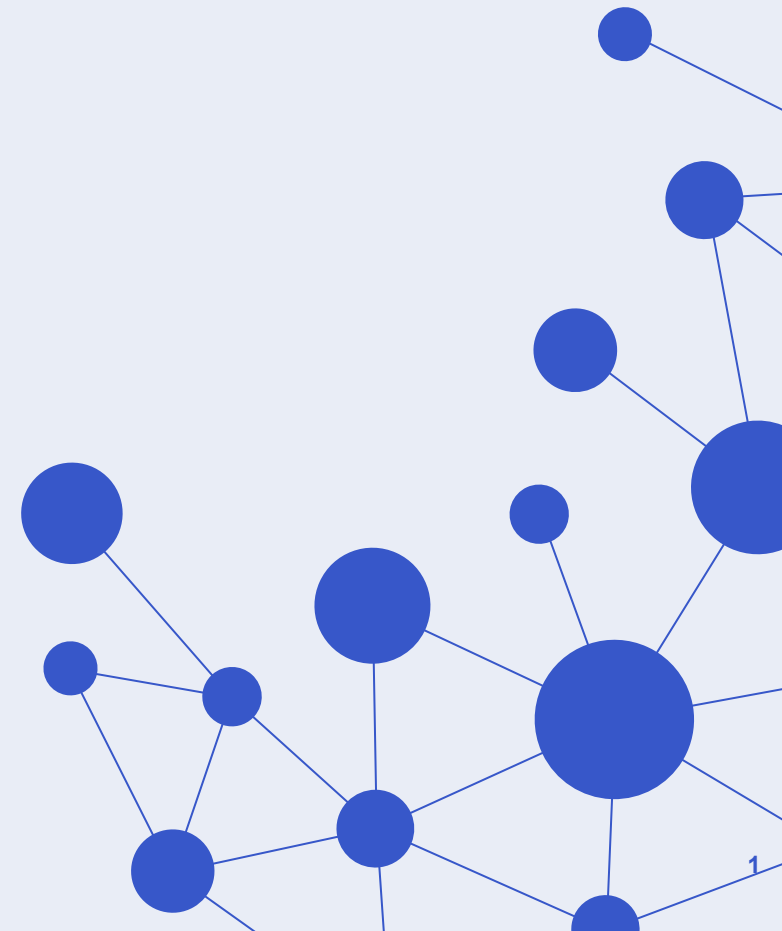


# Behovet av olika typer av flexibilitet i det framtida elsystemet

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VIND2019

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# Definition of flexibility

*“the extent to which a power system can modify production or consumption in response to variability or otherwise. In other words, it expresses the capacity of a power system to maintain reliable supply in the face of small and large imbalances, whatever the cause.”*

**2011, International Energy Agency - IEA**

*“the modification of generation injection and/or consumption patterns in reaction to an external signal (price signal or activation) in order to provide a service within the energy system.”*

**2014, EURELECTRIC**

*cost, to any change, which prevailed at the time it was planned.*

*“the capability of a power system to cope with the variability and uncertainty that VRE (variable renewable energy) generation introduces into the system in different time scales, from the very short to the long term, avoiding curtailment of VRE and reliably supplying all the demanded energy to customers”.*

**2018, International Renewable Energy Agency - IRENA**

**2018, International Energy Agency - IEA**

*“the ability to adapt to dynamic and changing conditions, for supply and demand by the hour or minute, and transmission resources over a period of years.”*

**Research Institute - EPRI**

*electricity system to respond to changes in the balance of supply and demand at all times.”*

**European Energy Regulators - CEER**

# What is power system flexibility?

**Flexibility relates to the ability of the power system to manage changes**

**ISGAN Annex 6** has made an effort to increase the understanding of different flexibility needs, in order to support the communication of flexibility within and outside the power system community

... flexibility is still not a unified concept  
“flexibility term” is used as an umbrella covering various needs and aspects in the power system

The outcome of **ISGAN ANNEX 6** work is a proposal on categorization of flexibility needs

... this complicates the discussion on flexibility and craves for differentiation to enhance clarity

# 5 Trends influencing the powers system



## Trends of flexibility needs :

### Decarbonisation

decreasing the carbon footprint from electric power production

### Decentralisation

transition from few and large, centralized plants to many smaller, decentralised, power production units

### Integration

increasingly integrated electricity markets, interconnection of previously independent grids, and more integrated energy systems including sector coupling

### Digitalisation

extensive implementation of and dependence on information and communication technologies and solutions

### Inclusion

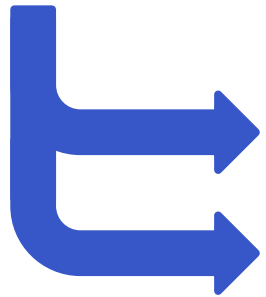
increasing demand for sustainable, affordable, accessible energy for all including increased electrification of e.g. industrial processes and transport

**volatility and uncertainty of the production and availability of electricity**

**operation and planning closer to the system limit**

# Analysis of flexibility needs

Flexibility needs have to be considered from:



**overall system perspective** (maintain stable frequency and secure energy supply)

**local perspective** (maintain bus voltages and secure transfer capacities)

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Flexibility needs are considered for both **operation** and **planning** of the power system, with flexibility support required in the timescales of:

fraction of a **second**

e.g. stability and frequency support

**minutes / hours**

e.g. thermal loadings and generation dispatch

**months / years**

e.g. planning for seasonal adequacy and planning of new investments

# Categorization of flexibility needs

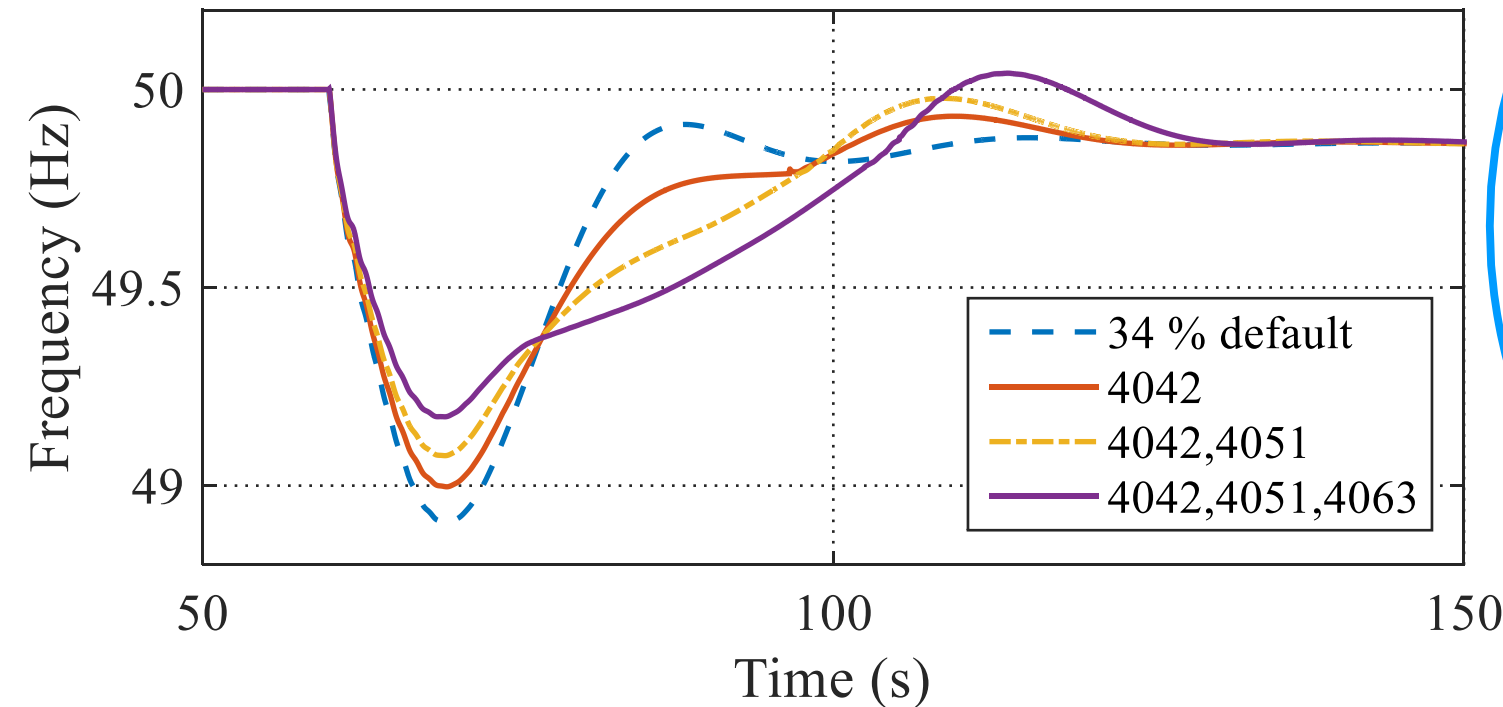
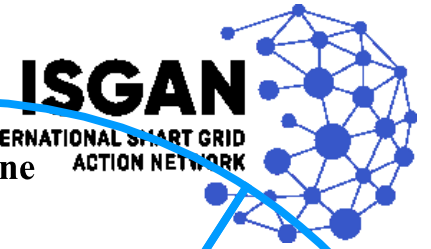
**Flexibility for  
Power**

**Flexibility for  
Energy**

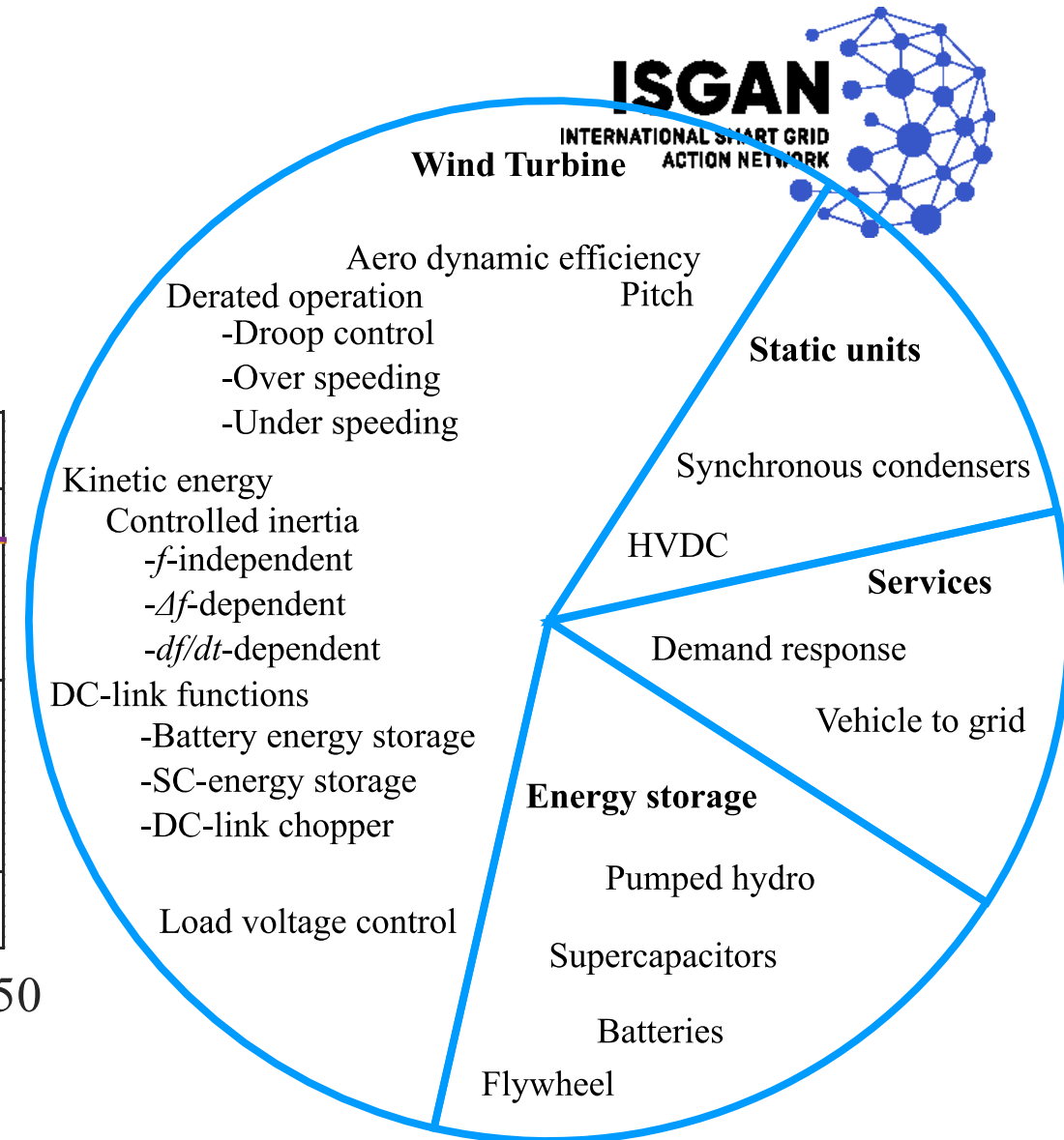
**Flexibility for  
Voltage**

**Flexibility for  
Transfer Capacity**

# Flexibility for: Power



Source: M. Persson, "Frequency response by wind farms in power systems with high wind power penetration", 2017.



# Categorization of flexibility needs

**Flexibility for  
Power**

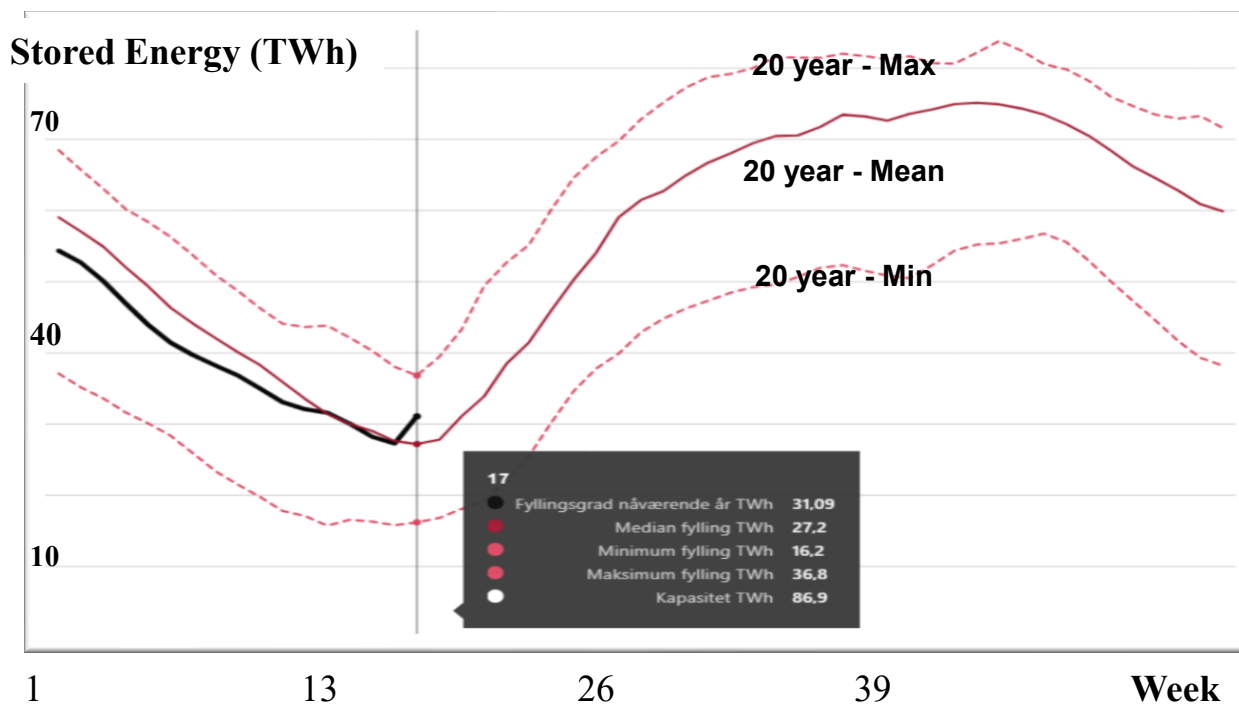
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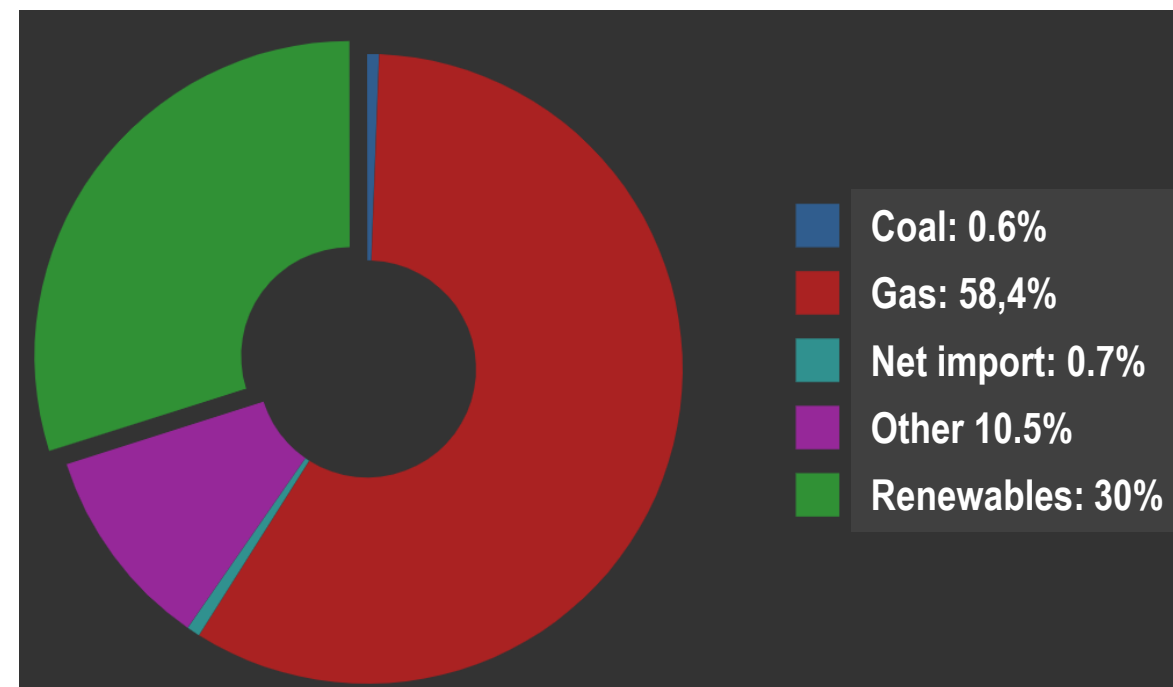
**Flexibility for  
Transfer Capacity**



# Flexibility for: Energy



Reservoir content Norway Source: NVE



Ireland's power system average fuel mix April 2019 Source: EirGrid

# Categorization of flexibility needs

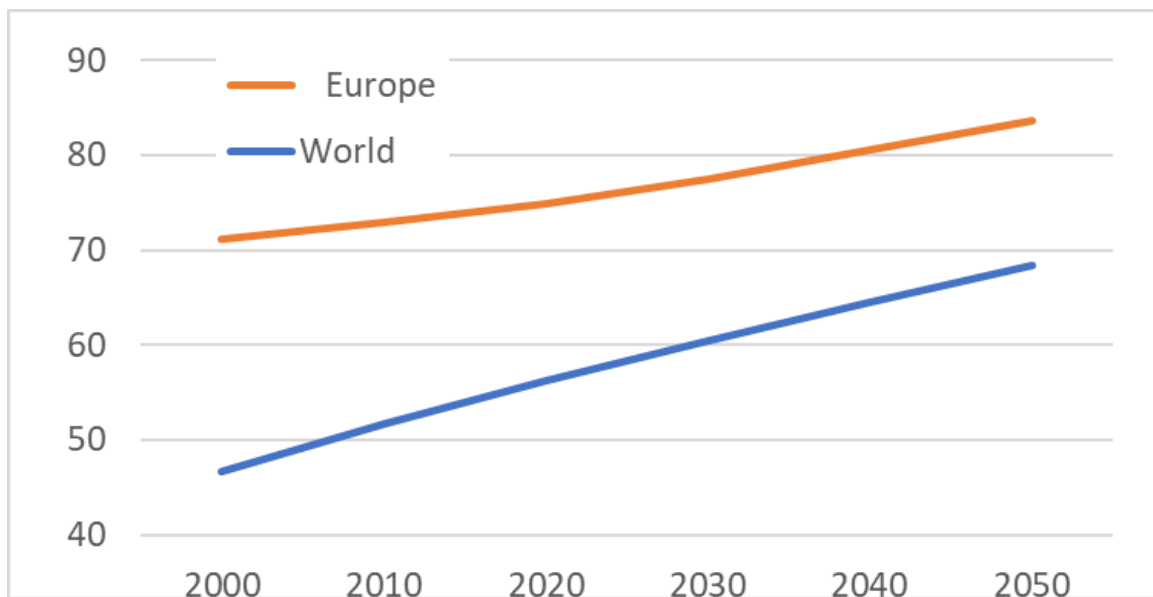
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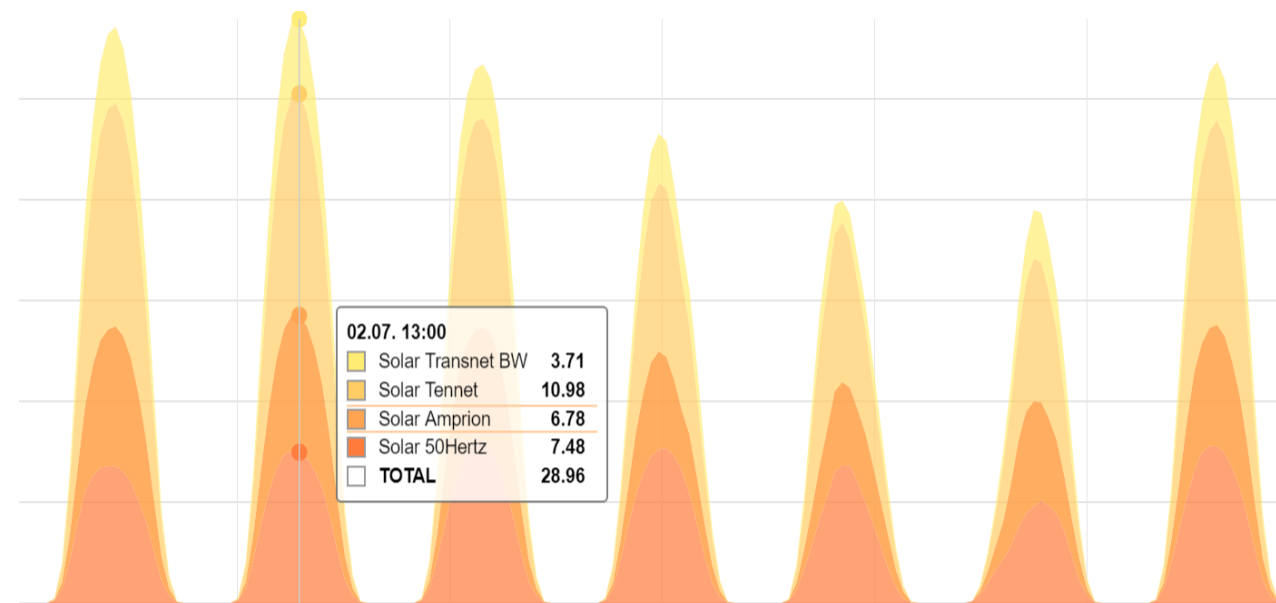
**Flexibility for  
Voltage**

**Flexibility for  
Transfer Capacity**

# Flexibility for: Transfer Capacity



Percentage of population in Urban areas *Source: UN*



PV production Germany 1<sup>st</sup> week July 2018 *Source: Fraunhofer*

# Categorization of flexibility needs

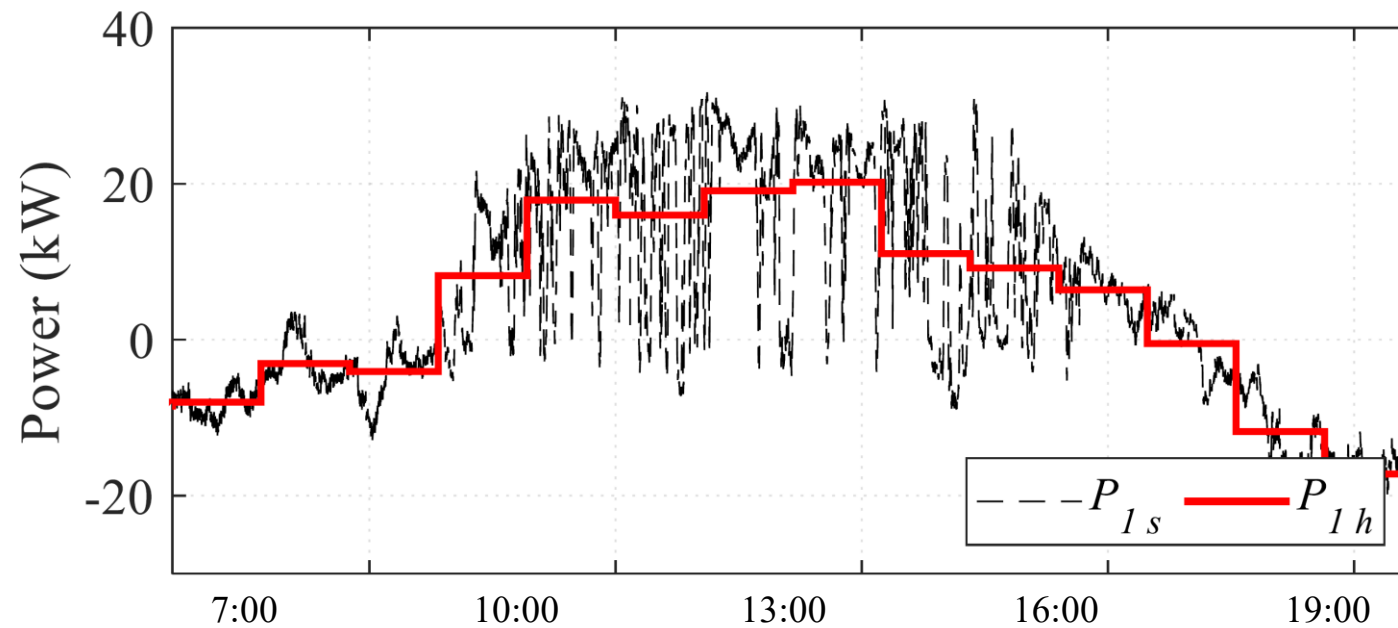
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**Flexibility for  
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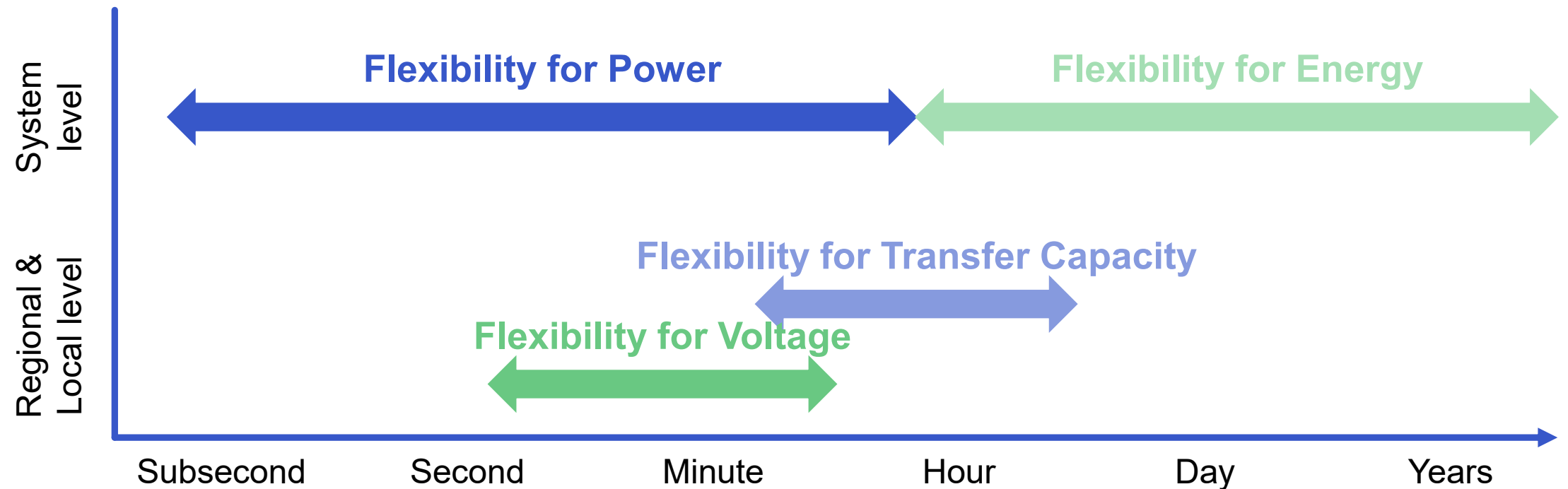
**Flexibility for  
Transfer Capacity**

# Flexibility for Voltage



Distribution transformer net load in system with PV (positive=overproduction) *Source: RISE*

# Flexibility needs in time and space

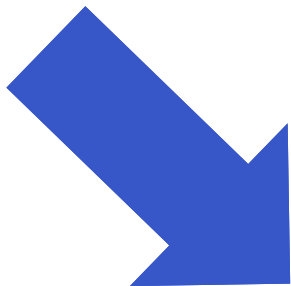


# Summary / Conclusion

Power system flexibility: **the ability of the power system to manage changes**

... a broad concept!

This work intend to support understanding and communication of flexibility, through categorization of flexibility into four needs:



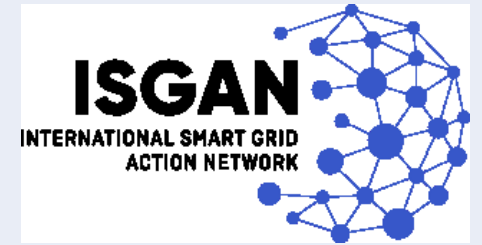
**Flexibility for Power**

**Flexibility for Energy**

**Flexibility for Voltage**

**Flexibility for Transfer  
Capacity**

For further reading, download the full report: [iea-iscan.org/flexibility-in-future-power-systems](https://iea-iscan.org/flexibility-in-future-power-systems)



# Thank you

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