

# Balancing markets and non-programmable (renewable) power coordination

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The market share of renewable energies, and among them, intermittent energies, is getting higher and higher. These energies offer various features in terms of predictability. Tidal energy is highly predictable. Instantaneous or daily production of a photovoltaic installation may be somewhat random, but annual and seasonal productions are fairly predictable. Individual production of a wind turbine is hardly predictable, regardless of the time scale.

This raises specific issues in order to ensure proper matching between supply and demand. In order to meet these issues, a number of solutions can be proposed:

- **Diversity:** Even though the production of an individual power unit may be hardly predictable, the overall production of a large number of units is usually much more predictable. Clustering non-correlated, or preferably, anticorrelated power units can improve significantly predictability.
- **Storage:** Energy storage is still expensive, costs are dropping steadily.
- **Exchange:** European grid markets include power exchange and bilateral contracts. This feature offers a large flexibility for balancing electricity demand and supply.
- **Previsions:** Accurate prevision models for production and consumption are a valuable support for grid management.
- **Adapting demand to supply:** A large number of electrical devices (thermal equipment, batteries,...) can support some power interruptions or delays in power supply without compromising the user's comfort. Adapting demand to supply, coupled with incentive pricing, may be a more relevant solution than the other way round.

The problem of balancing market can be view as an optimization problem in a competitive environment with uncertainty in resource and demand.

## References

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## Contributors:

Philippe Ezran and Yoram Haddad, Jerusalem College of Technology