Scenarios of deep decarbonization of freight transport for France by 2050

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Context: the issue of road freight decarbonation

- Decarbonation pathways
  - Multi-sectorial decarbonation pathways generally lack detail (e.g. SNBC: France's current national decarbonation strategy gives very little detail about freight transport)
  - There is currently no consensus on a feasible, credible roadmap towards the decarbonation of freight transport in 2050
- Road freight transport is one of the main emitters of GHG, and reductions are difficult
  - In France, rail freight transport accounts for less than 10% of tkm
  - This has reduced steadily over 50 years, despite many heavily costly policy attempts, and deregulation
  - Inland waterway transport is low in France, and stable

Objective: explore freight decarbonation and its underlying issues and questions

- Freight transport is a complex topic. Questions regarding its future pertain to:
  - The structure of the demand
  - The adequacy of the technical solutions (including transport modes)
  - The characteristics of vehicles
  - The way energy is provided to those vehicles
- The objective is not to provide a unique, prescriptive roadmap, but to reveal the underlying questions and their interdependencies

Method: GHG emissions drivers

- Freight transport is a complex topic. Questions regarding its future pertain to:
  - The structure of the **demand**
  - The adequacy of the **technical solutions** (including transport modes)
  - The characteristics of **vehicles**
  - The nature of the **energy** provided to vehicles

CO2 = Activity	**x Structure**	**x energy Intensity**	**x Fuel carbon content** *(Shipper et al, 2000)*
CO2 = Mt	*x km x veh/t*	*x MJ/vkm*	*x CO2/MJ*

Method : storylines + dashboards

- The objective is not to provide a unique, prescriptive roadmap, but to reveal the underlying questions and their interdependencies, as a support for dialogue
  - Scenarios combine **storylines** and indicators grouped in a **dashboard**
  - Quantification is used as a **consistency check** of the storyline
  - Scenarios are designed to reach **carbon neutrality** (backcasting philosophy)
- Why not a fully quantitative approach?
  - Simulations can be inadequate as a support for discussion
  - Distinguishing implicit and explicit assumptions of a model requires a very deep technical expertise

Designing the scenarios (1/2)

- Qualitative analysis:
  - Possible future trends were comprehensively listed, based on the academic and technical literature and from several experts
- Quantitative analysis:
  - Freight types were grouped into six categories:

    1 Agrifood / 2 Heavy industry / 3 Waste / 4 Construction / 5 Low AV manufactured products / 6 High AV manufactured products
  - Freight flow data was also segmented by
    - National vs international status
    - Distance ranges
    - Road vehicles (for road transport)

Designing the scenarios (2/2)

- Then, qualitative trends are transformed into quantitative changes on one or several of the quantitative indicators. Examples:
  - Agrifood transformation => less tons moved per inhab for this category
  - Regional relocation => less kms for low AV manufactured products
- These trends are grouped into two scenarios
  - **Scenario 1:** demand structure does not change much, decarbonation is technical
  - **Scenario 2:** demand structure changes substantially, through behavioral and organisational transformations; mode shift also contributes to decarbonation
- Road vehicles are modelled through a TCO approach. Different kinds of vehicles are considered (size and energy: ICE, electric, H2, etc.)

Scenario 1: storyline

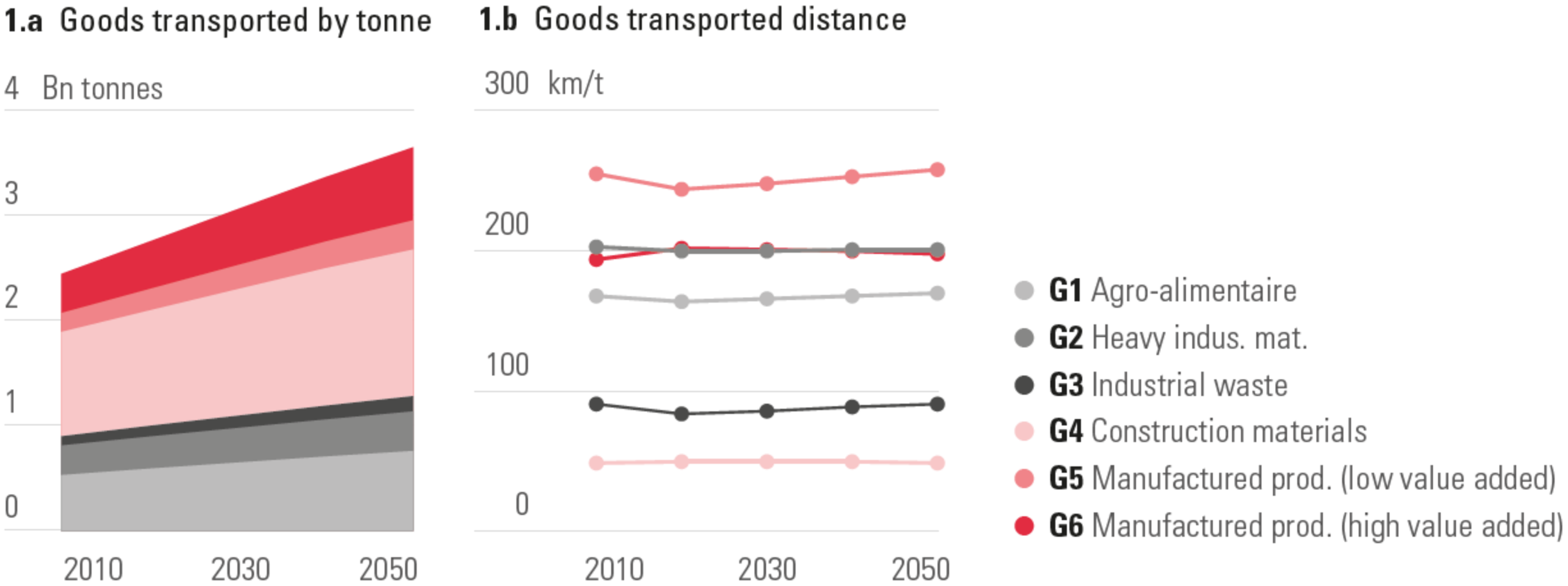
- Freight flows continue to increase
- Supply chains continue to demand flexibility, agility, etc.
- Road freight transport does not decrease
- Decarbonation relies almost entirely on road vehicles decarbonation
- Carbon neutral HGV for distances > 500km is a major challenge
- Agrofuels are needed in very large amounts

Scenario 2: storyline

- Production and trade systems change deeply
- Circular economy spreads widely
- Time constraints are loosened
- Economic activities are relocated
- Rail freight transport is heavily supported

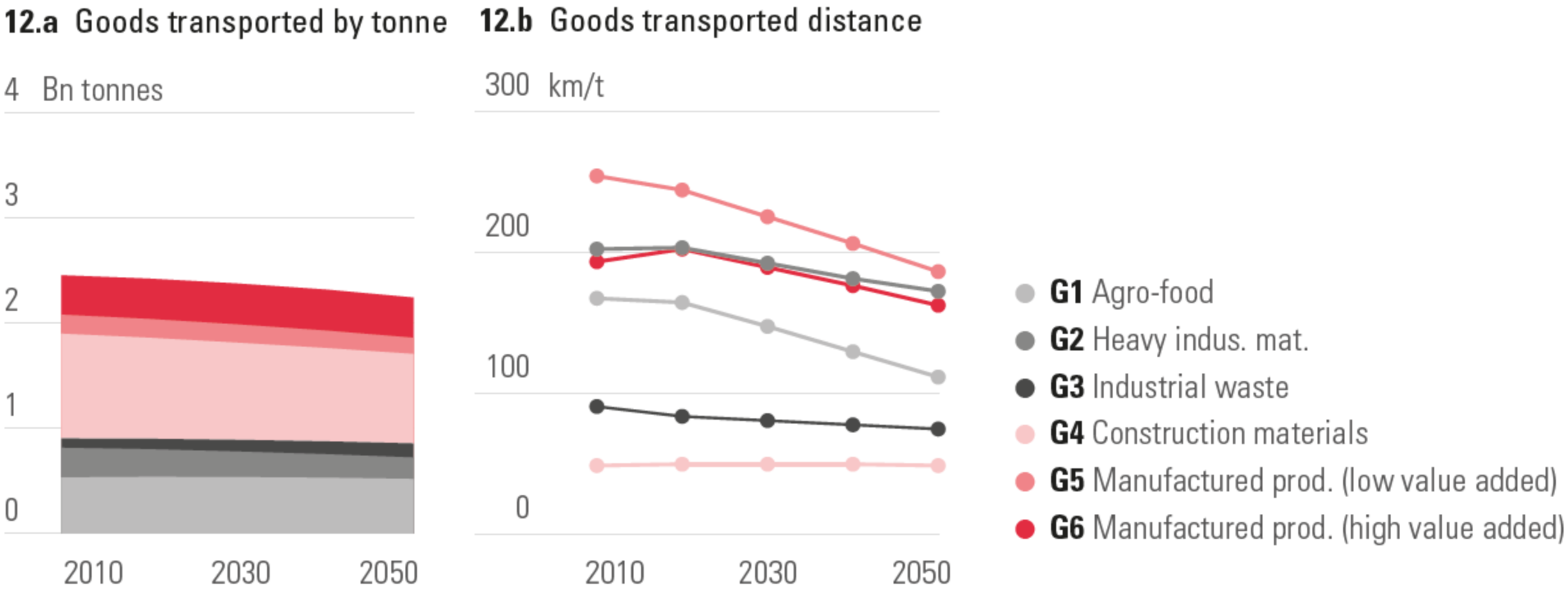
Scenario 1: demand

Transport demand per goods type, in billion tonnes transported



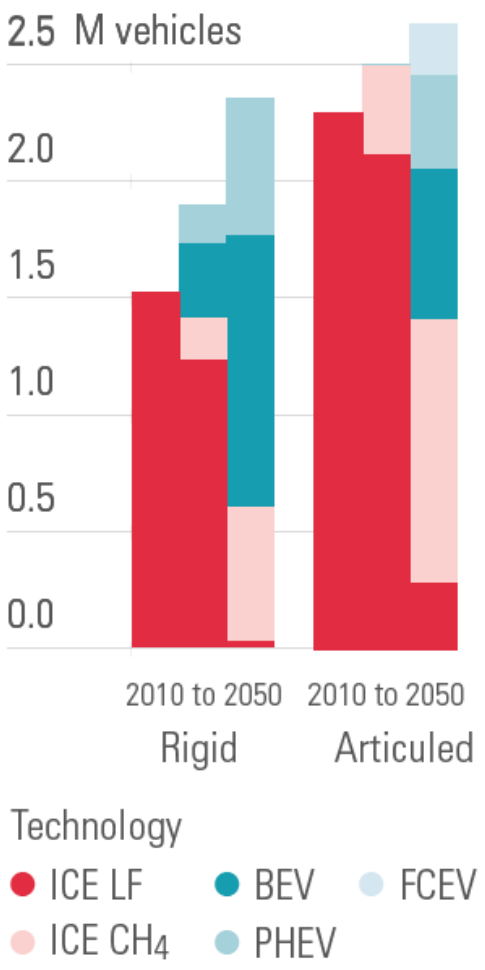
Scenario 2: demand

Demande de transport par marchandise et distance de transport

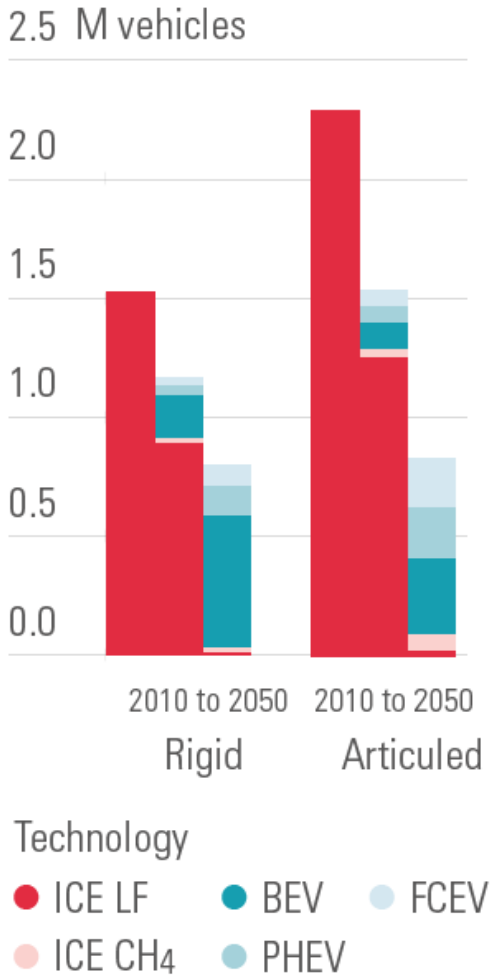


HGV stock and technologies

Scenario 1



Scenario 2



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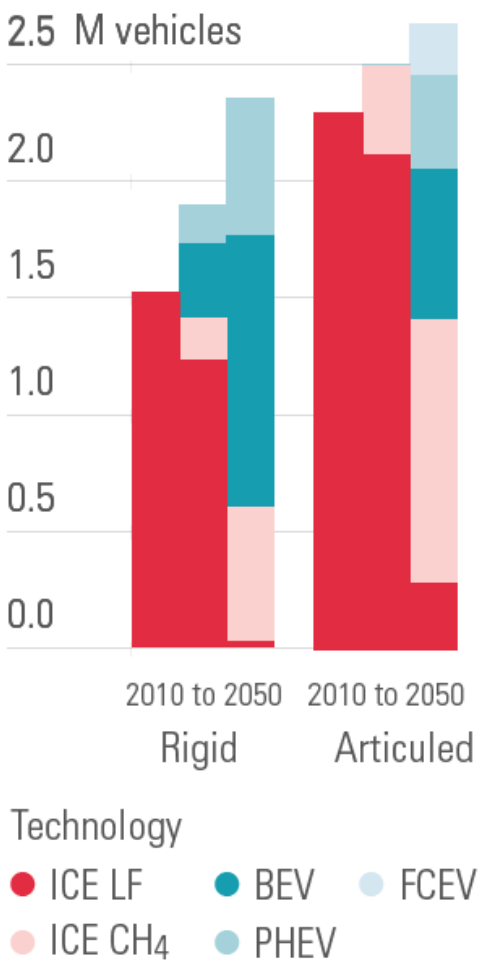
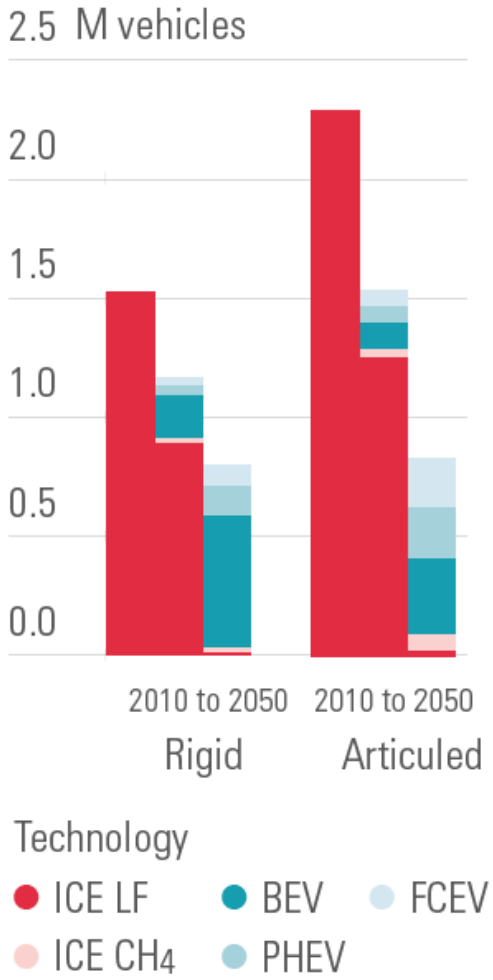


Scenario 2



Conclusion

- Complexity of freight transport:
  - Technical specificity of the sector
  - Lack of adequate data
  - Transversal nature
- Decarbonation pathway approach:
  - The scenarios are not roadmap per se, their value is in showing the questions which should be addressed
  - The contrast between a technology scenario and a demand based scenario shows two contrasted philosophies and their internal requirements
- Subsequent work: focus notes on specific policy issues (e.g. rail freight transport, currently considered as a part of the French economic stimulus in response to the economic consequences of covid)