



Need for Adjustable Speed Pump Storage Turbines in the Systems Having Large Capacity of Conventional and Pumped Storage Power Plants: A case study for Turkey

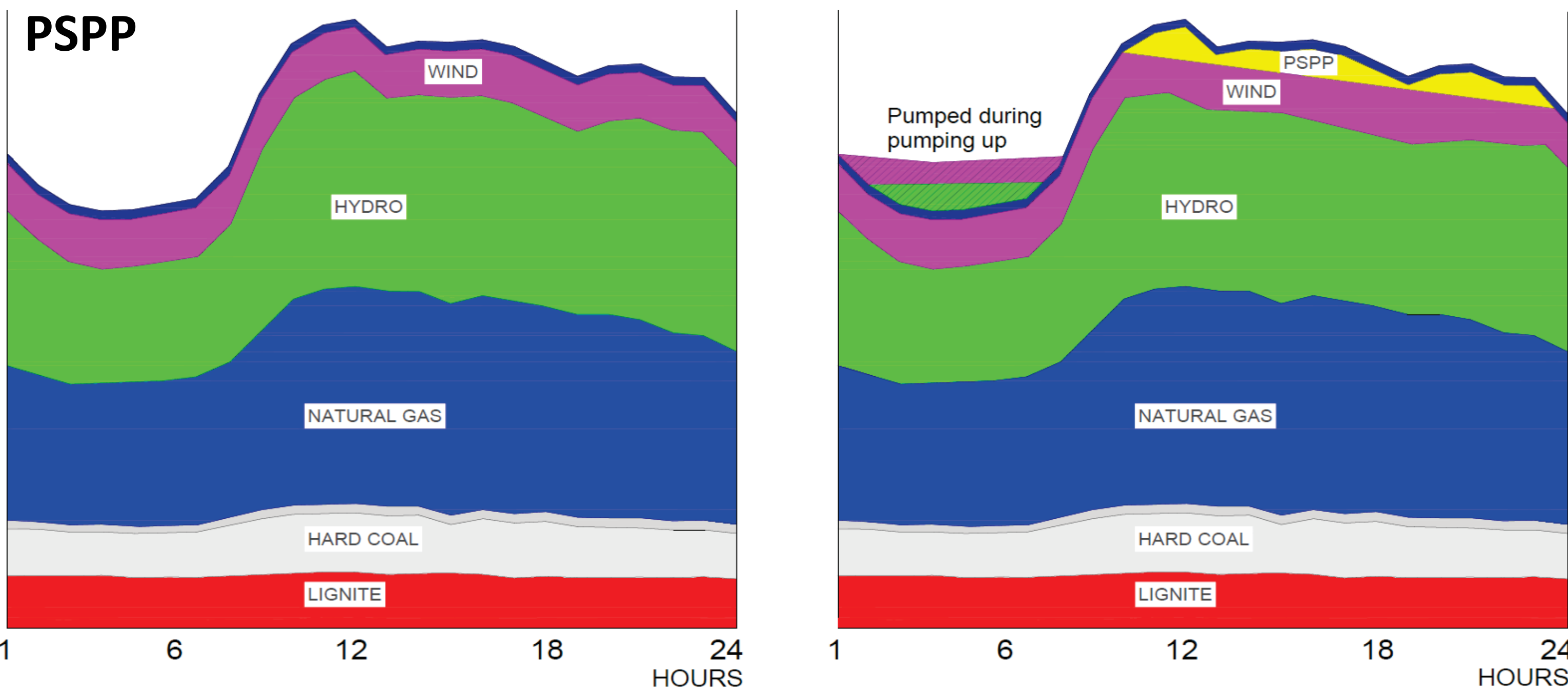
R. PALA E. ERAYMAN
Electricity Generation Company
Turkey

Motivation:

- Can existing and planned large scale HEPP's fulfill all balancing request of Turkish electricity grid system?
- What is the secure and sustainable way of resolving the missing function that may occur in the systems?

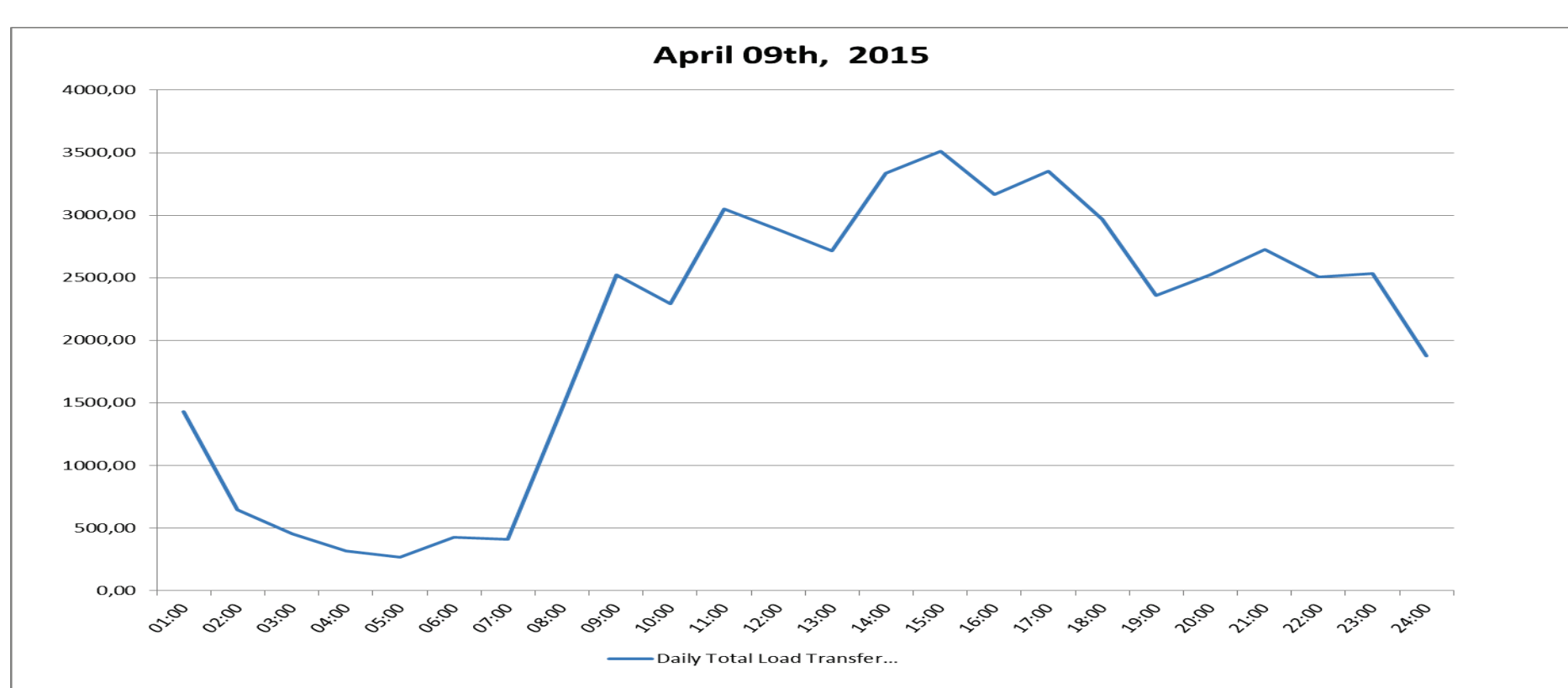
In this study, the importance of the presence of PSPPs in a large power system is evaluated, and its necessity and criticality is expressed as current state and future development plans of Turkish Power Grid which has large capacity of conventional storage power plants, are taken into account. Moreover, penetration of the Adjustable Speed Pumped Storage Power Plant (AS-PSPP) in Turkish power system is verified.

Electricity Power Systems Daily Operation Without PSPP With PSPP



Role of PSPP over the time:

Just as Pumped Storage Power Plants (PSPP) have undertaken the compensation role for the unbalances caused by the inflexible steam driven power plants in electricity grid in the past, presently problems arising from the unbalances caused by high penetration of RES such as wind and solar power which has intermittent characteristics, could be handled by PSPPs.



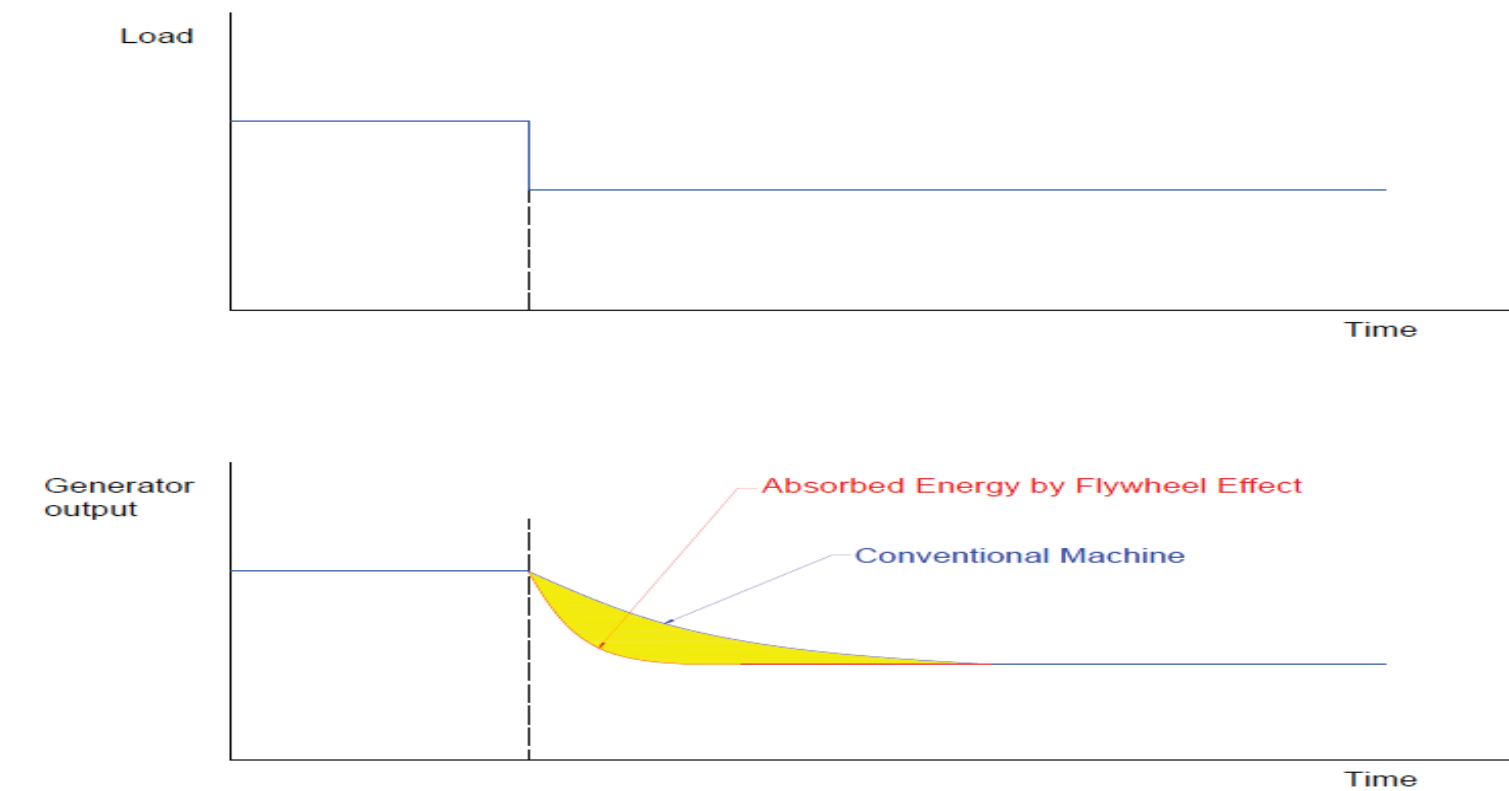
Turkish EPS's challenges on the window of balancing

- Excess amount of power under the scope of RES support mechanism (%22)
- Daily change of interarea power transfer (around 300-5000 MW)
- Target for more than 40 GW RES integration for 2025.
- Difficulty in adjusting frequencies during off-peak hours

Comparison of Flexibility of Hydro Plants

	Width of output change in generating operation mode (for 400 MW unit generation capacity)	Width of input change in pumping operation mode (for 470 MW unit pumping capacity)
AS-PSPP	130MW – 400MW	320MW – 470MW
Conventional-type PSPP	260MW – 400MW	470MW (Constant)
Conventional Type HPP	Same as Conventional type PSPP	N/A

AS-PSPP's Fast Response

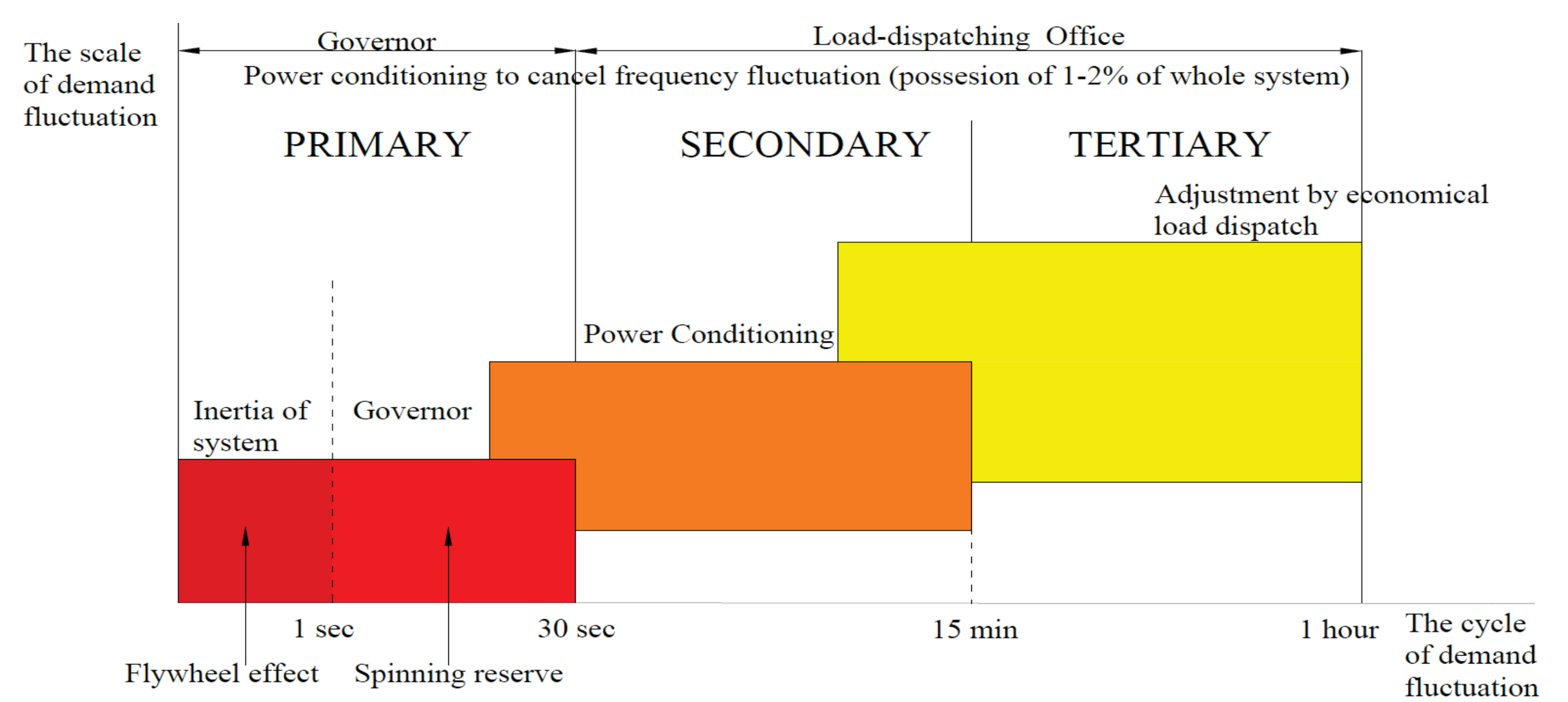


AS-PSPP Advantages:

- Fast response
- Wider operation range
- Frequency regulation capability during the pumping mode

Frequency Control Method

The reference frequency in Turkey is 50 Hz and frequency is controlled between 49.8 and 50.2 Hz. Figure shows ancillary services method for frequency control of grid that includes primary frequency control by demand fluctuation from a few seconds to a few minutes, secondary frequency control by demand fluctuation over fifteen minutes and tertiary control by demand fluctuation over more than fifteen minutes



Conclusion:

- Existing and planned HEPP's would not meet all balancing need in the future, Integration of AS-PSPP to the Turkish EPS systems can increase flexible load amount in demand side and effectively provide a remedy to balancing problem of the off-peak hours taking place in springs.
- AS-PSPP can strengthen the Turkish EPS against RES integration which targeted for 2025.
- PSPP can help overloading problem of the transmission lines from east to west in Turkey.