Classification of flexible resources

CINELDI international webinar on "TSO-DSO interaction on flexible resources"
2022-12-12

Hanne Sæle (Hanne.Saele@sintef.no)

Agenda

- What is flexibility?
- Characterization of flexible resources
- Flexibility value chain

CINELDI

What is flexibility?

- Flexibility is the *capability and willingness* to modify production and/or consumption pattern, on an individual or aggregated level, often as a response to an external signal, to offer a service to the power system or contribute to stable grid operation.

CINELDI-rapport (2020) "Scenarier for fremtidens elektriske distribusjonsnett anno 2030-2040", H. Vefsnmo, T. Hermansen, G. Kjølle, K. Sand

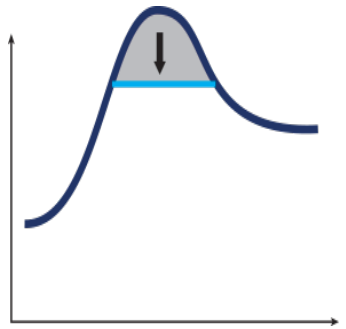
CINELDI

Flexibility

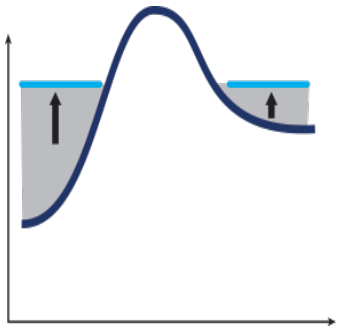
Type of activation

- **Implicit flexibility** = Price response in consumption (grid tariff)
- **Explicit flexibility** = External load control based on grid related needs, (ancillary services to maintain stability in the power system)

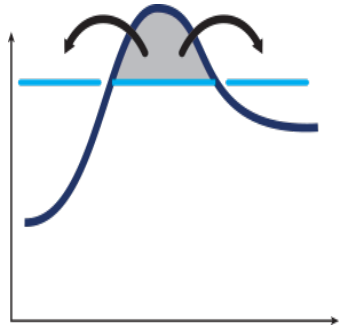
Alternative response



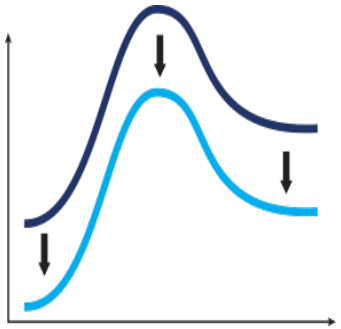
Peak clipping



Valley filling



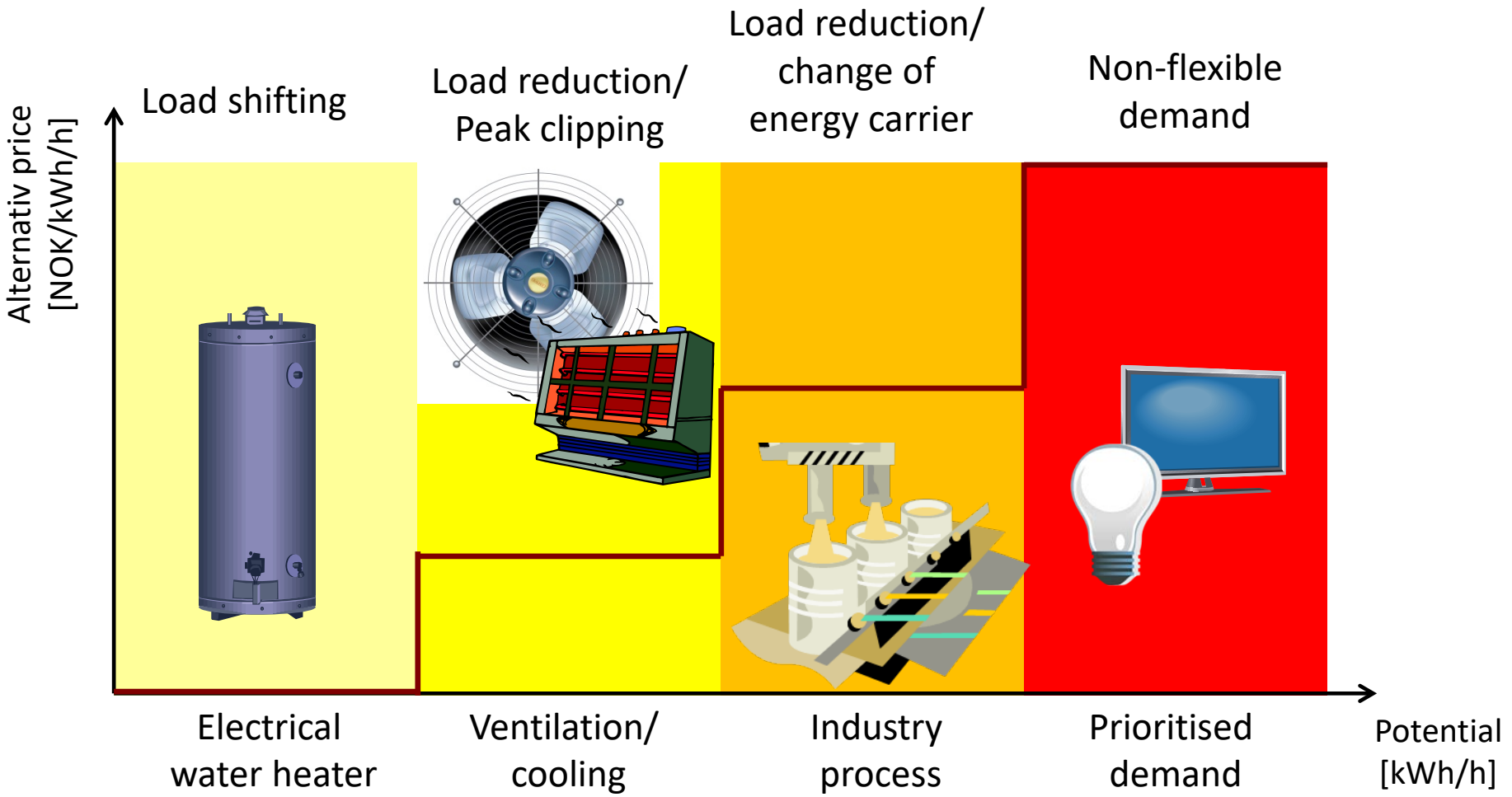
Load shifting



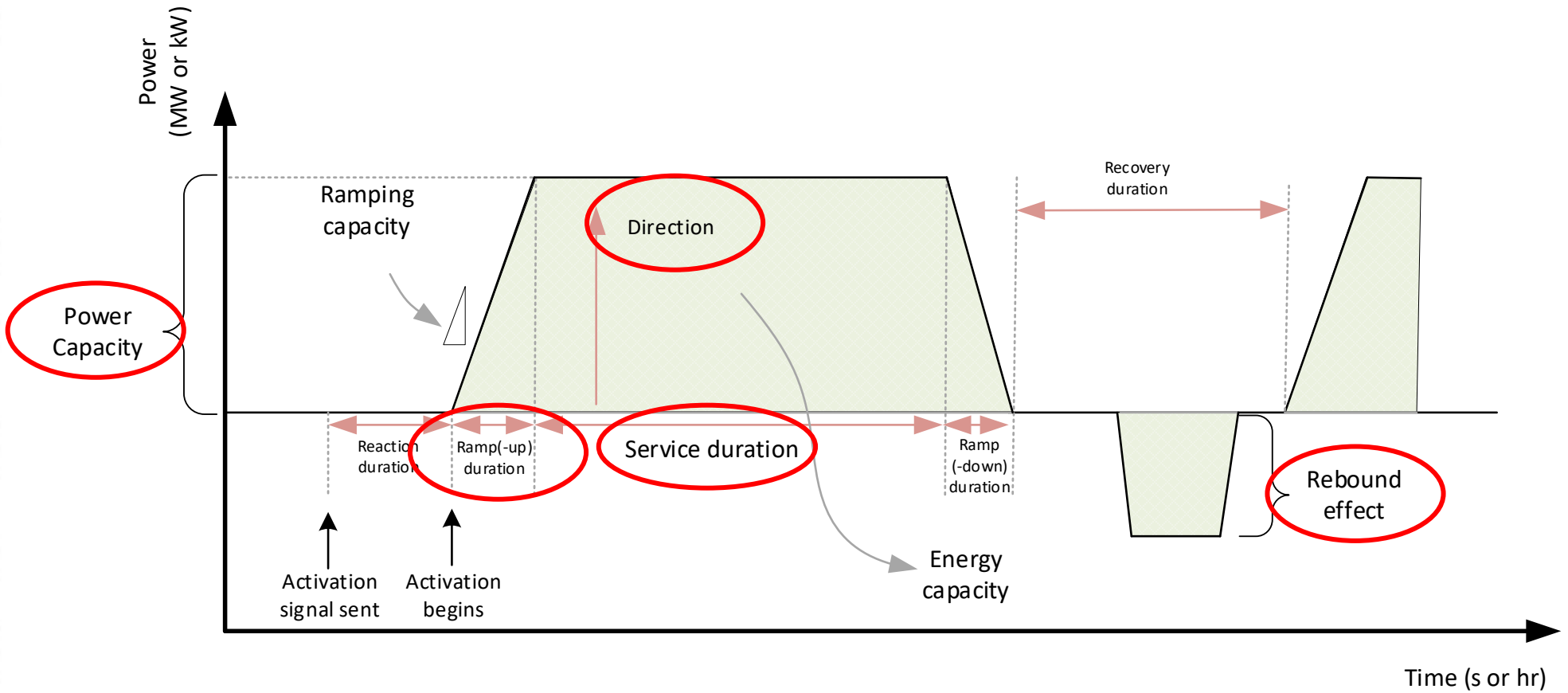
Energy conservation

CINELDI

Alternative price for flexibility = "Consequence for the customer"



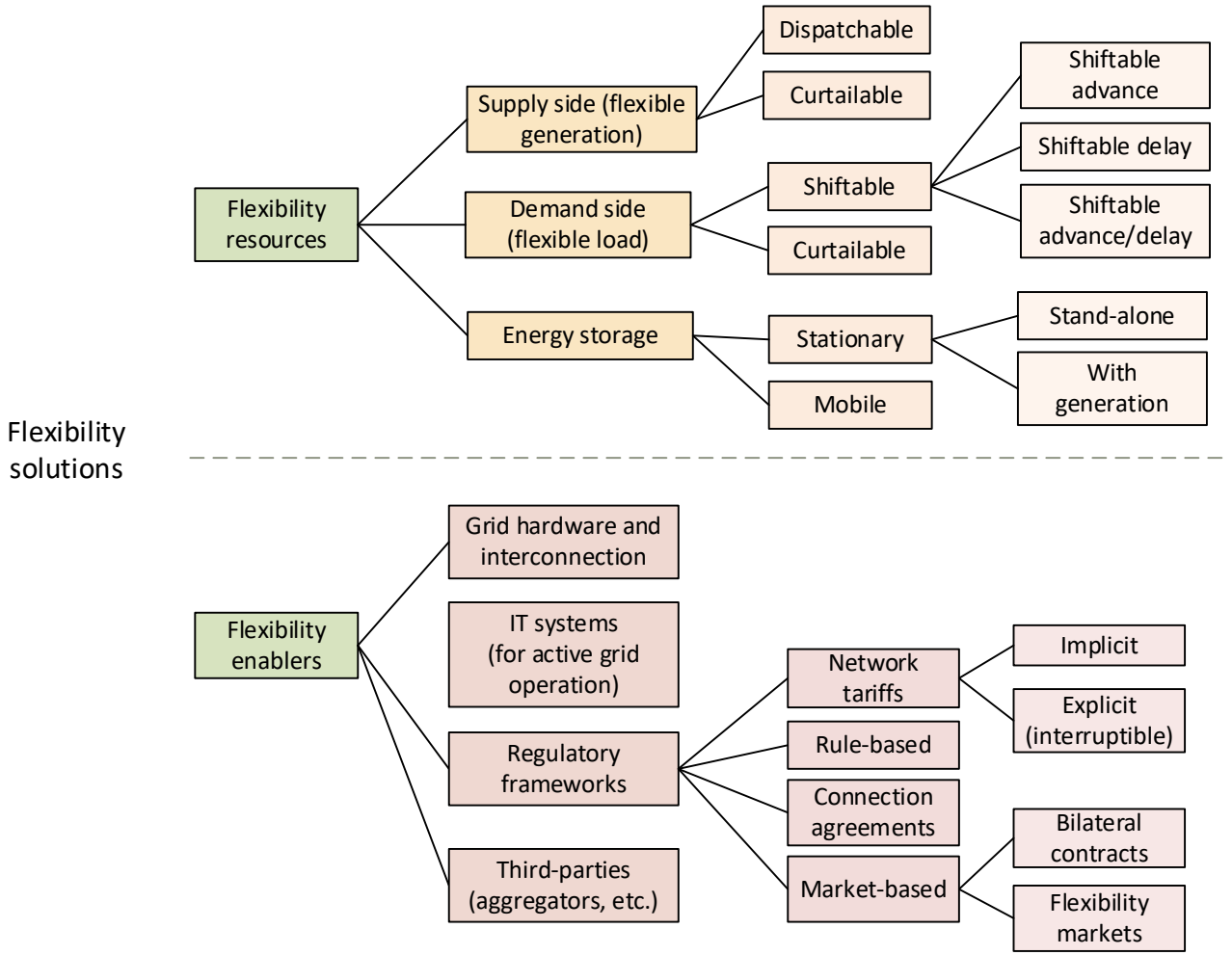
Characterisation of flexible resources (quantitative)



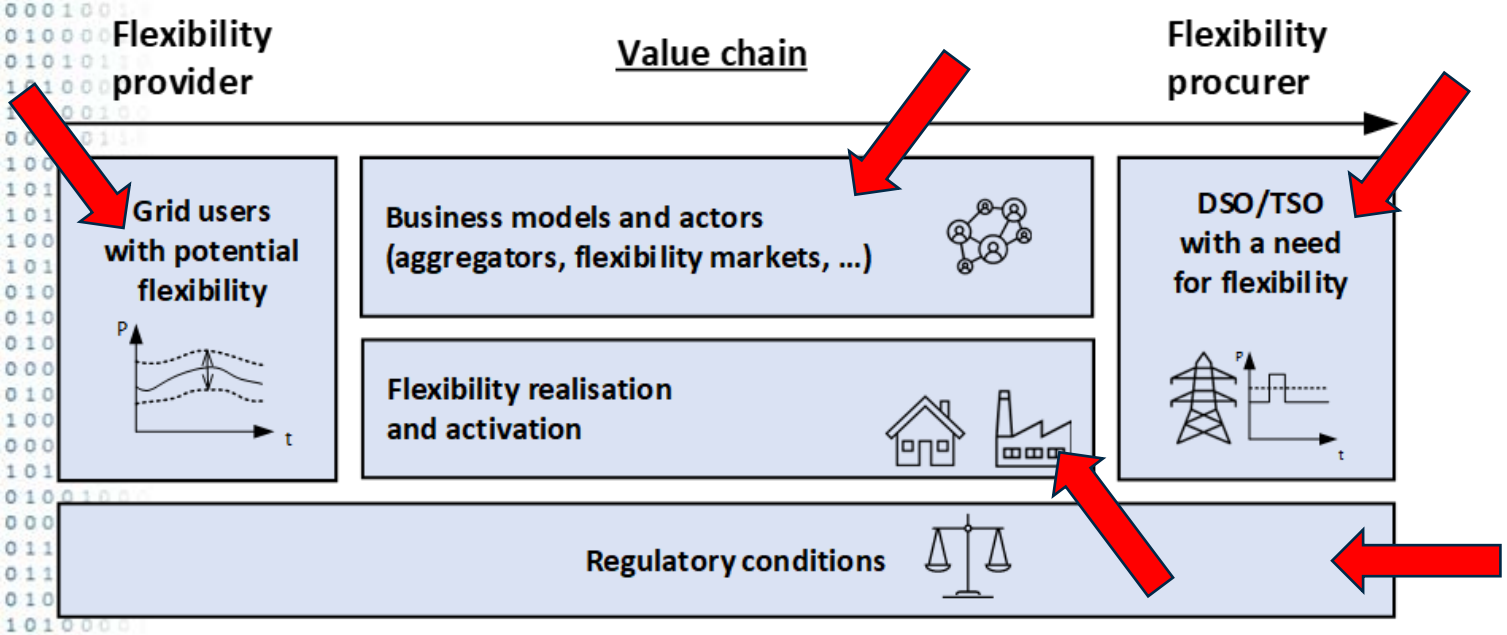
Reference in CINELDI:

- M.Z. Degefa, I.B. Sperstad, H. Sæle: "Comprehensive classifications and characterizations of power system flexibility resources", Electric Power System Research (Journal paper), 2021.

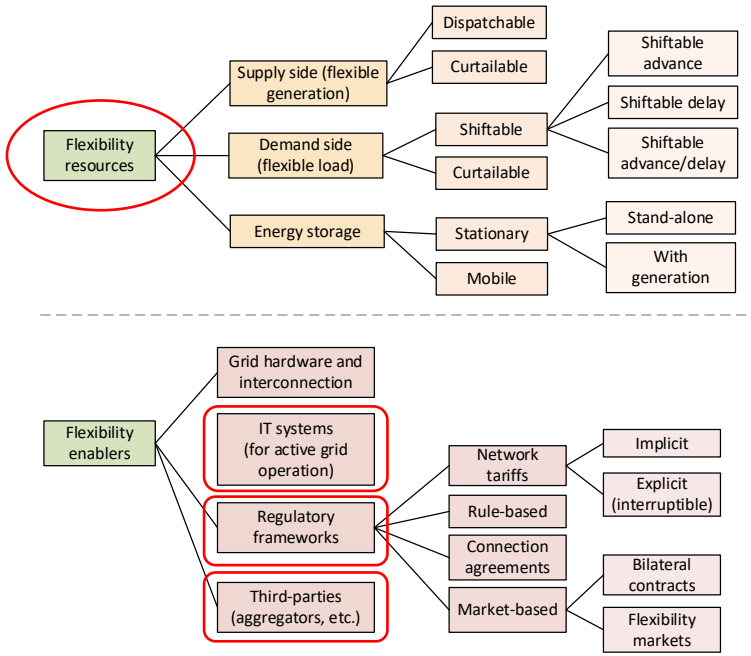
Grouping of flexible resources and their enablers



Flexibility value chain

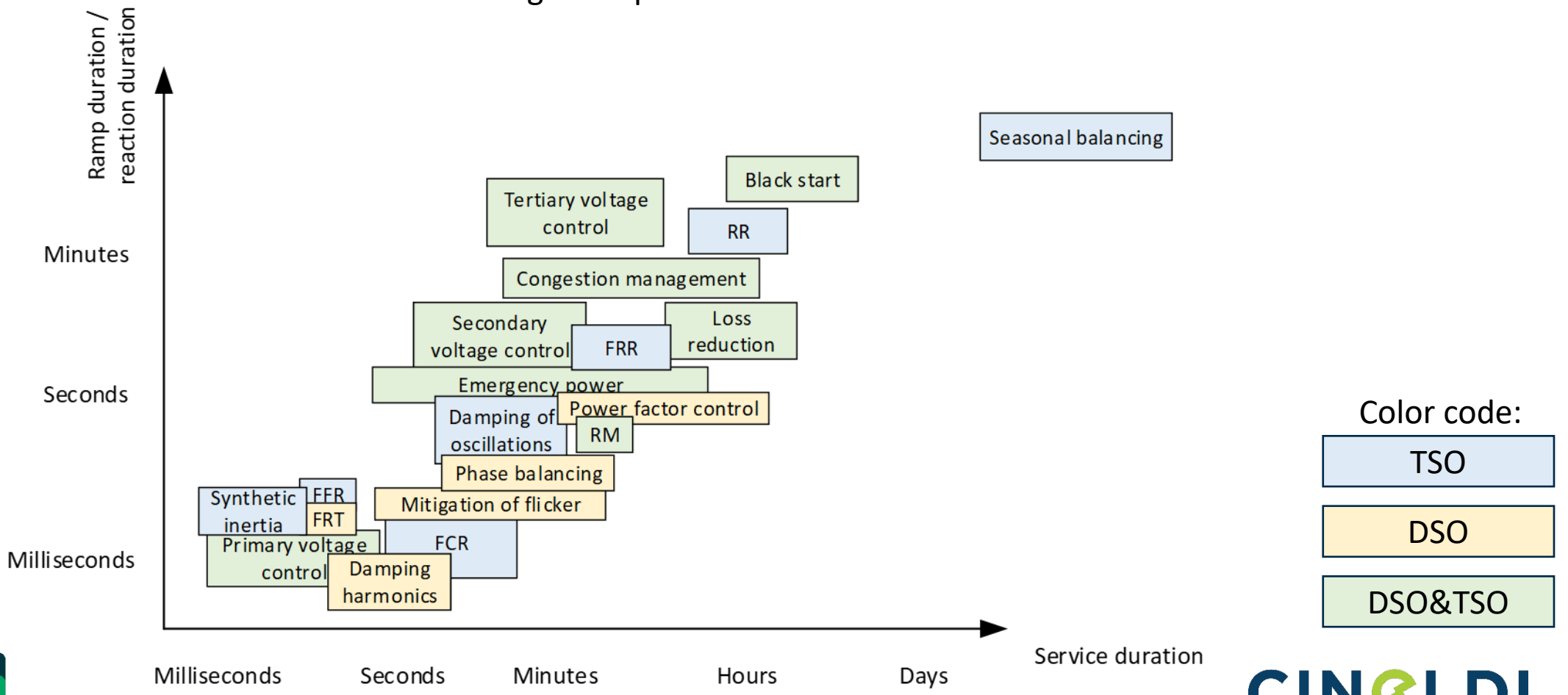


Flexibility solutions



Explicit flexibility: Ancillary services

Characterized according to response time and duration



Color code:

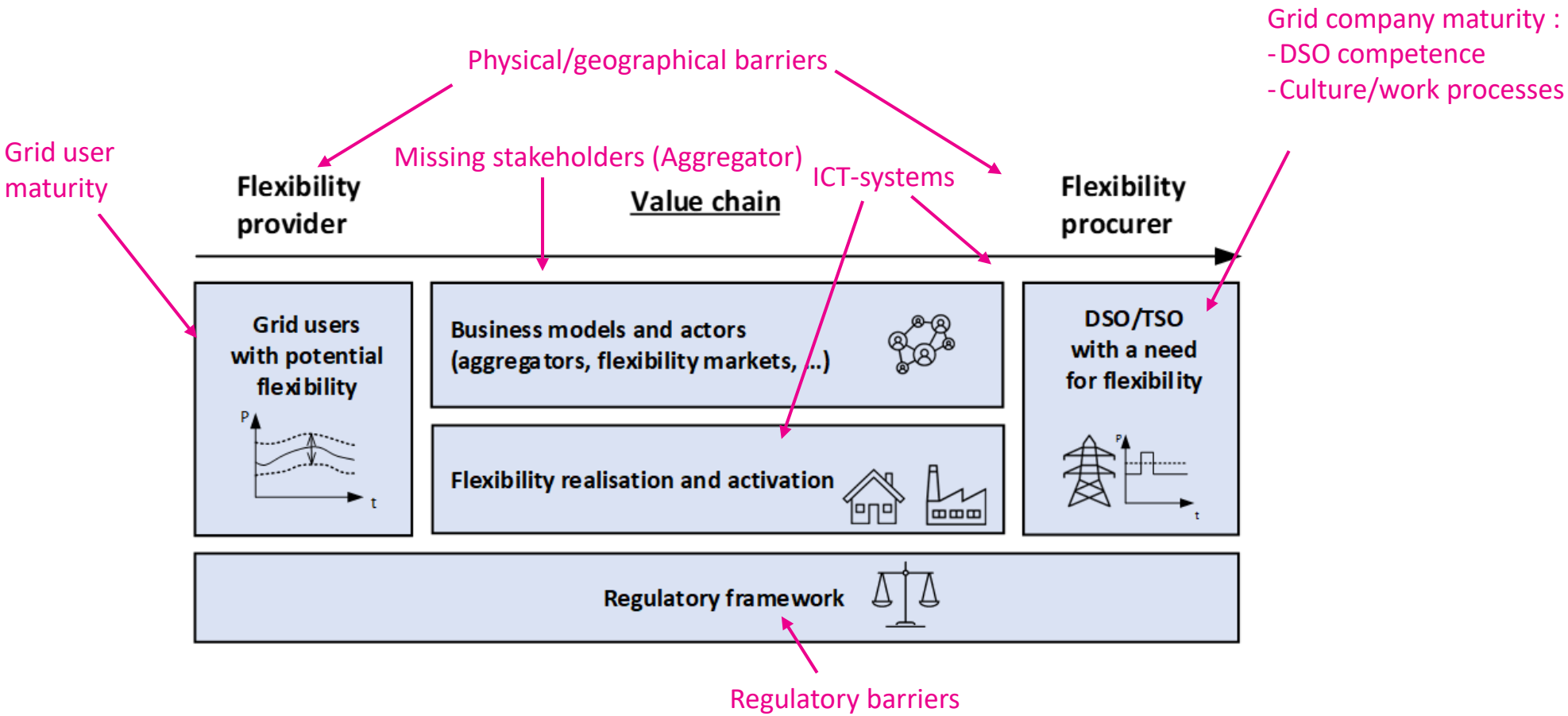
TSO

DSO

DSO&TSO

Kilde: Comprehensive classifications and characterizations of power system flexibility resources, February 2021, Electric Power Systems Research, Merkebu Zenebe Degefa, Iver Bakken Sperstad, Hanne Sæle

Barriers related to utilizing flexibility



Summary

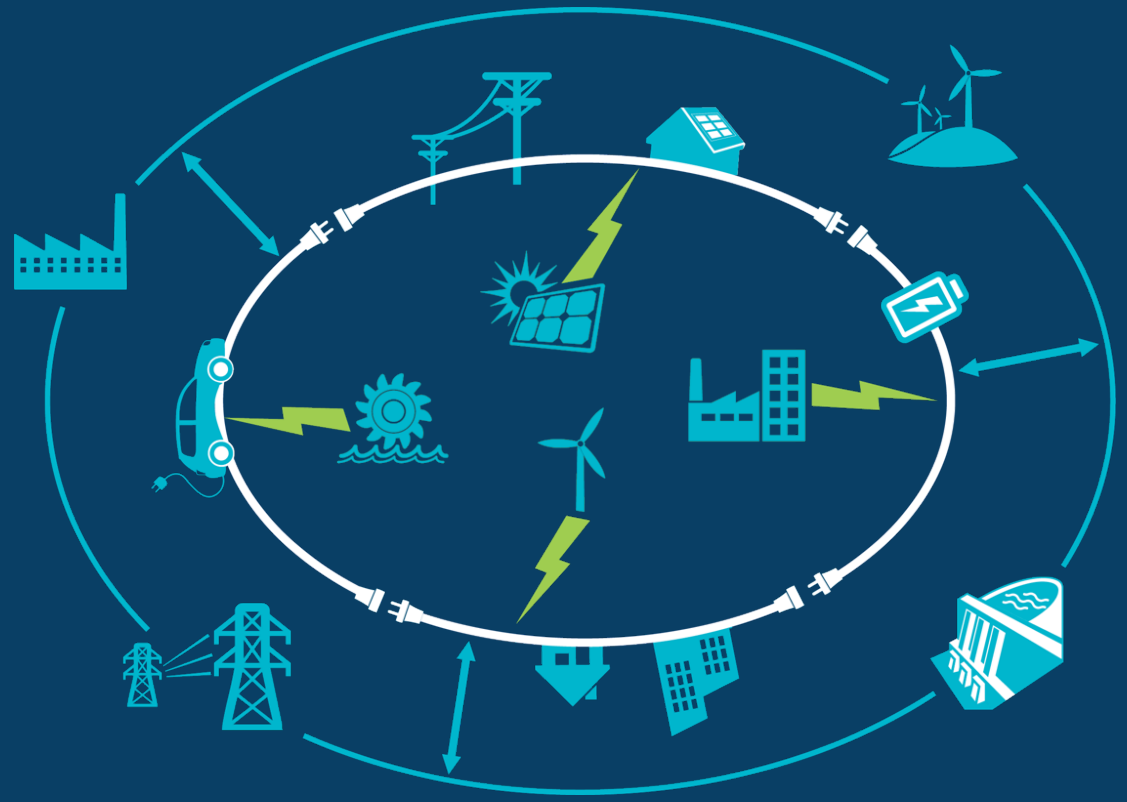
- Different types of flexible resources are available
  - Load, generation and storage
- A flexibility solution consists of both a resource and an enabler
- Barriers in the flexibility value chain need to be solved

Flexibility can contribute to improved utilization of existing grid capacity

CINELDI

Centre for intelligent electricity distribution
- to empower the future Smart Grid

Norwegian Centre for Environment-friendly Energy Research



This work is funded by CINELDI - Centre for intelligent electricity distribution, an 8 year Research Centre under the FME-scheme (Centre for Environment-friendly Energy Research, 257626/E20). The authors gratefully acknowledge the financial support from the Research Council of Norway and the CINELDI partners.

cineldi.no CINELDI_FME blog.sintef.com/ linkedin.com/company/cineldi/