Valuing CCS with a Electricity Grid
An Australian Case Study

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Levelised Cost of Electricity

LCOE
A simple metric designed to compare fossil plants, it takes no account of ‘the system.’
Assumption is that generation = MWh available

LCOE = Variable Cost + (Fixed Cost + Annualised Capex)
Annual Availability

Graph showing emissions reduction and cost of electricity ($/MWh) with different technologies.
System Cost of Replacement Electricity

SCoRE
SCoRE is similar to LCOE but takes account of the value of the technology to the system and its affect on system cost. It is designed to compare technology cost in a decarbonisation scenario.

SCoRE is lower at low decarbonisation because takes into account of plant that can be retired when new plant is added (unabated coal in this case)

Curtailment of renewables increasingly reduces its value at medium to high penetration

\[
\text{SCoRE} = \frac{\text{Increase in Total System Cost due to New Plant}}{\text{Annual Generation of New Plant}}
\]

Where TSC = Sum (variable + fixed + annualised capex)
For all plant on the system
TSC benefits from closure of old high carbon plant which is replaced by new technology (so long as system adequacy is not compromised.)

Calculated for NEM, closing oldest coal where possible.
LCOE vs SCoRE

SCoRE is a metric intended to replace LCOE, but has its limitations compared to a full Total System Cost approach

<table>
<thead>
<tr>
<th>Comparators</th>
<th>Examples</th>
<th>LCOE</th>
<th>SCoRE</th>
<th>TSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal plant for Baseload energy</td>
<td>Coal, gas, biomass</td>
<td>Yes - ideal</td>
<td>Yes - but overly complex</td>
<td>Yes - but overly complex</td>
</tr>
<tr>
<td>Inflexible thermal plant</td>
<td>Nuclear</td>
<td>No - deceptively high</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Variable renewables</td>
<td>Wind, PV</td>
<td>No - deceptively high</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Plant delivering grid services only</td>
<td>Synchronous condensers, standby</td>
<td>No - divide by zero error</td>
<td>No - divide by zero error</td>
<td>Yes</td>
</tr>
<tr>
<td>Storage</td>
<td>Batteries, pumped hydro</td>
<td>No - becomes negative</td>
<td>No - becomes negative</td>
<td>Yes</td>
</tr>
</tbody>
</table>
MEGS: Modelling Energy & Grid Services

- Energy must balance. Conservation of Energy
- There is sufficient supply of reserve and response services. Managing imbalances
- There is sufficient inertia Stability: time to react
- There is sufficient reliable capacity to meet peak demand Keeping the lights on!

Whilst minimising short run cost
- Fuel
- Carbon Storage
- Variable
- Start-up
And optimising storage

Adjusts capacity to maintain Loss of Load Hours
THANKS

For more details and information...

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