



Modelling methodology and assumptions

Prepared for IPART public forum

1 September 2009

Frontier's modelling

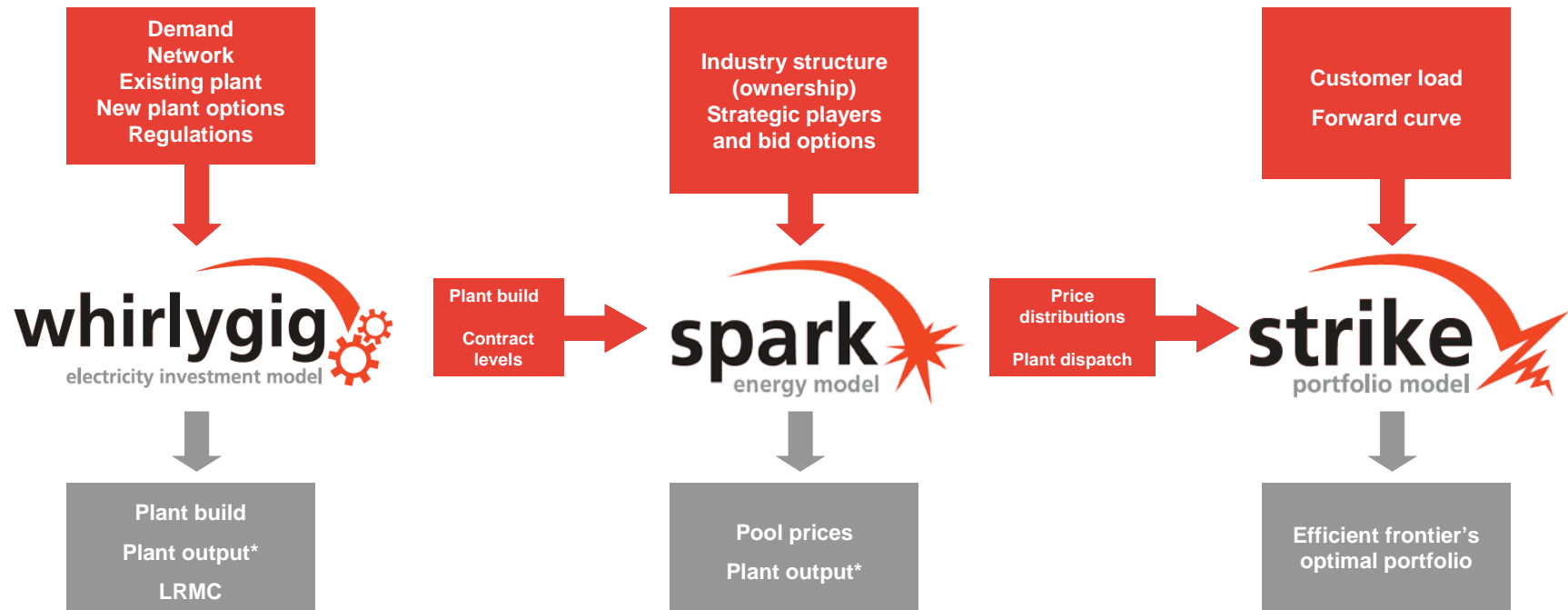
Frontier's scope of work

Frontier has been engaged to advise on:

- The LRMC of electricity generation
 - the ToR state that *the energy purchase cost allowance for each year must not be lower than the least cost mix of generating plant ... to efficiently meet each Standard Retail Supplier's forecast regulated load*
 - the LRMC represents the resource costs of supplying electricity to meet a particular load shape, and is driven by capital costs of generation plant, fuel costs, etc...
- The total allowance for electricity purchase costs and associated volatility, incorporating the impact of CPRS, GGAS, MRET, etc
 - the ToR state that *the energy purchase cost allowance should be set, using a transparent and predictable methodology, at a level that would allow a Standard Retail Supplier to recover the efficient costs of managing the risks associated with purchasing electricity from the NEM*
 - the energy purchase cost allowance for a particular load shape represents the costs of purchasing energy from the market to serve that load, and is driven by spot prices and contract prices

It is intended that the methodology for forecasting energy costs should draw on and expand the methodology used in the 2007 determination.

Frontier's modelling approach



Estimating LRMC

Estimating LRMC

WHIRLYGIG will be used to determine the resource cost of meeting the regulated load of each standard retailer at least cost.

The proposed approach is a stand-alone approach:

- Assumes no existing plant to meet load
- Assumes only the regulated load shape is served
- In other words, the model builds and runs a hypothetical least-cost generation system to meet only the regulated load each standard retailer

LRMC is calculated as the cost of supplying an increment to the regulated load:

- The increment to the regulated load has the shape of the regulated load – so the model costs a shaped load rather than a flat load
- The results, including LRMC, will differ with load shape – peakier loads will require a different mix of plant

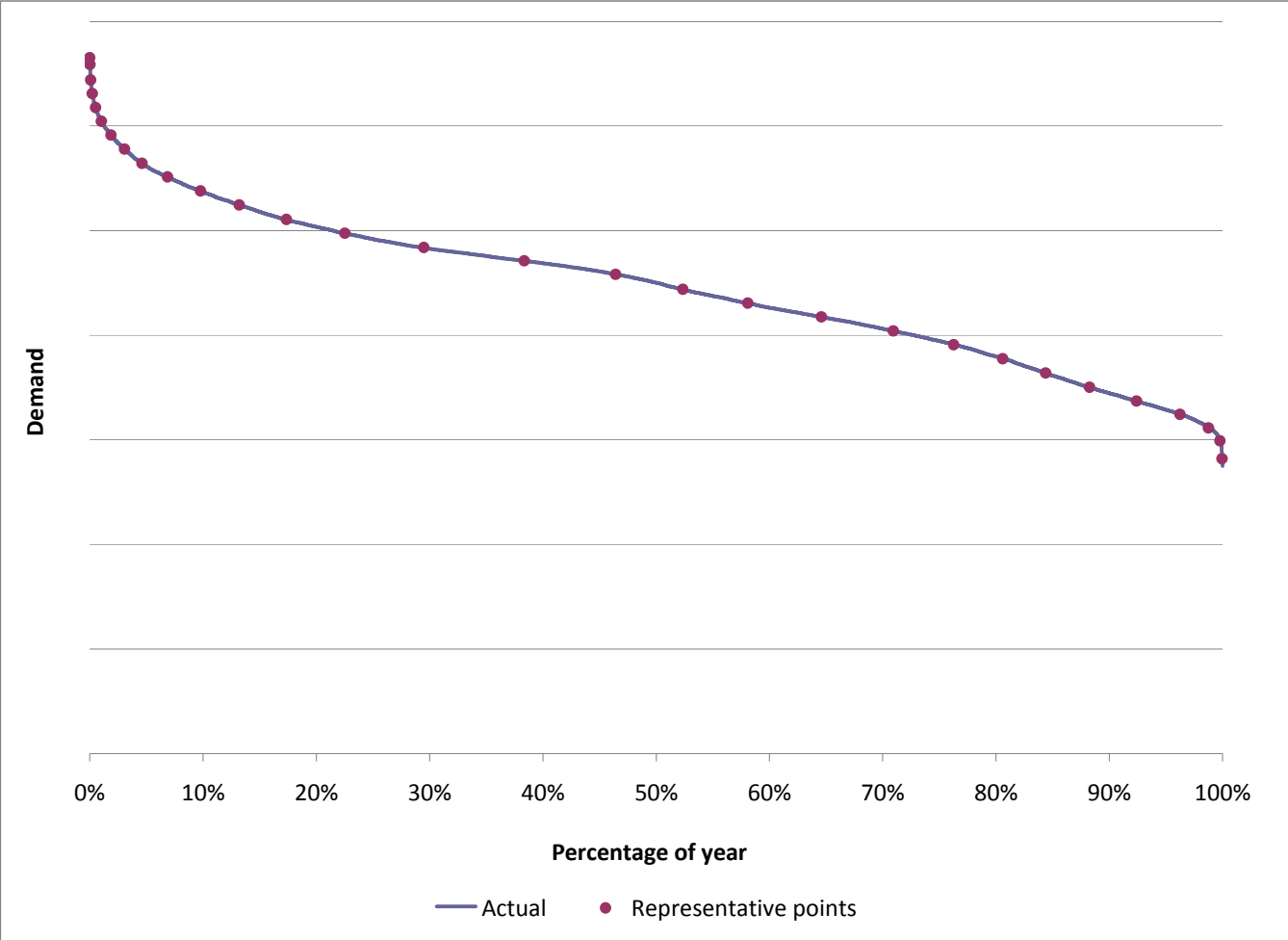
Estimating LRMC – input assumptions

WHIRLYGIG requires input assumptions including the following:

- Regulated load shape for each of the standard retailers
- Input assumptions for new generation plant
 - Capital costs – based on ACIL Tasman for NEMMCo, Concept Economics for QCA
 - SRMC – based on ACIL Tasman for NEMMCo, Concept Economics for QCA
 - Operating characteristics – based on ACIL Tasman for NEMMCo, Concept Economics for QCA

Full details are set out in Frontier’s report and attached spreadsheet.

WHIRLYGIG – representative demand points



**Estimating energy
purchase cost allowance**

Estimating energy purchase cost allowance

WHIRLYGIG, SPARK and STRIKE will be used to determine the energy purchase cost allowance:

- WHIRLYGIG models patterns of investment and output in the NEM, *which are an input into...*
- SPARK forecasts market prices, *which are an input into...*
- STRIKE determines efficient hedging strategies, and the costs of these strategies

In addition, information from other sources will be used to provide alternate views on energy purchase cost allowance:

- Spot and contract price forecasts for stakeholders can be used as an input into STRIKE
- Public price forecasts such as d-cypha can be used as an input into STRIKE

Estimating energy purchase cost allowance – WHIRLYGIG

For purpose of estimating energy purchase cost allowance, the proposed approach is an incremental approach:

- Assumes all existing and committed plant available to meet system load
- Assumes the system load (in each region) must be met
- In other words, the model invests in new plant as required, and runs existing and new plant, to meet system load at least cost

Input assumptions

- Existing plant – capacity, SRMC, operating characteristics
- New plant – fixed costs, SRMC, operating characteristics
- Interconnectors – capacity, losses
- System load – demand and energy forecasts
- Constraints – reserve constraint, greenhouse constraints (eg, MRET, GGAS)

Estimating energy purchase cost allowance – SPARK

SPARK incorporates strategic behaviour to forecast spot prices:

- WHIRLYGIG assumes least-cost dispatch – all generators make all capacity available at SRMC
- SPARK has all the same input assumptions, but allows generators different bidding strategies (eg strategic generators may not bid all capacity into the market at SRMC)

SPARK is run for a number of representative demand points:

- Each demand point represents an individual game
- Assume the game is “simultaneous” as participants do not know each others bids at time of making the bidding decision
- Use the “Nash Equilibrium” solution concept to determine equilibrium bids and outcomes

Analysis may produce multiple equilibria at each demand level:

- This provides a price distribution at each demand level

SPARK – modelling inputs

SPARK includes the same input assumptions as WHIRLYGIG:

- Existing plant – portfolio, capacity, SRMC, operating characteristics
- New plant – portfolio, capacity, SRMC, operating characteristics
- Interconnectors – capacity, losses
- System load – demand and energy forecasts
- Constraints – reserve constraint, greenhouse constraints (eg, MRET, GGAS)

In addition to input assumptions already built into WHIRLYGIG, SPARK also requires the following input assumptions:

- Bidding strategies (% of capacity offered to market) – based on ranges of observed bidding behaviour
- Contract levels – extent of generators' contract cover determines the payoff from different bidding strategies

Estimating energy purchase cost allowance – STRIKE

STRIKE uses portfolio theory to determine efficient contracting strategies, based on half-hourly load, half-hourly spot prices, and contract prices.

Adding any contract to a retailer's portfolio has two effects:

- It will change the expected cost of the portfolio (increase cost if contract sells at a premium to spot)
- It will change the risk associated with the expected cost (contracts can reduce risk on unhedged load, or can increase risk on over-hedged load)

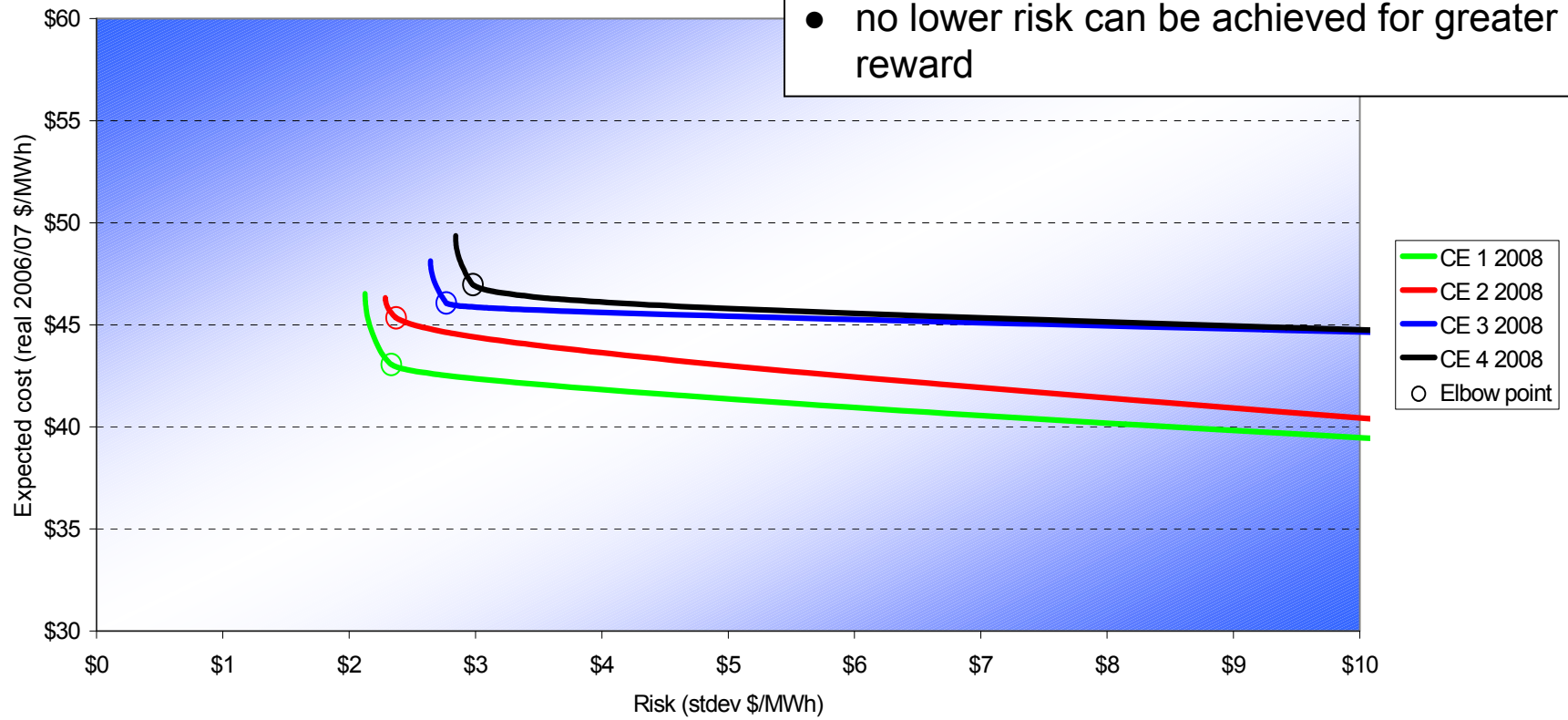
To determine the efficient contracting strategies, STRIKE determines the effect of each investment option in terms of:

- change in total reward
- change in total risk
- correlation with other options

STRIKE – efficient frontier

STRIKE produces an efficient frontier, quantifying the investment choices for which:

- no greater reward can be achieved for less risk
- no lower risk can be achieved for greater reward



CPRS

CPRS will be implemented over the course of current determination:

- Capped carbon price for 2011/12 (\$10/tonne)
- Uncapped carbon price for 2012/13

CPRS will affect thermal generators' costs, and therefore the spot price. Two ways of thinking about how CPRS will affect retailers:

- Carbon-exclusive spot price, plus a separate carbon cost
- Carbon-inclusive spot price, incorporating carbon cost

In either case, the impact of the CPRS will depend on the extent to which carbon costs are passed through to spot prices.

CPRS – costs

Frontier’s modelling incorporates a cost of carbon into generators costs:

- WHIRLYGIG
 - Carbon price and emissions intensity determine impact of CPRS on generators’ SRMC
 - This is accounted for in carbon-inclusive LRMC
- SPARK
 - Carbon price and emissions intensity determine impact of CPRS on generators’ SRMC
 - This is accounted for in generators’ bidding and forecast spot prices

Frontier’s modelling based on carbon price forecasts from Commonwealth Treasury

CPRS – risks

CPRS can create two key risks for retailers:

- Forecast risk – the carbon price may differ from Commonwealth Treasury’s forecast
 - Frontier will model sensitivities on a number of carbon prices – no CPRS, CPRS5 and CPRS15
 - Regulatory processes can provide for review of forecasts
- Price risk – the carbon price may impact on volatility of spot price, and therefore efficient hedging behaviour – this impact very difficult to forecast at the moment:
 - Volatility of carbon price is unknown
 - Impact of carbon price on spot price volatility is uncertain



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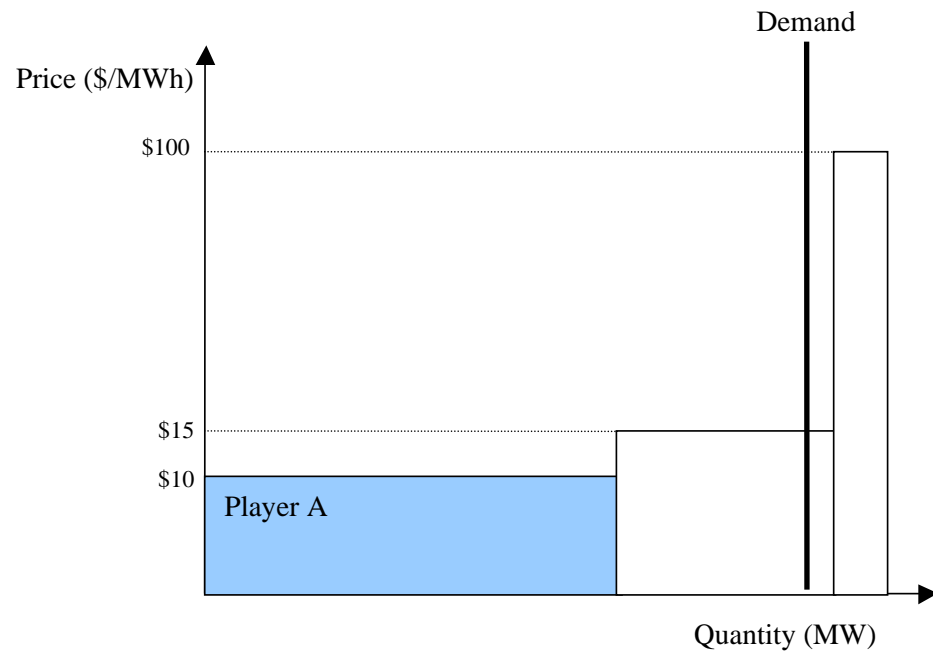
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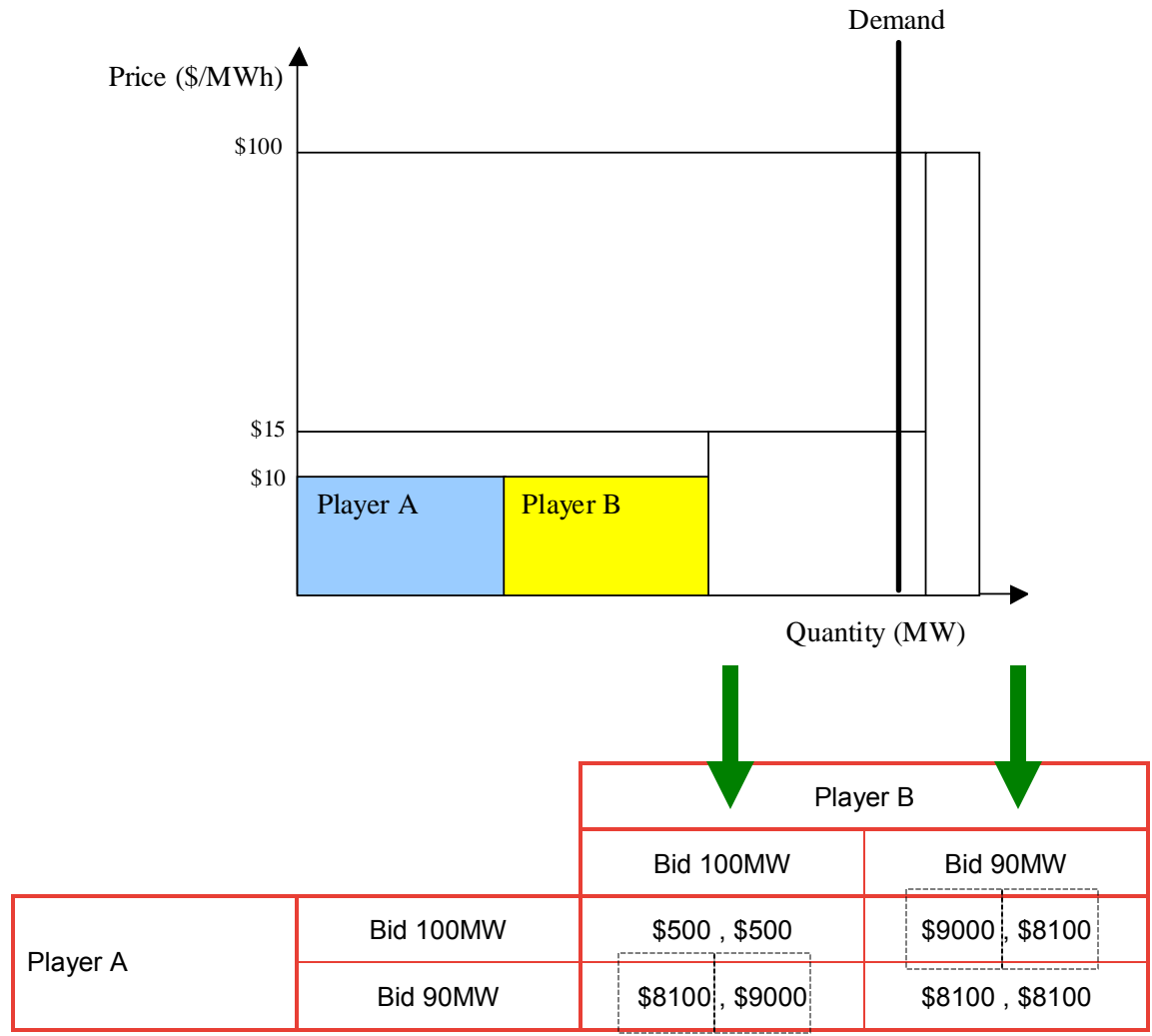
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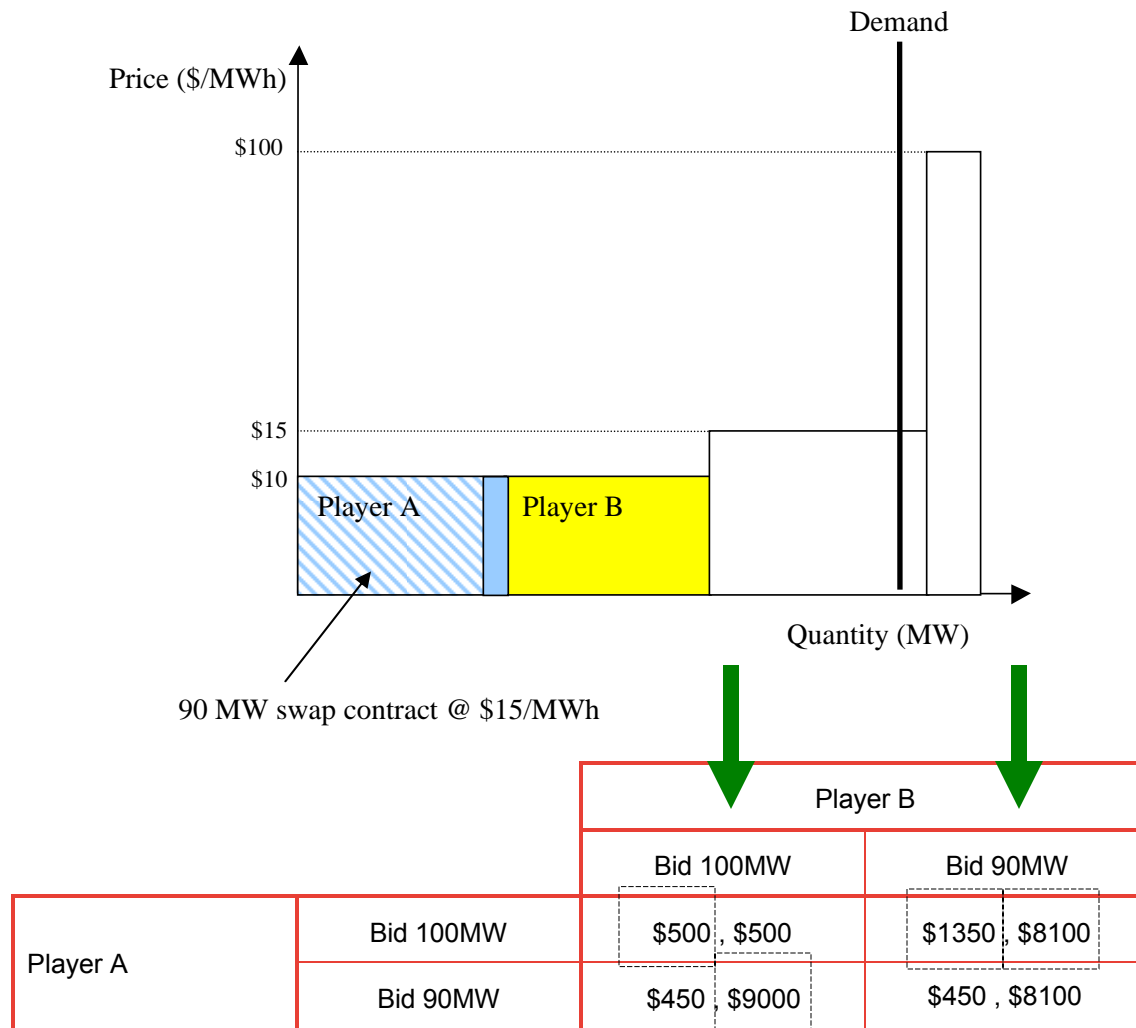
SPARK – Game theory example



SPARK – Game theory example



SPARK – Game theory example (contracts)



SPARK – Game theory example (contracts)

