

Operación económica de sistemas eléctricos nacionales con baja inercia

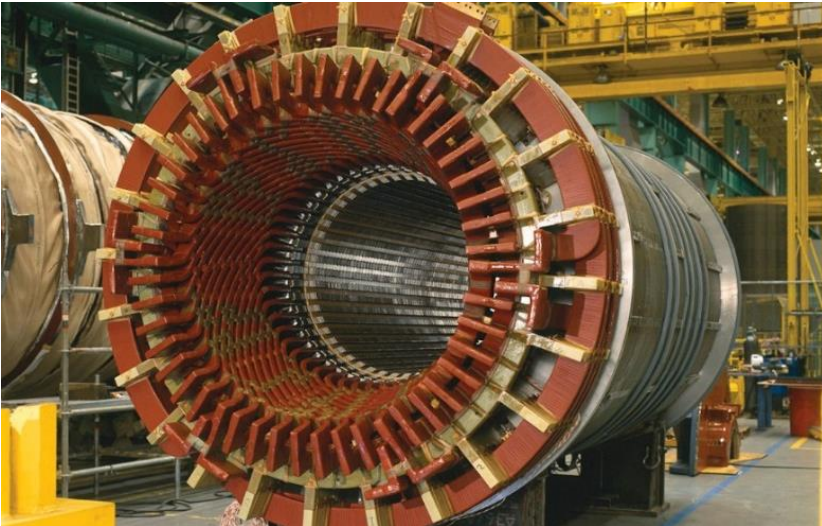
Luis Badesa Bernardo

Departamento de Ingeniería Eléctrica, Electrónica, Automática y Física Aplicada

Lower inertia on the road to lower emissions

“Inertia” means a rotating mass

*Thermal generators
(nuclear, gas, coal...):*



Inertia stores kinetic energy:

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

Decarbonization

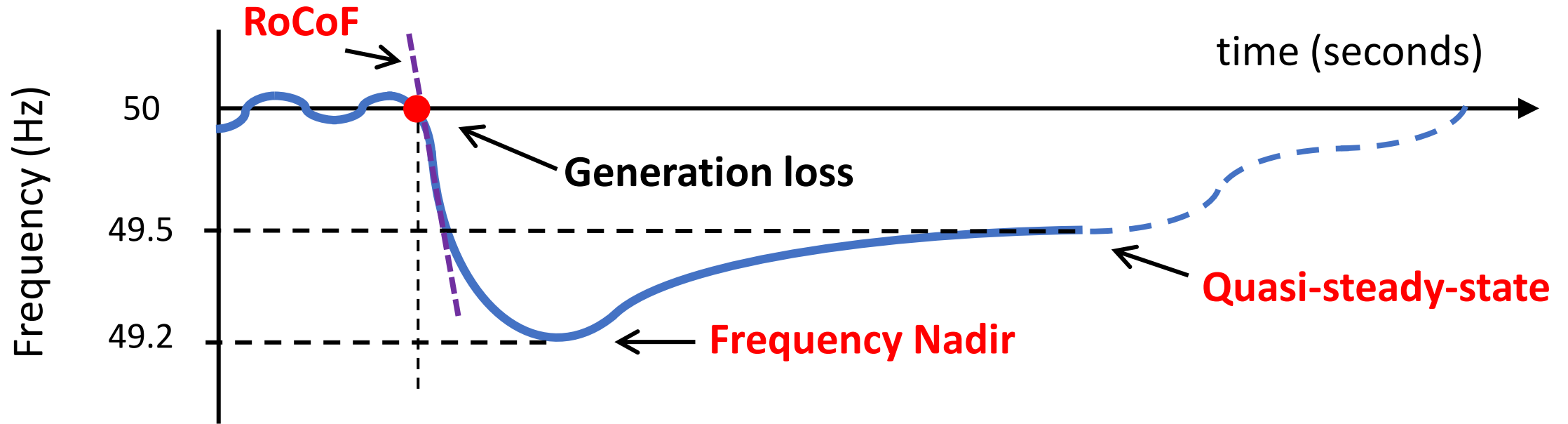


*Most renewables:
no inertia*



The risk of **instability**
has increased!

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

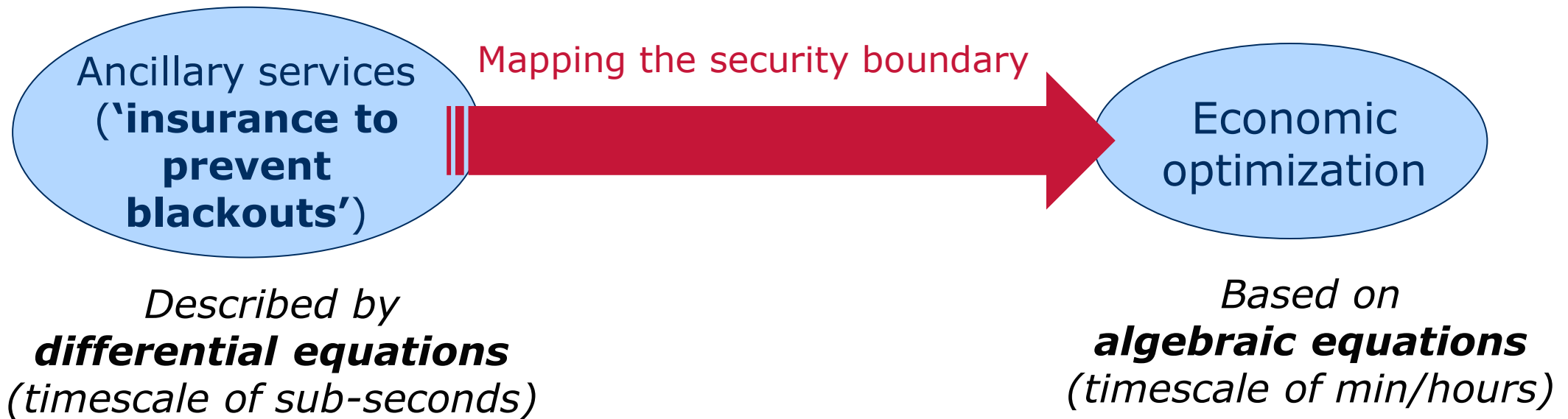


This system lacked inertia,
gas-fired plants had to be turned on simply for stability!

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?*



Goal:

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

What's next in research?

Challenges

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

Tools

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