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Transport Infrastructure Ireland

Options Available for Decarbonisation of the Freight Sector

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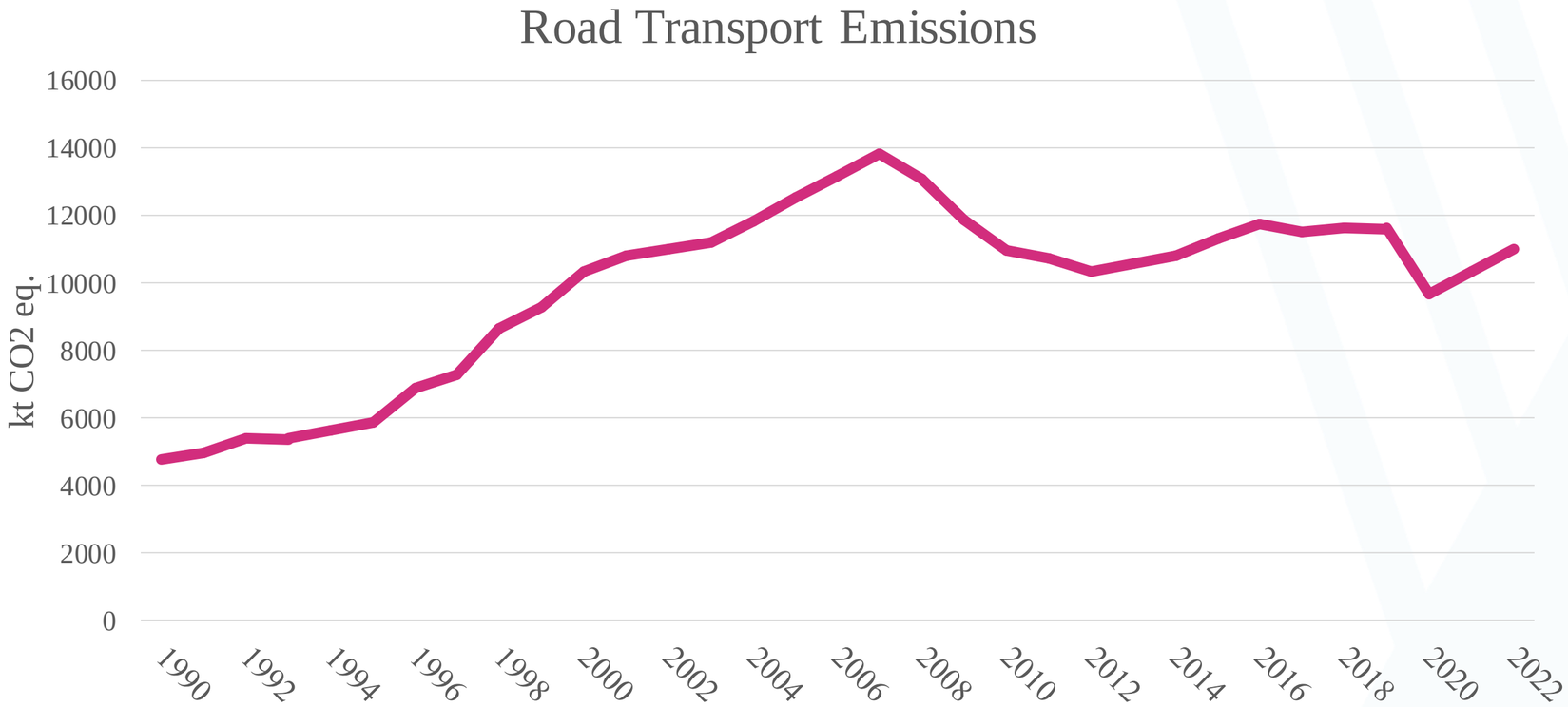
Emissions from Road Transport

- Reducing road transport emissions against a backdrop of strong growth is the challenge



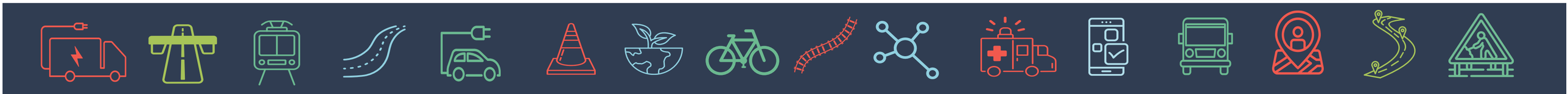
Source; EPA Ireland, 2023

Policies and Targets

- CAP23 commercial fleet 2030 targets include
  - 20% of LGV fleet made up of EVs
  - 30% of new heavy duty vehicle registrations are zero emission
  - 95,000 commercial EVs

- AFIR targets of charging stations for HGVs need to be deployed every 60km along the TEN-T core network, and every 100km on the TEN-T comprehensive network from 2025 onwards, with complete network coverage to be achieved by 2030.

- Hydrogen refuelling infrastructure for both cars and lorries must be deployed from 2030 onwards in all urban nodes and every 200km along the TEN-T core network.



Options to Decarbonisation

- Uptake of alternative fuels by HGVs.
- Using agricultural waste to power HGVs.
- Efficient movements.
- Reducing the Amount of Empty Running.
- Consolidation centres.
- Modal switch.
- National Transport Model.

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Review of Potential Fuel Technologies

Problems and Issues

Concerns for adopting EVs and other alternative fuel vehicles include:

- Availability of vehicles and supporting technology
- Cost of new vehicles
- Whole life costing
- Changes to processes
- Fitness for purpose, sufficient range and payload
- Charging times / fuelling infrastructure
- Vehicle maintenance
- Training of drivers and fitters

Review of Potential Fuel Technologies – Zero Emission

Electric

Medium Maturity Technology

- Increasing numbers of BEVs

Cheaper

- Less maintenance than diesel vehicles
- Electricity is often cheaper than diesel
- Whole-life cost-parity with diesel by 2030s

Hybrid systems

- Allows zero-emission movement within cities
- Fuel savings of up to 40%

Payload Restrictions

- Weight and size of batteries can impact payload capacity
- Reduction of operational flexibility

Limited Charging infrastructure

- Rapid charging for HGVs would require 700kW – 800kW chargers
- Current EV car rapid chargers are typically 43kW

Charging Duration

- Double shifted HGVs won't have enough time to charge

Hydrogen

Emissions

- No tailpipe emissions
- Only water vapour produced

Long Range

- Offers similar range and refuelling times to diesel

Production

- Can be produced from a variety of sources
  - By-product of petroleum refining
  - Electrolysis using renewables

Production

- Lack of infrastructure to produce, transport, and store
- Expensive and requires significant energy input

Infrastructure

- Currently no hydrogen refuelling stations in Ireland

Costs

- Higher upfront cost for hydrogen HGVs
- Only a few models available in left-hand drive
- Right-hand drive vehicles are usually specially adapted 'trial vehicles'

Review of Potential Fuel Technologies – Non-Zero Emission

Natural Gas

Cleaner

- LNG and CNG are cleaner burning fuels than petrol/diesel
- Produce lower levels of GHG emissions, NOx, and particulate matter

Cost

- Price of gas is generally lower than petrol/diesel

Infrastructure

- Less developed than for conventional fuels

Range

- Gas vehicles have a smaller range than diesel
- Especially true for CNG due to lower energy density

Transition Technology

- Gas is still a fossil fuel
- Should only be considered in the short-to-medium term

Biofuels (including HVO)

Source

- Derived from renewable sources such as crops, waste materials, and algae
- More sustainable alternative to fossil fuels

Biodiesel

- Diesel engines do not require modifications to run on biodiesel
- Can be produced from a variety of feedstocks

Biomethane

- Produced from captured methane from e.g. dairy farms
- Can allow both the agricultural and transport sectors to reduce emissions

Food Scarcity

- Using food crops for biofuel production can raise concerns about food scarcity
- Potential for competition for land use

Emissions

- Burning of biofuels still produces CO_2
- CO_2 emissions from biofuels are approximately half that of fossil fuels

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Rates at Which Technologies Will Be Adopted

Factors Affecting the Rates at Which Technologies Will Be Adopted

Type of Goods

Goods requiring refrigeration may require technologies that can provide sufficient cooling capacity

Goods requiring fast delivery may require quick refuelling or recharging, such as hydrogen fuel cell vehicles

Weight and volume of goods will influence the choice of technology, with heavier loads requiring more powerful vehicles

Type of vehicle used

Rigid HGVs are suitable for shorter distance transport, enabling faster adoption of EVs

Articulated lorries used for long-distance transport present challenges due to weight and range requirements, requiring larger battery packs or more frequent charging.

Origin and destination

Urban areas with congestion and pollution may prioritise electric vehicles

Rural areas may require vehicles with longer ranges and greater power

Availability of refuelling or recharging infrastructure will affect adoption

Industry concentration in a region impacts alternative fuel adoption

Market trends

Similar uptake rates predicted for each vehicle class

4-year lag expected between each vehicle class

Battery-electric vans account for the greatest share of newly registered alternatively-fuelled vans in Ireland (~2.5% of all newly registered vans)

Factors Affecting the Rates at Which Technologies Will Be Adopted

Electric

Range	• Range limitation is a main constraint for the uptake of BETs • Range will improve but currently diesel has a greater range
Infrastructure	• 10% to 30% of HGVs will require on-route charging
Costs	• Installation of high-powered charging points present challenges for BET adoption
Legal	• EU legislation requires provision for public chargers along motorways and in major cities
Emissions	• CO_2 reduction targets will be supported by requirements for charging capacity • BETs offer advantages such as zero tailpipe emissions
Perception	• Positive public perception of BETs may encourage adoption by road freight operators

Hydrogen

Emissions	• Hydrogen fuel cell HGVs can reduce road freight GHG emissions • The European Commission proposes a 45% CO2 reduction from new trucks sold in 2030
Infrastructure	• Lack of refuelling infrastructure in Ireland is a constraint to uptake • Aiming for a total of 80 hydrogen refuelling stations in Ireland by 2030. • There be one hydrogen refuelling site every 200km on PRN.
Production	• Hydrogen production for fuel cells could be sustainable, using electrolysis. • Green H2, produced through electrolysis, is cleaner but costlier vs Blue. • Electrolysis may be a viable energy storage option and renewable fuel.
Operations	• H2 offers longer ranges and shorter refuelling times compared to BETs. • Annual fuel costs for hydrogen are significantly lower than diesel. • FCEV produce minimal emissions and noise in urban areas.
Energy Security	• Investment in sustainable energy sources can enhance Ireland's energy self-sufficiency.

Factors Affecting the Rates at Which Technologies Will Be Adopted

Natural Gas

Infrastructure

- The adoption of natural gas as a fuel for HGVs is hindered by the lack of infrastructure for refuelling

Costs

- Upfront costs for natural gas-powered HGVs are higher compared to diesel-powered HGVs
- Operating costs can be lower, up to 40% in the UK

Emissions

- Natural gas is considered a transitional fuel
- Emits less CO_2 than diesel but not classified as a zero-emission technology
- Agriculture accounted for 38% of Ireland's total greenhouse gas emissions in 2021
- Biomethane has the potential to replace up to 28% of Ireland's diesel consumption in heavy goods vehicles

Biofuels

Production

- Adoption of biofuels faces a major constraint related to food security concerns
- Feedstocks used for biodiesel do not compete with food crops
- Other biofuels like bioethanol may have a higher potential for competing with food crops

Costs

- Bioethanol production is 34% more expensive than gasoline, and biodiesel production is 84% more expensive than diesel
- These costs are passed on to the customer (HGV operators)

Operations

- Diesel vehicles can operate without any modifications when using biodiesel
- Conventional diesel is blended with 7-10% biodiesel

HVO

Production

- A fully renewable fuel from vegetable oil used like diesel
- Does not contain harmful components found in fossil diesel
- Made from 100% renewable feedstocks
- The quantity of HVO that can be manufactured is uncertain

Costs

- 20% to 30% more expensive than conventional diesel

Operations

- It can be used as a direct replacement for diesel
- It is accepted by engine manufacturers, ensuring engine maintenance warranties are honoured

Emissions

- Some operators choose to use HVO due to the significant greenhouse gas savings it offers
- HVO still produces emissions which can contribute to poor local air quality
- Considered an interim fuel with a limited period of sales

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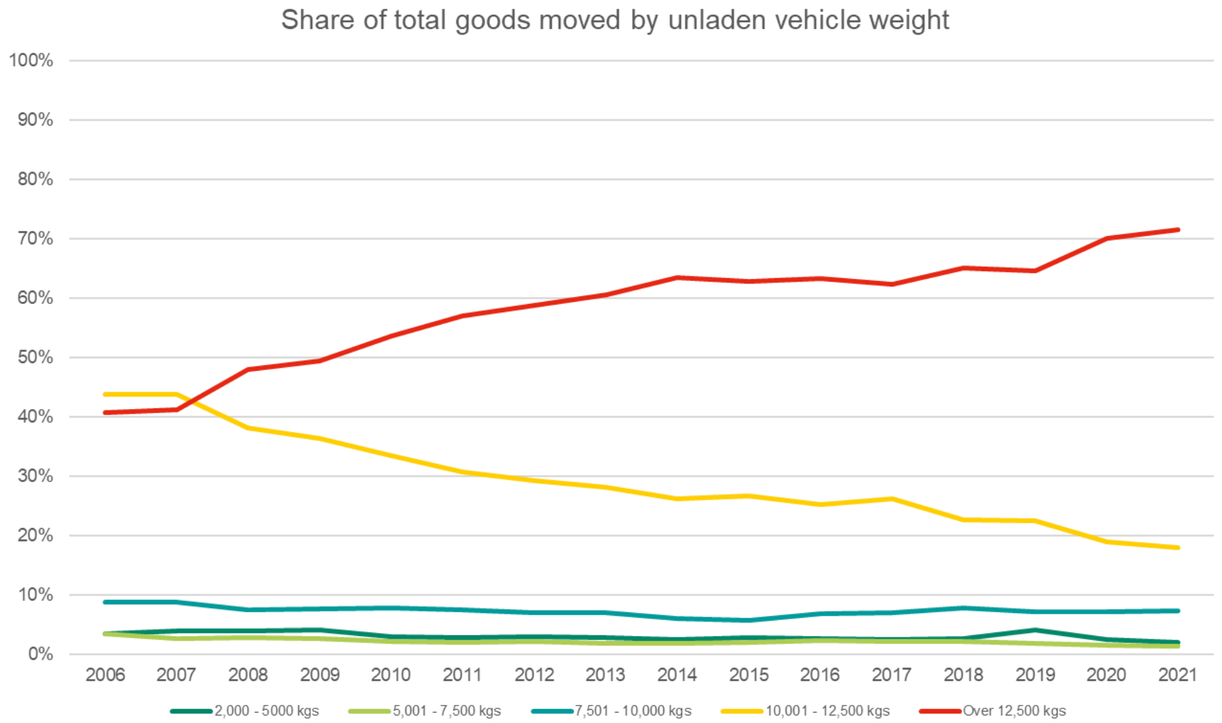
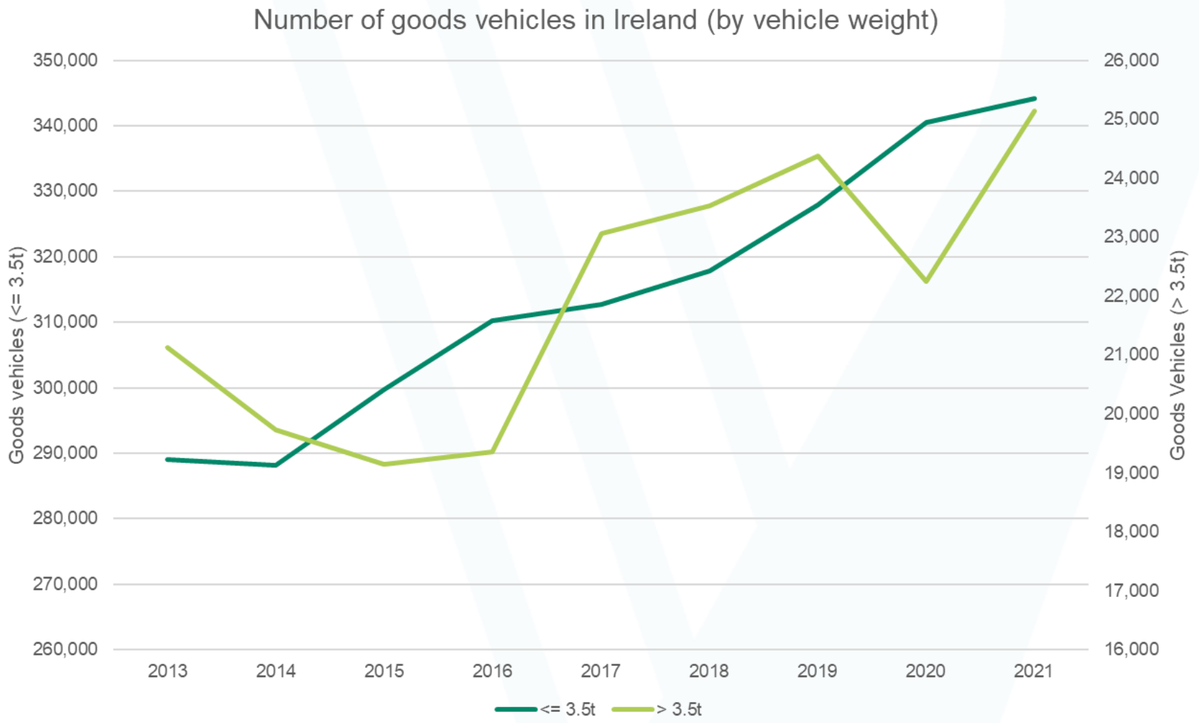
Freight Market Review

Freight Market Review

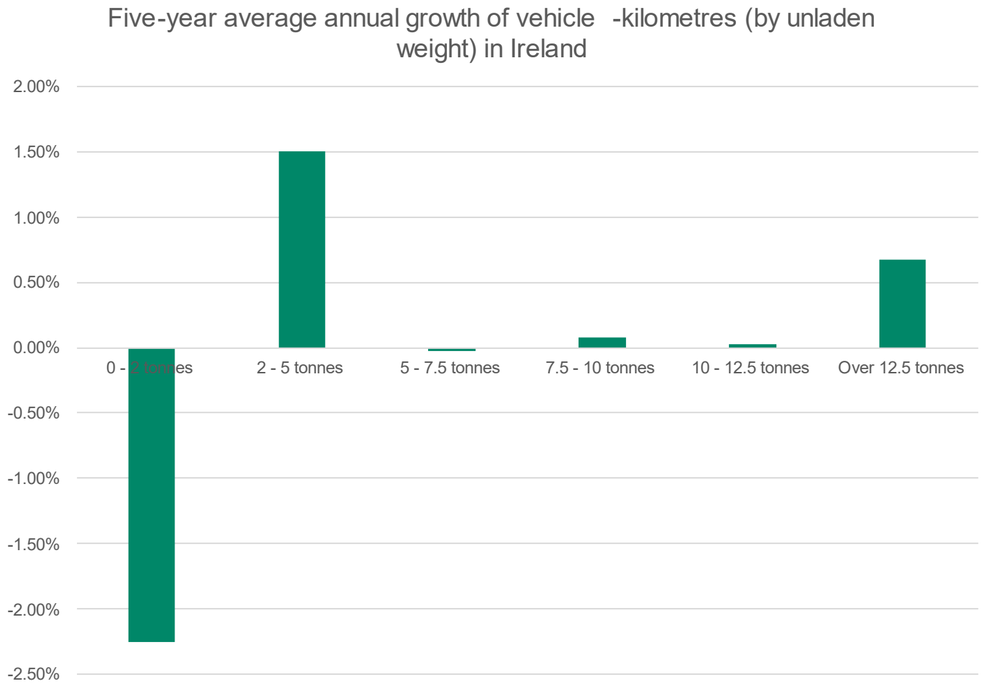


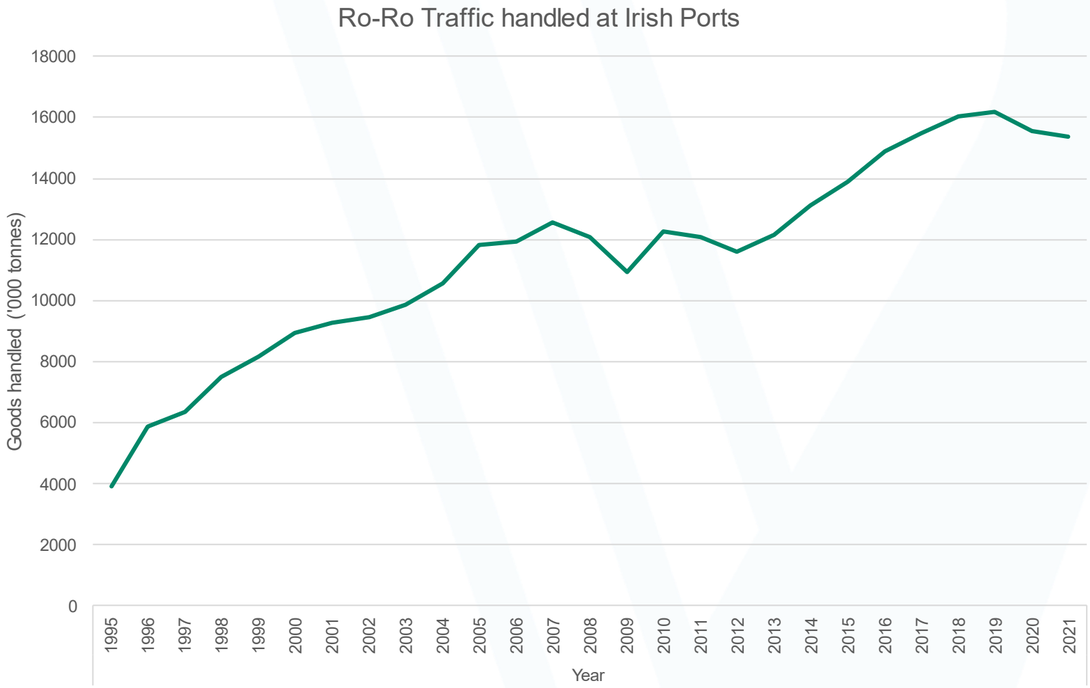
- Over 70% of total goods are moved by HGVs over 12,500kgs
- Increasing use of the heaviest HGVs
- Decreasing usage of HGVs between 10t and 12.5t
- Usage of all other weight classes remaining stable



- There are just over 25,000 HGVs in Ireland
- Approximately 20% increase in the number of vans Ireland
- The UK has seen a similar increase
- Approximately 20% increase in the number of vehicles over 3.5t in Ireland
- The UK has not seen the same increase

Freight Market Review





- Goods in Ireland are being transported in larger vehicles than previously
- Decrease in the share of goods moved by vehicles with an unladen weight of 0-2 tonnes
- Increase in goods moved by vehicles with an unladen weight of 2-5 tonnes and over 12.5 tonnes
- If this growth were to remain consistent, the share of vehicle kilometres attributed to lighter LGVs will approach parity around 2050

- RoRo traffic at Irish ports has almost doubled in 20 years
- Ferry trade between Ireland and the EU has almost doubled (from 10% to 18%)
- This will impact specific routes near ports

Major OEMs Now Have an Electric range of Vehicles for UK & Ireland

Biomethane (CNG) e.g. Scania and Iveco

Hydrogen-Electric HGV - Tevva

- Tevva's hydrogen-electric truck will have a range of up to 310 miles (500 kilometres), and its hydrogen tanks can be refilled in 10 minutes.
- It will be the first vehicle of its kind to be manufactured, designed and mass-produced in the UK.
- By adding a hydrogen fuel cell system to its battery-electric HGV design, Tevva delivers zero-emission solutions that will work for most fleet operators across various industries and sectors.
- In 2019 HGVs contributed 18% of the UK's greenhouse gas emissions in the transport sector, according to government figures.

Tevva's 7.5-tonne hydrogen-electric truck.

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Case Studies

Case Studies – Examples of Alternative Fuels and their Uses

Norway

- Battery electric HGV (66t) transporting lime from the Verdalskalk quarry to port
- Estimated annual reduction in fossil fuel consumption of 58,800 litres
- Estimated annual reduction in CO_2 emissions of 156 tonnes
- HGV has a draw-bar unit, allowing for larger batteries to be installed

Sweden

- Real-world study demonstrated the cost-effectiveness of electric HGVs
- Used data from a haulage company in Helsingborg
- Conducted by researches in collaboration with Swedish Transport Administration and Volvo Trucks
- Findings
  - Battery investment is justified with at least 1,400 charge and discharge cycles.
  - Electrifying HGVs is profitable, except for max weight vehicles

UK

- Amazon are using five BEV articulated HGVs for middle range haulage
- Bennamann is producing CFM gas and LFM fuel from livestock manure in Cornwall

Switzerland

- DPD are using zero-emission vehicles for transalpine distribution
- DPD aim to have a fleet of zero-emission vehicles, of which 90% will be electric, by 2030

Manchester Clean Air Zone (CAZ)

- A study was conducted to assess the potential impact of the CAZ on vans and HGVs in Manchester
- 31% of HGVs would have been affected if the CAZ had been introduced in 2021
- 33% of vans would have been affected by the 2023 introduction
- 38% of vehicles in the construction sector would have been affected

Food Distribution – BWG Foods

Using HVO, Renewable Gas-Fuelled Trucks and now EV HGVs

- BWG Foods' first electric HGV, a Volvo eFE 6×2 rigid truck, which has capacity for up to 33 pallet spaces, which is powered by four 240 kWh batteries, providing a range of up to 250 kilometres.
- BWG Foods, owners and operators of the Spar, EuroSpar, Londis, Mace and XL brands, now have aof low-carbon delivery fleet to 32 HGV vehicles, combining Biogas, Compressed Natural Gas and Electric, reinforcing the Group's status as having Ireland's most sustainable delivery fleet.
- Following a collaboration with Inver Energy, BWG Foods is transitioning a number of its delivery trucks across to HVO.
- BWG Foods supply over 1,000 stores nationwide.

Irish Biofuel HVO

- Irish Bioenergy Association (IrBEA) indicate that biofuels make up 98 per cent of all of the renewable energy in Ireland and that in 2020, biofuel use helped the country to avoid circa 520,000-tonnes of CO_2 emissions, the equivalent of removing about 230,000 petrol cars off the road.
- According to IrBEA, around 14% of Irish biofuels are made in Ireland, the rest imported.
- Most of that is waste cooking oil, which is refined into biodiesel. Some of it comes from by-products from meat processing, including animal fats and tallow.

- DPD announced that it is to switch its entire diesel HGV fleet to Gd+ HVO, an advanced hydrotreated vegetable oil (HVO) fuel by the end of 2023.
- DPD plan to decarbonise its Irish fleet by 2030.

Parcel Sector Electric Van Rollouts: Amazon, DHL, DPD

DPD promises to operate all electric fleets in the UK by 2025

Summer 2021: Oxford became first all electric city where DPD's fleet of 40 vehicles has delivered >15,000 parcels

Amazon to add 1,800 electric vehicles to the company's European last mile fleet

Fleet of 100,000 custom built electric vans being amassed in the U.S.

Early September 2021: DHL added 50 vans to its electric fleet in the current year; 50 more to be added by year's end

End of 2022: 220 more vans to be added

Heavy ZE Vehicles are Already in Our Cities

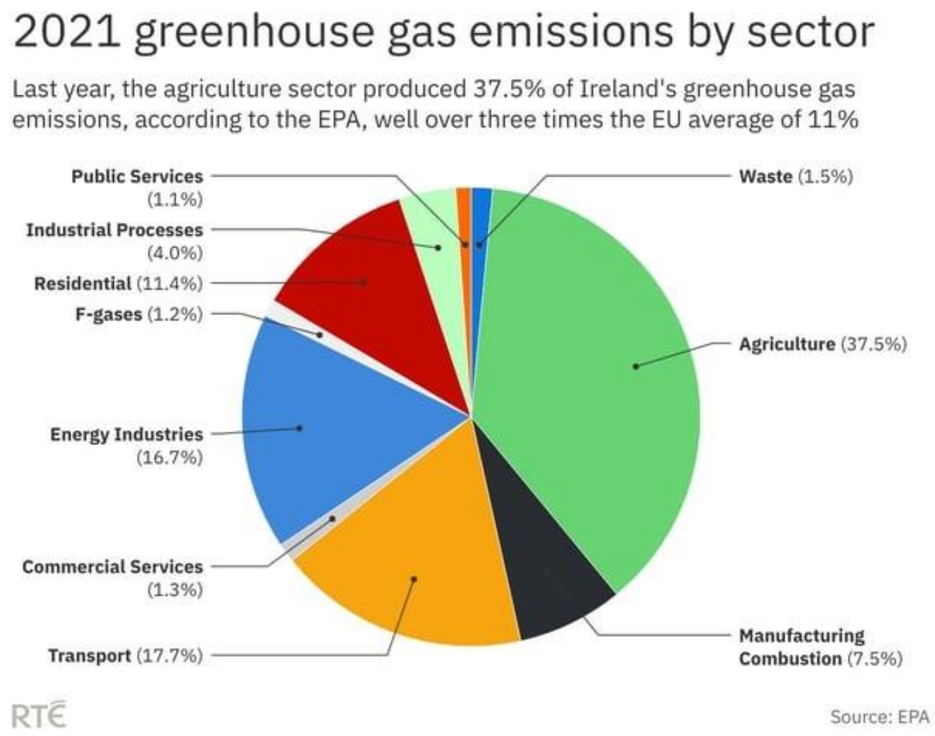
- Q1 2021: Warburtons began rolling out its first fleet of Zero Emissions vehicles
- The Renault D ZE can drive up to 150km (93mi) on a single charge with a capacity of 6 tonnes of bread and bakery goods
- The fleet is set to deliver to multiple locations across London as it is eligible for circulation in the capital's Ultra LEZ and Congestion Charge Zone
- Renault Trucks Battery Performance Promise guarantee 250MW of power delivery, equivalent to 10 years' worth of battery operation

Waste Collection : York ZE RCVs

- Dennis Eagle eCollect Rubbish Collection Vehicle, operated by York City Council
- 2 vehicles operating in the centre of York
- Each vehicle weighs 15 tonnes when empty and has an 11 tonne capacity for waste
- Each vehicle travels about 80 miles a day on 12 hour shifts
- The drivers, crew and residents appreciate the noise reduction experienced during periods of waste collection

Irish Agricultural Greenhouse Gases

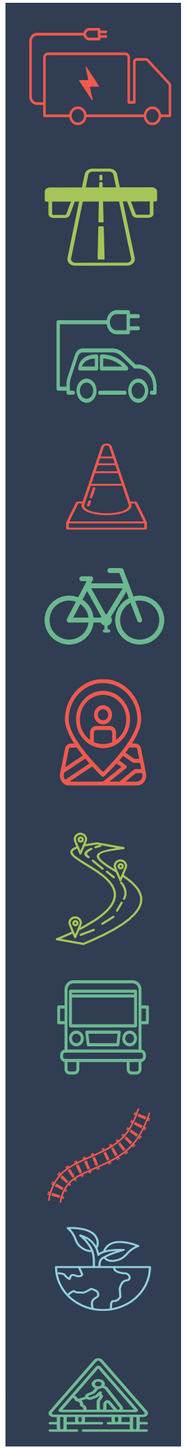
- Irish agriculture is under huge pressure to reduce emissions: Over 35% of national greenhouse gases come from agriculture, the highest level in Europe, where the average is 11%. And more than 60% of that comes from methane associated with cattle.
- There are 7.4 million cattle (including 1.6m dairy cows) in Ireland.
- 100,000 cows equate to 0.45m tonnes of CO2e /annum.
- Irish Government committed to reducing emissions by 25% by 2030.
- Farms can develop a slurry pit with methane-harvesting facilities to collect the harmful methane released from cow waste, instead of it leaking into the atmosphere.
- Collected methane can be used to power lorries e.g. Scania and Iveco
- This is not only helping to reduce input costs for the dairy business by saving on diesel and fertiliser, but it is also reducing fossil fuel use, greenhouse gas emissions and decreasing the farm's carbon footprint.



Construction Sector

Conclusions

- Current domestic and EU legislation and guidance is intended to increase the proportion of low and ZEV fuel technology to reduce CO2.
- Future road freight fuel technologies will be a complex mixture of electric, hydrogen, natural gas (LNG and CNG) and biofuels.
- BEV will emerge as the leading ZEV technology; however, this will be slower for vehicles in heavier weight classes.
- The adoption of alternative fuels will depend on:
  - Type of goods;
  - Vehicle used;
  - Origin and Destination;
  - Whole life costing; and
  - Market trends.
- Fuel technology may be influenced according to the route and other conditions and it will not be appropriate to apply a nominal overall rate of adoption to the fleet as a whole.



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