Imperial College London

escuela técnica superior de ingeniería y diseño industrial

Operación económica de sistemas eléctricos nacionales con baja inercia

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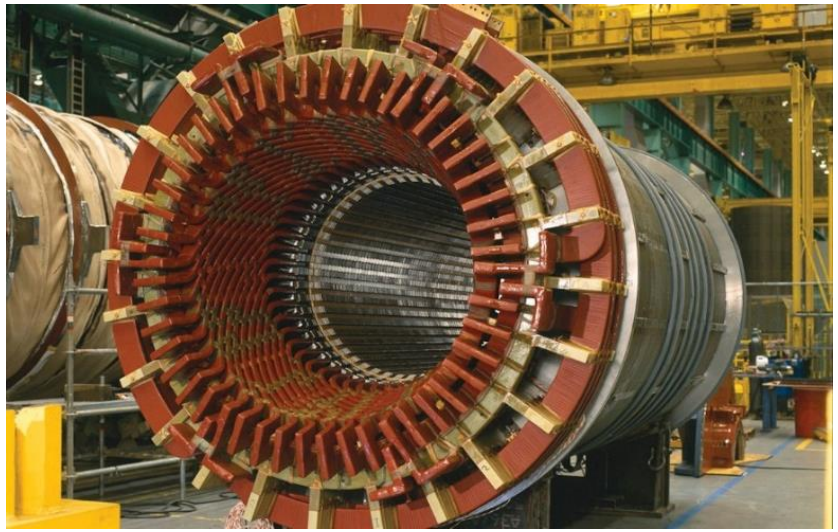
Lower inertia on the road to lower emissions

"Inertia" means a **rotating mass**

Thermal generators (nuclear, gas, coal…):



Decarbonisation

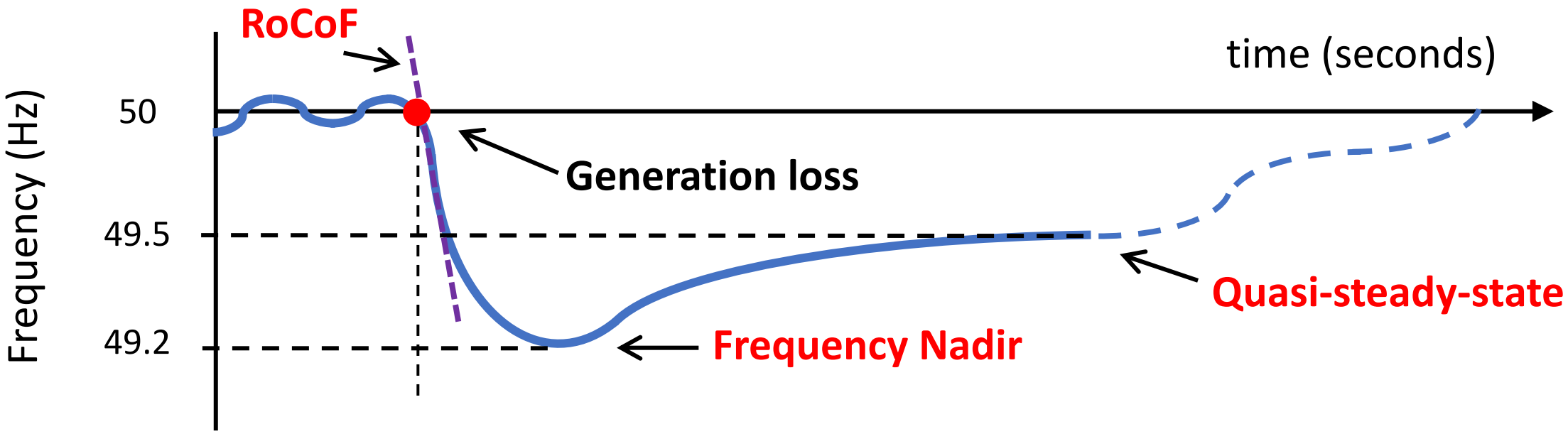
Most renewables: ***no inertia***

The **risk of instability has increased!**

Inertia <u>stores kinetic energy</u>:

this energy gave us time to contain a sudden generation-demand imbalance

Why is frequency important?



Key to keep frequency within safe limits to **avoid demand disconnection!**

What can go wrong? Blackouts!

theguardian Fri 9 Aug 2019

Transport chaos across England and Wales after major power cuts

EL PAÍS 24 jul 2021

Una rotura de la conectividad eléctrica con Francia provoca un apagón en media España

COVID impact on electricity grid stability

Supressed demand led to low electricity prices, resulting in this generation mix:

Renewables + ***Nuclear***

This system lacked inertia,
gas-fired plants had to be turned on simply for stability!

Inertia-related costs in GB were ~£300m *during May to July 2020,*
3 times more *than in the same period in 2019*

My research in a nutshell

How to optimally procure the ancillary services needed because of low inertia?

Described by
differential equations
(timescale of sub-seconds)

Based on
algebraic equations
(timescale of min/hours)

Goal:
Achieve **minimum cost** while keeping **system stability**

What's next in research?

Challenges

- *Decision making under **uncertainty***
- ***Market** design for decarbonised grids*
- *Planning of multi-energy systems*
- ***Stability** for power-electronics based grids*
- ***Resilience** of power grids*

Tools

- ***Optimization***
- *Artificial Intelligence (**AI**)*
- ***Physics**-based modelling*
- ***Economic** theory*