FIPSE-6 Short Presentation 3d

The Role of Process Flexibilization in an Isolated, Renewable Electricity Market

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ABSTRACT

New Zealand's electricity grid provides a unique insight into the future many regions will experience. Abundant renewable energy means the decarbonisation journey is well underway. With 87% renewable penetration and little dispatchable generation, this is a glimpse of a fossil fuel-free future. These conditions have led to steep offer curves and highly volatile spot prices. The reality for many exposed industries has not changed, with predetermined demand response and power purchase agreements being the norm. The combination of inaction and higher prices has meant sites have closed even without significant electrification.

In tandem with this, the electrification of process heat and other parts of the process are a significant focus for many industries. This is largely driven by social pressure, but government incentives, carbon tax compliance costs, and fossil fuel costs are also factors. The situation, as described, is not unique to New Zealand, but with its isolation and fragility, these concerns are amplified. The key to enabling electrification is flexible operation in response to real-time pricing and other signals.

The challenge for Process Systems Engineering is the operation of adjacent processes under this new paradigm. Work to date has focused upon reacting to predictable daily peaks and has largely focused on processes with significant capacity for immediate downstream storage. These works often utilise lengthy optimisation routines that are ill-suited for agile demand response. Clearly, storage of energy, intermediaries or other electricity derivatives are an important factor, but with substantial volatility, other options must be considered. We propose an operational technique where upstream changes are propagated to downstream operations with a wide array of operational points.

This operational paradigm comes with a plethora of open challenges, including:

- How do we extend flexible operation beyond process heat or feedstock generation?
- Control mechanisms for rapid throughput changes while retaining product specifications.
- How is process design impacted by flexible operation, i.e. how to efficiently oversize?
- How can the electrification of mid-stream processes be accommodated?
- How are price forecasts incorporated into control?
- How the grid is impacted by flexible operation.

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