification of all sectors makes electricity even more central to energy security around the world than it is today. Electricity system flexibility – **needed to balance wind and solar with evolving demand patterns – quadruples by 2050 even as retirements of fossil fuel capacity reduce conventional sources of flexibility**. The **transition calls for major increases in all sources of flexibility: batteries, demand response and low-carbon flexible power plants**, supported by smarter and more digital electricity networks. **Governments need to create markets for investment in batteries, digital solutions and electricity grids that reward flexibility and enable adequate and reliable supplies of electricity**. [page 23]*

- Also mentions high reliance on **nuclear power** for the outcomes (and hydro) but that:

  The relative contributions of nuclear, hydrogen, bioenergy and CCUS vary across countries, depending on their circumstances.

IEA Net Zero by 2050, A Roadmap for the Global Energy Sector Report (July 2021)

- The report also notes that in trying to achieve net zero emissions:
  - *This includes **new pipelines to transport captured CO2** emissions and systems to move hydrogen around and between ports and industrial zones. [page 15]*
  - *One of the **key advantages of bioenergy is that it can use existing infrastructure. For example, biomethane can use existing natural gas pipelines and end-user equipment**…[page 78]*
  - *Notes: Infrastructure includes electricity networks, public EV charging, CO2 pipelines and storage facilities, direct air capture and storage facilities, hydrogen refueling stations, and import and export terminals for hydrogen, **fossil fuels pipelines and terminals**. [page 81]*
- The IEA report also notes the massive investment required in renewable electricity generation assets and similarly a massive investment in hydrogen, in its modelling.
  - ***…annual investment in hydrogen, including production facilities, refuelling stations and end-user equipment, reaches USD 165 billion in 2030 and over USD 470 billion in 2050**. [page 82].*
- The other major study worth looking at is the landmark ***Princeton Net-Zero America Project**:*

  Comprehensive national-level modeling is used to define a diversity of technological pathways that would achieve net-zero emissions. Subsequent analysis is quantifying the scale and cost of physical assets, institutional change, and human-resource efforts for all sectors over time. A high level of spatial definition helps to illustrate the extraordinary scale, geographic impact, and pace of changes needed to achieve a net-zero emissions economy by 2050. Significant challenges and potential bottlenecks are implied, and provide a focus for future research to understand how best to address transition inhibitors.