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Insights from Irish Energy Systems Modelling on Decarbonising Road Freight and the Impact of Intangible Costs

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Trucks: Emissions & Demand

- ❑ CO_2 emissions during 1990 to 2021 have risen by 115%
- ❑ Transport sector is responsible for 34% of energy-related CO_2 emissions
- ❑ Trucks generate 20% of transport emissions
- ❑ Trucks make up 5% of total road vehicle stock
- ❑ The overall freight demand is expected to double by 2050

➡ meet increasing demand while minimising environmental impacts

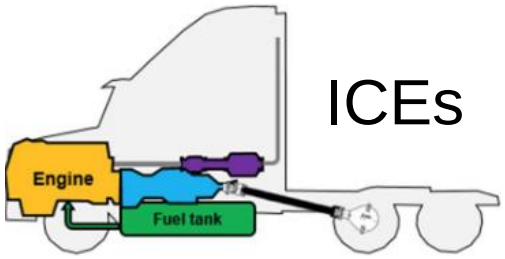
Decarbonising trucks

❑ Barriers

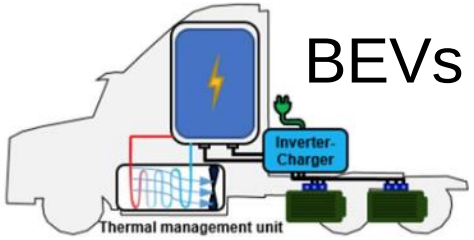
- Alternative fuel availability
- Recharging/refuelling time
- Decreased cargo capacity
- Capital-intensive infrastructures
- Well-to-wheel emissions
- Less commercialised technologies
- Hesitancy to invest in a less mature technology

➡ Need for a comprehensive Energy System Analysis

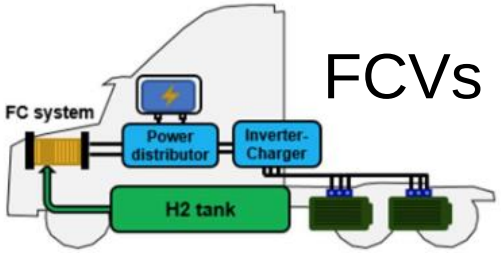
ICEs



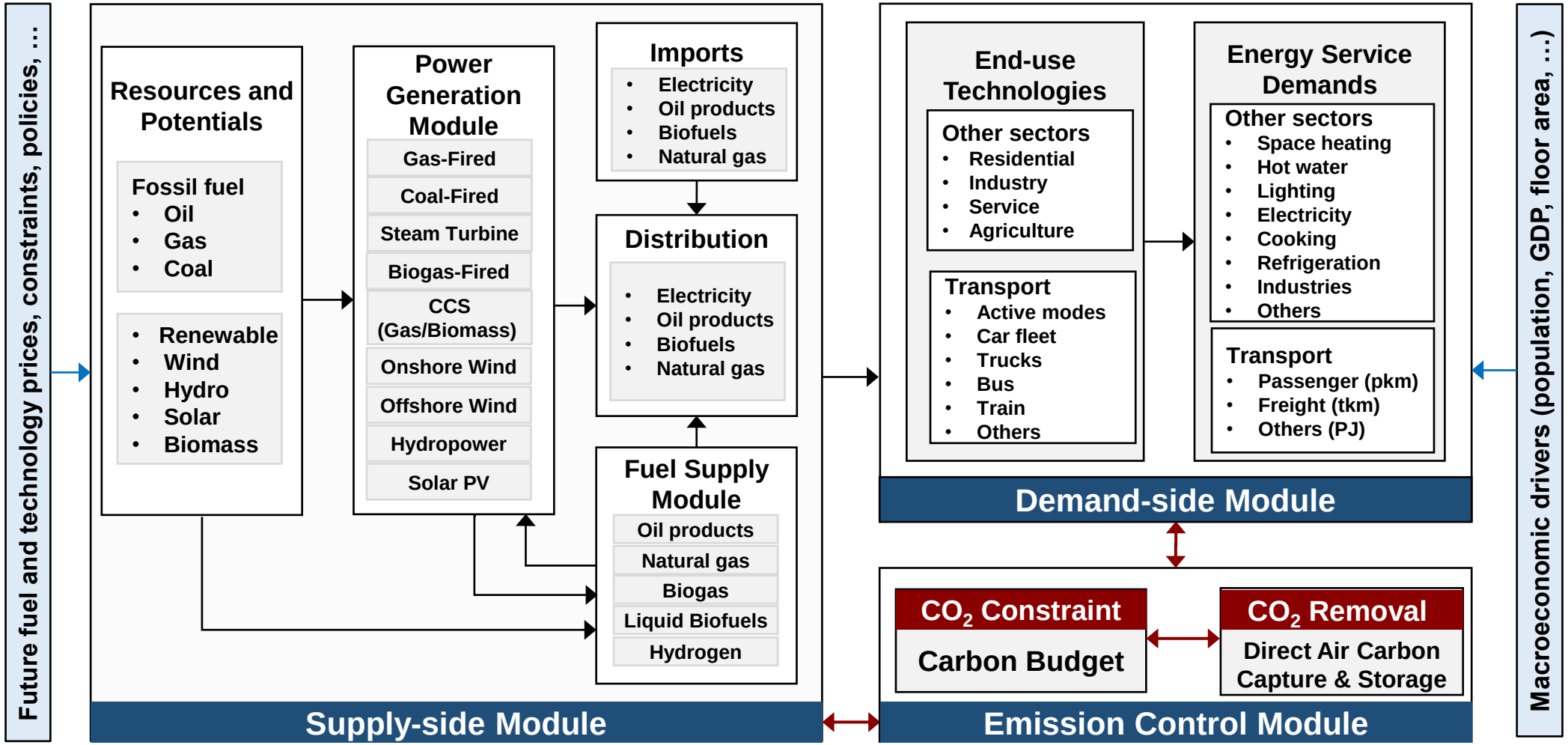
BEVs



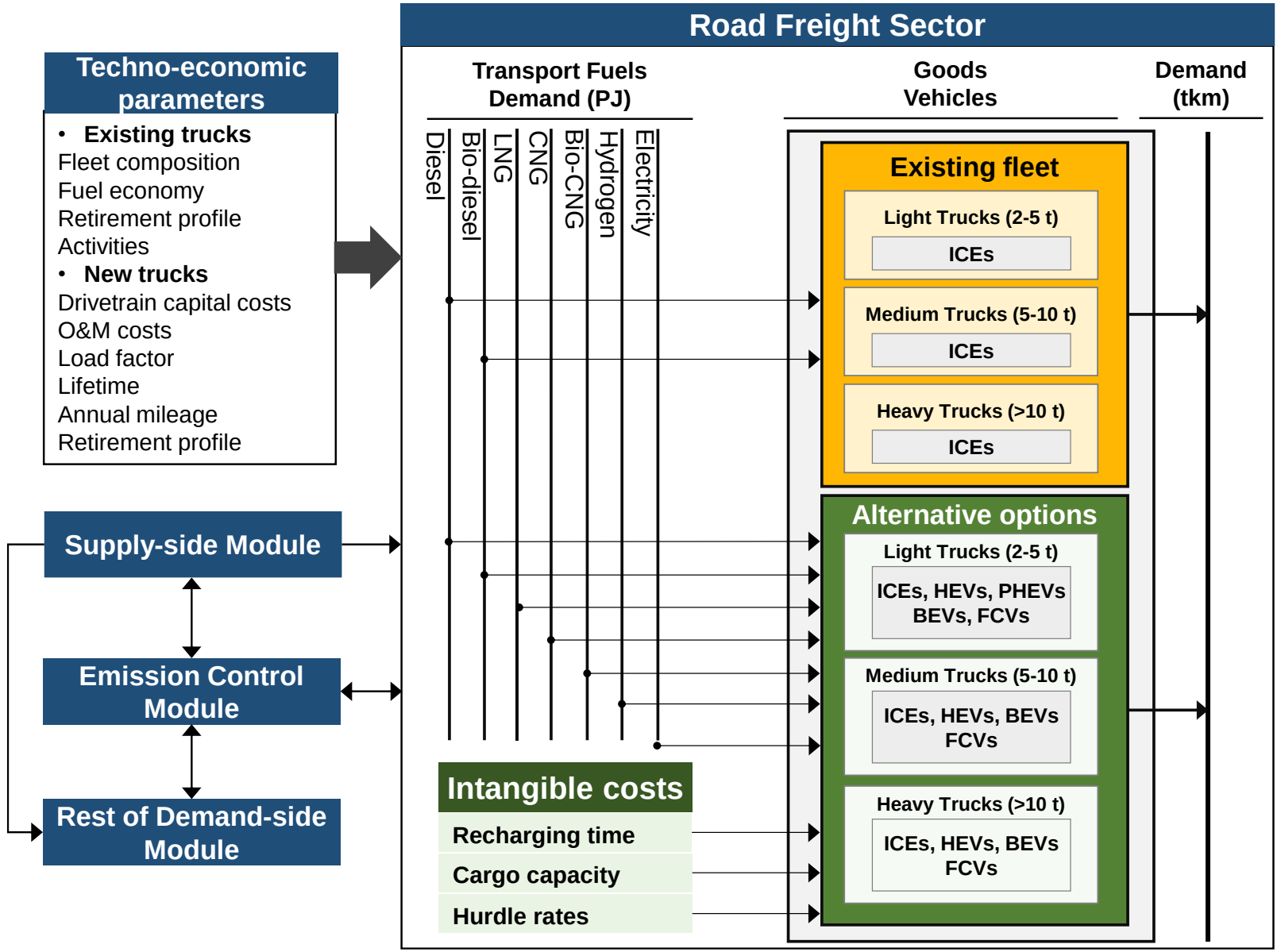
FCVs



TIMES-Ireland Model (TIM)



Freight sector and main input



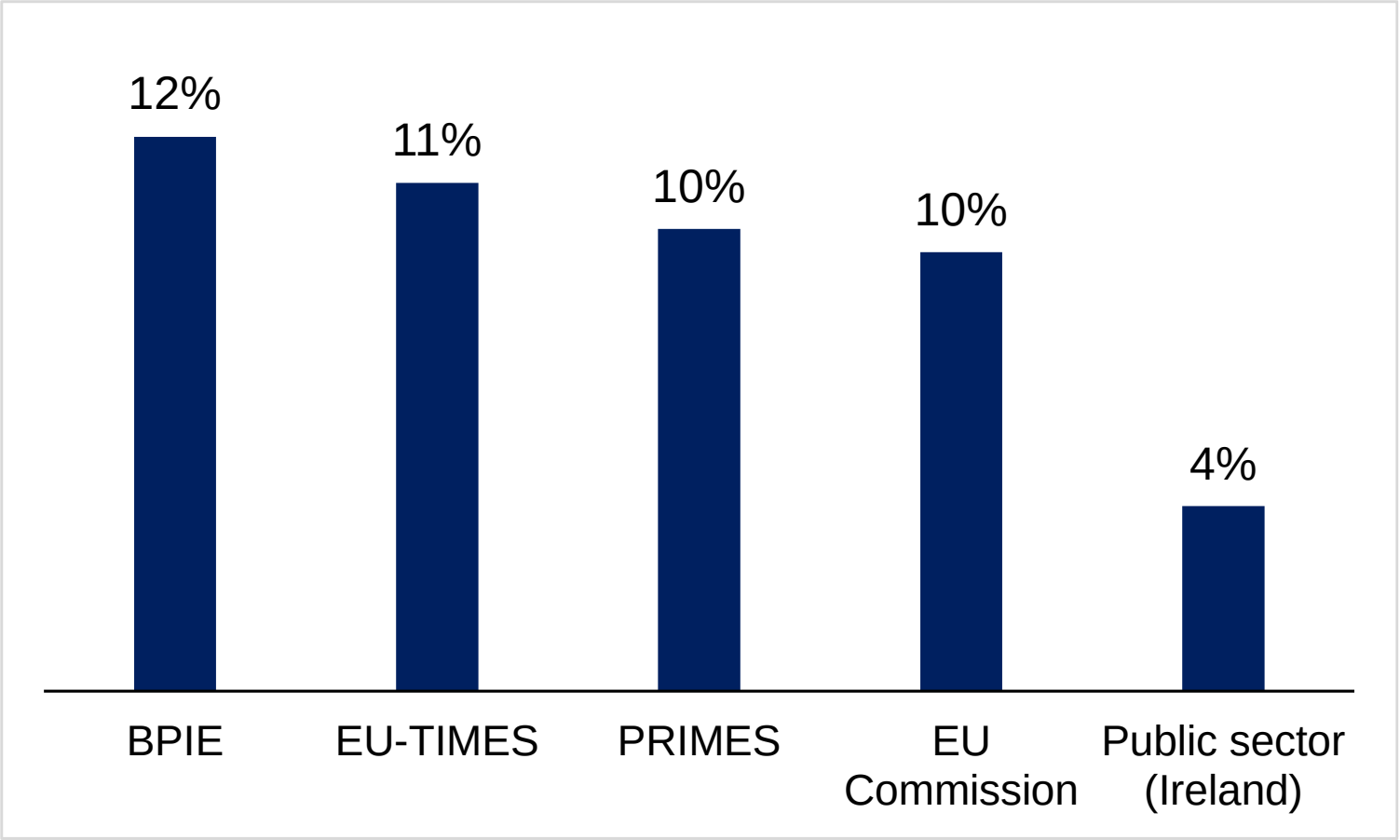
Cargo capacity and refuelling time

Technology	Cargo capacity relative to diesel ICE	
	2020	2050
ICEs (CNG)	0.99	0.99
BEVs	0.67	0.89
FCVs	0.9	0.96

8 ton to 5.4 ton

Source: Lajevardi SM, Axsen J, Crawford C. Simulating competition among heavy-duty zero-emissions vehicles under different infrastructure conditions. Transportation Research Part D: Transport and Environment. 2022 May 1;106:103254. https://www.sciencedirect.com/science/article/pii/S1361920922000840?via%3Dihub#f0005

Discount rate



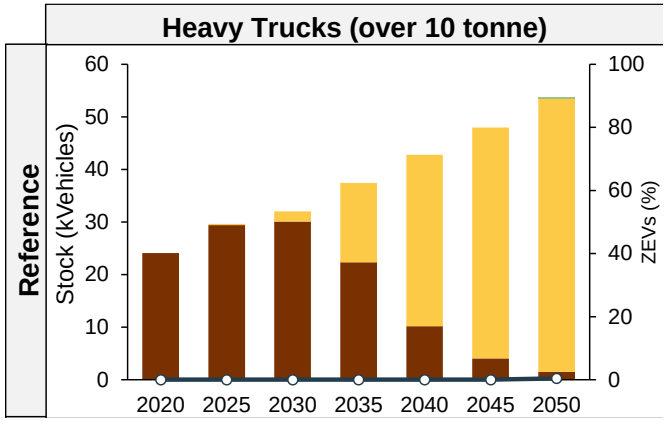
- **Social DR: 4%**
- **EU Range: 10-12%**
- **Ireland: 12%**
  - **High levels of competition**
  - **Low profit margins**
  - **Volatile fuel prices**
  - **Suggest a higher rate of return for investors**

Scenario definition

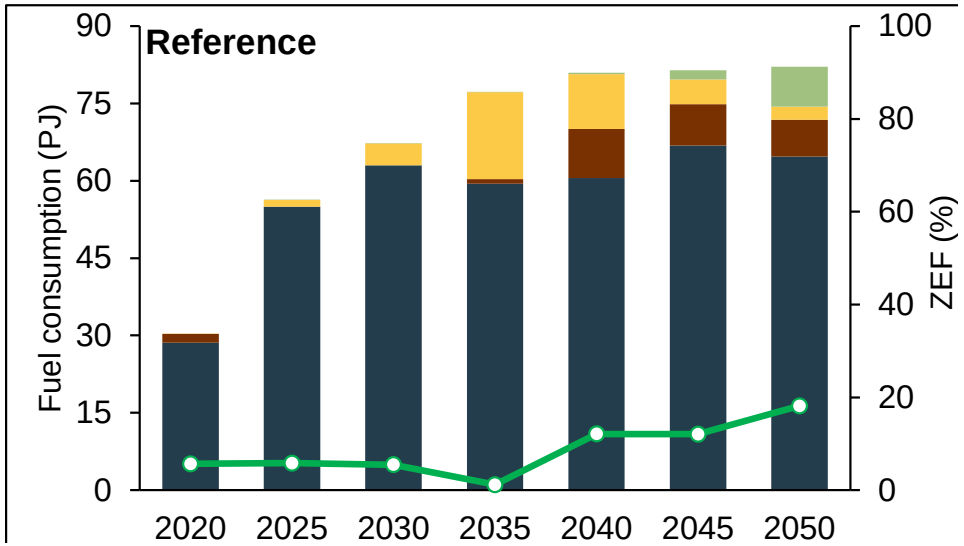
- ❑ Reference
- ❑ Net zero by 2050
- ❑ Net zero + Intangible costs

Scenarios	BAU	Carbon budget constraint	Intangible costs		
			Recharging time	Cargo capacity	Hurdle rate (12%)
Reference	✓				
Mitigation	✓	✓			
Mitigation+ Intangible	✓	✓	✓	✓	✓

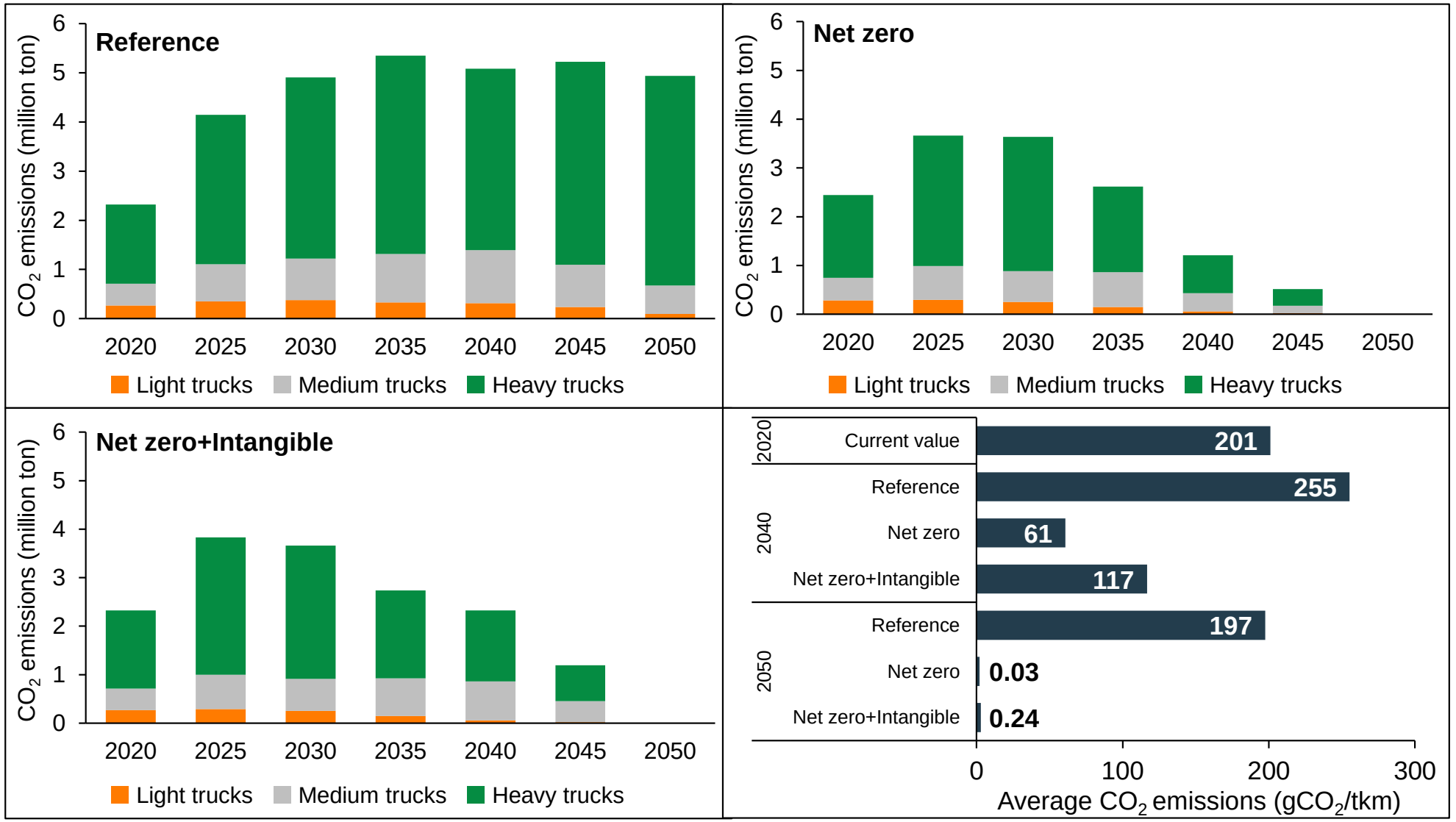
Results: Vehicle stock



Fuel consumption



CO_2 emissions



Key takeaways

- **Cargo capacity, refuelling time, and hurdle rates** can significantly change the results between **electrification** & **hydrogen FCV**

- **Intangible costs impact preference**
  - Hydrogen FCV may be favoured for medium and heavy trucks
  - BEVs are preferred without considering intangible costs

- **Importance of holistic evaluation:** Policy makers and stakeholders should consider both **tangible & intangible factors** for effective decarbonisation strategies

Future research

- Sensitivity analysis to further refine results
- The impact of driving range
- Infrastructure considerations (H2, EVSE)
- Technology readiness of zero emission trucks
- Series-production (manufacturing readiness)

Thanks for listening!

FUNDED BY:

Ireland's European Structural and Investment Funds Programmes 2014-2020
Co-funded by the Irish Government and the European Union

European Union
European Regional Development Fund

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