Who should pay for frequency-containment services?

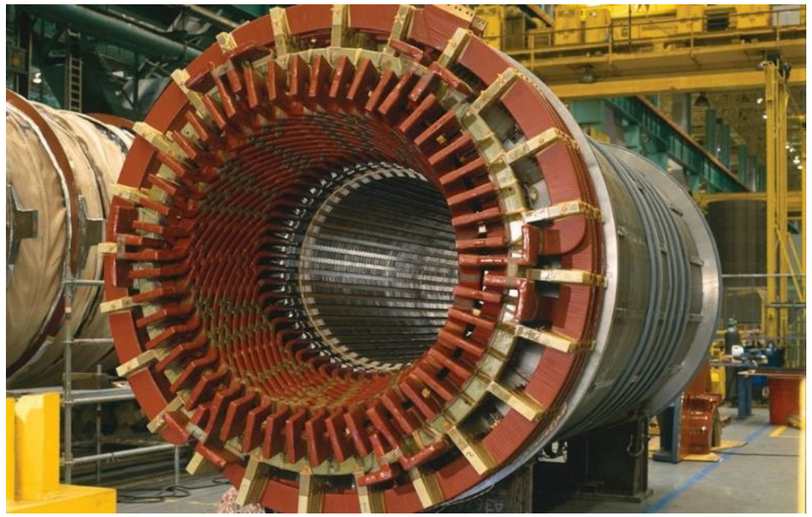
UNIVERSIDAD POLITÉCNICA DE MADRID

escuela técnica superior de ingeniería y diseño industrial

Imperial College London

Lower inertia on the road to **lower emissions**

Thermal generators
(nuclear, gas, coal…)



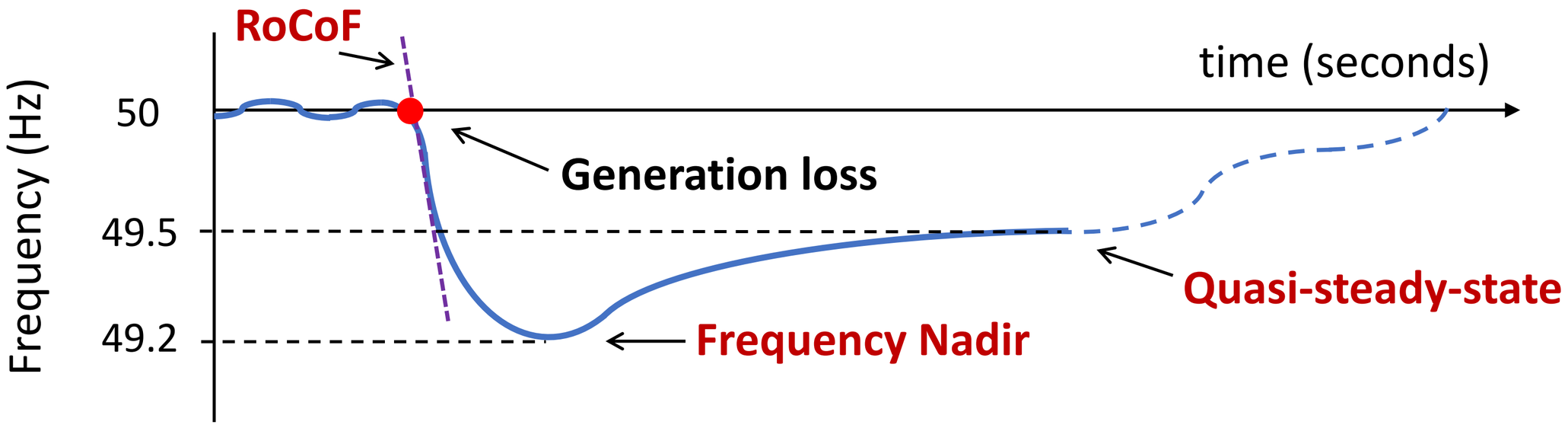
Decarbonization

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

Frequency stability



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

Cost allocation for stability services

Some **‘services’ are needed** to maintain grid stability, and **they have a cost**

1. **Who should cover this cost?**
   - Generators?
   - Consumers?
   - Only a subset of the former?

2. **How much should each market participant pay?**

First, why worry about who pays?

- Currently **costs are socialized** in most countries (except Australia)
- **Until recently**, irrelevant who paid (**costs were small** due to high inertia)

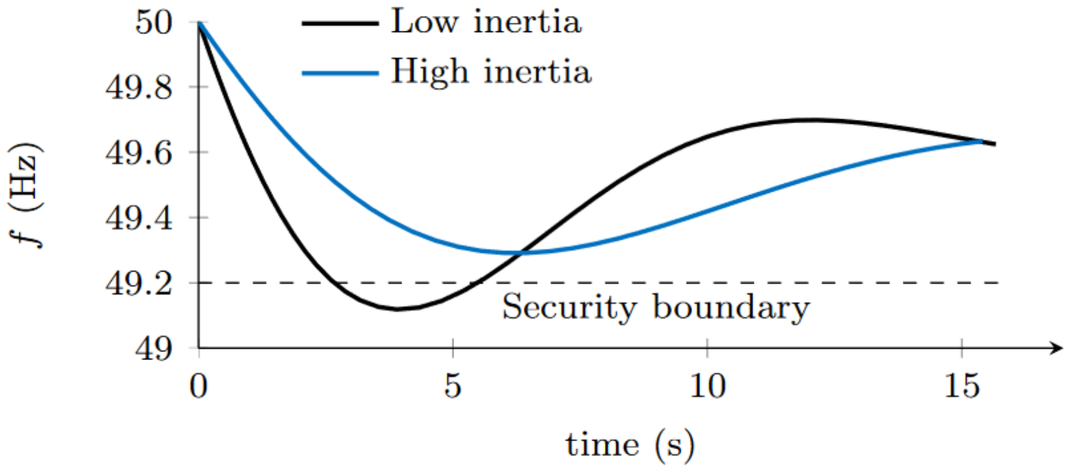
Goal of moving towards a **‘causer pays’ framework**:

To create **incentives to ‘do less harm’** to the grid

(in order to **reduce the cost** of frequency services for consumers)

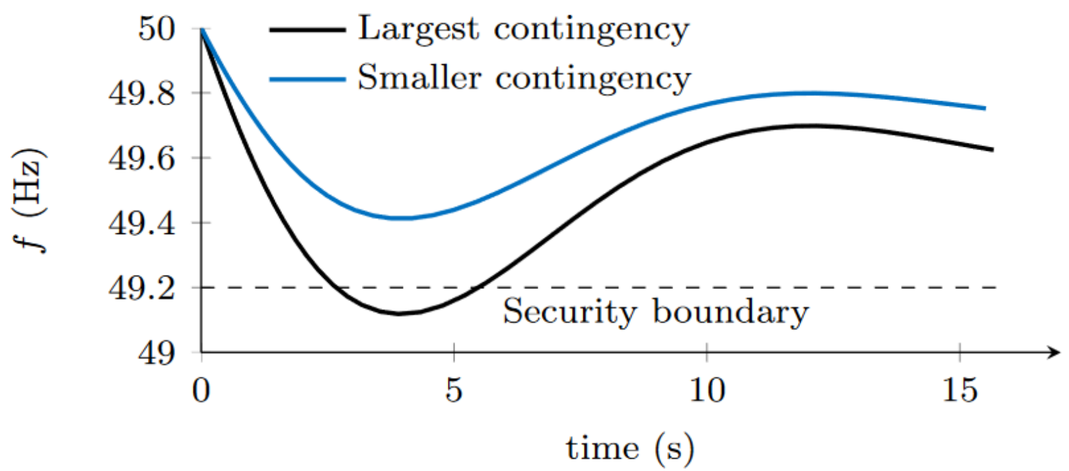
Who causes the need for frequency services?

Large units do: a low-inertia system would do fine if all units were small (there would be no large, sudden power imbalances)



Impact of inertia

under a large contingency



Impact of contingency size

in a low-inertia system

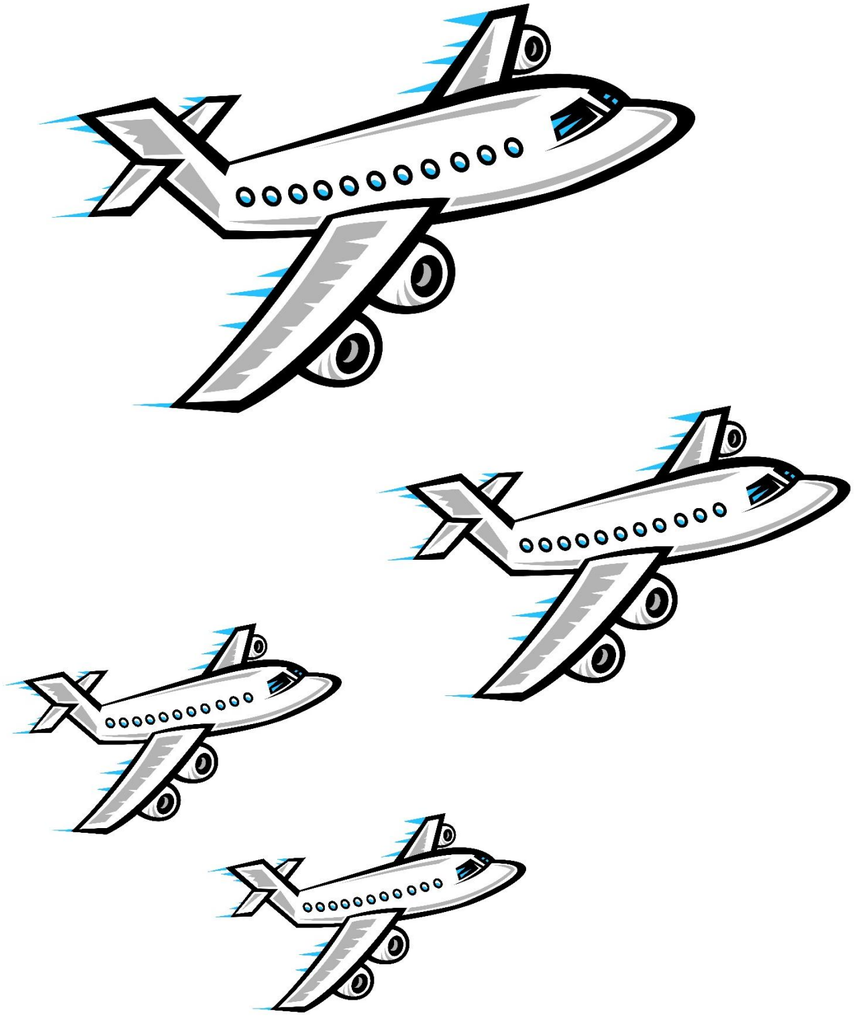
Who causes the need for frequency services?

Large units do: a low-inertia system would do fine if all units were small (there would be no large, sudden power imbalances)

We **rule out penalizing** the **lack of inertia**

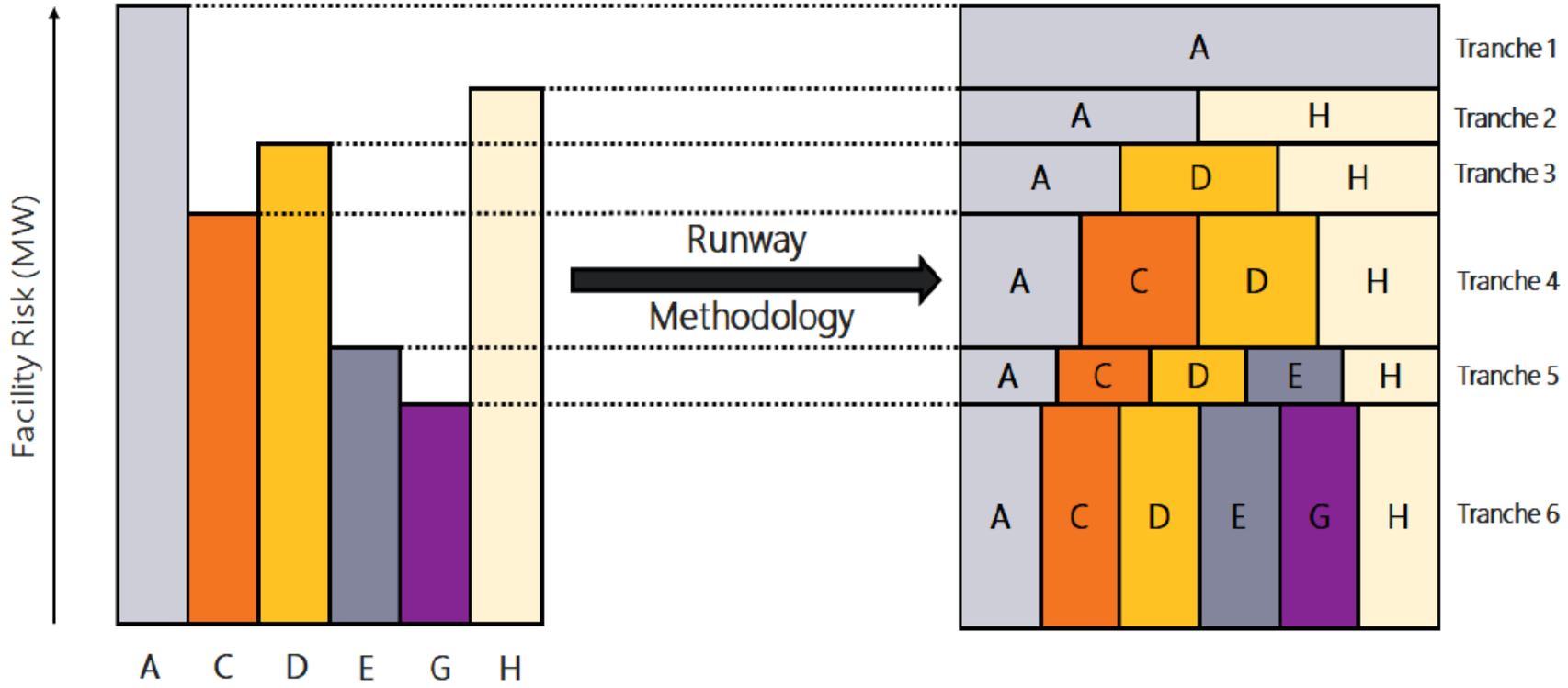
- Inertia is a service, it should be remunerated appropriately
- But lack of inertia is not a problem by itself

How to split the cost? ‘Airport problem’



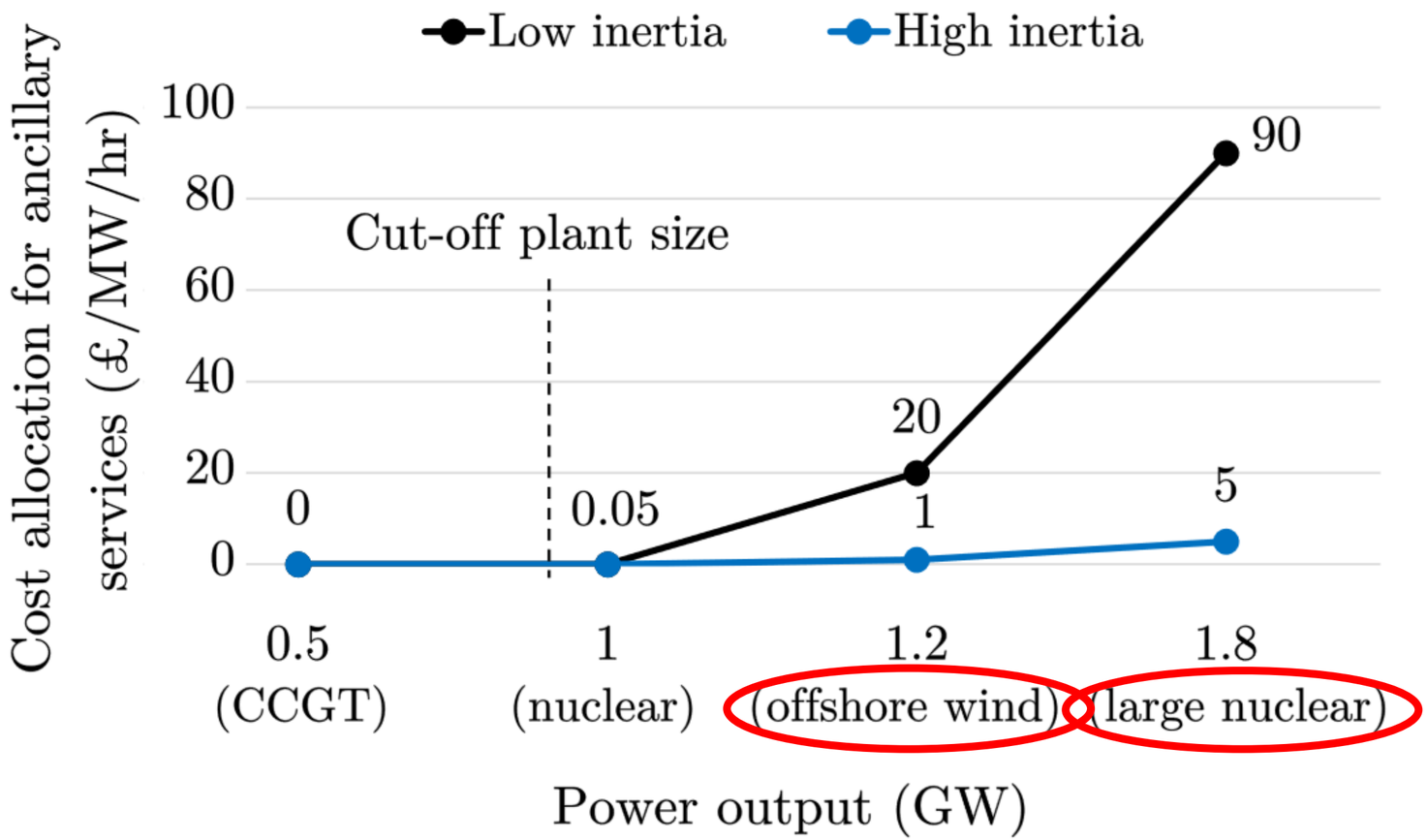
Sequential cost allocation (Shapley value)

Each unit pays for the **additional cost** that it creates



Reference: “A report describing the Wholesale Electricity Market in the South West Interconnected System”, Australian Energy Market Operator, September 2023

Analysis for Great Britain



Benefits of the cost allocation

- To create **investment signals**

  - Large units would **internalize their system-integration cost** (*e.g.*, nuclear, offshore wind, HVDC)
  - **Costs** would still **trickle down to consumers**, but appropriate economic signals for generation would be in place

- To **incentivize flexibility**

  - Large units can reduce the cost they are allocated by **reducing power output/demand**

Thank you for your attention!

This work was funded by MICIU/AEI/10.13039/ 501100011033
and ERDF/EU under grant PID2023- 150401OA-C22