Grid Interconnection Project Financing and Business Model, Case study from mature markets

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Observations from mature markets:
Interconnector system in Europe

Key drivers for investment

- Emission targets and genmix transformation, especially renewables
- Pan-European drive for greater integration of electricity markets
- Energy security and diversification
- Price arbitrage (extrinsic vs. intrinsic)

Revenue regime

Regulated

- Cap-and-Floor (C+F) provides min. revenue guarantee

Merchant

- Secure long term capacity contract with generators

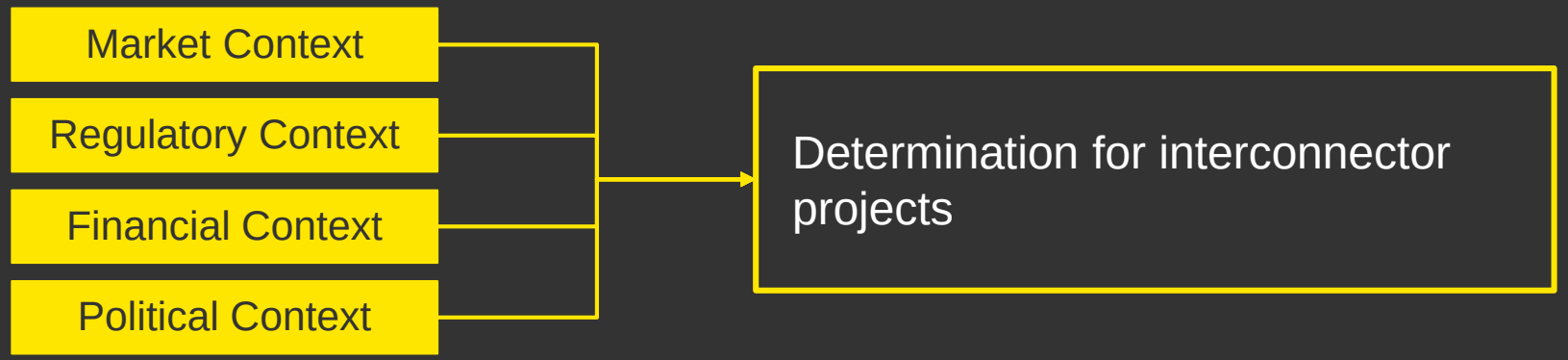
- Exemption from UK carbon tax and network charge offers additional price arbitrage advantage
- Capacity Market auction

Selected recent or under development interconnectors in Europe:

Target delivery	Project name	Country	Capacity (GW)	Estimated capex (£m)	Current ownership / developer	Revenue regime
2019	Nemo	Belgium-UK	1.0GW	£0.6bn	Elia, National Grid	C+F
	Eleclink	France-UK	1.0GW	£0.5bn	Eurotunnel, STAR Capital Partners	M
2020	IFA2	France-UK	1.0GW	£0.6bn	RTE, National Grid	C+F
2021	NSN (NorthSea Link)	Norway-UK	1.4GW	£1.75bn	Statnett, National Grid	C+F
	Greenlink	Ireland-UK	0.5-0.7GW	£0.3bn	Element Power	C+F
2022	FAB	France-UK	1.4GW	n.a.	RTE and FAB Link	C+F
	Viking Link	Denmark-UK	1-1.4GW	£1.5bn	Energinet.dk, National Grid	C+F
2023	NeuConnect	Germany-UK	1.4GW	£1.5bn	Greenage, Meridiam	C+F
	North Connect	Norway-UK	1.4GW	£1.5bn	Agder Energi, E-CO, Lyse and Vattenfall	C+F
	GridLink	France-UK	1.5GW	n.a.	iCon Infrastructure	C+F
After	Ice Link	Iceland-UK	1.0GW	n.a.	Landsvirkjun, National Grid	TBC

Observations from mature markets:
Interconnectors require significant planning and business case development

- Interconnector projects are results of “balance”
- Clarity on project goals, governance and sponsorship is vital
- Business cases for interconnectors are complex and multi-faceted, and quantification of benefits and risks is key to final investment decision



- Project management including choose of generation technology and cost/budget management etc.

Projects can “break” if the business base does not carefully consider Market, Regulatory, Financial and Political aspects.

Observation from mature markets:
Interconnector investment model in UK

(1) Cap and Floor – UK interconnector regulatory framework

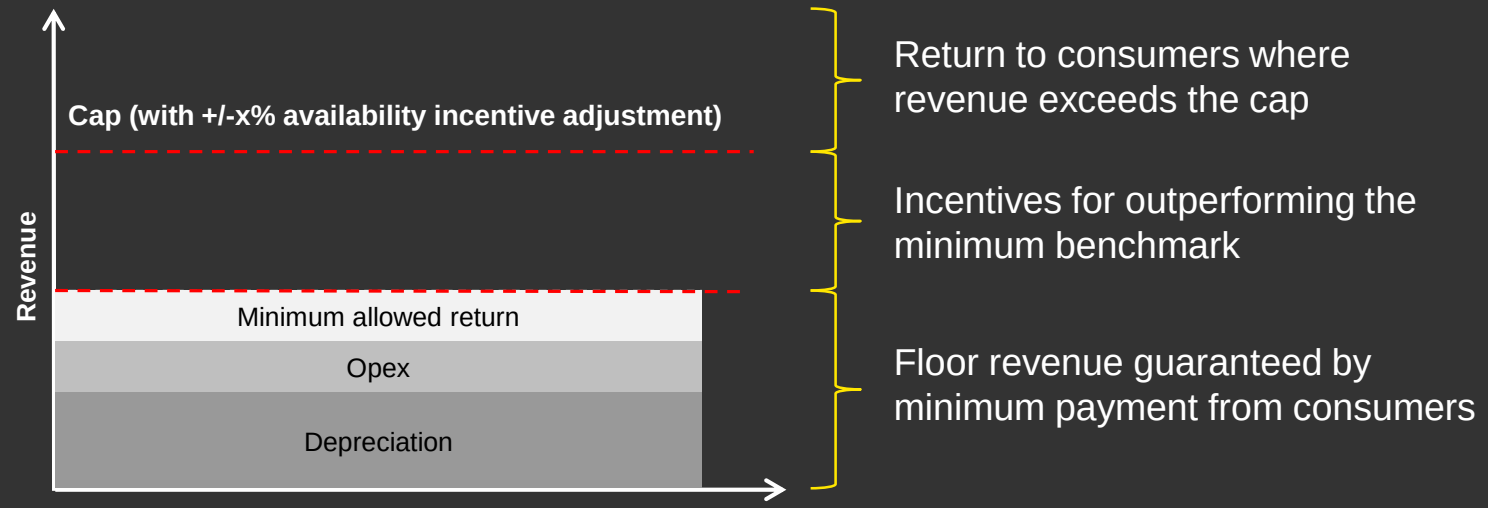


Illustration of high level components of the cap and floor
Source: Ofgem

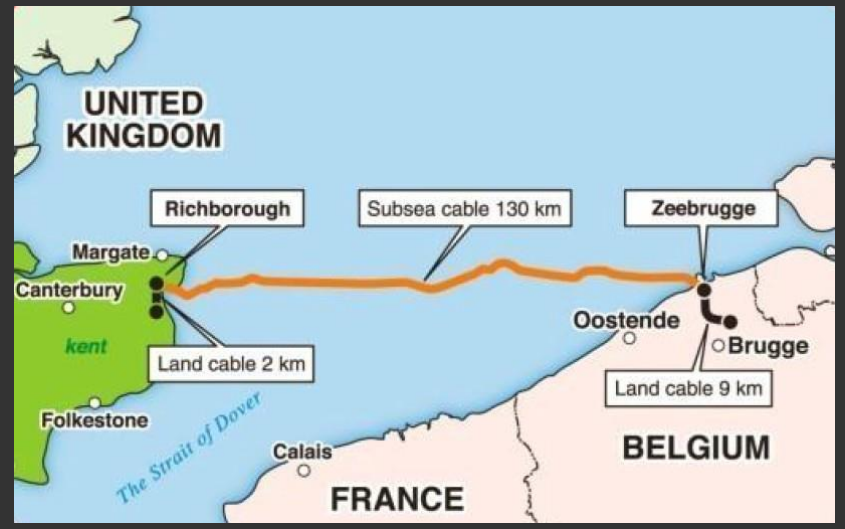
(2) Merchant route

- Developers can still seek exemptions from certain EU regulatory legislation in order to increase the safeguards for the business case of their investment.
- ElecLink is an example project which is currently developed via this route, similar to the existing BritNed interconnector.

Case study: Project NEMO
the 1st interconnector under Cap and Floor Regime in operation

Nemo Link®

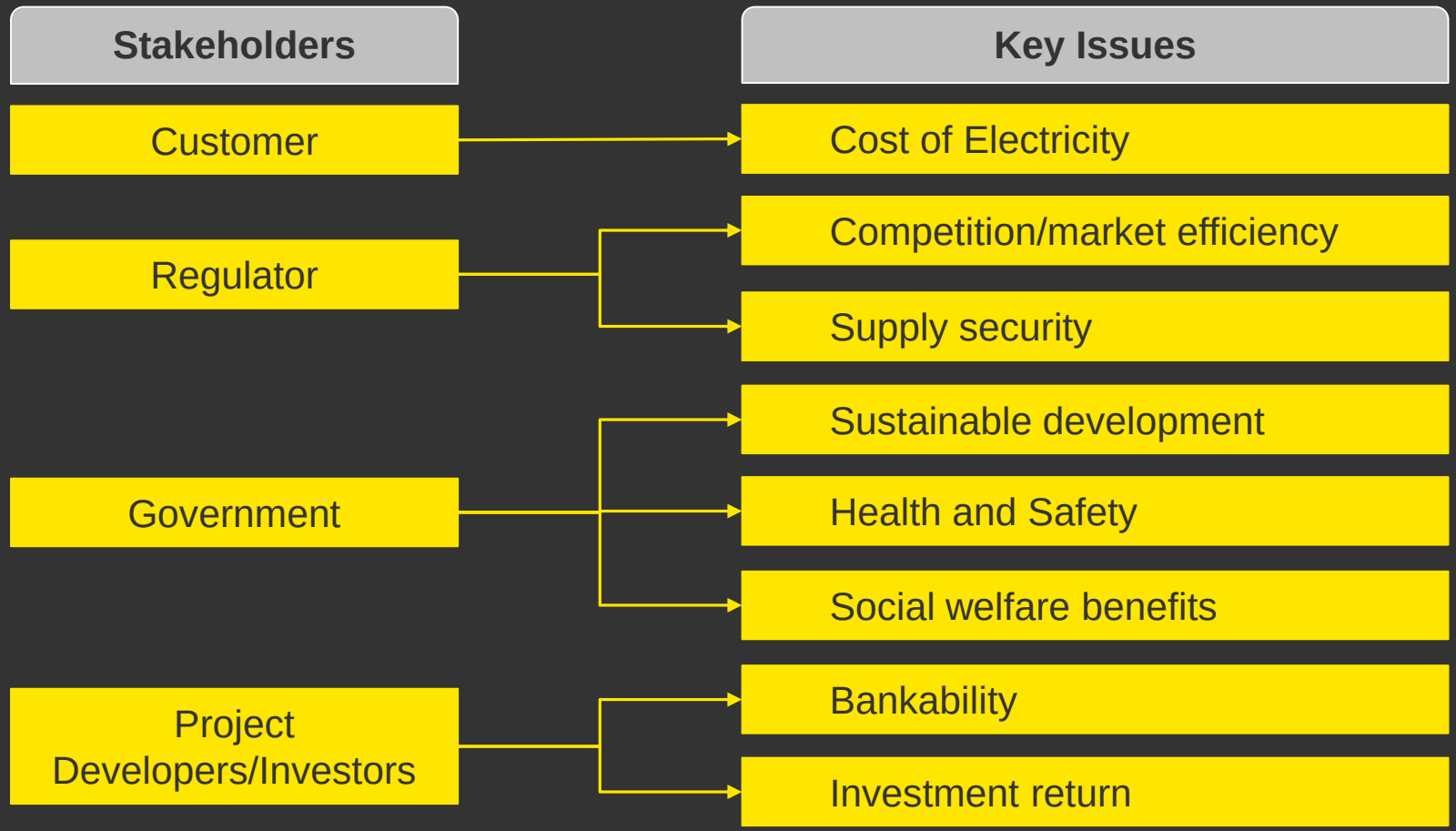
- The 1GW electricity interconnector between Belgium (“BE”) and Great Britain (“GB”) has achieved COD in Q1 2019
- Developers include National Grid NEMO Link Ltd. (a subsidiary of National Grid Plc) and Elia (the Belgian TSO)
- Developers will jointly own and operate the interconnector following construction.



Cable Length	Transmission Capacity	Project Cost	Status	Countries	Target Delivery	Revenue Regime
140 km	1,000 MV	GBP600m	Commercial Operation	UK and Belgium	2019	Cap and Floor

Case study: Project NEMO

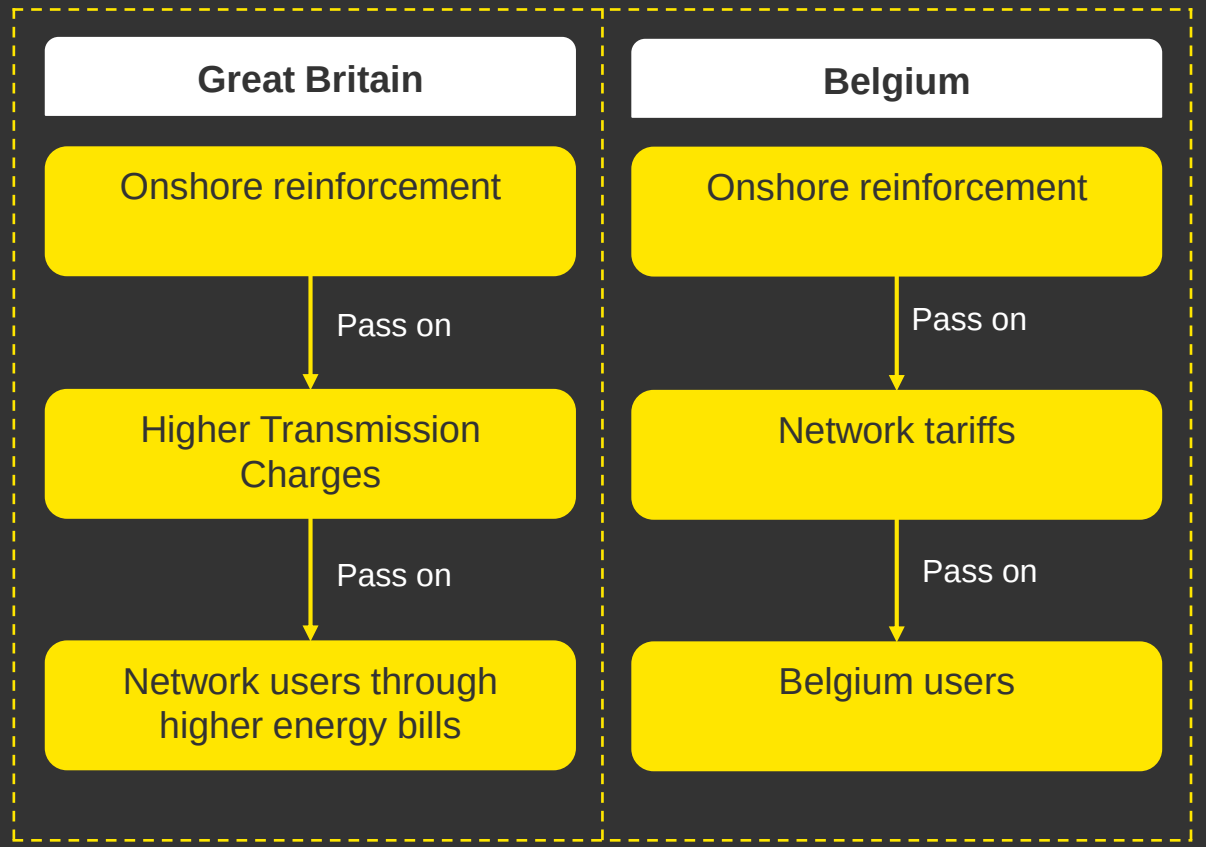
Key considerations that impact project viability



References:
Cap and floor regime for application to project NEMO: Impact Assessment, ofgem, 2013

Case study：Project NEMO
Impact assessment on customer

- Impact on wholesale market price
  - **Exporting Country:** The wholesale price is likely to rise if this exported generation effectively increases demand
  - **Importing Country**: Trade will reduce the wholesale market price in the country that is importing across the link, as demand will be met more efficiently
- The consumer surplus from changes in energy prices is likely to be the opposite of the producer surplus
  - *e.g.* GB predominately exports to BE in response to high BE wholesale prices
    → GB wholesale baseload and peak prices increases
    → consumer welfare decreases
- Costs pass to consumers from the onshore reinforcements in both GB and BE.



Case study: Project NEMO
Impact assessment on competition

- Impact assessment： measures of market concentration

	Largest company allocation		Atomistic competition	
	Pre-NEMO	Post-NEMO	Pre-NEMO	Post-NEMO
Concentration ratios				
CR(1)	34%	35%	12%	12%
CR(3)	49%	49%	27%	27%
HHI Test				
HHI Value	1492	1541	515	502
ΔHHI		49		-13

- CR(1): the share of the GB generation market held by the largest firm
- CR(3): the share of the GB generation market held by 3 largest firms

Scenarios

- **Largest company allocation**: full NEMO capacity is allocated to the largest player in each of the markets
- **Atomistic competition**: NEMO capacity is equally held by 10 new independent market entrants (*a closer representation of reality*)

Results

- **Little effect to the GB market**: the NEMO link will have little effect on the market share of the biggest players, due to the large size of the GB generation market as compared to the capacity of the NEMO link
- **The HHI values**: the NEMO link can reduce market concentration slightly in GB and in Belgium (under atomistic competition)

References:
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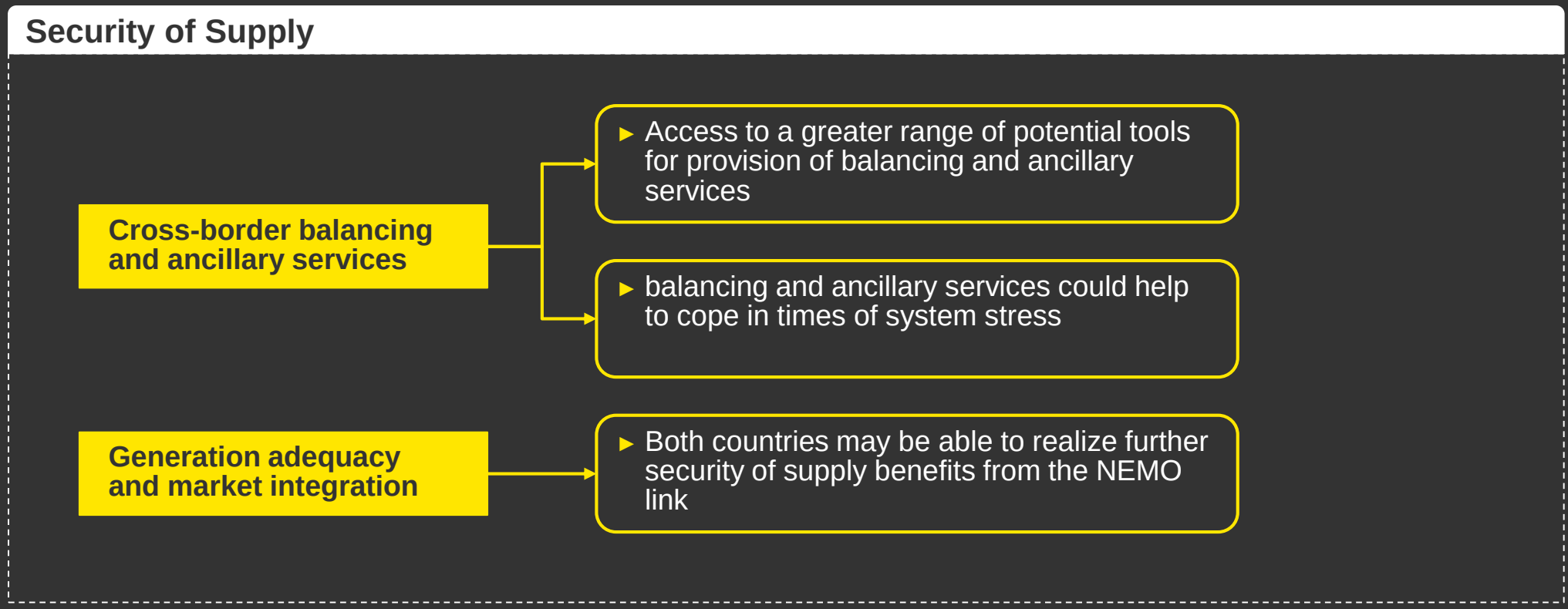
Case study: Project NEMO
Impact assessment on security of supply



Case study: Project NEMO

Impact assessment on sustainable development and the environment

Sustainable Development and the Environment

Integration of variable renewable generation

- Increased interconnection can help to reduce problems associated with variability of generation output
- Increased interconnection with neighboring markets provides the opportunity for cross-border flows of electricity when supply exceeds demand.
- Additional cross-border capacity would allow for the more efficient dispatch of generation between GB, Belgium and interconnected countries.

Impact on the environment

- Localized negative impacts on the environment.
- Visual dis-amenity, noise, localized vehicular pollution and transformation of the surrounding environment etc.

Case study: Project NEMO
Impact assessment on health and safety

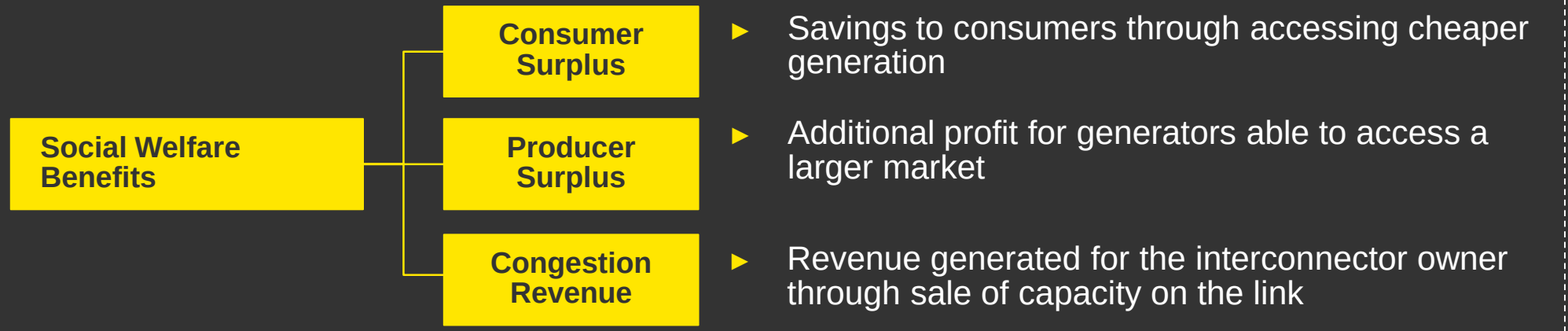
- Potential negative impacts if development does not comply with relevant legislation

Enforcing safe working practices in compliance with relevant legislation

Manage health and safety risks associated with the installation, operation and maintenance of the interconnector and associated equipment

Case study: Project NEMO
Impact assessment on social welfare benefits

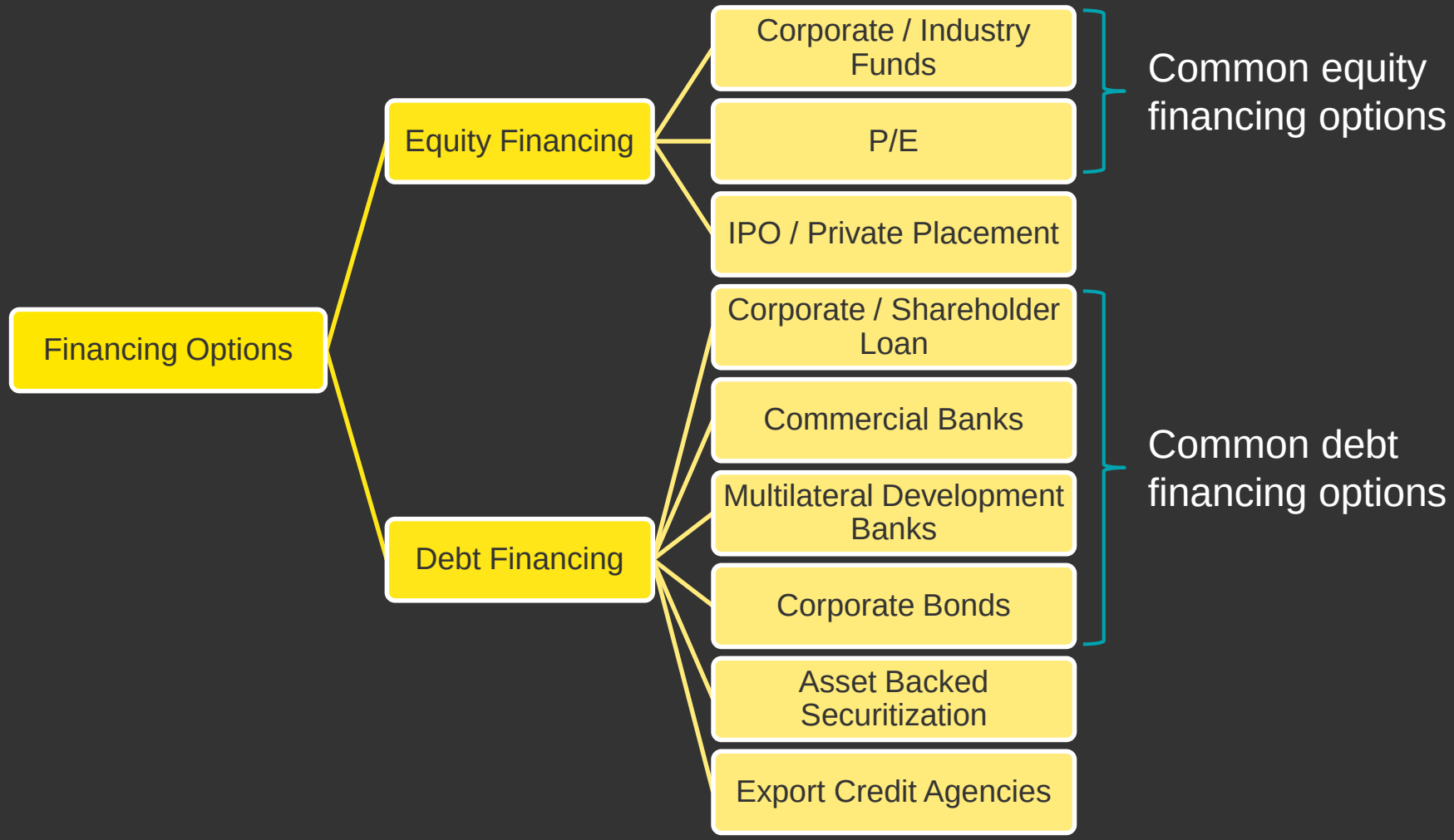
Components of social welfare benefits



- Study shows that both GB and BE make positive social welfare gains as a result of NEMO
- Initially BE makes the larger net social welfare gain, while GB making larger welfare gains by 2030.
  - BE will see fall in baseload prices and the opportunity for producers to export to GB
  - In GB, consumer welfare gains largely result from imports at peak demand periods

Case study: Project NEMO

Typical financing options for infrastructure projects



Case study: Project NEMO
Bankability

Bankability

- Payment from consumers are required if revenue falls below the floor.
- The total cost of the floor will be funded equally by GB and Belgian consumers
- Years when payments are required from customer are expected to be temporary

→ **A minimum level of revenue is ensured**

Case study: Project NEMO
Investment returns

Investment Returns

- Costs of development are passed on to the network users, who pass these costs on to customers through energy bills
- Financial expenses and risks, e.g. fluctuation of interest rates, are also passed on to network users.

→ **Costs of development and financing are recoverable**

- Under the Cap and Floor mechanism, additional congestion revenue is earned by the interconnector owner up to the cap level

→ **Room for upside revenue potential**

Case study: Project NEMO
Summary: Project NEMO Impact Assessment

Stakeholder	Key Issues	How the Cap & Floor Regime address issues?	Impact
Consumers	▪ Cost of Electricity	▪ Trade will reduce the wholesale market price in the country that is importing across the link ▪ For the exporting nation, the wholesale price is likely to rise	▪ Overall social welfare benefit
Regulator	▪ Competition / Market Efficiency	▪ NEMO link can slightly reduce market concentration in both countries	▪ Impact is minimal
	▪ Security of Supply	▪ Both GB and BE are likely to address potential security of supply challenges without NEMO	▪ NEMO link will bring further security of supply benefits
Government	▪ Sustainable Development	▪ Reduce problems with generation output variability ▪ More efficient dispatch of generation ▪ Visual dis-amenity, noise, pollution etc.	▪ Increased integration ▪ Negative impact on environment
	▪ Health and Safety	▪ Risks associated with construction	▪ Negative yet controllable
	▪ Social Welfare Benefits	▪ Consumer surplus and producer surplus from changes in market prices ▪ Revenue earned by interconnectors through sale of capacity	▪ Overall social welfare is achieved through the operation of NEMO
Project Developers / Investors	▪ Bankability	▪ The cap and floor mechanism requires a payment from consumers if revenue falls below the floor	▪ A minimum level of revenue is ensured
	▪ Investment Returns	▪ Costs of development and financing are passed on to the network users ▪ Additional congestion revenue is earned up to cap level	▪ Recoverability of costs ▪ Upside revenue potential

References:
Cap and floor regime for application to project NEMO: Impact Assessment, ofgem, 2013

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Mr. Lu joined EY in 2002 and now associate partner of Greater China Power & Utility and business development lead.

Focused on the P&U sector and is a core member of EY global P&U service network. Experienced to synergize the global best practices with needs from China market development. Through long term client service, accumulated indepth knowledge on sector transformation and development.

From strategy to execution, extensively involved in China P&U players' overseas investment and M&A activities, acquaint of the latest development of the global market. Deep insights on transaction value drivers and the challenges that Chinese players are facing.

Major clients include: State Grid, Southern Grid, CHN Energy, Huaneng Group, Datang Group, CECEP, PowerChina and Sinopec etc.

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