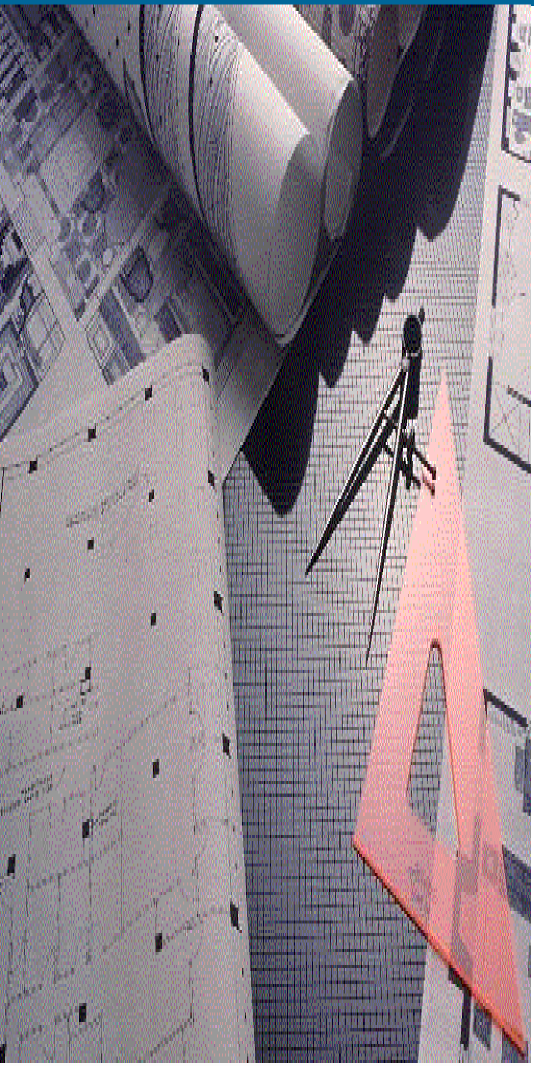
MARKET REFORM

Gas Market Parameter Review 2018

Market Reform

3 November 2017

Outline



- Background
- Markets and Trends
- Past Reviews
- Our Proposed Approach
- Modelling
  - Inputs
  - Market Simulation
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- Summary

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Introduction

- AEMO has engaged Market Reform to perform the Gas Market Parameter Review.
- This is part of a mandatory review required to be performed for the Short Term Trading Market (STTM), currently every 5 years but hereafter every 4 years.
- No similar mandate exists for the Declared Wholesale Gas Market (DWGM) but AEMO is combining this with the STTM review.
- Any change in the current parameters will normally apply from July 2020 to at least July 2024 (beyond which the next 4 year review decisions will apply).
- If an urgent requirement for change is found then the new parameters could apply from July 2019 to at least July 2024.

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The Current Parameter Settings

STTM		
Parameter	**Documented in**	**Current Setting**
Market Price Cap (MPC)	National Gas Rules	$400/GJ
Administered Price Cap (APC)	National Gas Rules	$40/GJ
Cumulative Price Threshold (CPT)	National Gas Rules	$440/GJ over 7 days (110% of MPC)
DWGM		
Parameter	**Documented in**	**Current Setting**
Value of Lost Load (VoLL)	National Gas Rules	$800/GJ
Administered Price Cap (APC)	Wholesale Market Administered Pricing Procedures (Vic)	$40/GJ
Cumulative Price Threshold (CPT)	Wholesale Market Administered Pricing Procedures (Vic)	$1,800/GJ over 35 periods

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The Advice AEMO Has Sought

Review is to:

- Consider links between markets
  - STTM & DWGM
  - Gas markets & NEM
  - Participants operating across markets
- Reflect industry structure and future developments
  - Current and foreseeable future structure
  - Should not focus on real participants but should look at range of participant sizes, types and their contract / spot positions.
  - Consider directions of other concurrent reviews.
- Use public data or reasonable estimates

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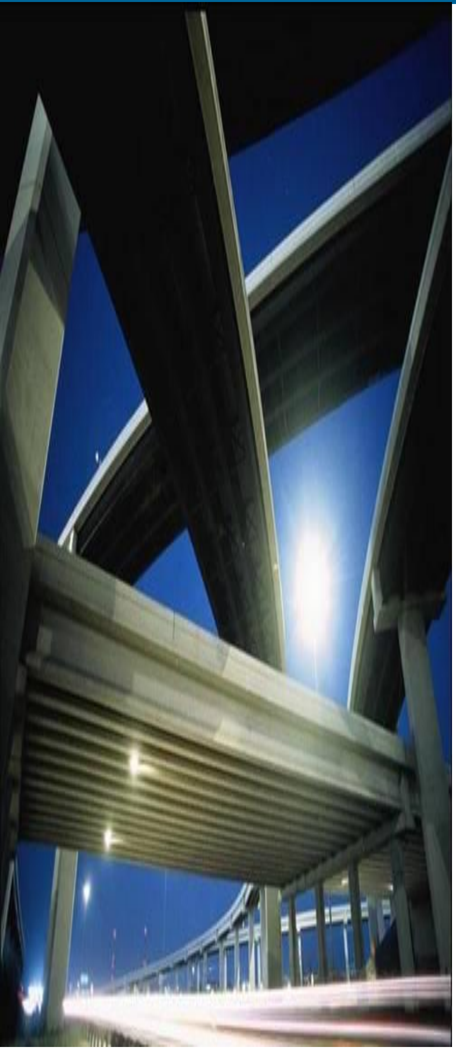
Role of Parameters



- Role of MPC/VoLL
  - Set maximum market price
  - Provide economic price signalling by allowing the market maximum opportunity to clear
  - Not a risk management tool, although does influence participant risk

- Bounds on MPC and VoLL
  - Greater than the maximum short term price expected to arise
  - High enough to support an investment response to shortages
  - Common across all schedules (STTM/DWGM) and hubs (STTM)

- Role of APC/CPT
  - APC/CPT limit unmanageable market risks

- Bounds on APC/CPT
  - APC should not undermine participant incentive to manage risk or distort investment decisions.
  - CPT should be set to allow for normal market clearing while limiting exposure to unmanageable risks.

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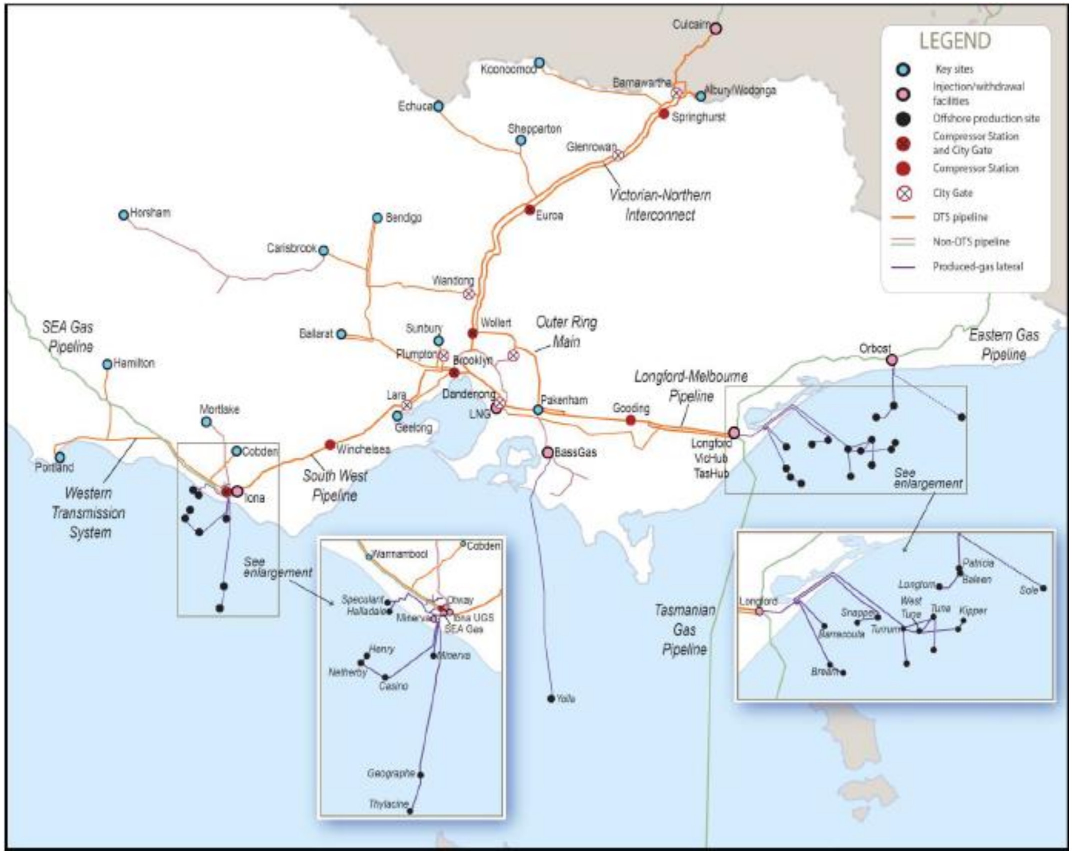
The Current State of the DWGM



Reproduced from Victorian Gas Planning Report, AEMO, March 2017

- Market carriage with schedules determined by bids and offers. Network funded separately.
- Most participants can match supply with their own load so limit exposure to market.
- Demand dominated by heating load and GPG.
- Summer peak consumption around 350 TJ/day
- Winter peak consumption exceeds 1000 TJ/day with 1 in 20 year peak of 1310 TJ/day.
- Interconnected with SA, NSW and Tasmania.
- Peak daily supply is split between Gippsland (~1170TJ/day), Port Campbell (~650 TJ/day) and LNG (87 TJ/day)

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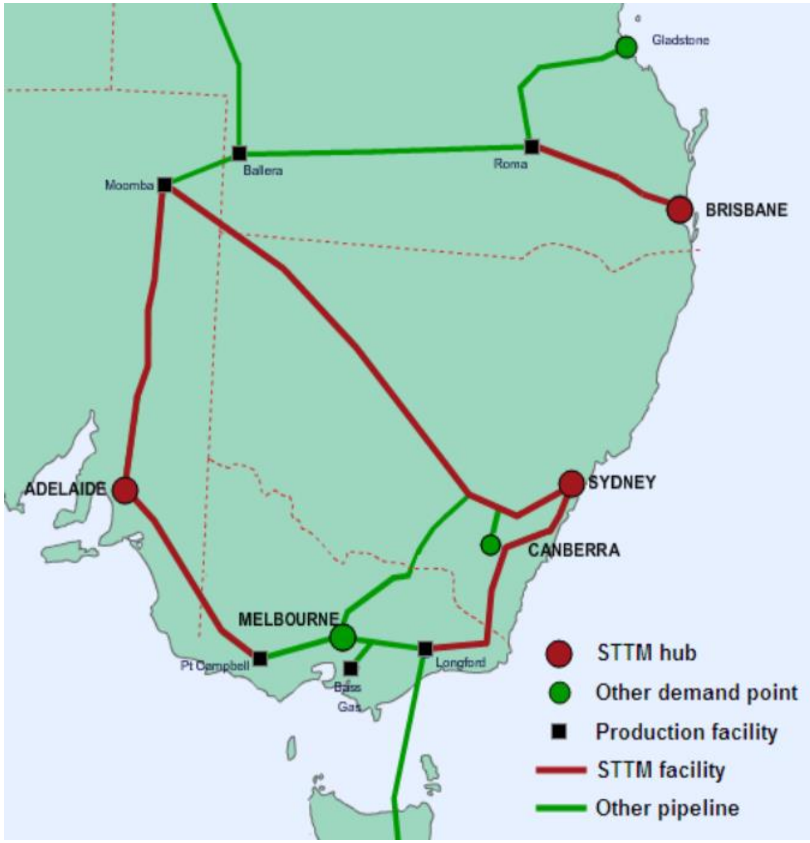
The Current State of the STTM



Overview of The Short Term Trading Market for Natural Gas, AEMO, 14 December 2011

- Three hubs – Adelaide, Sydney, and Brisbane
- Participants trade gas in day-ahead market then nominate on a relevant facility.
- Unlike the DWGM, pipeline shipping costs must be built into price
- On the day schedules can be adjusted bilaterally, or contingency gas market can run.
- Market operator service used to balance markets.
- Deviation pricing to settle deviations from modified market schedule.
- Indicative Demand
  - Adelaide 70-100TJ/day
  - Brisbane 70-100TJ/day
  - Sydney 250-320 TJ/day

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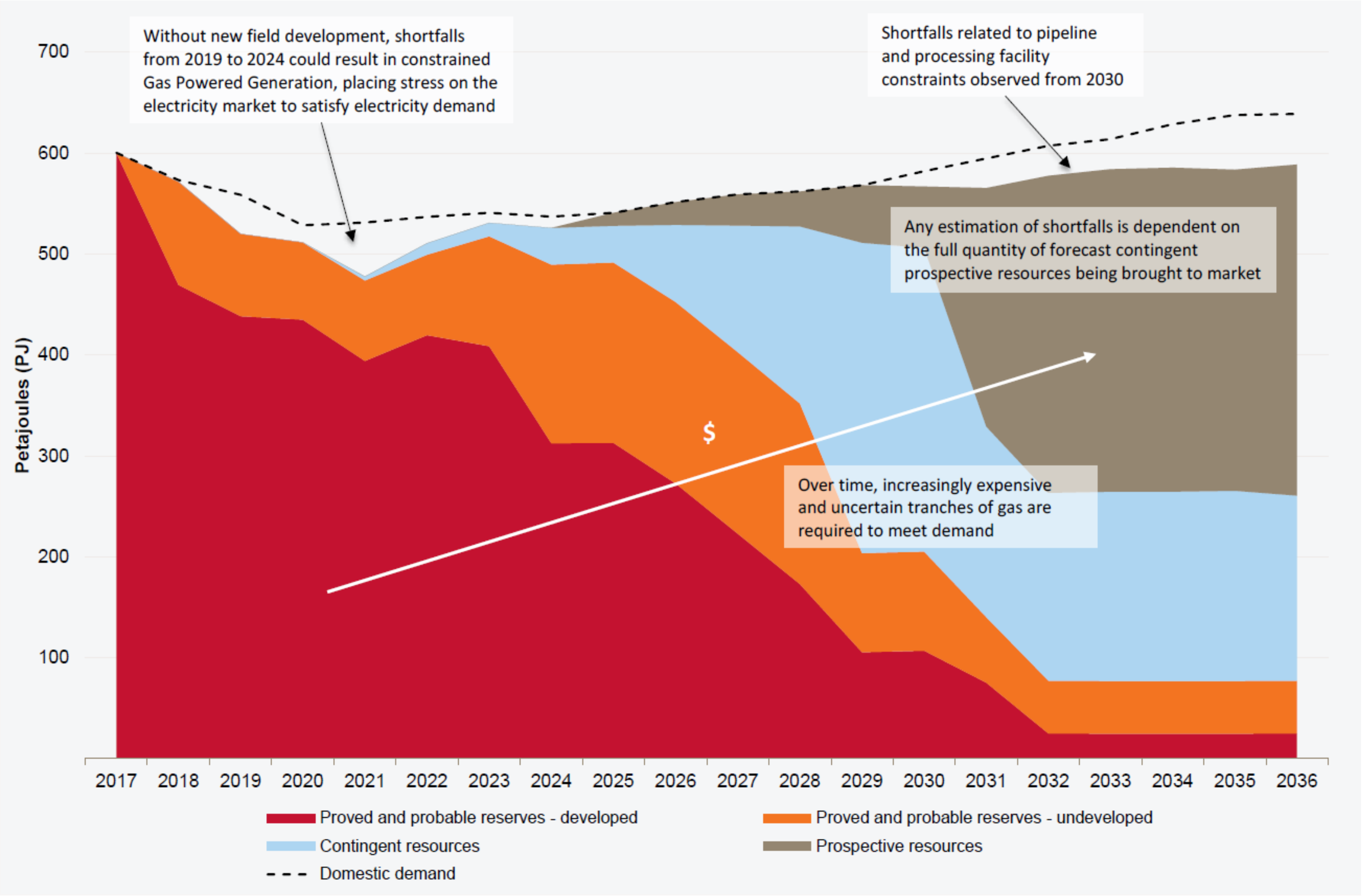
Market Trends – Broader Gas Market



Reproduced from: Gas Statement Of Opportunities for Eastern and South-Eastern Australia, AEMO, March 2017

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Market Trends – Broader Gas Market

- Industry Trends (from Gas Statement of Opportunity 2017)
  - LNG exports have tightened the supply and demand situation in eastern Australia
  - Traditional production sources are declining.
  - Even allowing for likely new supply sources, the GSOO forecast periods of supply and demand mismatch during the 2020 to 2024 period.

- Policy response
  - The Australian Domestic Gas Security Mechanism (ADGSM) whereby the Federal Minister for Resources may, after a consultation process, impose LNG export restrictions for years in which a domestic gas shortfall is forecast.
  - The Gas Supply Guarantee (GSG) is a separate mechanism developed between the Commonwealth Government and gas producers and pipeline operators to make gas supply available to electricity generators during peak NEM periods

- Implications
  - While policy response should avoid actual shortage, the risk of high priced events is increased.
  - Increased risk of situations where the market encounters situations where there is no competitive response available to bring down prices quickly (hours to days).

Market Trends – DWGM

- Industry Trends (from Victorian Gas Planning Review 2017)
  - Annual Gas Powered Generation (GPG) consumption to reach 18 PJ in 2017 & 20 PJ in 2018. Consumption forecast to decrease to 9.6 PJ in 2021 due to increased renewable generation.
  - Annual consumption to fall, due to improved efficiency and fuel switching. Demand is forecast to fall from 214 PJ in 2017 to 197 PJ in 2021 (falling at about 2% per year)
  - Gippsland annual production could drop by 34% (off setting increases since 2016) with daily production reducing by 27% to 857 TJ/day by 2021.
  - Supply from Port Campbell is estimated to decline by 81%.
- AEMC market design completed
  - Focusing more on removing barriers rather than adding them.
- Implications
  - From 2021 it may not be possible to always also supply gas to New South Wales and South Australia from Victoria during peak demand days.

Market Trends – STTM

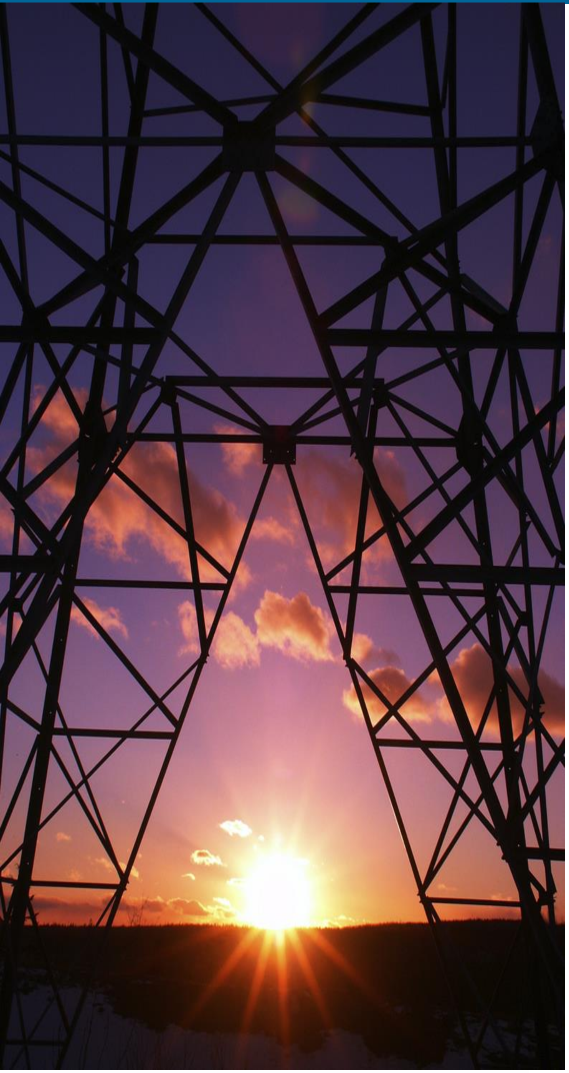
- There is less information focused specifically on the STTM.

- These hubs are just one of a number of loads on the one or two transmission pipelines they connect to.
  - While significant demand, at their peak demands the three hubs consume less than half of the DWGM
  - They are competing with the broader gas market.
  - Gas powered generation in or near hubs give them a strong linkage with the electricity market.

- Trends in the DWGM indicate much stronger linkages between outcomes in the Adelaide and Sydney hubs and the DWGM.

- Broader east coast trends will impact all hubs (though may vary with local policies on coal seam gas).

Market Linkages



- Links between DWGM and STTM
  - Long delivery times limit inter-market responses to short term issues
  - Multiple day issues are possible given market tightness.
  - Gas supply disruptions in one market increase demand for gas in other markets
  - Different market price caps (though this only matters if any one of them is too low).

- Links between gas markets and the NEM
  - Gas powered generation increasing in prominence
  - Electricity prices correspond to gas prices through the heat rate of the generator.
  - Sustained high electricity prices incentivise long term running of gas powered generation
  - Coincident and cascading linked events across markets are possible.

Potential Unmanageable Risk Events in DWGM

- Production failure on high demand day
- Pipeline compressor failure limiting ability to move gas
- Very high demand, e.g. due to:
  - Extreme cold weather
  - High rate of gas export to support other markets in stressed situation.
  - High GPG demand (e.g. surprise event during the day).

  Context of different events may impact administered outcomes and market risks for participants differently.
- Low reserves of stored gas (e.g. LNG to support Melbourne)
- VoLL triggered by bidding behaviour at a system withdrawal point (e.g. failure to schedule supply to hedge that position and drive price to VoLL).

Potential Unmanageable Risk Events in STTM

- Production failure limits supply to the hub
- Pipeline compressor failure limits ability to move gas to the hub
- High GPG demand outside the hub reducing capacity to deliver to the hub
- Very high demand (including in broader gas market).
- Contingency gas scenarios resulting from the above risks

Past Reviews & Our Approach

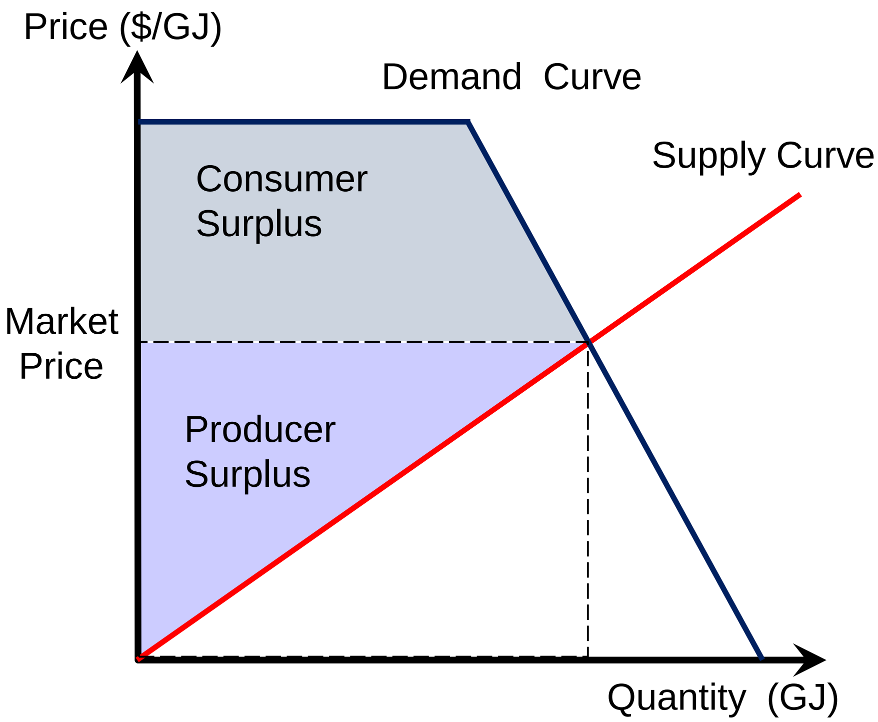
- Past reviews
  - Have focussed on two model components
    - Impact of market outcomes on retailers.
    - Revenue sufficiency for peak investment
  - Were outcome focussed
    - High price events were defined by the price and length of time the event persisted
    - While a valid approach, it was not clear what sort of underlying events supported those outcomes
  - Considered inter-market relationships by price cap comparison
- With this in mind, our approach
  - Considers underlying events and realistic responses as motivation for extreme price periods
  - Extends the retailer impact model to consider other types of market participant (GPG, market customers)
  - Continues to consider revenue sufficiency for peak investment
  - Extends the framework to consider inter-market relationships through their impacts on imports and exports and hence the supply and demand position in a market.

Maximising Market Efficiency

while

Keeping Participant Risk Acceptable

Market Efficiency



- Consumer Surplus is the difference between the value of a product and the price paid for it
- Producer surplus is the difference between the price paid for a product and its cost of production
- We can measure Market Efficiency as the sum of Consumer Surplus and Producer Surplus.
- If the market clears where the supply and demand curves cross then market efficiency is maximised.
- But if this implies high prices then this creates risk for the market

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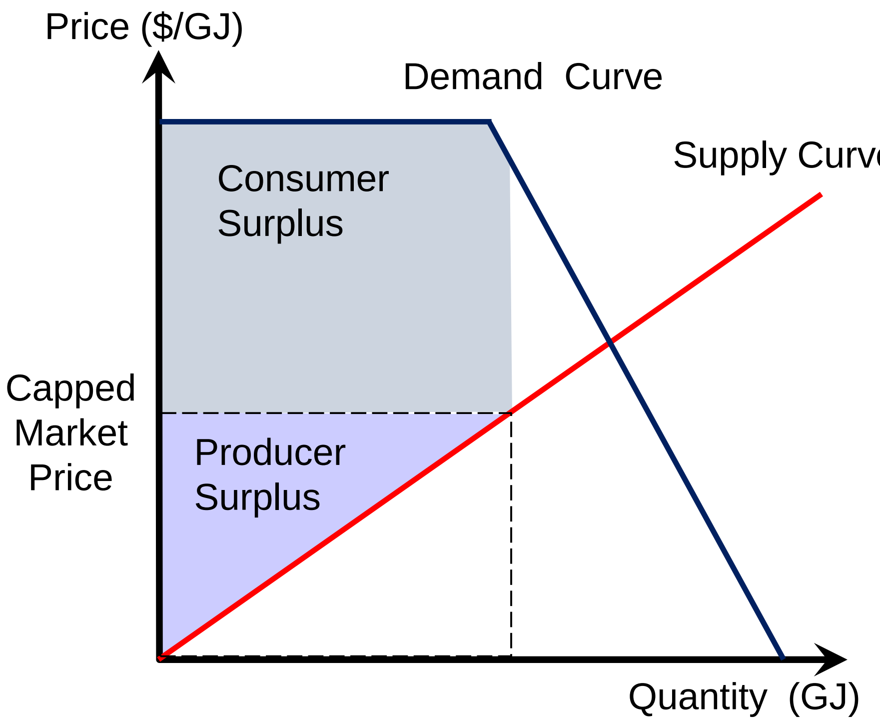
Administered Price Caps Can Reduce Market Efficiency



- If we impose price caps to limit prices, we can also limit trade.
- With a lower price cap supply is truncated and less quantity clears in the market
- The sum of the Consumer Surplus and Producer Surplus is reduced.
- Suppliers who would willingly sell to willing consumers at prices above the price cap cannot do so
- The market outcome is less efficient.

Keeping Participant Risk Acceptable

- On a high priced day, participants can be forced to buy gas at a loss if they are to operate.
- Based on annual profits, a participant will have a typical average daily profit.
- The ratio of these is the Days of Lost Profit due to an event.

$$Days\ Lost\ Profit = \frac{Profit\ Lost}{Average\ Daily\ Profit}$$

- The measure used in past reviews is that an Acceptable Participant Risk is no more than 500 days lost profit.
- Participants come in all shapes and sizes and with different degrees of hedge. Using a hypothetical example of each size and type of participant we can use simulation with different gas market parameters to determine which parameters maintain risk at acceptable levels across all of them.

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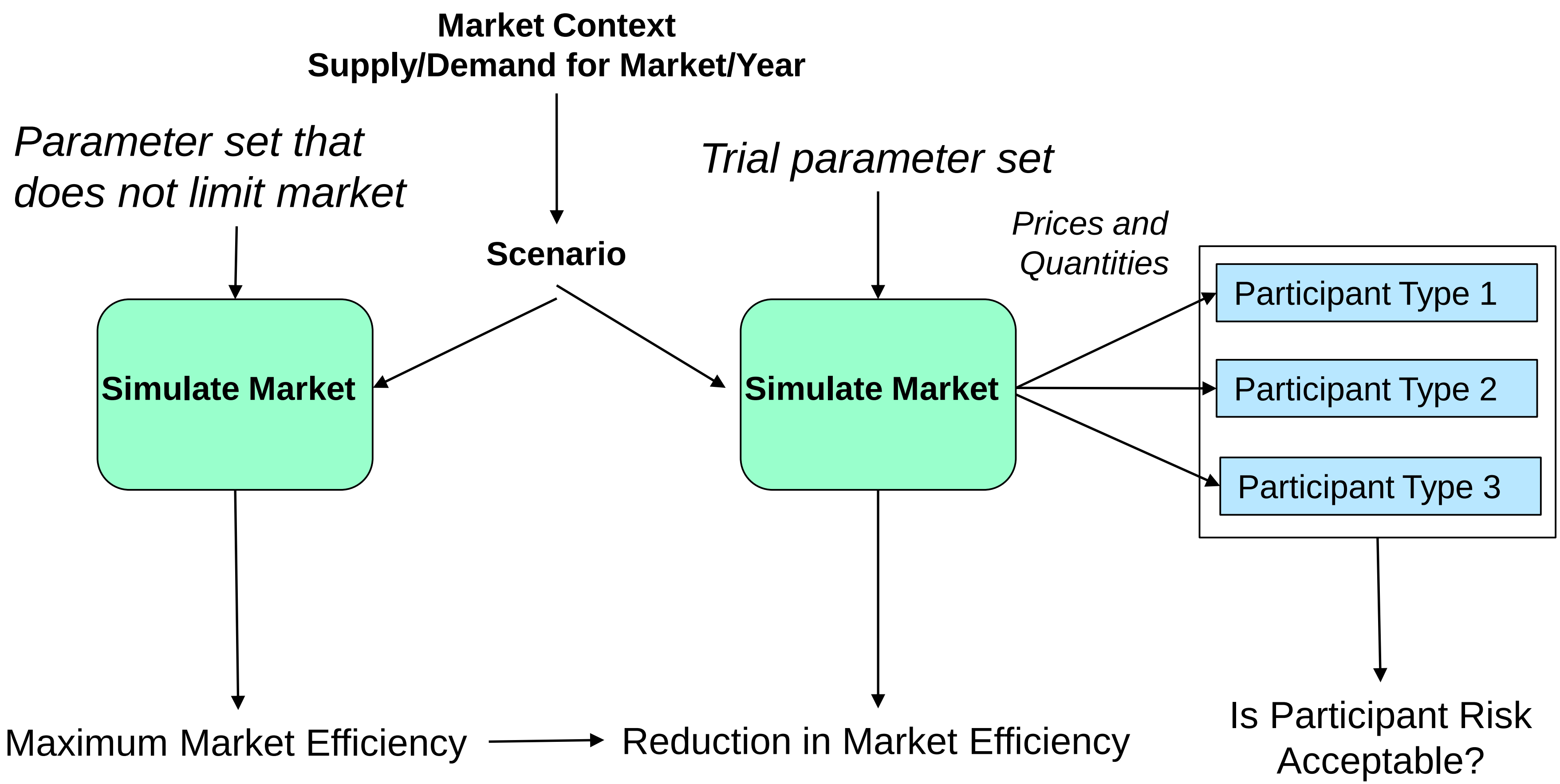
Proposed Modelling Approach



Goal: Find the best performing parameters that maximise market efficiency without participants facing unacceptable risk

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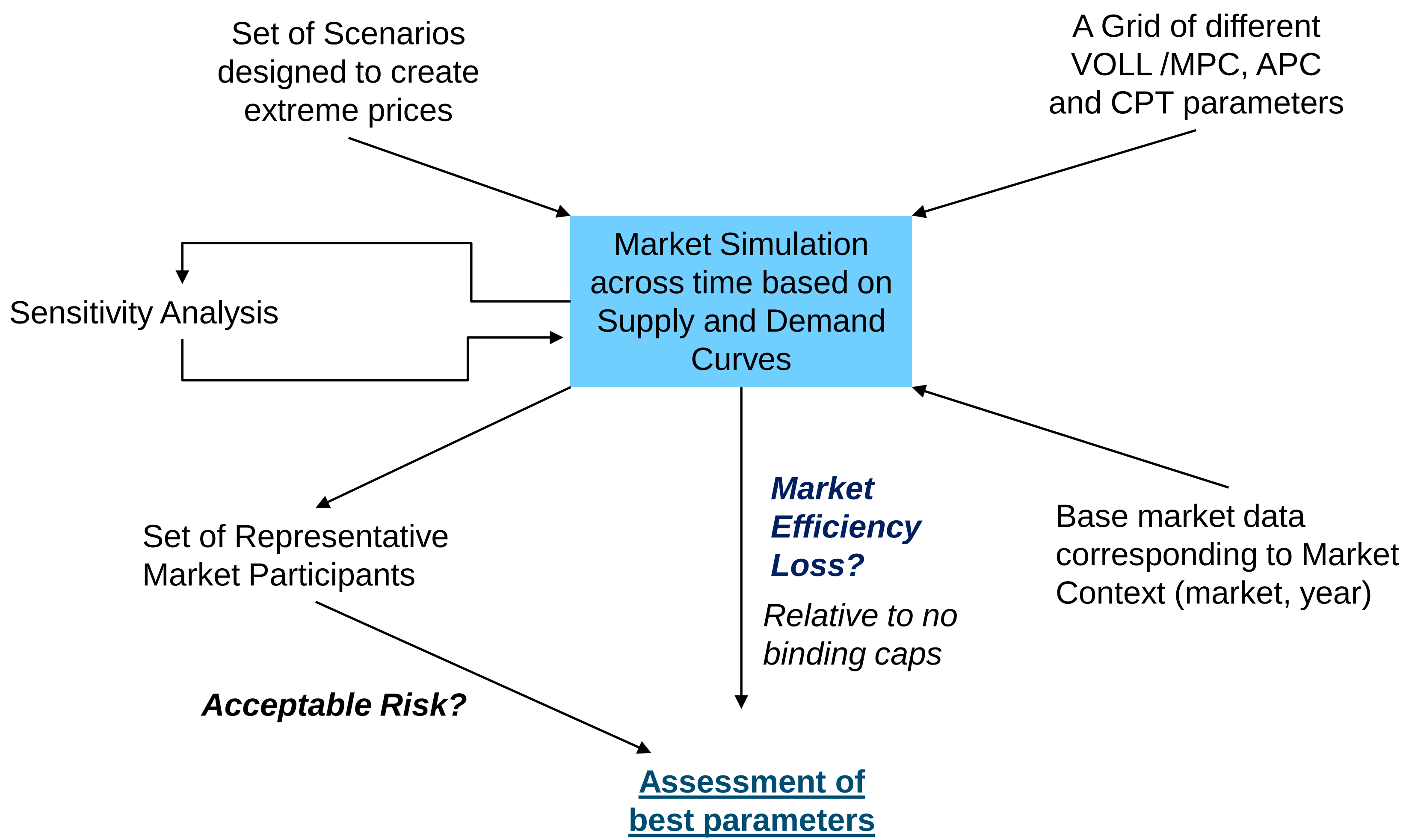
Model Components



Input – DWGM Scenarios We Are Considering

- Unexpected reduction (or delay in return to service) of Longford production during a high demand weekday
  - Exposure created for participants at injecting nodes relative to the beginning of the day schedule
  - Challenges for serving the daily peak.
  - Output restored from midnight

- Pipeline compressor failure near Melbourne
  - Compressor failure on a high flow day from Iona

- Moomba supply interruption with a high rate of flow to SA and NSW on a peak day
  - High rate gas export from DWGM to address issues in other markets
  - May occur for 3 successive days

- Peak winters day with limited LNG available to Melbourne
  - Assume low gas storage due to past events – high LNG offer prices.
  - Peak winter week.

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Input – DWGM Scenarios We are Considering

- High forecast GPG demand at times of high gas demand
  - Due to forecast electricity market factors
  - Flow of gas to SA (to manage increased GPG demand there) could limit Iona supplies.
- Unexpectedly high GPG demand at times of high gas demand
  - Victorian electricity prices unexpectedly rise across the peak causing GPG's to enter market within gas day.
  - Increased demand on LNG
  - GPG demand at limits of what can be supported.
  - Demand for GPGs remains high to third gas day.
- Demand in excess of 1:20 year scenario
  - High demand due to extremely cold weather
  - Assume all available supply is used within constraint limits
  - Demand may exceed normal contract/hedge limits

Input – STTM Scenarios We are Considering

- Reduced supply to hub due to upstream reduction in production (or due to off-takes up stream but not back haul)
  - Unusual events upstream over 3 days
  - 5% reduction of normal gas supply to the hub at a time of high demand, but not enough to trigger APC for technical reasons

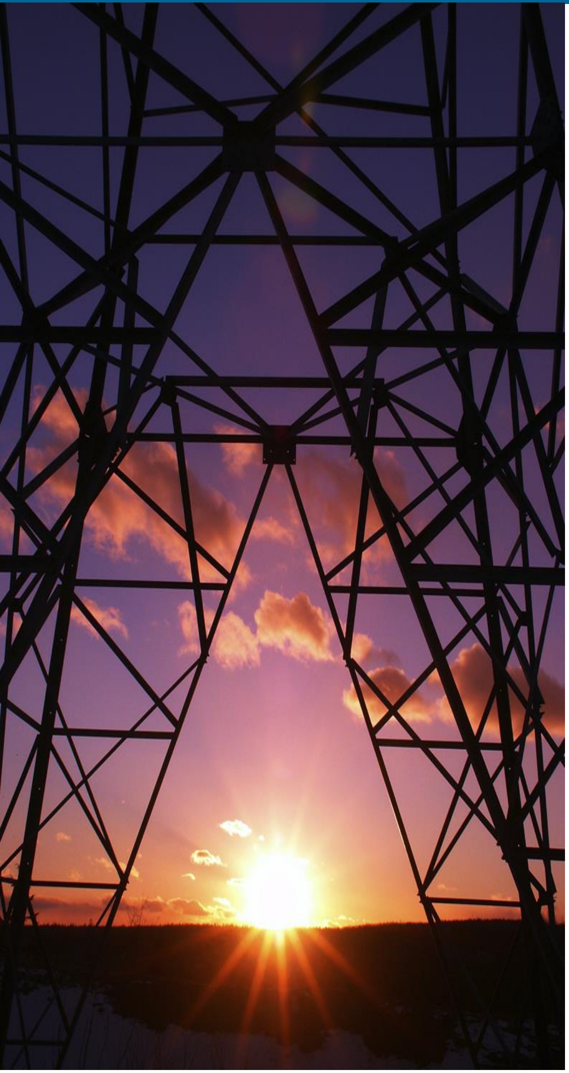
- Reduced supply to hub due to high GPG demand outside of the hub during ex ante market
  - GPG's buy high volume of back haul gas in ex ante market due to high electricity demand for 2 days

- Reduced supply to hub due to unexpected high GPG demand outside of the hub after ex ante market has run
  - GPG's buy high volume of back haul gas in ex ante market due to high electricity demand on two consecutive days

Input – Scenarios We are Considering

- Contingency gas scenario
  - Gas supply to the hub reduced by in excess of 5% (but not so much as to cause administered price)
- Extreme MOS costs
  - Day 1 has high deviation giving rise to the use of expensive MOS
  - Day 3 has high ex ante prices (due to an unrelated event) at the time MOS providers look to replace the commodity
- Gas supply disruptions in the broader gas markets places increased demand on gas that would normally serve the STTM or DWGM (e.g. to supply LNG production)
  - Possibly have DWGM supplying gas to SYD and ADL while electricity prices are high in VIC (and possibly NSW)
- High electricity prices for a sustained period incentivising long term running of gas powered generation at higher utilisation rates than usual

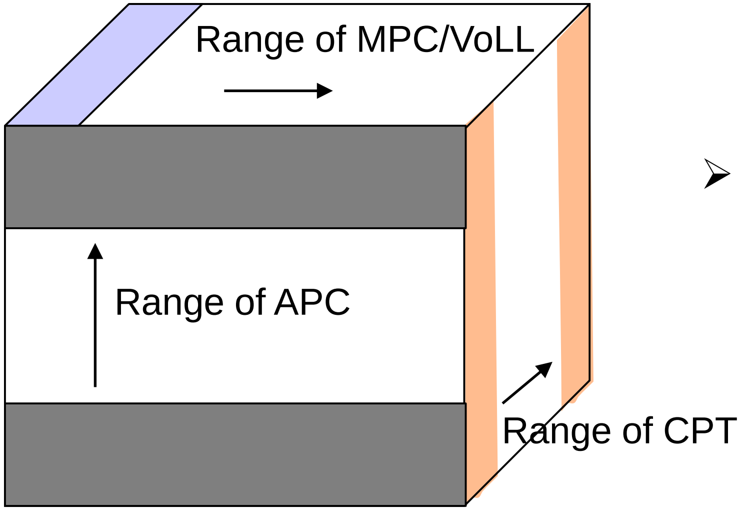
Input – Linked Scenarios We are Considering



- Scenarios which cause gas and electricity markets to become very inter related. Example:
  - Event 1: Electricity shortfall in South Australia,
  - Event 2: High GPG demand in South Australia drives Adelaide STTM hub price.
  - Event 3: High demand for gas in South Australia drives up gas prices in the DWGM.
  - Event 4: High DWGM gas prices force GPG out of the market in the DWGM (limiting degree of price increase) but driving up prices in the NEM.

This scenario would consider the impact of a participant trading in both gas and electricity.

Inputs – Parameter Sets



- Parameter grid is three-dimensional
- The same grid, though applied to different contexts/scenarios would be applied to both STTM and DWGM hubs.
- Searchable area contains:
  - Parameter settings aligned with the minimum and maximum bounds (e.g. to low for investment to be feasible)
  - Current parameter settings
  - A range of different discrete settings interspersed between maximum and minimum values
- Evaluating parameter settings
  - Not focused on a single value.
  - Rather look for parameters that perform well across markets, scenarios and perform robustly with changes in model inputs (sensitivity analysis).

Inputs – Market Context

- Market Context is a term used to describe the underlying market conditions to be used in a simulation, e.g.
  - The Market – a specific STTM Hub or the DWGM
  - A year during the study period
  - Assumed market conditions,
    - Available supply options and capacities
    - Levels of demand (including price responsive demand)
    - Normal export and import behaviour.
    - Contract levels
    - Capabilities of network / storage.

- The Market Context will be evolved from the current conditions based on GSOO and other forecasts.
  - Intended to provide plausible scenarios for future supply and demand position
  - Some aspects will need to be approximated – e.g. we may assume aspects of the shape of the overall bid and offer curves based on current data but corrected for changed reference contract positions.

Market Simulation – Supply and Demand Curves

- Supply and Demand curves:
  - Daily supply and demand curves estimated using available historical values and adjusted according to the market context/scenario
  - Curves separately tracked for different sources so can be modified separately – e.g. DWGM production offer curves could be adjusted independently of import bids from South Australia.
  - We would capture all the main sources, including representing start and end of day linepack as bids and offers if material.

- Injection and Off-Take Limits and Storage
  - Maximum quantities in curves for day moderated by injection and offtake limits.
  - Different curves for different storage levels (e.g. of LNG), with levels driven by scenarios.

- Contracting/Hedging
  - Contracts influence participant bids/offers
  - This requires that bid / offer curves are adjusted with respect to contract position.
  - Contract levels assumed in context.

Market Simulation – Sensitivity Analysis

- The best performing parameters may only happen to perform well for the specific simulations we perform.

- It may be that if inputs change slightly those parameters could perform very poorly

- Sensitivity analysis involves shifting values of key parameters and re-running simulations. Demonstrates stability (or not) of parameters.

- We would like to apply the same changes (e.g. as a %) to all simulations regardless of market or scenario. E.g. we could change
  - Uncontrollable demand
  - Gas powered generation demand
  - Volumes in offer / demand curves (and separately for imports and exports)
  - Prices in offer / demand curves (and separately for imports and exports)
  - Levels of contracting

Market Simulation – Surplus Calculation

- Ideally we would use “true” benefit and cost curves to estimate market surplus.
  - These would be invariant to parameter settings.
  - But the true benefit of consumers is not knowable.
  - The actual contract position is also relevant as this links the ultimate benefits and costs of buyers and sellers.

- We propose to use (market context adjusted) versions of historic bid and offer curves as our benefit and cost curves.
  - Will assume in all cases that uncontrollable demand is at the same invariant cost. The logic is that we are focusing on market clearing events that precede involuntary curtailment.
  - We accept some inaccuracy in this – most particularly that the imposition of APC could change some aspects of how participants structure bids and offers.
  - But we really only care about the change in market surplus – not the absolute position – so some systematic inaccuracy is tolerable.
  - It can also be argued that they reflect a participants perceived value of gas at different positions relative to contract position.

Detailed Methodology - Participant Types

- For the participant risk assessment we focus on those predominantly buying from the market:
  - Retailers of varying sizes
  - A smaller market customers with no diversity and less sophisticated approaches to risk management
  - Gas powered generators.

- We will have some variation in the contract levels, imbalances, deviations and risk behaviour of different participants.

- Base profitability will be based on a simple assessment of the normal profitability of each participant in a given market context.

- Given outcomes of each simulation for each participant type we can assess their risk exposure.

Detailed Methodology – Investment

- Investment decisions require consideration of at least:
  - Cost of constructing additional capacity
  - Required rate of return (of similar investments)
  - Economies of scale in construction and operation mean that marginal cost measures are not appropriate
  - Utilisation of peaking capacity will typically be partial when considering an economically sized investment

- We do not propose to explicitly model the investment decision
  - Too difficult to model in such a framework
  - Influence of investment assumptions on outcomes is too great

- We propose instead to:
  - Estimate investment costs
  - Include investment cost recovery as a lower bound on MPC / VoLL values
  - This is the same approach as taken in previous reviews

Data – Sources and Processing

Sources

- AEMO Public Market History
  - Daily injection and withdrawal
  - Daily Prices
  - Daily total injections and withdrawals
  - End-of-day linepack
- Gas Statement of Opportunities (2017)
  - Provides forecast of market growth and shrinkage
- Victoria Gas Planning Report (2017)
- State of the Energy Market (2017)
- ABS Australian National Accounts
  - Average Revenue at Risk
- Previous Reviews
  - Investment parameter estimates
  - Participant profitability

Processing

- Bid and offers curves to be modified to suit the context of future conditions

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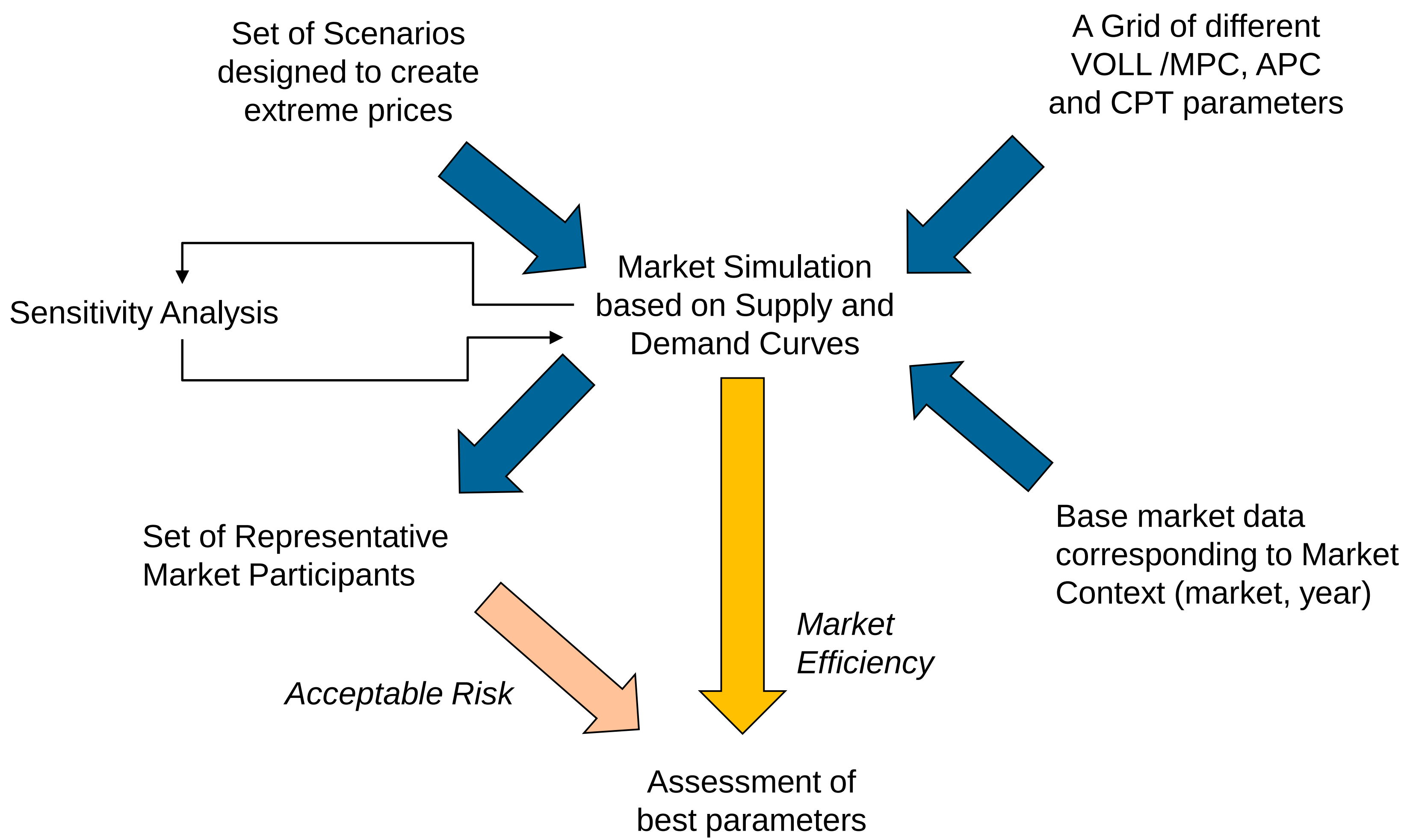
Summary

- Key objective:
  - Identify gas market parameters that maximise efficiency while respecting the risk management limits of participants

- Context:
  - Market is tight throughout the period the parameters are applicable
  - Linkages between gas markets and NEM are increasingly significant

- Our Approach:
  - Considering plausible future states of the market
  - Simulate market outcomes over a variety of scenarios likely to induce extreme prices
  - Consider a range of market parameters with logical upper and lower limits defined by their roles, investment and market feasibility considerations.
  - Evaluate the efficiency and risk management properties across those parameter settings, including sensitivity analysis

Summary


Set of Scenarios designed to create extreme prices
A Grid of different VOLL /MPC, APC and CPT parameters
Sensitivity Analysis
Market Simulation based on Supply and Demand Curves
Set of Representative Market Participants
Base market data corresponding to Market Context (market, year)
Market Efficiency
Acceptable Risk
Assessment of best parameters

Questions