Soft-linking Energy Models: Best of both worlds or just getting the wrong answer quicker? Paul Deane
Structure

• Why we do what we do
• How it could be improved
• Is reducing complexity just getting the wrong answer quicker
• Experiences in increased temporal/technical resolution
What level of complexity is appropriate in long term energy system models given the uncertainty in the inputs over time...what is the relationship between required complexity and inherent uncertainty
Insights from other modelling fields

The art is to find an approximation simple enough to be computable, but not so simple that you lose the useful detail - Prof Michael Levitt

Deciding what counts as a good model [sic] depends on intense, detailed discussions between groups of experts who usually agree about fundamentals - Eric Winsberg

Within complex systems, understanding the interactions between system components can be more important than the contribution of each to disease risk - W Maziak
Why we do what we do

We soft-links models to enhance and add value to the results of our TIMES Integrated modelling
The Software we use for electricity/gas/water: PLEXOS

- Academic License
- Transparent and auditable
- Strong Documentation
- Strong commercial user base
- Strong R&D focus from development team
- Extremely Flexible Model Builder
- Very Scalable Model Builder
- Production Cost Simulation
- Electric and Gas modelling
- Capacity Expansion Capability
- Market Analysis and Market Design
- Transmission Analysis
- Stochastic Optimisation
- Hydro Generation Resource Management
PLEXOS Integrated Gas and Electricity model soft-links to Energy system model

Power System Model Provides:
-Detailed analysis of energy system model results using soft-linking techniques
-High temporal resolution (15min-1 hr)
-High technical detail, reserve modelling, hydro modelling, multi-stage stochastic UC
-Ramping costs, flexibility metrics

EU 28 Model- 3,000 generators, 22 PHES Units, 53 IC Lines

How soft-linking has added value to our modelling

- Overestimate the ability of the power system to absorb variable renewables and underestimated curtailment
- Our TIMES model underestimated the value of storage
- Overestimated the impact of residential electric heating (ASHP)
- Didn’t capture impact of variable renewable on gas grid
- Did not do a good job of producing wholesale market electricity prices
Advantages to our approach

• Provides insights and adds value to our TIMES modelling

• Allows us to leverage insights from outside a core TIMES modelling community (avoid silo thinking-system Inertia for example)

• (Possibly) faster and easier than building a ‘unified model’

• Multi-model approaches allow for good sense and sanity checks
Disadvantages to our approach

- Only a one way flow of information (no convergence, not an optimal)
- Needs more humans to maintain more models
- Requires ‘hardwiring’ in of new constraints (not elegant)
- Interoperability between models is an issue
Does simplifying temporal resolution* add value or does it allow us to get the wrong answer quicker
Our experience with Increased Temporal Resolution

- Irish TIMES Model
- Simple
- Start Costs
- MSG
- Ramp rates
- Reserve

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Our experience with Increased Temporal Resolution

![Graph showing annual system costs at various temporal resolutions: 60 minute resolution at €1.55, 30 minute resolution at €1.56, 15 minute resolution at €1.57, and 5 minute resolution at €1.58.](image-url)
Our experience with Increased Temporal Resolution
Our experience with Increased Temporal Resolution
Conclusions

The importance of temporal resolution depends on the question being asked
- appears to have limited impact on costs
- important for technology choice especially storages/batteries
- using a number of models from different users has important broad benefits
- Research should focus on getting the right balance between complexity and uncertainty rather than trying to model to run quicker.
Thank You

www.ucc.ie/energypolicy