The Energy for Future Transport

Can Formula E electrify mainstream motoring?

LowCVP
Low Carbon Vehicle Partnership

Annual Conference 2015

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Transport infrastructure roadmap to 2050

Celine Cluzel – Element Energy

A study commissioned by the LowCVP

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Providing a refuelling infrastructure for low emission vehicles will be key to meeting the UK's emission reduction targets

Drivers for change in the transport system:

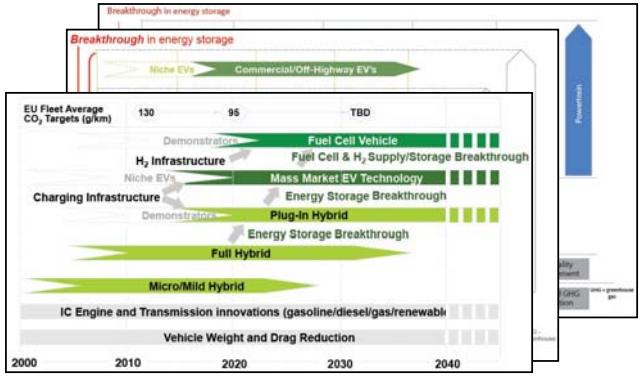
- GHG reduction targets: Climate Change Act, Renewable Energy and Fuel Quality Directives
- Air Quality targets: EU regulations on NO2 and Particulate Matters, EURO specifications

The required changes in vehicle technologies and fuel have already been set out through published roadmaps (see right)

The corresponding refuelling / recharging infrastructure needs have not yet been quantified and this is the main focus of this study

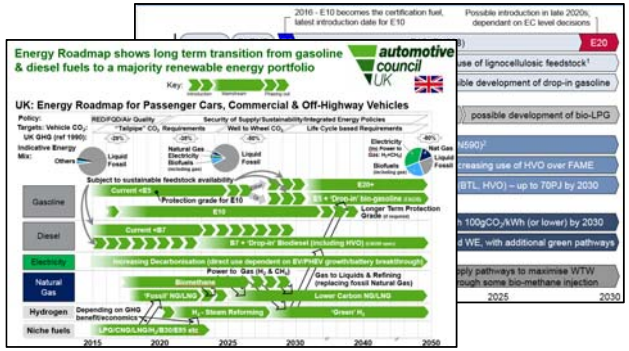
The outputs will inform the national policy frameworks submitted by EU Member States by October 2016 in answer to the 'Clean Power for Transport' EU Directive

Vehicle roadmaps



Source: Auto Council and LowCVP

Transport fuel roadmaps



Source: Auto Council and Element Energy for the LowCVP

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Objectives

- **Estimate the infrastructure needs and barriers for deployment** of electric, hydrogen and gas refuelling stations to 2050, including impact on upstream distribution
- **Evaluate the change in refuelling infrastructure of 'conventional' liquid fuels** (gasoline and diesel blends, LPG) and possible future fuels (liquid air, methanol, E85)
- **Make recommendations for delivery of infrastructure deployment**, both at national and local government level

Scope and approach

- Developed four reports: electricity, hydrogen, methane and liquid fuels
- Considered road vehicles

- **Extensive industry consultation through**:
  - Steering Committee: 14 organisations
  - Four workshops (38 attendees)

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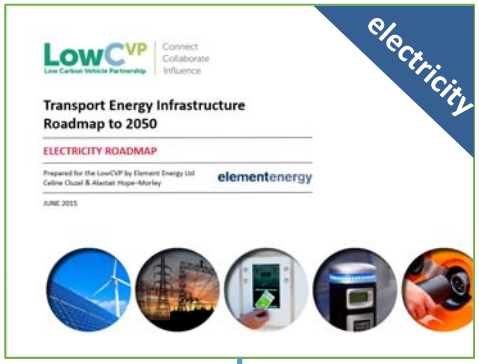

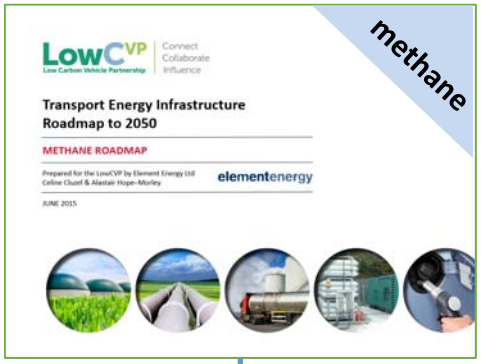

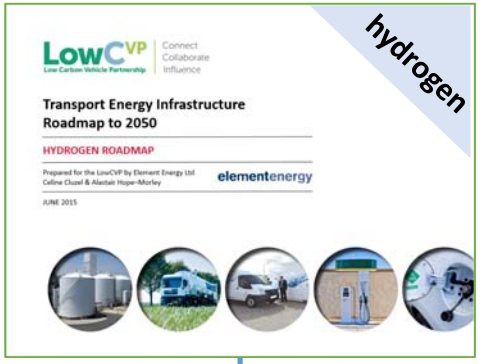

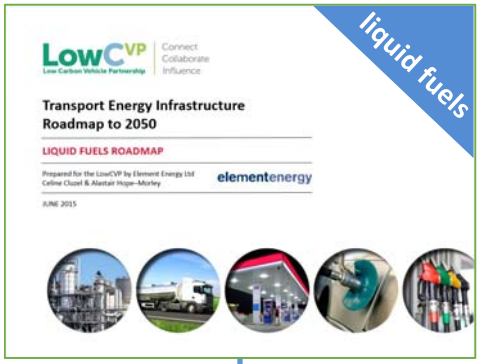

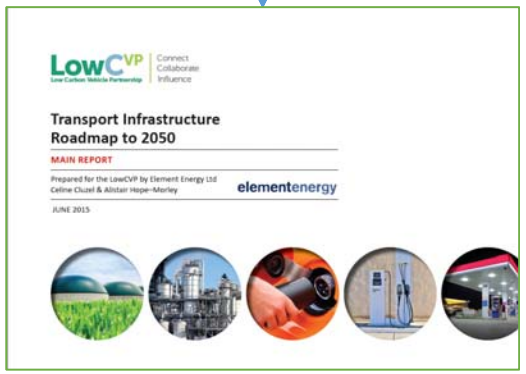

Final report summarising findings from each energy vectors

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The majority of charging events will take place at home and workplaces, supported by a well managed and reliable public network

electricity

- A **peak power demand (GW)** challenge could emerge rather than a production (TWh) challenge: EVs could add 28 GW of demand by 2050 (c.70% of current peak) if charging time is not controlled
- Main demand will be from **cars**, requiring both residential charge points and a national public network

Key topics for recommendations:

End user experience of public chargers	Improve the currently fragmented driver experience of public infrastructure by ensuring the network is well marketed, easy to operate and immediately accessible
Economics of public chargers	Business case for public charge points remains challenging due to low utilisation levels but could be improved with support mechanisms (financial and loading)
Charging in residential areas	New solutions, both technical and commercial, are needed for households without private off-street parking
Charging at depots / workplaces	Fleet operators are likely to be faced with high local network reinforcement costs an investment in assets not owned by the fleet operator: an unfamiliar risk and procedure
Impact on electricity networks	Without management, EVs could (when added to other technologies such as heat pumps) require large investment in new distribution infrastructure

Many opportunities exist for Heavy Duty Vehicles to use natural gas supported by mature refuelling technologies

methane

- An extensive gas grid is already in place and can easily absorb the transport gas demand, although new Liquefied Natural Gas terminals might be required
- Main demand from heavy duty vehicles, which require bunkered refuelling (at depots) and public refuelling for long haul applications

Key topics for recommendations:

Planning guidance and safety issues	A guidance document could improve local interpretation of the relevant refuelling station technical standards available, and safety regulations could be updated
Station economics and support	Areas with low throughput are likely to require support, whilst infrastructure in areas of higher throughput will continue to be commercially operated
End user experience	Harmonising future infrastructure deployments could improve the currently fragmented driver experience (e.g. multiple nozzle types, irregular downtime)
Depot infrastructure sharing	Consider including semi-private stations (offering third party access on a pre agreed commercial basis) as 'public' facilities in response to Directive 2014/94/EU
Well-to-Tank (WTT) emissions	Measures to minimise the GHG emissions related to distribution and dispensing of gas should be adopted for future infrastructure siting and technology

Widespread use of hydrogen for mobility will require substantial growth in existing production and distribution infrastructure

hydrogen

- A successful rollout of hydrogen vehicles (i.e. reaching millions of vehicles after 2030) will require a quadrupling of existing production capacity, met by conventional and green sources
- A national refuelling network will be required to support passenger cars and private customers
- Innovation opportunities include production/distribution cost reduction, quality assurance, metering

Key topics for recommendations:

Deployment of early public H2 stations	Industry and government will need to work closely to secure deployment of the early public HRS network and hydrogen vehicles
Maximising utilisation of early stations	Ensuring infrastructure is compatible with all vehicle types and publically accessible will maximise station utilisation (key for economics of stations)
Coordination	H_2 stakeholders should identify an appropriate forum for coordination activities, and to present an aligned UK strategy in outreach to international vehicle manufacturers to maximise appetite for bringing vehicles to the UK
Siting and planning process	Existing regulations should be amended to harmonise the planning approval process, thereby streamlining infrastructure installation
H_2 production pathways	New policy may be required in the medium term to ensure that the future hydrogen production mix delivers strong emissions savings

A fully functioning infrastructure for dominant liquid fuels exists to supply the UK vehicle parc but will be faced with decreasing demand

liquid fuels

- Demand will significantly decrease post 2030, to reach -50% to -80% by 2050 compared to today
- For LPG, a possible increase in demand mostly based on Air Quality policy drivers
- Liquid air is the most promising 'niche fuel', suited for refrigeration units but has potential skill shortages

Key topics for recommendations:

Station economics and support	Identify future supply shortages and support full UK coverage as commercial forecourt operation becomes increasingly difficult with declining throughput
Planning permission guidance	To minimise forecourt closure rate, planning guideline could be improved to avoid delays for modifying existing infrastructure
Innovation opportunities	Upgrading existing infrastructure to accommodate higher biofuel blends is costly, opportunities to optimise costs through R&D could be pursued
Multi-fuel infrastructure integration	Forecourt utilisation could be improved with the co-location of multiple fuel infrastructure for which technical barriers should be identified and regulatory standards developed
Communication of forecourt availability	Forecourt availability could be dynamically communicated to drivers via a nationally consistent platform as total forecourt number decline

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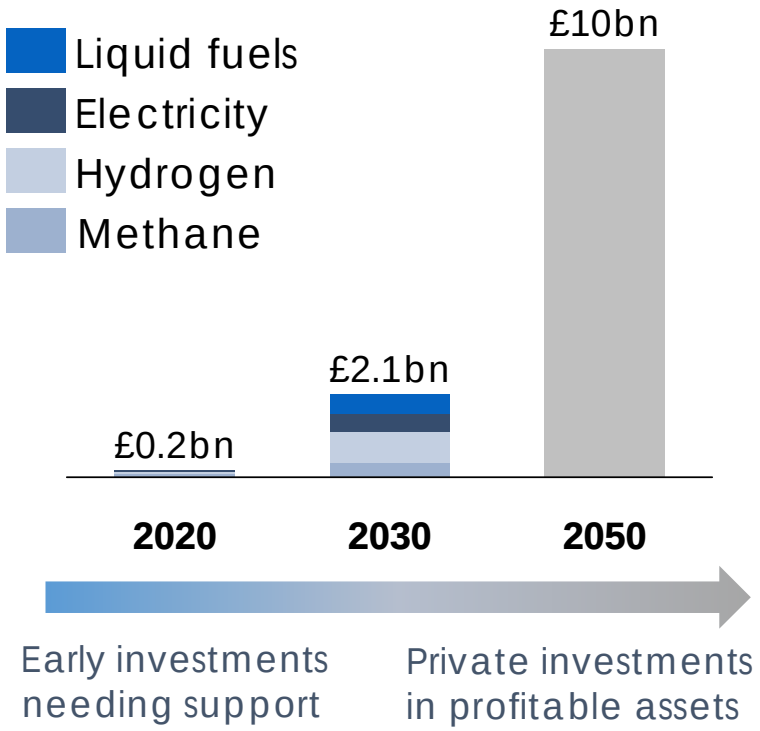
The deployment of public refuelling infrastructure for transport will require significant new investment and long term policy clarity

Investment to deliver the future refuelling/recharging infrastructure will require:

- **Strong confidence for private investors**, i.e. clear and long term government position for different fuels and policy drivers, confidence in long term revenues to justify upfront investment
- **Funding support in some cases in early years** (when asset utilisation levels are low)
- **Coordination across government, regulators and industry** to remove certain barriers to installation of new infrastructure e.g. lack of/unclear planning guidance, harmonisation of safety procedures, integration of new fuels in existing forecourts

Cumulative public infrastructure investment[1]



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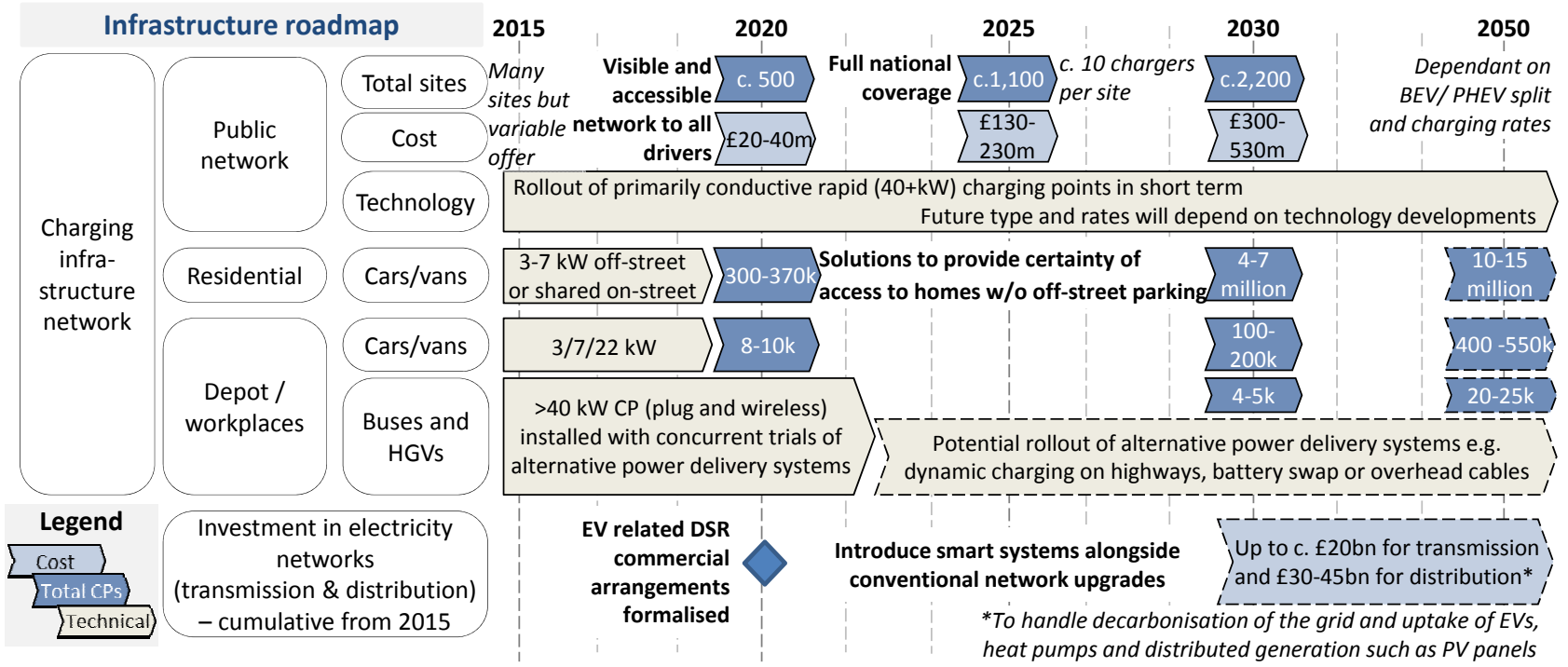
Thank you for your attention

Reports are available for download from the LowCVP:

http://www.lowcvp.org.uk/news,lowcvp-2050-transport-energy-infrastructure-roadmaps-show-the-way-to-transport-decarbonisation_3263.htm

Millions of charge points (mostly residential) will be needed to support widespread EV deployment, with uncertainty over charging technologies

electricity



Plug-in electric vehicles stock

Projections are based on policy-led uptake scenarios in line with the UK's GHG reduction targets

Data supported quantification of infrastructure requirements

	Thousand vehicles	2020	2025	2030	2050
Cars		300	1,500-2,500	4,000-8,000	20,000-25,000
Vans		60	250-400	700-1,300	3,400-4,000
HDVs		<5	10	20	130

Dashed lines represent high uncertainty

Major milestone /enabler

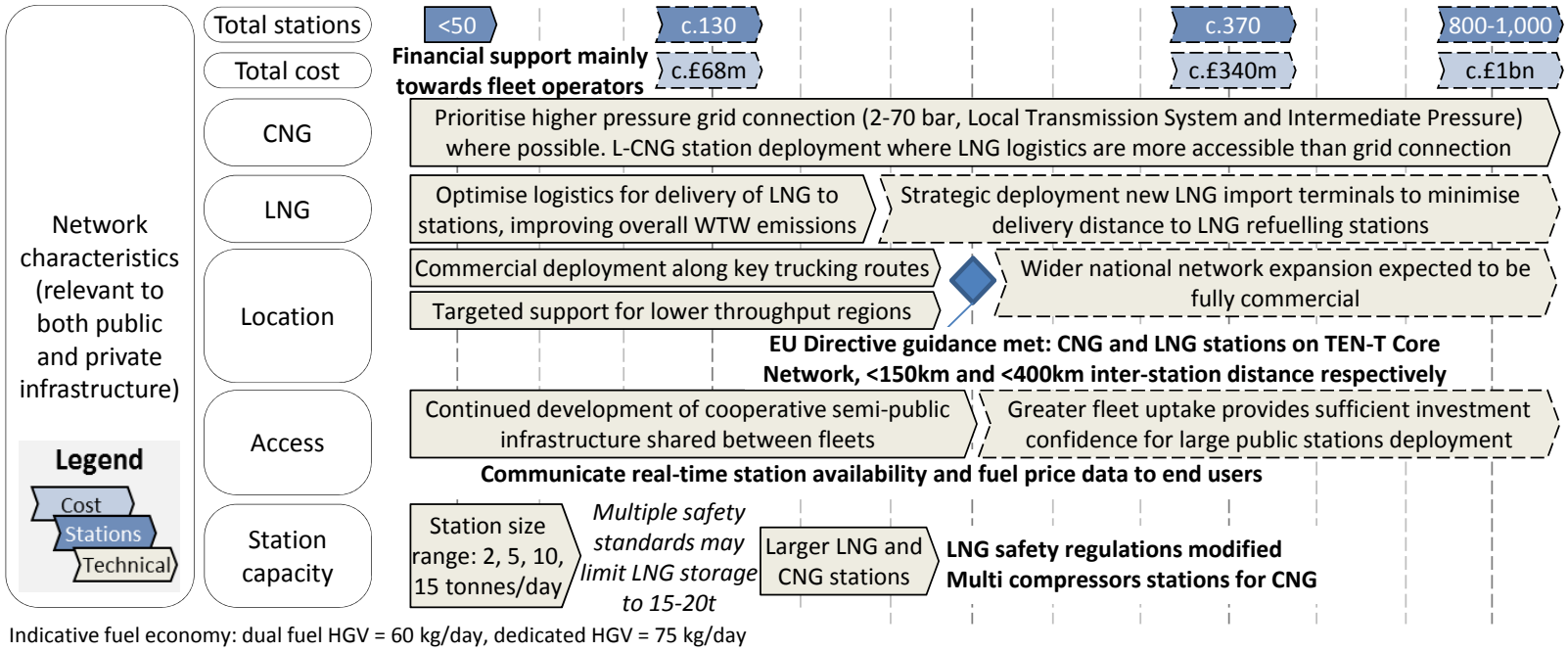
Cost estimates are cumulative costs from 2015

CP = Charge point

Regulatory barriers will be the primary focus for enabling natural gas infrastructure, whilst a number of technical issues must also be resolved

methane

Infrastructure roadmap



Indicative fuel economy: dual fuel HGV = 60 kg/day, dedicated HGV = 75 kg/day

Natural gas vehicle stock

Thousand vehicles

Projections are based on policy-led uptake scenarios in line with the UK's GHG reduction targets

Data supported quantification of infrastructure requirements

	2020	2025	2030	2050
HGVs <18t	4.0	13	26	105
HGVs >18t	4.0	12	24	85
Buses	2.0	5.1	9.7	17

Dashed lines represent high uncertainty

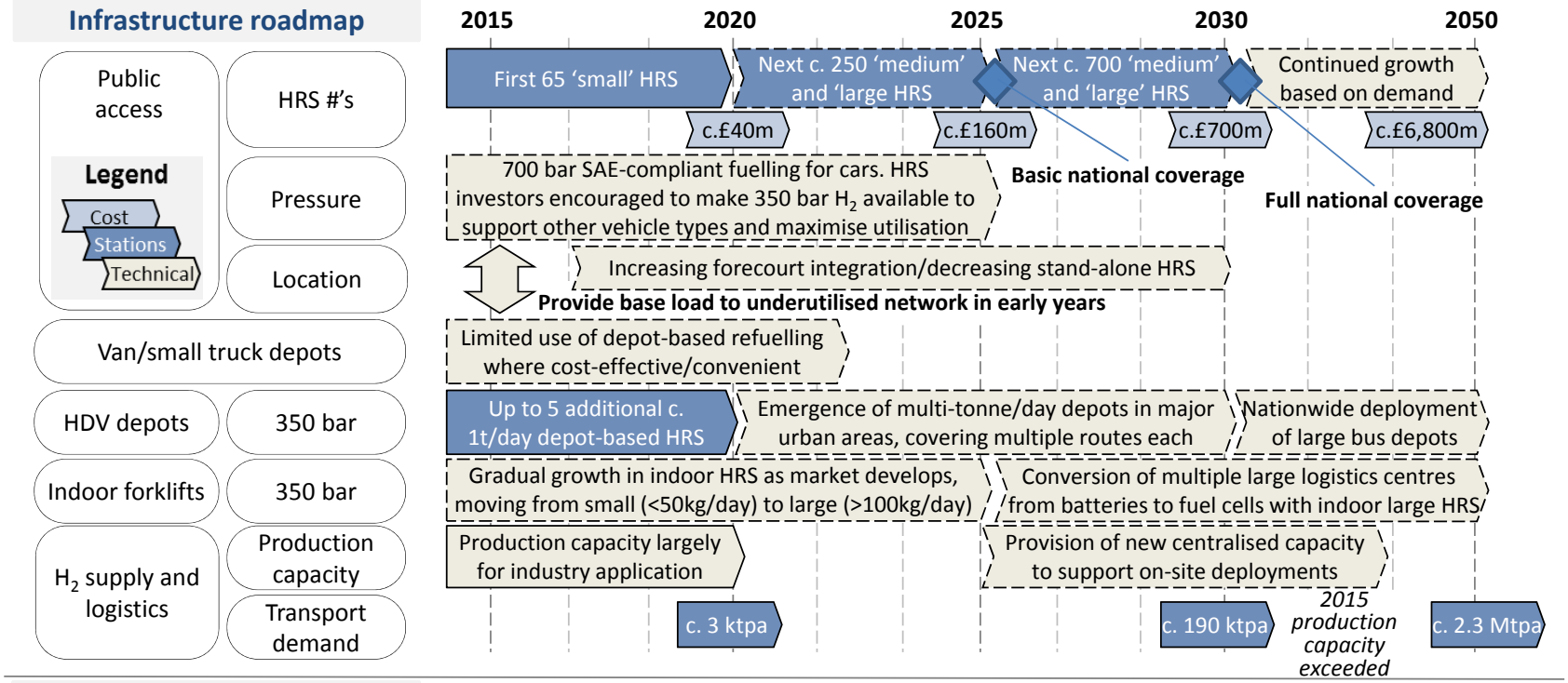
Major milestone /enabler

Costs based industry input, future cost reductions not included

The H_2 infrastructure roadmap reflects the diverse refuelling needs of different vehicle types and the uncertainty about the speed of the rollout

hydrogen

Infrastructure roadmap



Hydrogen vehicle stock

Projections are based on policy-led uptake scenarios in line with the UK's GHG reduction targets

Data supported quantification of infrastructure requirements

Thousand vehicles	2020	2025	2030	2050
Cars	2	180-350	680-1,400	4,200-16,800
Vans	<1	30-60	100-200	750-3,000
HDVs	<1	3	8	130

Dashed lines represent high uncertainty

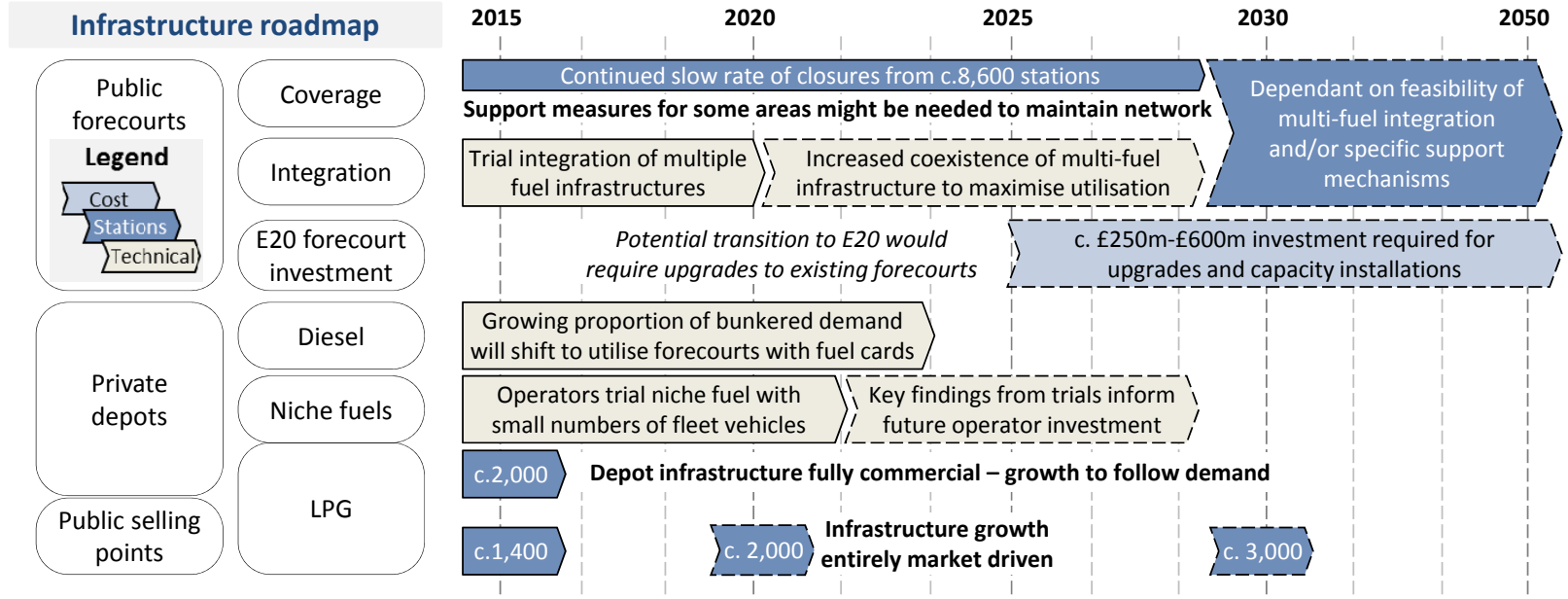
Major milestone /enabler

HRS: hydrogen refuelling station

With a predicted demand decrease for liquid fuels, forecourts might have to integrate new fuels and possibly be supported in certain areas

liquid fuels

Infrastructure roadmap



Liquid fuel vehicle stock

Thousand vehicles

Projections are based on policy-led uptake scenarios in line with the UK's GHG reduction targets

Data supported quantification of infrastructure requirements

	2020	2025	2030	2050
Cars	30,000	32,000	32,000	6,000-31,000
Vans	4,000	4,300	4,300	1,000-5,000
HDVs	700	700	700	360

By 2050 cars are mostly RE-EVs / PHEVs

50-80% decrease in fuel demand on 2015 levels

Dashed lines represent high uncertainty

Major milestone /enabler