

Zero-Carbon Transport

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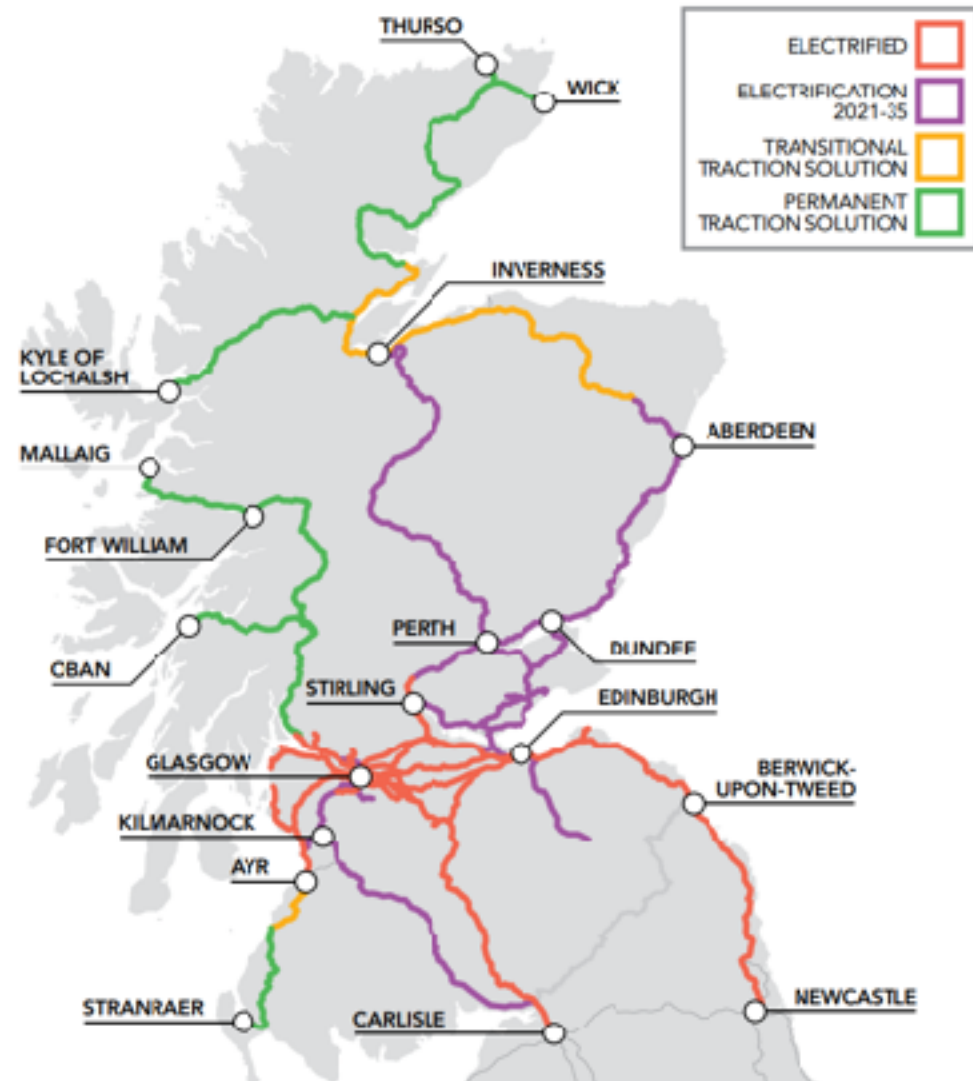
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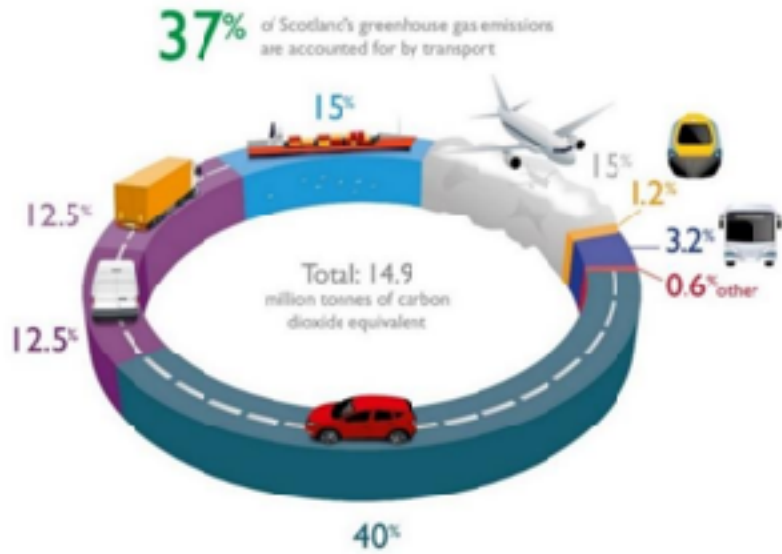
SCOTLAND'S RAILWAY
BETTER IN THE MAKING

Decarbonisation of Scotland's Railway

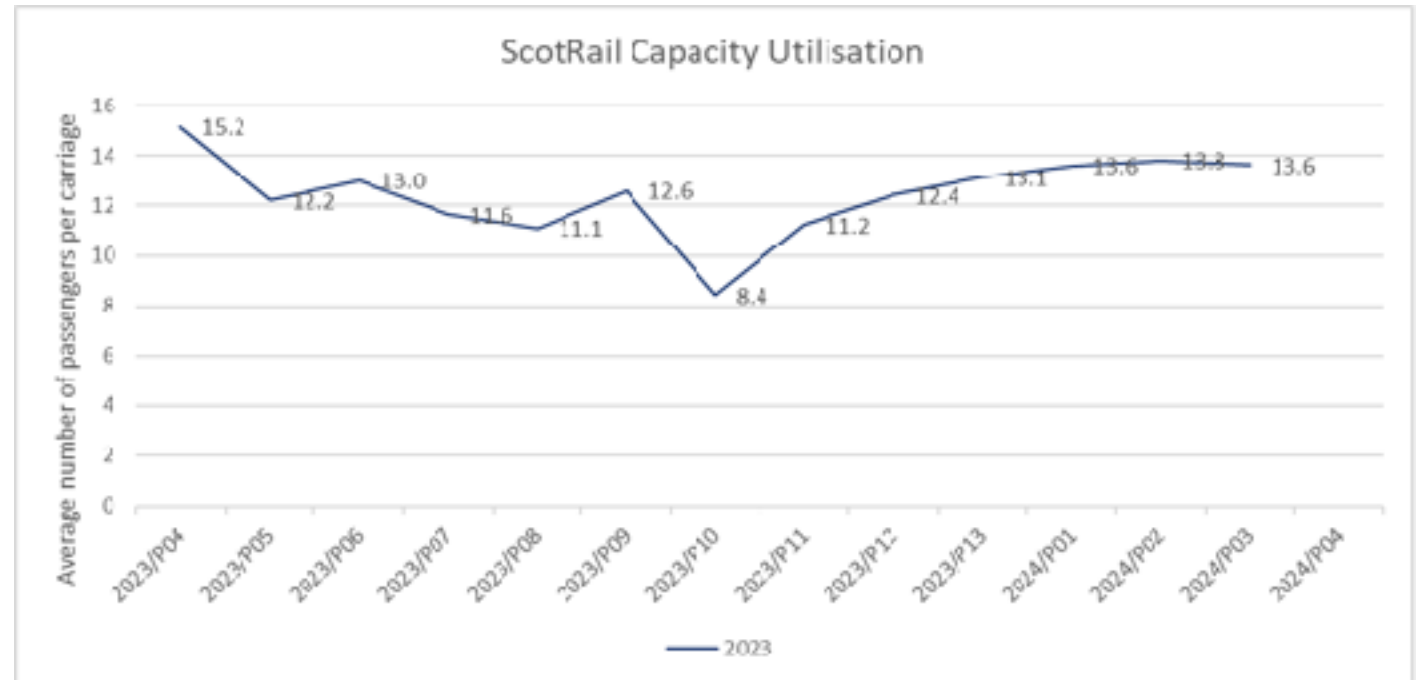
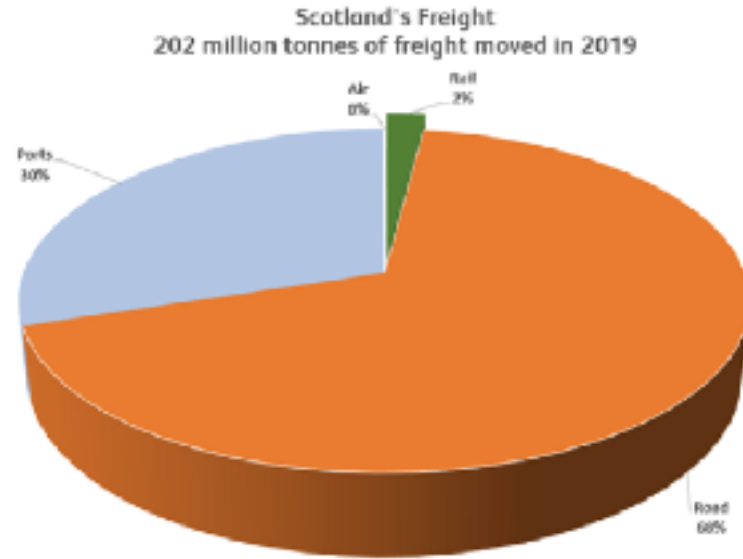
In July 2020, the Scottish Government published the Rail Services Decarbonisation Action Plan which sets out ambitious plans to electrify more of the rail network and transition from diesel to zero emission trains on the routes that aren't viable or suitable to electrify.



Net zero, Net cost



Share of greenhouse gas emissions by mode in 2017



Data For A Changing Landscape

Key drivers of travel



Understanding journeys and passenger requirements



Demand and leisure markets





SCOTLAND'S RAILWAY
BETTER IN THE MAKING

Accessibility Strategy

Mission: to embed accessibility within Scotland's transport network by providing guidance to eliminate barriers, making the rail journey equitable and fair for all.



Benefits for passengers








An aerial photograph of a large industrial or rail yard. The scene is dominated by multiple parallel tracks running diagonally across the frame. Several large, long buildings with corrugated metal roofs are situated along the tracks. In the upper portion of the image, there is a large parking lot filled with numerous cars and several semi-trailers. The overall impression is one of a busy, large-scale industrial or transportation facility.

What would make you choose rail for more of your journeys?

How do we collaborate to encourage people to choose public transport?

Data For A Changing Landscape

Requirement		Considerations
Existing passenger and freight users		Gaining insight into existing customer satisfaction to support whether we meet requirements and identify where improvements are required
Travel markets		Understand the contrast of the travel markets, those making frequent trips, commuter, business and leisure customers
Rail use		Understand why people are partly/rarely/never using the railway in relation to specific geographic areas and corridors
Modal integration		Understand modal integration and the connections people look to make
Sustainability		Gain people's views on sustainability and the role of public transport and rail in meeting government targets

More than just the trains

It's not just advancements in trains that make an impact

Scotland's rail network is vast and takes a lot to keep it running smoothly. Stations, depots, offices, platforms and even what goes into the bins all makes an impact. Over the past few years these are a few of the areas where improvements have been made to reduce ScotRail's carbon footprint:

- Reduced its own total carbon footprint by 7,800 tonnes of CO2.
- Installed LED lighting on all key Edinburgh to Glasgow route stations.
- Invested in installing the Driver Advisory System to all new trains, which helps reduce energy usage by 5%.
- Diverted 94% of waste, by tonnage, from landfill.
- Invested £50,000 in upgrading customer recycling facilities.
- Improved biodiversity at stations and depots through native planting and reduced mowing – recognised by numerous awards.

HST Driver Advisory System

Fitment of the Driver Advisory System (DAS) is now complete on our HST fleet of diesel trains. With the installation of DAS on the HSTs, all fleets within ScotRail will have DAS which provides important safety information and eco driving advice to the driver whilst adhering to the timetable. With DAS fitted, the Diesel Multiple Unit fleet can expect to save around 3-5 per cent on fuel and emissions whilst the Electric Multiple Unit fleets are expected to save around 4-6 per cent.

A trial is being carried out in conjunction with Siemens to test the next stage of DAS which is Connected DAS. This will allow the DAS units to communicate with another and allow real time information to be passed to the drivers allowing them to alter their speeds if there are delays on the route. As it stands DAS is not able to communicate with other DAS units so this next stage is seen as an evolution of the system capable of tying in with Traffic Management Systems.



Inverness Electric City Network

Let's talk about sustainable
travel in Inverness

05/04/23

What is sustainable travel, and why should we choose it?

- Transport continues to be Scotland's biggest emitting sector, accounting for 35.6% of emissions in 2018
- An average of 171g emissions for a medium diesel car or 192g for a medium petrol car
- One double decker bus can take up to 75 cars off the road
- Electric buses and trains further reduce emissions
- Multi modal transport – eg cycle to bus also good for health



What benefits do electric buses bring?

- They are zero emission vehicles, meaning that when they are operating there are zero emissions at the tailpipe
- Electric vehicles make the city a wee bit quieter, and help to improve air quality
- With over 51,000 people living in Inverness, swapping a few journeys a week to zero-emissions bus rather than using their car could make a huge impact on the overall carbon footprint of the city

INVERNESS

ELECTRAC CITY

Jump on board the UK's first
fully-electric city bus network

About the Inverness Electric City Network

- 25 brand-new zero-emission Yutong E10 buses are now operating on all city centre routes, completely replacing the previous diesel fleet
- The vehicles can operate from morning to evening on a single daily charge
- They feature USB charging points at each seat, interior LED lights and contactless payment facilities
- Charging infrastructure was successfully installed at the Inverness depot ahead of the launch

Are any emissions generated during the charging process?

- As Stagecoach use 100% renewable energy across the business, there are no carbon emissions generated from the charging process
- We are working with our suppliers to ensure the batteries for the vehicles have the best lifespan possible, including implementing a process for bringing the vehicles in at 30-40% battery to be topped up, rather than letting them run down fully, as this prolongs the life of the battery and therefore reduces waste

What difference are the new vehicles making?

- The vehicles on the Inverness City Network cover around 1.5m KMs per year, and as such in turn contributed around 1.2m tonnes of CO2e annually before the introduction of the fully-electric fleet
- The introduction of the vehicles equates to a 13% annual reduction in emissions year on year for our operations across the Highlands
- We'll see a total reduction of around 1.2m tonnes of CO2e per year within the Inverness City Network itself
- 17% of our Highland Fleet is now Electric with 76% of the diesel fleet being Euro 6 standard.

How does this all tie into government climate strategy?

- Decarbonising public transport and encouraging modal shift is a key part of the strategy to reduce greenhouse gas emissions for both the Scottish and UK governments
- Of the £10.8m investment in our new vehicles, around £5m was provided by the Scottish Government's Zero Emission Bus Challenge Fund (ScotZEB)
- Stagecoach has received a total of 119 fully electric vehicles across Scotland through the SULEB and ScotZEB schemes so far, and our passengers have made over 5 million zero emission journeys (281,769 in Inverness as of March 2023)

What else is Stagecoach doing to be more sustainable?

- Not every route is suitable for operating using an electric vehicle as yet, but as the technology improves, we are keen to progress with it. We have trialled Hydrogen vehicles and continue to monitor the market to see what is available.
- We're renewing our fleet in Aviemore and Tain shortly, and replacing older diesel vehicles to help further reduce emissions in the Highlands
- We now use recycled 'ELeather' for our seat covers
- We've also begun to introduce energy-saving lighting to depots and offices
- As a business, we have a target of a zero emission UK bus fleet by 2035, and net zero by 2050

Thank You



Bus Industry Snapshot

- Approx 80% of public transport journeys in Scotland are by bus.
- Approx 5% of road transport emissions are attributable to bus and coach (compared to around 55% from private car).
- SG stated aim that zero-emission buses will replace “the majority” of diesel buses in Scotland by the end of 2023 in the 2021 Programme for Government.
- Transport Scotland have invested ~£113m so far to support the roll out of zero and low emission buses, including funding over 5 years through Scottish Zero Emission Bus Challenge Fund (ScotZEB) and previous (Scottish Ultra-Low Emission Bus) SULEB schemes.
- Work to progress this aim includes the Scottish Bus Decarbonisation Taskforce, a joint initiative between industry and government, which published ‘Scotland’s Pathway to Zero Emission Buses’ in August 2022.

SCOTLAND'S PATHWAY TO ZERO EMISSION BUSES



THE PATHWAY ABOVE WILL LEAD TO A FUTURE WHERE...

- Bus operators exclusively run zero-emission battery-electric and hydrogen fuel-cell buses
- The bus sector provides an excellent service meeting passengers' day-to-day needs
- People enjoy travelling on buses and knowing that doing so is one of the most climate-friendly choices they can make;
- There are vibrant ownership and leasing markets for buses which benefits operators, manufacturers and the finance sector
- The smart technology on buses enables them to be operated in the most energy efficient way
- There is an even stronger and diverse domestic manufacturing sector and supply-chain comprised of high-quality skilled jobs with continued innovation reducing manufacturing and supply chain emissions
- Energy networks, bus operators and Local Government are used to working together to ensure depots are powered/fuelled and all potential users are able to benefit from the energy provision centred at depots and on-route charging infrastructure
- Buses and infrastructure are fully recycled at the end of asset life contributing to the circular economy, reducing waste and supporting further decarbonisation efforts
- After an important period of support, the Government has ceased subsidising battery-electric and hydrogen fuel-cell buses, but continue to support innovation in new zero-emission fuels and technologies of the future
- Scotland is recognised the world over as a leader in the design, manufacture and operation of high quality zero-emission buses and other large road vehicles, alongside associated green finance solutions

ALL DIESEL BUSES

MOST NEW BUSES ARE ZERO EMISSION

ALL BUSES WILL BE ZERO EMISSION



Alexander Dennis facts and figures

95+ million
zero-emission miles covered

130,000+ tons
CO2e emissions avoided

2,000
zero-emission buses
sold to date

15
facilities in 9 countries

2,100
team members

Established
1895

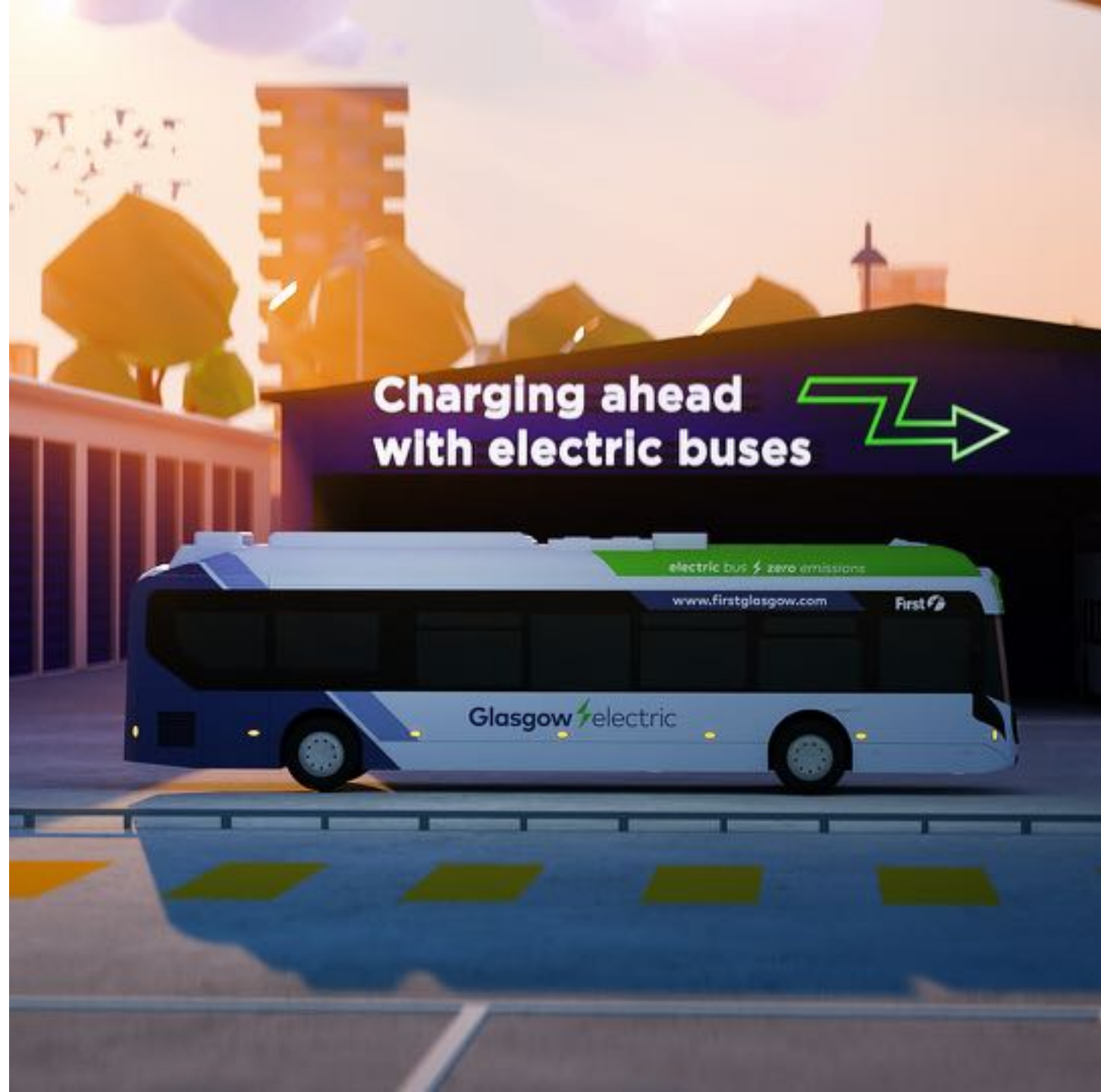
Supporting a total network of
31,000
buses and coaches

Part of

since 2019

Challenges

- Transport must play a key role in supporting decarbonisation and environmental objectives.
- Transport should not be viewed in isolation, without the support for infrastructure it won't work, needs to be a whole system view.
- The current gap in cost between diesel and ZE buses is too high to be able to make the case for investment without a level of public support.
- The availability and connection of electricity are also uncertain and costly. It is difficult to make a case for doing these in all but the "cheapest" locations without support.
- Skills transition in the move from diesel to ZE.
- Diesel purchases still very much present in the wider market.





Moray Growth Deal Project - Bus Revolution

Stevie Robertson
Senior Project Officer



Bus Revolution

Project Aims and Objectives:

- Increase the number of people using public transport to get to and from rural areas to places of work, education, etc.
- Reduce the environmental impact of transport in the area by 30t CO₂e p.a
- Reduce the number of people facing transport barriers to employment, education or recreation.

Bus Revolution

- The project has 2 key elements:
 - The development of an “uber-style” app to enable customers to track the position of buses and book journeys within a reasonable response time (max. 1 hour).



- An investment in quality green fleet (electric buses), to increase the flexibility and hours of operation of on-demand bus provision across Moray, with additional facilities such as on board Wi-Fi, USB charging facilities etc.



Delivery Model

Looking for reliable, convenient and affordable travel in and around Moray?

m.connect

Moray's brand new on demand bus service

Book your journey up to 1 hour before your time of travel

Download the app or call 01460 1234565 to book and plan your journey

Available on the App Store | GET IT ON Google Play

Simply enter your destination, your preferred time of travel and leave the rest to us.

For more or service information visit moray.gov.uk/mconnect

Funded jointly by the Scottish Government and Moray Council through the Moray Growth Deal

Your guide to travelling with m.connect

Our new and improved m.connect service operates across a number of areas throughout Moray.

Plan your journey with our handy zone and fare guide.

m.connect fare structure		
Zone	Single	Return
1	£5.00	£9.00
2	£5.50	£9.00
3	£7.50	£9.00
4 or more	£9.00	£9.00

Fares
To pay you can use cash, card, vouchers and QR coded travel schemes as well as Scotland wide NEC cards, either on-board or via the passenger app payment function.

Purchase of a £9.00 ticket will automatically qualify the ticket holder to all day travel on the service, subject to a confirmed booking on the service and the presentation of a valid ticket at point of boarding.

Out of Service information
The Service will not operate on the following days:
 25 December
 26 December
 01 January
 02 January
 May Day holiday

1 Find your start and end point
2 Count the fewest number of zones connecting them
3 Look up the fare in the fare table

m.connect

Planning Considerations

- Phase one operational plan – Current Bus network – gaps in provision – rural links required – community consultation
- Charging Infrastructure – Specification – Location – Shared resources
- Vehicle size – Accessibility – Range
- Shift patterns
- Charging cycles required
- Battery performance - Seasonal considerations

Carbon Emissions Impact

- The initial capital investment will involve embodied carbon emissions, however the project will aim to be operationally net zero.
- The embodied carbon is derived from the construction of the electric bus fleet, as well as the installation of new EV charging infrastructure. Whilst the project uses a significant amount of electricity in day-to-day operation, the planned decarbonisation of the national grid will enable the project to operate at net zero.
- In calculating carbon emissions, the assumption is that each new electric bus will create a high level of embodied carbon of 88 tCO₂e. It has been assumed that charging infrastructure will require 1 x 1m³ concrete base per charging unit, each producing 0.27 tCO₂e. These figures include a +10% contingency.

Reducing the environmental impact

- By operating a flexible demand responsive service model supported by technology, it is anticipated that there will be a considerable uptake of this new renewable travel option. This influence has been quantified pragmatically as a 1% shift from work-related car use in Moray. Over the project lifespan, this is estimated to represent a 2,114 tCO₂e offset.
- In addition, the software systems proposed enable each vehicle to minimise energy use by calculating the most efficient route available to pick up/drop off passengers – vehicles will not be restricted to a pre-defined route. This will have a positive impact on the project's carbon footprint by lowering energy consumption and extending the life of consumables (e.g. tyres).

Reducing the environmental impact

Direct emission targets

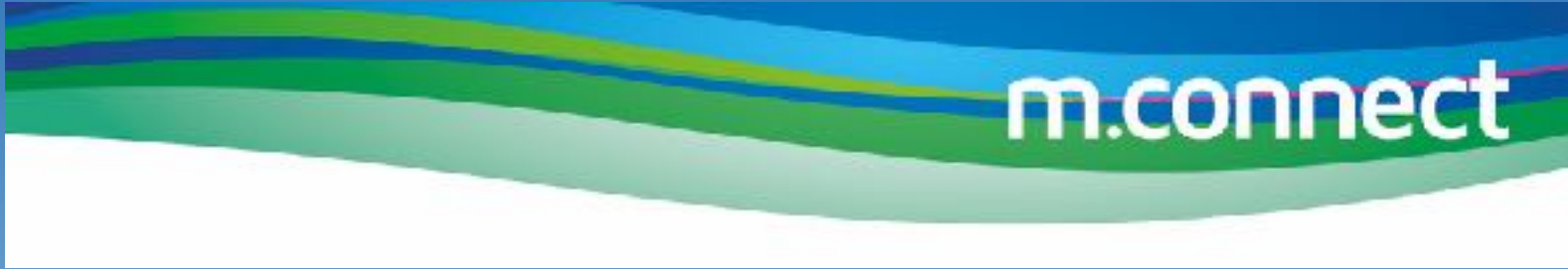
- Based on 2019, total diesel carbon emissions associated with on-demand bus service operations were 283t CO₂e based on 124,263 miles ran, equalling 0.0023 carbon emission per mile.
- Calculations will be reviewed each year using UK government conversion factors and applied to miles completed associated to m.connect services. Similar calculations will be completed to capture the EV emissions in a similar fashion.
- Carrying this exercise out on an annual basis should evidence reduction in per mile carbon emissions.

Indirect emission targets

- UK governments (BEIS) for 2019, suggests that roads in Moray are responsible for 168,000 tCO₂e of carbon emissions annually. Approx. 74m miles travelled in Moray to generate this.
- Bench marking these figures whilst monitoring increased passenger use, mileage increases on m.connect services and any decrease in overall Moray wide emissions will validate reduced private car use throughout the project life cycle.
- Any passenger number increase during peak travel periods will be assumed as a displaced journey from a private car.

Challenges

- Future vehicle procurement
- Warranty and parts
- Longer repair times
- Skill gap for workshop / maintenance staff
- Grid and sub station upgrade
- Energy costs



www.moray.gov.uk/mconnect





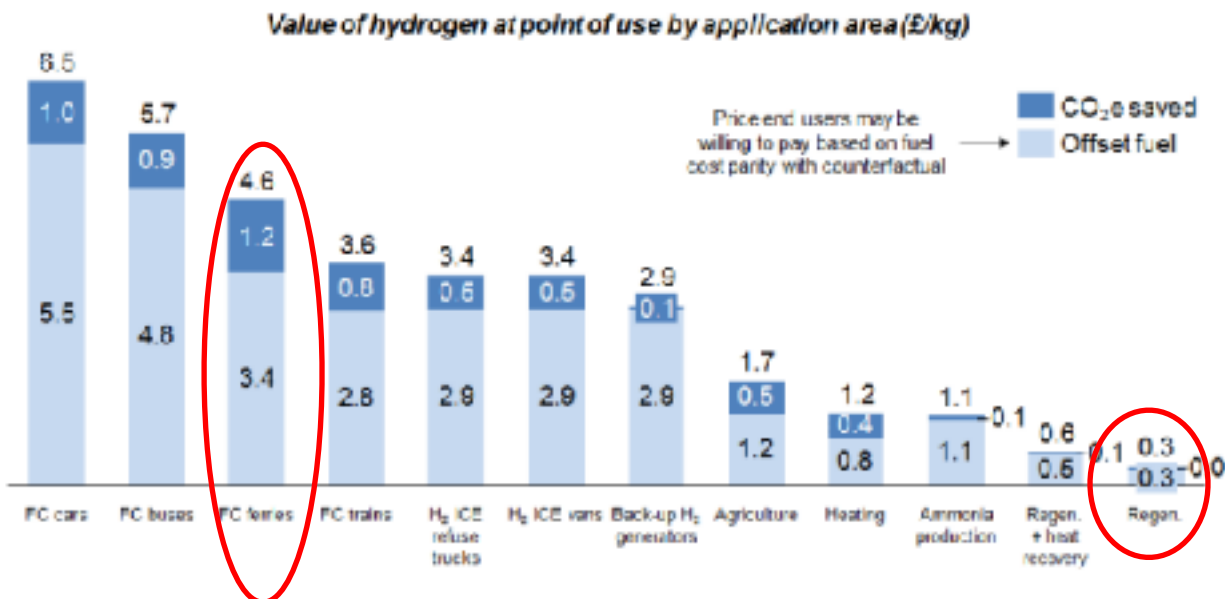
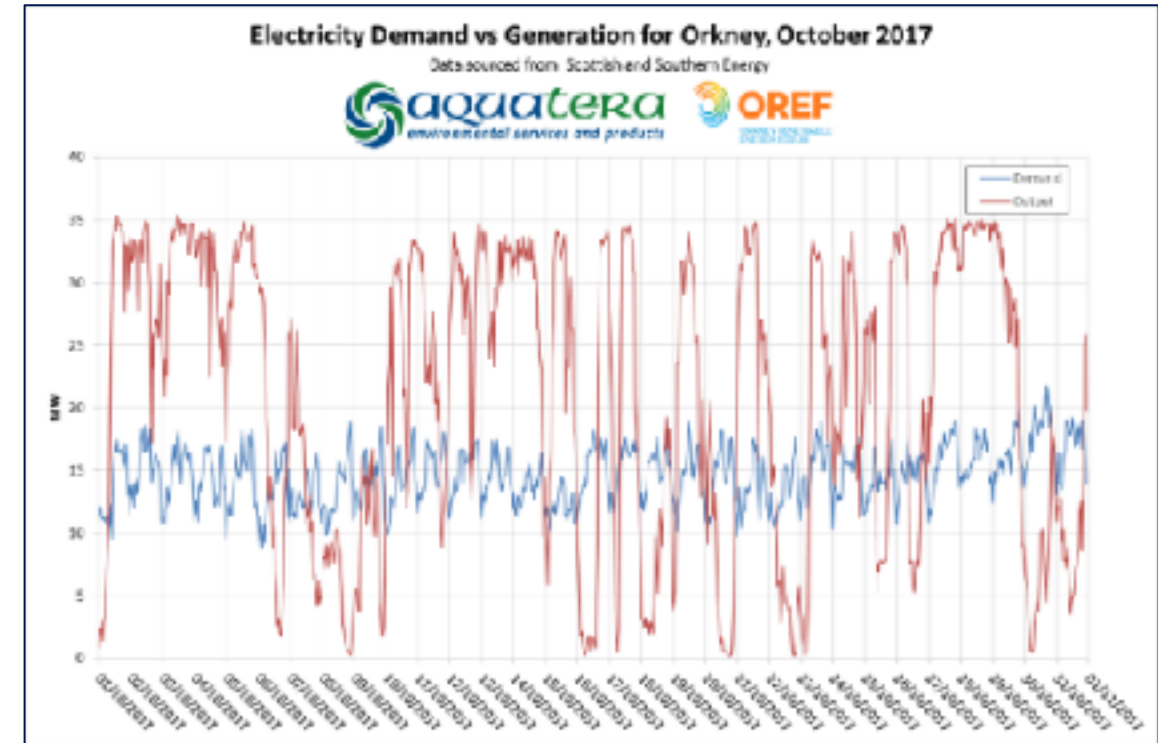
Why Ferry Fuels Matter

– an Energy Island perspective

Neil Kermode
Managing Director
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Orkney's progress

- >100% renewable electricity demand since 2013
- Pilot projects in hydrogen
- First hydrogen from tidal energy

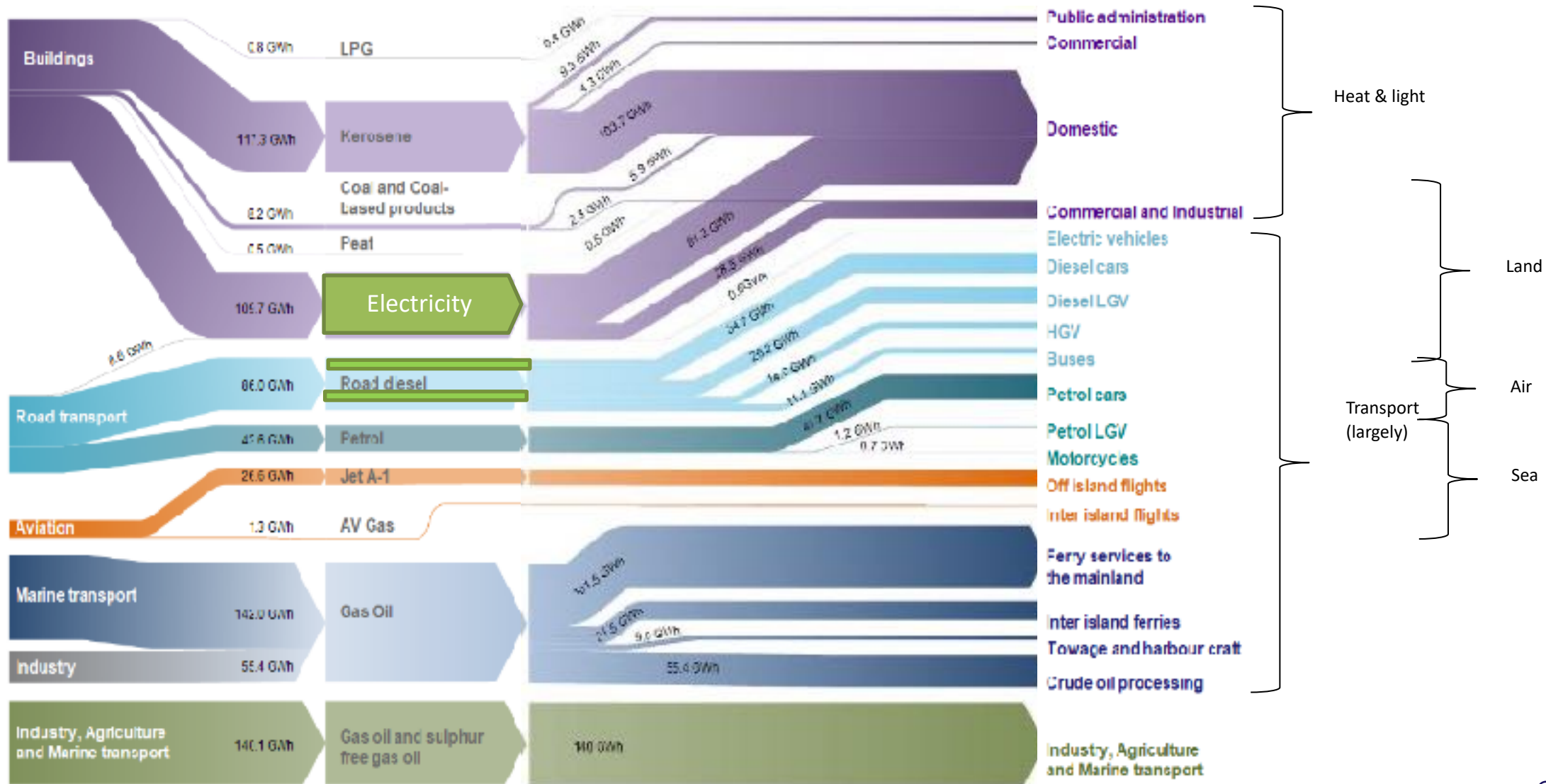


HyDime project -MV Shapinsay

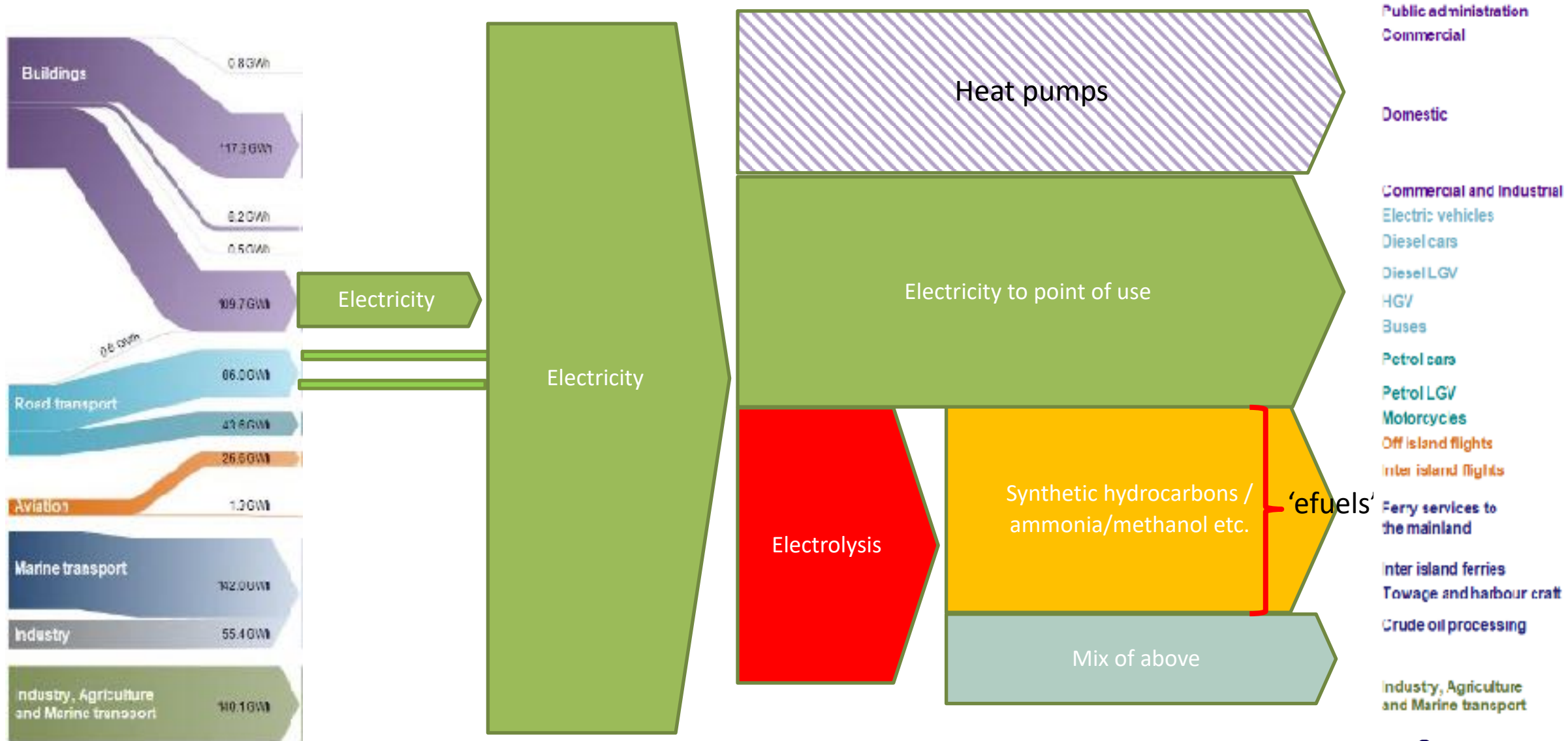
EMEC HYDROGEN



Orkney Energy Audit 2019



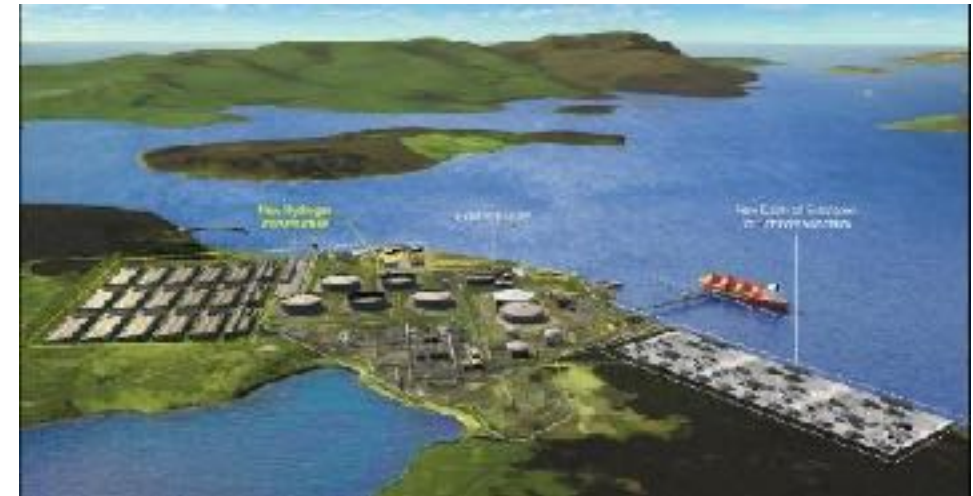
Orkney Energy 2030



EMEC as an enabler

EMEC's job is to remove barriers

- Supporting Zero Avia with their hydrogen powered flight trials.
- Hosted Zero Petroleum's E-fuel plant for Project Martin.
- Linking with Repsol & partners to re-task Flotta oil terminal to H₂
- ✗ Failed to get H₂ aboard vessels (so far).



Efficiency?



MV Alfred

100 cars

16 kts

3 MW

£19M

755l/hr



MV Hamnavoe

95 cars

19 kts

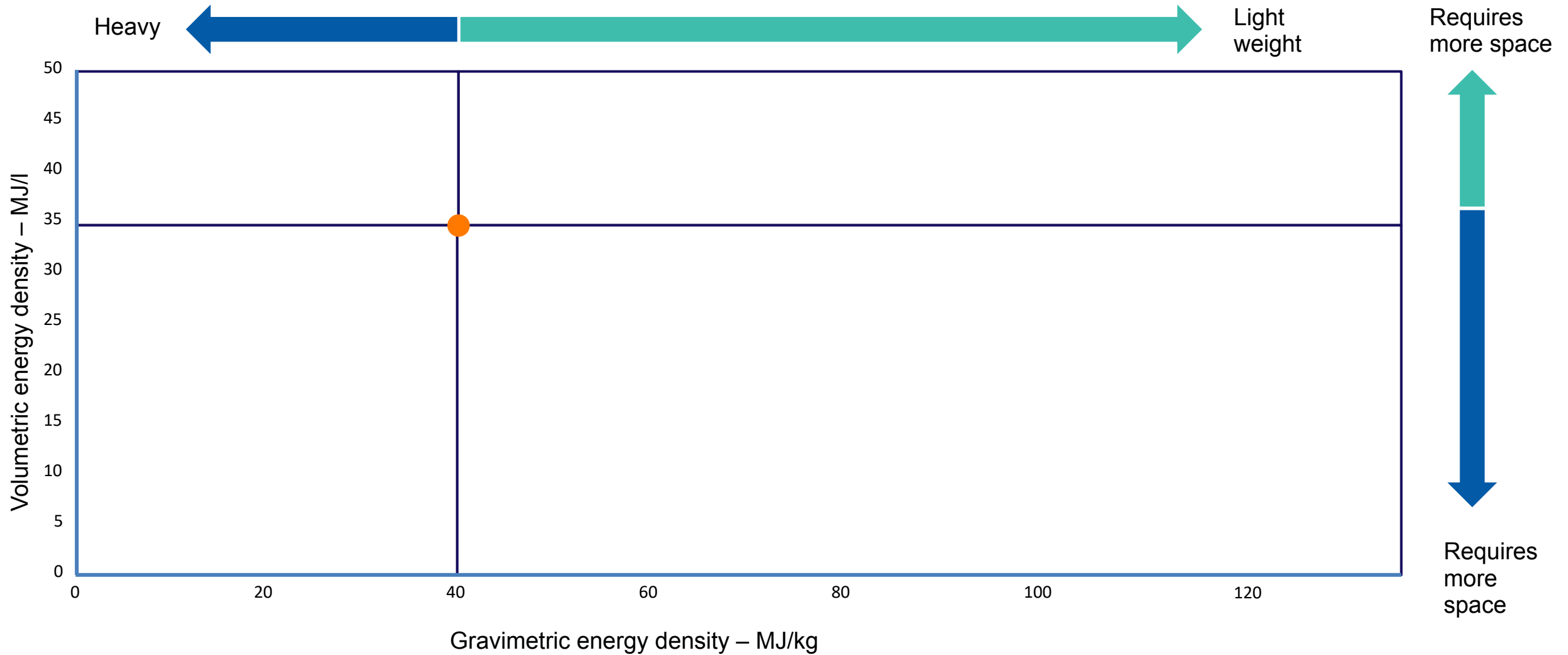
8.6 MW

£56M

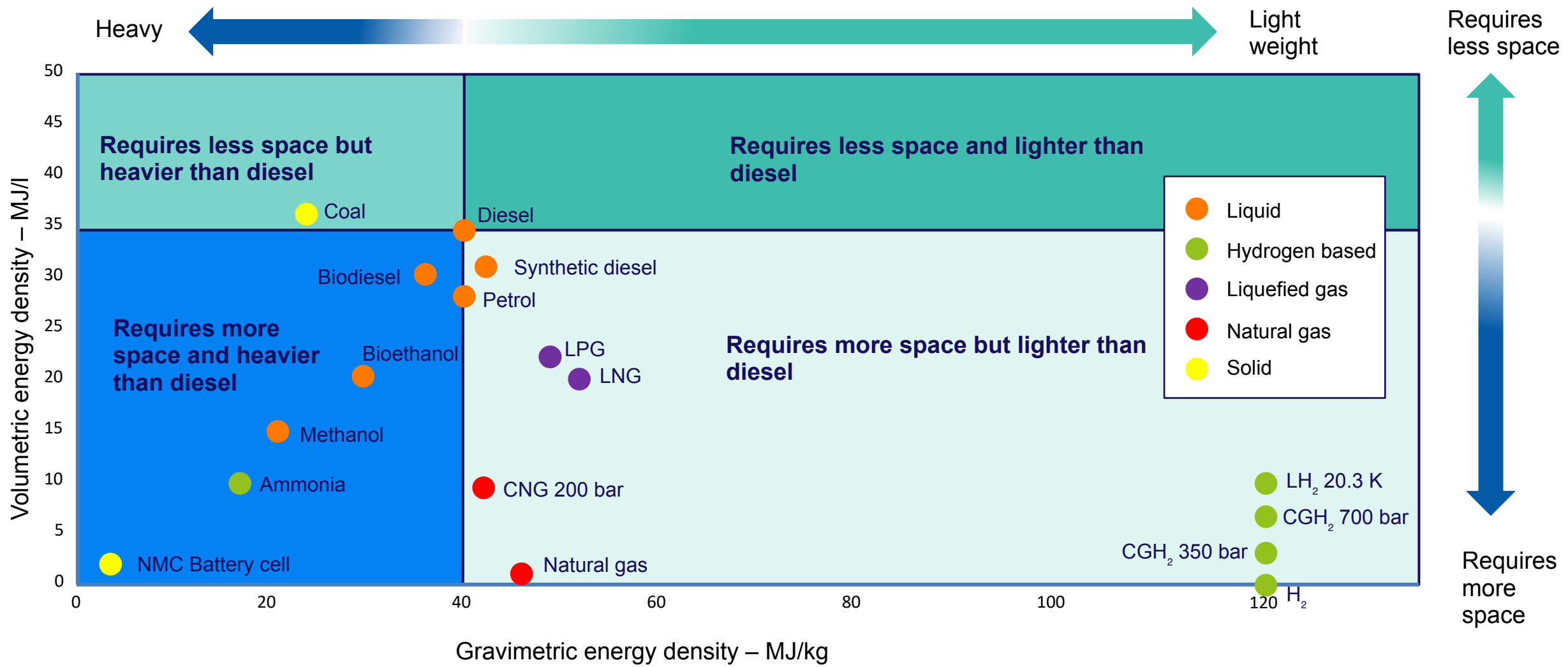
1500l/hr (ish)

1/3 the capital cost
1/2 the energy consumption?
(½ the effort to decarbonise)
Could be electric today.

Chemistry: Diesel/Kerosine



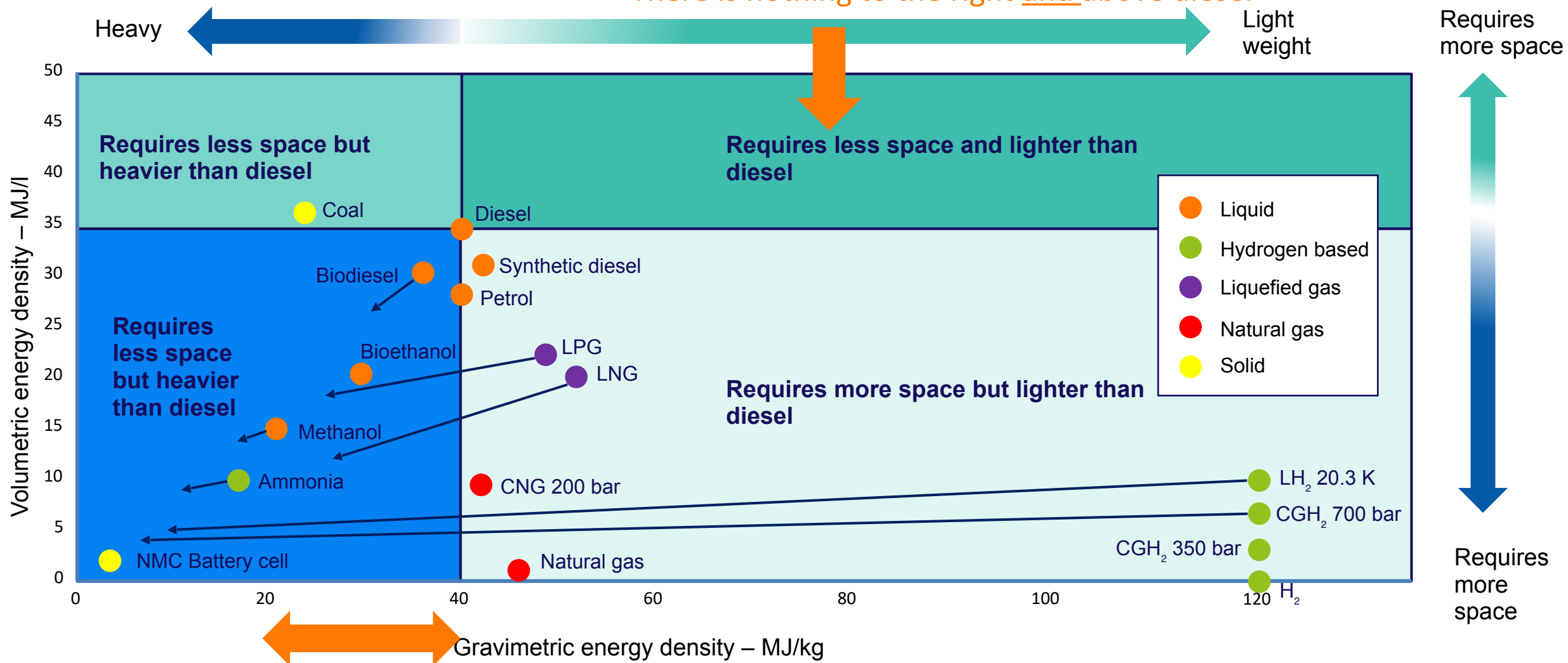
Diesel/Kerosine



Original source material & graphics: DNV

The alternatives

There is nothing to the right and above diesel



Original source material & graphics: DNV

Including storage, there is practically nothing half as good

