Operational and Financial Impacts of 70% Variable RES-E

A Case Study of Ireland

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Presentation overview

- Research objective
- Backbone power system model
- 2030 portfolios
- Operational results
- Financial results
- Concluding remarks

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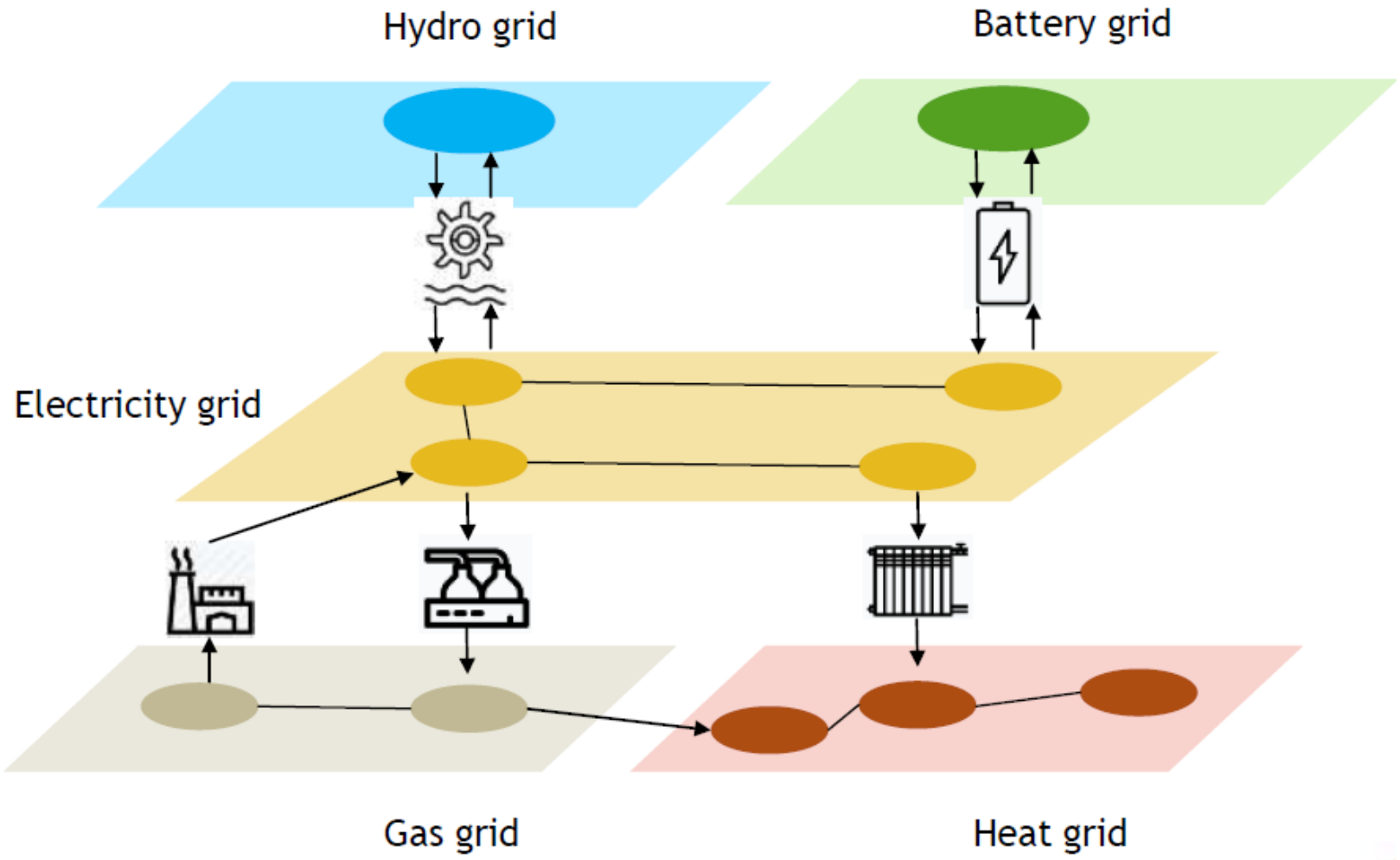
Background

- EMPowER project, funded by DCCAE
- Split into 3 packages
- Challenges of high RES-E
- Backbone power systems model

Backbone model

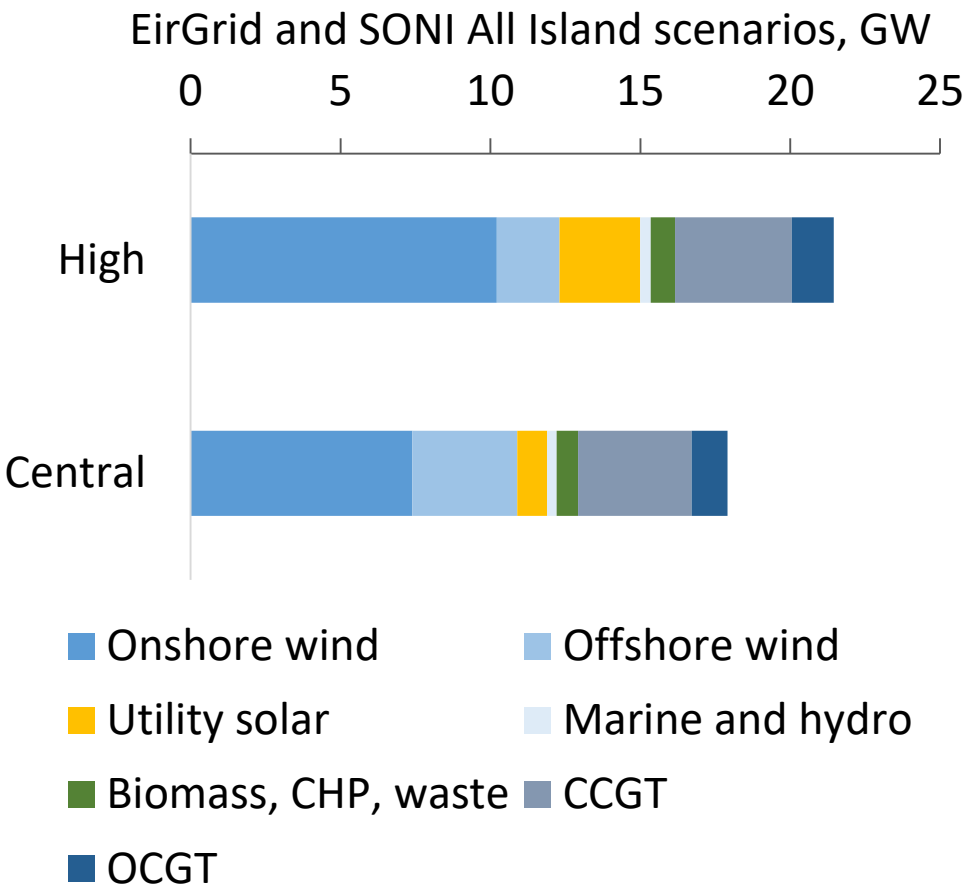


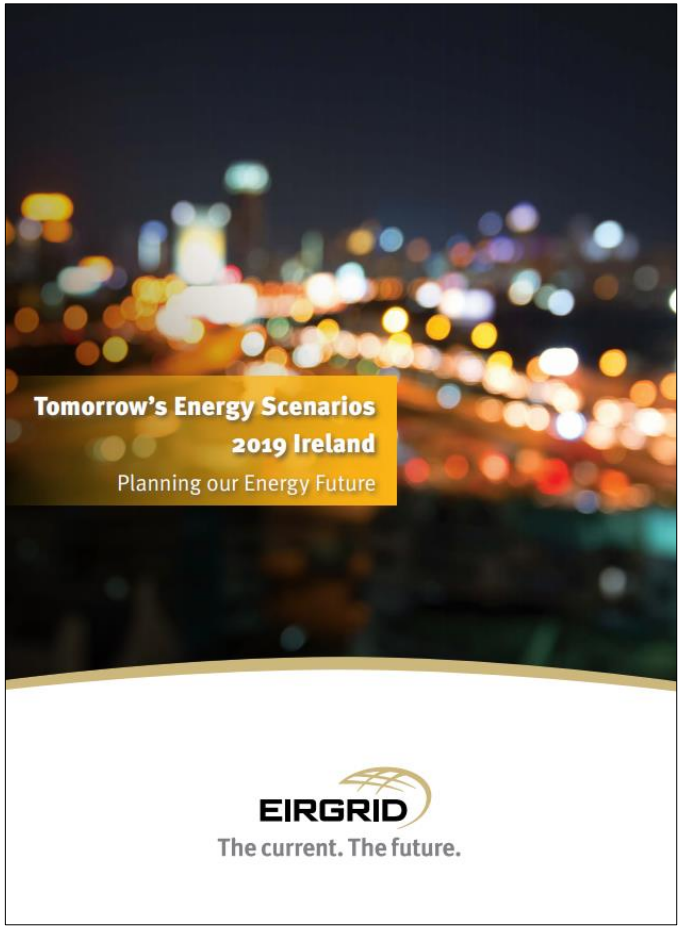
Irish version of Backbone

- Focus on electricity sector
- All Island, GB and France nodes
- 70 units, flexibility and reserves

- Application so far:
- Impact of system services on optimal investment
- Flexibility from data centres

70% RES-E portfolios



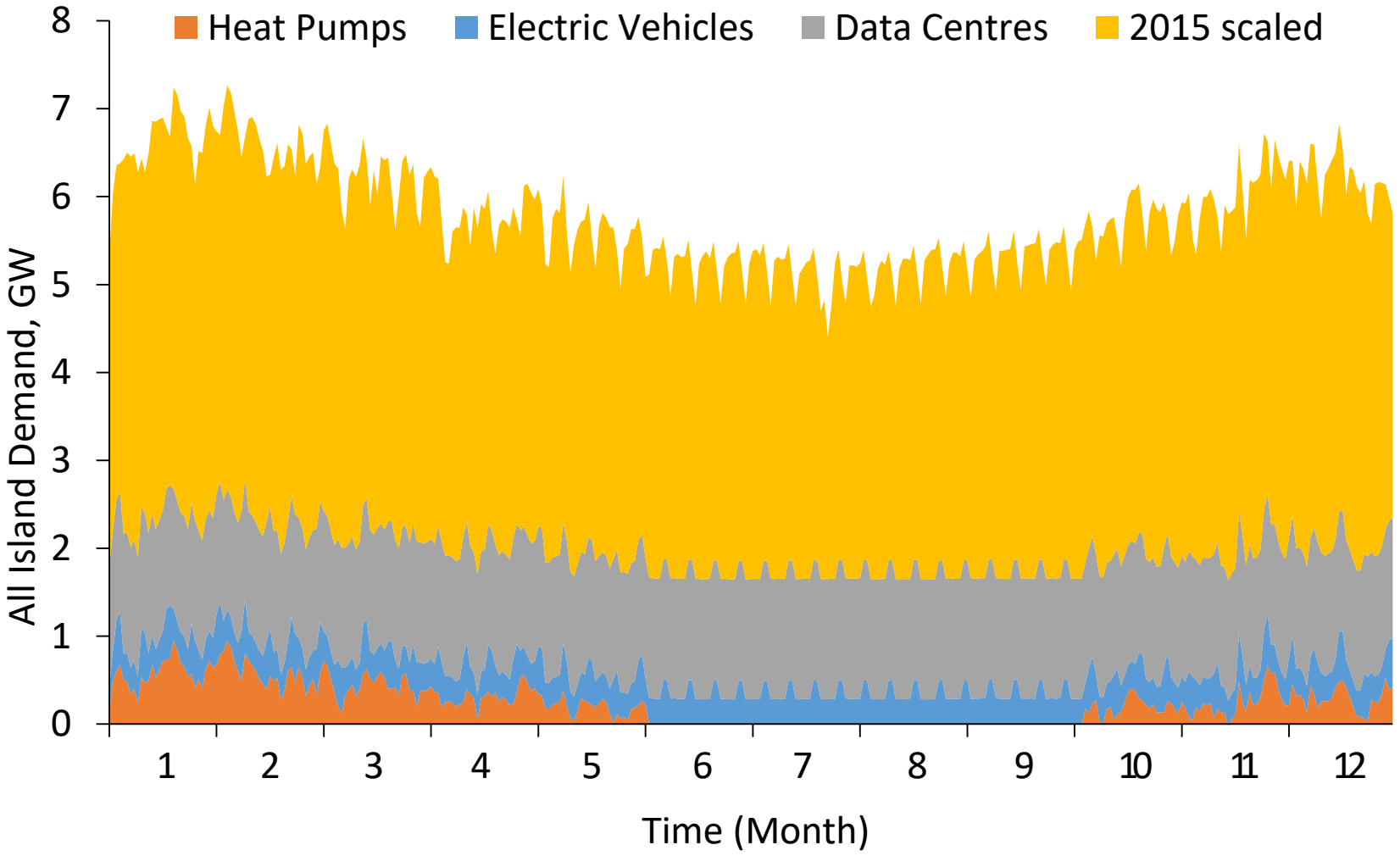


Operational constraints in 2030

- Energy balance at each node
- Energy transfer limit
- RoCoF limit of 1 Hz/sec
- Primary and tertiary reserve requirements

- Additional run without constraints to derive marginal prices in energy only market

All Island demand, 2030



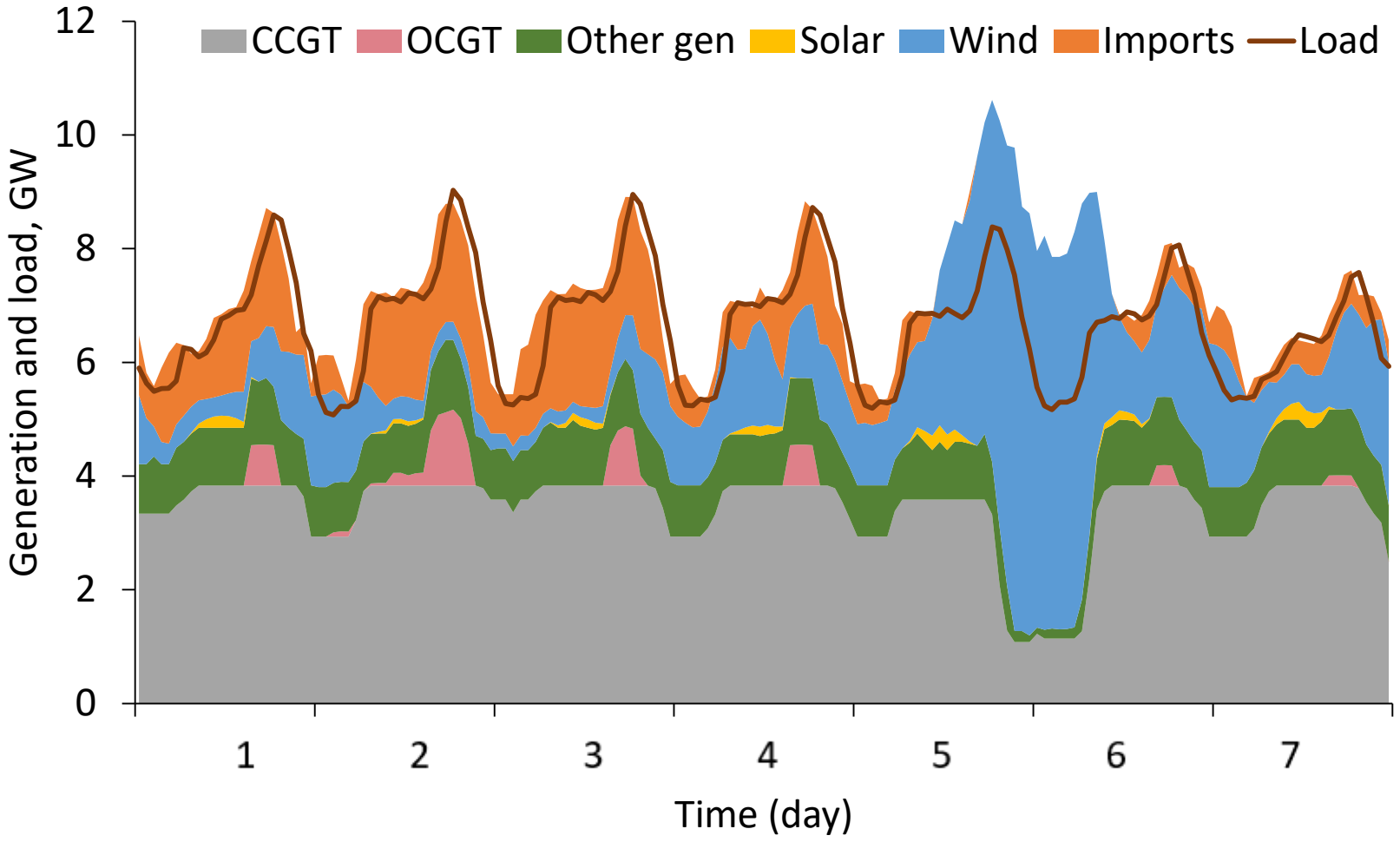
Results

- 2 scenarios - central or high RES-E installed capacity
- Both run with constraints for generation
- Without constraints for marginal prices

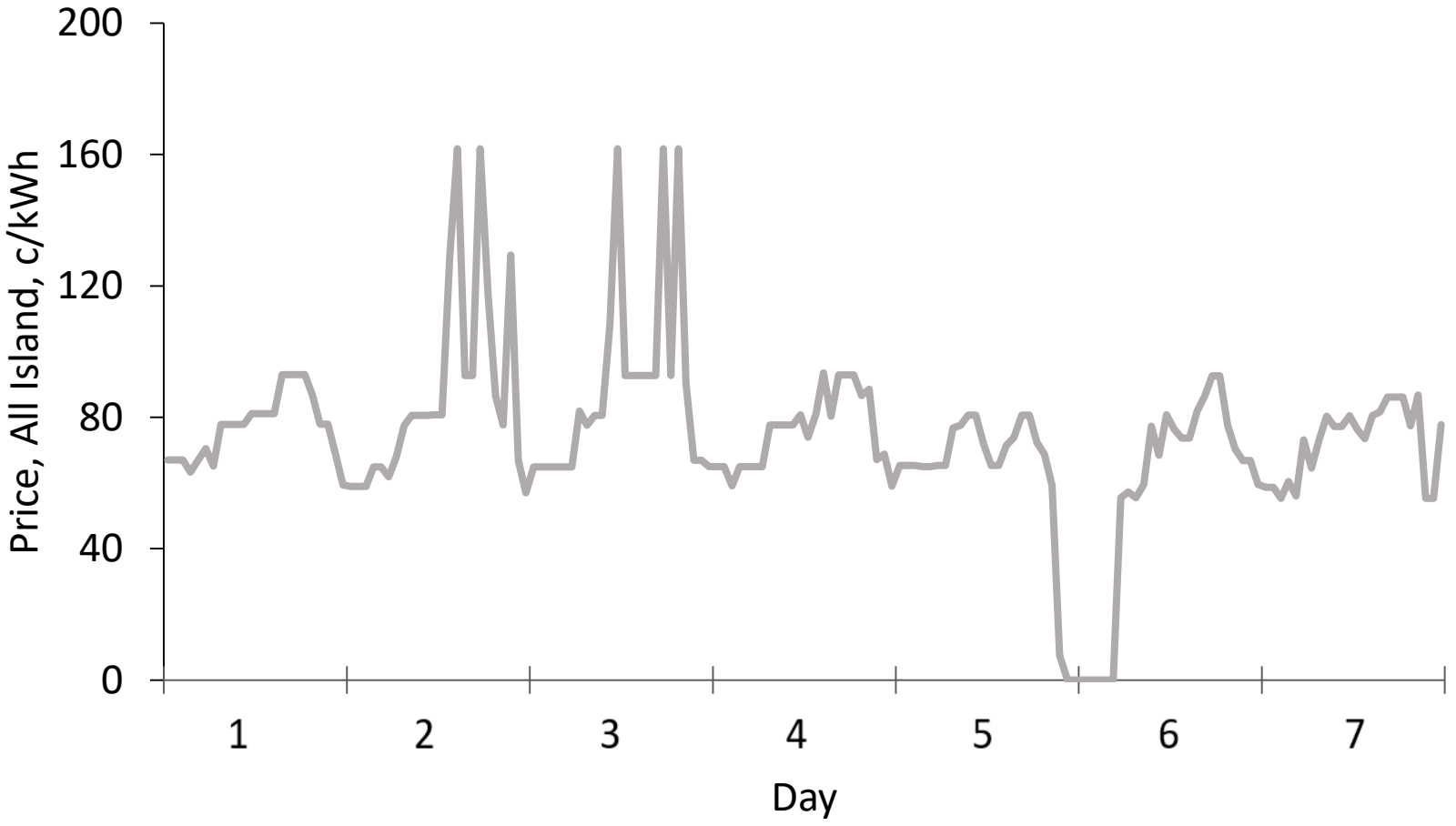
- Insights into:

- generation mix
- operational constraints; impact on curtailment, trade
- prices
- unit revenues

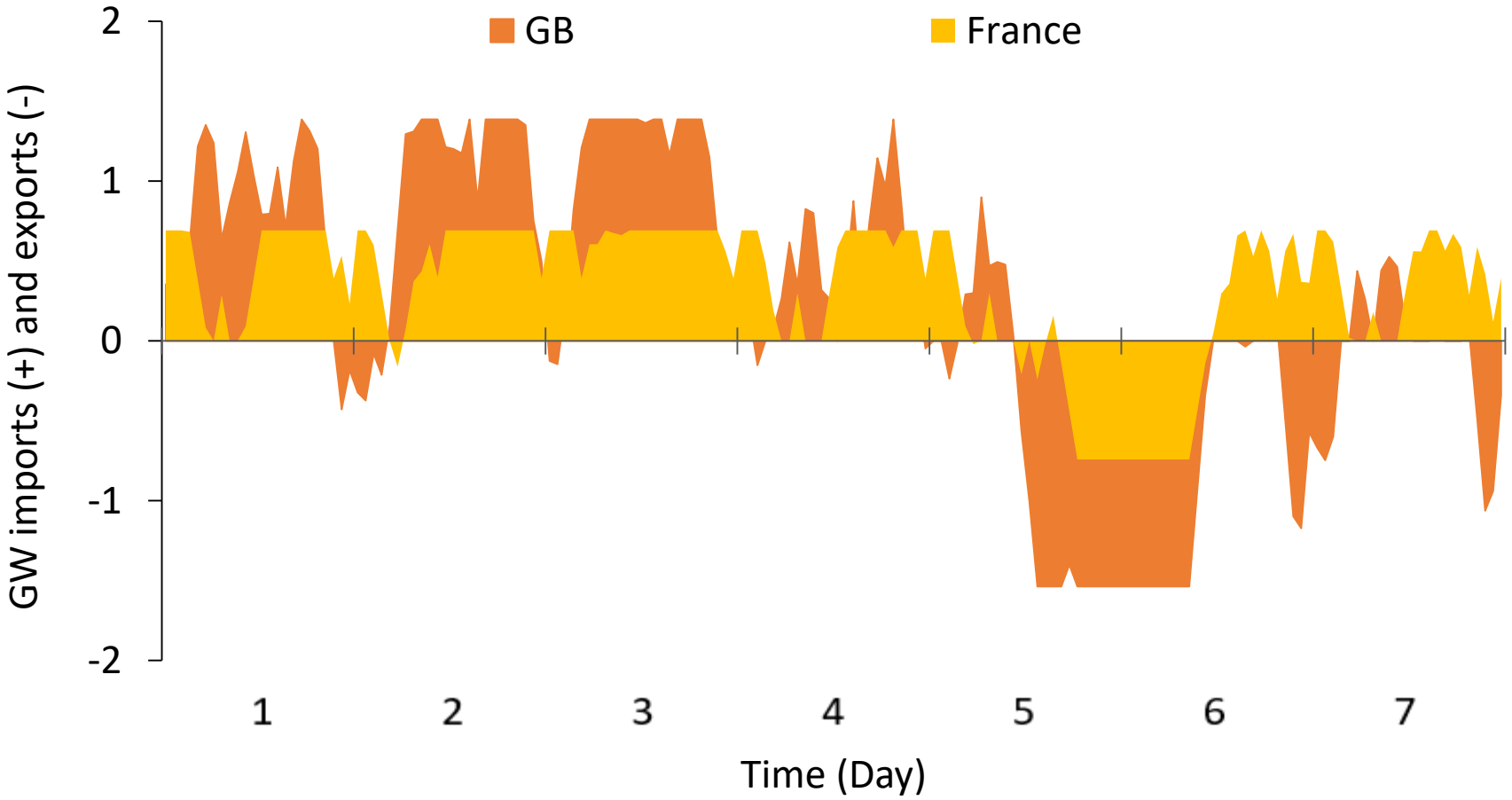
Week in winter, 2030



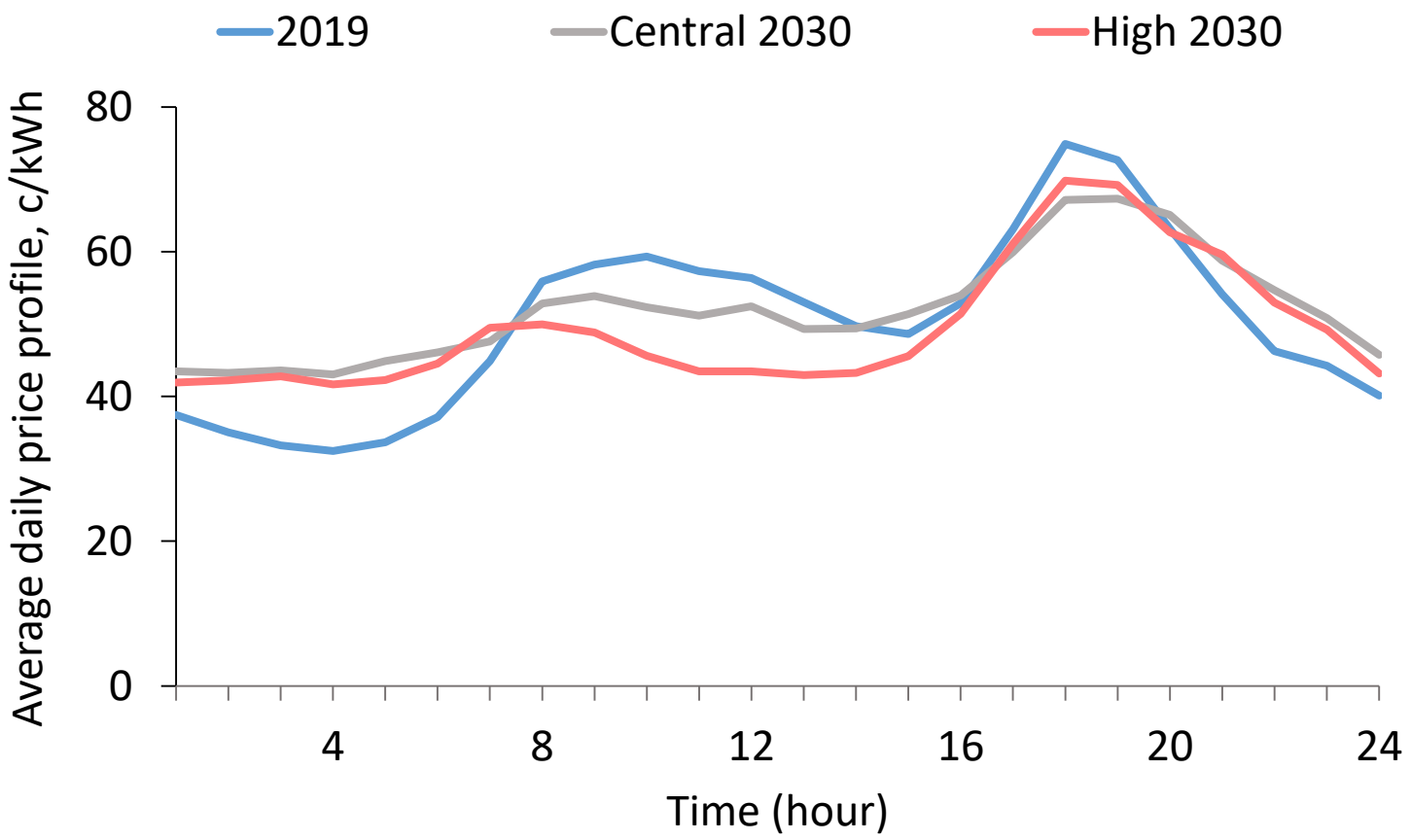
Week in winter, 2030



Week in winter, 2030



Average marginal price, 2030



Financial analysis: MVF, NPV

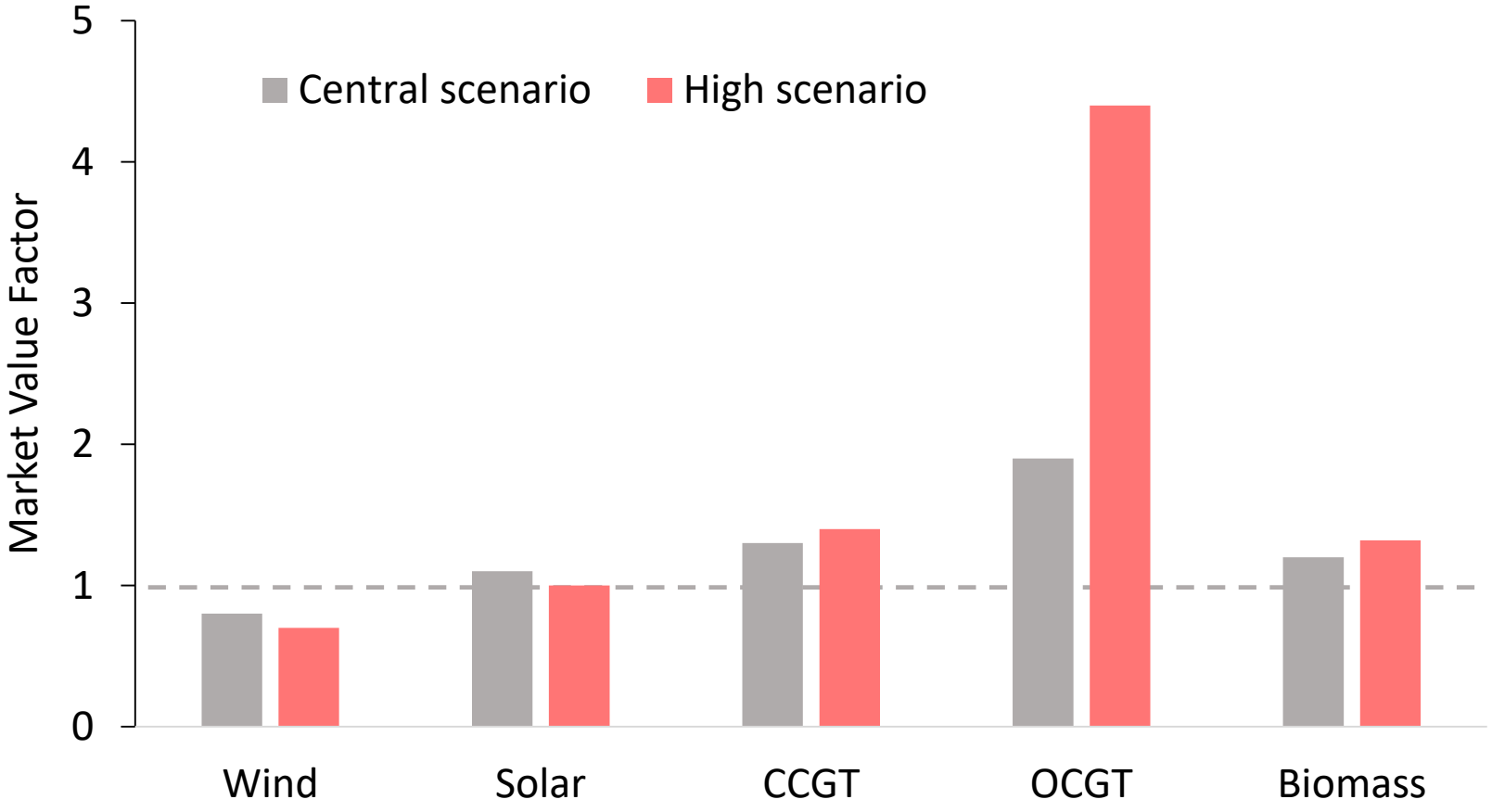
- Value of electricity is based on the price at time of sale

$$\text{Market Value Factor} = \frac{\sum \left(p_t^{pred} q_t^u \right)}{\sum \left(p_t^{mean} q_t^u \right)}$$

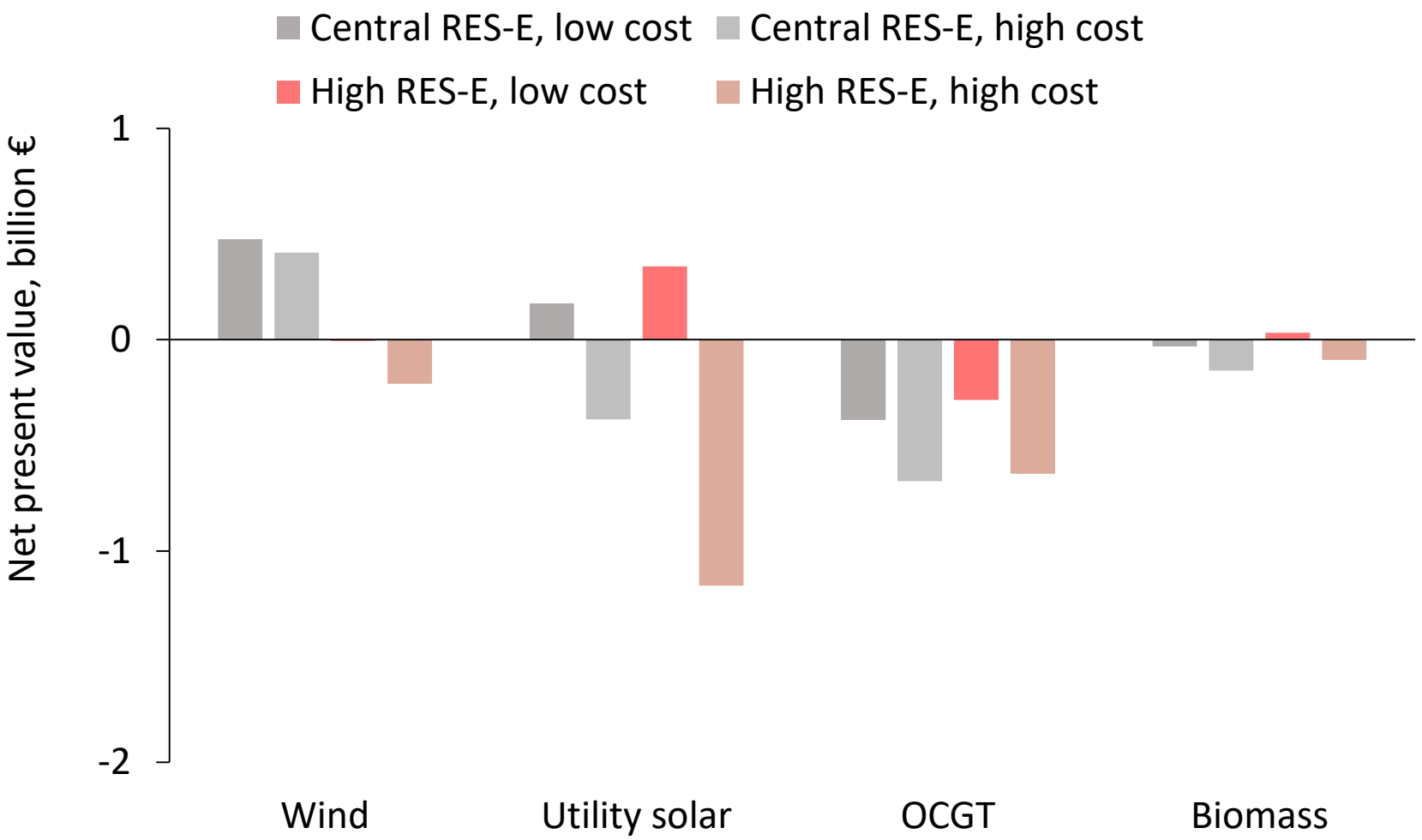
- Net present value

$$\text{NPV} = \sum \frac{cash\ flow}{(1+r)} - initial\ investment$$

Market value factor, 2030



Net present value



Conclusions

- Flexibility important to manage variation
- RES-E can at times greatly exceed the load
- Role for demand shaping and storage
- Question of incentives
- System adequacy during periods of low wind and PV
- Profitability of conventional generation