

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

Business | Charging forecast

Clean energy's next trillion-dollar business

Grid-scale batteries are taking off at last

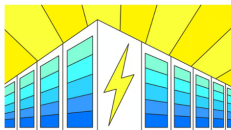


Illustration: Alisa Wied

See 1st 2024

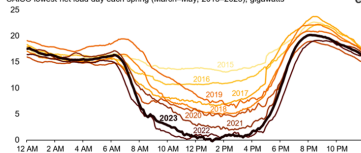
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JUNE 21, 2023

As solar capacity grows, duck curves are getting deeper in California

California's duck curve is getting deeper

CAISO lowest net load day each spring (March–May, 2015–2023), gigawatts



Data source: California Independent System Operator (CAISO)

CAISO Duck curves.

Economist: September 1, 2024.



Energy & Environment | Energy Transition | Renewables & Advanced Energy | United States and Canada

New Atlanticist | May 15, 2024

California's battery boom is a case study for the energy transition

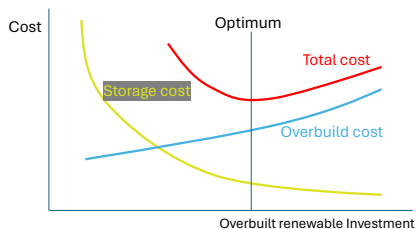
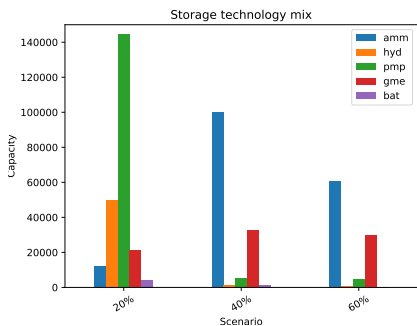
By Joseph Webster

California is the country's largest and most mature solar market, but it's also changing in important ways. On April 25, California marked a major milestone, as it became the first state to [deploy](#) 10 gigawatts (GW) of battery storage

CAISO battery boom.

- 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