



Centre for Energy and
Environmental Markets

UNSW
THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA



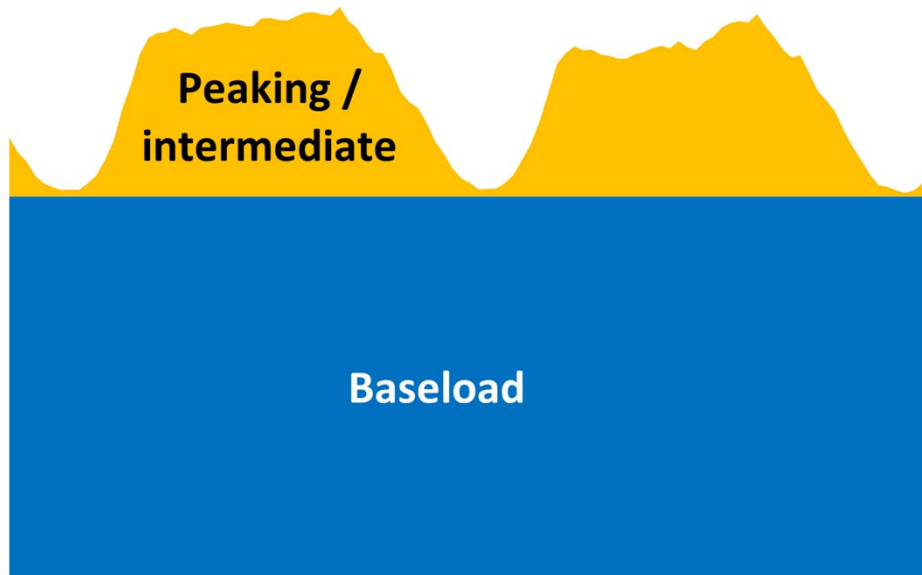
Wind as the new “Base Load”

The role of wind in future electricity markets

Dr Jenny Riesz

April 2014





A new power system paradigm

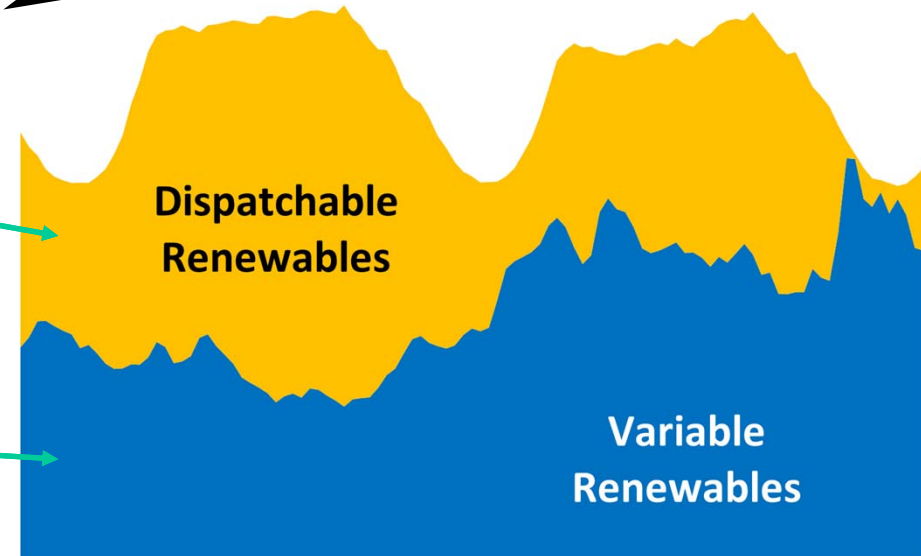


Top up with dispatchable renewables

- Hydro with storage
- Geothermal
- Biomass
- Solar thermal with storage

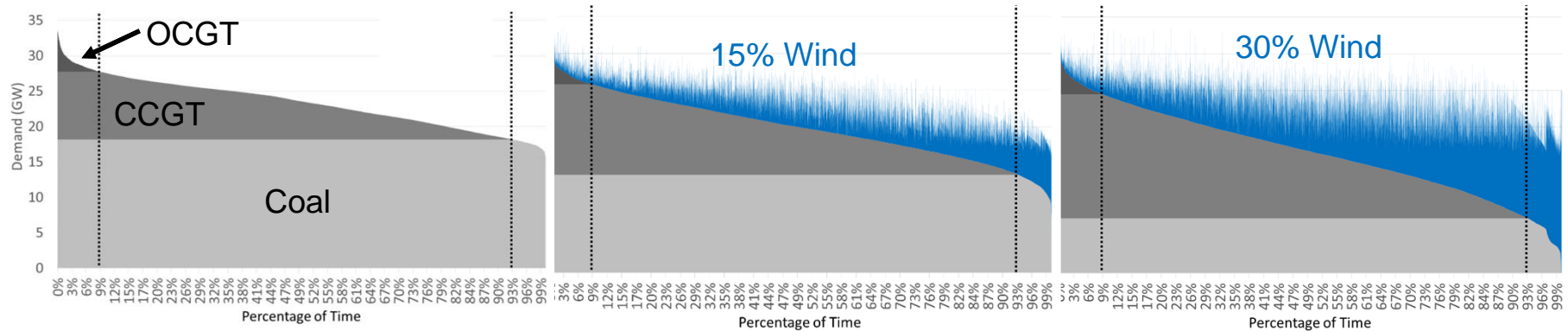
Use cheapest technologies first:

- Wind
- Solar PV
- Run of river hydro



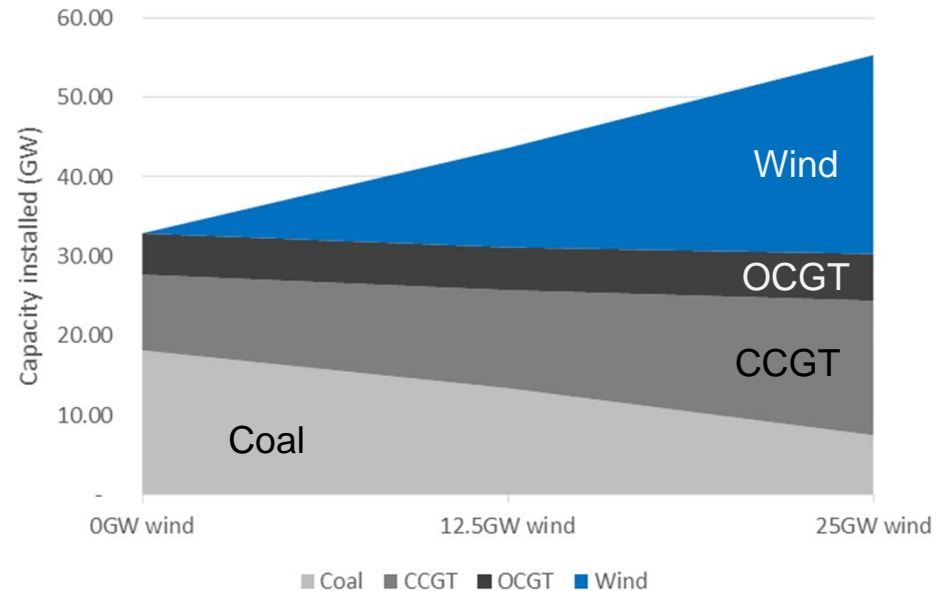
Wind displaces baseload generation

Least cost optimum generation mix:



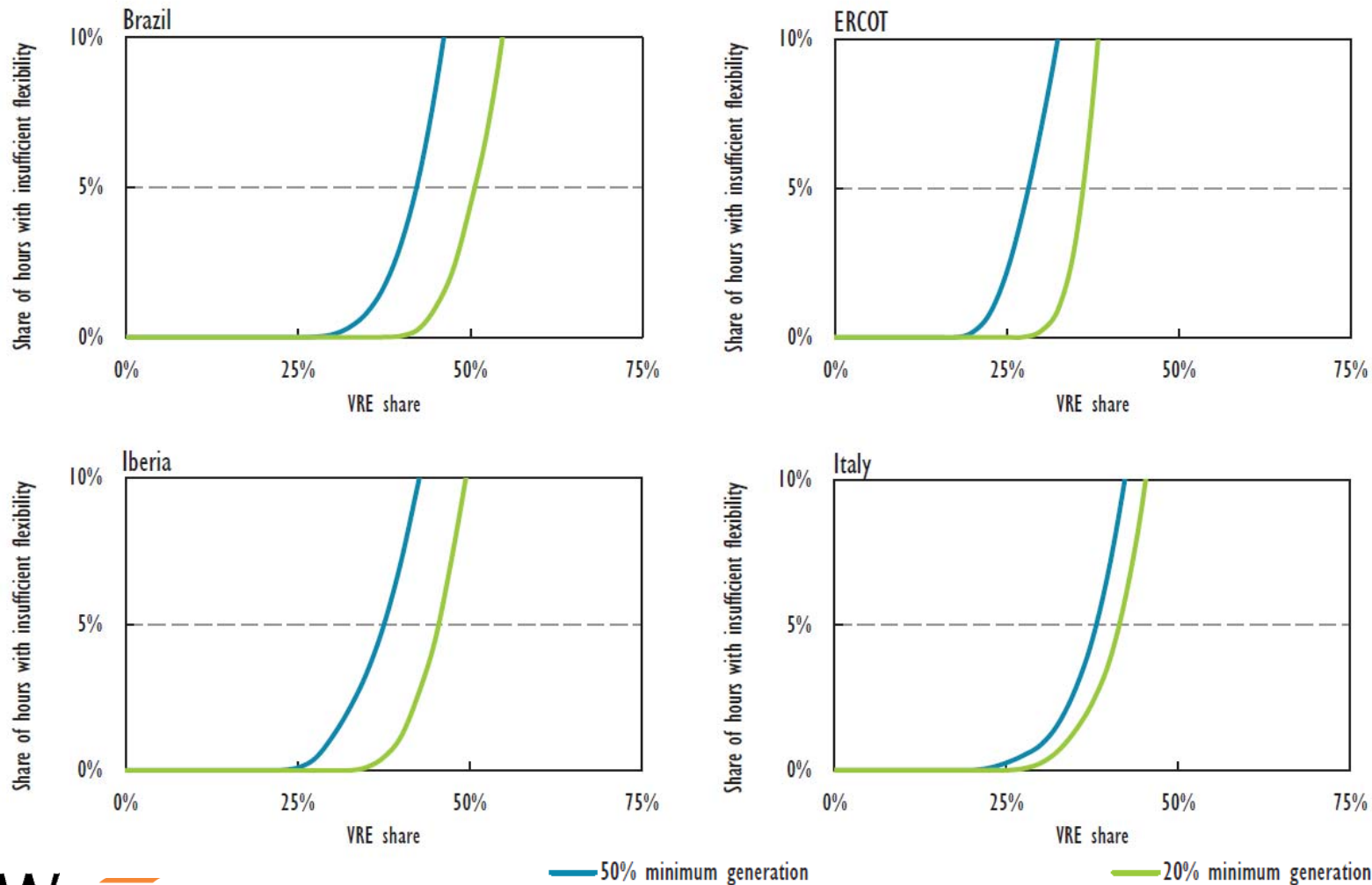
Optimal capacity of coal-fired generation (baseload) declines as wind is added

J. Riesz, J. Gilmore, (2014) "Does wind need "back-up" capacity – Modelling the system integration costs of "back-up" capacity for variable generation". Accepted for presentation at the 2014 International Energy Workshop (Beijing)



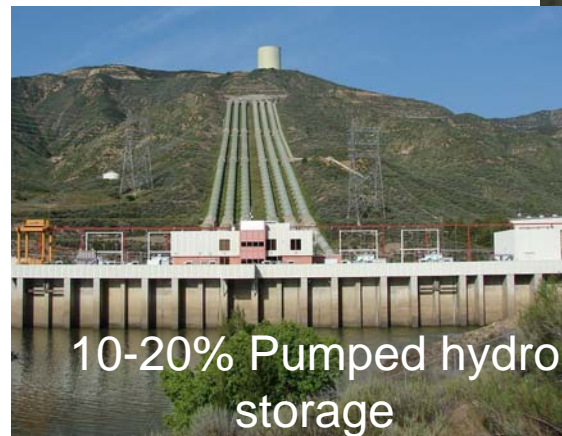
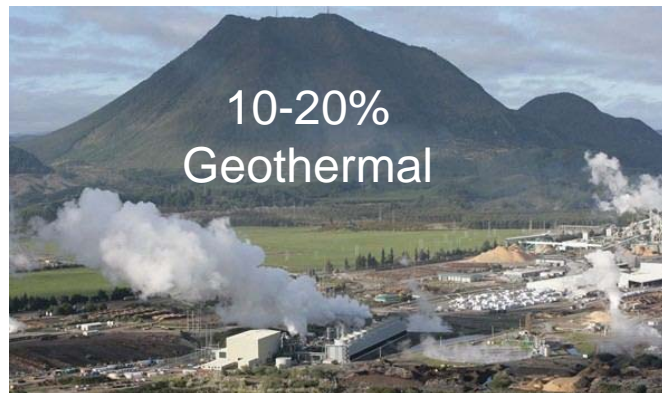
Flexibility of existing power systems

- IEA study: All regions studied have sufficient flexibility to support 25% - 40% variable renewables
- If accept a few hours of curtailment per year numbers increase considerably (>50% in some systems)
- Low “turn down” levels are important
- Increasing technical flexibility (eg. Batteries, flexible plant) increases potential penetration of VRE further

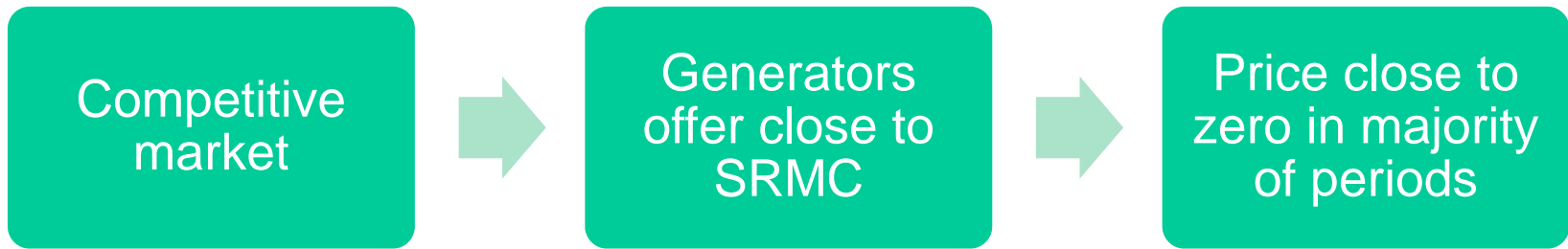


Possible 100% Renewables technology mix (NZ)

(by capacity)



What about the *market*?



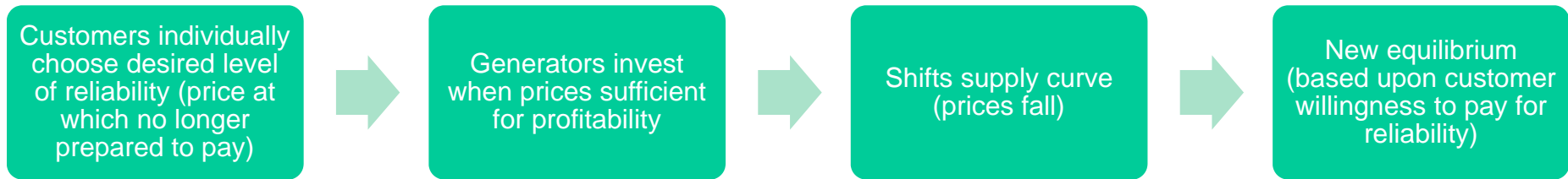
How do generators recover costs?

How do we maintain accurate investment incentives?

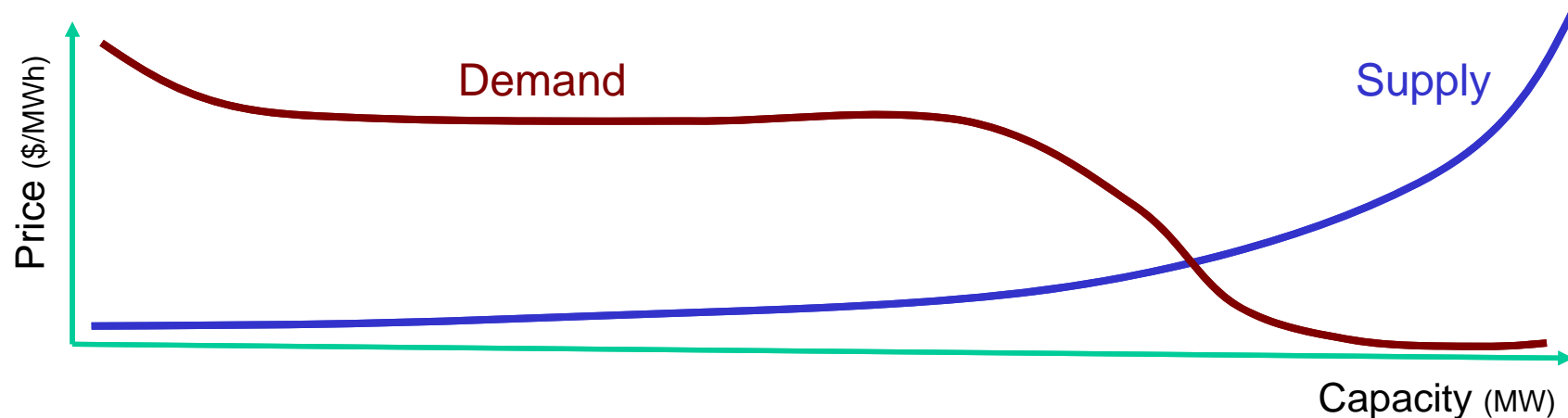
SYSTEM ADEQUACY

Managing system adequacy in energy-only markets

- In theory:

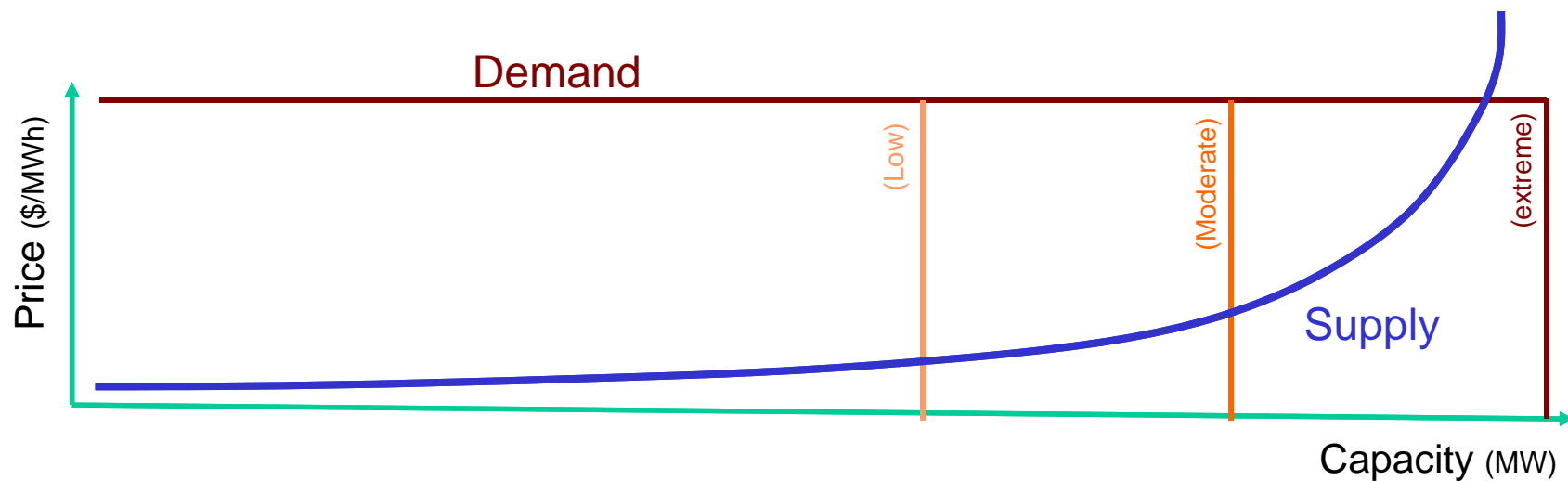


Contracting between customers and generators allows risk management
(more certain revenues for generators, and more certain reliability for customers)



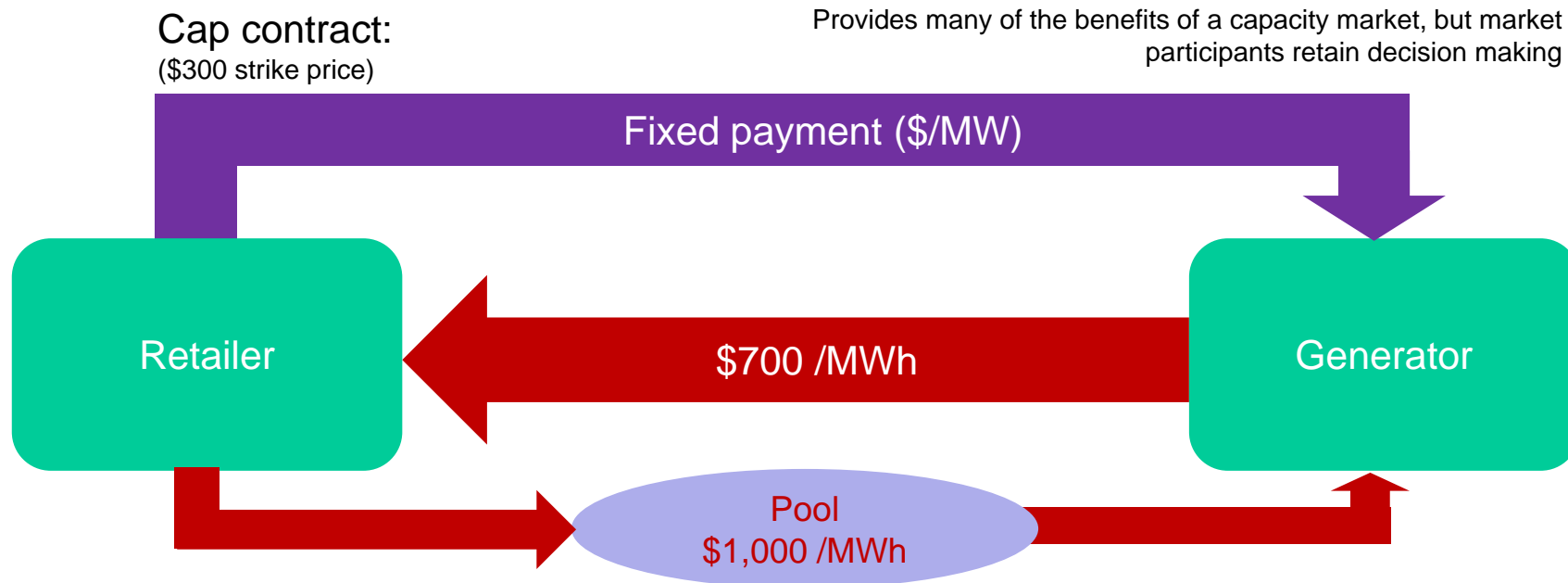
Managing system adequacy in energy-only markets

- In reality:
 - No market has sufficient demand side participation (yet?)
 - Regulator sets market price cap, based upon assumed customer willingness to pay (eg. Australian NEM)
 - Price cap must be high enough to ensure sufficient generation investment, even when scarcity occurs rarely

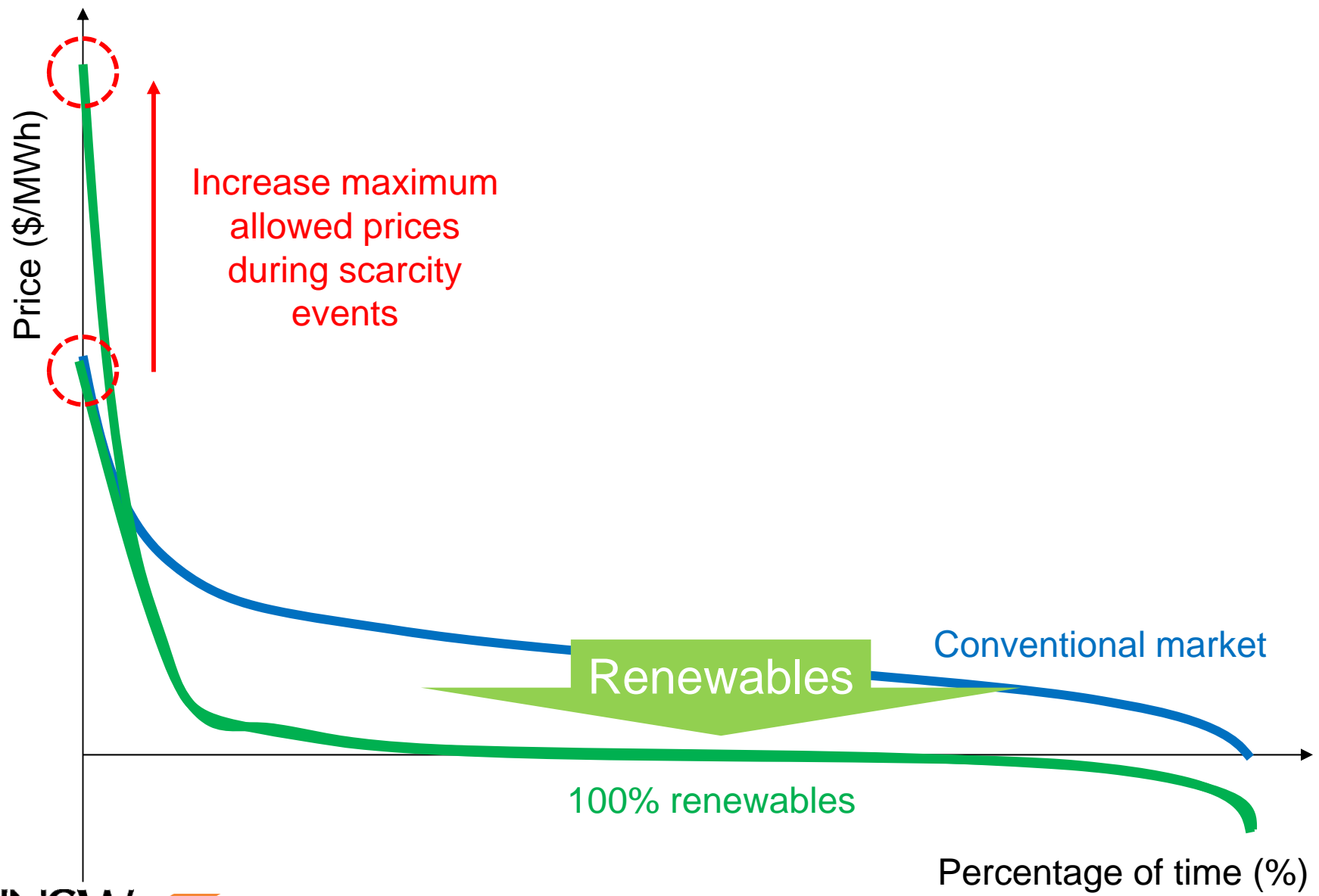


Managing price volatility

- Energy-only markets should exhibit high price volatility
 - Periods of extreme prices necessary for recovery of fixed costs
- Market participants manage price volatility via:
 - Contractual arrangements – mature derivatives market, or
 - Vertical integration



Impact of renewables



How much would scarcity prices need to increase?

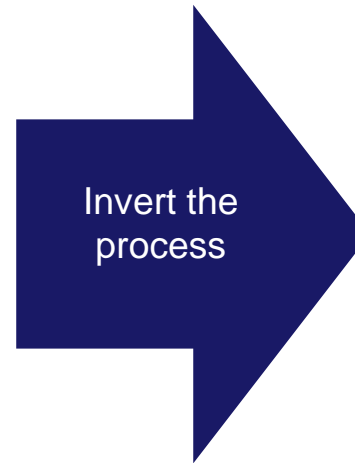
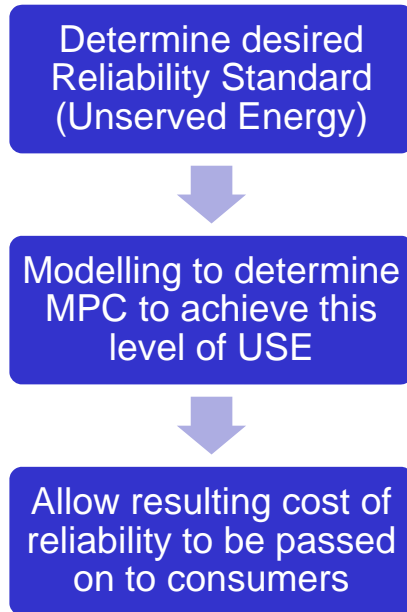
- Analysis for Australian NEM:

	MPC (\$/MWh)
Present Market Price Cap (MPC)	\$13,100
To maintain historical aggregate revenues (with move to 100% renewables)	~\$30,000
Sufficient aggregate revenues to support 100% renewables	~\$60,000 to \$80,000

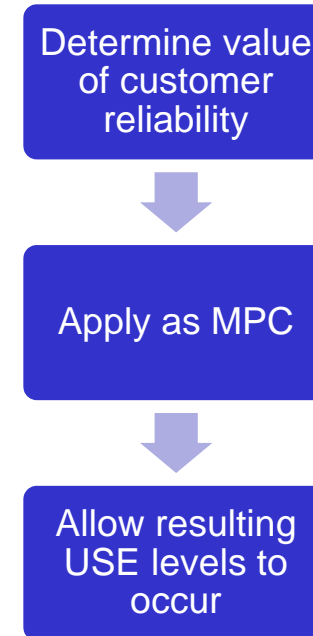
For New Zealand – will need to accept increasingly extreme scarcity prices

Perhaps this isn't crazy...

Process applied in the Australian NEM:



Theoretical "best practice":



Renewables don't affect VCR, so shouldn't affect MPC

	Value of Customer Reliability (\$/MWh)
Residential	20,710
Small business	413,120
Large business	53,300
Average	94,990

Issues with allowing higher extreme prices

Increased costs of hedging

Increased prudential obligations

- Increased barriers to entry for retailers

Discouragement of inter-regional contracting

- May interfere with generation locational decisions

Issues for New Zealand

Increasing importance of contracts market

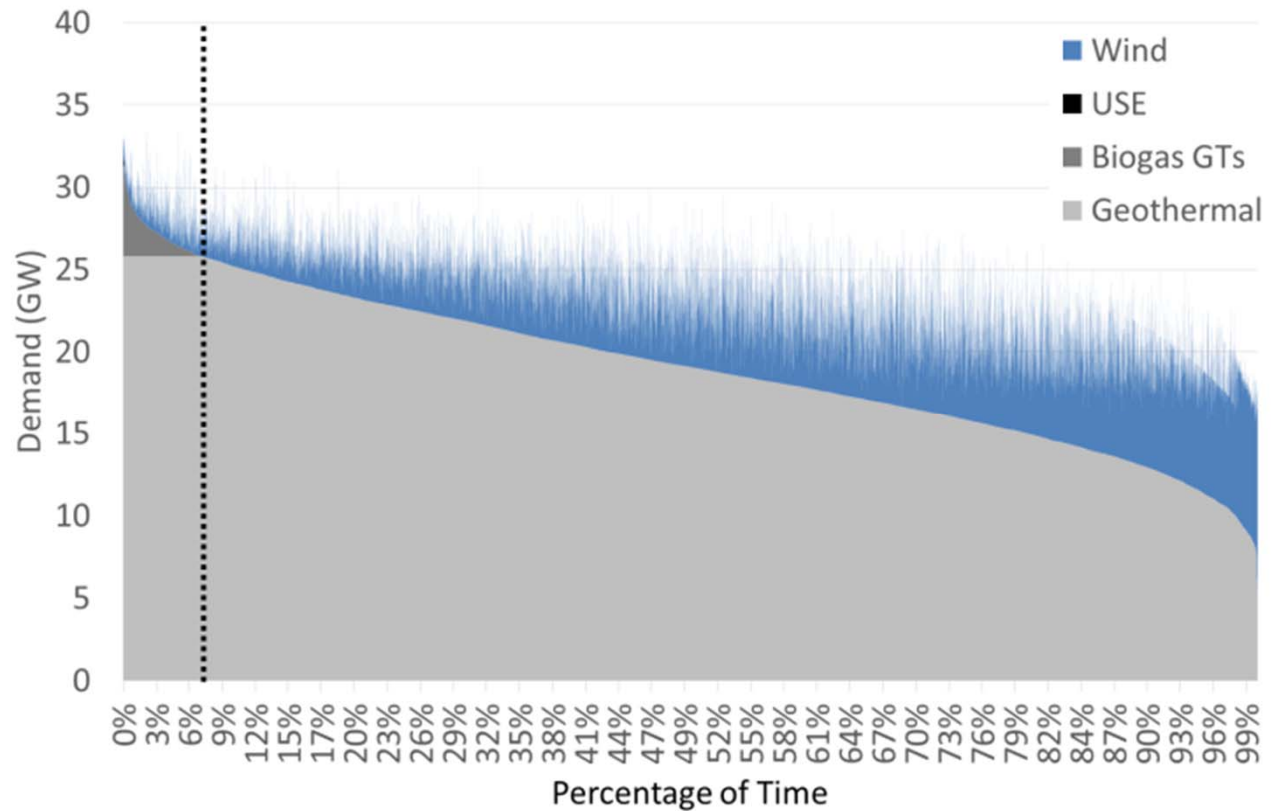
- Consider mechanisms to increase participation in futures markets
- Disincentivise vertical integration? (reduces liquidity and contracting options)

Increasing importance of Demand Side Participation

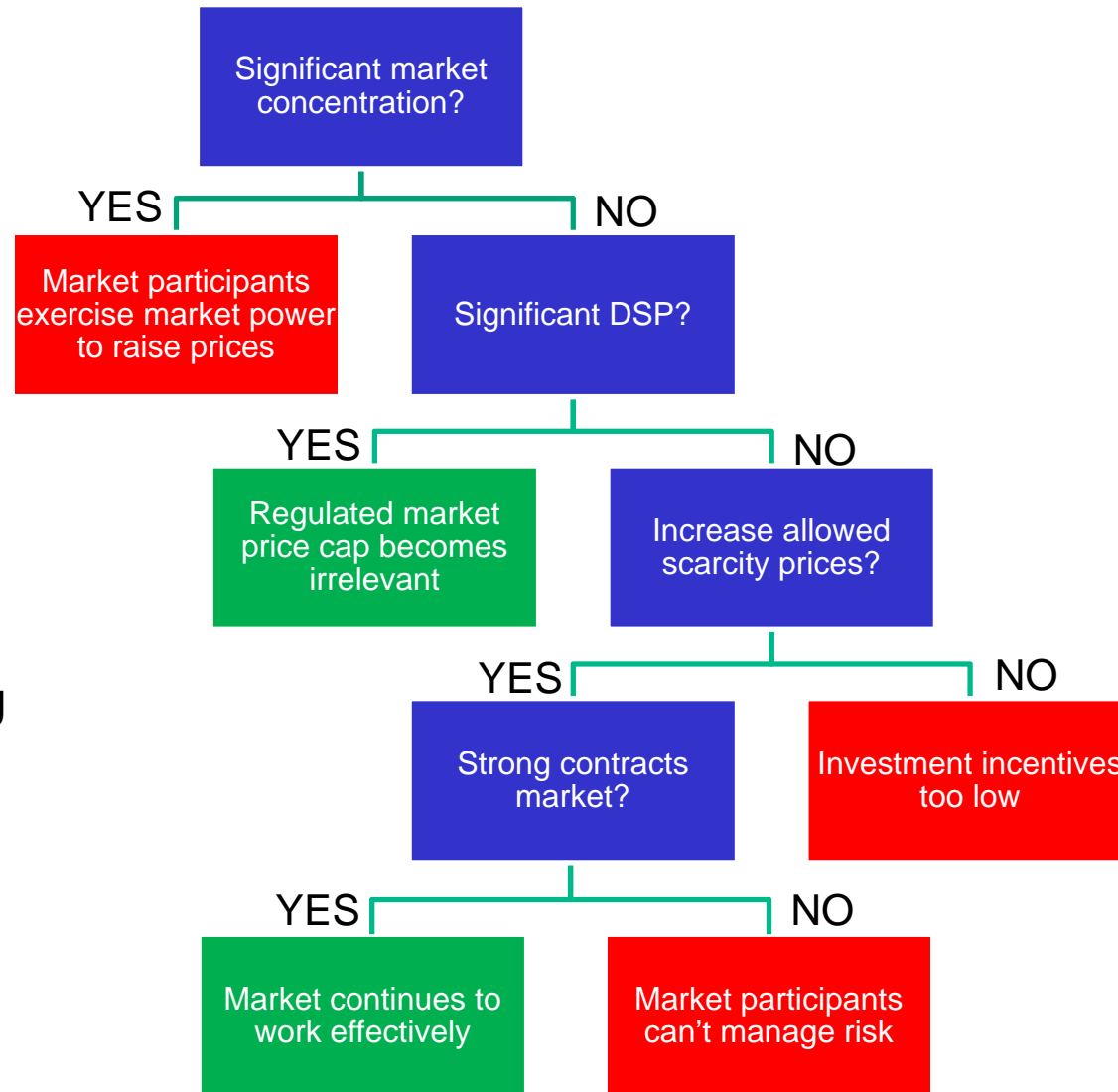
- DSP allows customers to individually choose their desired level of reliability
– reduces need for regulatory intervention

Cost recovery – variable renewables?

If generation mix is least-cost optimised, all generator types earn revenues that precisely cover costs (in theory)



Will energy-only markets work with high renewables?



Constant monitoring is wise – new issues will arise over time

Operational considerations – market design

- Lots of other considerations in market design for integrating variable renewables
 - Accessing flexibility on operational and investment timeframes
- Discuss at 1.45pm
 - “The Market & Wind” parallel session



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Thank you

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