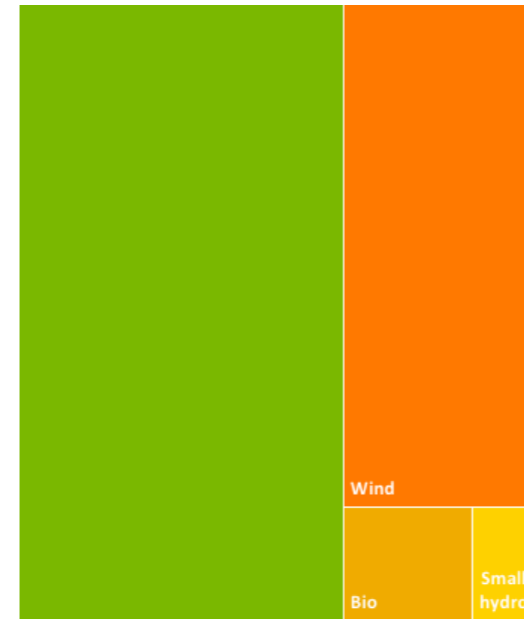


New Ukraine - new grid



New grid reality: green is the new black

- The Ukrainian government has committed to increase renewables from around 4 per cent of the energy mix today, to 25 per cent by 2035.
- As per 2021 5,795 MW generated by solar power plants, 1,252 MW of wind generating capacities, and 189 MW produced by bio¹.
- **11 May 2021** was a first day in Ukraine history when RES generation overrun TPP by 8,9% (21,9% and 20.1% respectively).
- Much of this growth and pipeline, particularly in wind and solar, has been fueled by a rush to secure the FIT.
- The government's 2035 energy mix target will require significant, and sustained investment in new renewable capacity, storage and transmission networks.



¹The National Energy and Utilities Regulatory Commission. Statistics on alternative power facilities enjoying the feed-in tariff. URL: <http://www.nerc.gov.ua/?id=26435>

Maintain balance between generation and load under uncertainty

- RES curtailment is costly. For the 6 days in May TSO curtailed 5176 MW:
 - 11 May: 1500 MW, paid
 - 14 May: 700 MW, paid
 - 15 May: 1300 MW, paid
 - 16 May: 1676 MW (643 MW paid, 1033 MW not paid)
- FCR (frequency containment) reserve has never been cleared out more than 30% (normally around 15%) by TSO.
- Ukrainian grid required flexibility, not adequacy.



Ways to make grid flexible

- Flexibility can be characterized along three dimensions: first, the absolute power output capacity range (MW); second, the speed of power output change, or ramp rate (MW/min); and third, the duration of energy levels (MWh)
 - More interconnectors
 - More reserves of unloaded capacity on dispatchable generation
 - More demand response
 - More storage
- DTEK has built first grid scale battery storage in Ukraine. It's a 1MW / 2,25 MWh LFP. The goal is to find a scalable, profitable business around storage and catalyze regulatory changes.



