Role of storage in operation of future fossil-free electric utility

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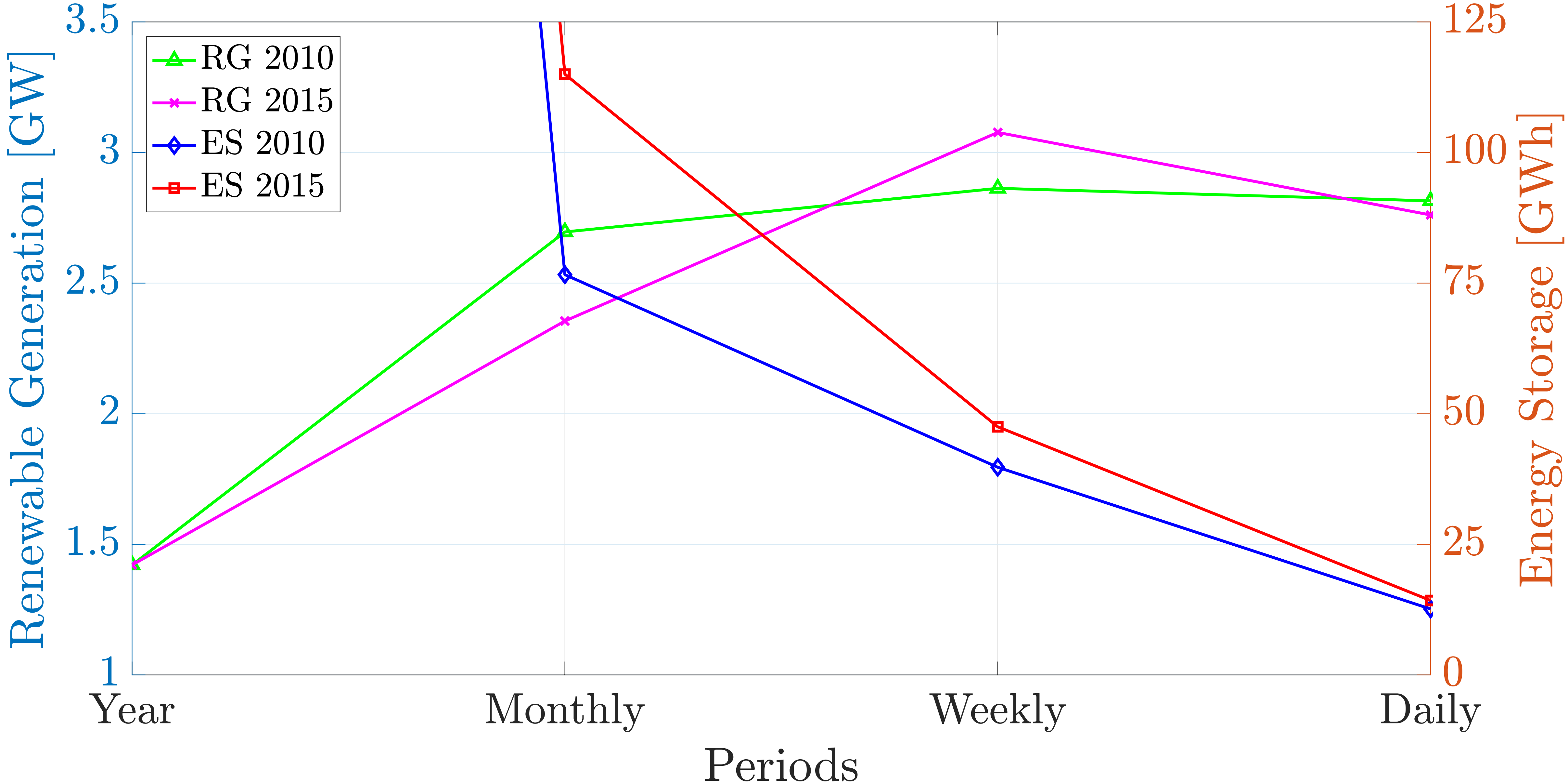
Modeling

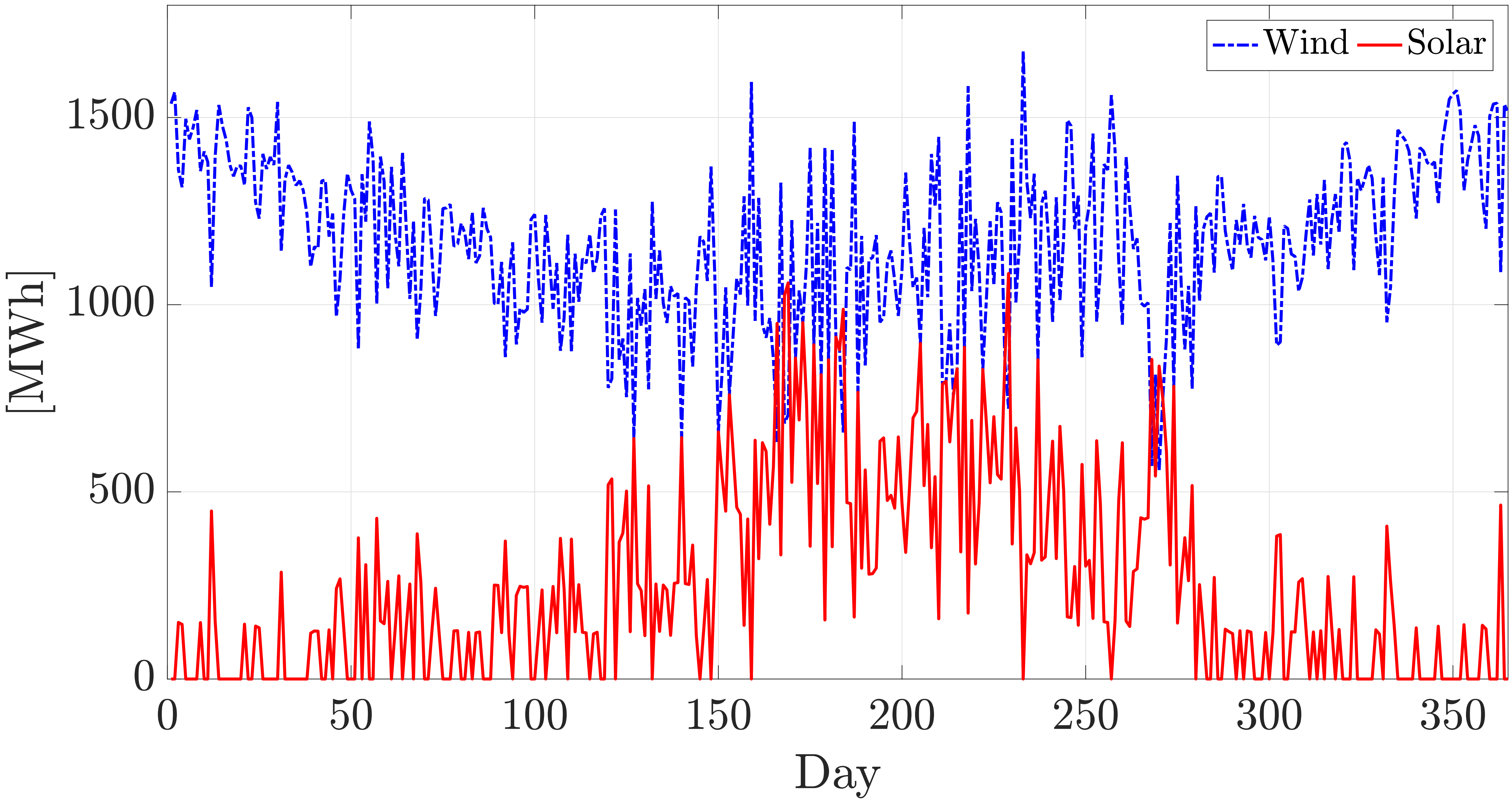
- Match fluctuating demand to fluctuating solar and wind supply with storage
- Storage must be “charged”
  - This requires preplanning, and implies breaking year into planning periods
  - Length: a) Year, b) Month c) Week d) Day

Modeling (Con't)

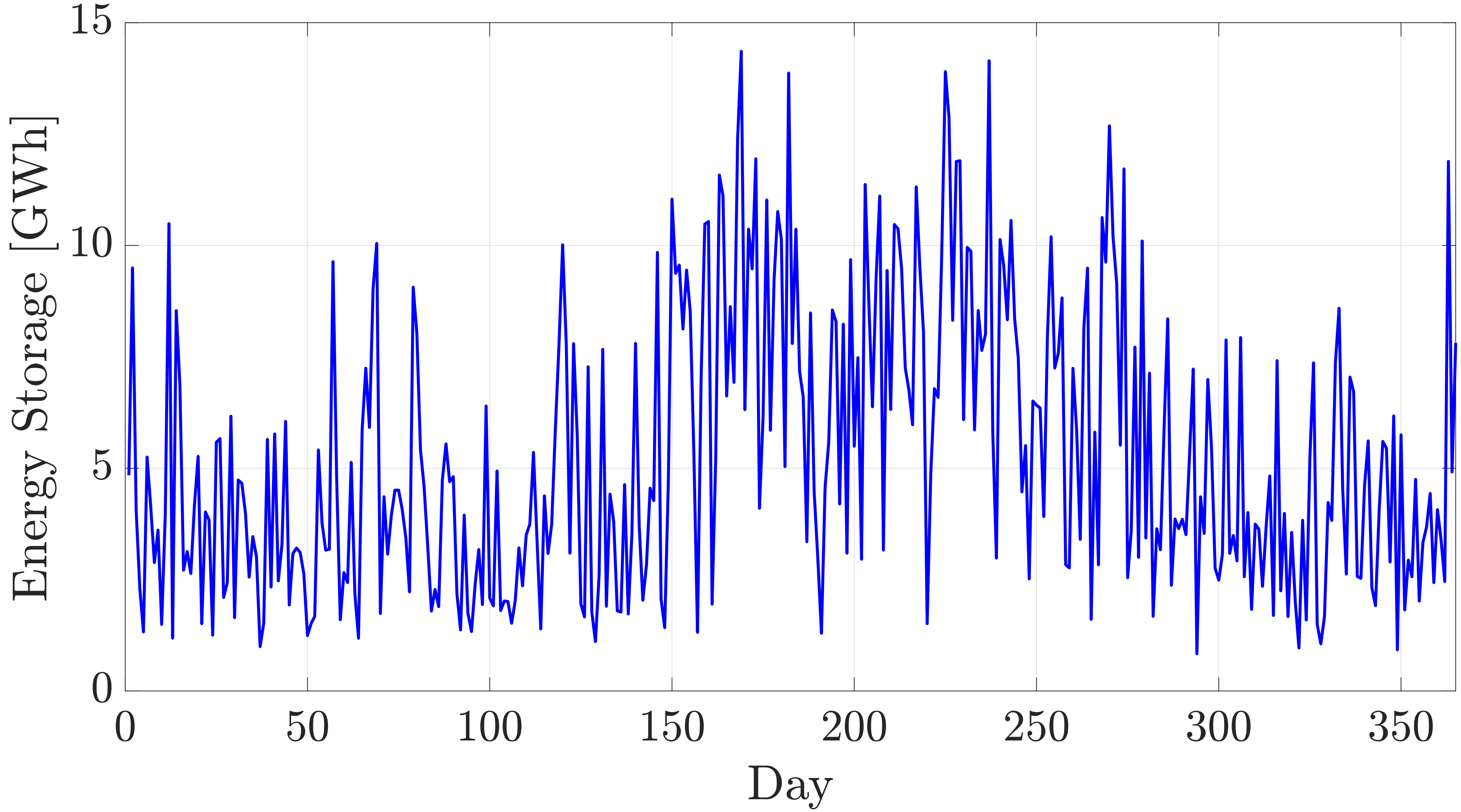
- Method is **Retrospective — Finds generic behavior**
    - Obtain PNM 2010, 2015 hourly demand
    - Project to 2030
    - Obtain solar and wind power from distributed sources
    - Deploy storage to match demand with 2010, 2015 solar and wind
    - Find yearly resource and storage needs
    - Full statistical predictive method needed to actually operate future utility
- Take ratio solar/wind to minimize storage



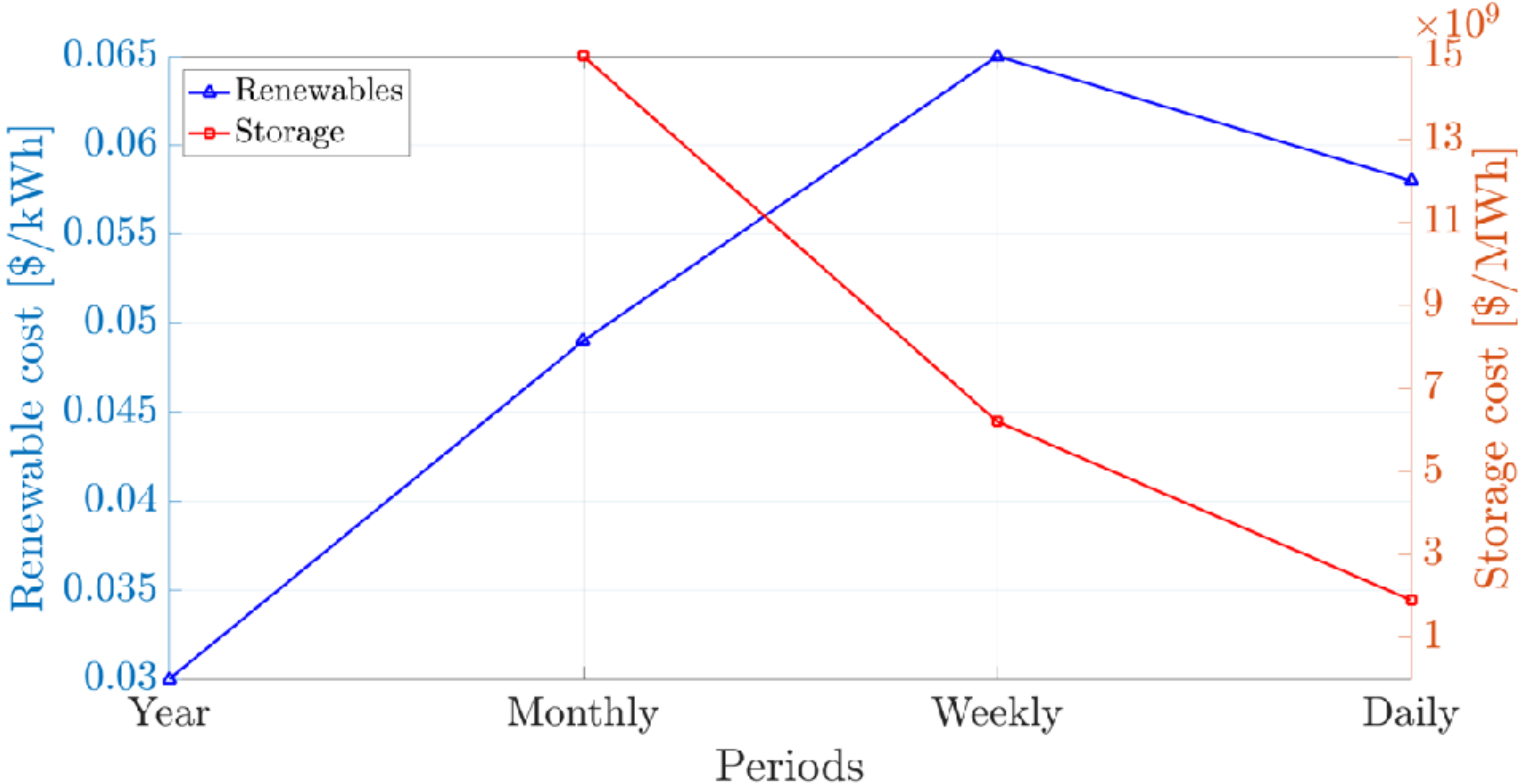
Resource and storage as function of period length



Daily wind and solar production for daily periods (2015)



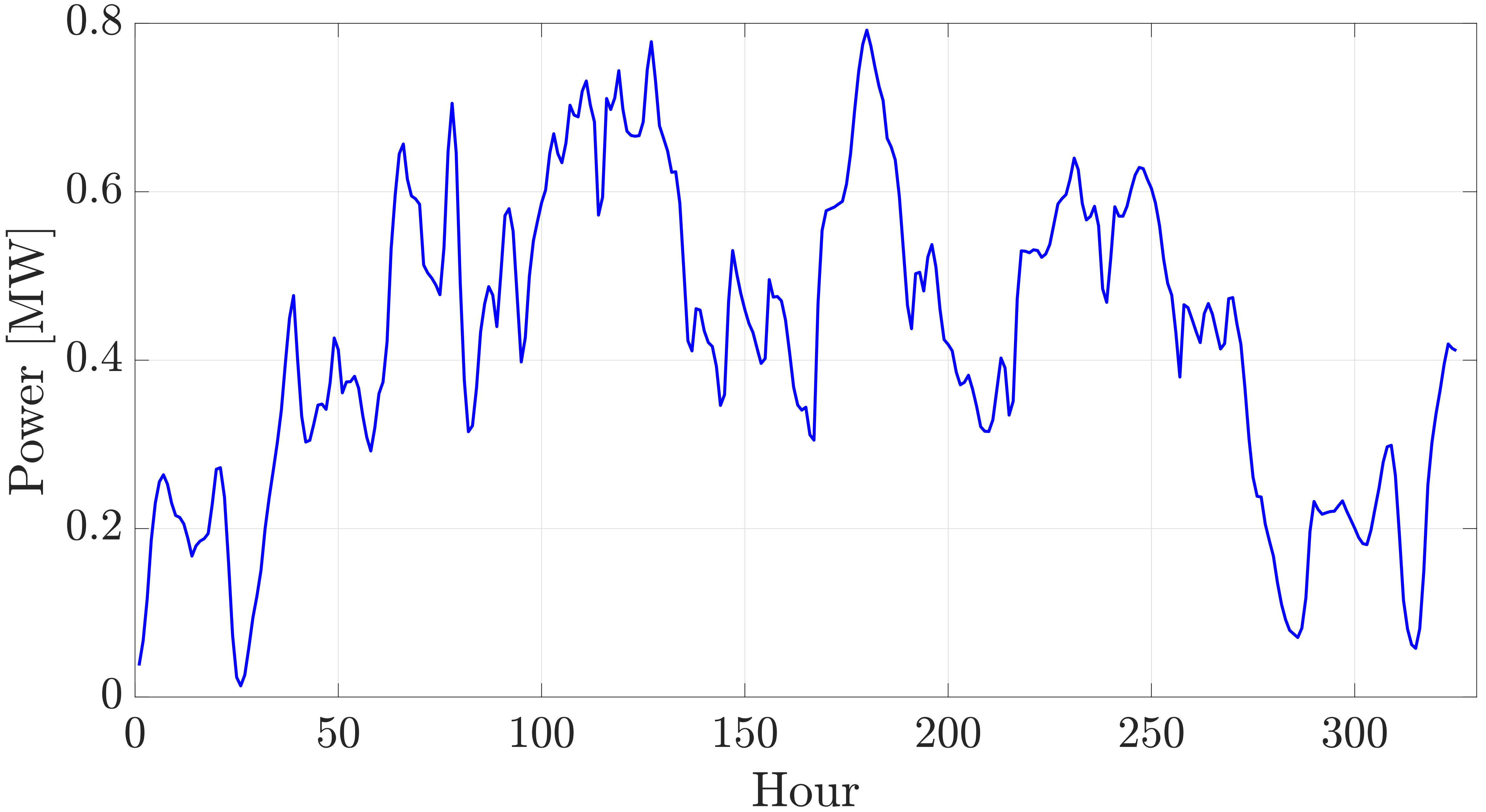
Daily storage deployment for year daily periods (2015)



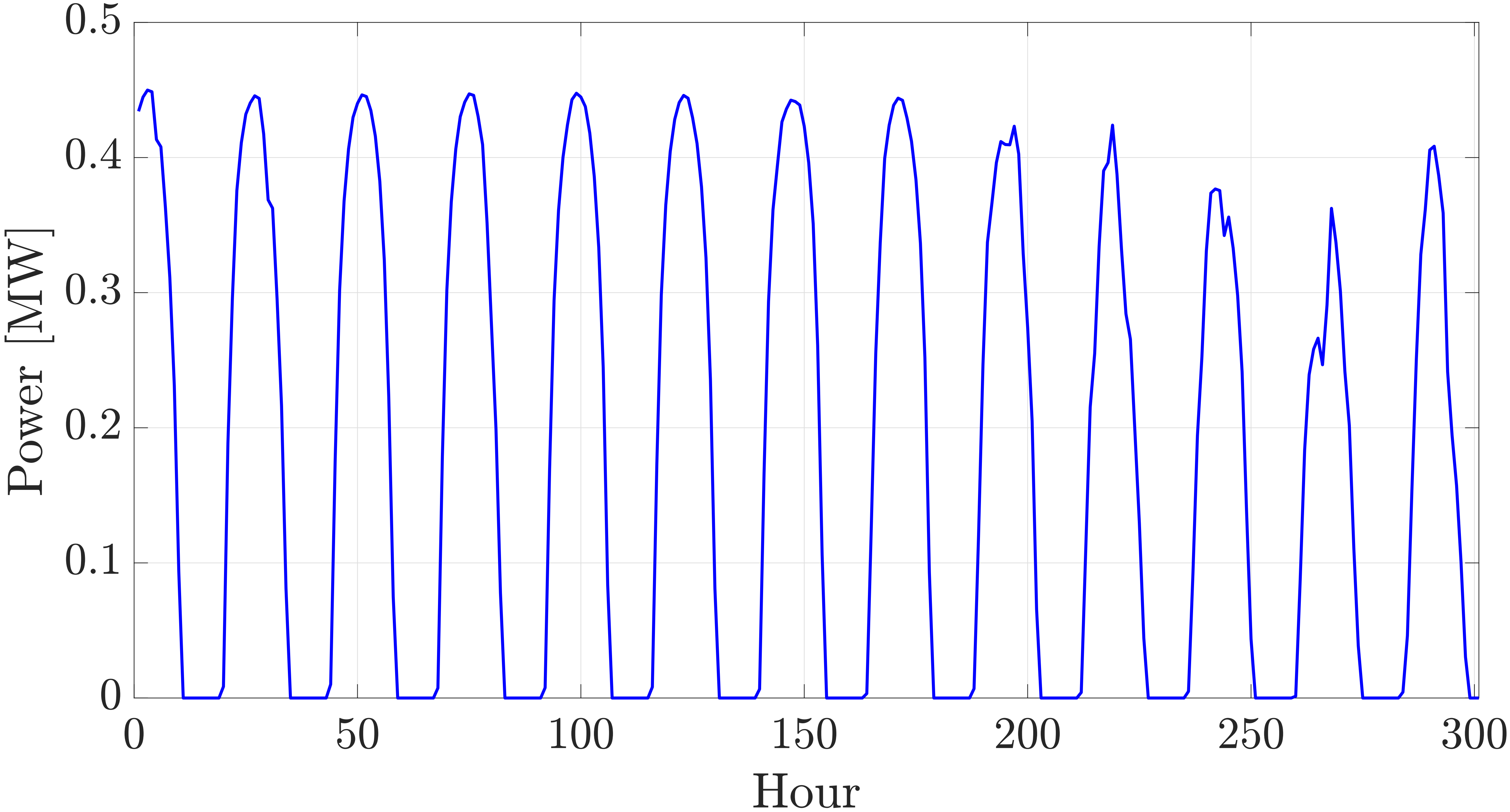
Estimated Costs

Findings

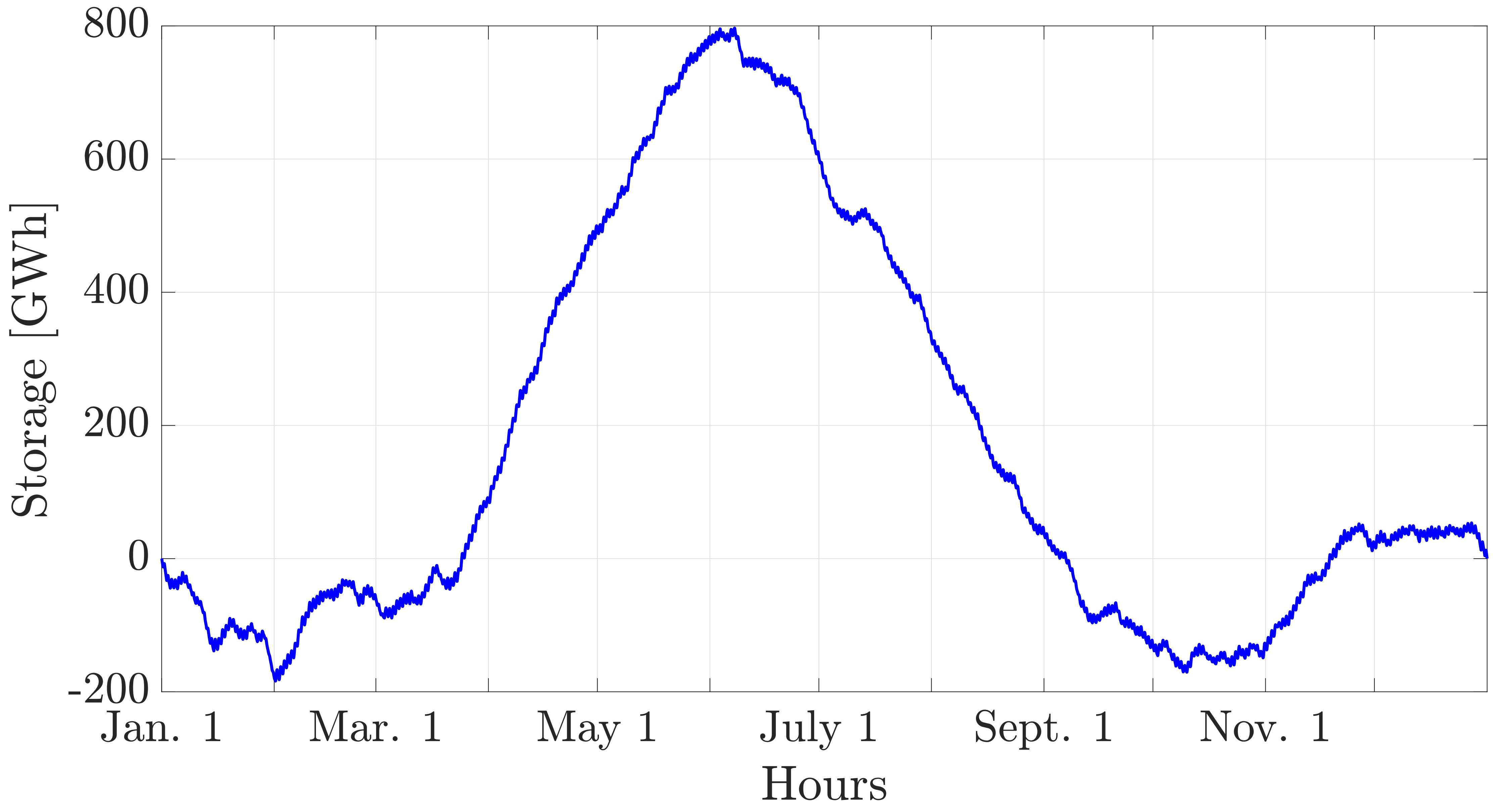
- Planning periods essential to “charge” storage system
- Future utility operation will be based on detailed statistical analysis of all system aspects.
- Shorter (daily) periods best
- Costs seem feasible for daily periods (Capital costs of storage dominant factor)
- Geographic averaging (especially wind) essential: Implies a national grid system desired
- Solar by itself is not economic — needs wind to smooth out day-nite fluctuation.
- Fossil free system feasible.



Wind power for two weeks in summer 2015



Solar power for two weeks in summer 2015



Storage function for a year