Centre for Energy and Environmental Markets

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100% Renewable Energy

A feasible option for Australia?

Dr Jenny Riesz

Epuron – 1st November 2013

Centre for Energy and Environmental Markets

Powerlink QUEENSLAND

ASI AUSTRALIAN SOLAR INSTITUTE

UNSW THE UNIVERSITY OF SYDNEY

AGL

Ausgrid

ElectraNet electricity transmission

westernpower

Clean Energy Council

origin

Australian Coal Association

imo Independent Market Operator

RioTinto

Delta electricity

AEMC Australian Energy Market Commission

AEMO AUSTRALIAN ENERGY MARKET OPERATOR

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

ROAM CONSULTING ENERGY MODELLING EXPERTISE

AECOM

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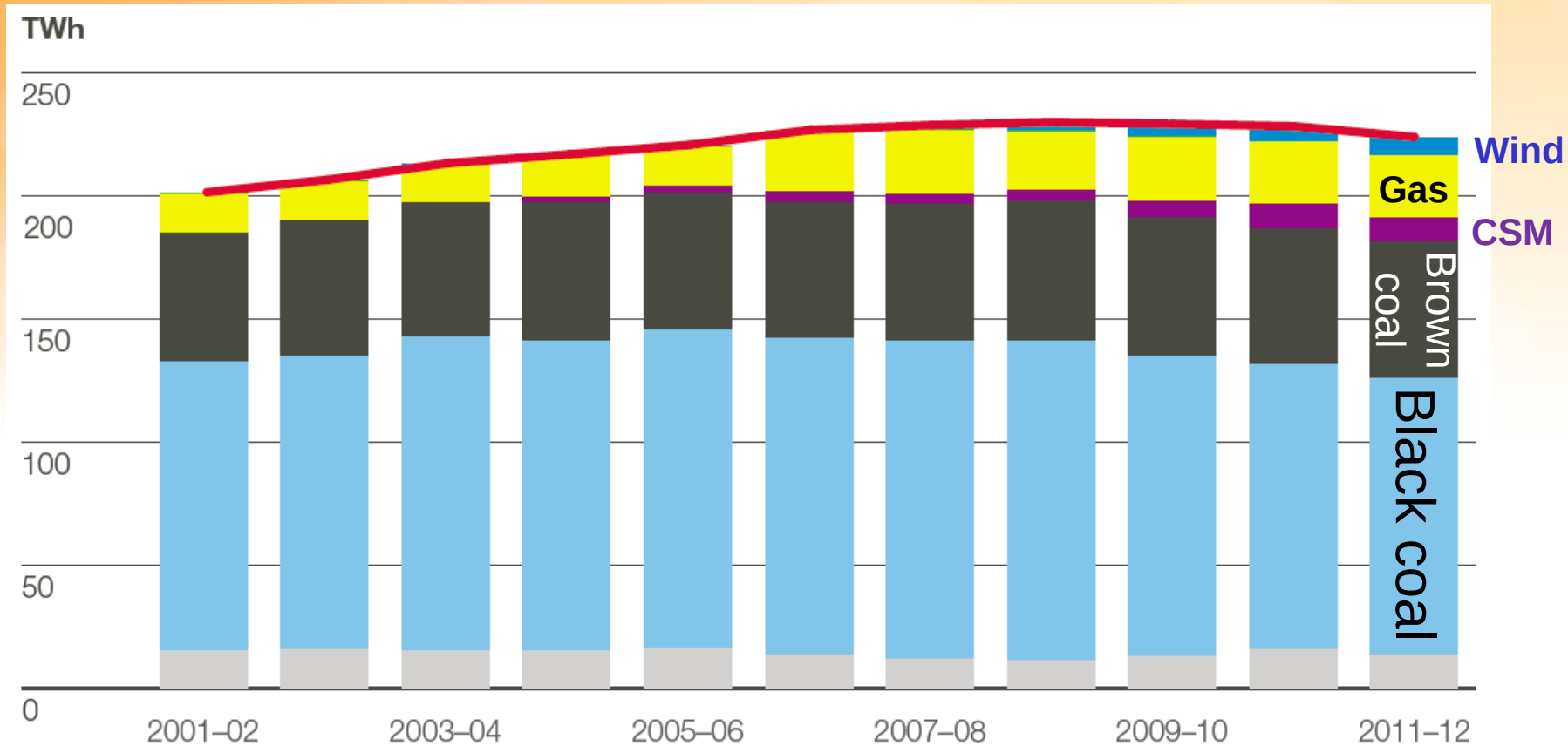
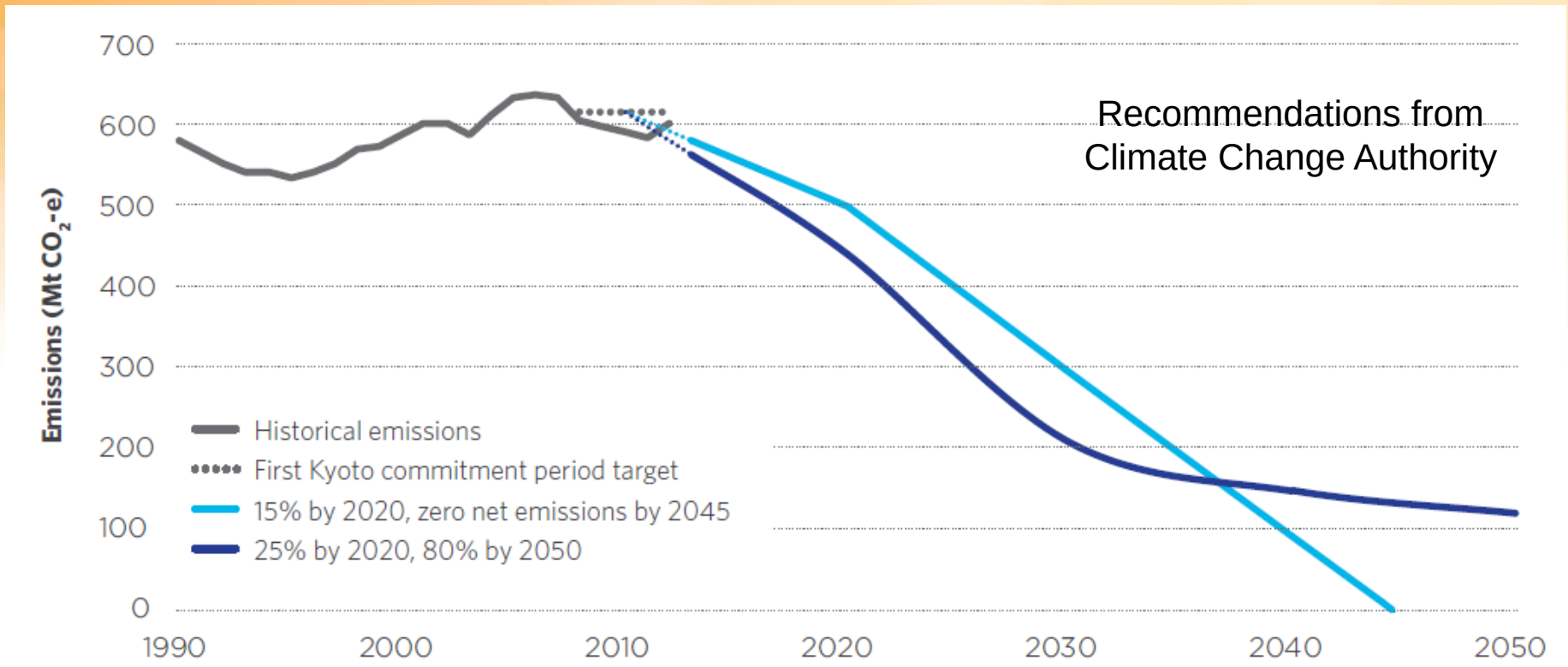
Energy mix in Australia

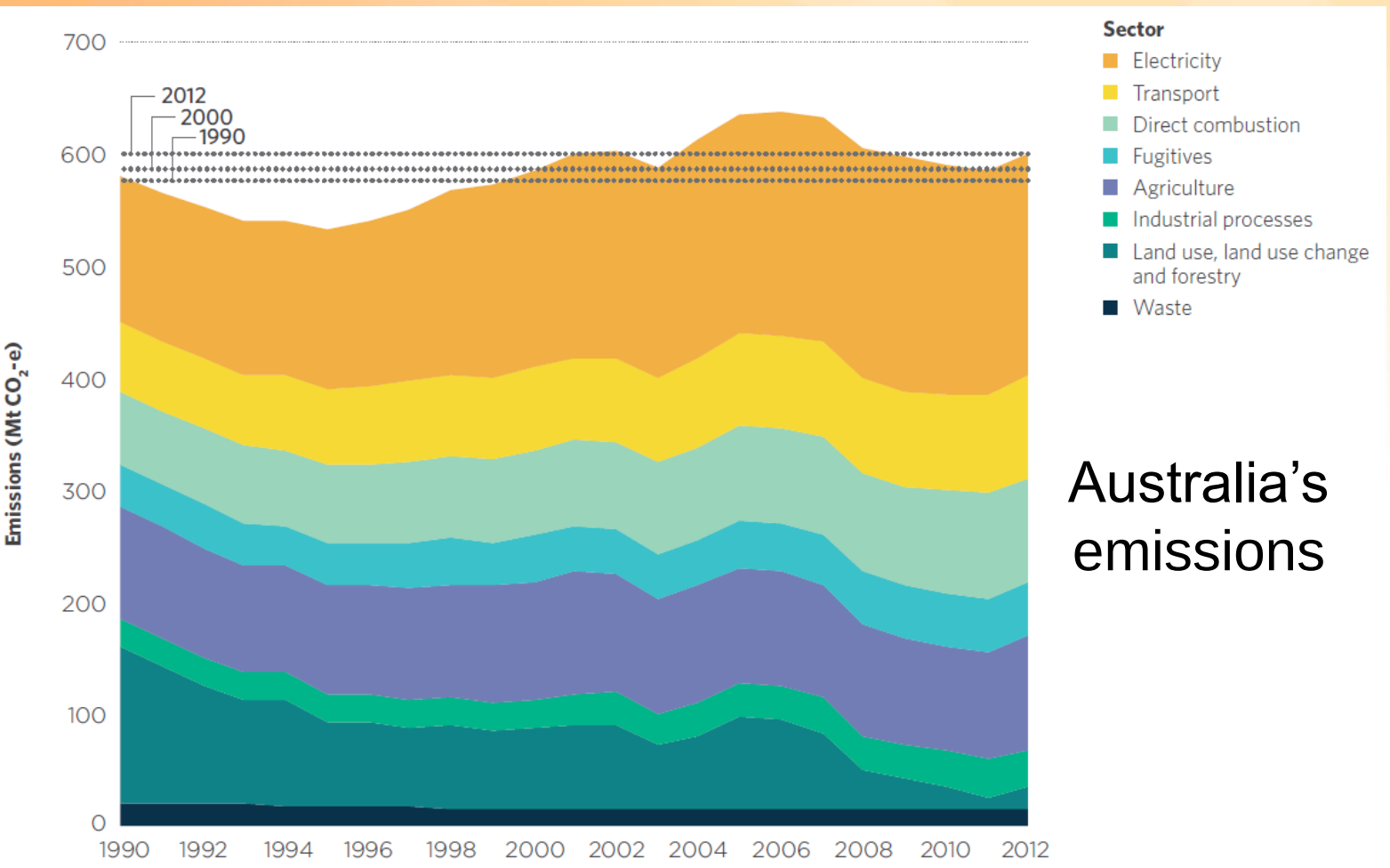


NSW: 90% of electricity from black coal

Growing pressure to reduce emissions



The electricity sector will be key



Australia's emissions

- Studies indicate 100% renewables is technically feasible and reasonably affordable

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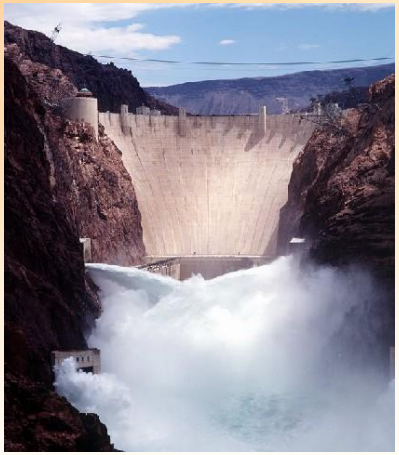
Elliston, MacGill, Diesendorf (2013) Least cost 100% renewable electricity scenarios in the Australian National Electricity Market. Energy Policy (in press)

AEMO

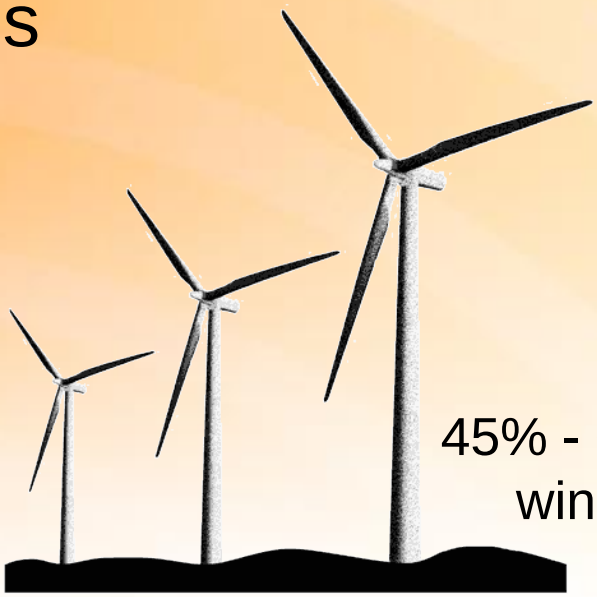
Australian Energy Market Operator (April 2013) 100 per cent renewables study – draft modelling outcomes

Renewable technologies



Variable technologies

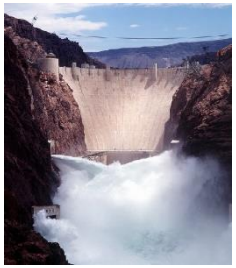
Diversity is key



45% - 60%
wind

14% - 22%
Solar thermal

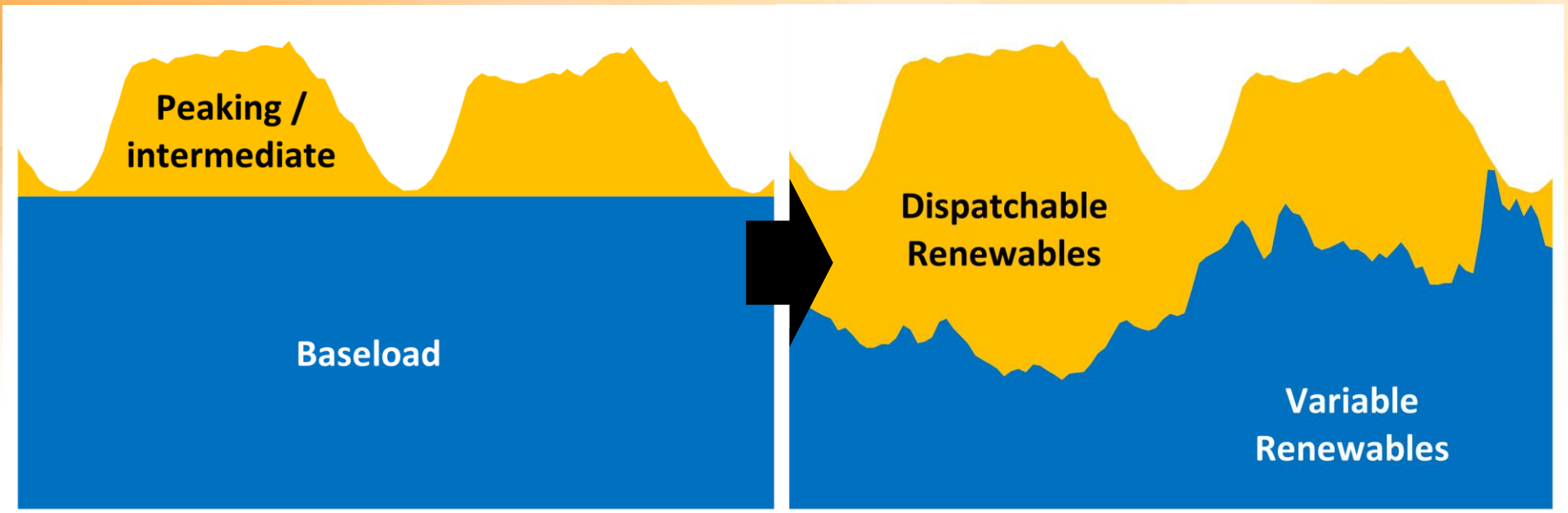
15% - 20%
PV



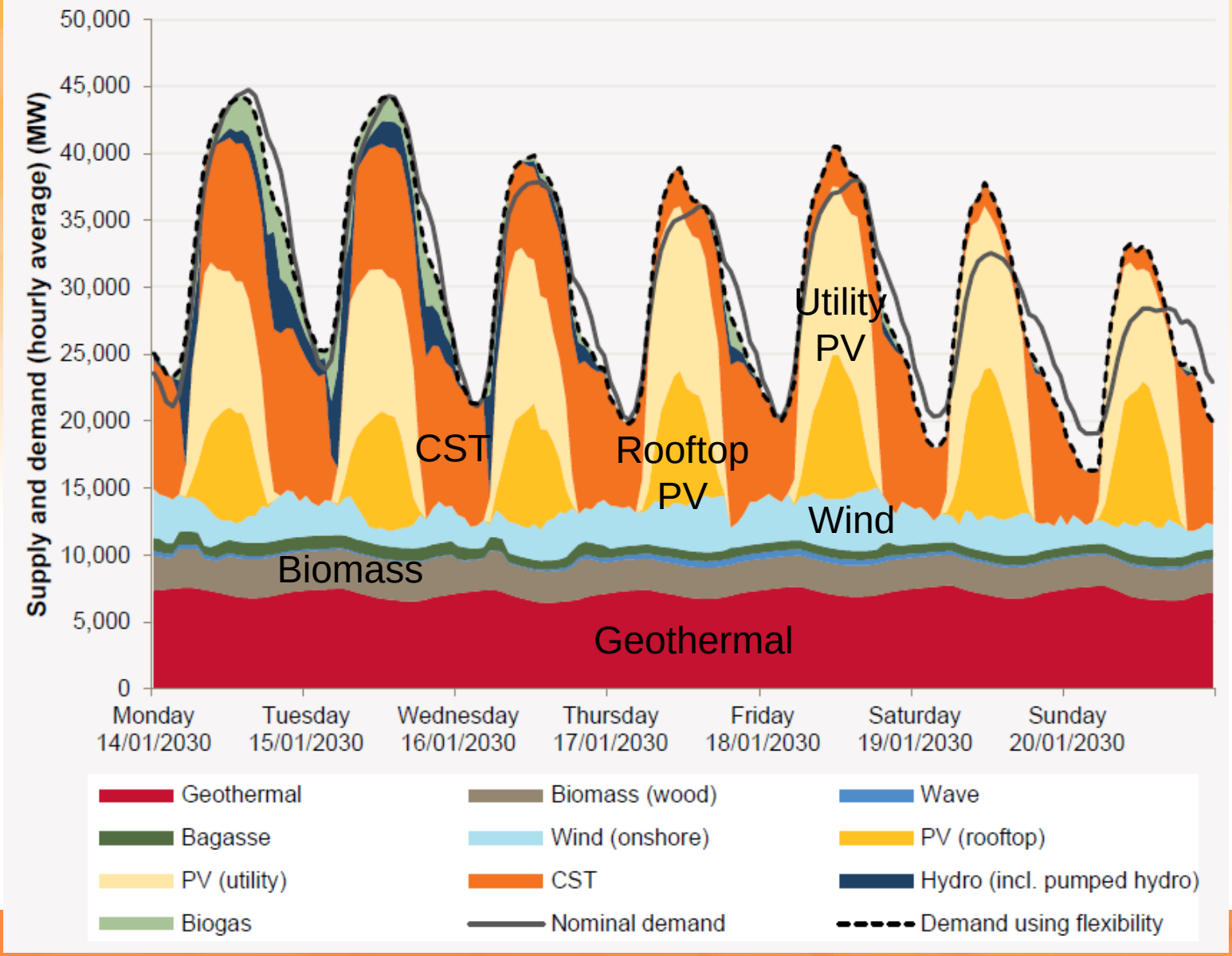
5%
Hydro
(existing)

6%
Biomass

Elliston, B; MacGill, I; Diesendorf, M (2013) Energy Policy, "Least cost 100% renewable electricity scenarios in the Australian NEM"



A new power system paradigm


Supply and demand (hourly average) (MW)
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Monday 14/01/2030
Tuesday 15/01/2030
Wednesday 16/01/2030
Thursday 17/01/2030
Friday 18/01/2030
Saturday 19/01/2030
Sunday 20/01/2030
Utility PV
CST
Rooftop PV
Wind
Biomass
Geothermal
Geothermal
Biomass (wood)
Wave
Bagasse
Wind (onshore)
PV (rooftop)
PV (utility)
CST
Hydro (incl. pumped hydro)
Biogas
Nominal demand
Demand using flexibility

- Costs are projected to be reasonably affordable

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Average cost:
$104 - $173 /MWh

AEMO

Average cost:
$111 - $133 /MWh

Present average wholesale price: $55 /MWh

2 - 3 times increase in wholesale prices

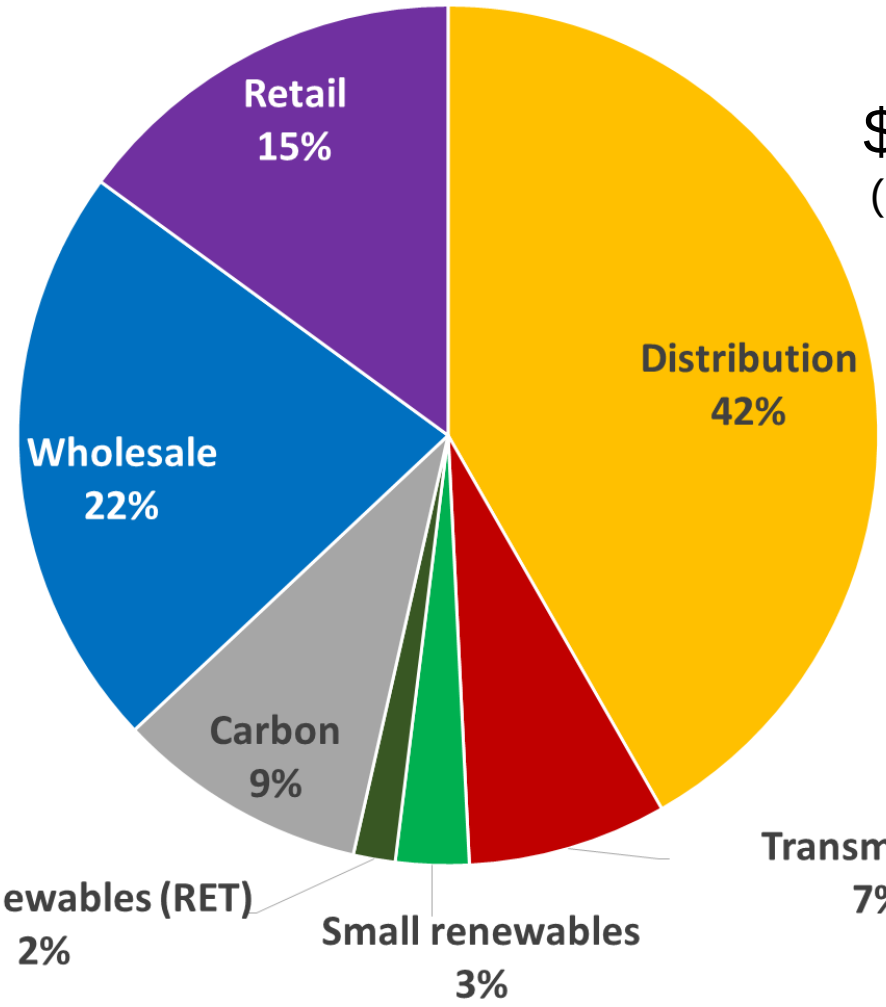
Components of retail prices

$300 /quarter

$390 /quarter
(100% renewables)

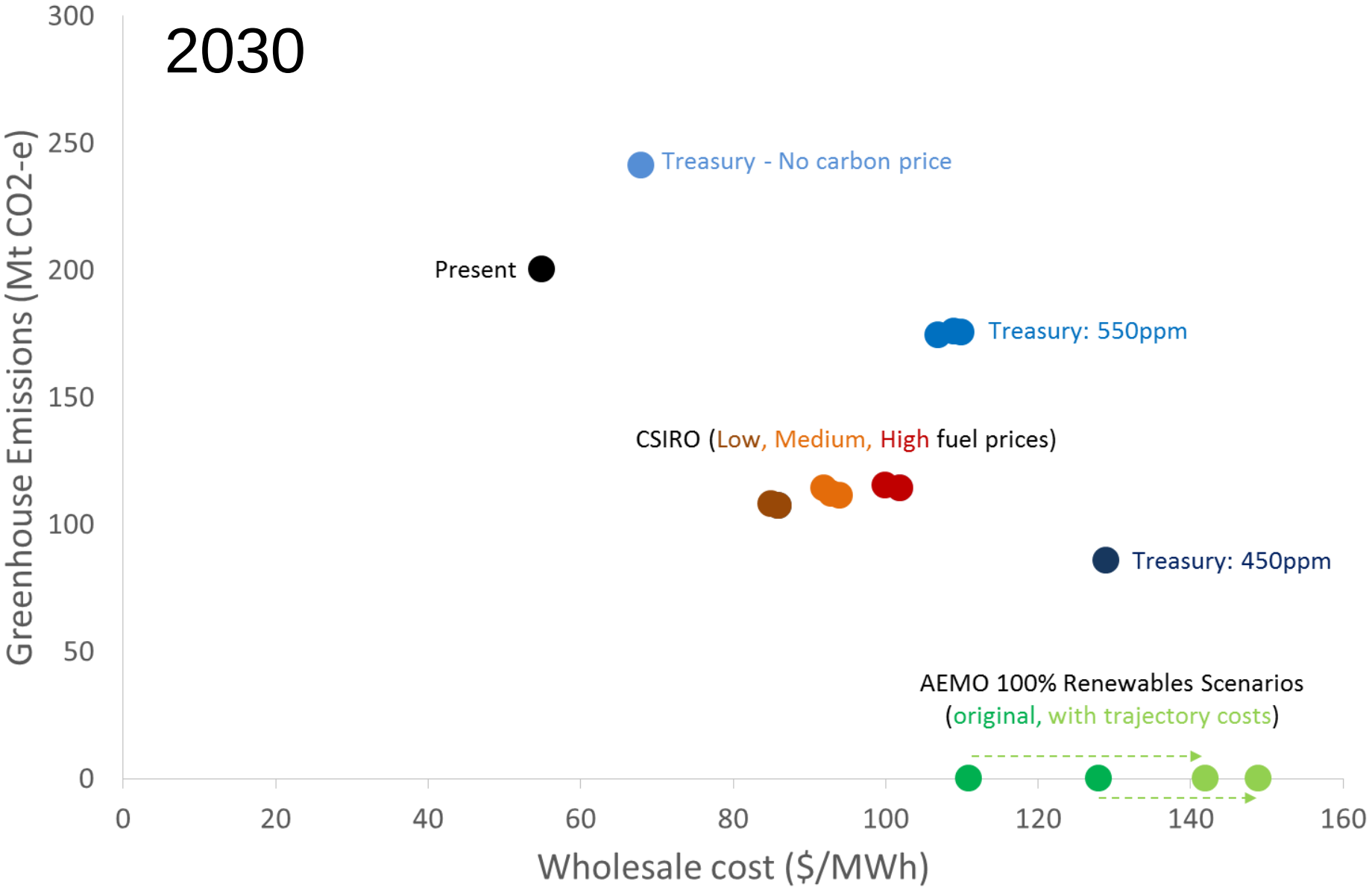
$55 /MWh

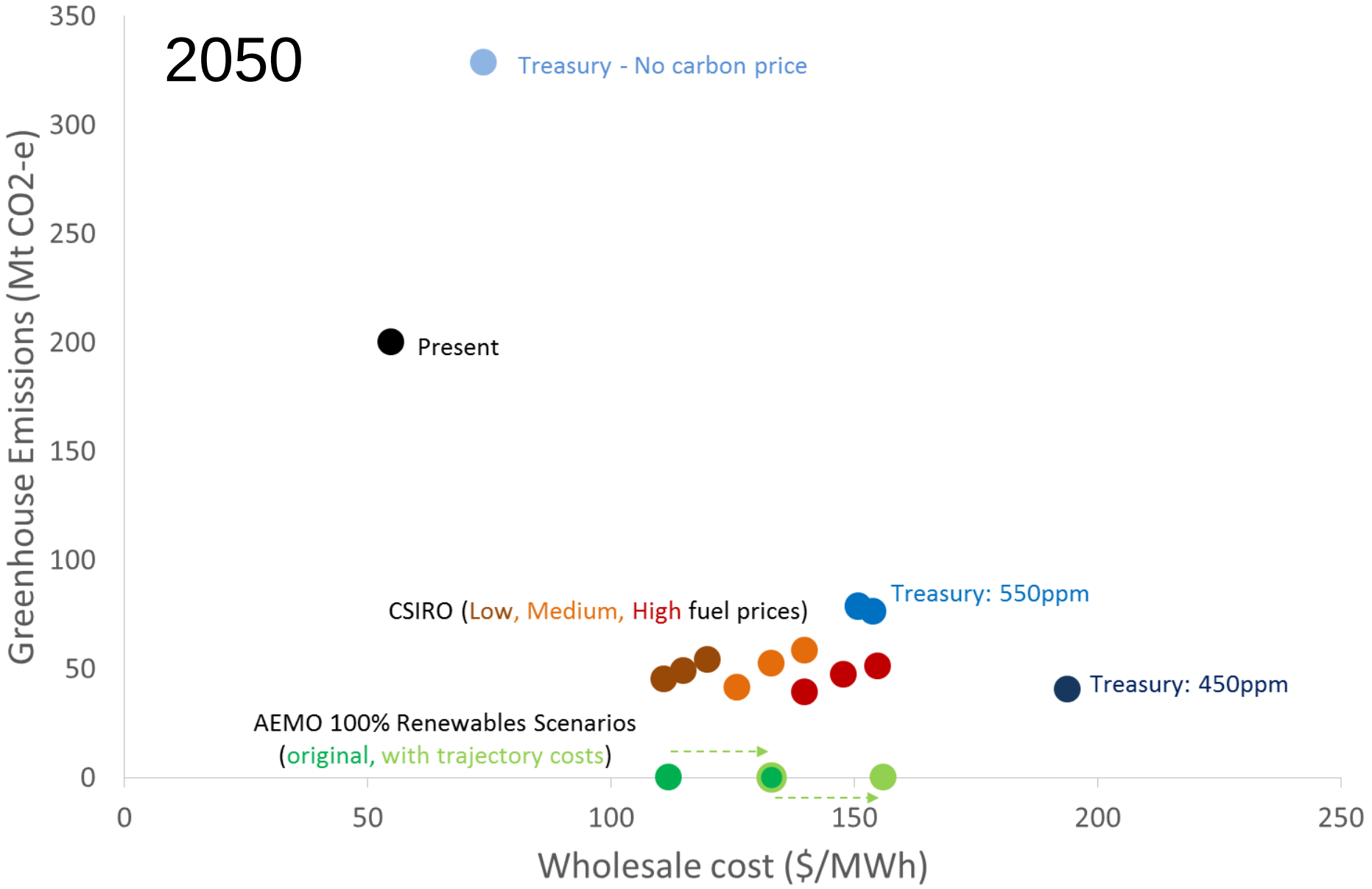
$110 /MWh



AEMC, Electricity Price Trends Final Report, March 2013, Results for QLD in 2012-13.

- 100% GreenPower only costs 20-30% more than normal electricity


2030
Greenhouse Emissions (Mt CO2-e)
300
250
200
150
100
50
0
Treasury - No carbon price
Present
Treasury: 550ppm
CSIRO (Low, Medium, High fuel prices)
Treasury: 450ppm
AEMO 100% Renewables Scenarios
(original, with trajectory costs)
0
20
40
60
80
100
120
140
160
Wholesale cost ($/MWh)


2050
Treasury - No carbon price
Present
CSIRO (Low, Medium, High fuel prices)
Treasury: 550ppm
Treasury: 450ppm
AEMO 100% Renewables Scenarios
(original, with trajectory costs)
Greenhouse Emissions (Mt CO2-e)
350
300
250
200
150
100
50
0
0
50
100
150
200
250
Wholesale cost ($/MWh)

100% renewables is:

- Technically feasible
- Similar in cost to other power systems in the future
- Much lower risk
  - Exposure to gas/carbon prices
  - Costs of establishing a nuclear industry
  - CCS technology risk

Will the NEM work with high renewables?

Competitive market → Generators offer close to SRMC → Price close to zero in majority of periods

How do generators recover costs?

How do we maintain accurate investment incentives?

SYSTEM ADEQUACY

Managing system adequacy in the NEM

Determine Market Price Cap (MPC)

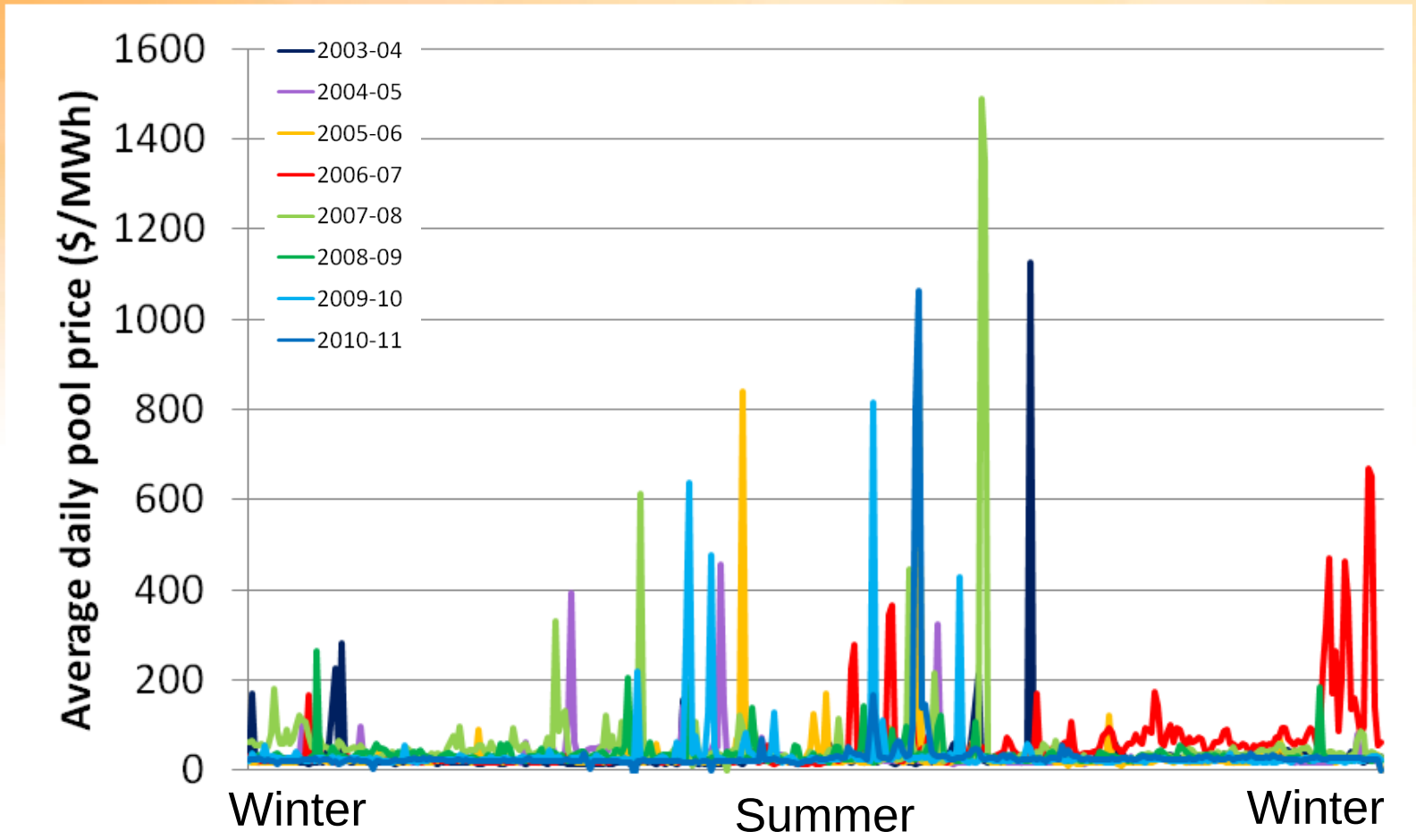
- Simulate future market
- adjust installed capacity to meet 0.002% USE
- Adjust MPC to allow last generator to meet costs

Market participants make investment decisions

- Higher MPC rewards more investment

Price volatility

Generators already earn 20-50% of annual revenue in top 20 days of the year

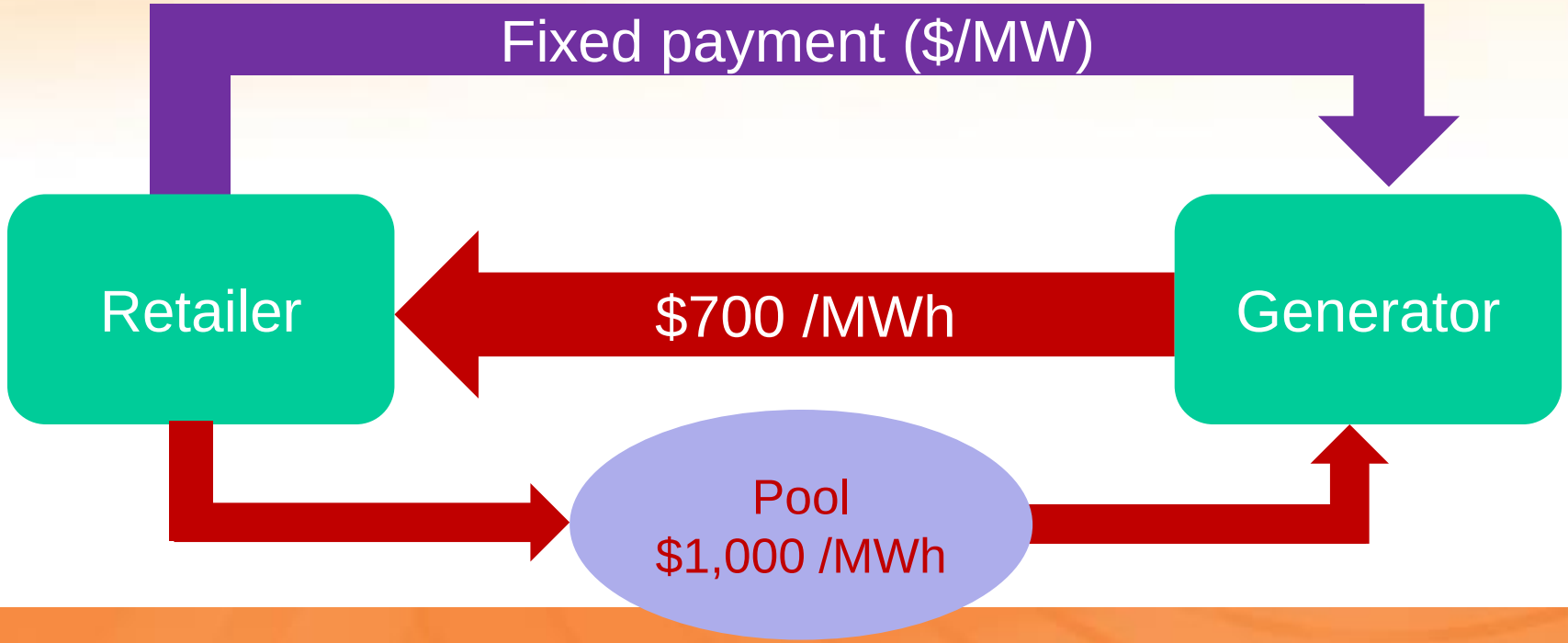


Managing price volatility

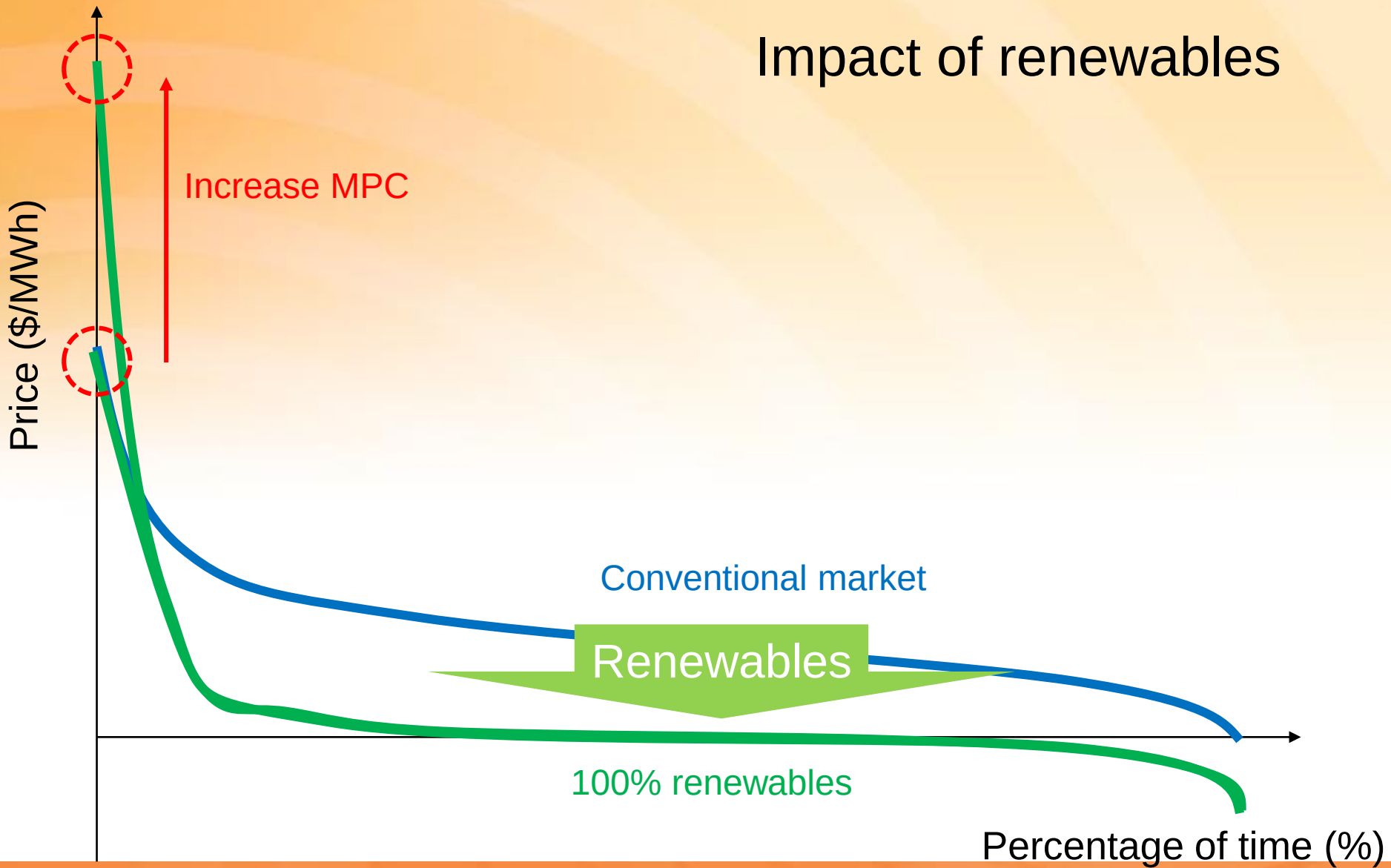
- Market participants manage price volatility via:
  - Contractual arrangements – mature derivatives market
  - Vertical integration

Provides many of the benefits of a capacity market, but market participants retain decision making

Cap contract:
($300 strike price)



Impact of renewables



How much would the MPC need to increase?

2009 selected for analysis (closest level of USE to the Reliability Standard)

Set all historical half-hourly prices below $300/MWh to zero

Multiply all remaining prices by a “scaling factor”

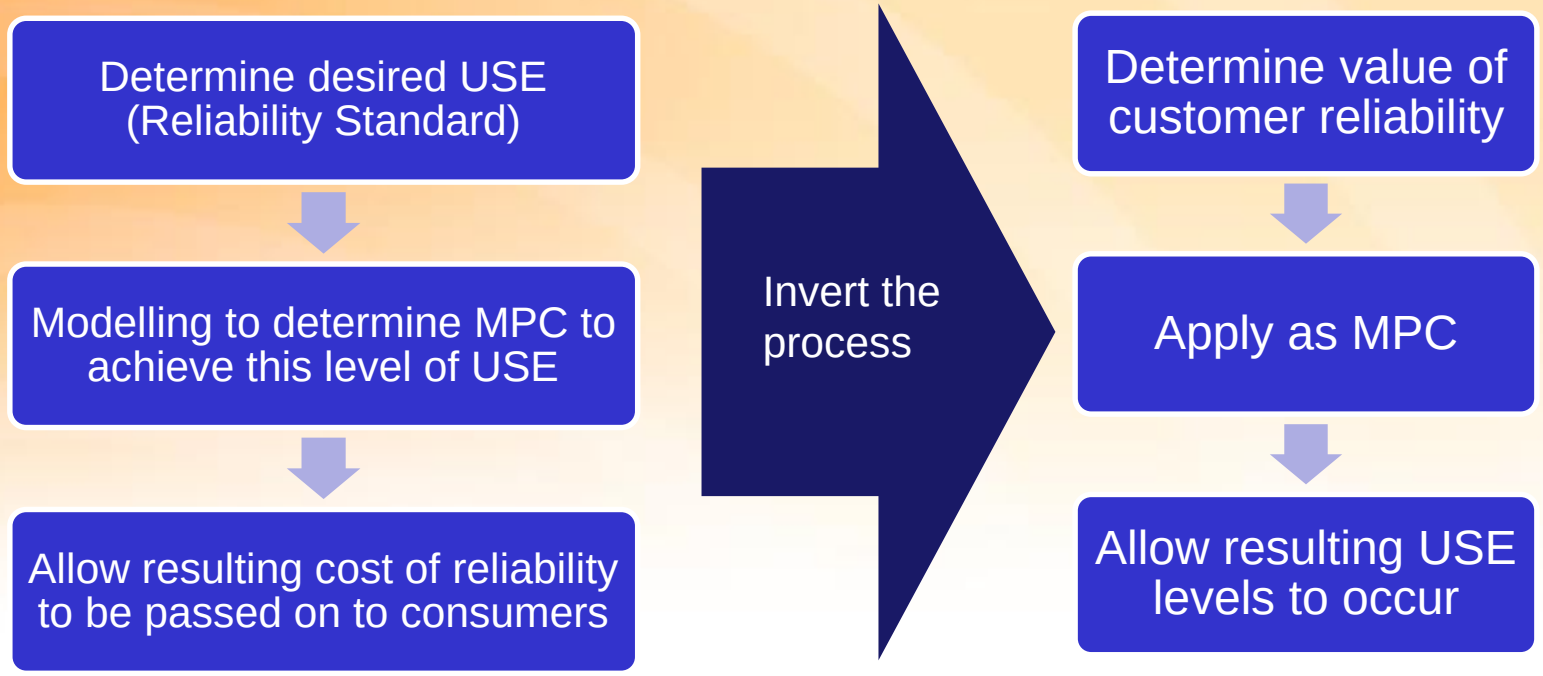
Adjust scaling factor so that total revenues earned achieve cost recovery (in aggregate) for 100% renewable system

How much would the MPC need to increase?

	Scaling Factor	MPC ($/MWh)
Level in 2009 (reference year)	1	$10,000
Maintaining historical aggregate revenues	3	$30,000
Sufficient aggregate revenues to support 100% renewables	6 - 8	$60,000 to $80,000

Perhaps this isn't crazy…

Renewables don't affect VCR



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

Oakley Greenwood, "NSW Value of Customer Reliability", Australian Energy Market Commission, 2012

Issues with increasing the Market Price Cap

Increased costs of hedging

Increased prudential obligations

- Increased barriers to entry

Discouragement of inter-regional contracting

- May interfere with generation locational decisions

Increasing importance of the contracts market

Consider:

- Close monitoring
- Mechanisms for increased transparency
- Disincentivise vertical integration?
  - Reduces liquidity and contracting options

Demand Side Participation

Why have a Market Price Cap?

- Demand is inelastic
- Need to protect consumers

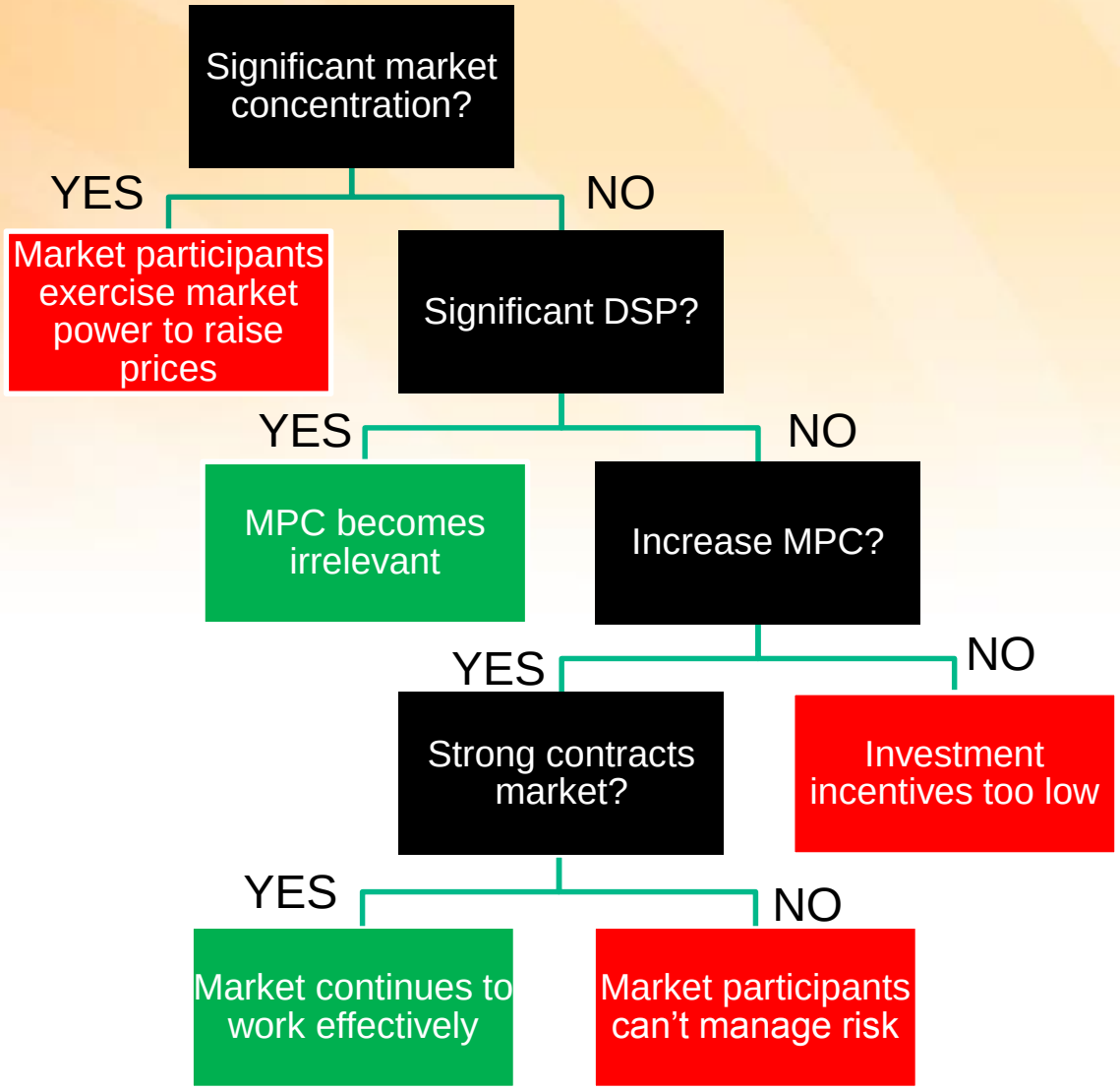
Increase DSP sufficiently → True representation of "value of lost load" in market, for each consumer → No MPC required

Conclusions

More renewables → Prices close to zero in majority of periods

- Not that different from the present NEM
- Already:
  - High price volatility
  - Market Price Cap » generator SRMC
  - Participants manage risk via contracts or vertical integration

Will the energy-only market work?



Constant monitoring is wise – new issues will arise over time

Questions for you – The Long Term

- Financing depends upon suitable PPA
  - Retailers seeking RECs
  - PPA is an energy-only contract (no capacity component)
- But what happens beyond the RET?
  - What kinds of innovative contracting arrangements might suit variable renewables? (wind & solar)

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Thank you

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