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Transition codesign for purposive road freight decarbonisation

Phil Churchman – tspdc@leeds.ac.uk

Centre for Sustainable Road Freight Conference – Dec 2023

UNIVERSITY OF LEEDS
Institute for Transport Studies

Why purposive codesign? – Foundational assumptions

- The road freight system is complex and interconnected
- Operators and shippers are constrained in the decarbonisation actions they can take individually due to supply chain, infrastructure, regulatory, financial and other dependencies
- To create the potential for large scale decarbonisation, certain key collective decisions are required
- These decisions can either be mandated by government or codesigned by industry participants and policymakers
- The UK government has stated that it will not mandate decisions such as technology selection
- This means that some level of collaborative decision making (codesign) is required
- Codesign is hard and will not happen at the speed and scale required unless it is purposive: i.e., planned, deliberate, structured and organised

Research objective

Churchman et al. (2023) identify 3 preconditions for rapid and radical road freight decarbonisation:

1. Techno-economically feasible options able to deliver this outcome
2. A shared understanding of the design choices that need to be coordinated
3. A politically, socially and organisationally feasible codesign framework to make these design choices

Semi-structured interviews were designed to test these preconditions with industry participants, government / transport authorities and experts, and to capture views on decarbonisation opportunities and barriers.

Focused on HGV (>3.5 tonne) delivery of food products within Great Britain (GB) to supermarkets and supermarket distribution centres (DCs):

- Large freight volume
- Large identifiable key actors
- Relatively independent of other freight segments
- Demanding logistics requirements including short shelf life and chilled products
- Sustainability an important consideration for participants
- Economically, socially and politically prominent

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Interview participants

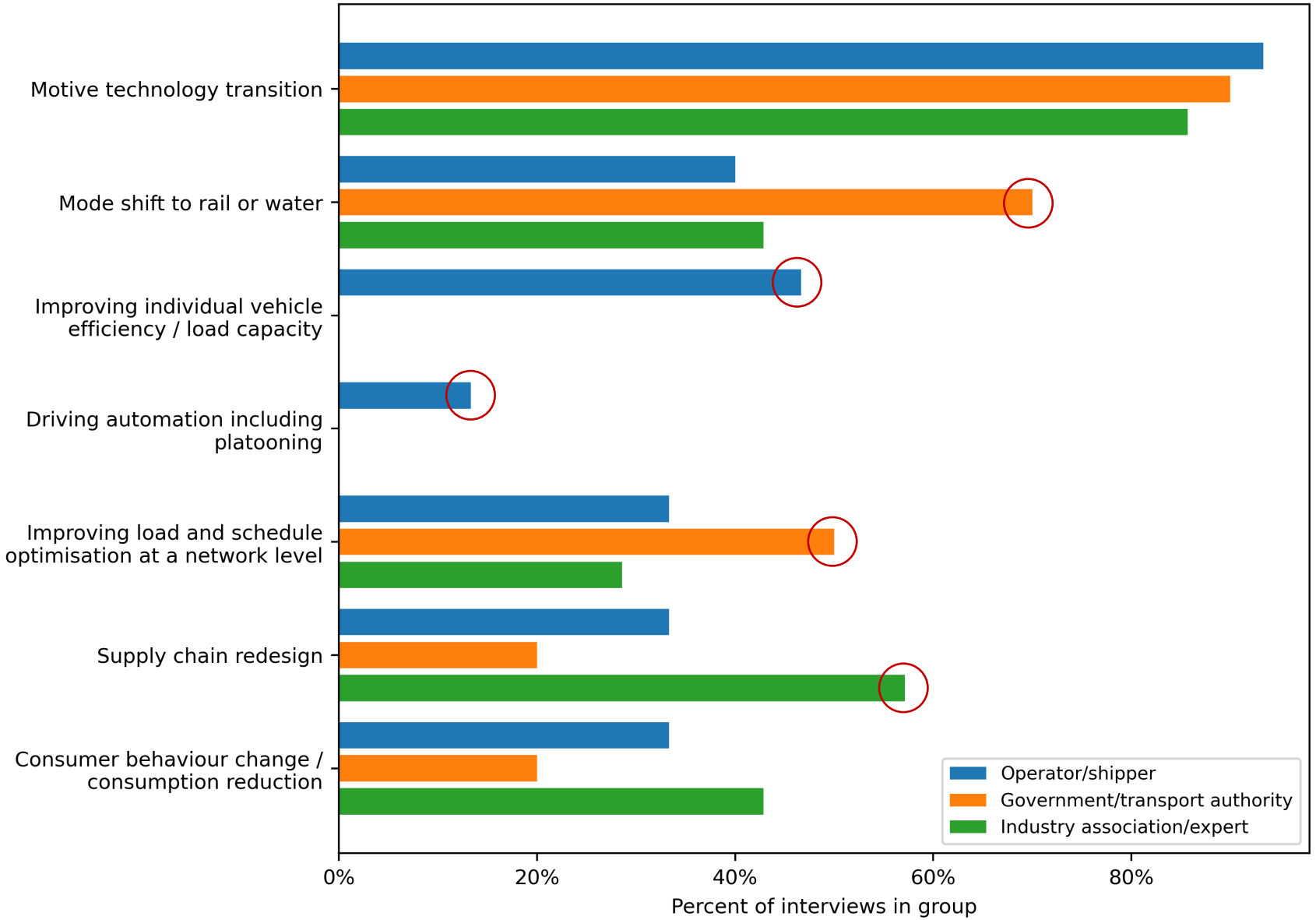
	Participants	Interviews
Freight operators and shippers	***17***	***15***
Supermarkets	8	7
Third party logistics providers	6	5
Food manufacturers	3	3
Government and transport authorities	***13***	***10***
National (including devolved country authorities)	4	2
Regional and combined authorities	7	6
Local and city	2	2
Industry associations and experts	***7***	***7***
TOTAL	**37**	**32**

1: Techno-economically feasible options able to deliver rapid and radical decarbonisation

Solution		Selected in structured responses	Unstructured responses		
			Supportive	Non-supportive*	Neutral or no comment
Motive technology shift	Biodiesel / biomethane	11	8	9	15
	Hydrogen fuel cell	16	10	8	14
	Battery electric	26	16	3	13
	Electric road system	8	5	10	17
Mode shift	Rail	14	11	10	11
	Water	6	2	12	18
Individual vehicle efficiency / load capacity		7	5	6	21
Driving automation / platooning		2	1	13	18
Improve load and schedule optimisation at a network level		12	14	4	14
Reduce total supply chain carbon emissions		11	6	4	22
Consumer behavior change	Reduced rapid / next day delivery	8	11	0	21
	Consumption reduction	0	0	11	20
	Other	8	1		

*: includes limited impact

1: Techno-economically feasible options able to deliver rapid and radical decarbonisation

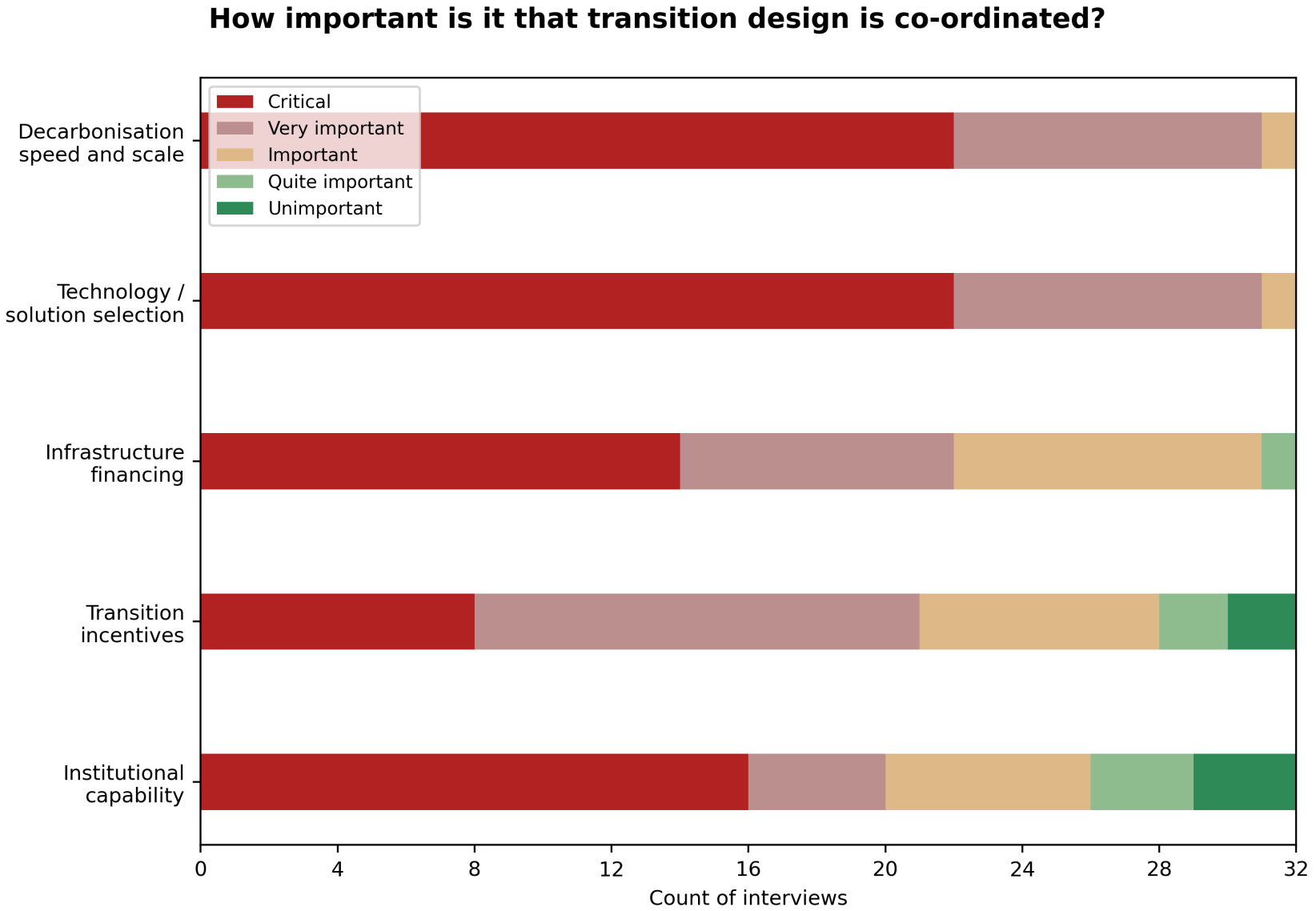


1: Techno-economically feasible options able to deliver rapid and radical decarbonisation

Hydrogen:	“Whether it's fuel cell or direct drive hydrogen, for me it's the future for the longer distances.”	**versus**	“Hydrogen is more promising for, for example, aeroplanes where you have a whole system with big quantities, but not road necessarily … It's a very expensive technology to use in road.”
Biofuels:	“That's why things like biodiesel, particularly HVO, is so powerful, because with HVO you haven't got to touch the vehicle or the refuelling mechanism.”	**versus**	For biodiesel and biomethane, there are options that we've looked at, for example, HVO. We walked away from HVO because it's more expensive and there's a challenge around how that fuel is manufactured.”
Mode shift to rail:	“The way we're tackling it, mode shift is our biggest opportunity in the long term. We've already made decisions about the position of the new DC.”	**versus**	“I'd never build my business on the idea that it was going to get somewhere by rail. You only have to look at what's going on at the moment.”

2: Design choices requiring coordination

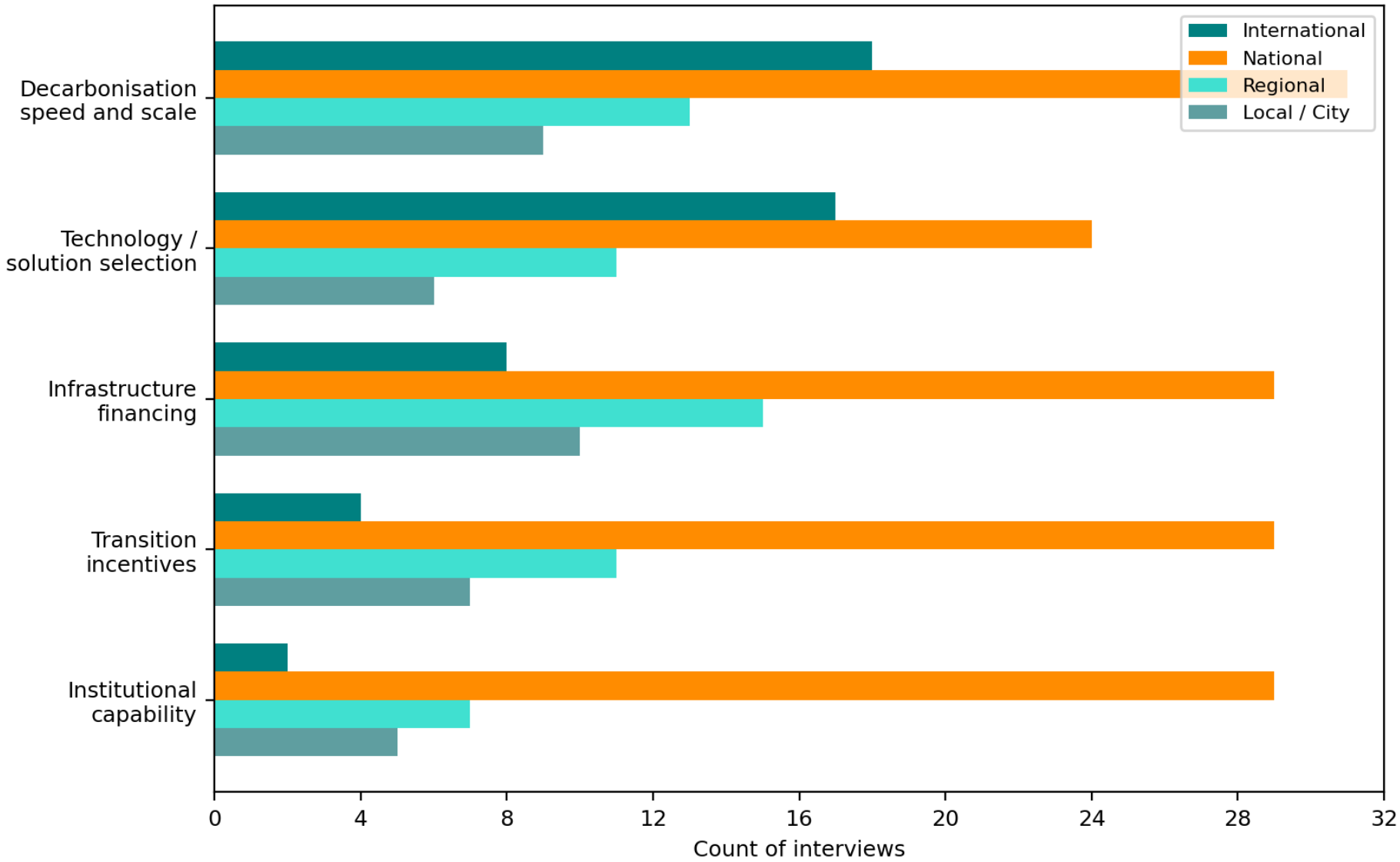
- There is broad consensus that coordinated design is important
- Education and training were identified as additional important areas for coordination



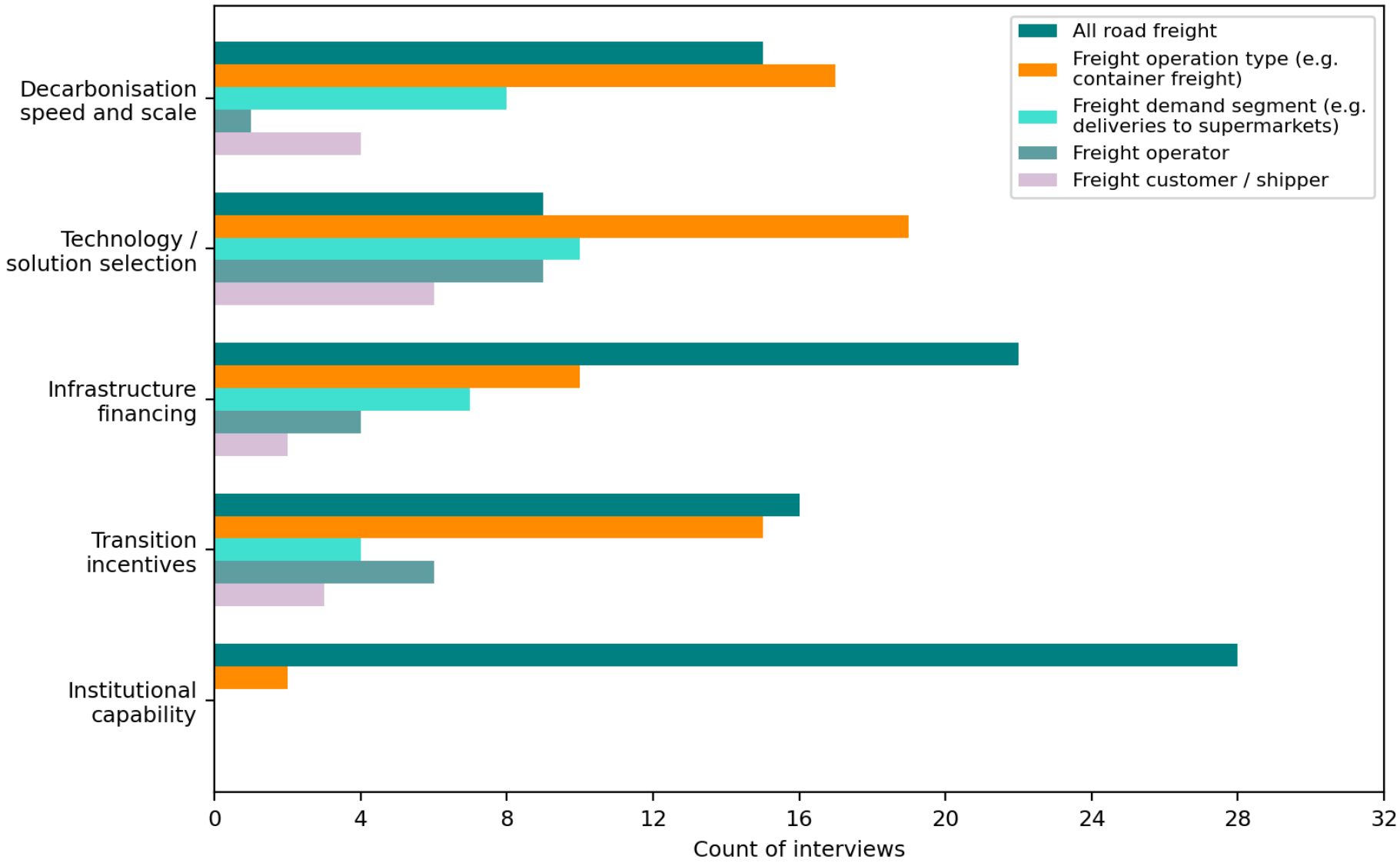
2: Design choices requiring coordination

Speed and scale:	“It's critical that we know what speed we're going at and how much we have to achieve. There has to be that policy direction that everybody can follow.”	**versus**	“The market should be allowed to evolve, to innovate, and sometimes it just needs that freedom. I would suggest, with developing technologies, coordination smacks of a command and control situation.”
Technology / solution selection:	“And then having a real industry alignment, at least at the European level, that this is the route we're going down for HGV. It's mandated that either it's electric, it's hydrogen or it's some form of other fuel that reduces carbon.”	**versus**	“I firmly believe that in order to decarbonise, you've got to try and be the best you can at the point in time you're at.”
Incentives:	Although the business case can be positive with alternative fuels, your capital cost is higher … and therefore you need more funding in order to make it happen.”	**versus**	“Incentivising the transition is largely going to be driven by the sector themselves when they have confidence in the technology having been demonstrated to be effective for their needs.”

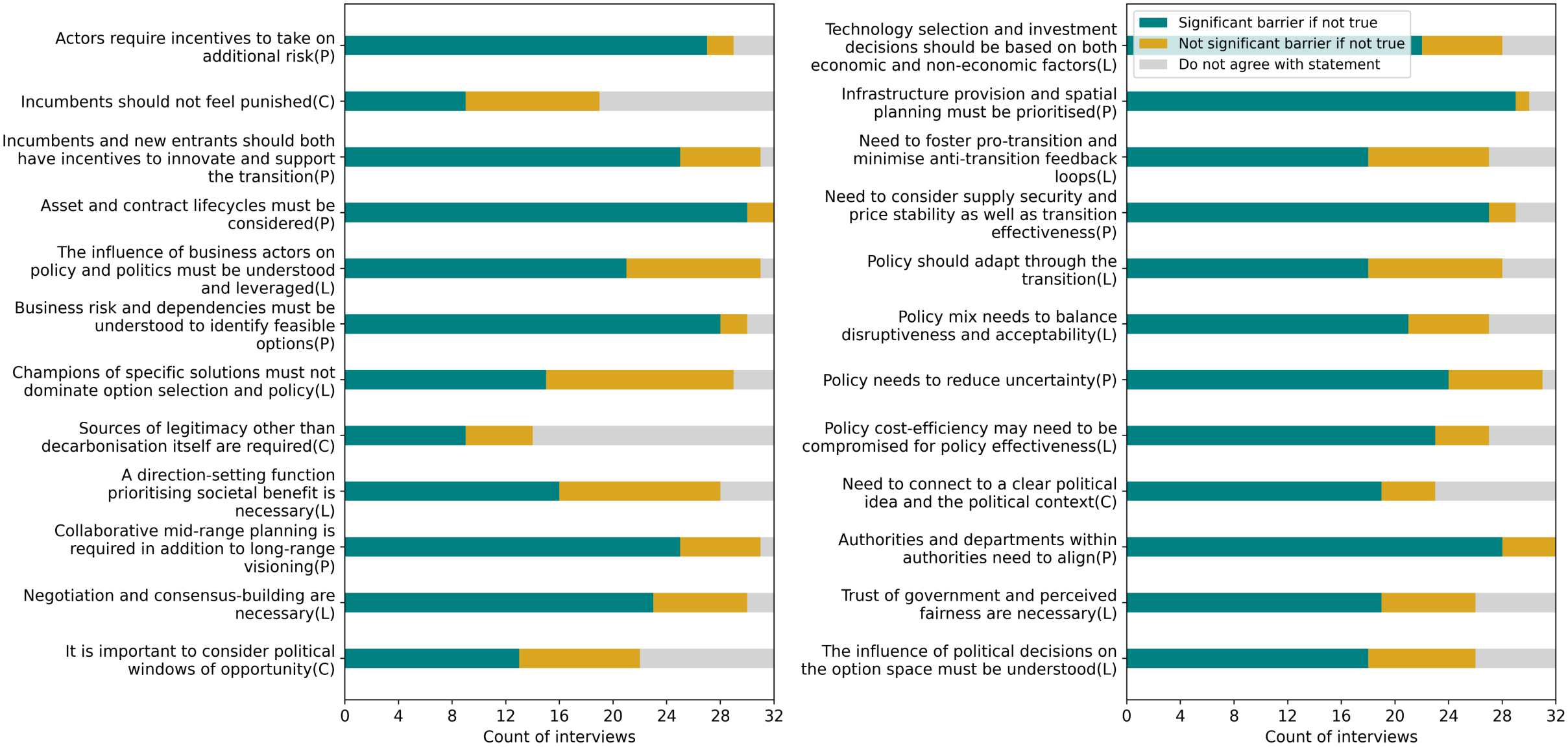
2: Design choices requiring coordination – Geographic level



2: Design choices requiring coordination – Freight segment level



3: A politically, socially and organisationally feasible codesign framework



P = Priority, C = Conflict, L = Lower priority

Most mentioned barriers

- Technology uncertainty / immaturity (28)
- Lack of clear direction or plan (24)
- Lack of strategic infrastructure planning or funding (23)
- Inconsistent incentives and policy (23)
- First mover disadvantage (20)
- Chicken and egg between infrastructure provision and demand (12)
- Collaboration barriers (11)
- Lack of incentive funding (8)
- Barriers for smaller operators (7)
- Lack of incentives from freight customers (7)
- Lack of vehicle availability (6)
- Rail network limitations (5)
- Insufficient grid capacity / connectivity (4)

(Number of interviews in which mentioned in brackets)

Potential sources of conflict

Techno-economically feasible options:

- Opposing positions on hydrogen, biofuels and mode shift to rail
- Keeping emerging technology options open versus proceeding rapidly with solutions that are already proven at scale
- Whether incremental decarbonisation solutions are valid alternatives to solutions capable of achieving radical decarbonisation

Design choices that need to be coordinated:

- Top-down versus market-led approach
- The use of direct incentives to freight operators versus demand / market incentives
- Whether a level playing field for smaller operators is required or feasible
- Centralised versus devolved policymaking

Codesign framework:

- Whether additional sources of legitimacy are required
- Whether incumbents should feel punished
- Whether need to consider political windows of opportunity
- Whether need to connect to a clear political idea and the political context

Conclusions

- Confirmation of 3 preconditions for rapid and radical road freight decarbonisation:
    1. Techno-economically feasible options
    2. A shared understanding of the design choices that need to be coordinated
    3. A politically, socially and organisationally feasible codesign framework to make these design choices
- Areas of agreement and potential sources of conflict
- Existing research and trials focus mainly on precondition 1
- Much less work considering preconditions 2 and 3
- Precondition 3 is dependent on precondition 2
- Planned next steps therefore focus on precondition 2

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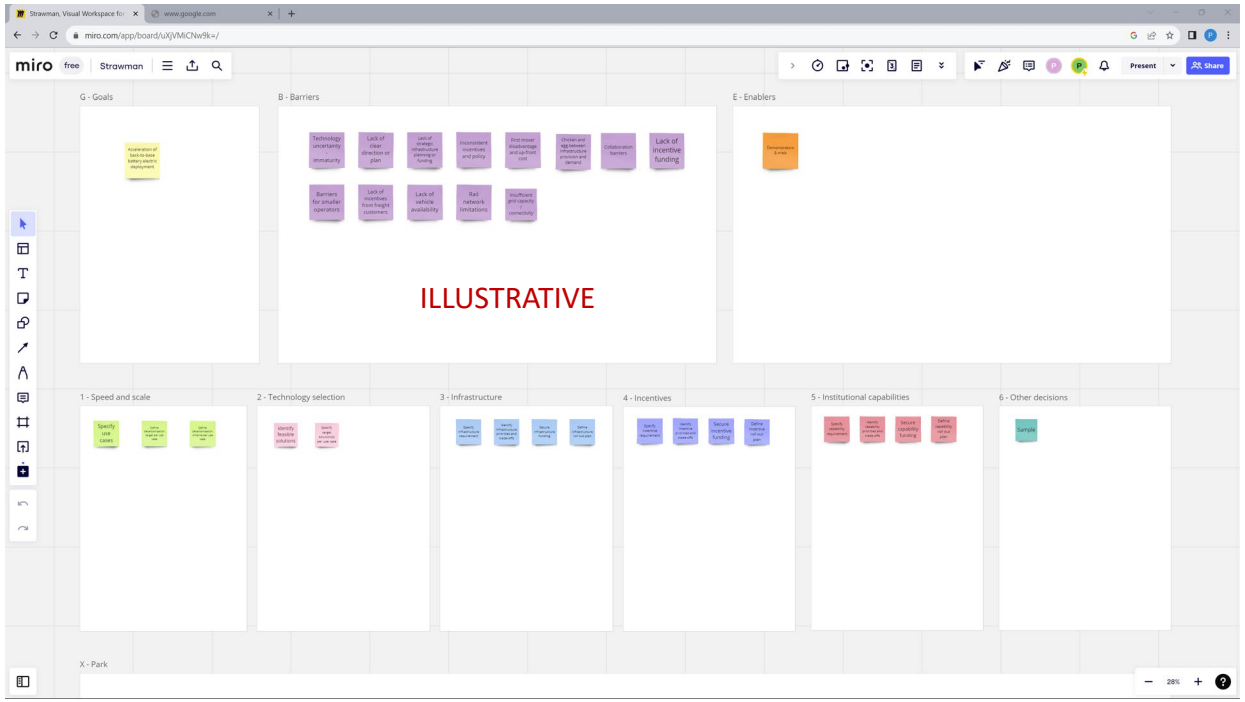
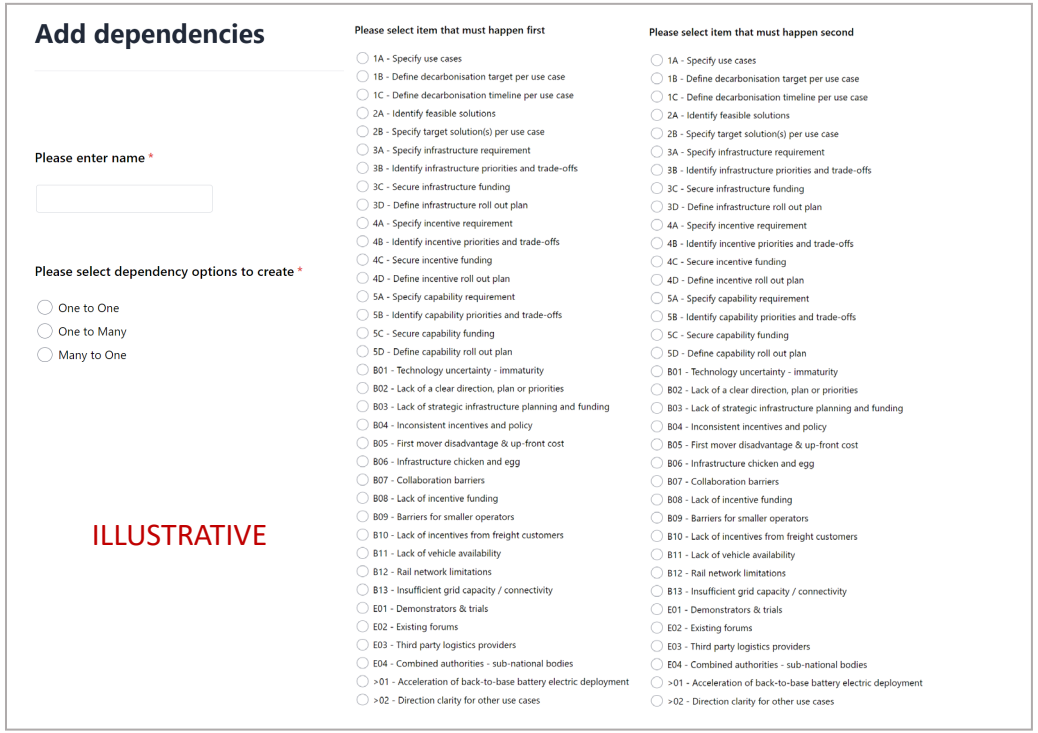
Next steps – Decision pathway workshops

Agree decarbonisation goal → **Identify and prioritise barriers, enablers and decisions** → **Identify dependencies** → **Consider and where possible resolve "chicken and egg" loops** → **Review resulting decision sequence**

Miro / Post-Its

Jisc Online Surveys / Pathplotter





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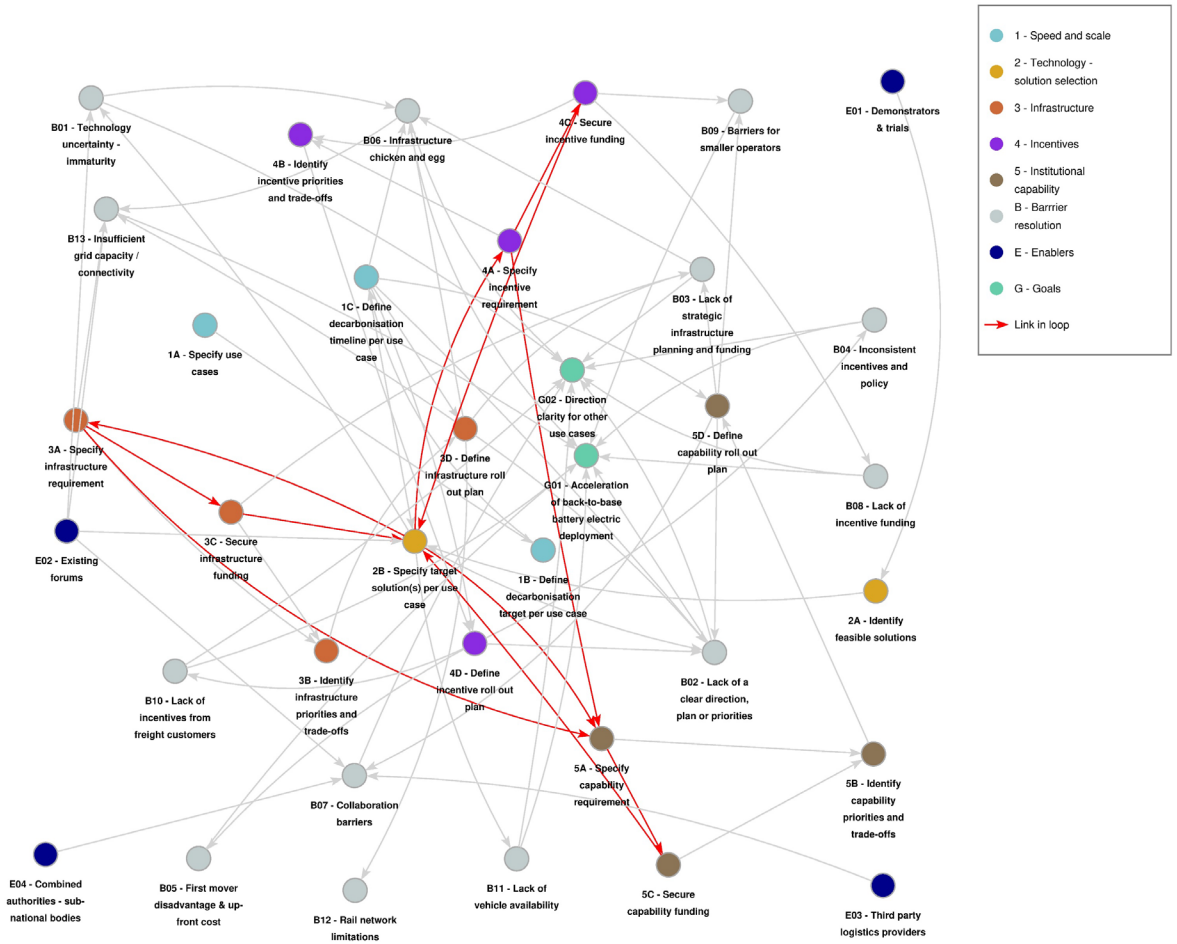
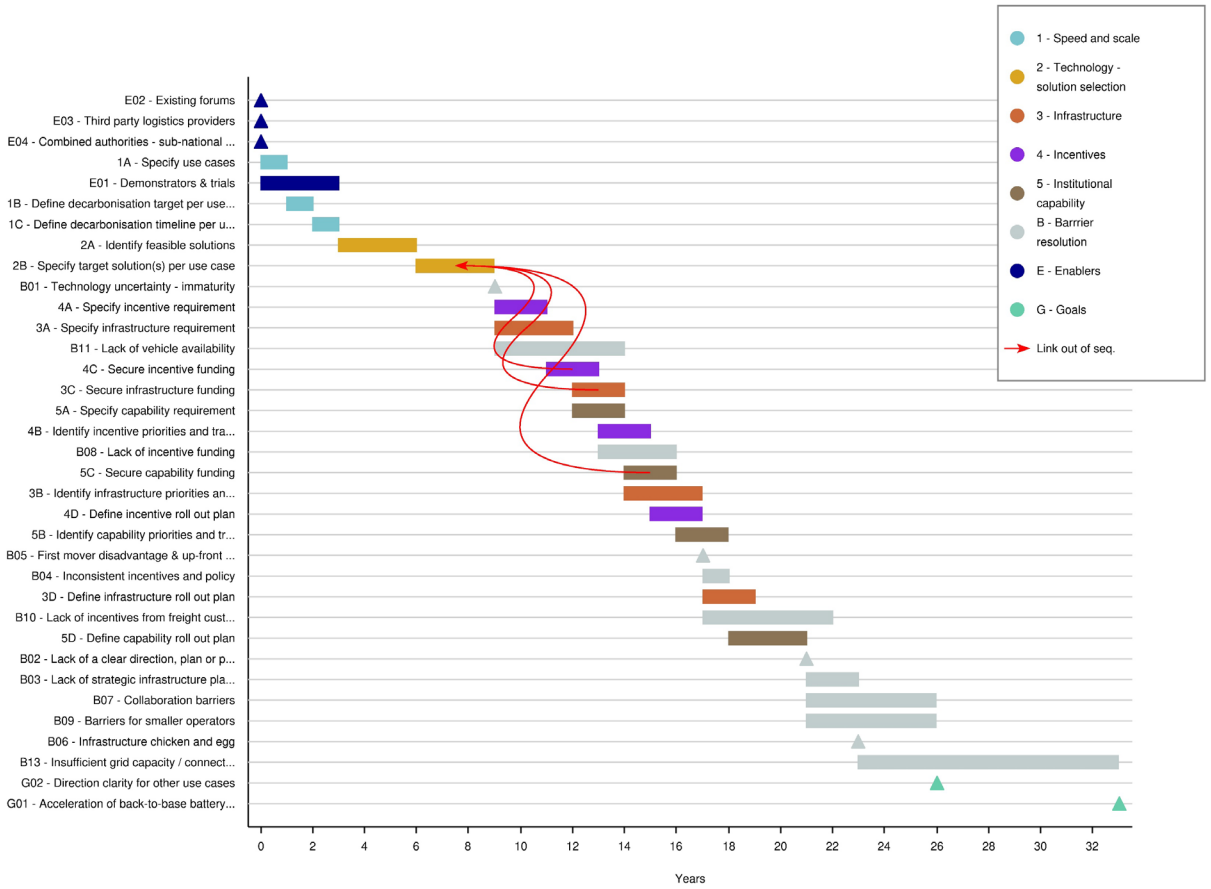
Next steps – Pathplotter





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References

- Churchman, P., Dekker, T., Anable, J. (2023). A transitions literature perspective on purposive road freight decarbonisation. Unpublished manuscript