



EPRG Seminar – Spring 2024

Offshore transmission expansion in the North Sea

Towards solving a market failure

An efficient level of transmission is likely to bring significant benefits, but the market may not always be able to make such decisions on its own



Socially efficient level of transmission:
Marginal cost of additional transmission = Marginal societal benefit of additional transmission

Transmission infrastructure has positive benefits...



Additional transmission may improve the affordability of power, by reducing congestion between different zones



Additional transmission may help maintain security of supply



Additional transmission may encourage the integration of intermittent sources of renewable power generation

...but is complex and risky to develop



The costs of transmission infrastructure are large and lumpy



Transmission assets can have countervailing external effects on producers, consumers and other transmission owners

Explainer: Fatal blow for Scotland's Norwegian green energy dream

11th July 2023

ENVIRONMENT POLITICS



France-Spain power link delayed until 2028 – watchdogs

(Montel) The new 2.2 GW interconnector linking Spain and France will likely come into operation in 2028, one year later than previously expected, the regulators of both countries said.

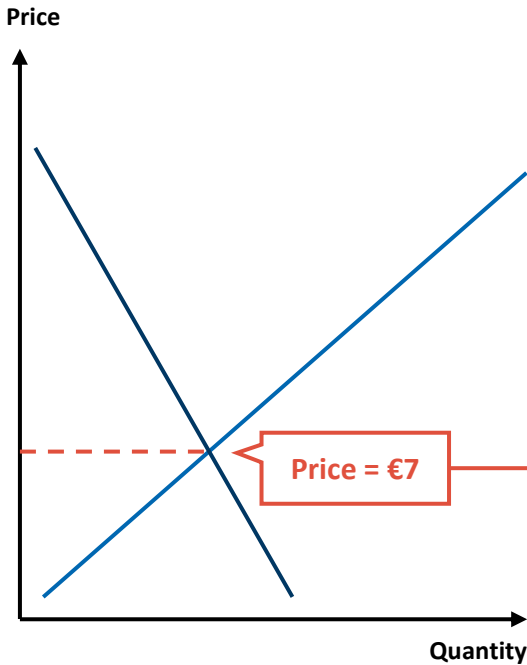
The Brussels Times

HUM BUSINESS ART & CULTURE EU AFFAIRS WORLD BELGIU

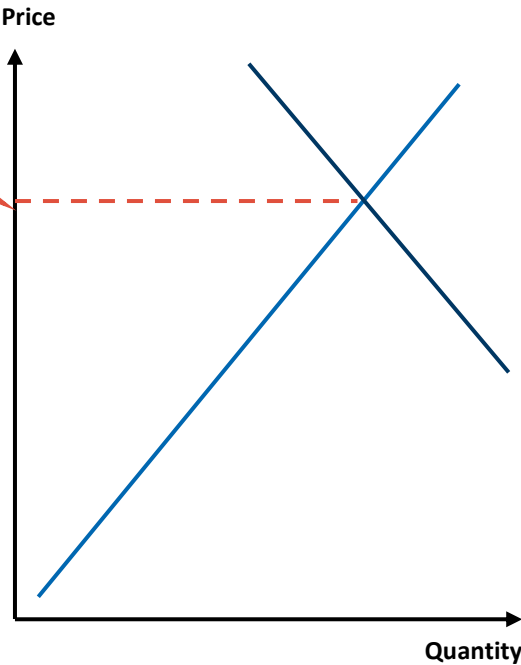
Energy link between Belgium and Denmark delayed by three years

Where material locational price differences exist (e.g between different countries), beneficial transmission is reasonably straightforward to identify

Exporting Region, Country A



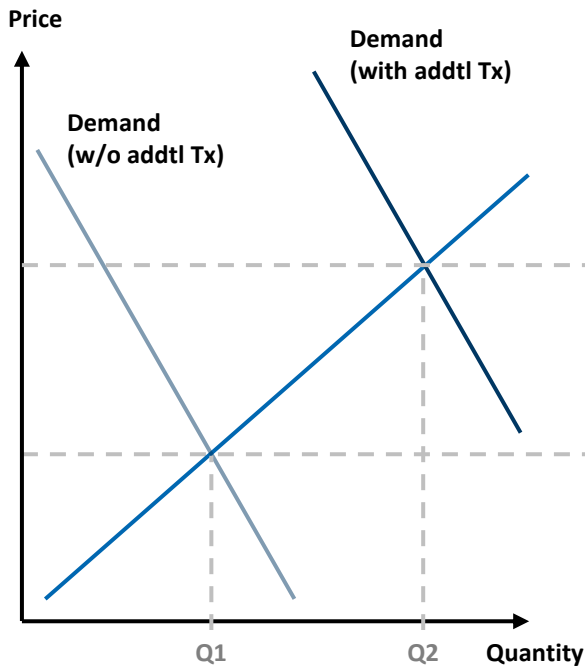
Importing Region, Country B



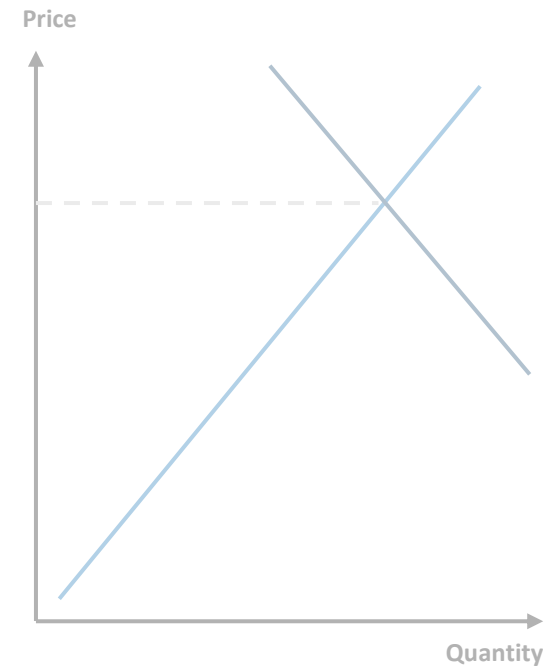
Price differential of €3/MWh implies some potential benefit from transmission investment between the 2 regions

Increased transmission capacity will result in an increase in the demand for power in the exporting region...

Exporting Region



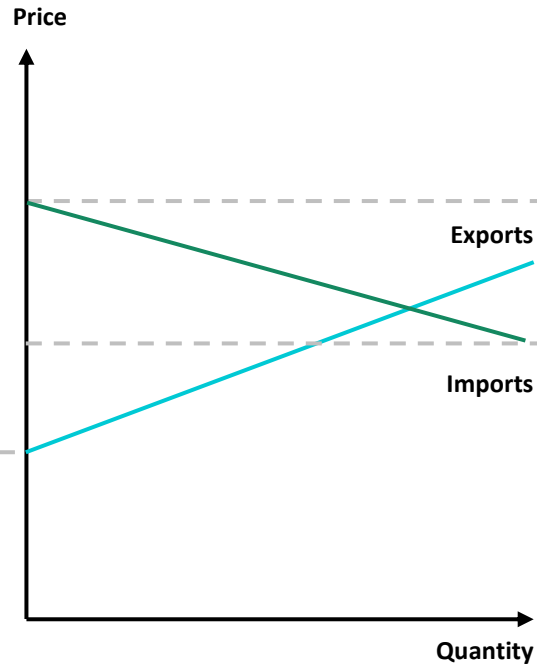
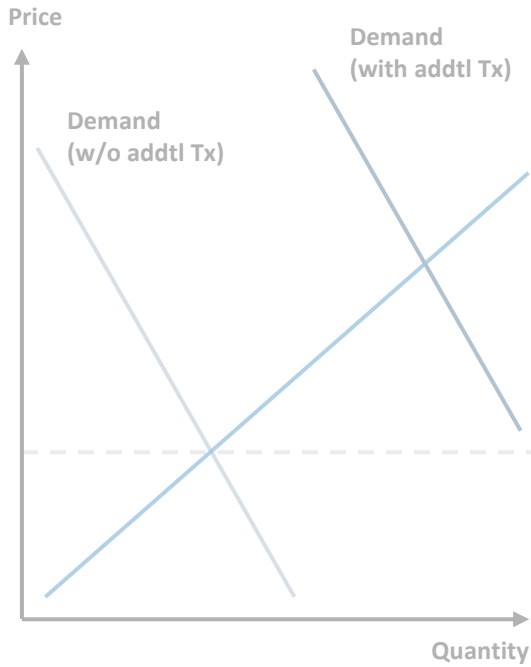
Importing Region



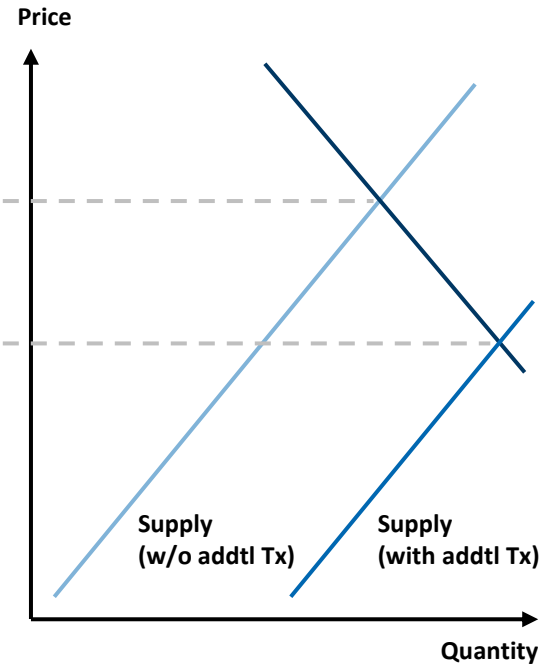
Diagrams not drawn to scale, but for ease of exposition, Q2 – Q1 are of equivalent distance in both diagrams

...and increased supply for power in the importing region

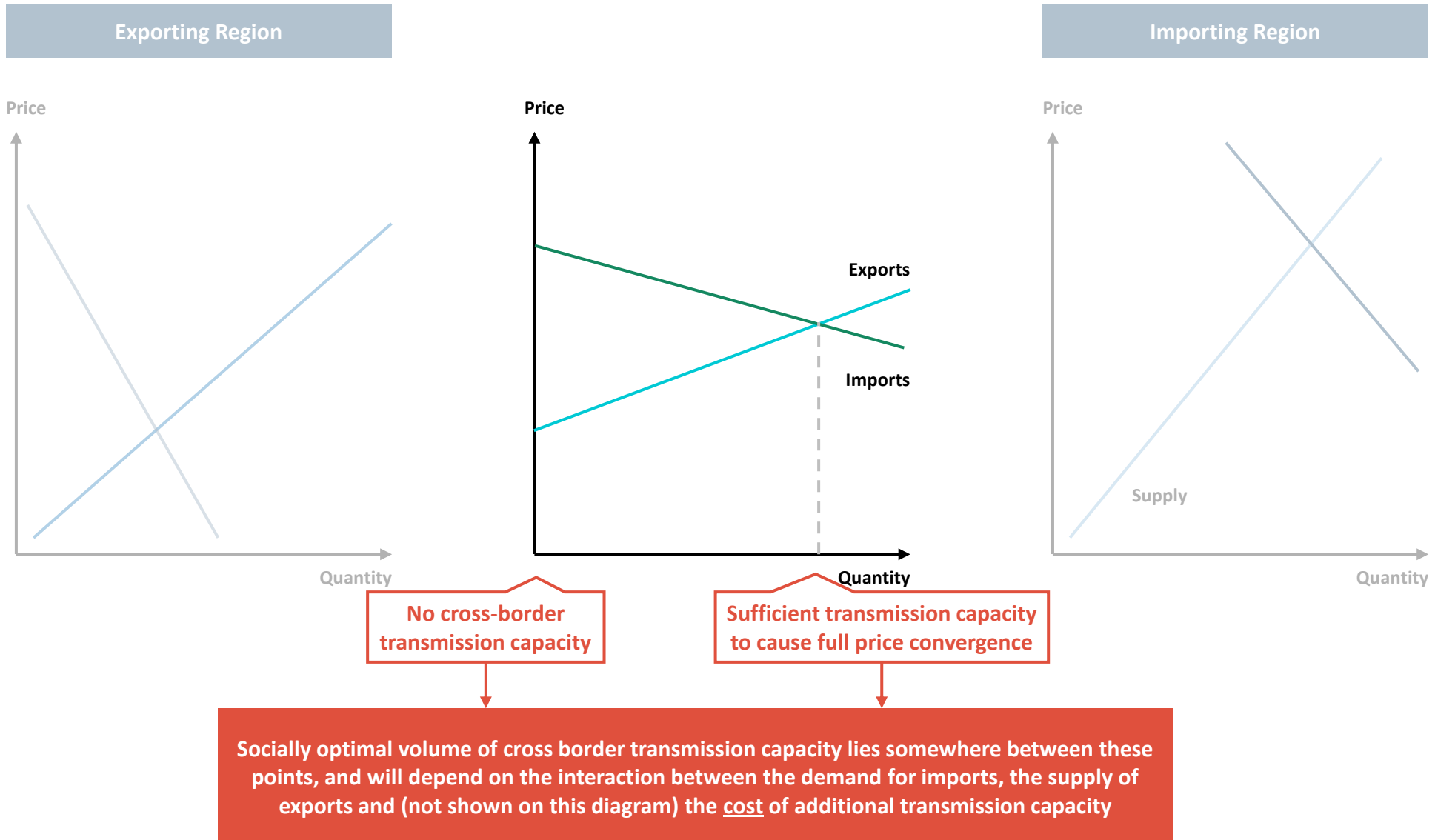
Exporting Region



Importing Region

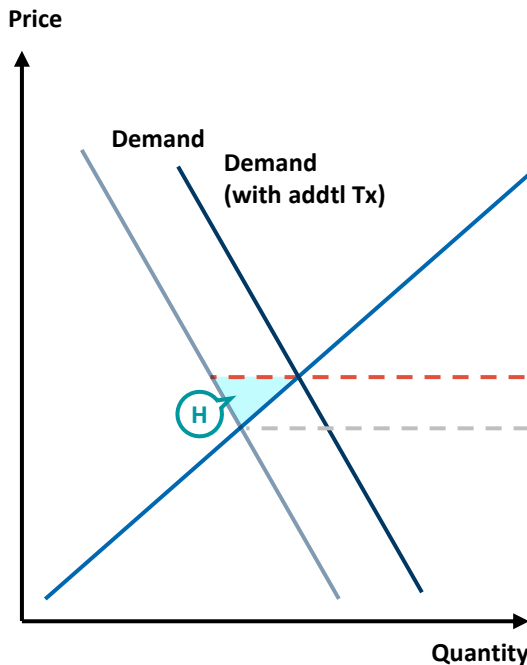


Between any two price zones, there exists a socially optimal volume of transmission capacity between ‘zero’ and ‘full price convergence’

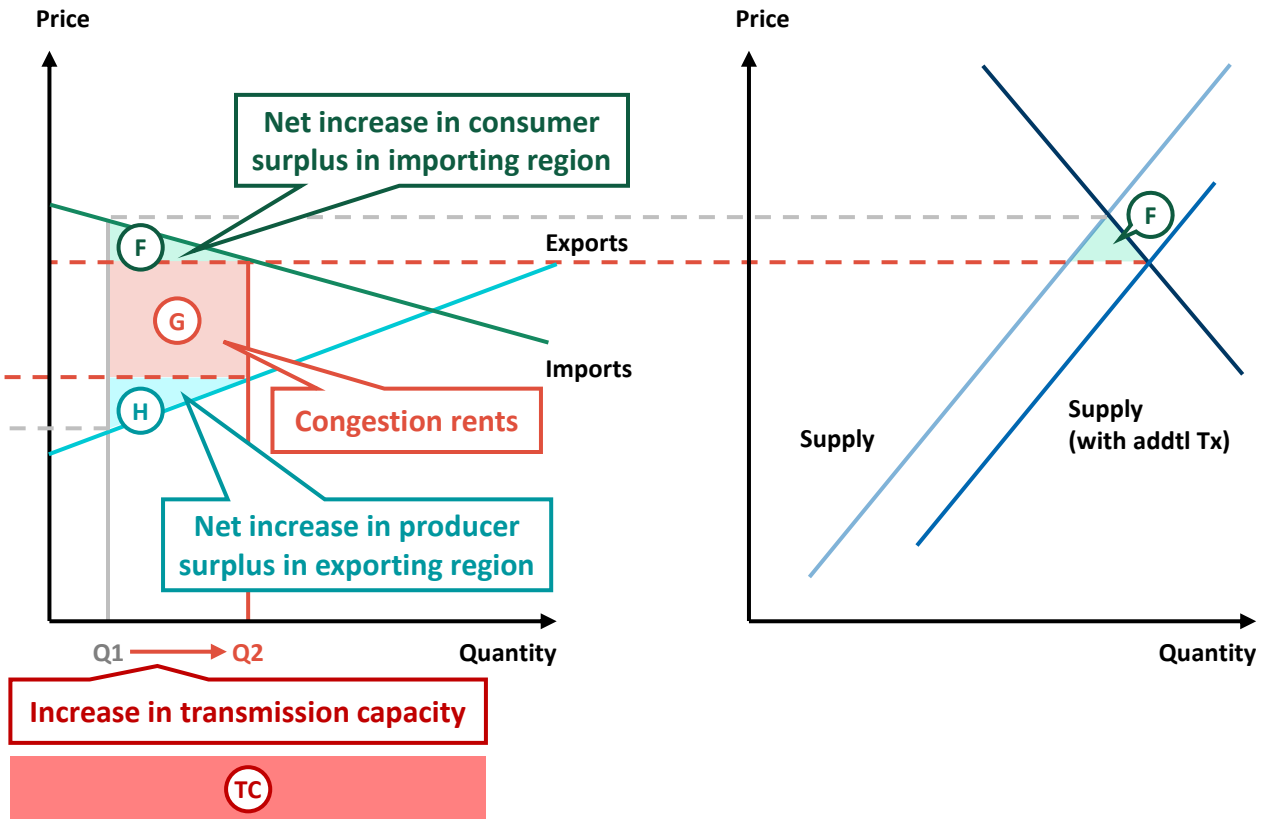


Welfare impacts of cross-border transmission asset accrue to a diverse set of stakeholders: consumers, producers and transmission owners

Exporting Region

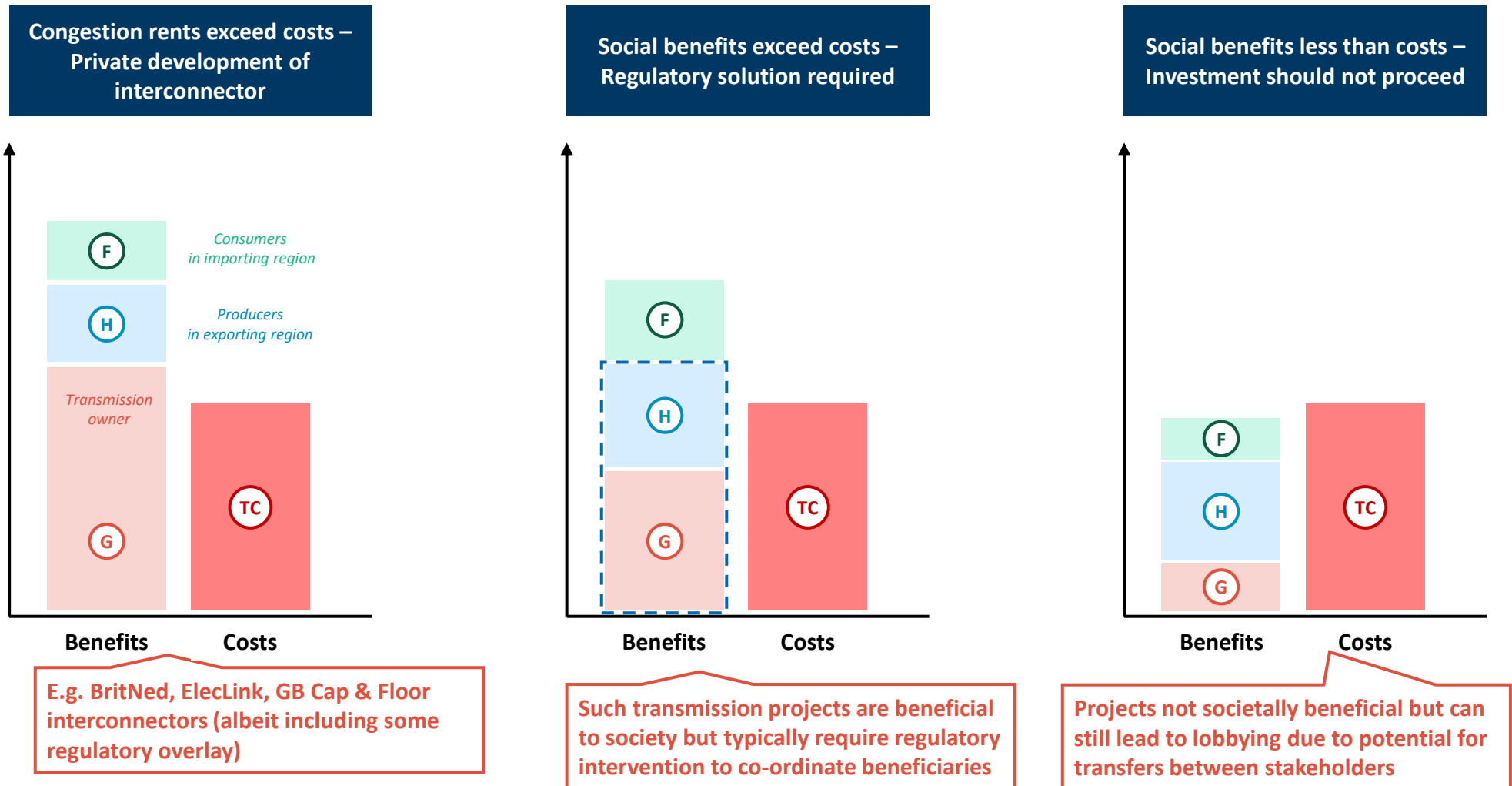


Importing Region



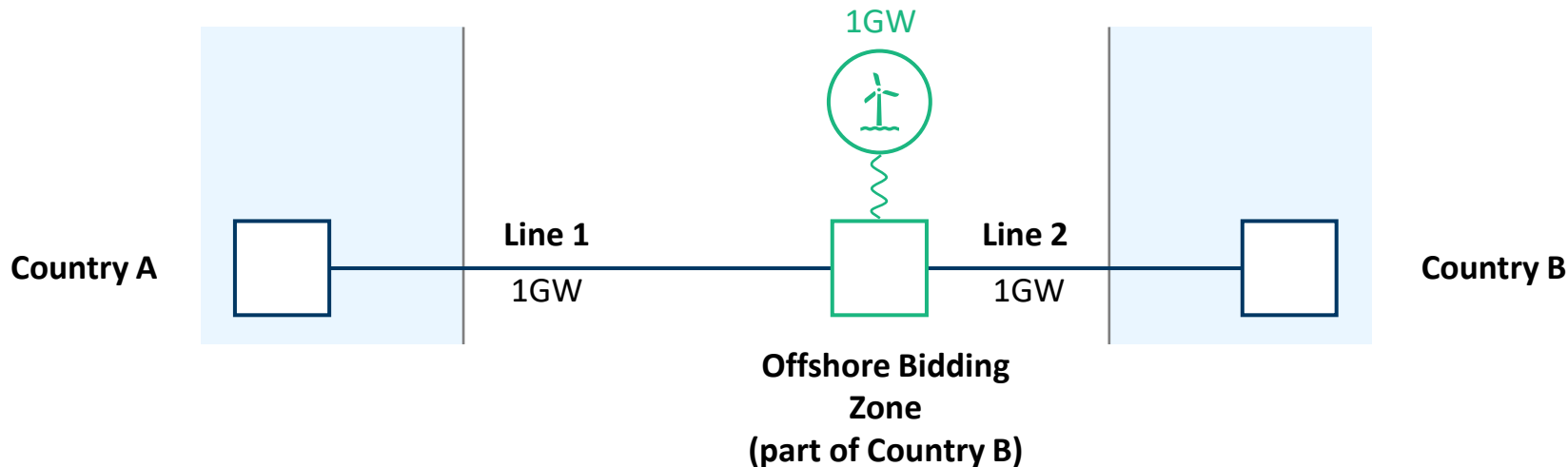
- Merchant development if $G > TC$.
- Socially beneficial development if $F + G + H > TC$.

In some situations, where merchant revenues are not sufficient, regulatory interventions are likely to be required to induce investment



In the absence of regulatory intervention, co-ordination may be difficult to achieve. These “market failures” have been identified by Joskow & Tirole and also Hogan. 8

Hybrid / multi-purpose interconnectors are potentially very beneficial, but disjointed regulatory approaches leave risk of sub optimal outcome



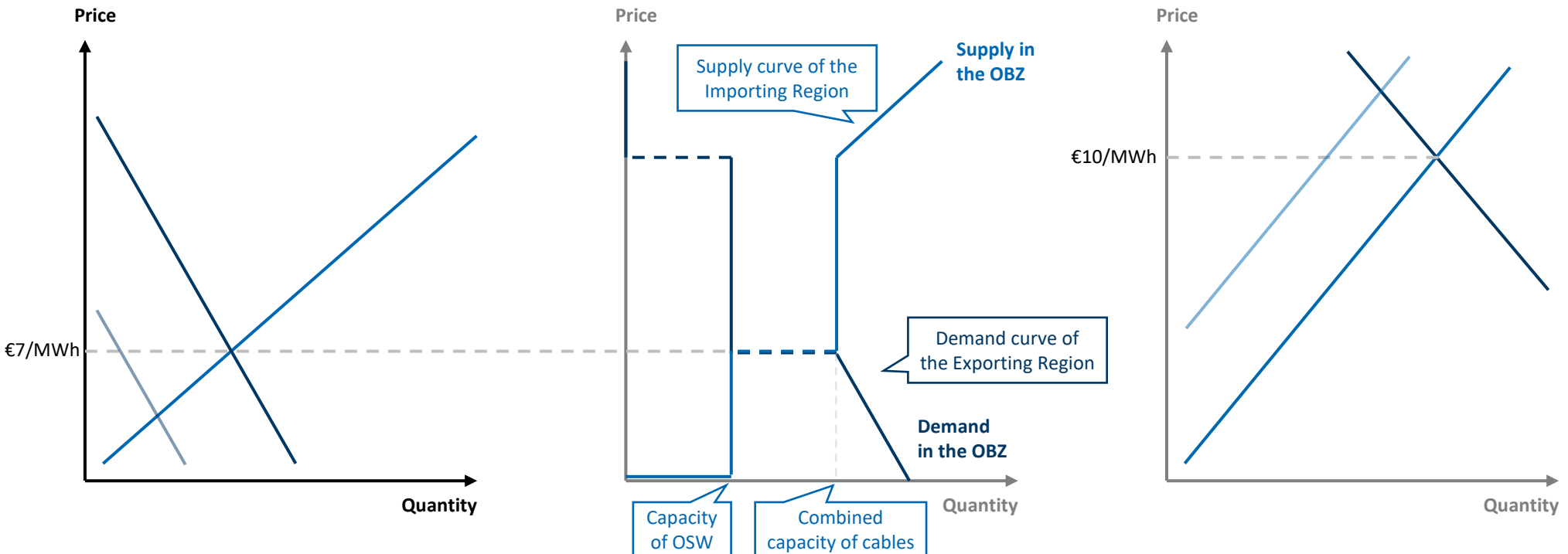
- Multi-purpose interconnectors / offshore hybrid assets offer potential additional benefits: improved transmission utilisation, reduced environmental impacts
- However, presence of Offshore Bidding Zones along the way complicates matters:
 - New price zone between Country A and Country B changes where congestion rents arise;
 - Transmission is large and “lumpy” relative to the OBZ “market”, and can drive large swings in welfare among stakeholders; and
 - Initial tendency among stakeholders to view hybrid assets through a “your side” and “my side” lens.
- Coordination among stakeholders in developing MPIs is even more critical than for point-to-point interconnectors.

When an OBZ is connected to 2 onshore price zones, the price in the OBZ clears at the lower of the 2 onshore prices

Exporting Region (Country A)

Offshore bidding zone

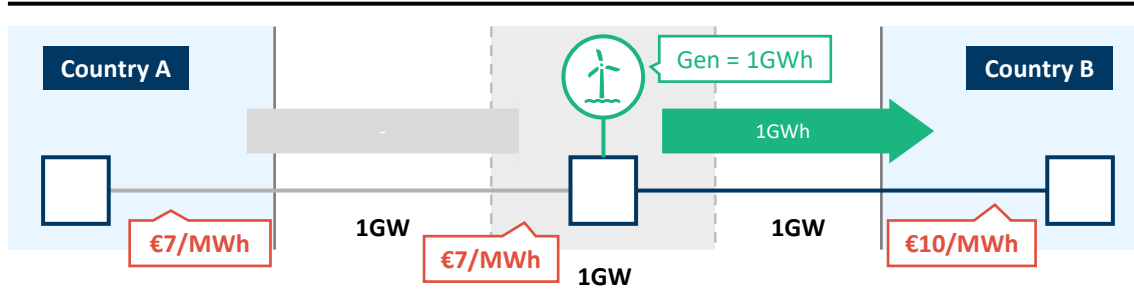
Importing Region (Country B)



- Assumes a symmetrically sized Multi-Purpose Interconnector (“MPI”) capacity of the windfarm is equal to the capacities of each of the cables to the onshore price zones.
- The OBZ price converges to the lower of the 2 onshore price zones – i.e. the price of the exporting region.

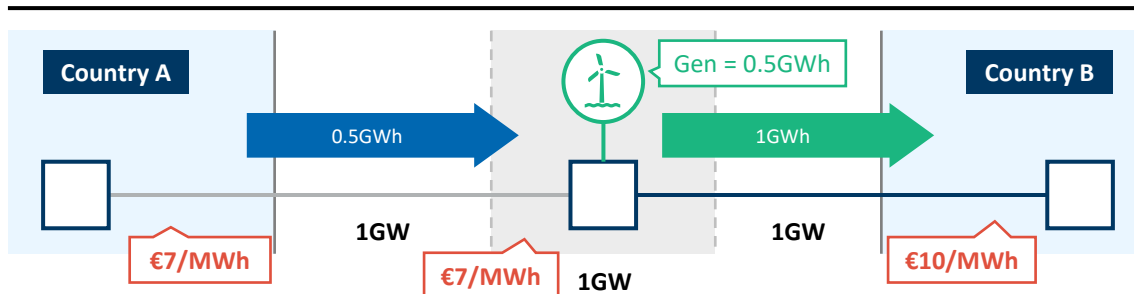
Congestion rents on an MPI are unevenly distributed, and (in this case) fall predominantly onto the side of the importing country (Line 2)

OSW generates at full capacity



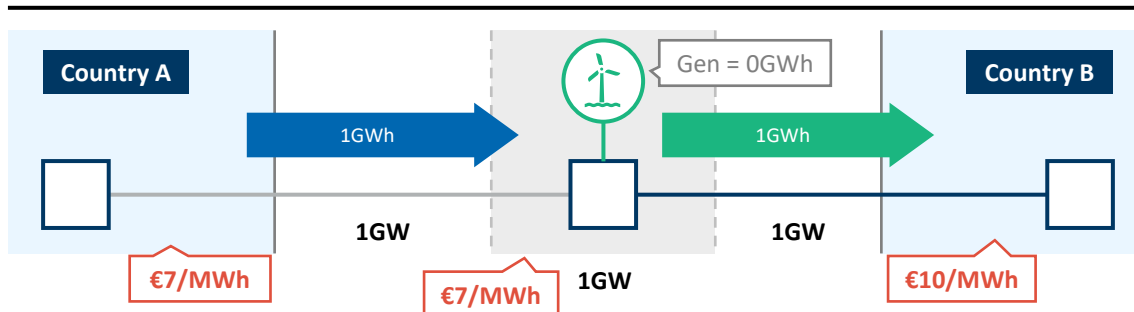
- No power is exported out of Country A
- Congestion rents earned on the cable to Country B

OSW generates at partial capacity



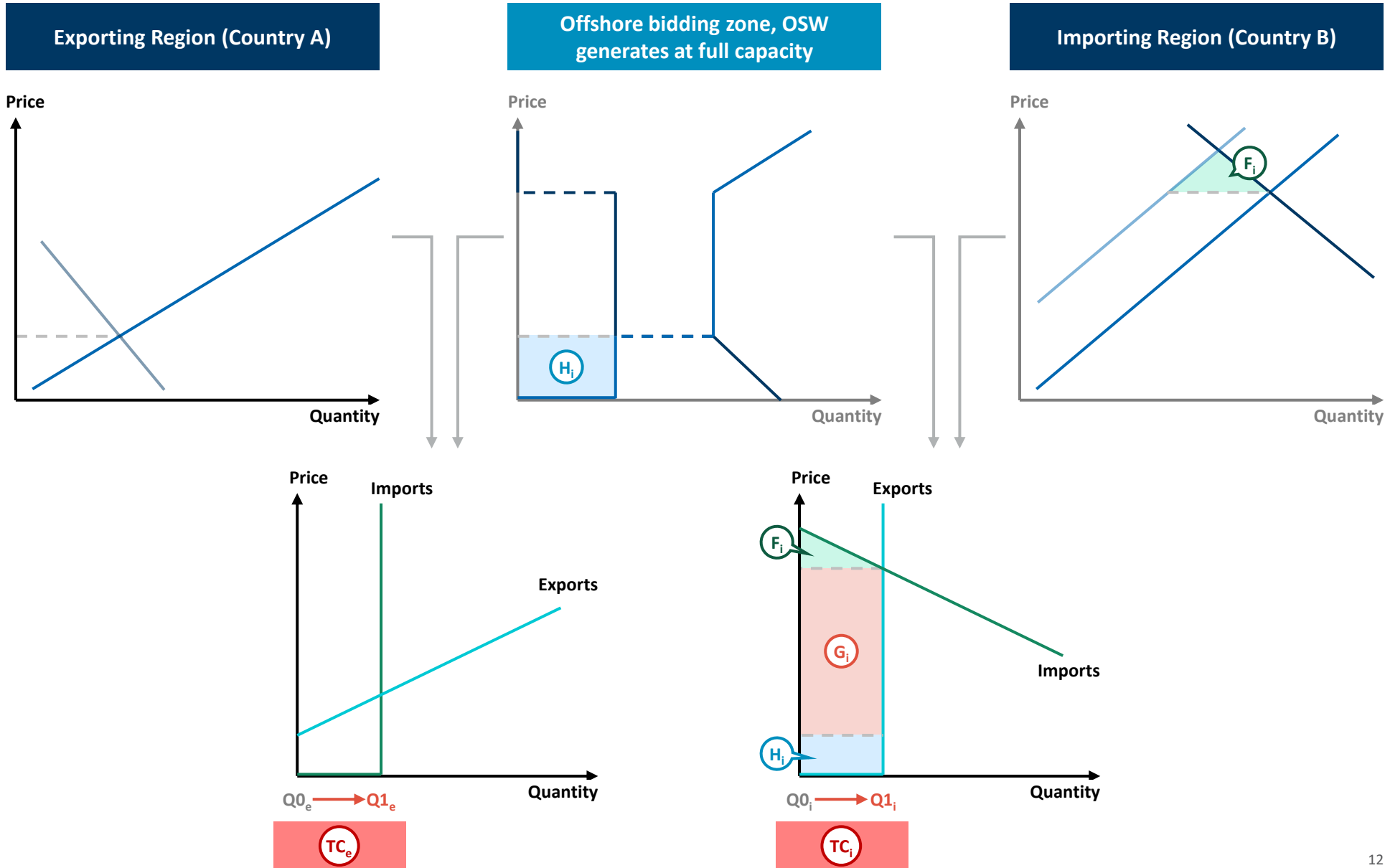
- 0.5GWh exported out of Country A...
- ...with the remainder provided by the windfarm.
- Congestion rents earned on the cable to Country B

OSW does not generate

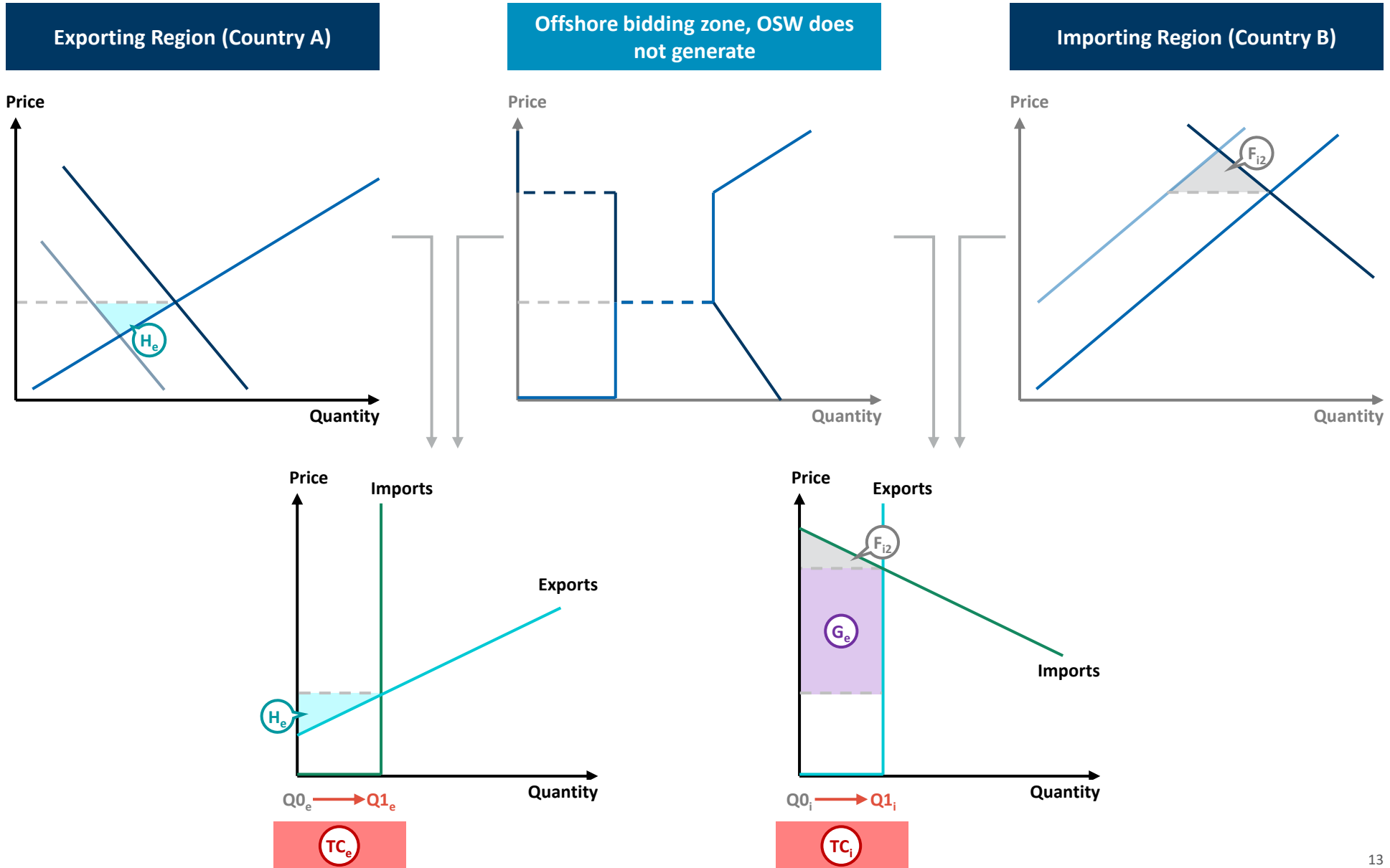


- All power is exported out of Country A into Country B
- Congestion rents earned on the cable to Country B

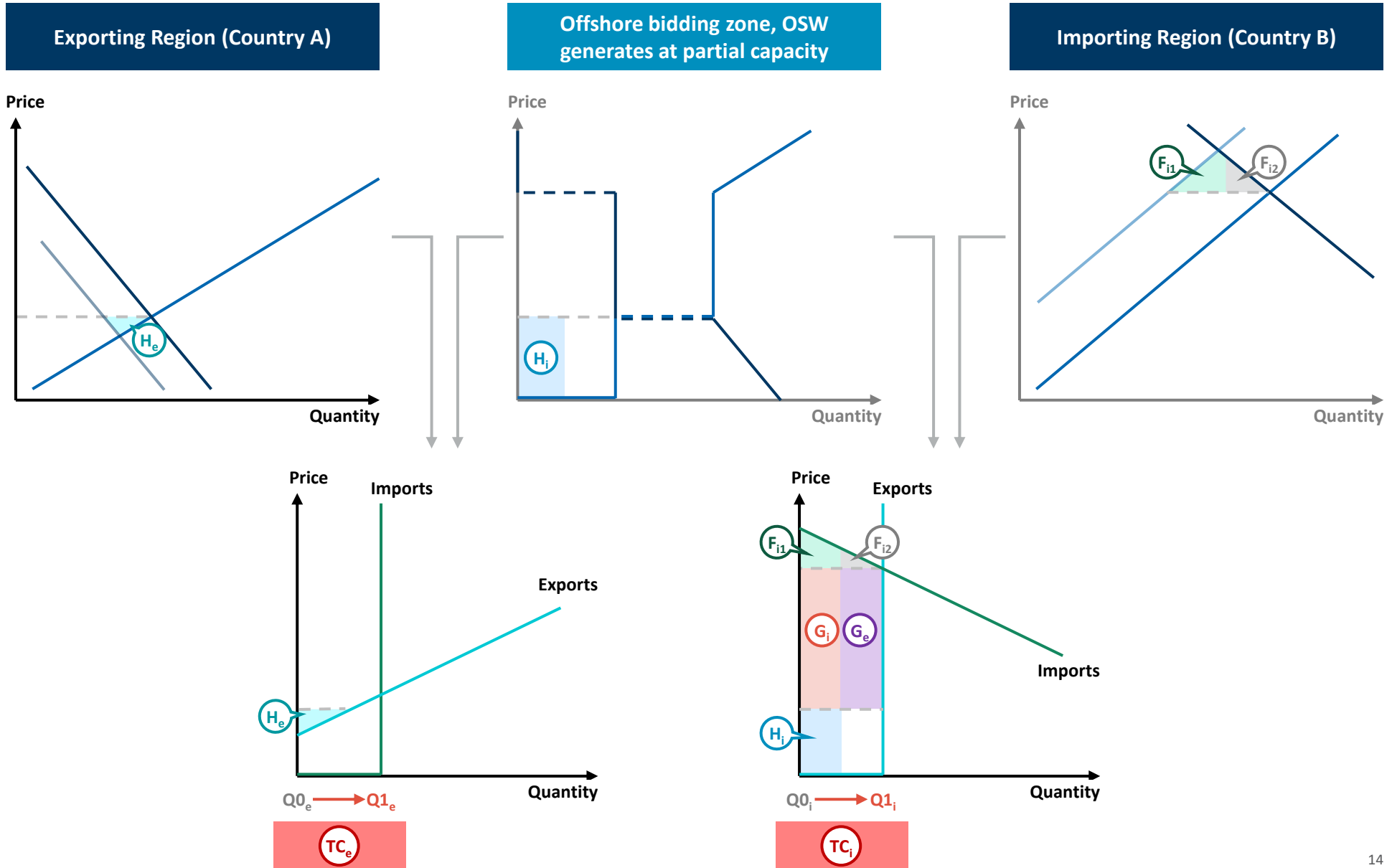
When the OSW generates at full capacity, the MPI has no effect on Country A, and all welfare benefits accrue to OBZ and Line 2



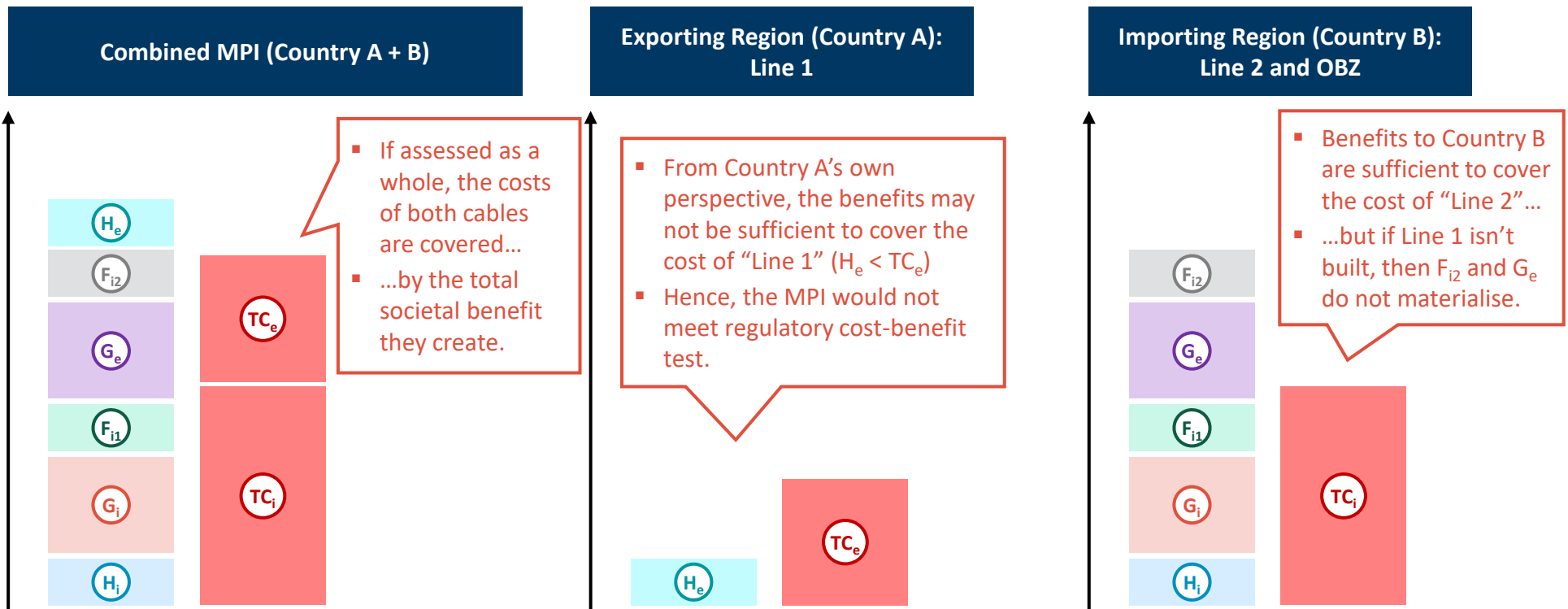
When the OSW does not generate, congestion rents still accrue on Line 2 of the asset (which now operates effectively as a “pure” interconnector)



When the OSW generates at partial capacity, congestion rents still accrue on Line 2 (though with some producer welfare benefits to Country A)



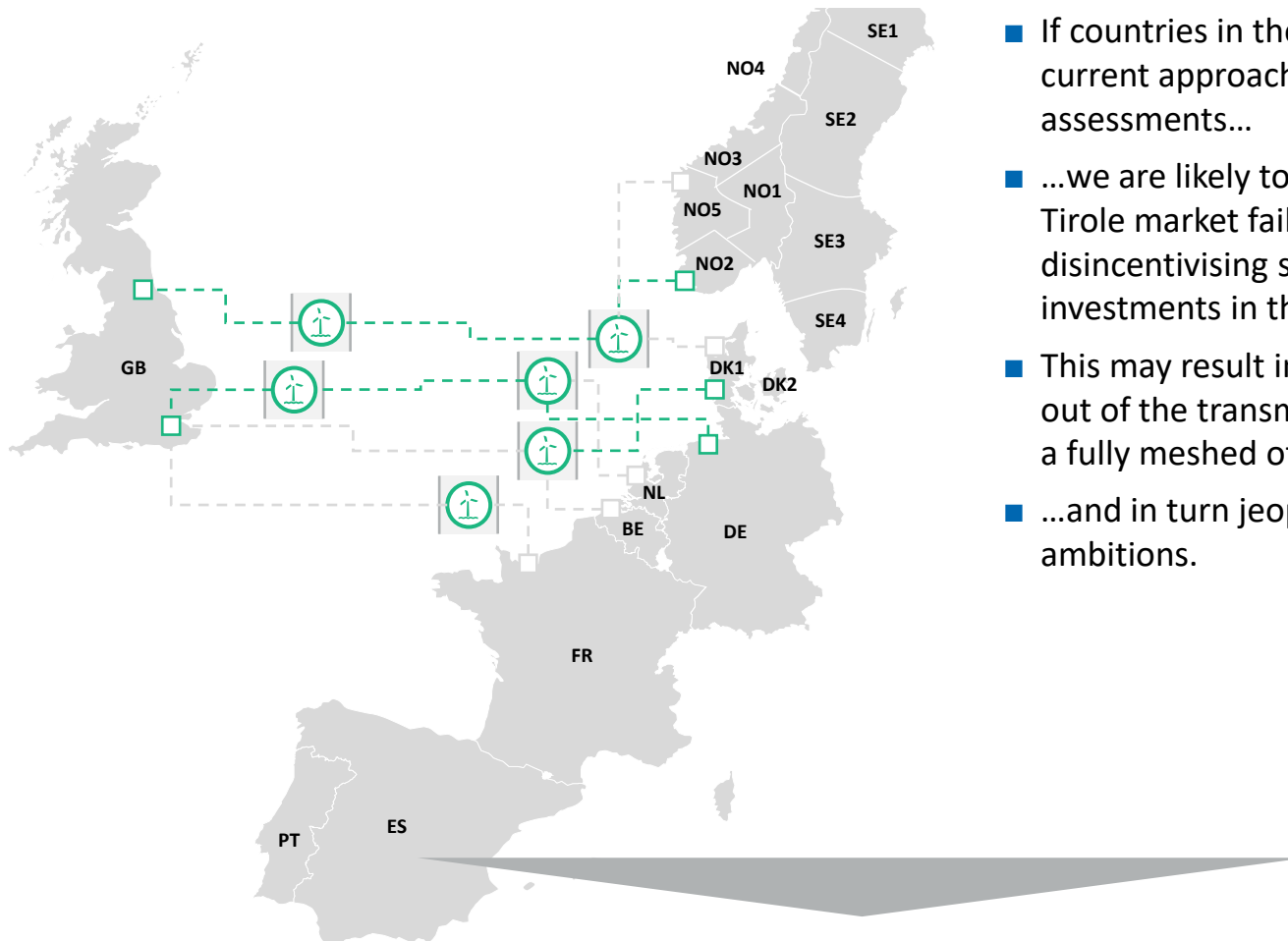
If individual cables connecting to an OBZ are assessed individually, the full range of benefits is unlikely to be accounted for



- Exporting and importing regions typically vary on an hour by hour basis, so if an MPI leads to relatively balanced flows, this may not be a significant issue.
- However, there are potential strong disincentives for predominantly exporting countries to proceed with investment in MPI transmission capacity (and the two countries may not forecast the same direction of flows).
- This is a classic example of the market failure (Joskow & Tirole, Hogan), leading to suboptimal volumes of socially beneficial transmission capacity.

Failure to coordinate among stakeholders may drive an inefficient volume of MPI transmission in the North Sea, jeopardising Net Zero ambitions

Illustrative North Sea meshed offshore grid



- If countries in the North Sea continue to pursue the current approach of uncoordinated cost-benefit assessments...
- ...we are likely to continue to observe the Joskow & Tirole market failure of large, lumpy costs disincentivising socially beneficial transmission investments in the North Sea.
- This may result in an unduly slow (or unduly low) roll-out of the transmission capacity necessary to achieve a fully meshed offshore grid...
- ...and in turn jeopardise European decarbonisation ambitions.

Instead of protracted bilateral negotiations among stakeholders, a common methodology for sharing the costs and benefits of MPIs would help avoid a suboptimal outcome for all countries.

Any questions?



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