Western Interconnection Gas – Electric Interface Study

Public Report Presentation

2018

Overview

- Project background
- Drivers affecting the gas-electric interface in the Western Interconnection
- Potential disruptions to the gas supply
- Mitigation options

Project Background & Context

Background

In 2017, WECC commissioned Wood Mackenzie, E3, and Argonne National Labs to undertake an evaluation of the reliability of the gas/electric interface in the Western Interconnection.

This study consisted of multiple work-streams:

1) Identifying and modelling the impact of potential power system vulnerabilities stemming from gas system disruptions
2) Evaluating potential mitigation options and their associated costs and capabilities for reducing such impacts
3) Identifying reliability risks associated with gas contracting strategies as well as existing market rules & protocols
4) Providing reasonable and actionable recommendations for WECC and key stakeholders

Context

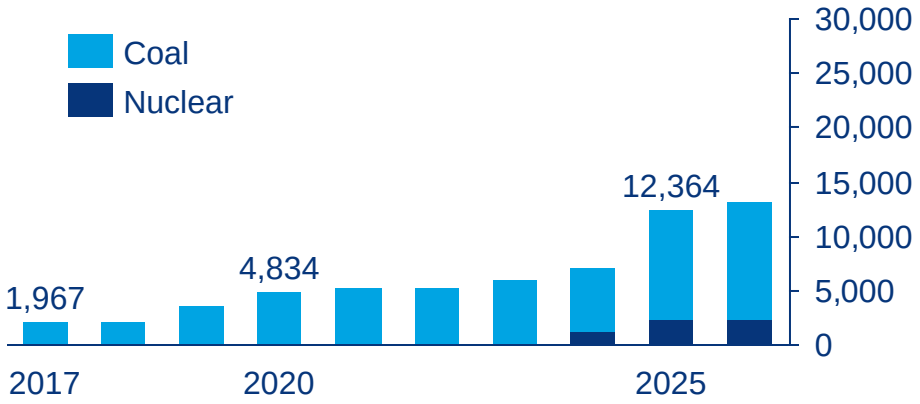
- **In the West, we have entered a period in which it is both possible and reasonable to aspire to low wholesale power costs and steady reductions in emissions**
- **However, the transition away from large, baseload nuclear and coal generation towards more intermittent resources places a considerable potential strain on overall system reliability**
- **In this context, natural gas generation will take on an increasingly important role due to its flexibility and ability to compensate for the variability of renewable resources**
- **Consequently, the ability of the gas/electric systems to handle both everyday variability as well as unforeseen disruptions becomes critical for ensuring energy security in the West**

The configuration of the gas/electric system combined with the loss of Aliso Canyon will create region-wide reliability issues that need to be addressed

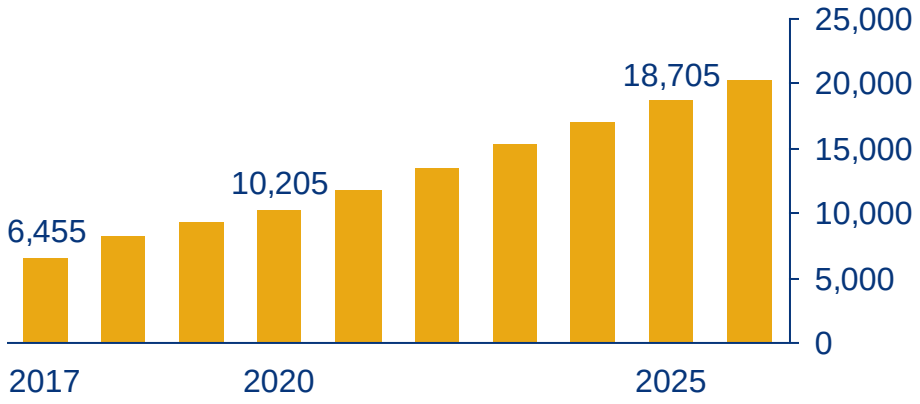
Baseload retirements and load growth will drive natural gas demand growth, creating constraints on the gas system	• Prior to the 2015 gas leak, the 86 bcf of market-area gas storage available at Aliso Canyon played a key role in managing system volatility and reliability • Renewables additions help mitigate but do not replace the increased need for firm, dependable resources stemming from the 11 GW of coal and nuclear retirements • Pipeline flow analysis indicate concerns around volumetric constraints, which limits daily operational flexibility
Absent key balancing with storage, Southern California and the Desert Southwest are at risk from disruptions of the gas system	• The Desert Southwest (DSW) and Southern California regions are particularly at risk from disruptions of pipeline infrastructure or gas production • The Pacific Northwest (PNW) is more resilient to major gas system disruptions, largely owing to market area gas storage (in OR, WA and Northern CA) and electric transmission connectivity
There is no silver bullet: a portfolio of mitigation solutions will be necessary to address the reliability risk	• A combination of physical solutions will be required: investments in renewable generation, battery storage, demand response programs, gas infrastructure and storage as well as dual-fuel fired generation • Improved regional coordination, reserve adequacy accounting, curtailment priorities and forecasting would decrease market frictions and improve the ability of the system to respond to disruptions and day-to-day variability

The Western grid is being transformed through retirements of baseload resources and additions of solar and wind generation

Cumulative West Coal/Nuclear Retirements to 2026



Cumulative New CA Solar Capacity through 2026

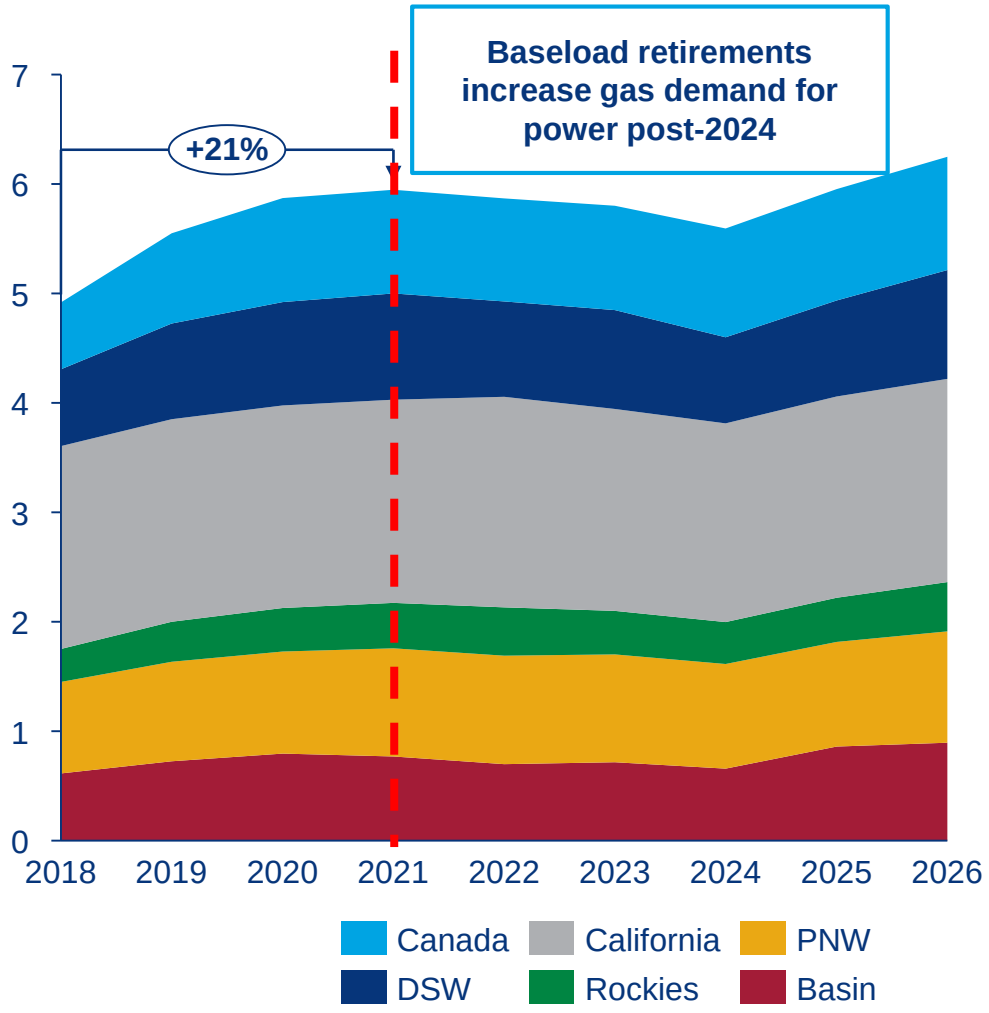


- **9 GW of coal and 2.2 GW of nuclear generation is projected to be retired by 2026**
- **Up to 20 GW of new solar (utility & distributed generation) is projected to be installed in California by 2026**
- **Bulk electricity storage will play an increasing role, but there is little clarity on the scale and timing**

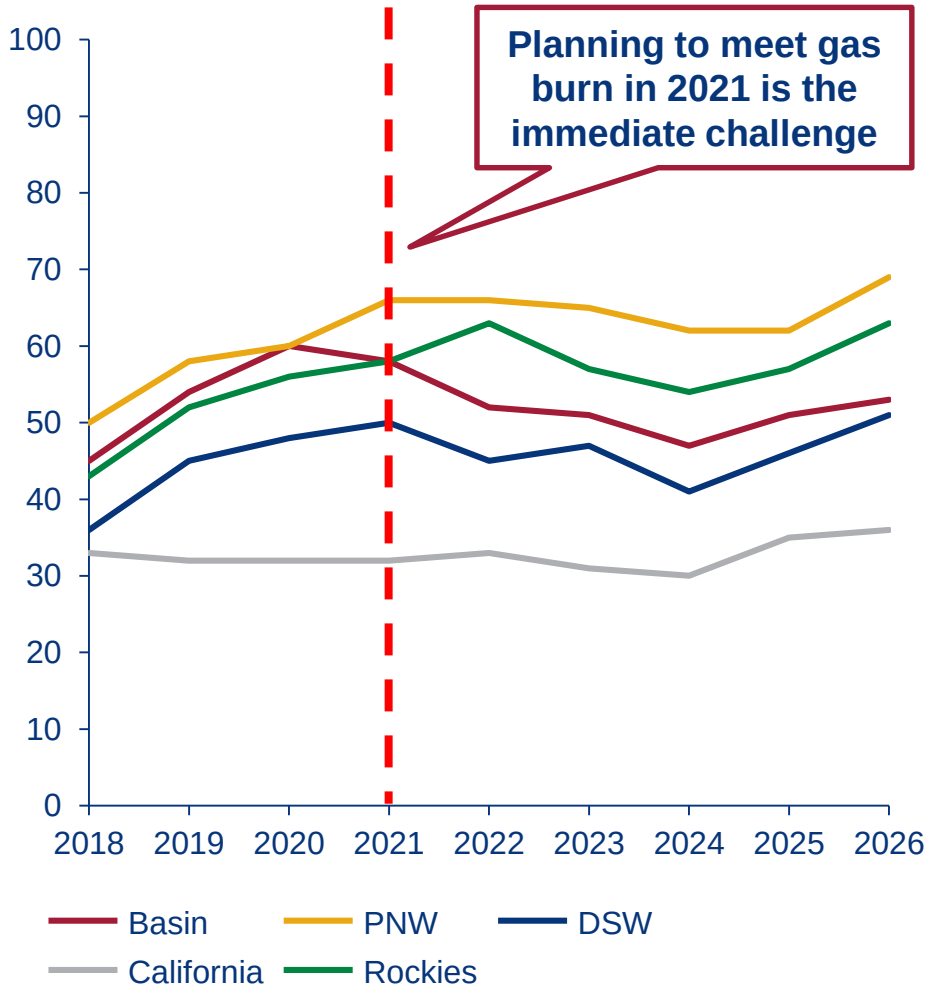
Source: WECC 2026 Common Case

Gas burn for power could increase by ~21%* or slightly more than 1.0 bcfd through 2021

Western Interconnection gas power burn (bcfd)



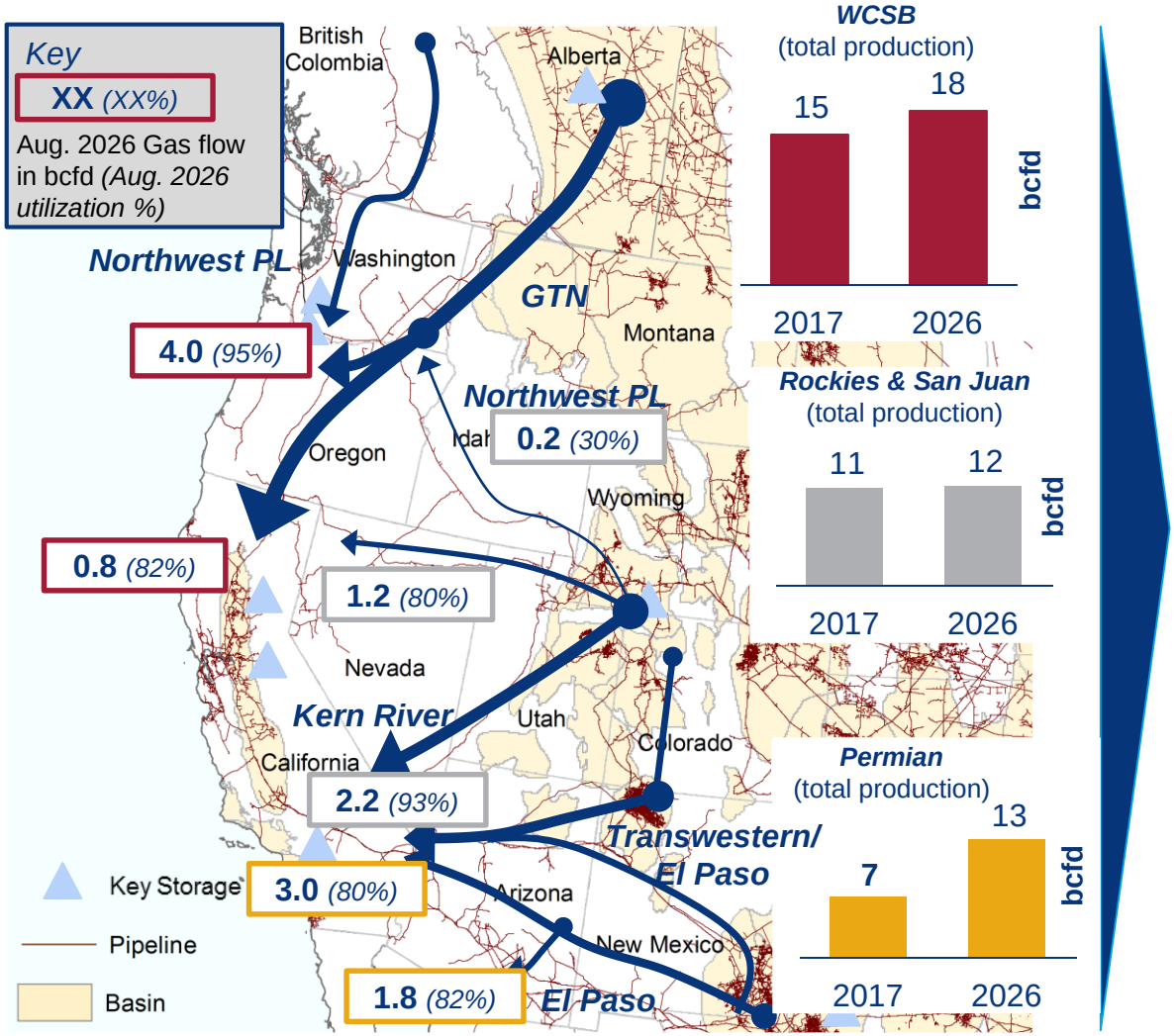
Average CCGT capacity factors (%)



Source: Wood Mackenzie, E3 based on 2026 WECC Common Case
*Purely on an energy, not capacity, basis keeping gas burn flat through 2021 would require 26 GW of solar power

The Western Interconnection and other West Coast natural gas markets become increasingly dependent on 7 long-haul pipelines and 3 supply basins

West US & Canada Gas Pipes & Producing Basins



Source: Wood Mackenzie

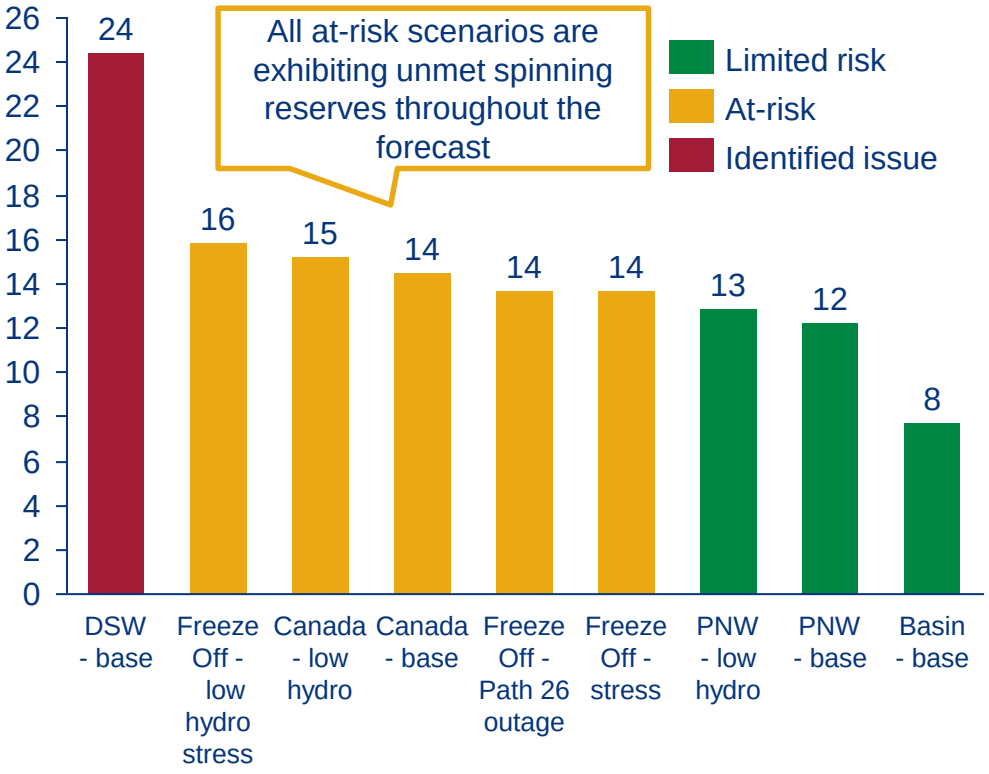
- **The West is blessed with access to diverse and economic supply sources between Western Canada, Permian and Rockies plays**
  - » Combined reserves of 350 tcf available at less than $4/mmbtu for dry gas and $50/bbl for associated gas
- **However, several major interstate pipelines are already highly utilized (<75% on annual basis)**
- **Western Canada remains a critical supply source for the Western US demand centers**
- **Greater reliance on Permian gas increases reliability risks in Desert Southwest and Southern California**
- **Market area underground gas storage is a key resource**

The study evaluated 5 key base cases representing major disruptions to the Western Interconnection as well as 5 additional sensitivities

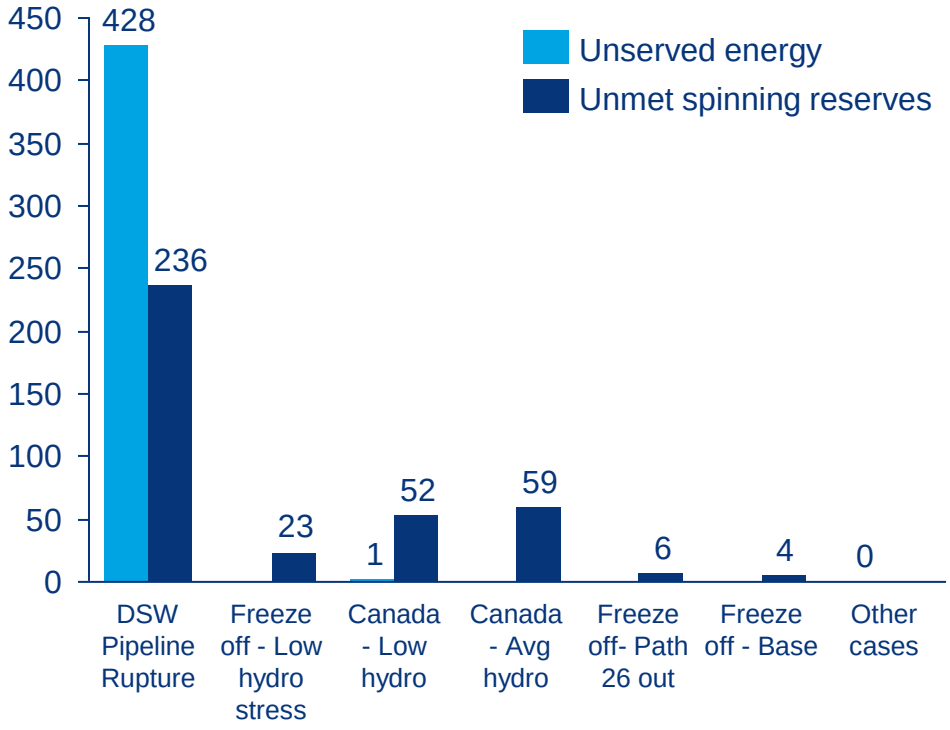
	Regional focus	Base (N-1) Case	N-2 case
Disruption on a PNW pipeline	Pacific Northwest	Disruption at the US/Canada border (or upstream) receipt point on the system	Low hydro conditions
Seismic event disrupting Alberta supply	Pacific Northwest	M6+ earthquake in the Rocky Mountain House area, that disrupts natural gas production in Alberta	Low hydro conditions
Disruption on a Basin pipeline	Basin/ California	Disruption on the critical mainline section downstream of the supply basin and upstream of the demand centers	Low hydro conditions
Disruption on a DSW pipeline	Desert Southwest/ Southern CA	Disruption on critical Southern NM section of DSW pipeline	NA
Winter supply freeze-off in the Permian & San Juan	Desert Southwest	Week-long winter supply freeze-off in the Permian and San Juan basins reducing supply by 1.5 bcfd, higher residential gas demand. 15% of generation in AZ/NM unavailable due to freezing conditions	Low hydro conditions / Transmission outage from CA wildfire

The Southwest disruptions constitute the primary vulnerabilities within the Western Interconnection that we have identified to date

Outage nameplate capacity (GW)



Unserved energy & unmet reserves (GWh)

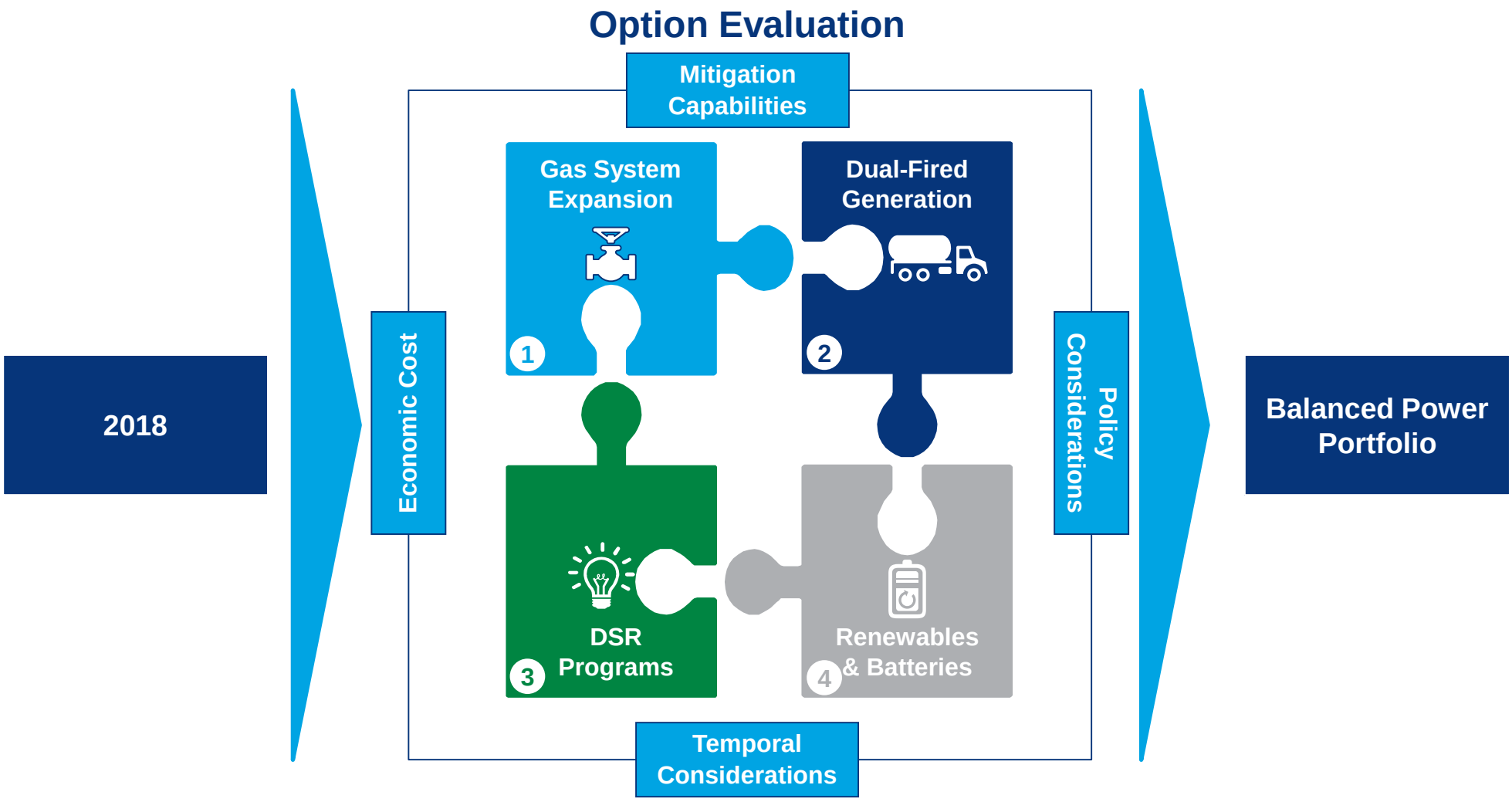


Unrisked Economic Impact[1] ($US bn)	$27.4	$2.2	$3.4	$3.7	$0.8	$0.6	$0
Risked Economic Impact[2] ($US bn)	$1.1	$0.27	$0.002	$0.02		$0.6	$0

Unserved energy in the DSW scenarios results from the configuration of the gas network, which limits deliverability in isolated "islands" of power plants in Phoenix and Southern California

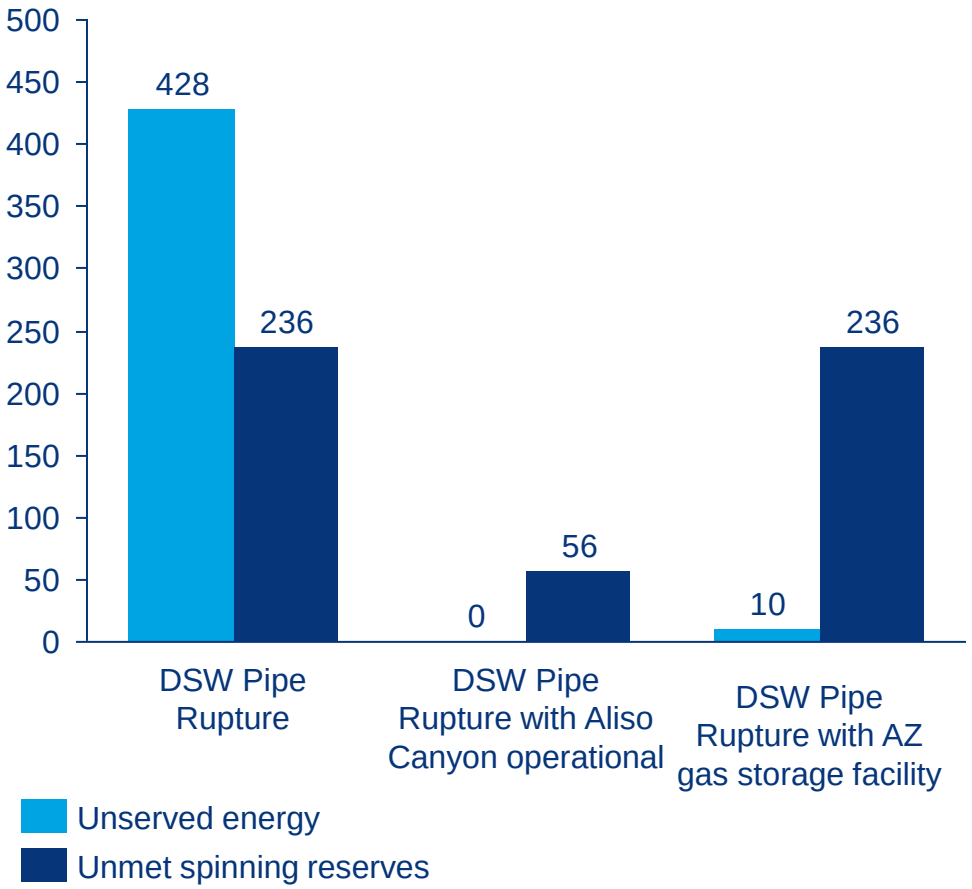
Notes : (1) Economic impact estimated based on cost of unserved energy in each state for each type of demand sector
(2) Risked Economic Impact estimated based on probability of each disruption
Source: Argonne National Labs , E3, Wood Mackenzie

Meeting the future needs of the Bulk Power System in the Western Interconnection reliably and at lowest cost will require a portfolio of options



The availability of gas storage facilities located in key demand basins significantly decreases the impact of a DSW pipeline disruption

Unserved energy & unmet reserves (GWh)



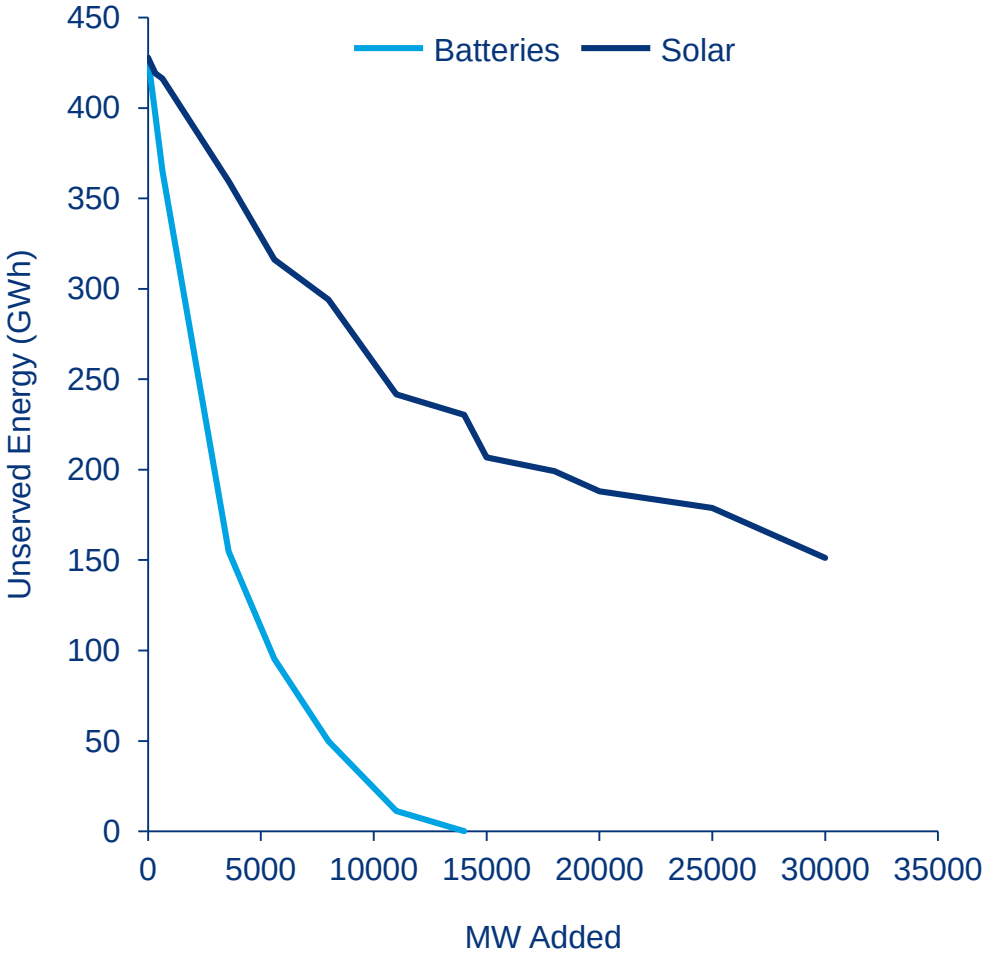
- **The study modelled two alternative cases of the DSW pipeline disruption to examine the impact of the availability of gas storage in key locations**
  - » The first case keeps Aliso Canyon operating at the current limitations on its working capacity and withdrawal rate
  - » The second case models an additional underground natural gas storage facility in the Phoenix, AZ area, based on the open season proposed by Kinder Morgan

Case	Working capacity *(mmcf)*	Max withdrawal rate *(mmcfd)*
DSW base case	**Aliso Canyon decommissioned**	
Aliso Canyon operational	**24,000**	**800**
AZ Gas Storage	**4,000**	**400**

Source: Argonne National Labs , E3, Wood Mackenzie

It will be necessary to bridge the path to battery storage implementation with other mitigation options

Mitigation Capability of Battery & Solar Additions



- **We estimate that ~14 – 15 GW of 4-hr battery storage would need to be installed to mitigate all unserved energy in the EPNG scenario**
  - » The associated capex of installing the battery storage needed to compensate for the DSW pipeline disruption scenario is estimated to be ~$12 – $18 bn
- **The limitations of solar capacity to flex on peak hour demand yield diminishing returns**
  - » Consequently, solar capacity by itself is not able to completely compensate for impacts from the EPNG disruption
- **A feasible, explicitly articulated path forward utilizing a combination of mitigation options is critical for bridging to proposed renewables targets in a safe and reliable manner**

Source: E3

Reconciliation and improvement of natural gas/electric coordination will be key to maximizing ability to manage increased gas demand

	Recommendations	Benefits
Improved Regional Coordination	● Conduct regional contingency planning exercises led by WECC to prepare for a number of disruption scenarios	● Maximizes compensation ability for utilities across the Western Interconnection
Resource Adequacy Assessment	● Greater transparency of firm contracting and linkage to power plants served in firm reserve reports	● Allows for more robust planning processes, especially as gas and power capacity dynamics tighten
Curtailment Priorities	● Re-visit classification of electric generation as “non-core” end-use ● Designation of plants critical to grid reliability as core end-use	● Ensuring that critical power plants are not the first to be curtailed allows for additional flexibility for compensation via transmission
Forecasting & Execution	● Require intra-day LDC core load balancing to ensure fair implementation of OFOs and penalties ● Additional clarity around interstate pipeline curtailment protocol	● Higher accountability for prior-day forecasting allows easier utility operation ● Explicit interstate curtailment protocols allow for better contingency planning
Gas-Electric Day Mismatch	● Split weekend nomination period into daily blocks, resulting in a 7-day nomination cycle	● A feasible step for both gas and electric sides that would minimize response lead times over the weekend period

Source: Wood Mackenzie, E3

WECC's Next Steps

- Outreach
  - Shine light
  - Discussion forum(s)
- Assess
  - WECC led
  - Entity specific
- Monitor
  - Regulatory trends
  - Industry trends and response

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Branden Sudduth – WECC Director, Reliability Risk Management branden@wecc.biz

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Wood Mackenzie
A Verisk Business

Europe +44 131 243 4400
Americas +1 713 470 1600
Asia Pacific +65 6518 0800
Email contactus@woodmac.com
Website www.woodmac.com