Agenda FISE-CIGRE CONFERENCE 2021
Nuevos retos, nuevos caminos para la sostenibilidad
Noviembre 18 de 2021

Desafíos para la integración en la operación de los sistemas de fuentes no sincrónicas y DER

Jayme Darriba Macêdo – CIGRE SC.C2 Chair

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Introducing CIGRE SC.C2 - Power System Operation and Control

SC.C2 – Power System Operation and Control

- OUR MISSION:

a) To facilitate and promote knowledge dissemination and worldwide collaboration;

b) To facilitate unbiased technical information exchange, integrating solutions and recommendations;

c) To prepare for the foreseen future challenges by integrating and consolidating available knowledge and taking into account the usage of new and proven technologies;

d) To engage and encourage young members to increase their involvement in the SC activities.

SC.C2 – Power System Operation and Control

2.OUR TECHNICAL DIRECTIONS:

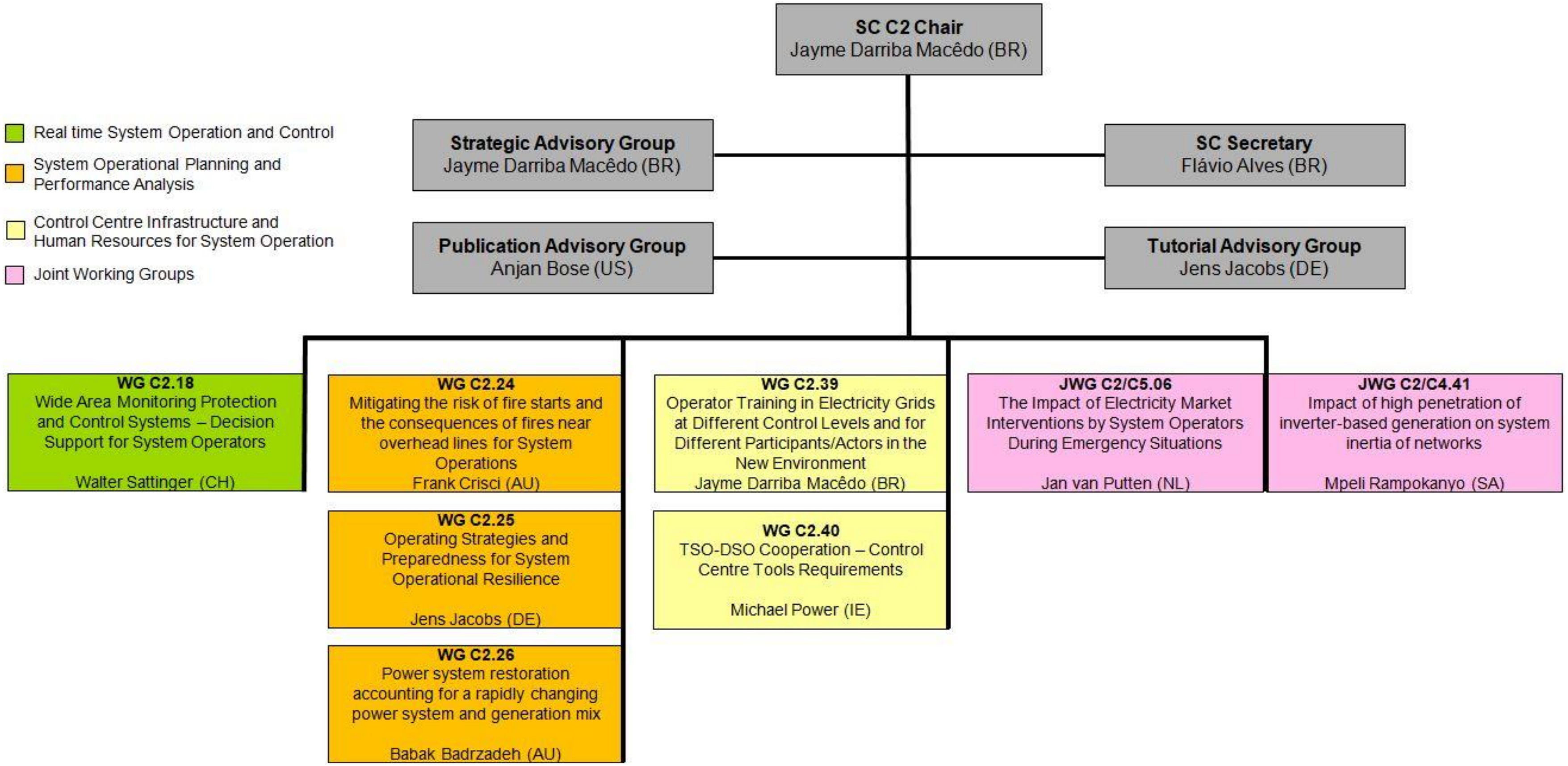
TD-1: Real-Time System Operation and Control;

TD-2: System Operation Planning and Performance Analysis;

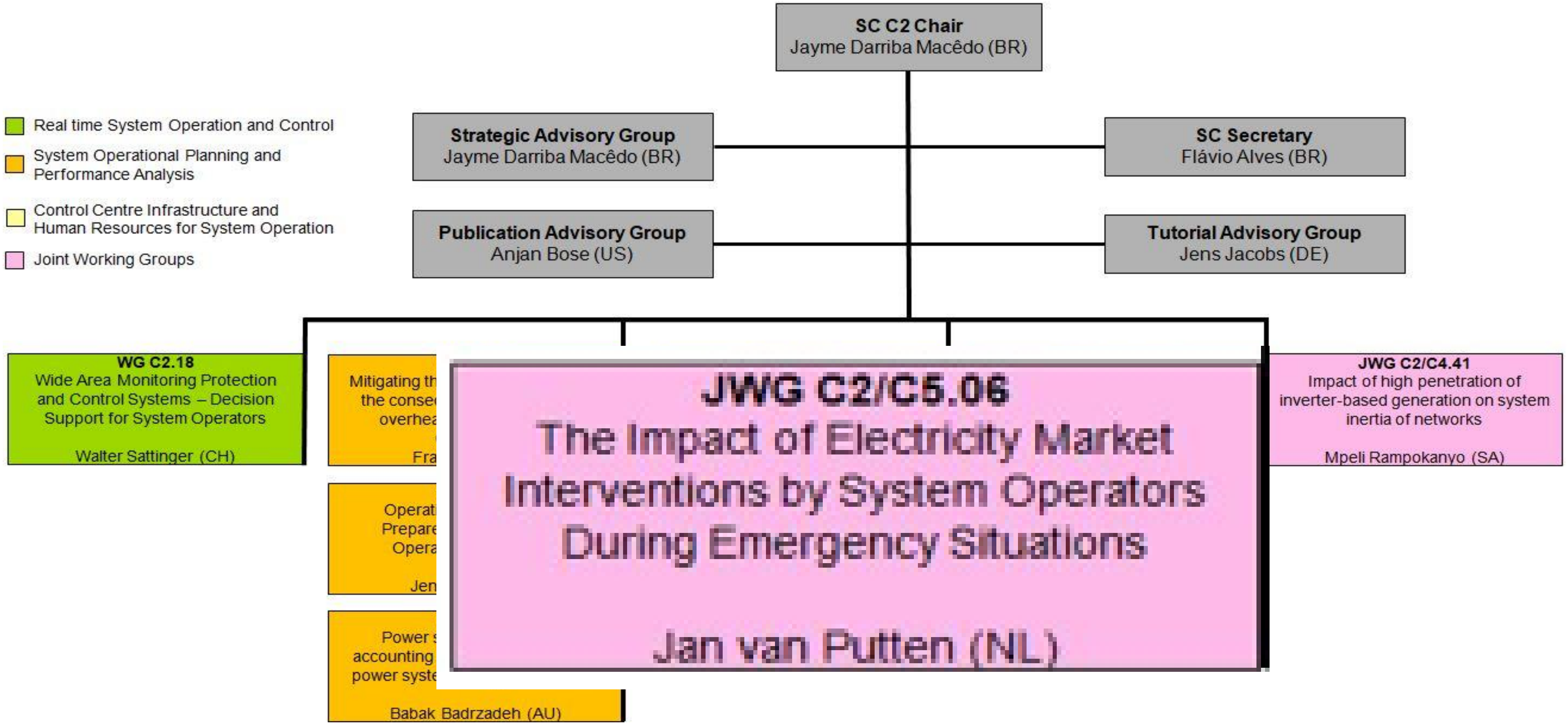
TD-3: Control Center Infrastructure and Human Resources for System Operation.

SC.C2 – Power System Operation and Control

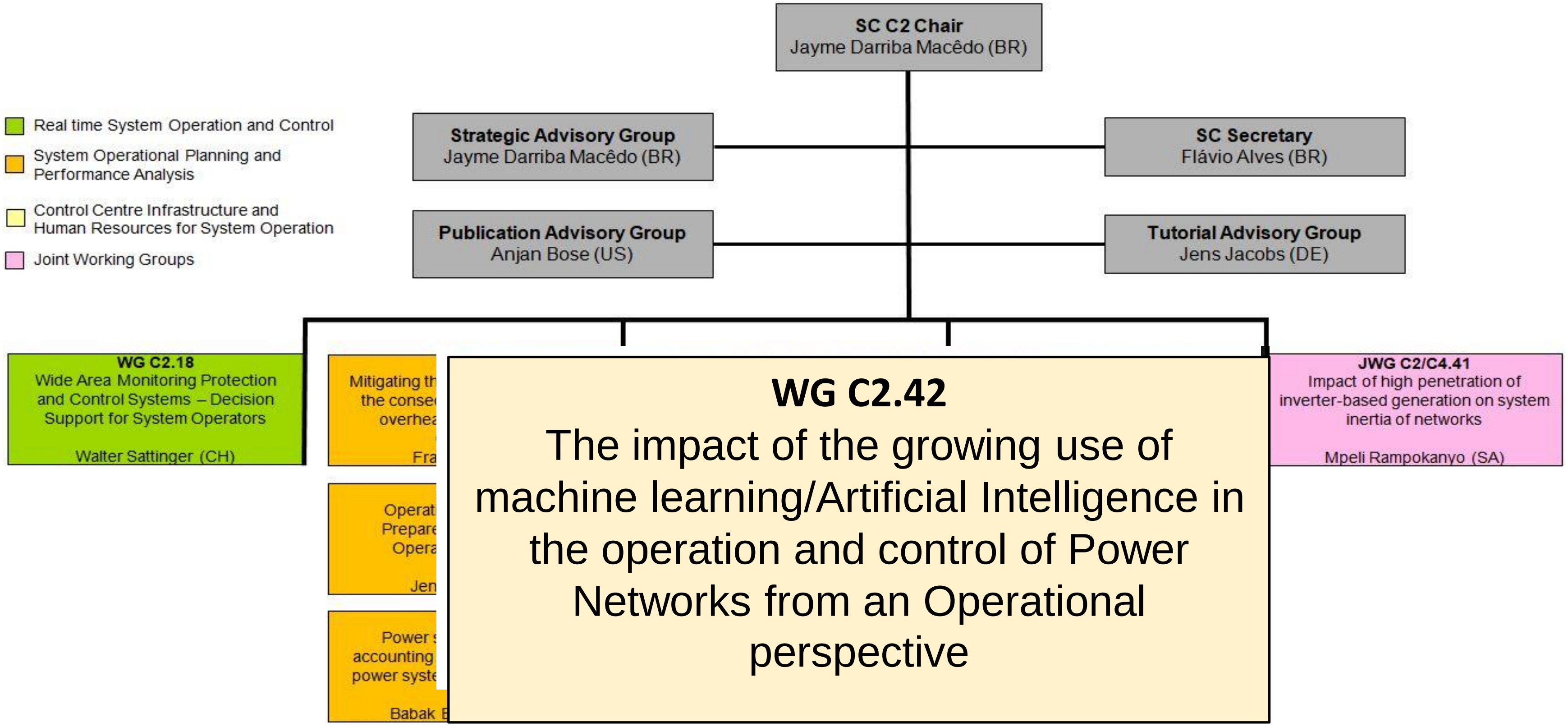
3. OUR STRUCTURE:



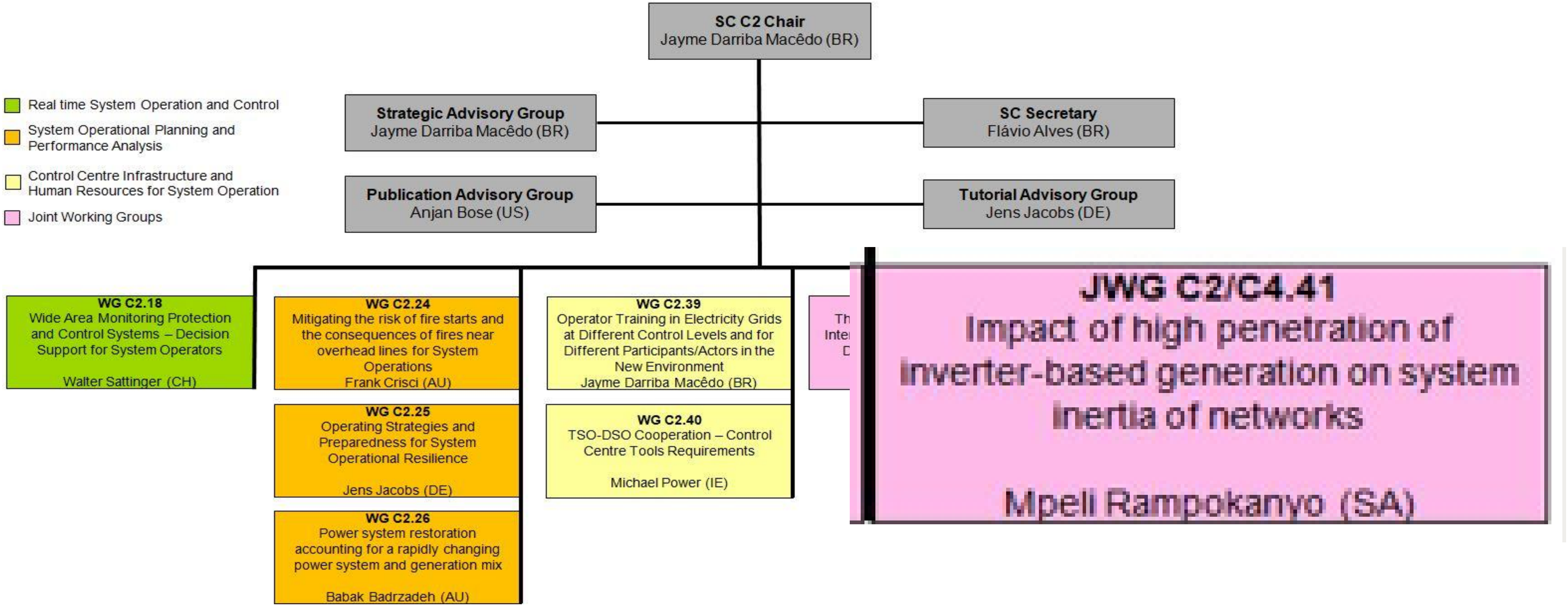
And... To bring YOU to SC.C2...
WG starting work



And... To bring YOU to SC.C2...
WG starting work soon



AND FOR TODAY?



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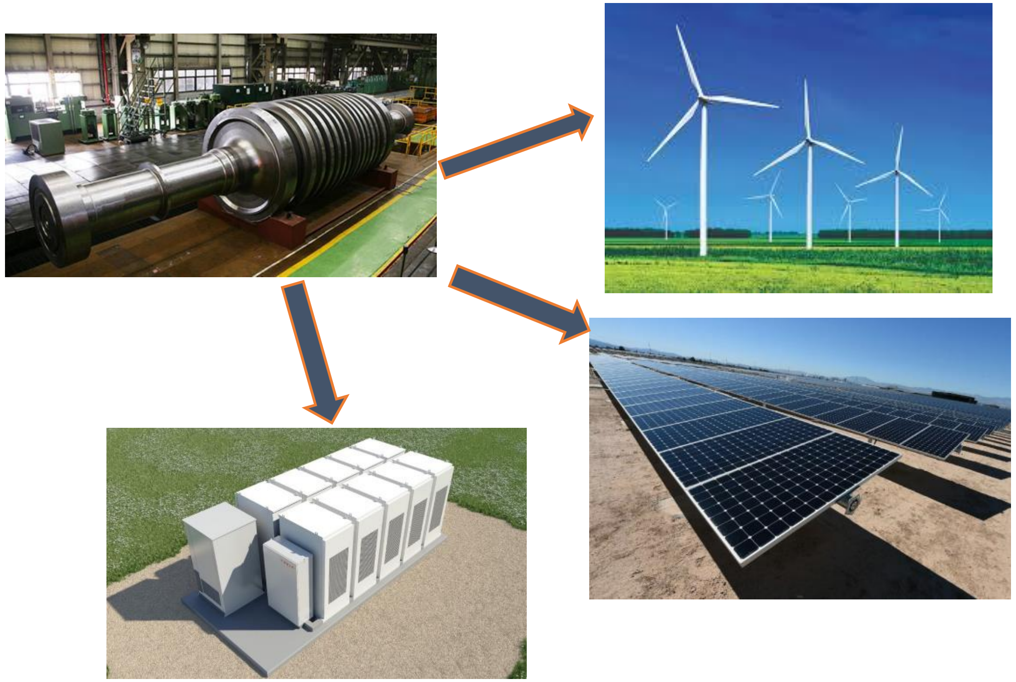
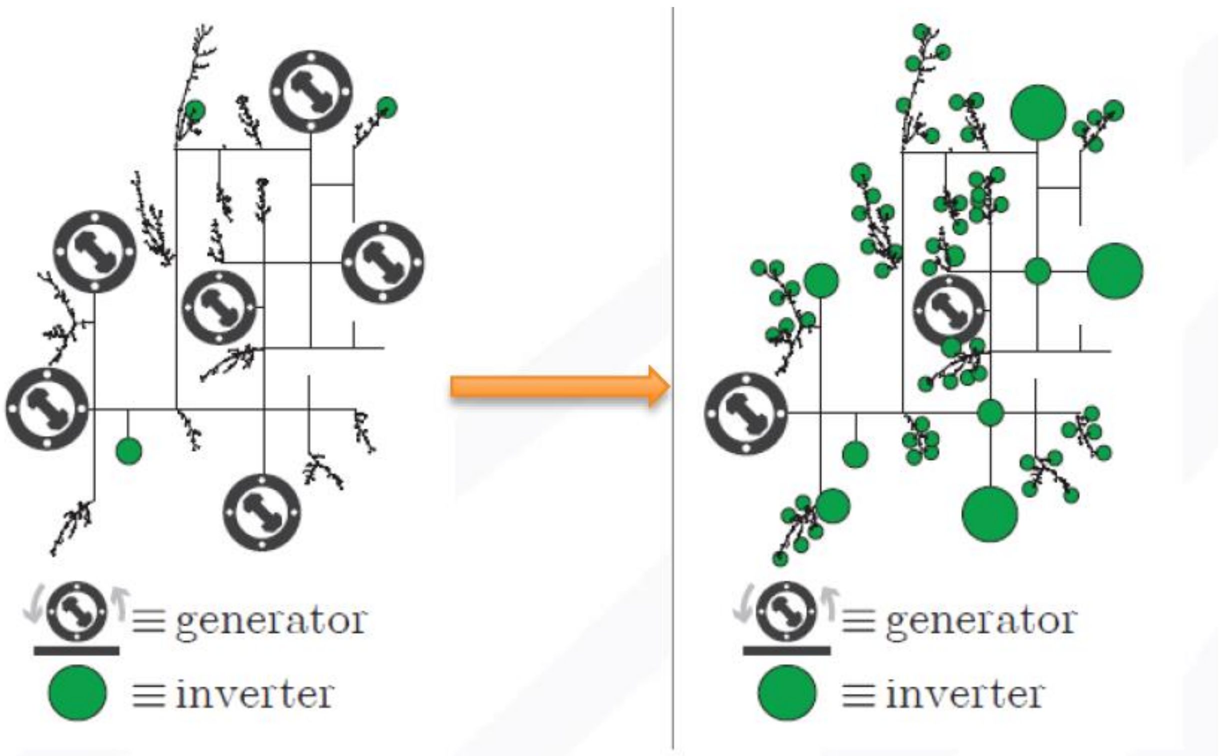
Desafíos para la integración en la operación de los sistemas de fuentes no sincrónicas y DER

Changing Resource Mix



Grid Today

Grid Tomorrow



Source: DOE Solar Energy and Technology Office

New technologies bring these new problems
but also offer the solutions

Changing Resource Mix – What is for fun?

Desafíos para la integración en la operación de los sistemas de fuentes no sincrónicas y DER

Part 1: Impacts of Power System Inertia
Mitigations of Power System Inertia

Part 2: Variability of Wind/Solar Generation

Part 3: Distributed Energy Resources - DER

Desafíos para la integración en la operación de los sistemas de fuentes no sincrónicas y DER

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Nov/2021 = TB 851 – available in e-cigre.org

JWG C2/C4.41 - Objectives and Scope

To advise and formulate philosophies for system operations in order to prepare for the on-going energy transition and mitigate against the impact of the reduction of synchronous inertial energy on the power system as a result of integration of non-synchronous renewable generation.

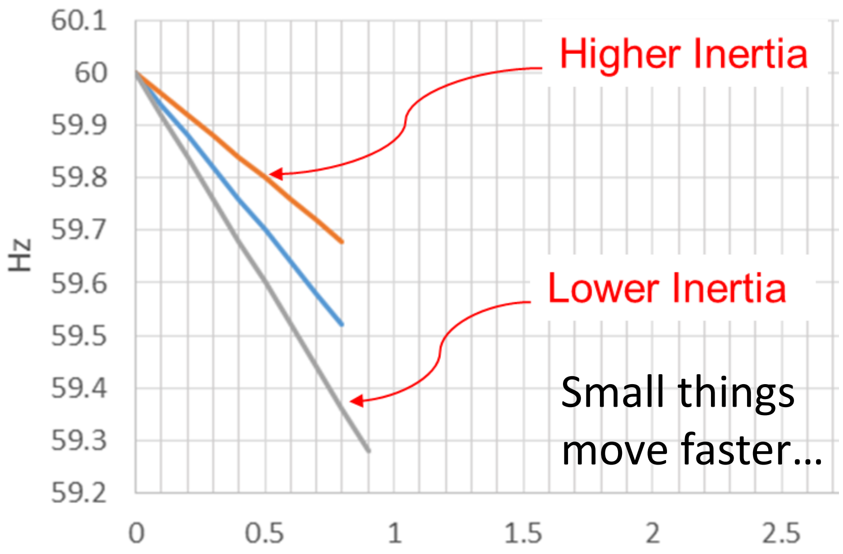
Key Scope Areas:

- Review and consolidate the challenges posed by reduced inertia
- Understand existing best practice, codes and policies
- Define operational measures for inertia requirements, dispatch and estimation
- Quantify reserve requirements and study methodologies
- Establish availability of mitigation methods and technologies

What does inertia do?

Synchronous inertia determines the rate of frequency change immediately after any imbalance between generation and demand

- Immediately after a contingency event (e.g. generation trip), stored kinetic energy is used to balance supply and demand
- **But**, mechanical power input of the generators is still unchanged.
- **So**, generators will start to slow down, and the system frequency declines as a result
- The rate of change of frequency (RoCof) depends on the total amount of inertia response available at the time of an event.
  - ✓ **The more energy a machine must provide relative to its stored energy the more that machine will slow down**
- **Inertia plays a key role in limiting RoCoF in power systems**

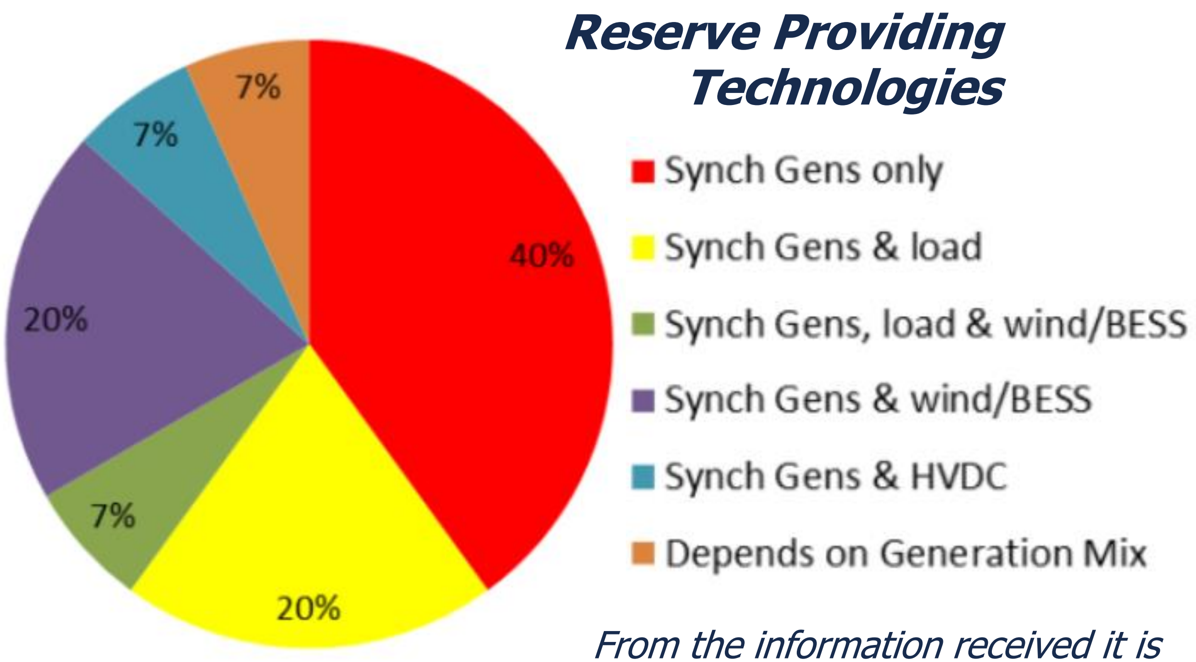


For power system expertise

International experience

Procurement of frequency control reserve

- Market based
  - AEMO (Australia), Amprion (Germany), Statnett – Nordic (Denmark), ERCOT (USA)
- Reliability criteria
  - ONS (Brazil), Hydro-Quebec (Canada), Manitoba Hydro (Canada), TenneT TSO B.V. (Netherlands), Swissgrid (Switzerland), EirGrid (Ireland)
- Mandatory for all generators
  - Red Eléctrica de España (REE)



From the information received it is evident that synchronous generators i.e. thermal, hydro and gas play a pivotal role in providing PFR capacity

Losing synchronous generators doesn't just mean lost inertia

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For power system expertise

International experience

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1. Brazil - Operador Nacional do Sistema Electrico (ONS)

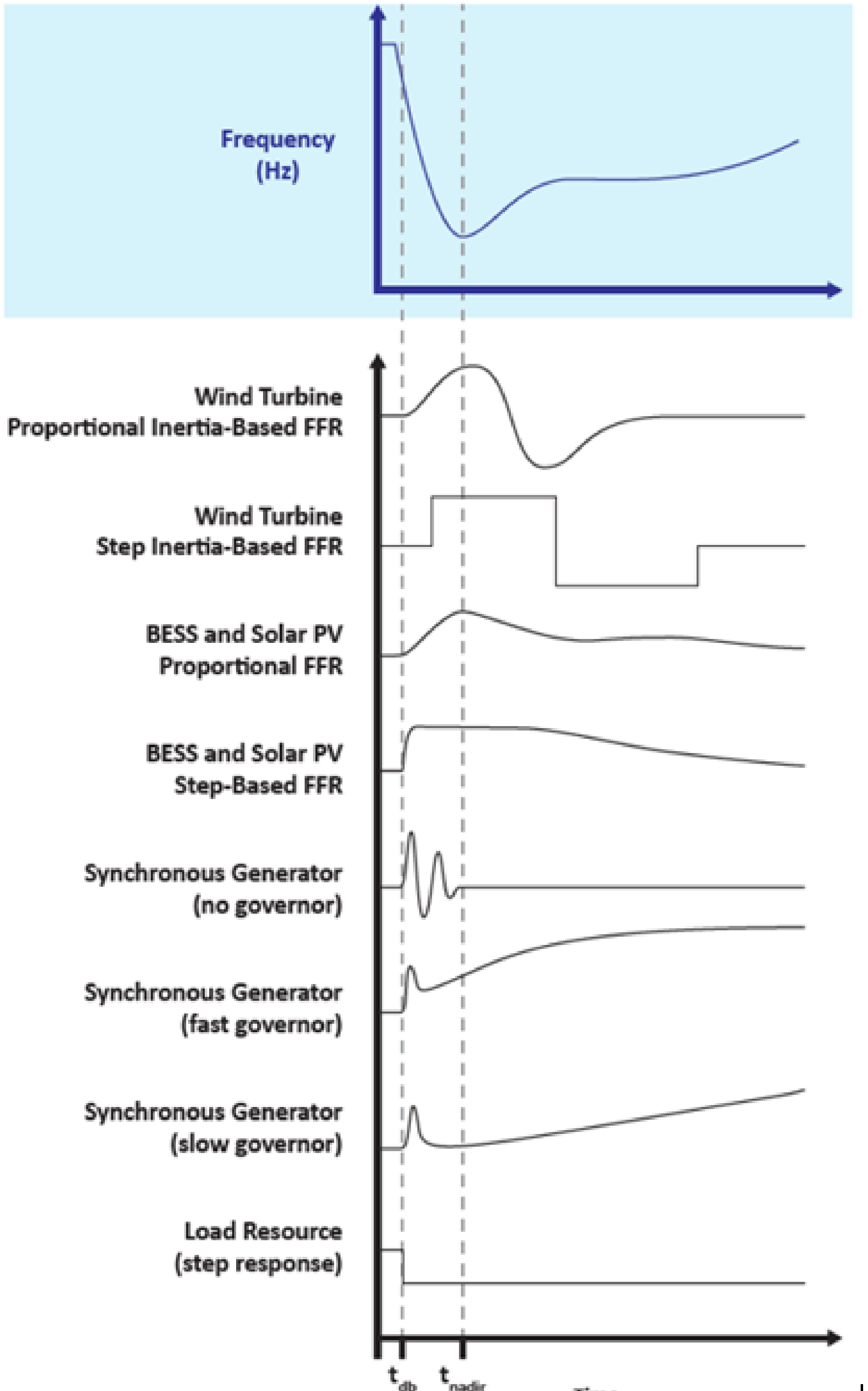
In Brazil

- All thermoelectrical and hydro units with speed governor must provide FCR unless they are at full load.
- New wind power plants larger than 10 MW are required to have proportional speed governor for over-frequency in the range 60.2-52.5 Hz (with 3%/0.1Hz droop based on available power) and synthetic inertia for under-frequency below 59.8Hz.
- The calculation of the FCR is done with mechanisms of the reliability criteria based on probabilistic calculation. Each control area is required to provide a minimum FCR equal to the 1% of its total load (including power exchanges).
- There are currently no definitions or requirements pertaining to FFR. In the South Region, there are special schemes of automatic conversion from synchronous compensators to generators in underfrequency events.

Losing synchronous generators doesn’t just mean lost inertia

For power system expertise

Frequency Response from Different Resourse Types



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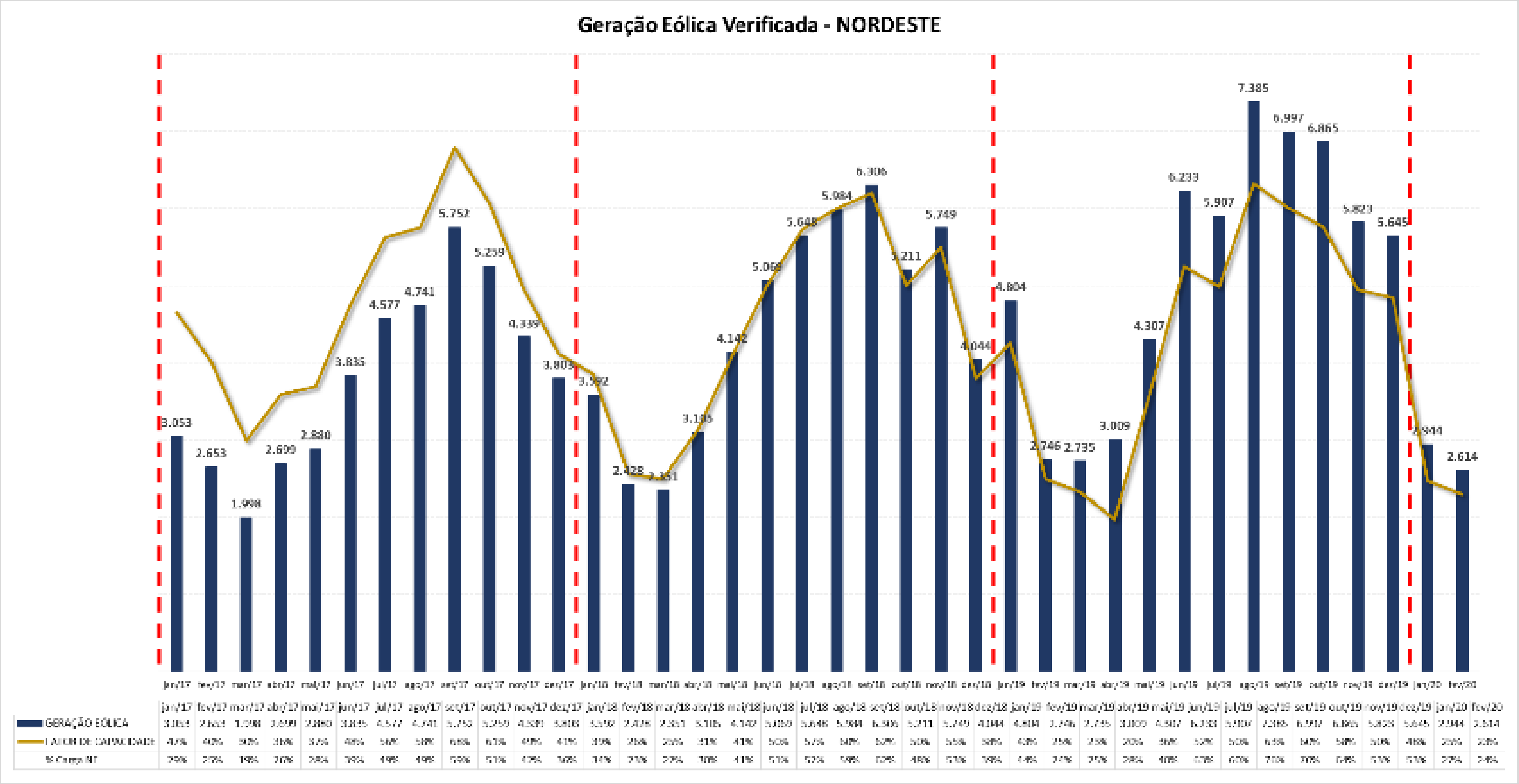
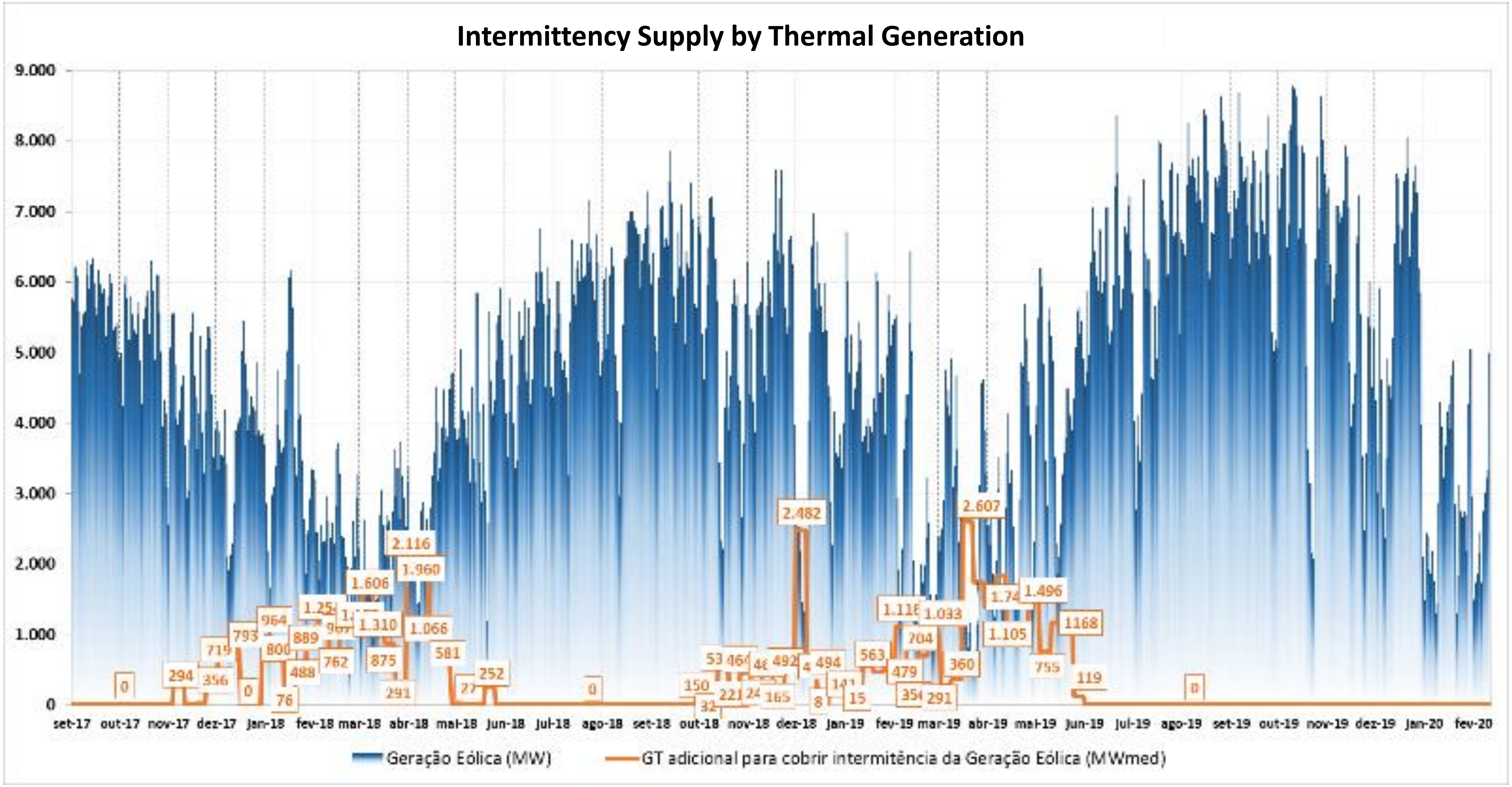
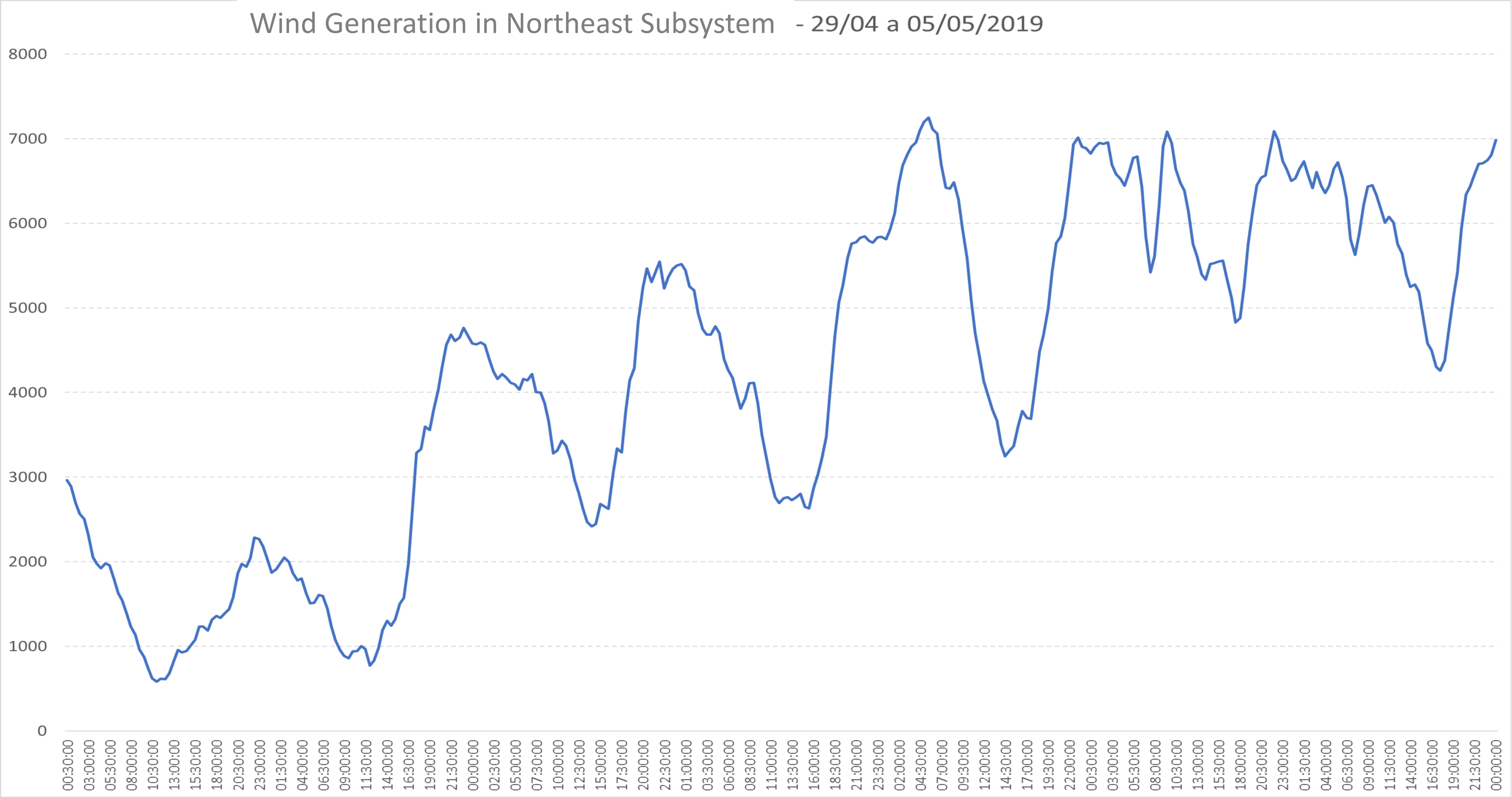
Variability of Wind Generation (last 3 years)



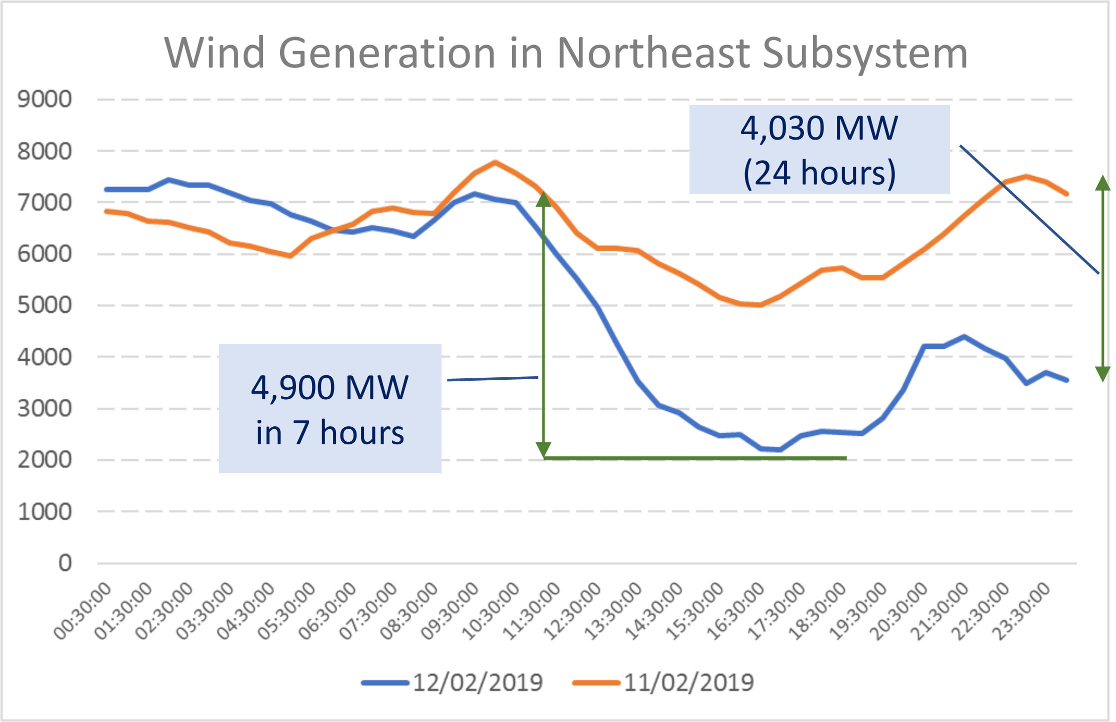
Variability of Wind Generation (last 3 years)



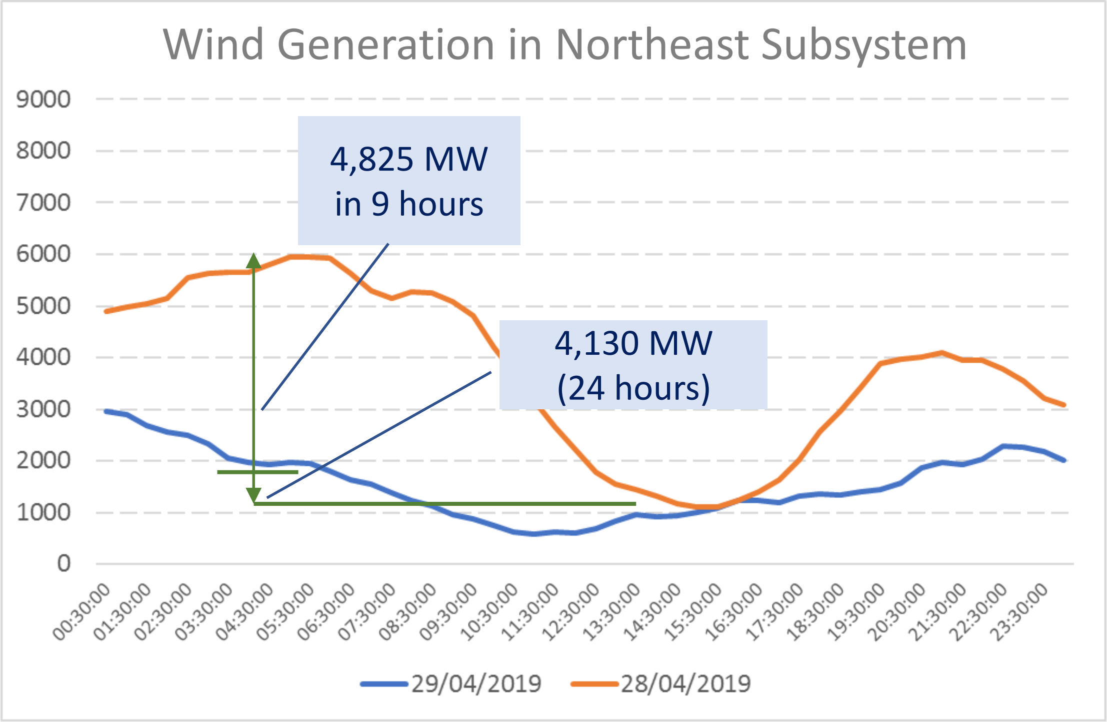
Variability of Wind Generation (weekly)



Variability of Wind Generation (daily)



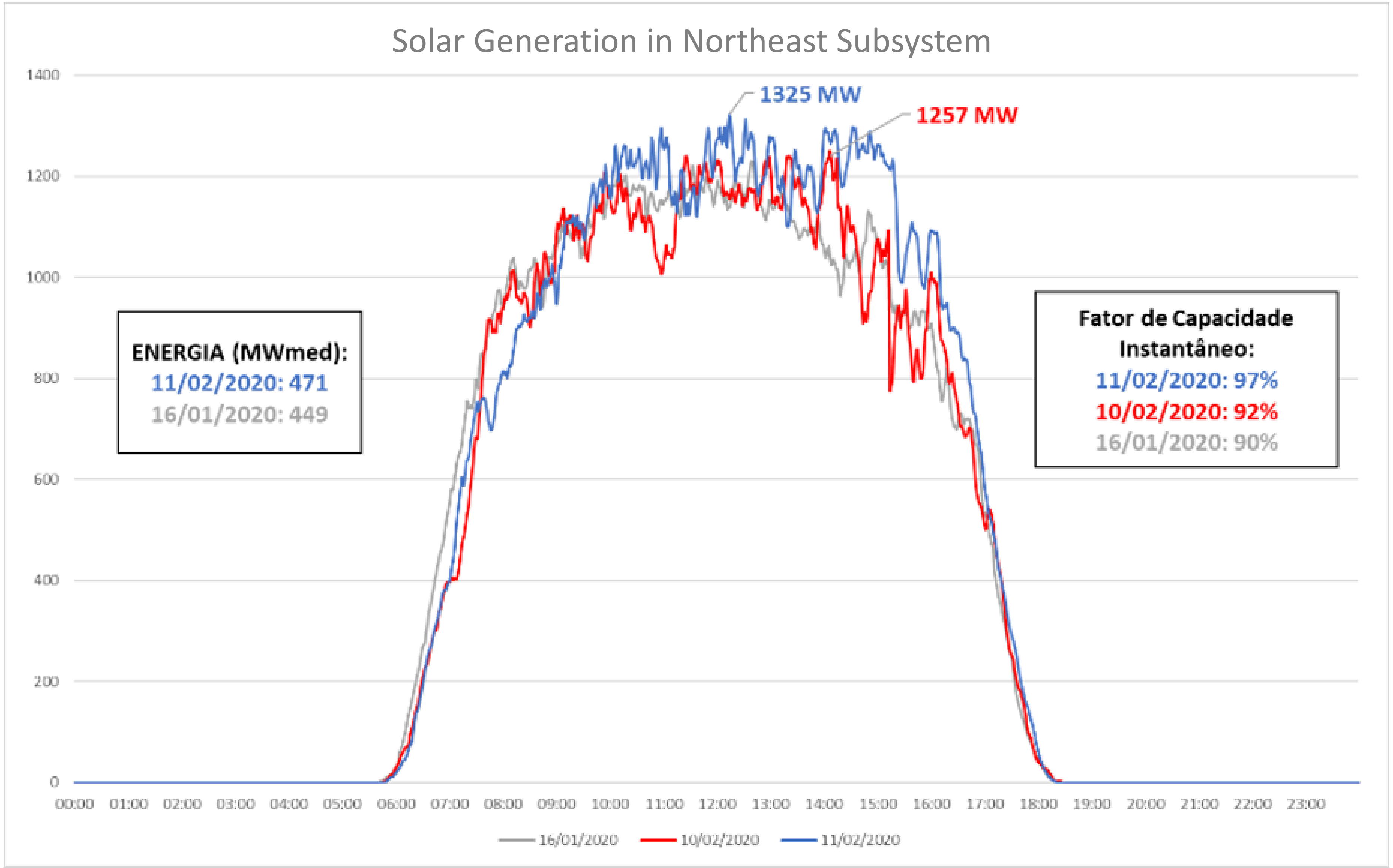
Variation equivalent to 40% of the maximum load of the Northeast Subsystem on this day



Variation equivalent to 50% of the maximum load of the Northeast Subsystem on this day

HPP Xingó (Biggest Northeast Subsystem HPP) = 3,162 MW

Variability of Solar Generation (daily)



How to Cope with...

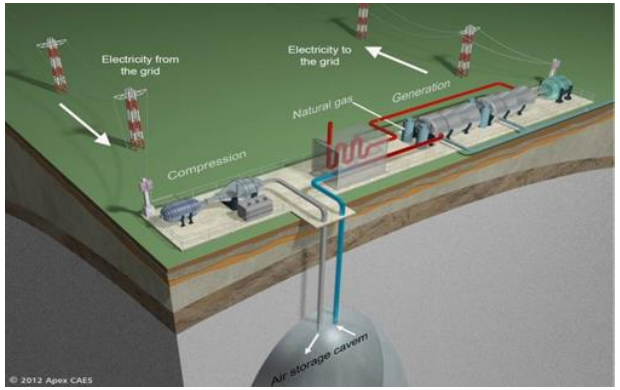
HPP

FLEXIBLE TG
($)

Variability of Wind/Solar Generation

PUMP STORAGE

BESS
($)



COMPRESSED AIR

...

How to Cope with...

BRASIL

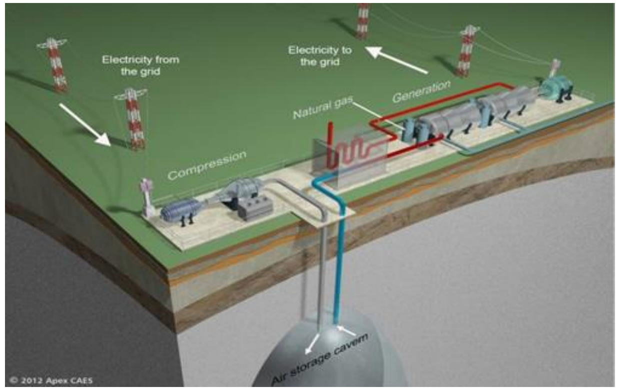
HPP

Variability of Wind/Solar Generation

FLEXIBLE TG
($)

PUMP STORAGE

BESS
($)



COMPRESSED AIR

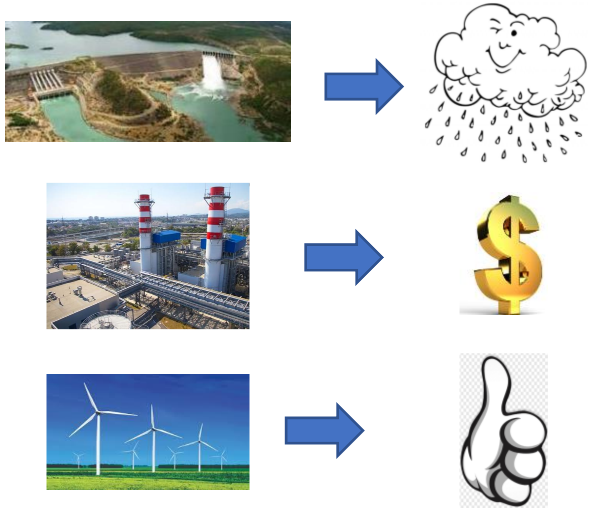
...

System Operation – What we need…

ENERGY	POWER	FLEXIBILITY

System Operation – What we need…

ENERGY



POWER

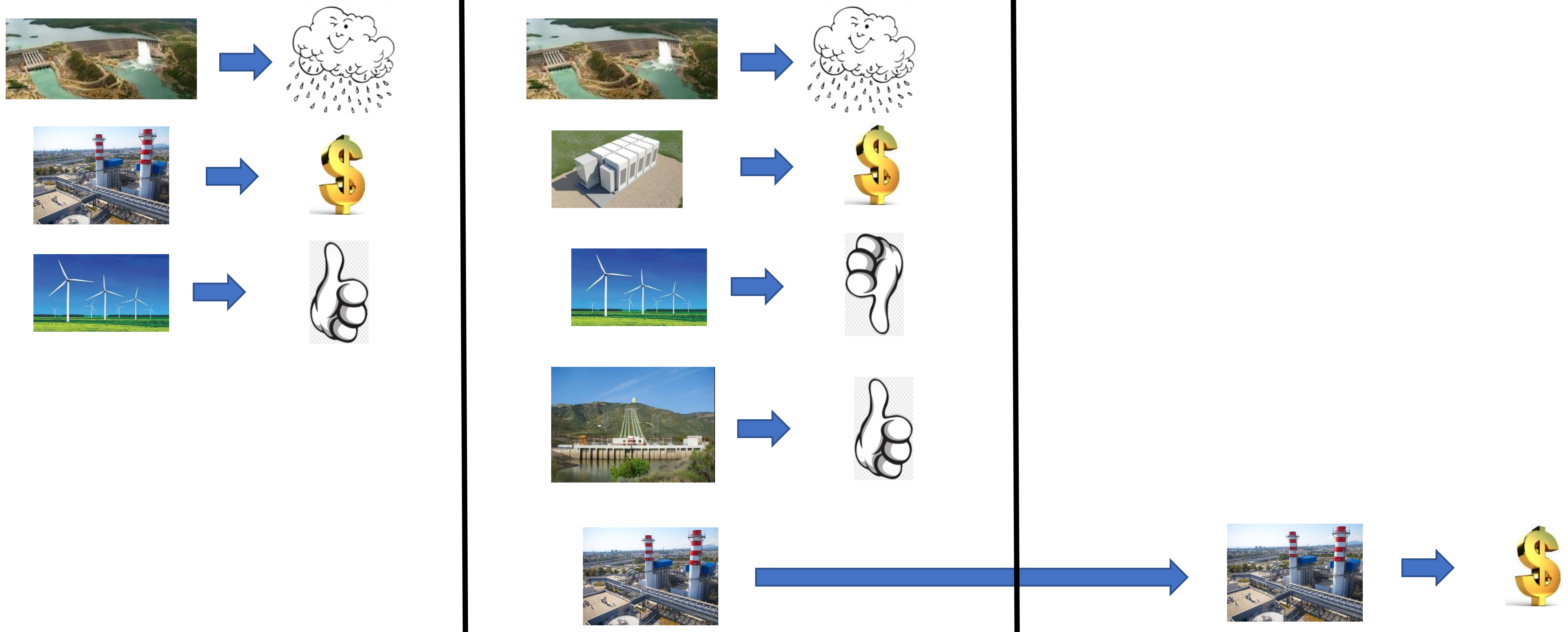
FLEXIBILITY

System Operation – What we need…

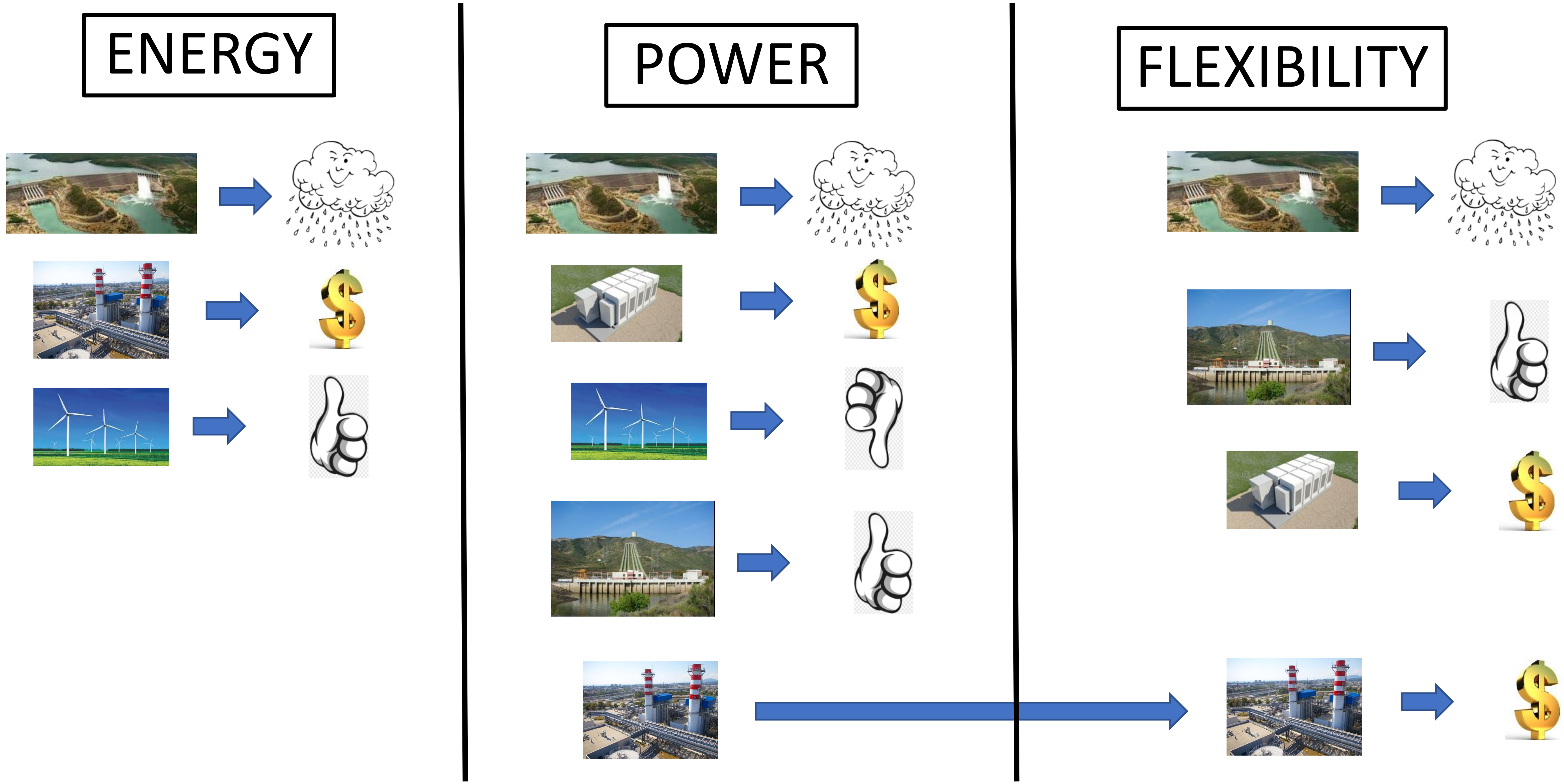
ENERGY

POWER

FLEXIBILITY

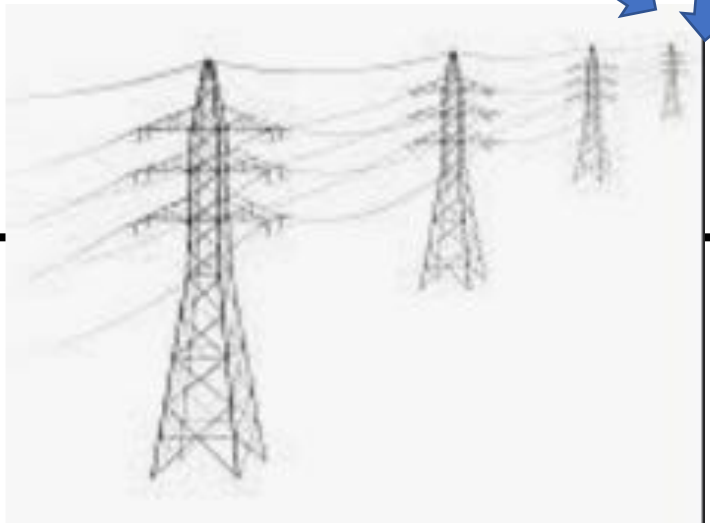


System Operation – What we need…



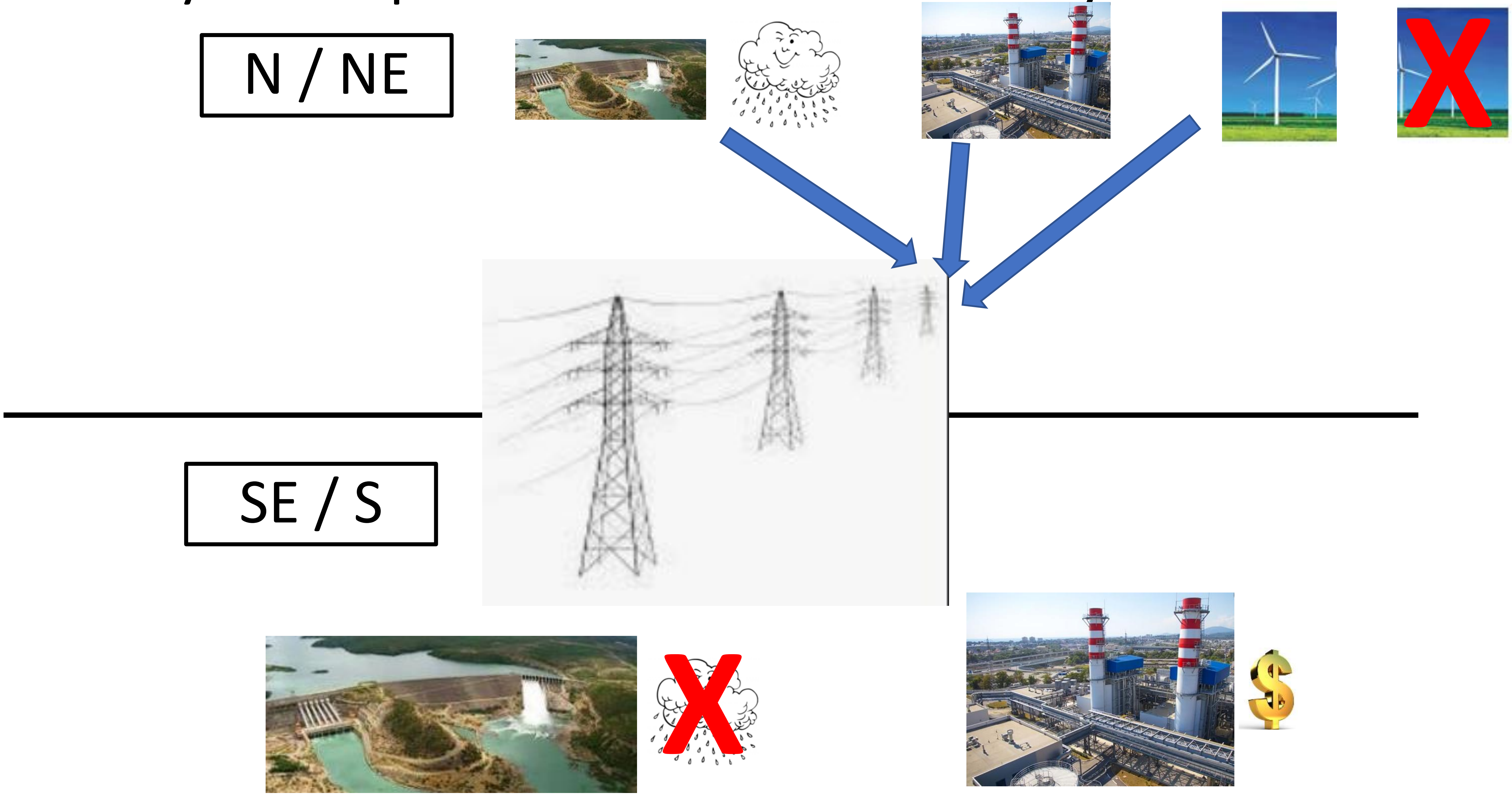
System Operation – Transmission System

N / NE



SE / S

System Operation – Transmission System



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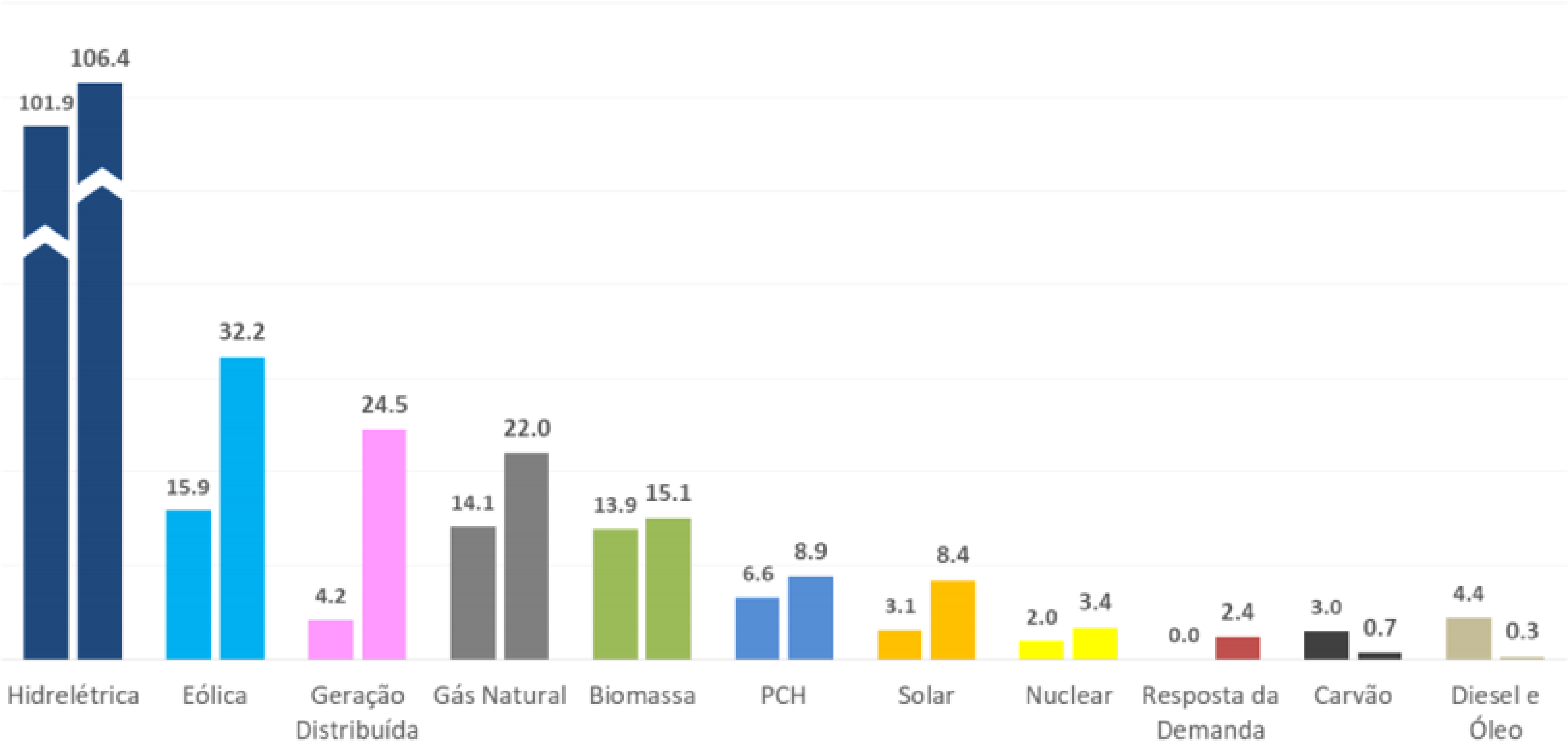
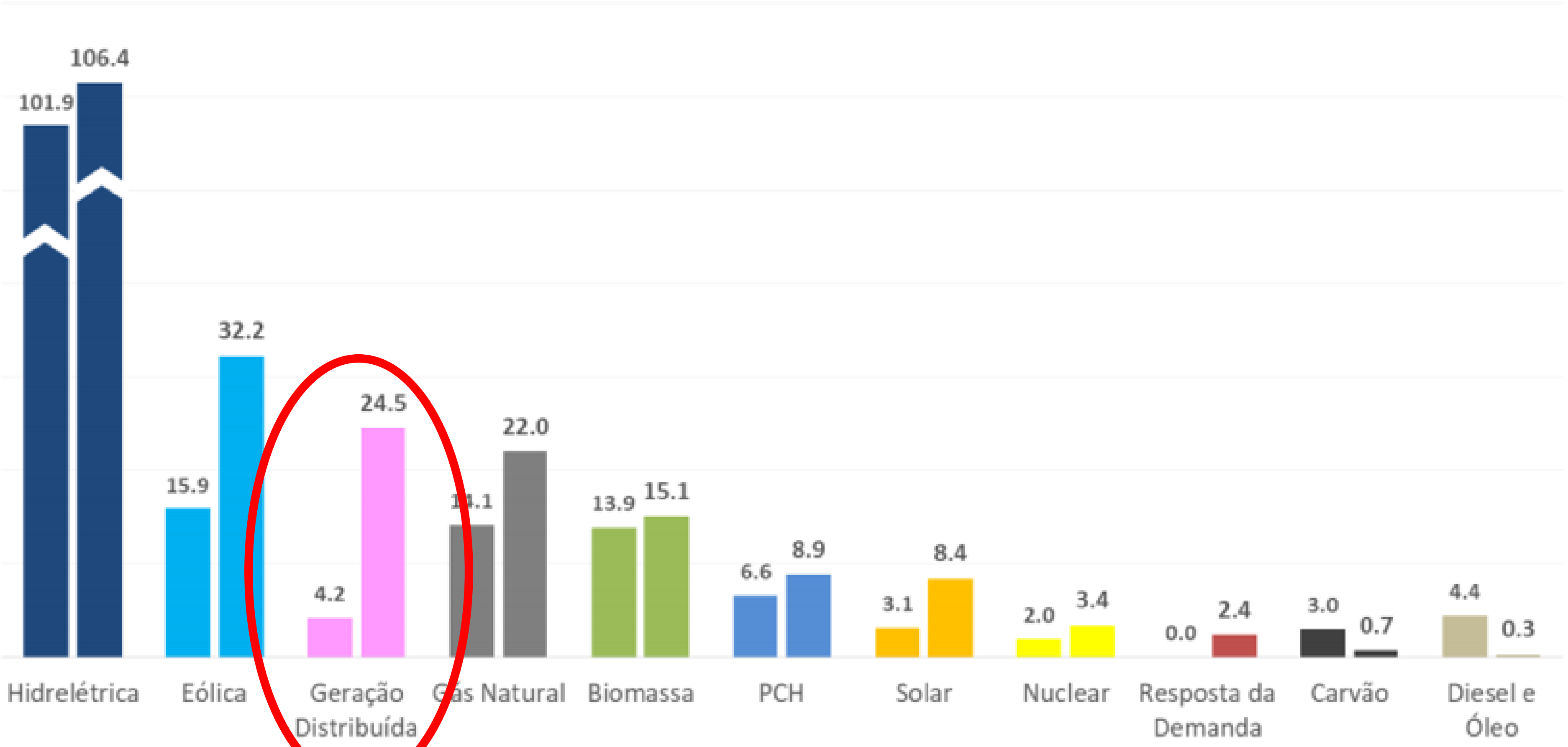
Current Installed Capacity Variation and with PDE 2030 per Source (GW)



Notas:
(a) Dados de dezembro de 2020 e 2030
(b) Gás natural inclui gás de processo
(c) Para fins de exibição as barras de Hidrelétricas tiveram sua escala ajustada, entretanto os valores mostrados correspondem à capacidade instalada
(d) Não inclui a parte paraguaia da usina de Itaipu

Fonte: PDE 2030

Current Installed Capacity Variation and with PDE 2030 per Source (GW)



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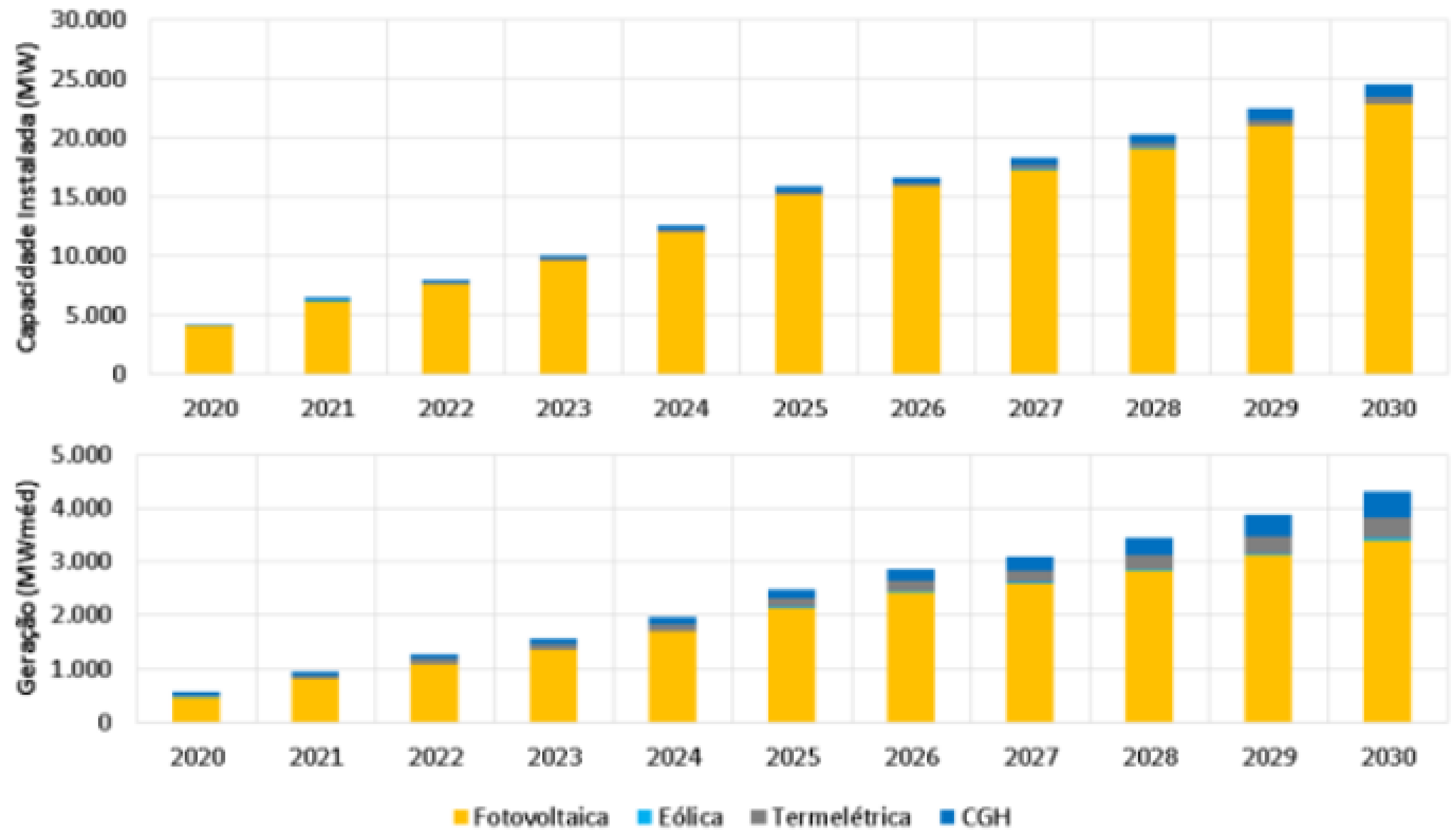

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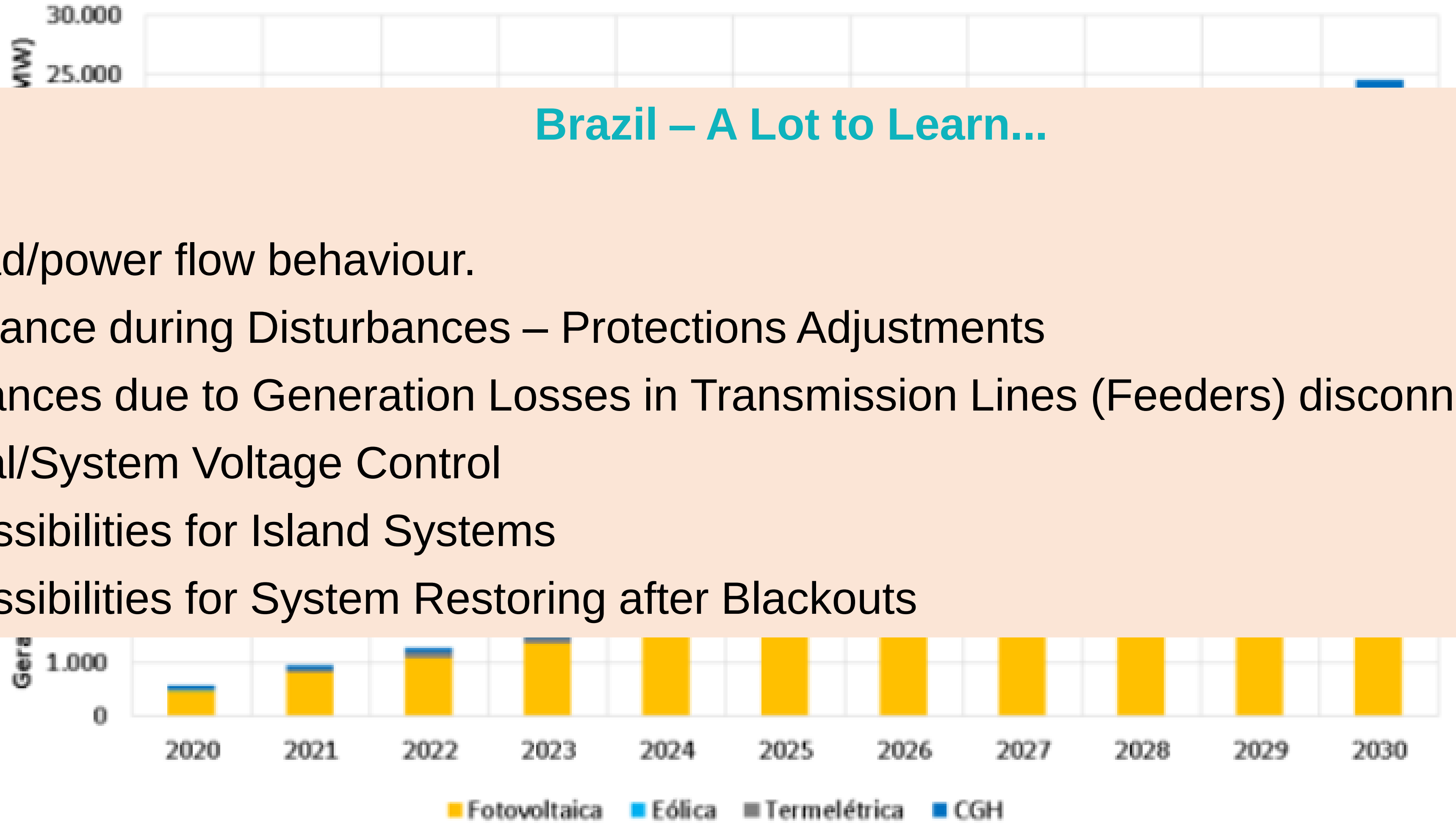

Brazil – A Lot to Learn...

- New load/power flow behaviour.
- Performance during Disturbances – Protections Adjustments
- Disturbances due to Generation Losses in Transmission Lines (Feeders) disconnections.
- Regional/System Voltage Control
- New possibilities for Island Systems
- New possibilities for System Restoring after Blackouts

Fonte: PDE 2030

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MUCHAS GRACIAS !!

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