Ten challenges for mathematical modelling of the energy transition

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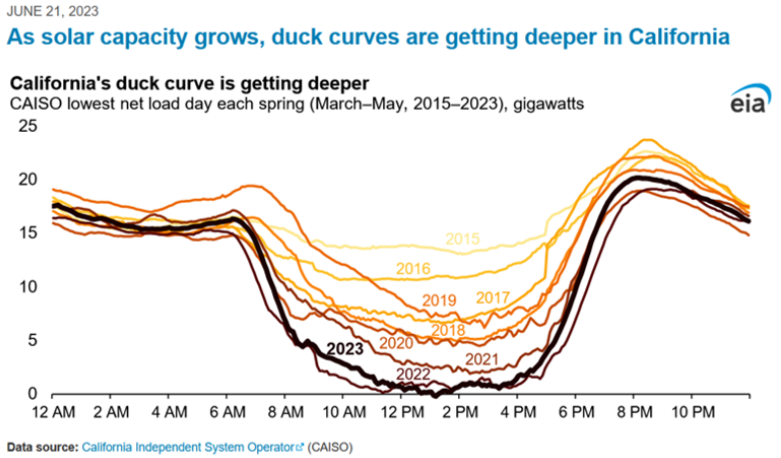
"...we will outline ten significant challenges, where the currently available analytical tools are inadequate to tackle the problems thrown up by the green energy transition. We believe that these challenges need to be addressed alongside the scientific and engineering advances that are needed. Doing one without the other will not be sufficient."

The Challenges for Energy Modelling

1. Policy choices for infrastructure planning
2. Constraints on deployment
3. Price formation in wholesale markets
4. Stability and control of systems with high renewables
5. Predicting the behaviour of wholesale energy market participants
6. The impact of consumer decisions on the energy system
7. Dealing with long-term uncertainty and the associated risks
8. Reliability and resilience to extreme events
9. Justice and equity
10. Computation and validation for solution of large energy models

Economist: September 1, 2024.

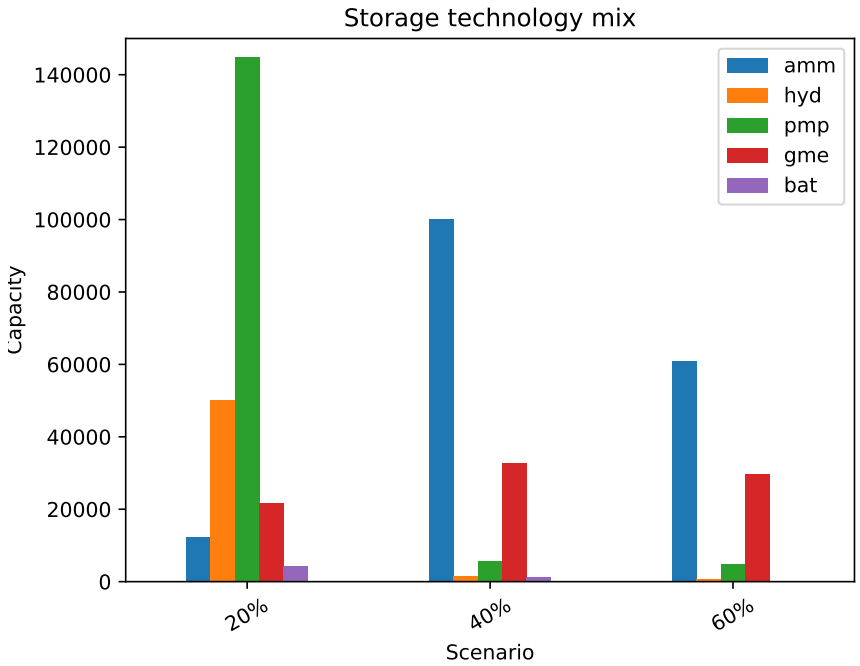
CAISO battery boom.

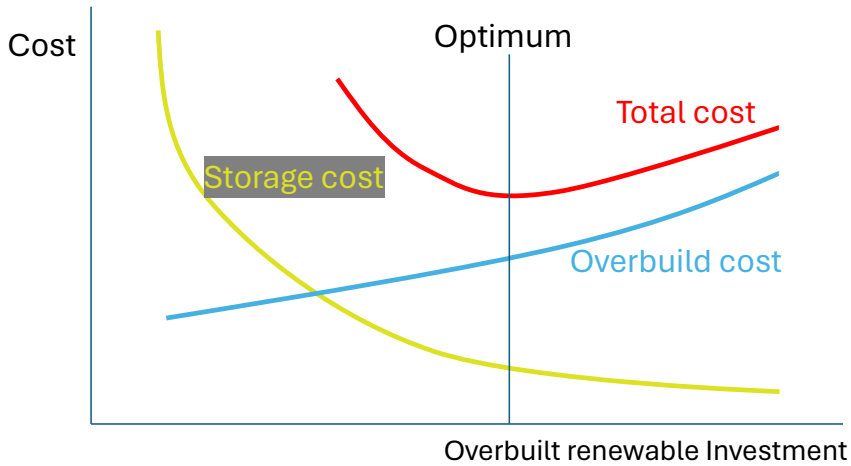


CAISO Duck curves.

- Renewable energy (wind and solar) growing in scale.
- Grid-connected storage increasing.
- Proposal: return to single-period dispatch but use decision rules defined by a dynamic programming policy.
- Change how the market treats financial and operational risk

What and how much to build?





- ammonia, hydrogen, pumped storage, green methane, and battery
- tradeoff of storage cost vs overbuild cost