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The case for rail

Comparing the passenger emissions for Lumo Trains with alternative modes

lumo

Low emission travel on Lumo Trains

Carbon savings on rail compared to flying

This report summarises analysis of passenger carbon emissions travelling on the Lumo Trains network compared with equivalent journeys on other modes.

Lumo is a train service travelling exclusively on the East Coast of the UK between London and Edinburgh, calling at Stevenage, Newcastle and Morpeth. The service provides low-carbon regional and national connectivity as an alternative to car and air travel.

A single passenger travelling on Lumo's intercity electric trains for a return trip from Edinburgh to London saves the equivalent annual CO2 sequestered by **11 trees**[1] when compared to flying.

A one-way Lumo trip between Edinburgh and London emits approximately 6.8 kgCO2e[2] while the equivalent journey flying emits 149 kgCO2e.

A single passenger could therefore take 22 one-way rail trips before creating the same emissions as a single flight.

A return trip from Edinburgh to London on Lumo Trains saves the equivalent of up to 11 trees worth of annual carbon when compared to flying

(1) Assuming a single tree sequesters approximately 25kg CO2 per year on average - it is acknowledged that this figure can differ depending on factors such as tree type, management, age and soil type for example, as well as how the rate of sequestration varies over the lifetime of trees.
(2) Emissions are presented in terms of kilograms of carbon dioxide emissions equivalent ($kgCO_2e$)

Route emissions by mode

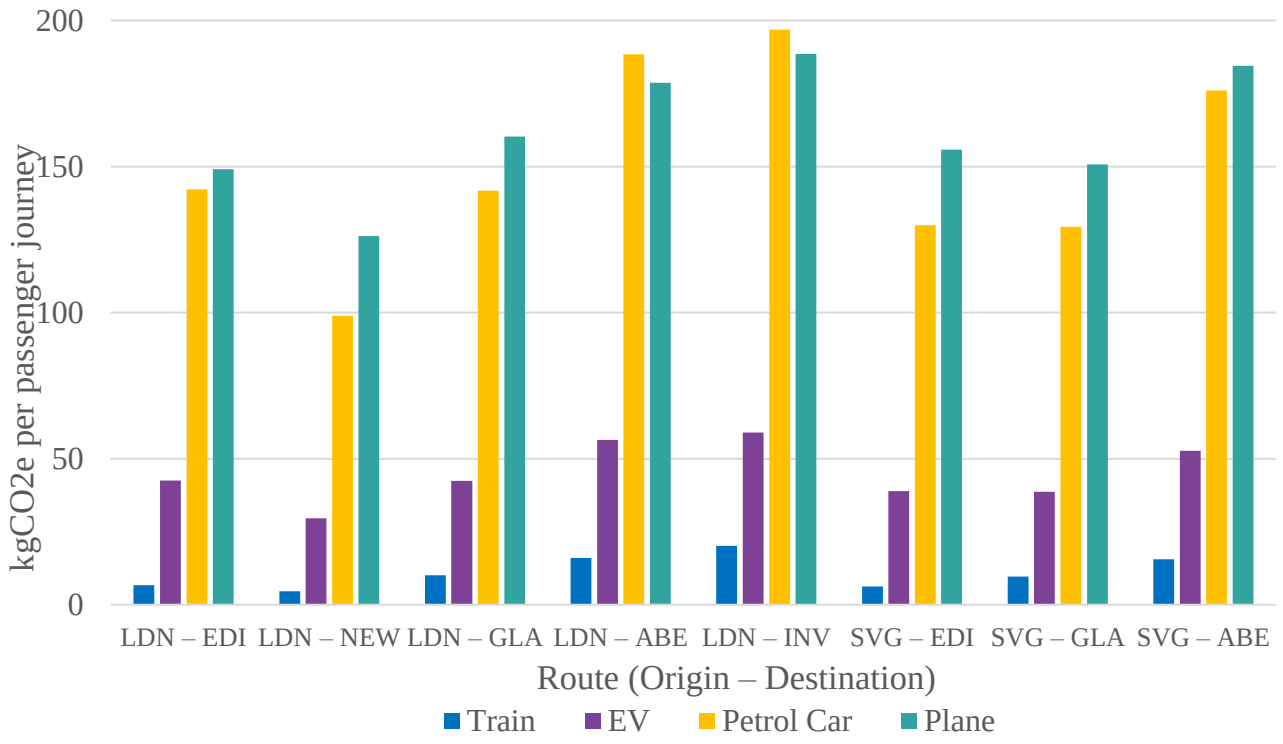
A comparison of emissions generated by passenger journeys on selected routes for different modes

The graph shows the combined Scope 1 and Scope 3 emissions[3] for passenger journeys for Train, EV, Petrol Car and Plane on selected routes.

Rail is evidently the lowest emitting mode for journeys on all the routes even when compared with electric vehicles. On average across all routes travelling by rail emits 17 times less than flying, 15 times less than travelling by petrol car and 4.5 times less than travelling by EV. On routes exclusively on the Lumo network this drops to **25 times less than flying, 21 times less than petrol car and 6 times less than EV**.

These numbers have been derived through a comprehensive analysis of available data however other data sources are available and may produce different results.

A summary data table can be found in Appendix 1.



LDN: London
EDI: Edinburgh
NEW: Newcastle
GLA: Glasgow
ABE: Aberdeen
INV: Inverness
SVG: Stevenage

(3) Scope 1 covers direct GHG emissions from owned or controlled sources or activities, for example emissions from company owned vehicles. Scope 2 emissions relate to purchased electricity, heat and steam where emissions occur elsewhere (e.g. power station in the case of electricity generation). Scope 3 emissions relate to indirect emissions from 3rd parties such as purchased goods or leased assets.

Shifting from aviation to rail

The potential for modal shift

Since its launch in 2021, Lumo has captured an increasing number of passengers on its 100% electric network and this modal shift from domestic aviation to rail can deliver significant carbon savings.

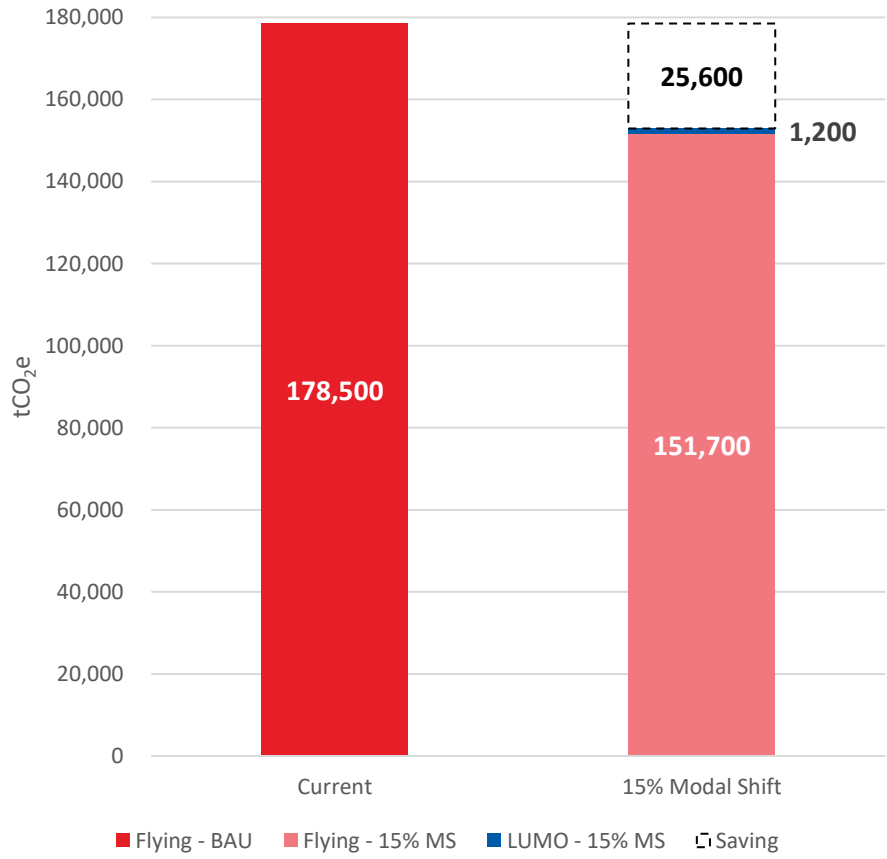
If just 15% of passengers who flew from Heathrow to Edinburgh[4] had instead travelled via Lumo rail, 25,600 tonnes of CO_2e could have been saved over a year. **This is equivalent to a million trees**[5] or 3,650 hectares of forested land[6] needed to offset these emissions.

The Government's Transport Decarbonisation Plan[7] states that for the UK to meet its net zero carbon target by 2050, modal shift towards low-carbon public transport is a necessary measure.

The Government has also set an intermediate target of reducing national greenhouse gas emissions by 68% by 2030 based on 1990 levels, acknowledging that immediate action is needed.

A summary data table illustrating mode shift savings from different routes can be found in Appendix 2.

A 15% modal shift of annual London to Edinburgh journeys from flights to Lumo would save 25,600 tCO2e



(4) Based on CAA 2019 monthly air passenger data (https://www.caa.co.uk/data-and-analysis/uk-aviation-market/airports/uk-airport-data/)
(5) Assuming a single tree sequesters approximately 25kg CO2 per year on average - it is acknowledged that this figure can differ depending on factors such as tree type, management, age and soil type , as well as how the rate of sequestration varies as trees grow/ mature over time.
(6) Mixed broad-leaved woodland sequesters 7 tCO2e per hectare of area per year (average taken over 100 year lifetime). Source: Natural England (http://publications.naturalengland.org.uk/publication/5419124441481216)
(7) Department for Transport (2021) available online: https://www.gov.uk/government/publications/transport-decarbonisation-plan

Looking ahead

Decarbonisation of the grid

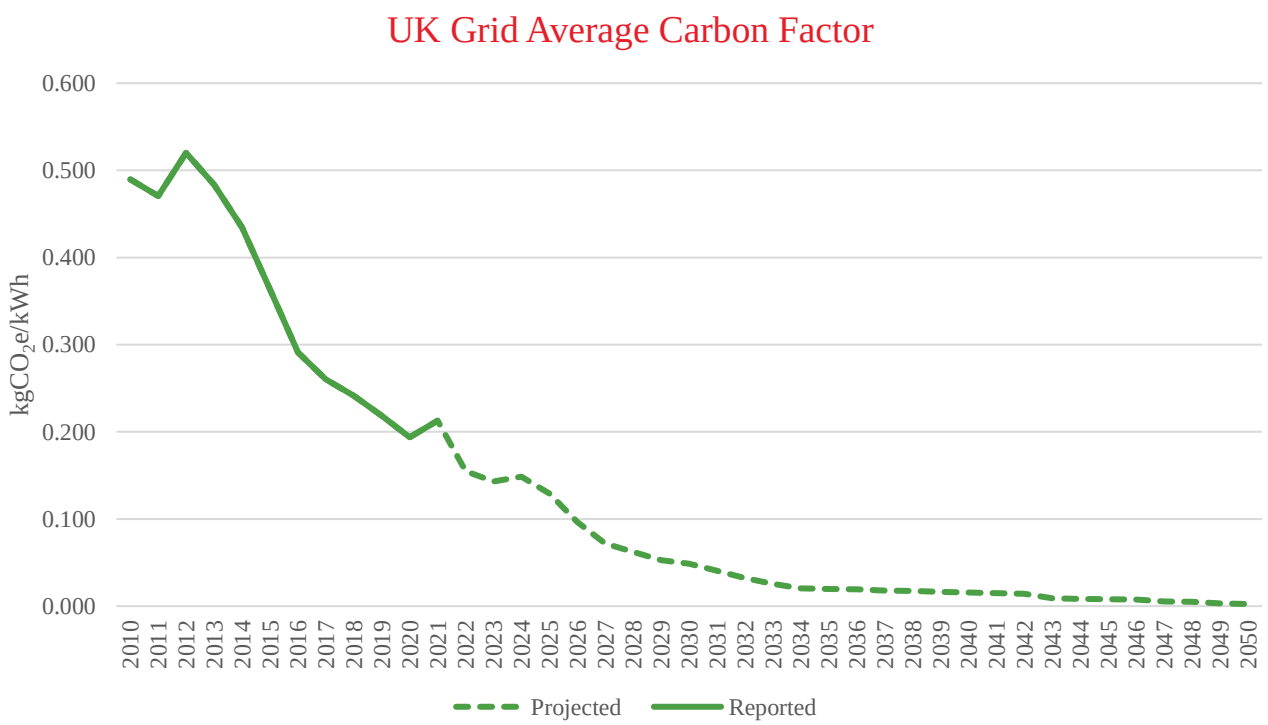
The rapid decarbonisation of UK electricity production since 2010 has seen the grid average carbon factor drop from 0.490 kg of CO2e per kWh generated, down to around 0.194 kgCO2e/kWh by 2020.

This 60% reduction in the carbon factor is due to the rapid increase of renewables that account for an increasing proportion of electricity generation[8].

With continued investment in renewables such as wind and solar, and a shift away from coal, the UK government projects the grid carbon intensity to reach 0.072 kgCO2e by 2027[9].

This transition will feed through to Lumo's operating emissions further reducing it's overall footprint.

Network Rail have, since 2013, a power purchase agreement (PPA) in place with EDF Energy to purchase low carbon electricity generated by nuclear power to fulfil all their traction electricity requirements. For this analysis we have used a location-based method using the UK grid to determine emissions and have not considered the additional reduction to emissions from this market agreement.



(8) National Grid grid carbon intensity live dashboard: https://www.nationalgrideso.com/future-energy/our-progress/carbon-intensity-dashboard
(9) Source: BEIS Green Book Projections: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Looking ahead

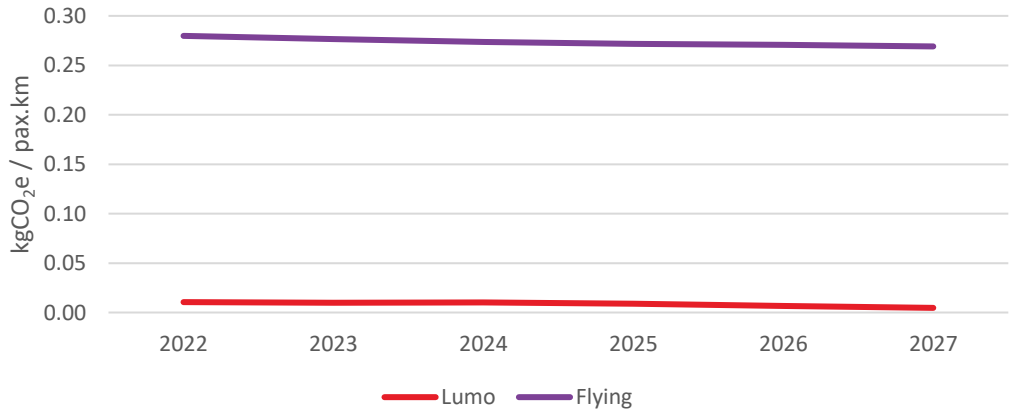
5-year outlook

The decarbonisation of the grid will directly impact Lumo's operational emissions. A 5-year outlook shows Lumo's carbon emissions could reduce by 54% against 2022 figures. This would equate to an annual emissions saving on London to Edinburgh trips of 1,500 tCO2e in 2027 (based on current ridership numbers).

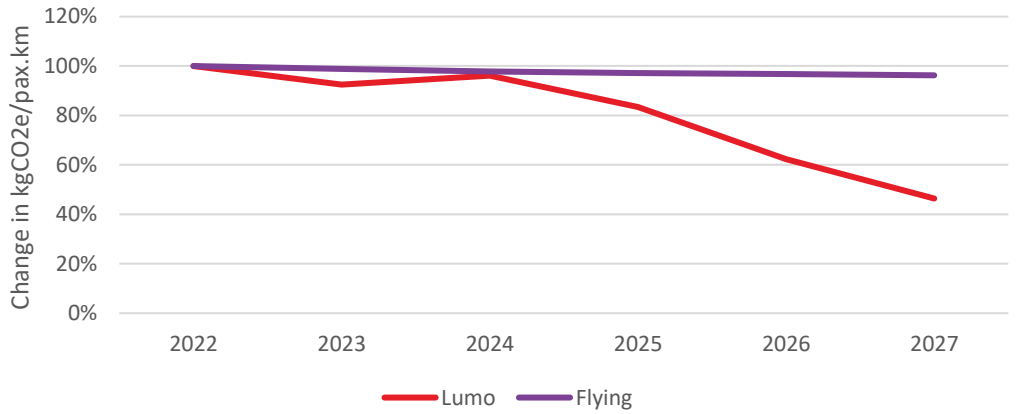
This is in contrast to domestic aviation emissions where no significant breakthroughs are expected in the next 5 years according to the government's Jet Zero Strategy[11] – with only a small uptake of sustainable aviation fuels (SAF) expected. Data from the Jet Zero Strategy report was interpreted to show the carbon intensity of flights from London Heathrow to Edinburgh reducing from 106,600 to 102,500 tCO2e per annum, between 2022 and 2027 - only a 4% reduction.

The 5-year outlook for car journeys also shows less potential for a significant reduction in journey emissions compared to the Lumo 5-year outlook. The Department for Transport forecasts that in 2027, only 23% of vehicle kilometres travelled by car will be completed by electric vehicles[12].

The passenger km emissions gap between Lumo and flying is significant



Baselining to 2022 shows the relative change in emissions and the significant reduction in Lumo's projected emissions



(10) Based on LUMO annual passenger data between December 2021-November 2022.
(11) Source: Jet Zero Strategy for UK aviation: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1095952/jet-zero-strategy.pdf
(12) Source: DfT Transport Analysis Guidance: TAG data book - GOV.UK (www.gov.uk)

The case for Lumo

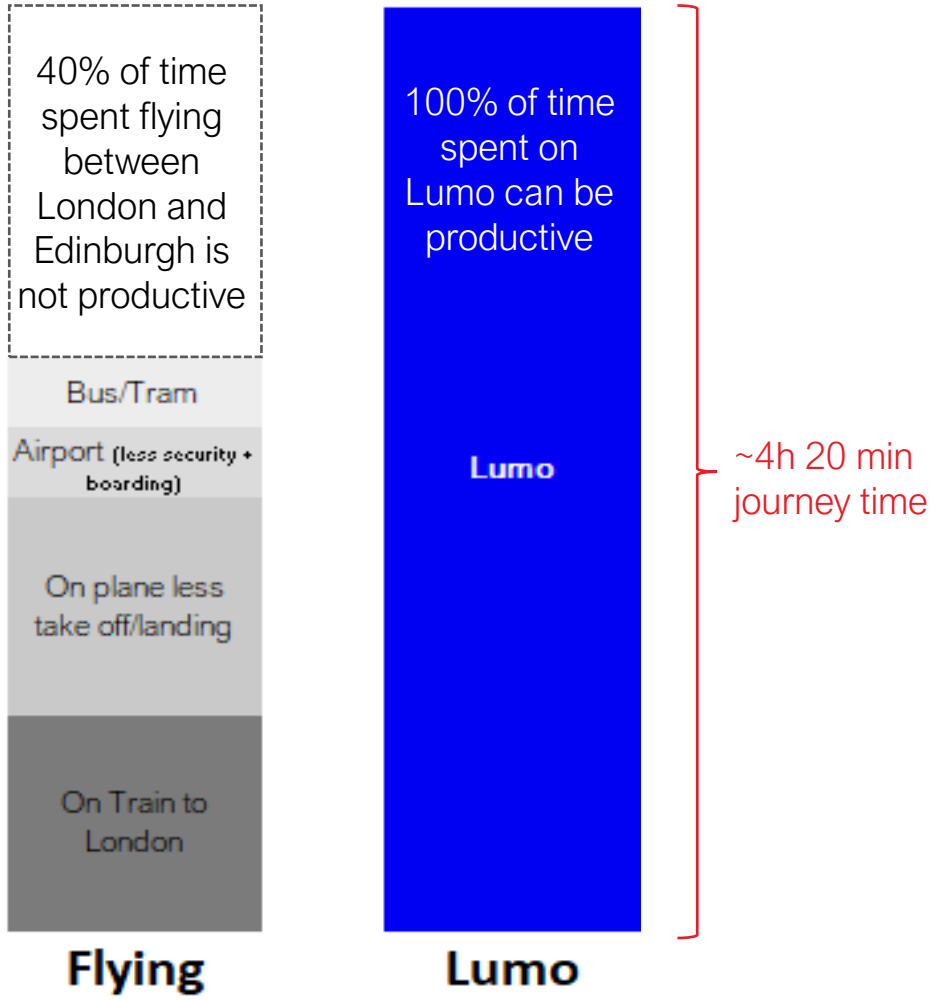
Compelling evidence of the environmental benefits of travelling by Lumo

Lumo provides low-carbon connectivity along the east coast of the UK, relying on existing technology and a decarbonising grid which is projected to reach as low as 2 grams of CO2e per kWh by 2050. This is in contrast to aviation which is considered one of the most challenging sectors to decarbonise. We have shown that it is 25 times cleaner to travel on the Lumo network than to fly.

Lumo's innovative approach and use of low-cost ticketing has grown the share of passengers travelling between London and Edinburgh by rail with over 50% of trips now taking place via rail.

In addition to providing low-cost and low-emission city centre to city centre connectivity, travelling by rail also provides passengers with a more productive environment. Passengers travelling via Lumo can choose to spend 100% of their time being productive while the equivalent for flying is estimated to be around 60% and for driving is zero (0%).

This report and the Lumo carbon calculator present compelling evidence of the environmental benefits of Lumo train travel compared to flying and driving, with the additional productivity benefits of intercity rail travel.



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Appendix 1 – Emissions by mode on selected routes

Route	Scope 1 & 3 Emissions (kgCO2e per passenger journey)			
	Rail (Lumo leg)	EV Car	Petrol Car	Plane (with RF*)
London – Edinburgh	6.77 **(6.77)**	42.59	142.25	149.16
London – Newcastle	4.63 **(4.63)**	29.62	98.93	126.21
London – Glasgow	10.14 **(6.77)**	42.45	141.79	160.32
London – Aberdeen	16.08 **(6.77)**	56.42	188.45	178.70
London – Inverness	20.16 **(6.77)**	58.93	196.86	188.56
Stevenage – Edinburgh	6.29 **(6.29)**	38.90	129.92	155.76**
Stevenage – Glasgow	9.67 **(6.29)**	38.74	129.40	150.71**
Stevenage – Aberdeen	15.61 **(6.29)**	52.71	176.07	184.44**

* RF: Radiative Forcing
** Quoted value includes the scope 1 & 3 emissions associated with driving a petrol car from Stevenage centre to Luton centre (accounting for ~ 5 kgCO2e of total value)
Plane routes connecting to London are assumed to depart from/arrive at London Heathrow Airport

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Appendix 2 – Mode shift data table

Journey		Air baseline case		15% modal shift case					
Origin	**Destination**	**Annual pax**	**Annual tCO2e**	**Annual pax (Air)**	**Annual pax (Lumo)**	**Annual tCO2e (Air)**	**Annual tCO2e (Lumo)**	**% reduction in CO2e**	**Annual saving tCO2e**
Heathrow	Edinburgh	1,196,921	178,535	1,017,383	179,538	151,755	1,215	14%	25,565
Heathrow	Newcastle	461,804	58,286	392,533	69,271	49,543	320	14%	8,423
Heathrow	Glasgow	865,008	138,675	735,257	129,751	117,874	1,316	14%	19,485
Heathrow	Aberdeen	692,289	123,713	588,446	103,843	105,157	1,670	14%	16,887
Heathrow	Inverness	140,358	26,465	119,304	21,054	22,495	425	13%	3,545
Luton	Edinburgh	312,737	47,148	265,826	46,911	40,076	295	14%	6,777
Luton	Glasgow	245,638	35,791	208,792	36,846	30,422	356	14%	5,012
Luton	Aberdeen	79,592	14,282	67,653	11,939	12,139	186	14%	1,956

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