ERSE
ENTIDADE REGULADORA
DOS SERVIÇOS ENERGÉTICOS

Energy System Flexibility

Portuguese regulatory context

Jorge Esteves

ENERGY FOR SUSTAINABILITY

Workshop on
Energy System Flexibility

INESC Coimbra
Instituto de Engenharia de Sistemas e Computadores de Coimbra

2 February 2022

Energy System Flexibility
A developing regulatory framework

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1. Towards a Neutral Carbon Society
2. Flexibility: a key for the energy system of the future
3. Flexibility applied to a 2030 scenario
4. Reflections on the regulatory framework

25 years of EU energy policies

How did we start?

- 1st, 2nd, 3rd EU Energy Legislative Packages
- Liberalisation
- Unbundling
- Internal energy market
- New EU entities & NCs

Where are we going?

A modern, resource-efficient and competitive economy, where:

- There are no net emissions of greenhouse gases by 2050
- Economic growth is decoupled from resource use
- No person and no place is left behind

1996, 2003, 2009

2019

New packages under preparation

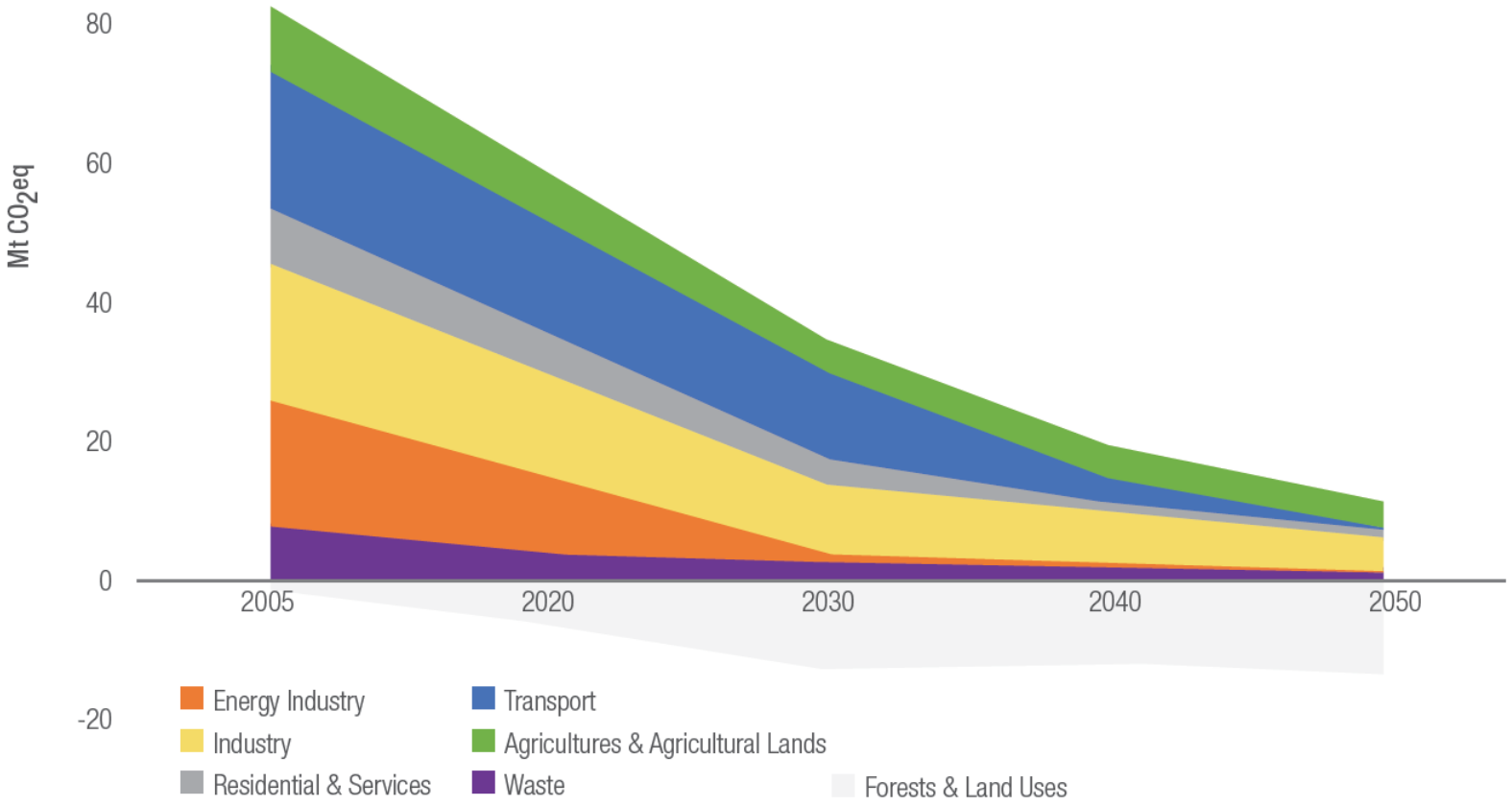
Timeline

Where are we?

- Clean Energy EU Legislative Package
- Decarbonisation
- Decentralisation
- Digitalisation
- Active consumers
- Energy efficiency

Towards a Neutral Carbon Society

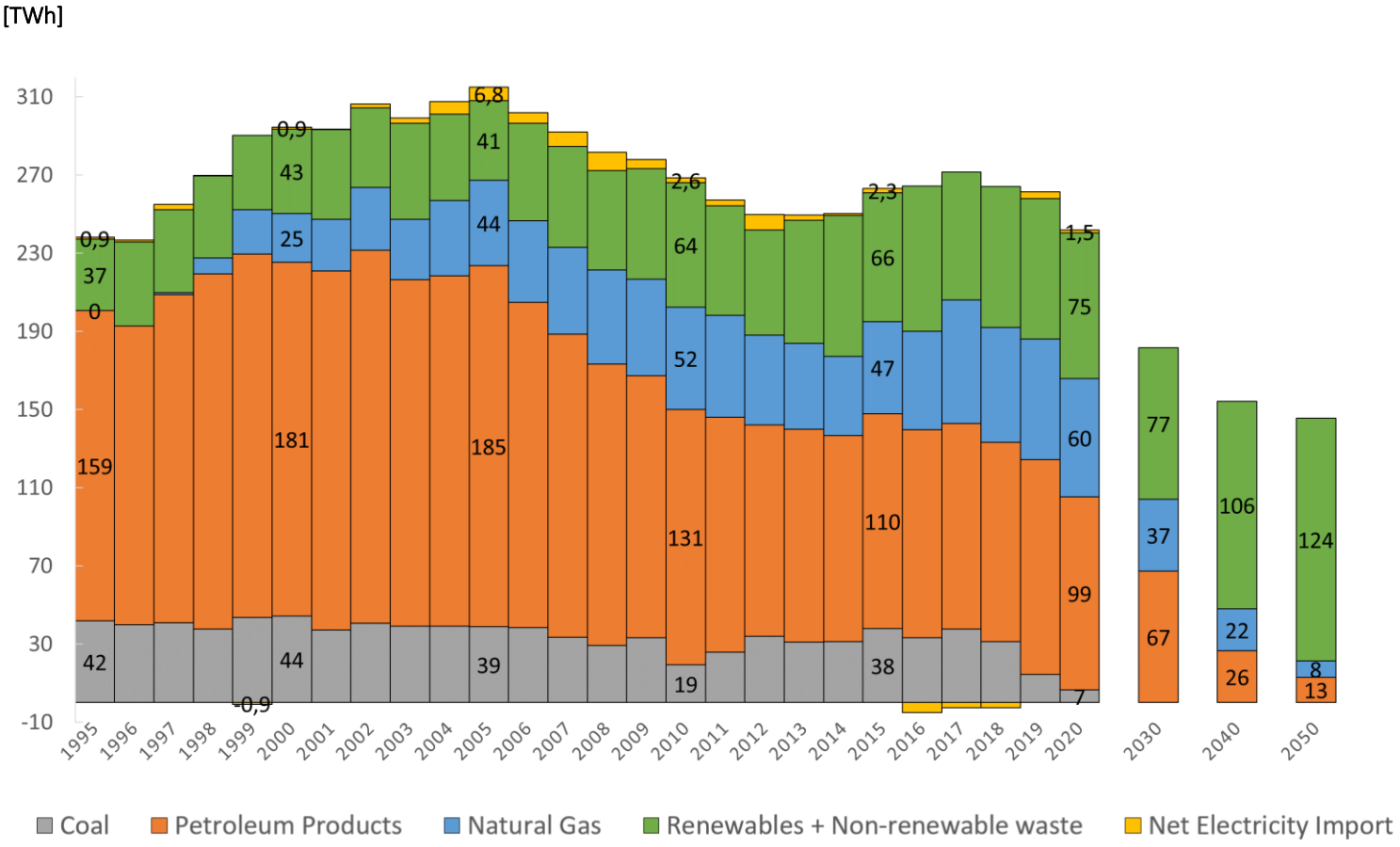
Sectoral contribution to the GHG emissions reduction trajectory by 2050



Source: Portuguese Government; *Roadmap for Carbon Neutrality 2050 (RNC 2050), Long-term Strategy for Carbon Neutrality of the Portuguese Economy by 2050*; June 2019; https://descarbonizar2050.apambiente.pt/en/

Towards a Neutral Carbon Society

Evolution of the Portuguese energy mix and the goals from the Portuguese RNC 2050



Towards a Neutral Carbon Society

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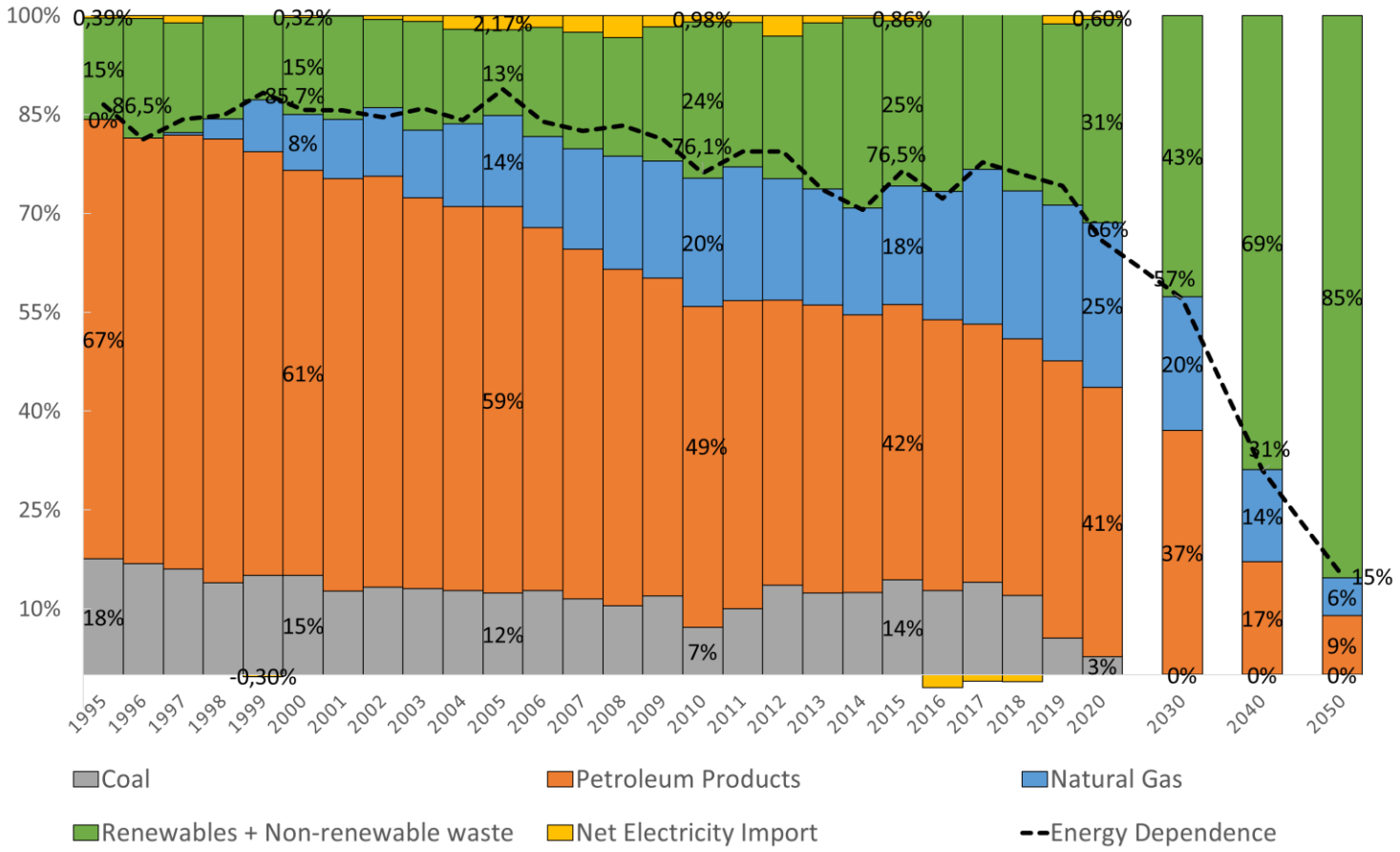
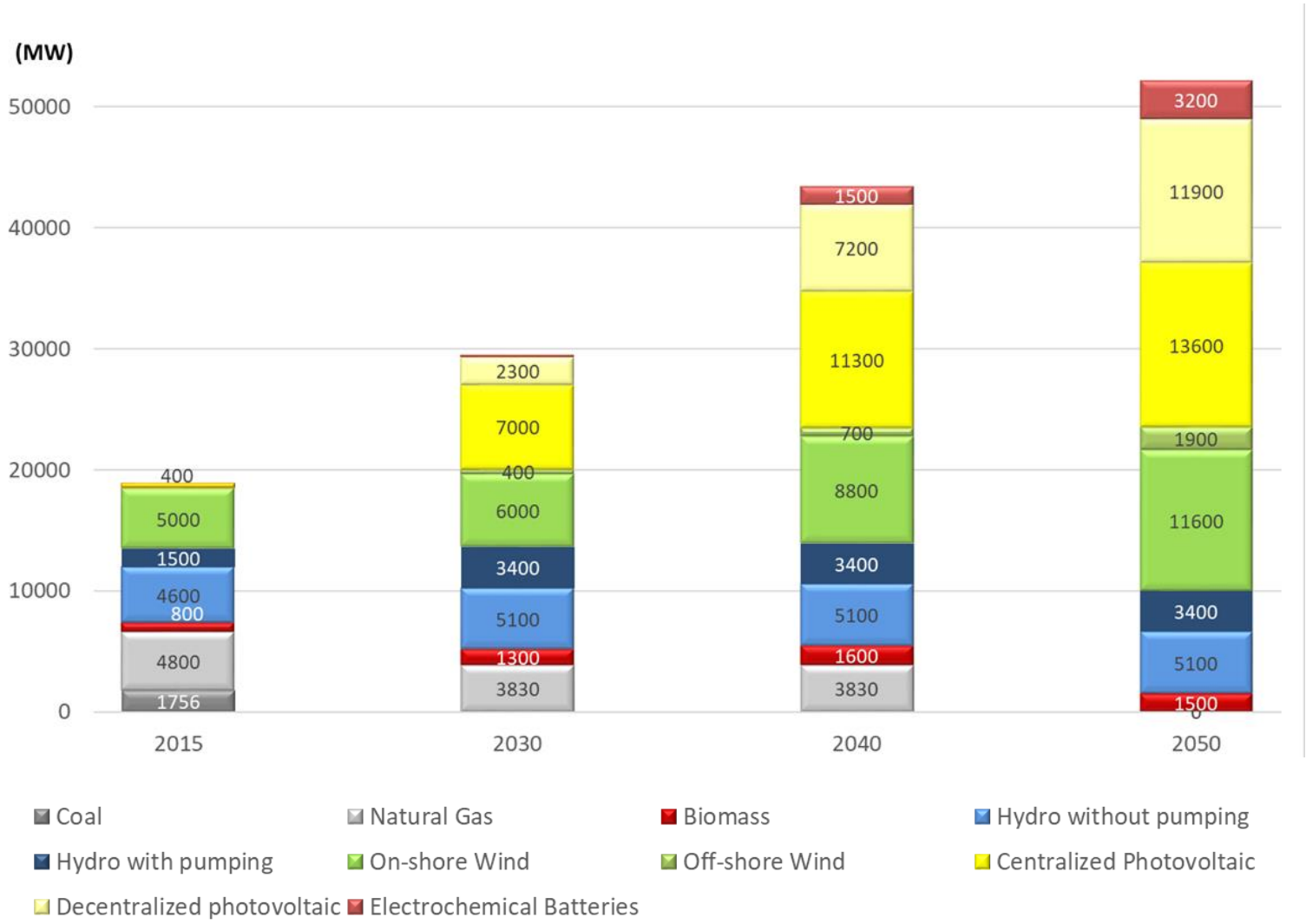


Towards a Neutral Carbon Society

Installed capacity evolution from the different power generation technologies



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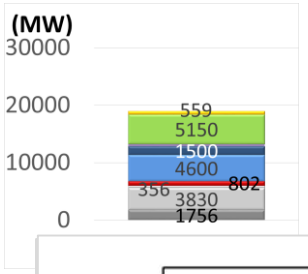
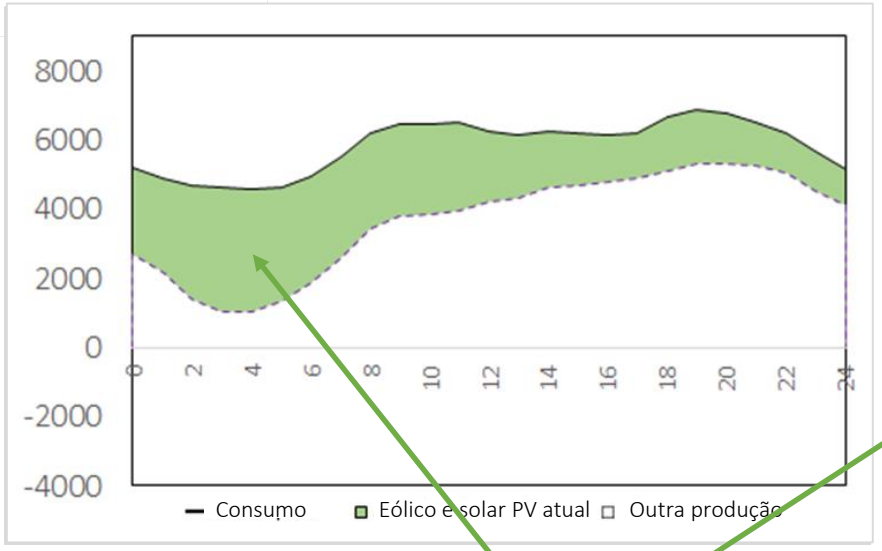
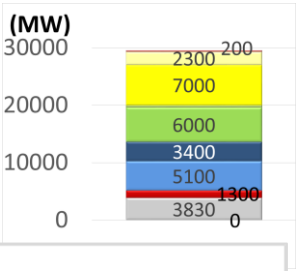
The growing importance of the Balancing Market and of the Flexibility Service Providers

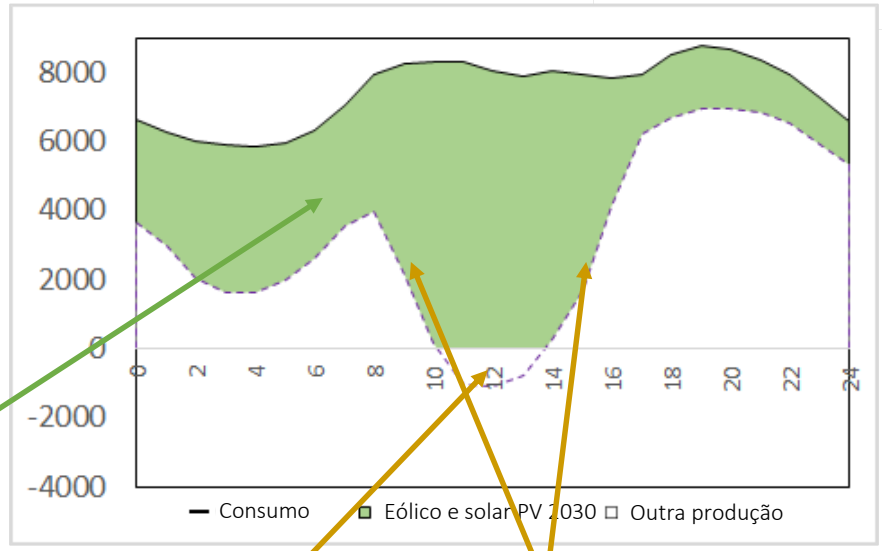


2018



2030





Consumption provided by the Solar PV and Wind power plants

Potential curtailment situation

Bigger ramps

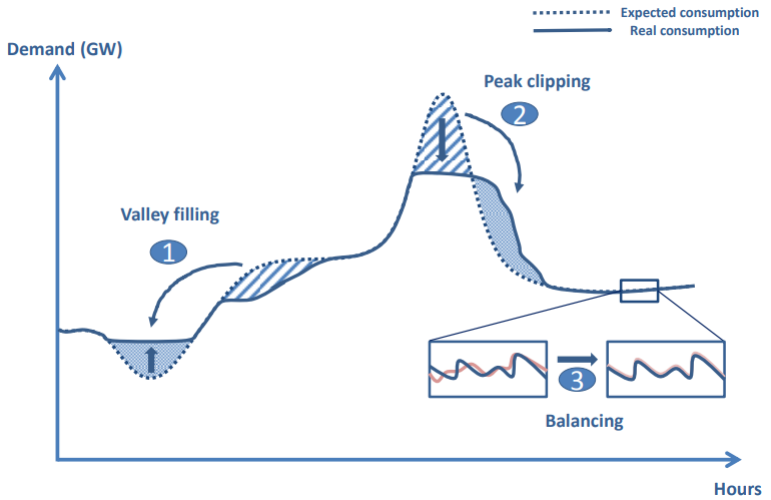
Great challenges for the balancing services providers

Flexibility: a key for the energy system of the future

Flexibility can be defined as **the ability** of the electricity system **to respond to fluctuations of supply and demand** while, at the same time, **maintaining system reliability**.

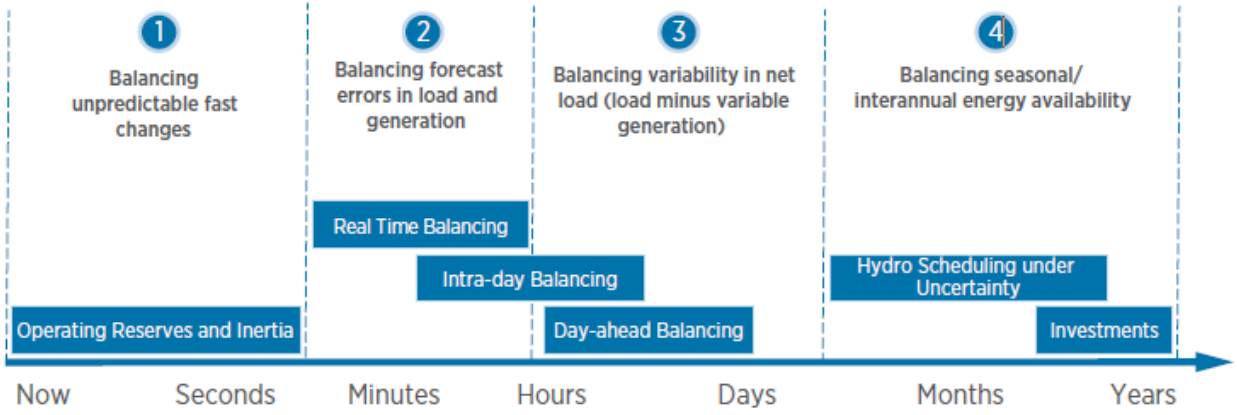
At the facility level (generation / consumption / storage), **flexibility** is **the modification of** generation injection and/or consumption **patterns** in reaction to an external signal (price signal or activation) **in order to provide a service within the energy system**.

The parameters used to characterise flexibility include the amount of power modulation, the duration, the rate of change, the response time, the location etc.



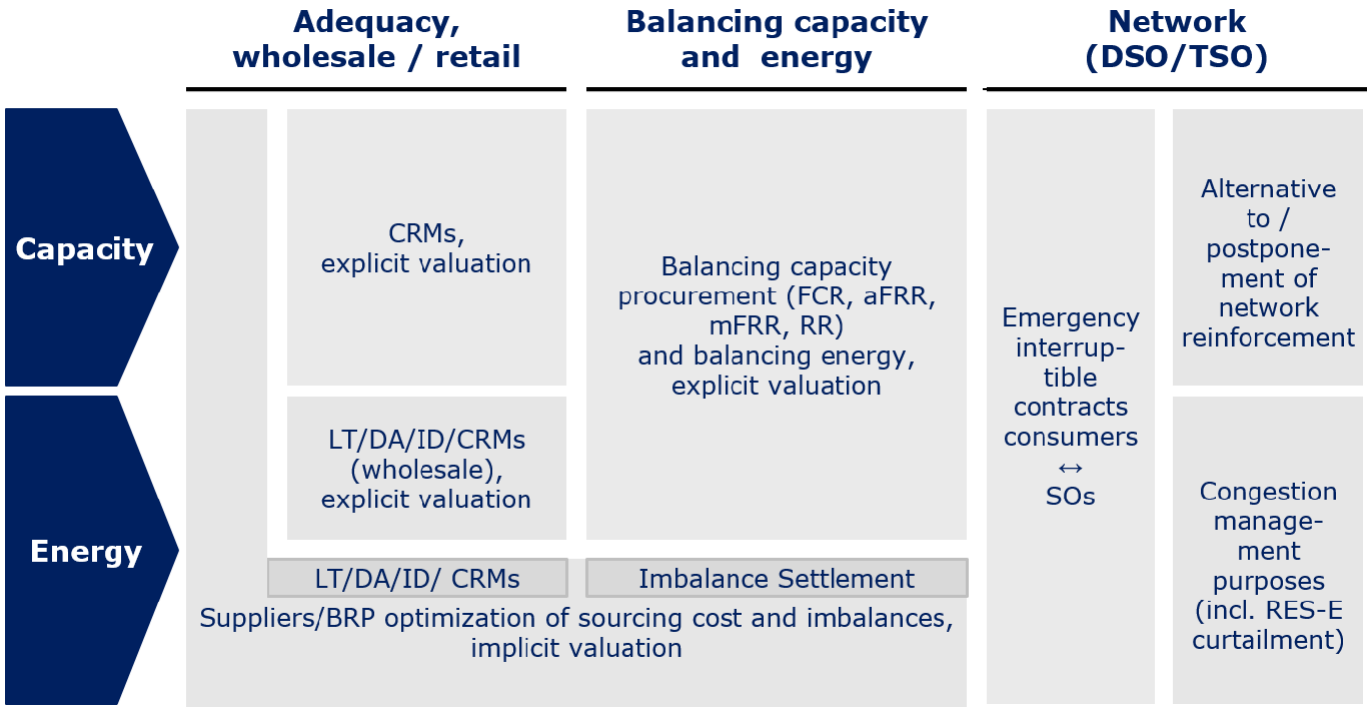
Source: "CEER Advice on Ensuring Market and Regulatory Arrangements help deliver Demand-Side Flexibility, CEER, June 2014

Different time scales for providing flexibility services



Source: IRENA, *Report on future of solar photovoltaic*, November 2019

Power system segments where flexibility adds value



aFRR – automatic Frequency Restoration Reserves
BRP – Balancing Service Provider
CRM – Capacity Remuneration Mecanism
DA – *Day Ahead*
DSO – Distribution System Operator

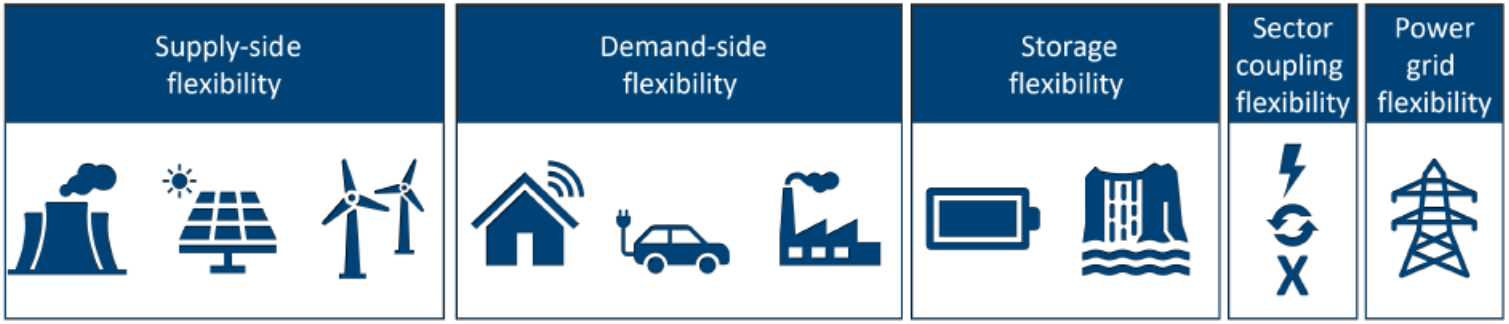
FCR – Frquency Containment Reserves
ID – Intraday
LT – Long Term
mFRR – Manual Frequency R Reserves
RES-E – Renewable Energy Sources

mFRR – manual Frequency Restoration Reserves
RR – Replacement Reserves
SO – System Operation
TSO – Transmission System Operator

Source: "The new retail market design places consumers in the centre", CEER Specialised Training on Wholesale and Retail Market Monitoring, Manuel Sánchez-Jiménez, DG ENER, European Commission, February 2019

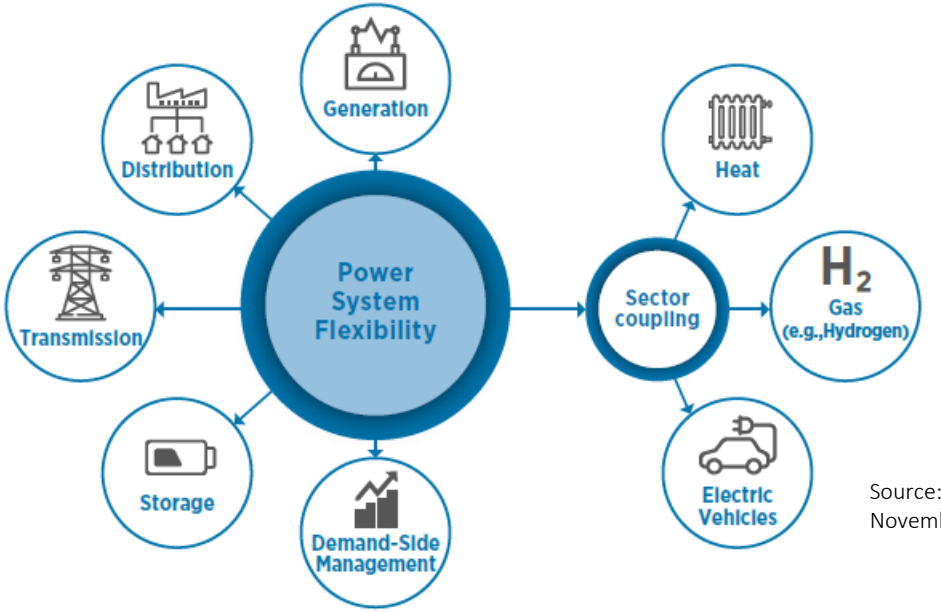
Flexibility solutions

Energy Resources with technical flexibility potential



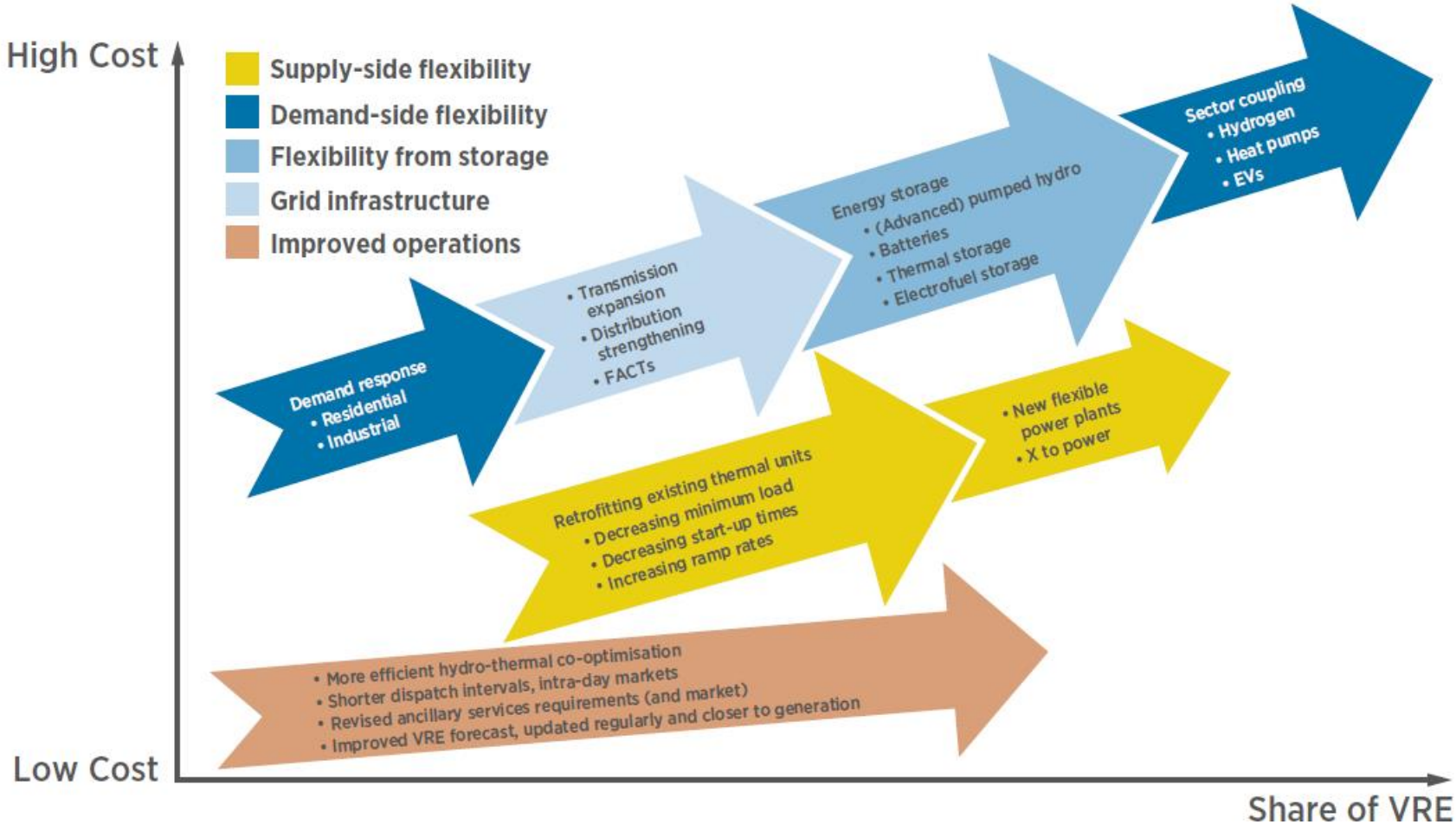
Source: Ahunbay, M., Ashour Novirdoust, A., Bhuiyan, R., Bichler, M., Bindu, S., Bjørndal, E., Bjørndal, M., Buhl, H. U., Chaves-Avila, J. P., Gerard, H., Gross, S., Hanny, L., Knörr, J., Köhnen, C. S., Marques, L., Monti, A., Neuhoff, K., Neumann, C., Ocenic, E., Ott, M., Pichlmeier, M., Richstein, J. C., Rinck, M., Röhrich, F., Röhrig, P. M., Sauer, A., Strüker, J., Troncia, M., Wagner, J., Weibelzahl, M., Zilke, P., 2021, *Electricity Market Design 2030-2050: Shaping Future Electricity Markets for a Climate-Neutral Europe*, https://doi.org/10.24406/fit-n-644366

Power system flexibility enablers in the energy sector



Source: IRENA, *Report on future of solar photovoltaic*, November 2019

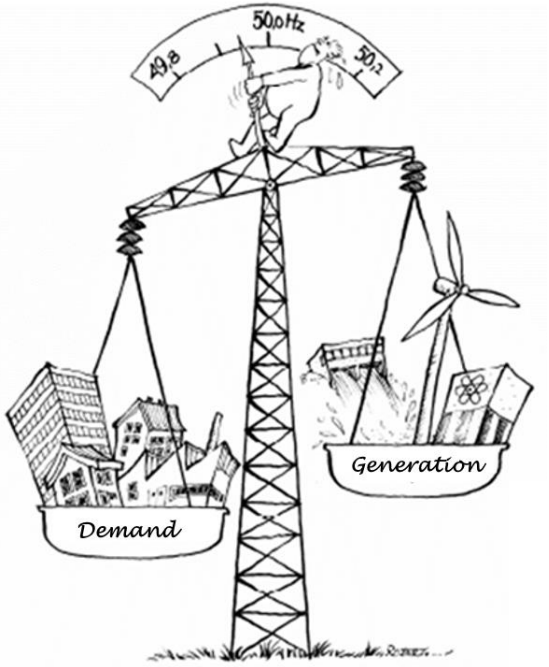
Technical options to increase system flexibility

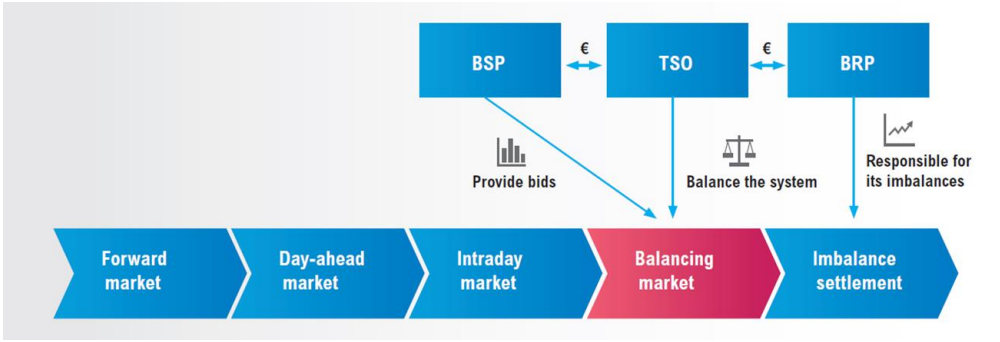


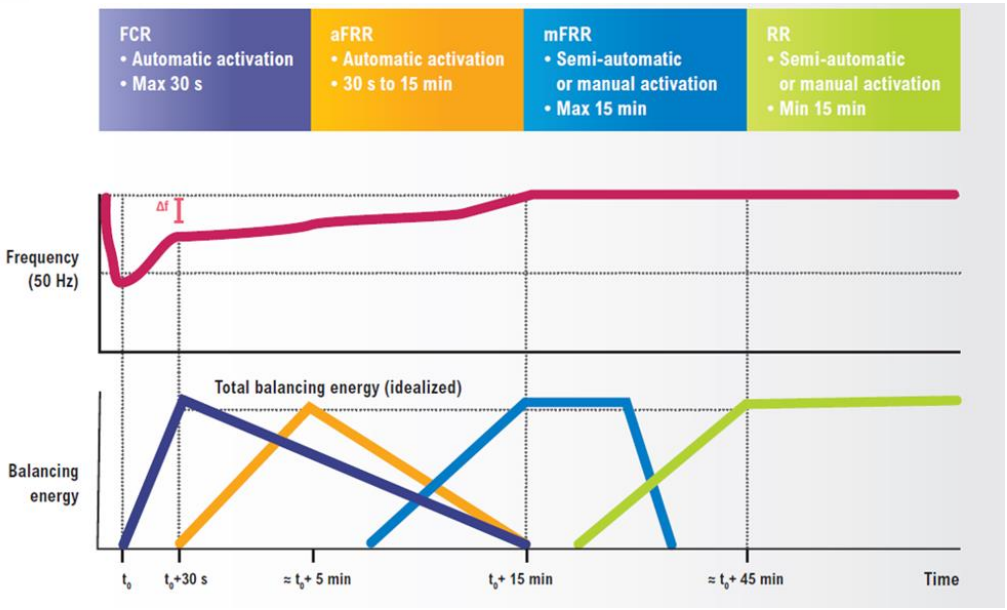
Source: IRENA, *Report on future of solar photovoltaic*, November 2019

Pilot Project "Participation of Consumption in the Regulation Reserves Market" developed from 2019 in Portugal

Perspectives of a bigger importance of the balancing market in the future







More information at: http://www.erse.pt/pt/electricidade/regulamentos/operacaodasredes/Paginas/ProjetoPilotoReservaRegula%C3%A7%C3%A3o.aspx

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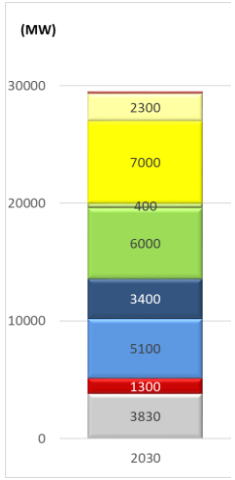
“Expected Power demand” in 2030

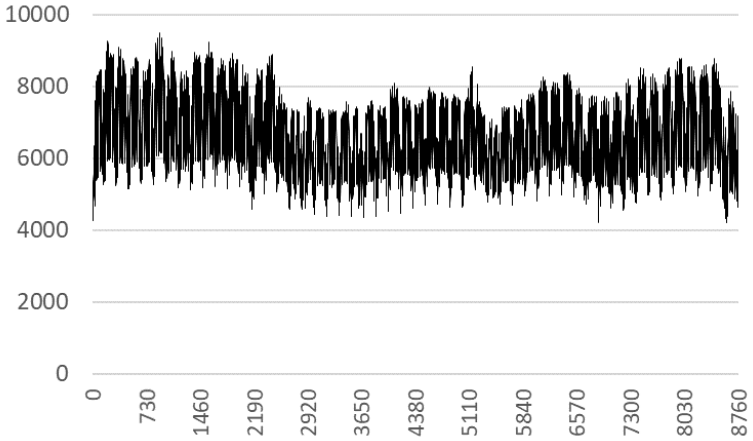
Assumptions RNC 2050 for 2030



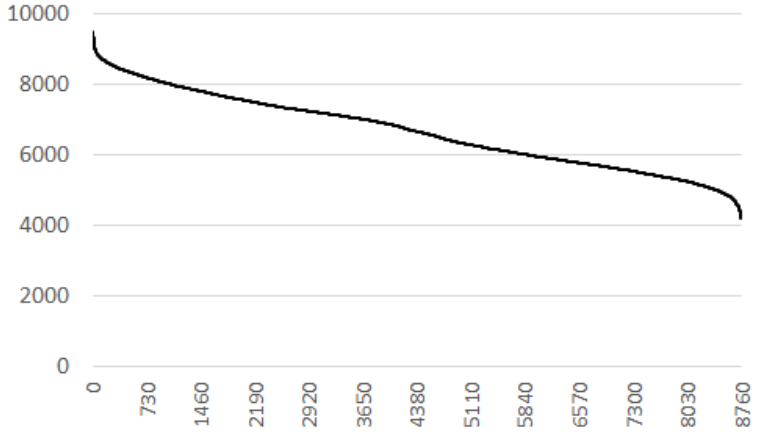
- Coal
- Natural Gas
- Biomass
- Hydro without pumping
- Hydro with pumping
- On-shore Wind
- Off-shore Wind
- Centralized Photovoltaic
- Decentralized photovoltaic
- Electrochemical Batteries

58 TWh of electricity consumption per year

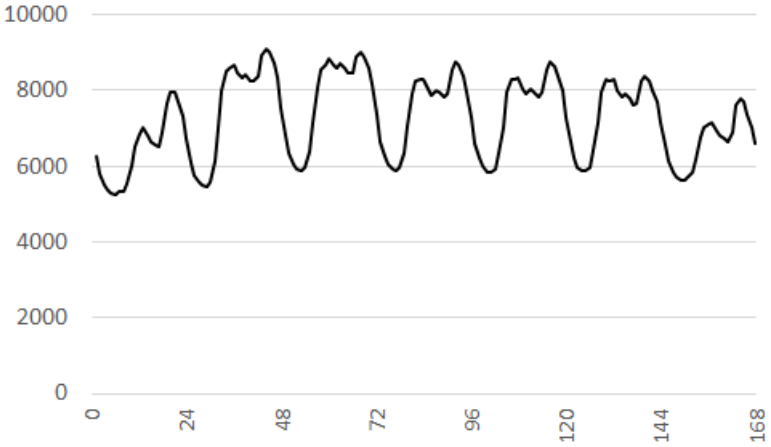
Year



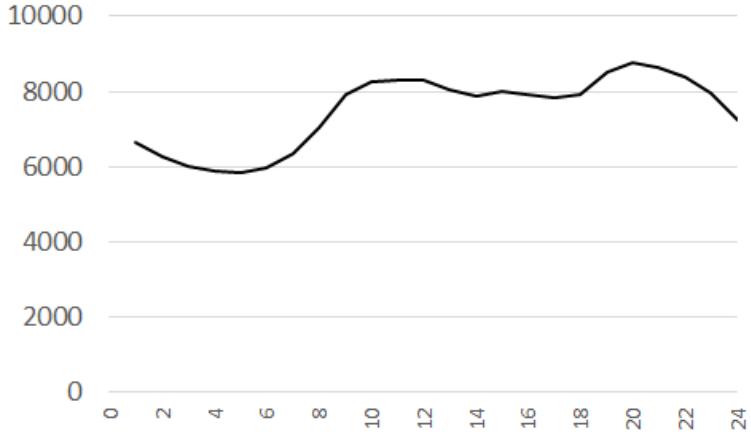
One year histogram



Week



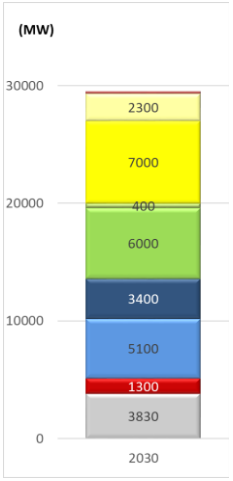
Day



Hourly profiles of consumption based on values occurred during 2018 projected to the “expected” value for 2030 according to the RNC 2050. Values to be considered as indicative ones and only presented as an example.

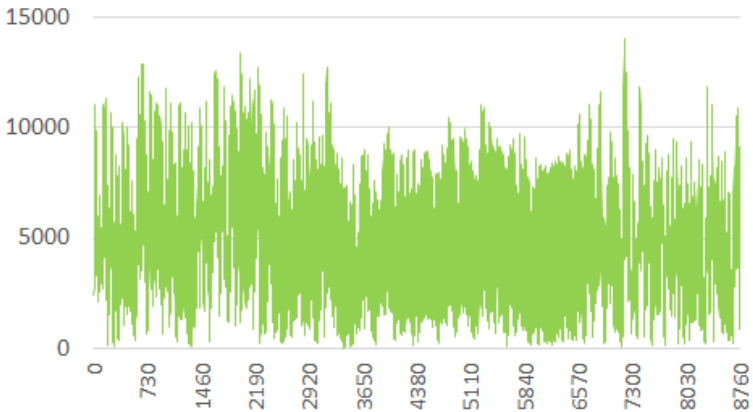
Non-flexible power generation (Solar PV and Wind)

Assumptions RNC 2050 for 2030



36 TWh of non-flexible power generation per year

Year



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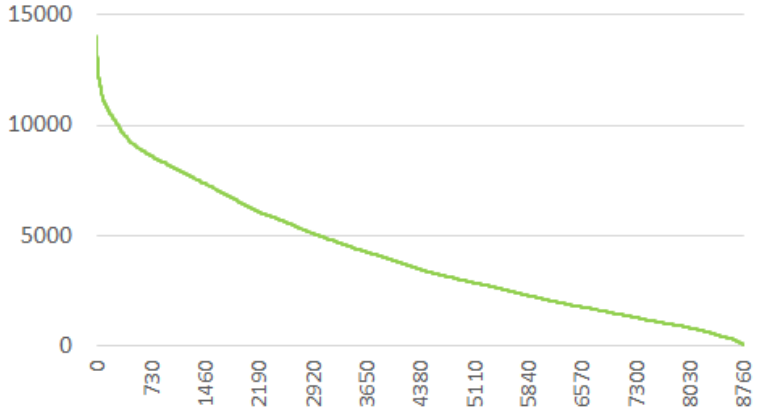
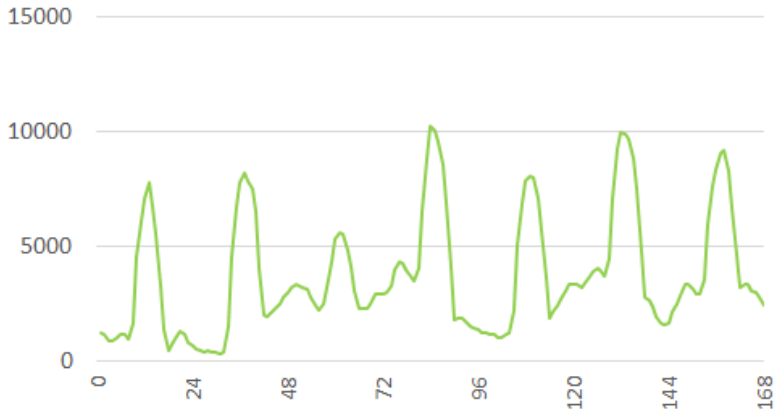


Week



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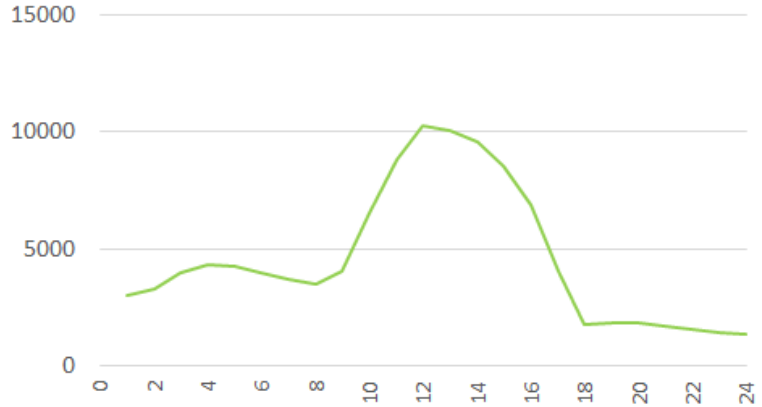

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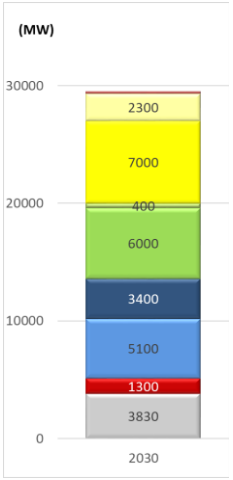
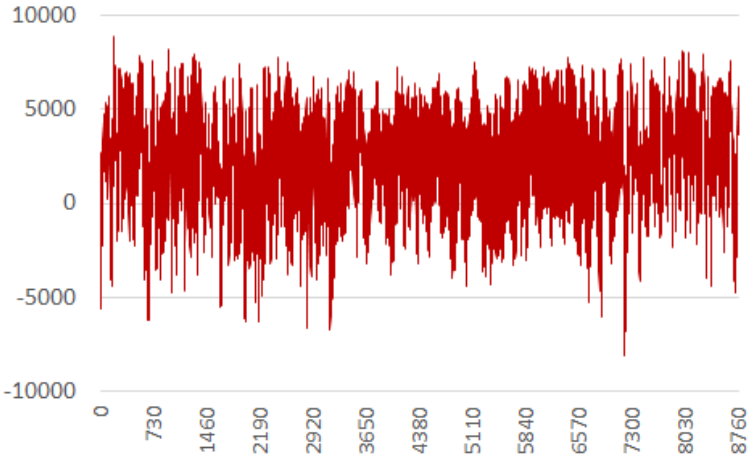
Expected flexibility services to be provided

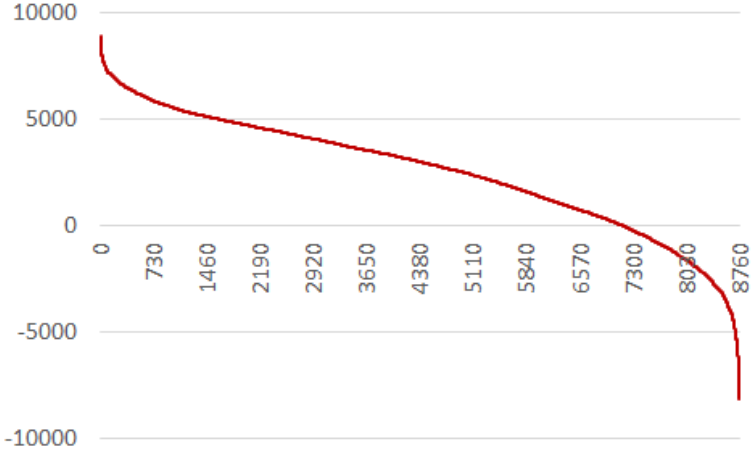
Assumptions RNC 2050 for 2030



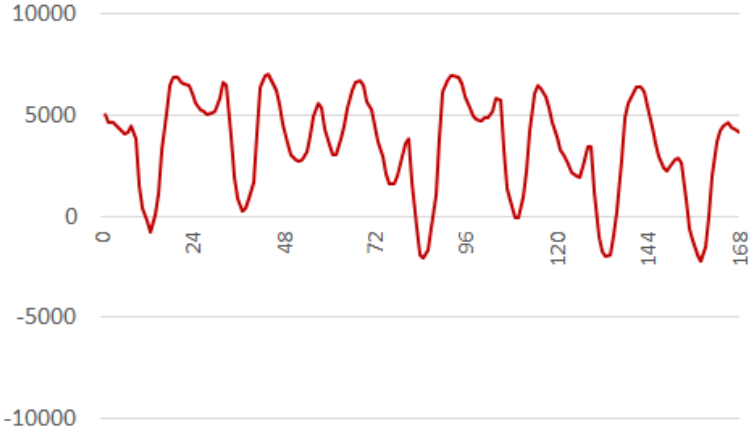
Year



One year histogram



Week



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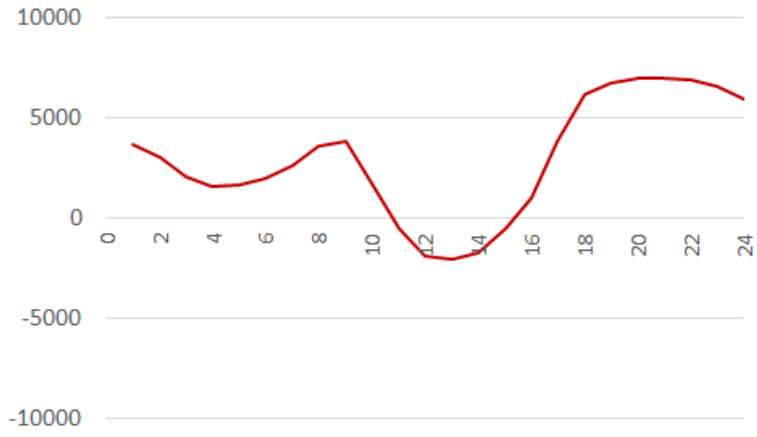

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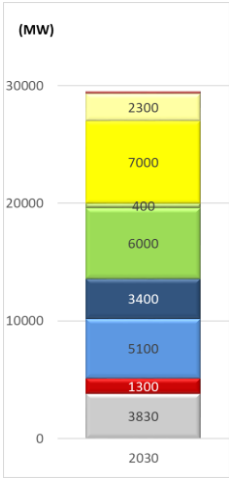
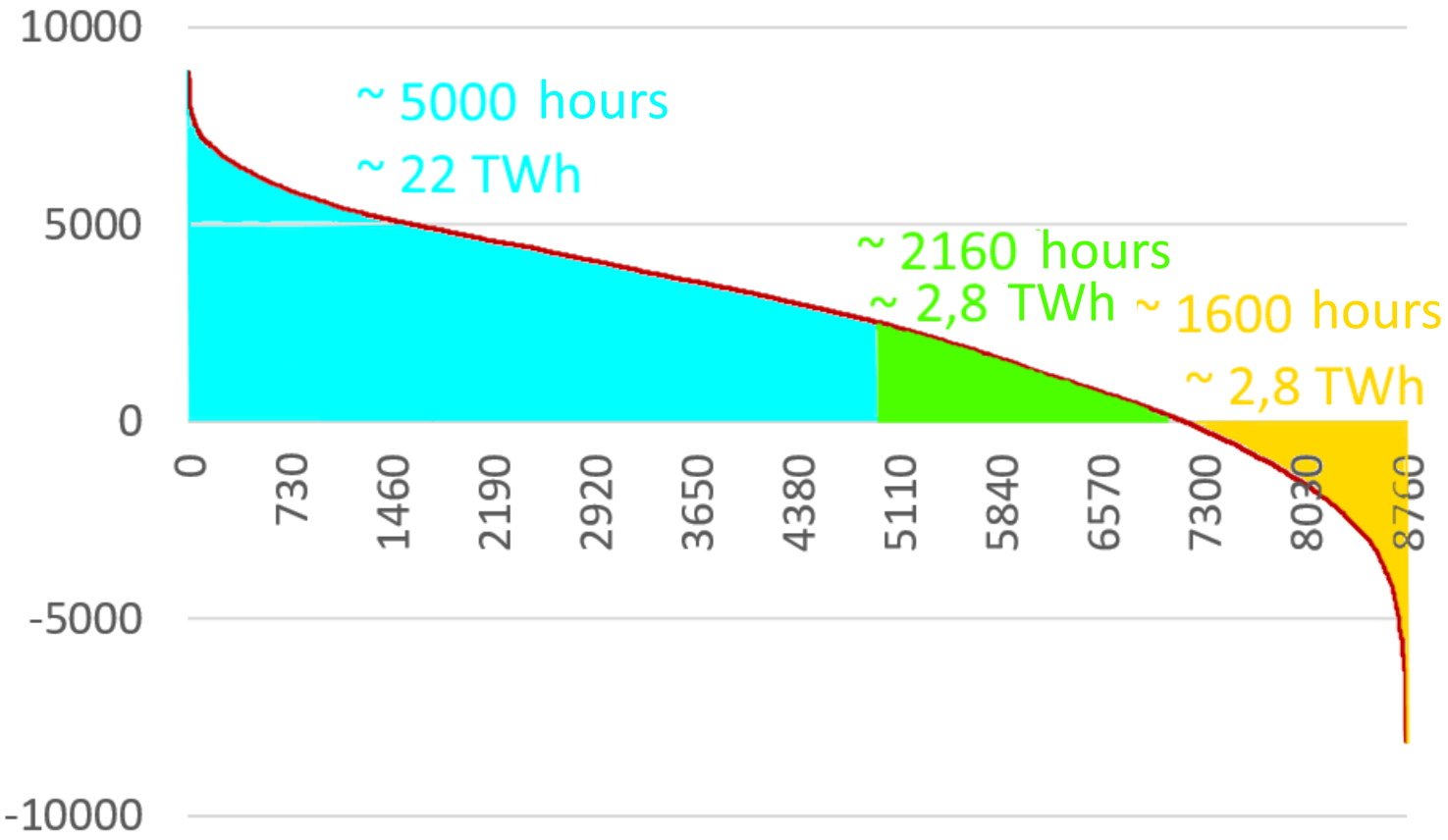
Expected flexibility services to be provided

Assumptions RNC 2050 for 2030





22 TWh + 2 x 2,8 TWh of flexibility services to be provided per year

22 TWh of consumption not provided by the non-flexible power generation.
2,8 TWh of generation with potential to be curtailed

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Reflections on the regulatory framework

The electricity system of the future needs the involvement of all the **Distributed Energy Resources** and a more active **demand participation,** in complement to the **supply side flexibility**.

Cooperation between TSO and DSOs will be key for the well-functioning of the electricity system of the future.

The **regulatory framework** should:

- Be **technology agnostic and non-discriminatory** but should assure that load, storage (including vehicle to grid technology), and distributed generation, aggregated or not, have *de facto* access to all electricity markets segments. No resource providers should be excluded. **Aggregation and aggregators** can help this implementation.
- Define products, services, markets. Flexibility involves all the traditional **wholesale markets**, including **balancing markets**, but also procurement for **non-frequency ancillary services** and **congestion management services**.
- Define **requisites for pre-qualification** to be service provider.
- Define principles for **data exchange** (including exchange of data between TSO and DSOs but also between system operators and service providers).
- Establishes principles for the **interaction between markets** and for the **value stacking** resulting from the possibility of services providers to be active in several markets.

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Thank you!

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