



CSIRO Future Grid

P4 - Robust energy policy frameworks for investment into future grids

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CURRENT WORK

- Two major projects:
 - Revenue modelling with high renewables
 - Electric Vehicles impacts on grids



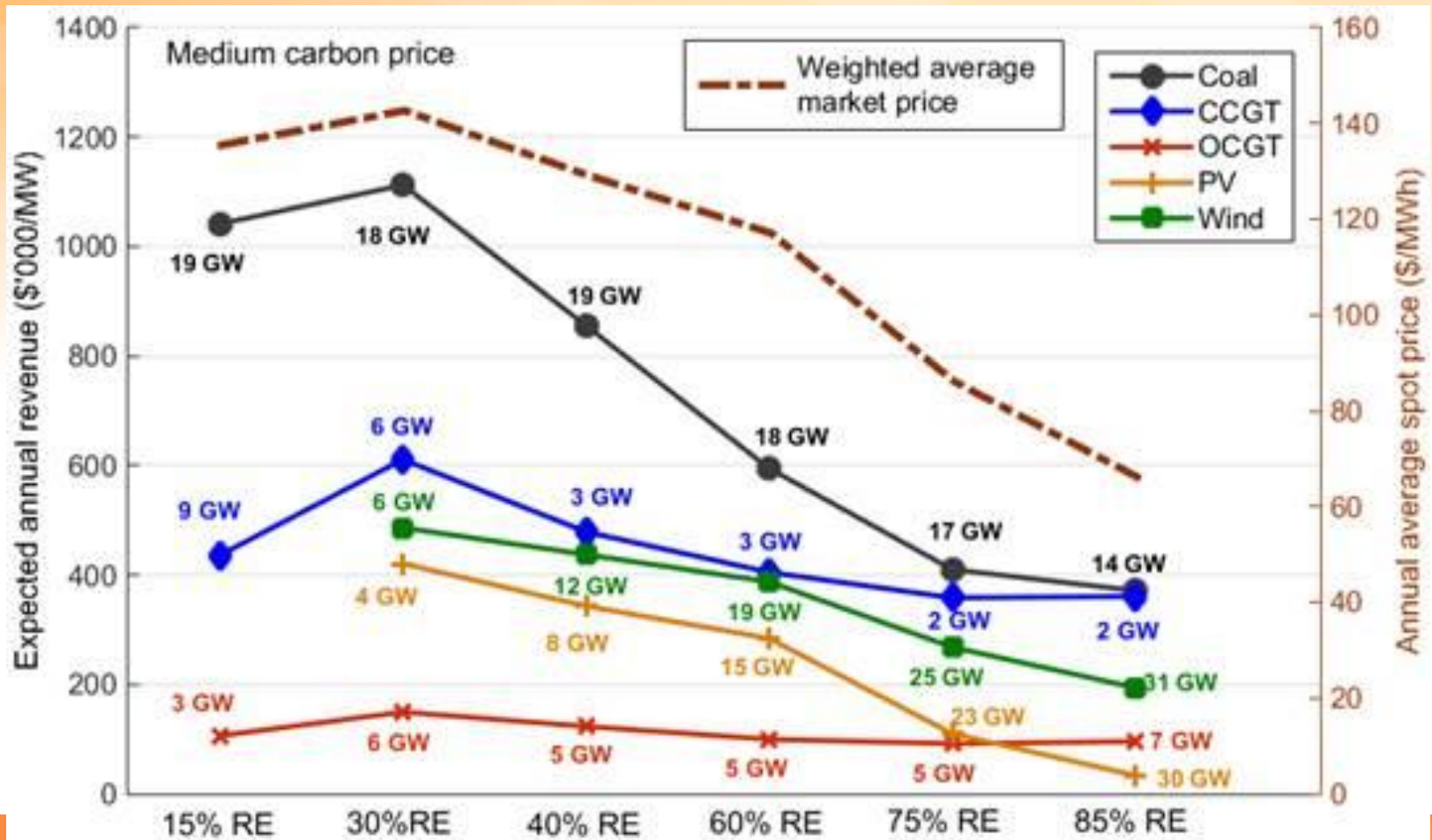
Market modelling with high renewables

- Probabilistic generation portfolio modelling tool
- Including very high proportions of wind and PV (up to 85%)
- Now calculating prices and revenues
 - Based upon Short Run Marginal Cost

P. Vithayasrichareon, J. Riesz, I. MacGill, "Market Pricing and Revenue Outcomes in an Electricity Market with High Renewables – An Australian Case Study", IAEE International Conference, Antalya 2015.

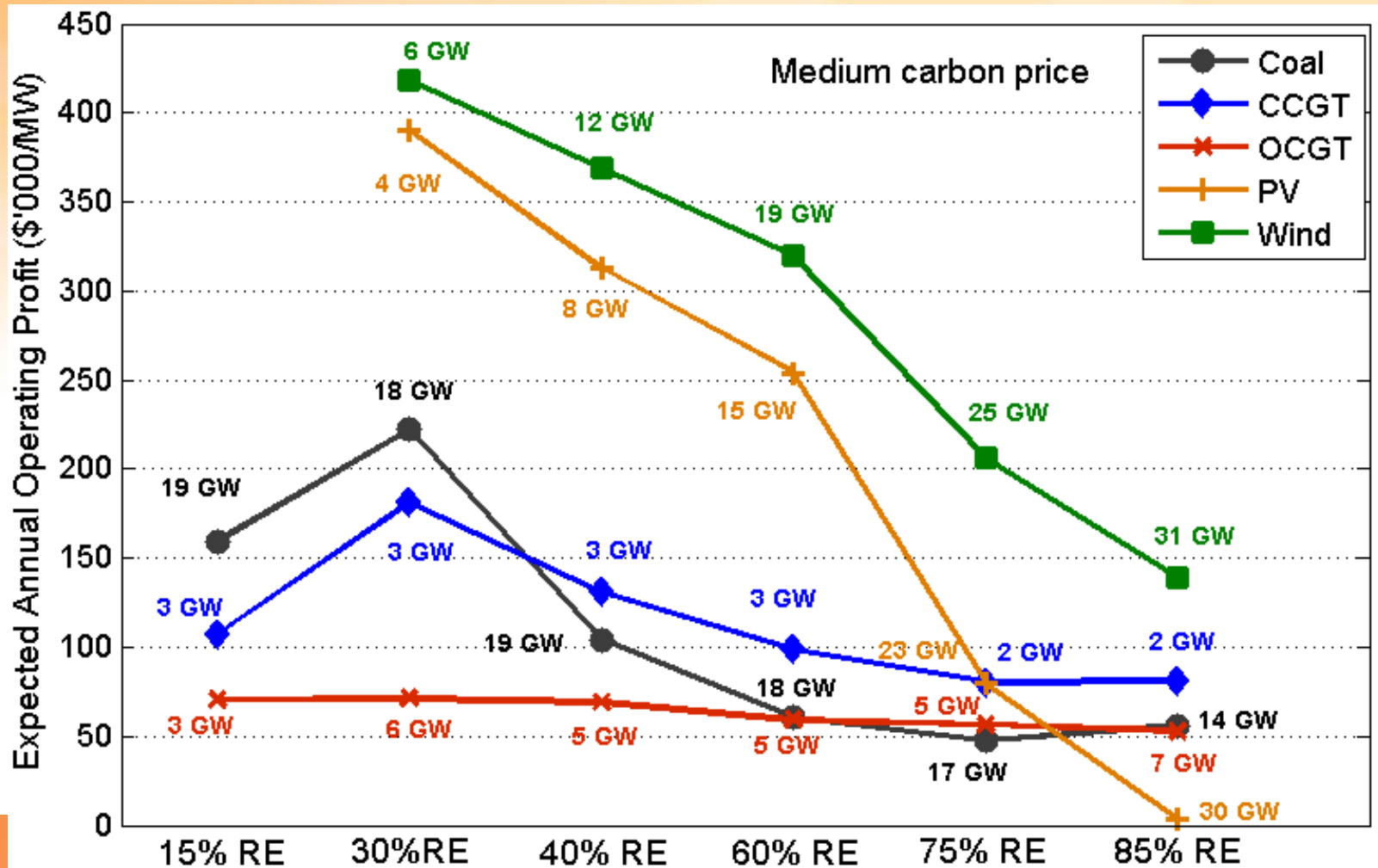
Revenues with high renewables

- Prices decline, and revenues decline for all plant types, if the MPC remains static



Operating profits

- Profitability declines for wind and PV especially



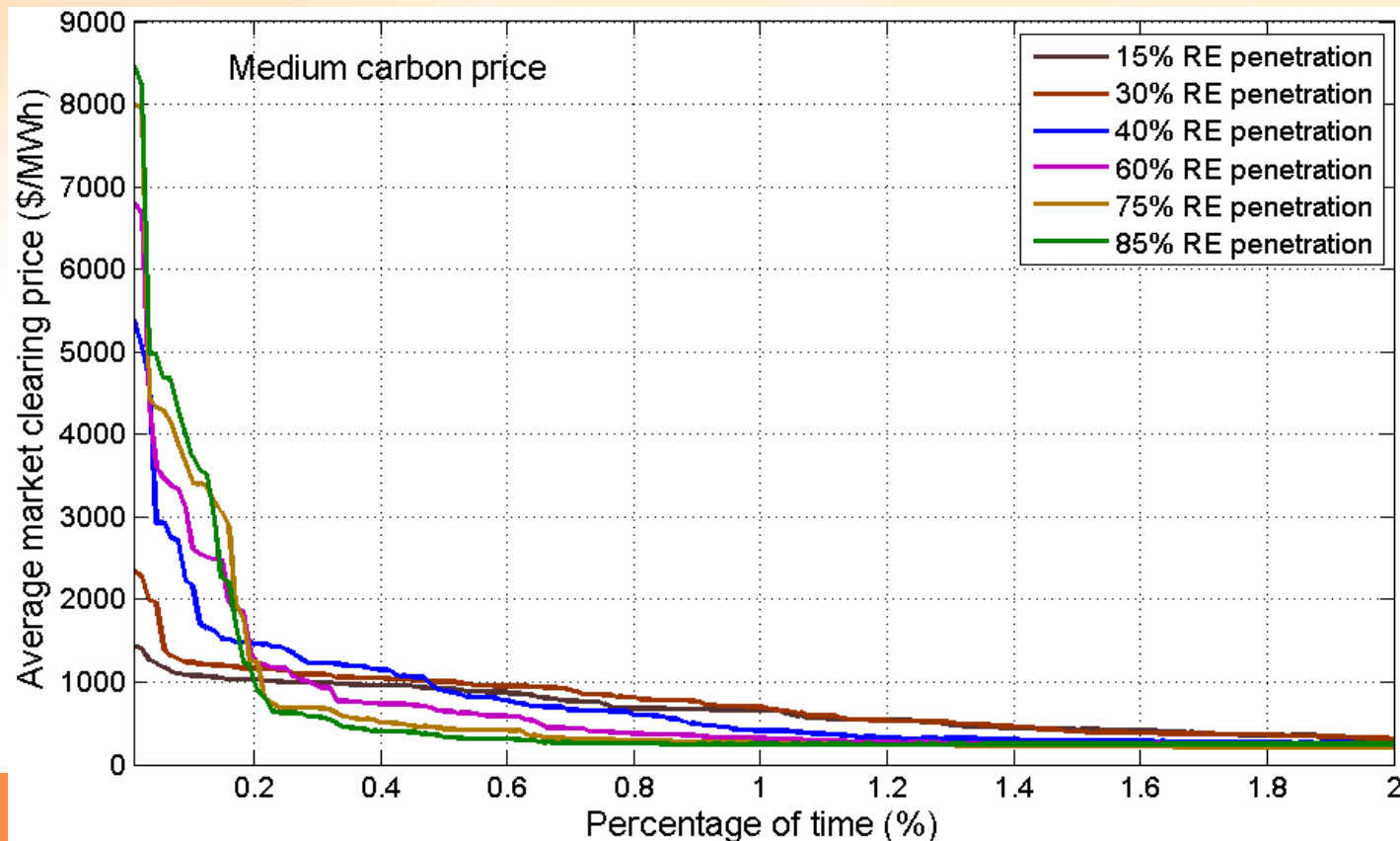
Market modelling with high renewables

- As renewable penetrations increase, spot revenues are earned in increasingly rare periods
- Will need to increase the MPC to maintain the same reliability standard

How much does the MPC need to increase?

How do plant revenues respond?

Can the energy-only market work effectively if the MPC is increased?



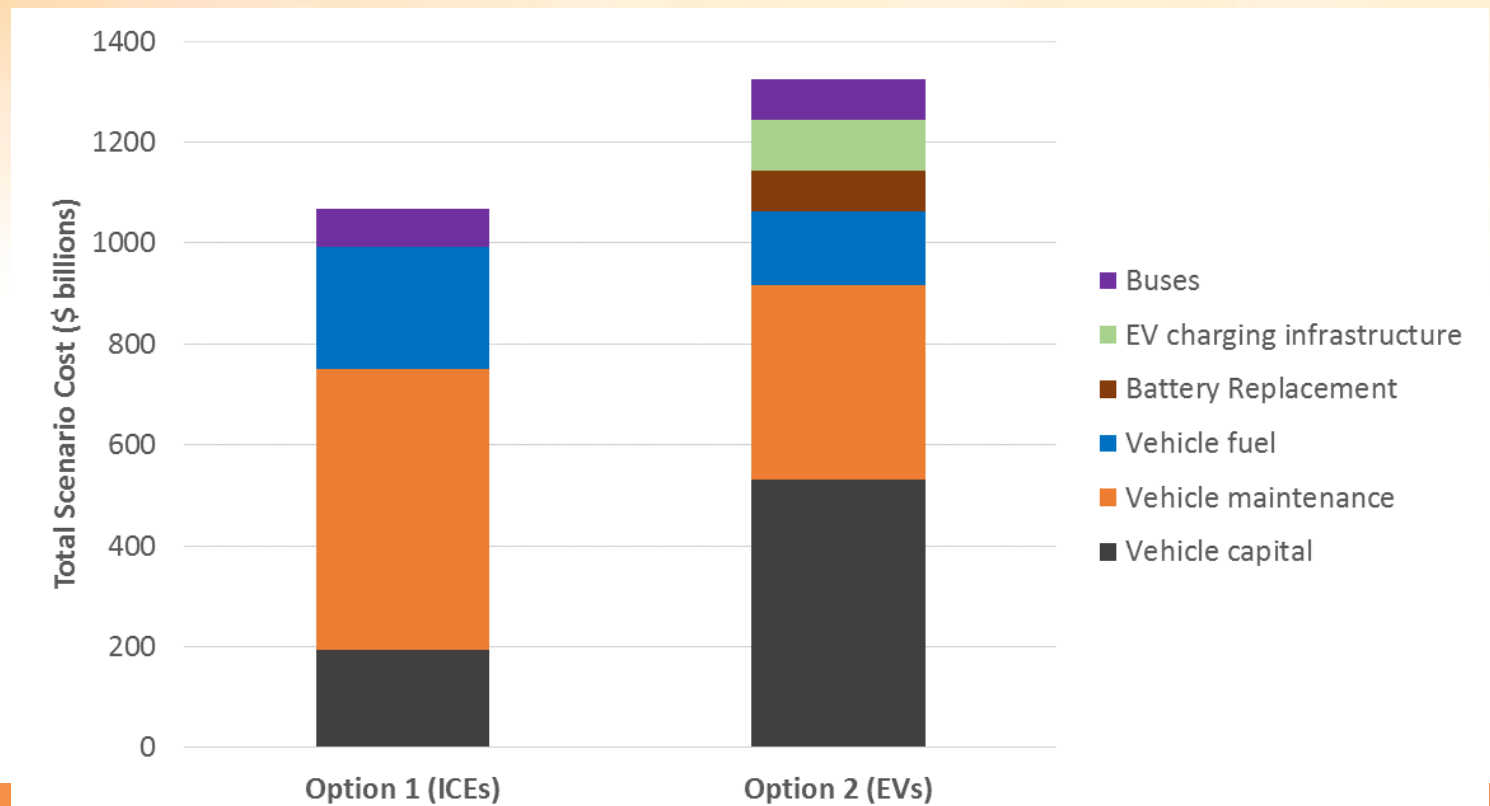
Electric vehicles

- What would be the impact on electricity grids, if there was a rapid transition to very high EV ownership?
 - Compare with unexpected rapid uptake of PV
 - Understand potential impacts, to project necessary changes to regulatory and market frameworks
- Modelled transition to 100% EV ownership in 10 years



High cost scenario

- Conservative assumptions
- \$21 per capita more per week (24% higher)



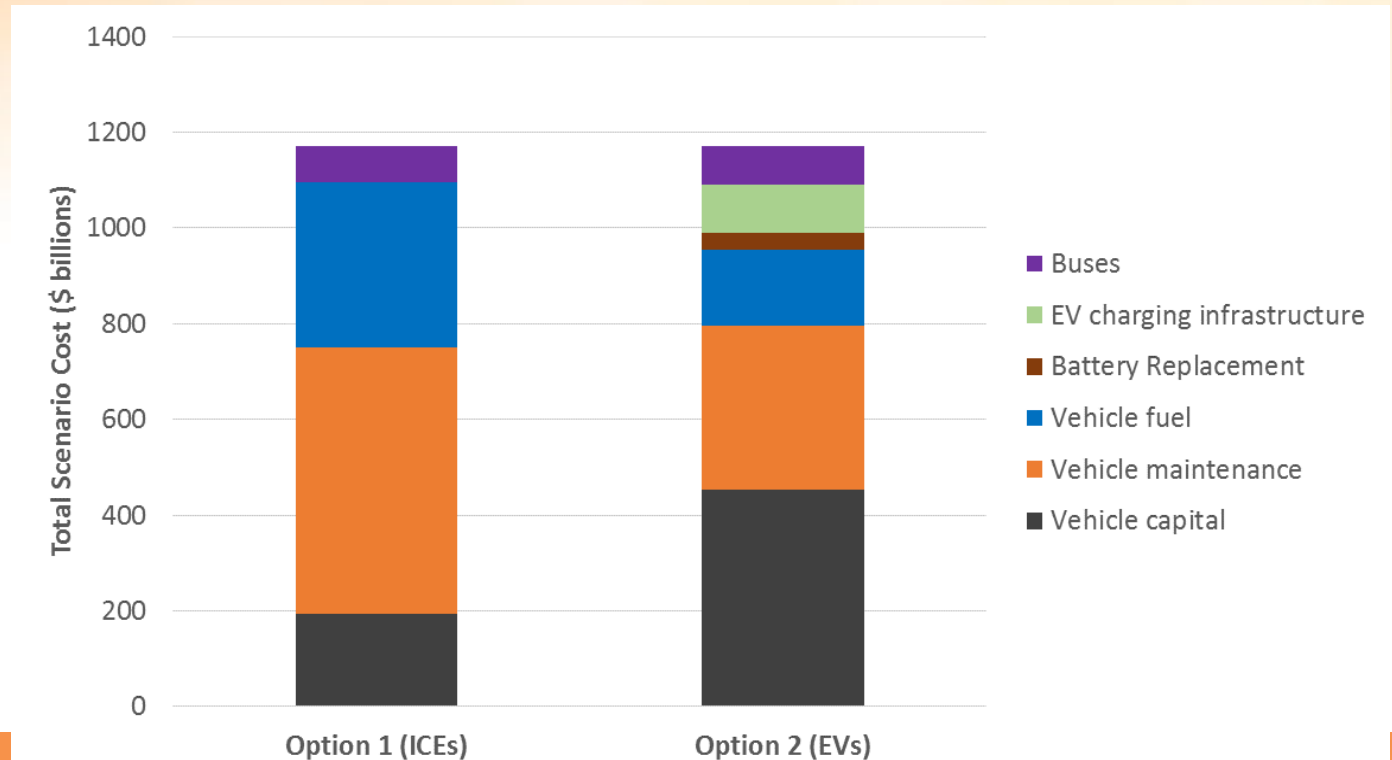
Low cost scenario

- Capital cost parity in 2025 (rather than 2035)
- Battery replacement costs reduce more rapidly
 - US DOE goals met
- Maintenance costs 20% of ICEs (rather than 75%)
- Petrol prices follow high projection

Costs are the same as for BAU!

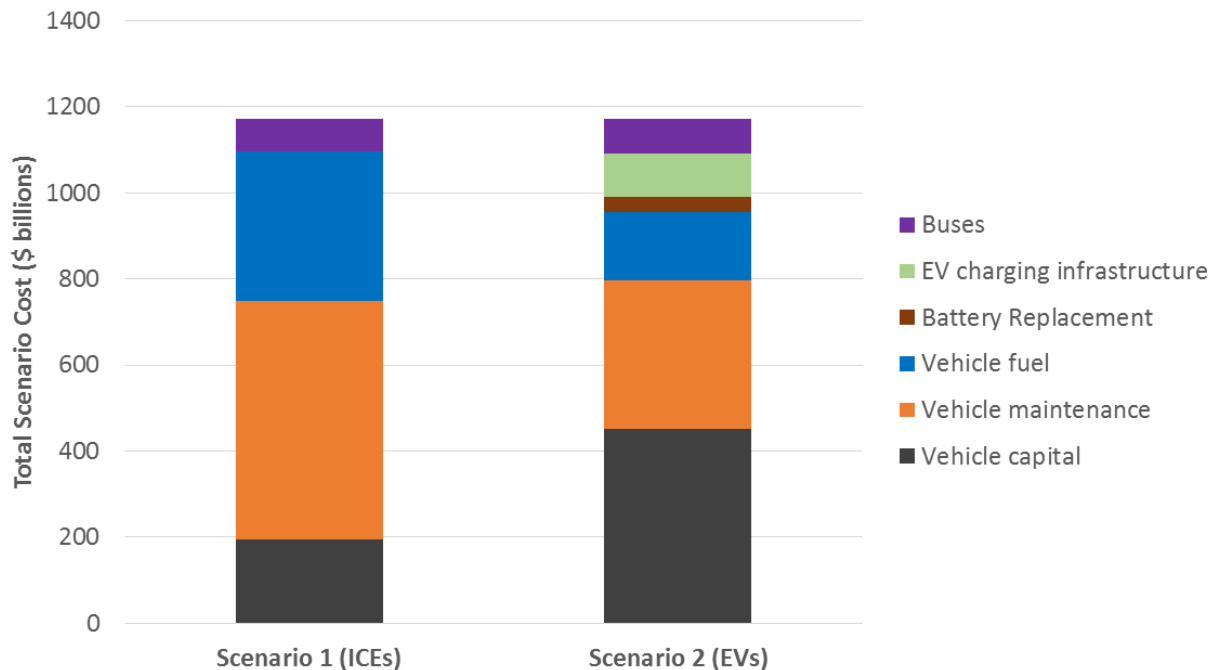
Suggests rapid change could occur under some circumstances

Early preparation of regulatory and market frameworks would be wise

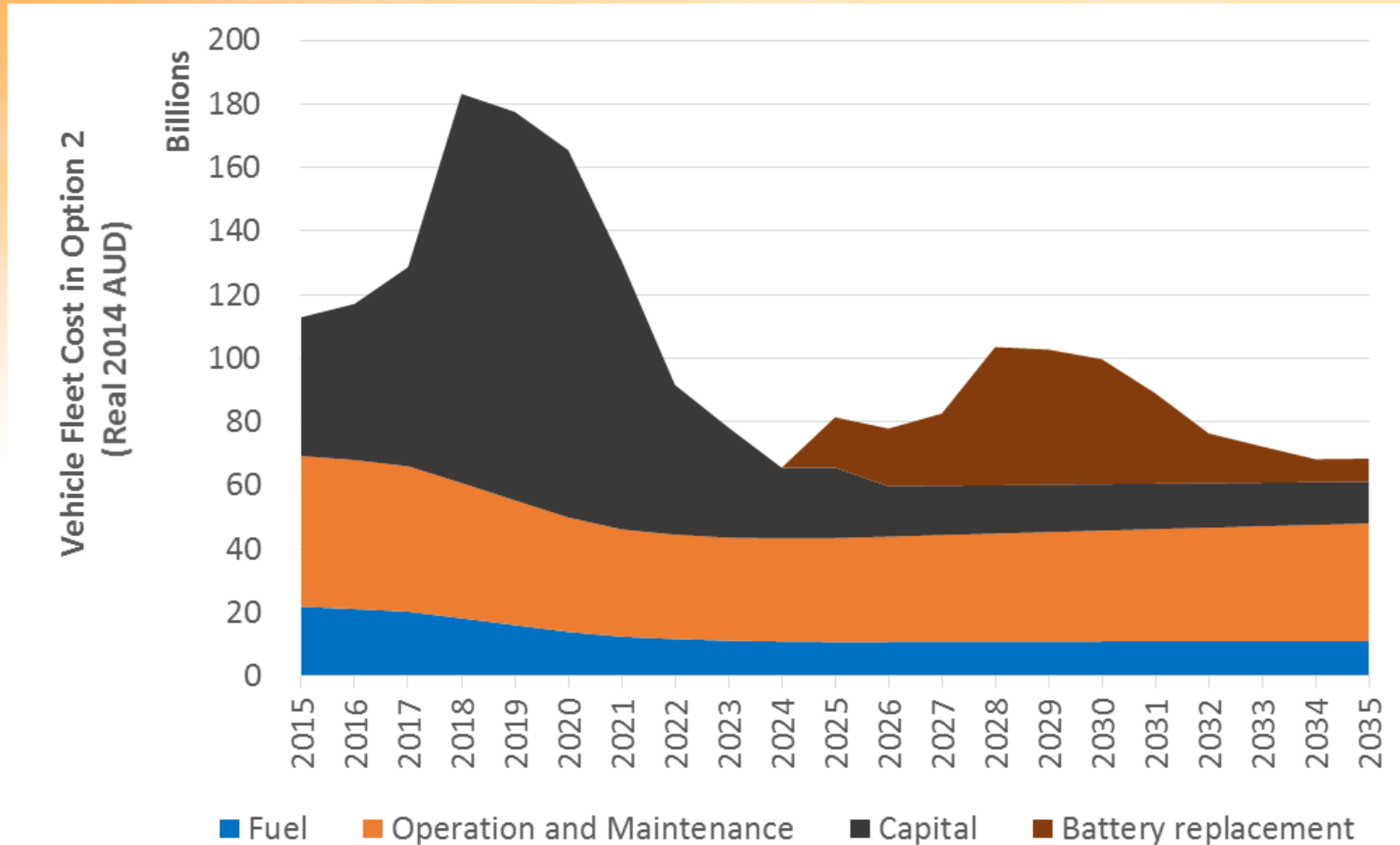


Electric Vehicles

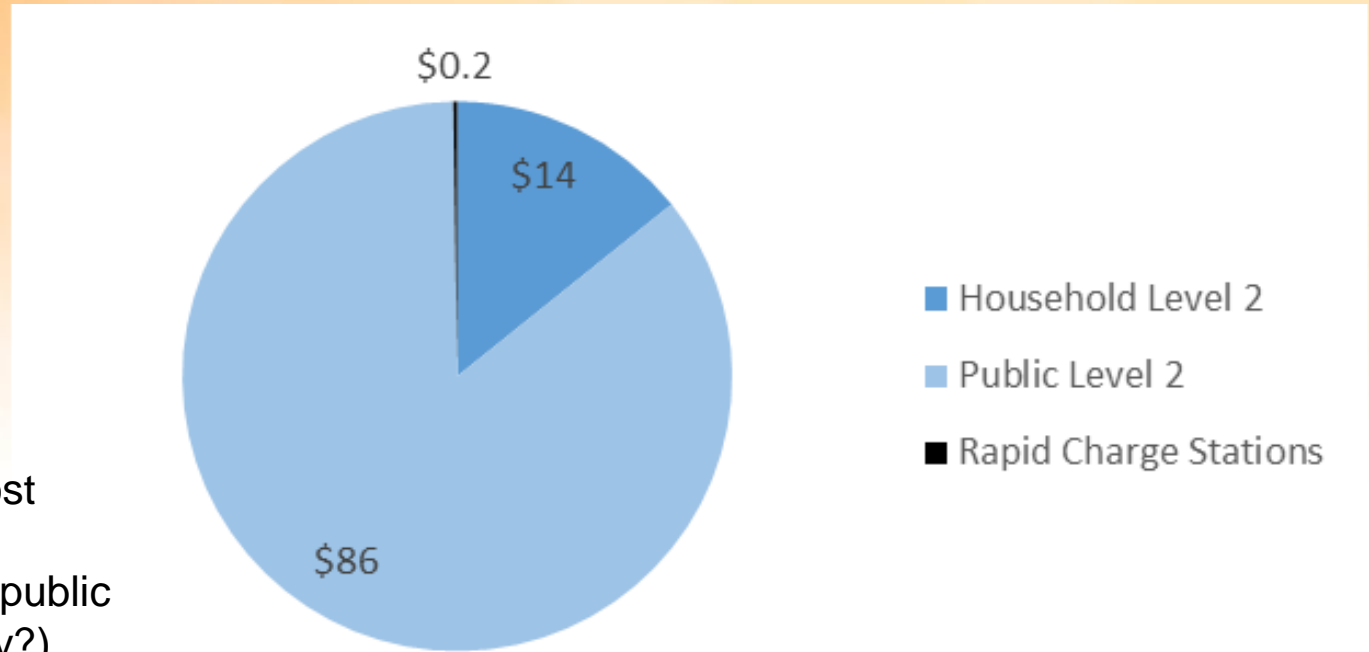
- Under certain conditions, a very rapid (10 year) transition to 100% EVs could cost the same as BAU
- Suggests urgency around policy & regulatory frameworks for managed charging
 - Potential for rapid transformation



Costs over time (High Cost Scenario, shift to EVs)



Charging infrastructure



Not a significant cost

Most cost is in Level 2 public
chargers (necessary?)

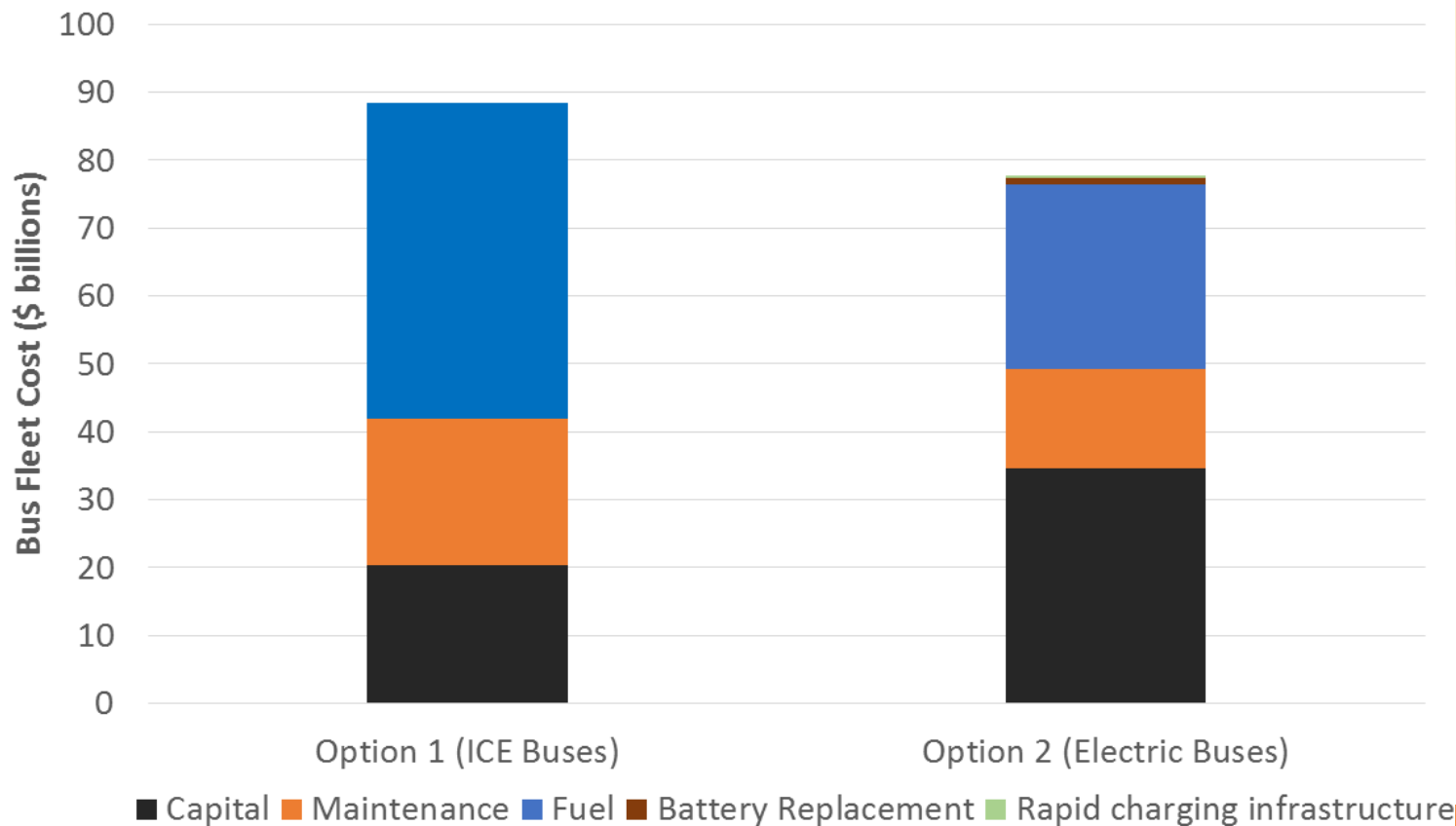
Rapid chargers at 5km radius
have trivial cost (consider
electrical load from significant
rollout of these?)

\$ billions NPV

Electric buses

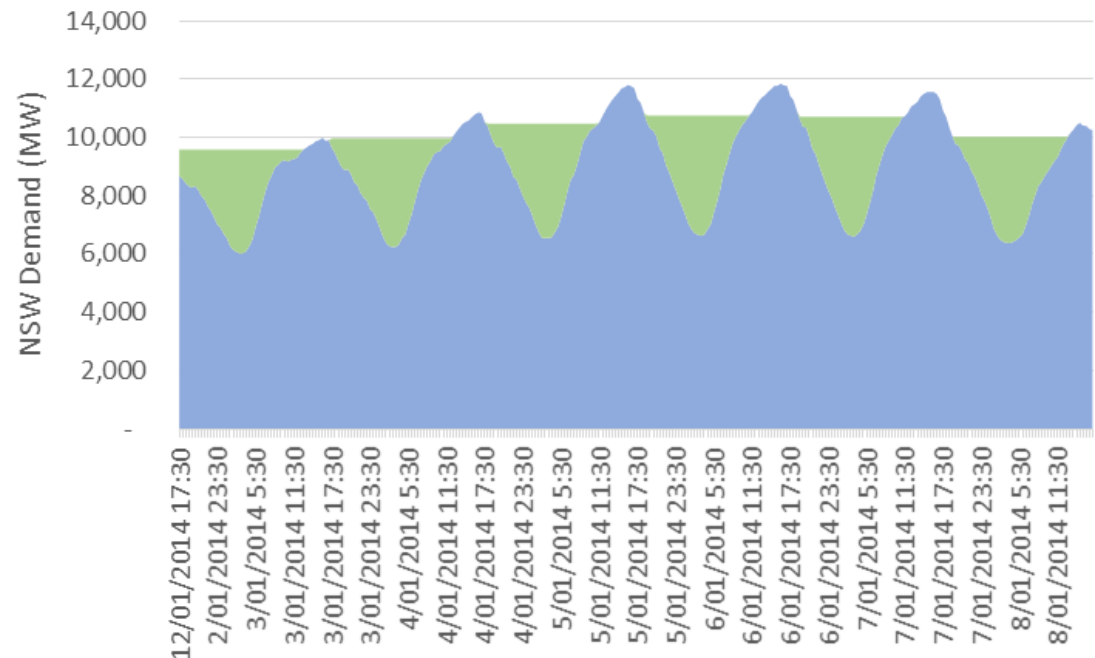
- Transition to electric buses is even more feasible (30% lower cost in Low Cost Scenario).

Prepare
distribution
grids for bus
charging
loads?



Grid impacts

- Facilitation of managed charging is essential!
 - Urgent priority
- Probably minimal issues for transmission and generation systems
- May be significant impacts for distribution networks
 - Consider mechanisms for DNSPs to interact with customers to minimise impacts?
 - Biggest opportunities for V2G probably for DNSPs
 - New business models!





UPCOMING WORK

Market outcomes with 100% renewables

Revenue and market price modelling

- How will market prices evolve as the proportion of renewables increases?
- How high might the MPC need to be to ensure system adequacy?

Trading simulations with high renewables

- Experimental economics study using NEM traders in a simulated “game” environment
- Examine novel trading strategies that might arise as the proportion of renewables increases in the market
- Determine how electricity prices might evolve with “real” trading behaviours

Nuclear vs Renewables

- Comparing risks, uncertainties and costs

Questions for other groups

- P1
 - Technical insight into stability and inertia challenges
 - Regulatory questions on Tony's 'group dist. Gen.' work
- P2
 - Considering low gas scenarios?
 - Gas regulation and market design?
- P3
 - Overlap with Plexos work and Peerapat's modelling, model validation
 - Transmission investment frameworks
- CSIRO Scenarios
 - High renewables, leave the grid, more of the same



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