Lessons from policy scenario modelling and questions of modelling requirements

A. A. Solomon, D. Bogdanov, C. Breyer
Lappeenranta University of Technology
Finland
Transition Results:
Levelized cost of Electricity for various Scenarios

Key insights:
- Projected RE technology cost could lead to fast transition without carbon cost
- Present policies may lead to multiple risks including increased cost of electricity

For more details on policy lessons see:

- Contrary to intuition, LCOE for scenarios without Curtailment was higher than the corresponding years scenario with curtailment. E.g. LCOE for the BCWC scenarios in 2045 and 2050 were 10.3% and 8.6% higher than the BC. Similarly, NCCWC is 8.5% and 8.4% higher than the NCC scenario, respectively.

A change in LCOE for (a) BC; (b) NCC; (c) CP; (d) BCWC; (e) NCCWC scenarios of the electric power system transition from 2015 to 2050.
Key insights:

- Two curves that level off at a VRE penetration of approximately 90% and 70% of the annual demand were obtained for combined curve fits to scenarios with and without curtailment, respectively. These inflection points are not random points.

VRE penetration versus bulk energy storage capacity when storage capacity on x-axis is given (a) in units of GWh and (b) daily average demand. Note that daily average demand value of Israel varies from year-to-year (example 168 GWh by 2015 and 410 GWh by 2050).
Curtailment-penetration-storage nexus and its role

Key insights:
- The curve for the Israeli system shows an inflection at a VRE penetration of about 70% and energy storage capacity lower than one daily average demand. The inflection for the Californian system is at lower penetration.
- It was also reported that storage of the order of daily average demand was sufficient to reach to approximately 90% penetration for both power systems with curtailment.

We concluded that the change in trend shows the change in storage application and as a consequence also a change in suitable technology preference resulting due to seasonal and diurnal matching.

VRE penetration (left axis) and UI (right) versus the storage energy capacity

Data source:
Curtailment-penetration-storage nexus and its role

The relationship between VRE penetration and total energy loss, total energy loss and energy storage for various scenarios.

Key Insights:

- VRE penetration increases together with total energy loss even though the magnitude of their interdependence depends on the applied curtailment policy.
- The total energy loss also shows a sharp rise with energy storage capacity before levelling off depending on the applied curtailment policy.
- Note that c) and (d) shows that current policy also does not follow the nexus trend because of inflexibility.
Summary and Conclusions

- Policy making should be based on a detailed understanding of the requirements of their future energy system, which depend on the local resource and demand characteristics.
- Effective transition needs policy goals that are cognizant of the upcoming operational challenge. Thus, it is important to set a target on rules and designing criteria’s produced by detailed techno-economic modelling.
- The models should conform to some of the technical details that are required to be closer to the optimal nexus curve.
