21th Meeting of the COMCEC TCWG

Measuring the Environmental Impacts of Transport Infrastructures in OIC Member Countries Project

Conceptual Framework and Global Trends

12.10.2023

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ESCARUS
[TSKB Sustainability Consultancy]

Measuring the Environmental Impacts of Transport Infrastructures in OIC Member Countries Project

Conceptual Framework and Global Trends

Contents

01 Introduction

Haramain High Speed Railway - Saudi Arabia

Global Sustainability Trends

In response to global environmental concerns and commitments to the **Paris Agreement** and **United Nations Sustainable Development Goals (SDGs)**, countries worldwide are striving for a Net Zero future, aiming to limit global warming and address various social, economic, and environmental challenges.

Transportation Infrastructure

Daily Mobility

Supply Chain Systems

Socioeconomic Development

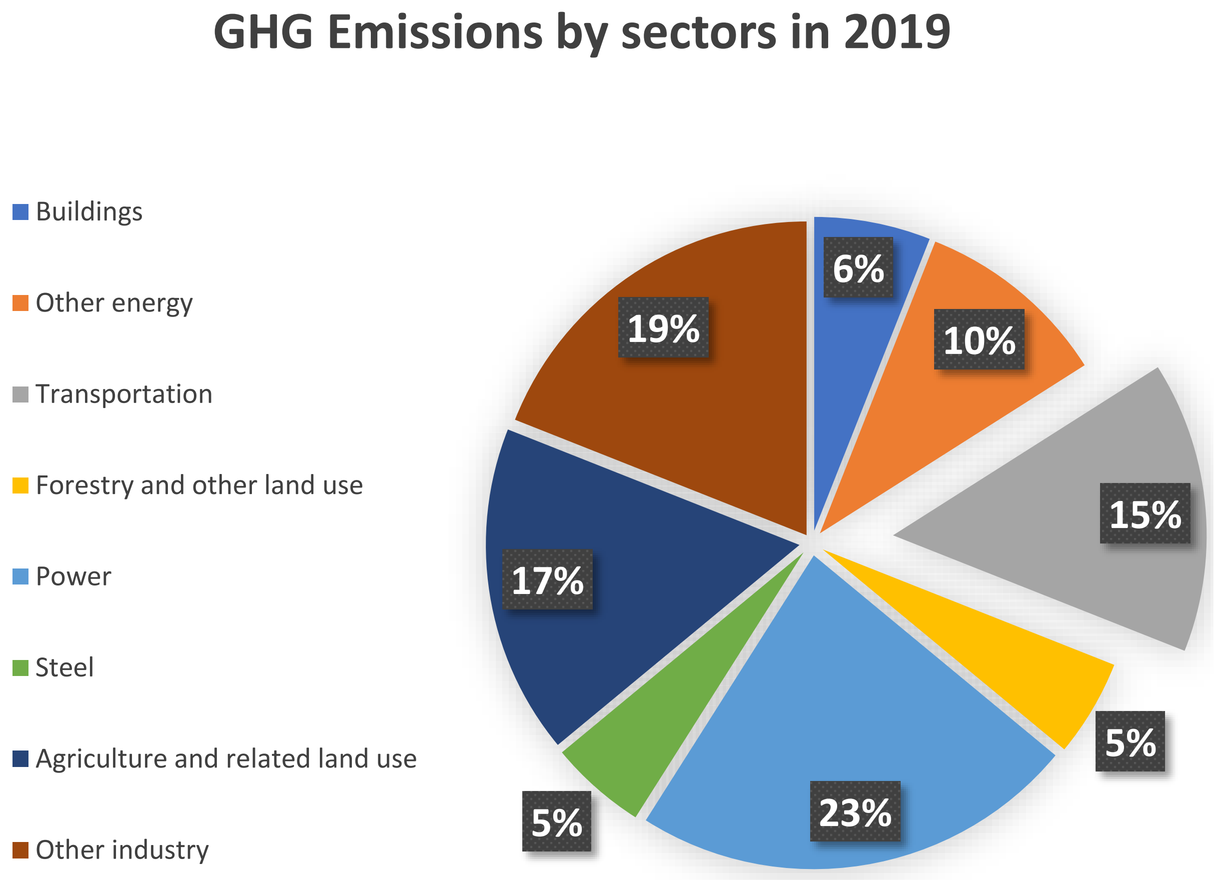
It is essential to establish design standards for transportation infrastructure that prioritize the **reduction of negative environmental impacts** and the **preservation of ecosystems.**

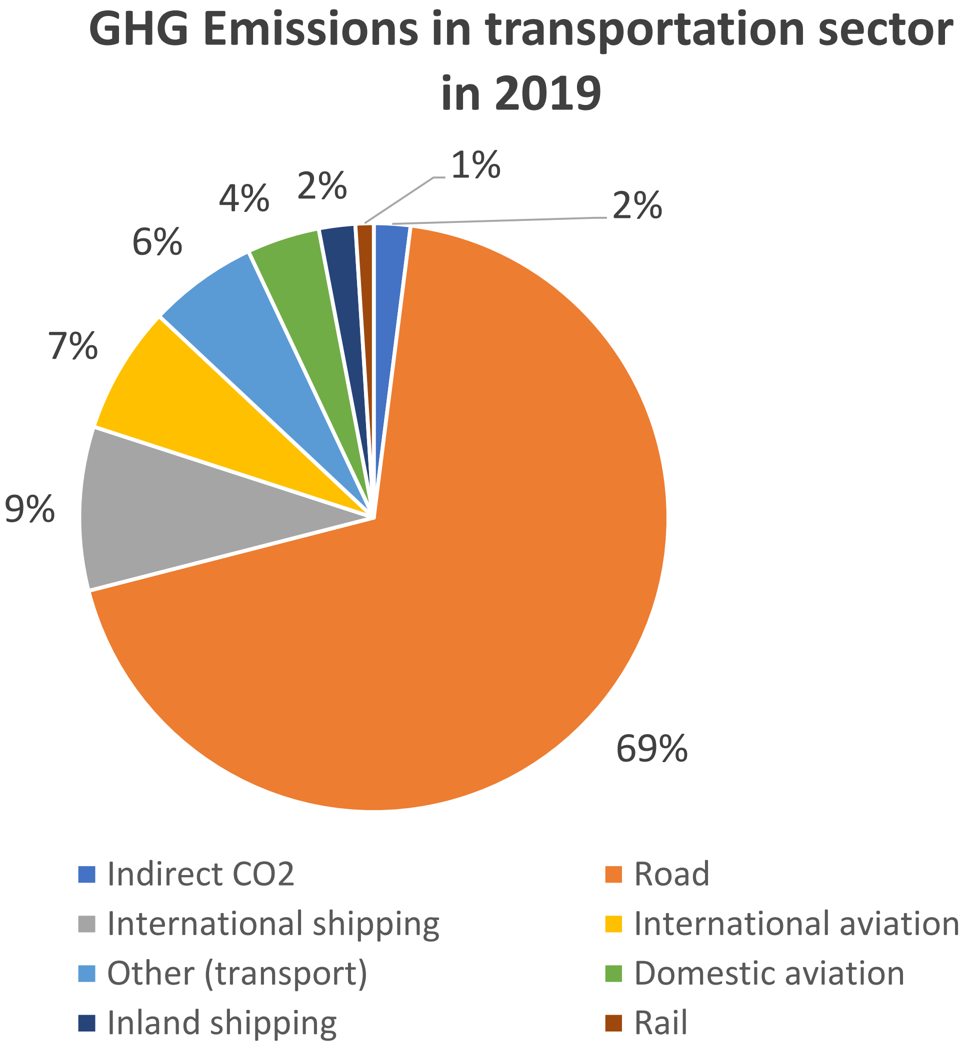
The Paris Agreement aims to limit the global average surface temperature to **2 C°**. The European Green Deal sets a bold target of reducing GHG emissions from the transportation sector by **90%** by 2050.

THE EUROPEAN GREEN DEAL

SUSTAINABLE DEVELOPMENT GOALS

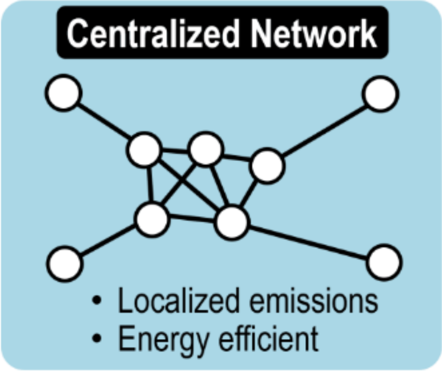
Emissions by Transportation Sector





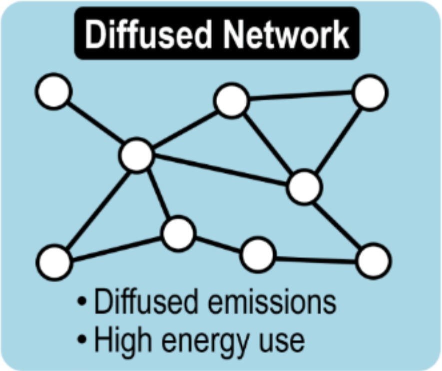
Source: https://www.iea.org/data-and-statistics/charts/greenhouse-gas-emissions-by-sector-2019

Transportation Systems and the Environment



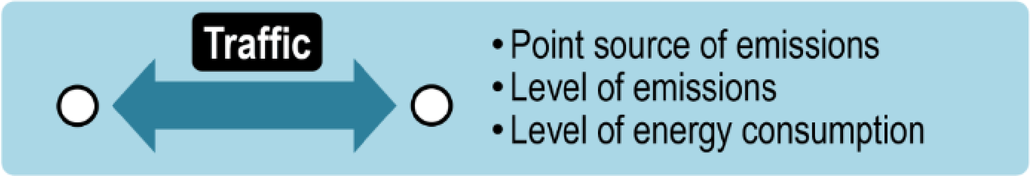
Centralized Networks have localized emissions and use energy efficiently.

Diffused Networks have diffused emissions and consumes high energy.



Nature of emissions and nature of energy consumption change due to **mode of transport**.

Point source of emissions, level of emissions and level of energy consumption depend on **traffic** conditions.



Environmental Impacts Categories

In an ever-evolving world, the expansion of passenger and freight mobility has resulted in increased environmental impacts from the transportation sector. Environmental impacts are influenced by the level of activity, emission factors, pollution load and mode-specific parameters.

Direct Impacts
- Noise Pollution
- Carbon Monoxide Emissions

Indirect Impacts
- Health Problems
- Greenhouse Gases Effect

Cumulative Impacts
- Climate Change
- Natural Phenomena

Transportation is a domain where significant environmental impacts are generated by various factors.

Land Use | **Noise Pollution** | **Climate Change** | **Air Pollution** | **Biodiversity Loss** | **Water Pollution** | **Soil Pollution**

02 Project Objective & Outputs

1915 Çanakkale Bridge - Türkiye

Project Objective

To develop a guideline for measuring the environmental impacts of transport infrastructure in OIC member countries

To identify areas where OIC countries are adopting best practices and areas where they may be falling behind

To promote sustainable transport infrastructure development in OIC member countries through evidence-based decision-making

The Aim of Guidebook

OIC members can exchange and disseminate information to promote best practices

OIC members can compare their different initiatives

OIC members can identify barriers and opportunities to measure the environmental impacts of infrastructures while respecting national and regional contexts

Project Outputs

A comprehensive report on th environmental impacts of transpo infrastructure in OIC member countries

A guideline for measuring th environmental impacts of transpo infrastructure in OIC member countries

Recommendations for improving th sustainability of transport infrastructur development in OIC member countries

03 Project Components

Hamad International Airport- Qatar

Project Components

Report and Guidebook Improvements

21st Meeting of the COMCEC TCWG — Oct

1st Draft of Guidebook — Sept

Site Visits to Malaysia and Jordan — July

20th Meeting of the COMCEC TCWG — May

Key Findings

- **Collaborate with Experts:**

Partner with environmental experts and researchers to strengthen the scientific foundation of projects. For instance, ecologists can help identify sensitive ecological zones near proposed routes, guiding planners to choose ways that minimize harm to local ecosystems.

- **Embrace Green Technologies:**

Adopt innovative solutions like electric buses to significantly reduce air pollution. Integrating these technologies makes it possible to decrease the carbon footprint and establish a model for sustainable urban development.

- **Use Nature-Based Solutions:**

To mitigate environmental impact, incorporate nature-based solutions, such as green roofs and urban forests. For example, constructing noise-absorbing green walls along highways reduces noise pollution and enhances the infrastructure's visual appeal.

Key Findings

- **Foster Multi-Stakeholder Partnerships:**

Partner with NGOs, local communities, and private sectors to amplify impact. Collaborate with environmental NGOs for initiatives like reforestation drives near newly constructed roads, enhancing community involvement and project outcomes.

- **Ensure Continuous Monitoring and Adaptation:**

To ensure continuous monitoring of the project's impact on air quality, noise levels, and ecology. Immediate adaptive measures, like altering routes causing unexpected disturbances, maintain harmony with the environment. If, for instance, a new highway leads to random disorders in a bird sanctuary, adaptive measures can be taken quickly.

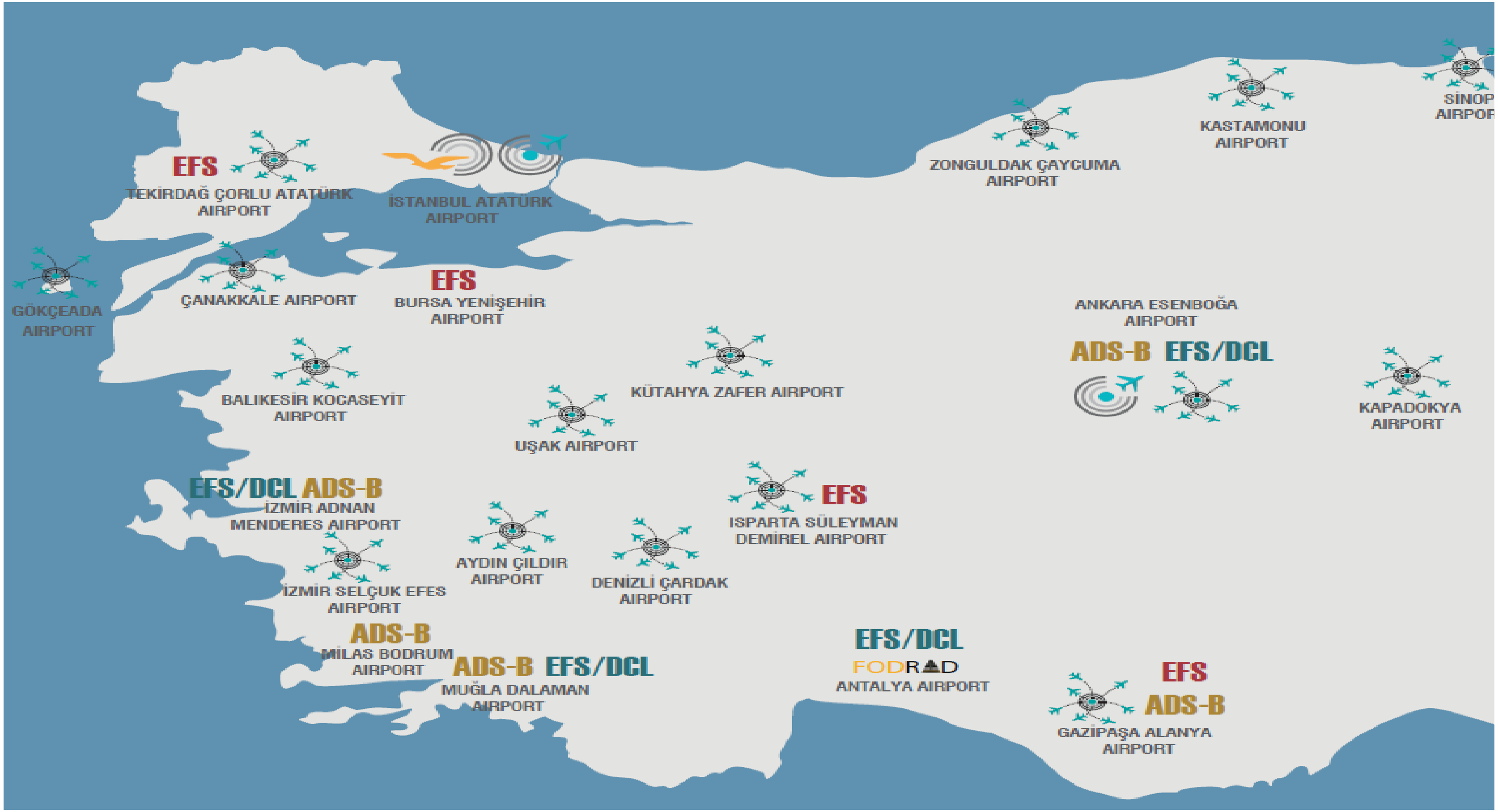
- **Introduce Financial Incentives for Green Choices:**

Introduce financial incentives, such as tax breaks for companies with electric vehicle fleets, encouraging the private sector to contribute to environmental conservation efforts. For instance, tax breaks for companies employing a certain percentage of electric vehicles in their fleets can encourage the private sector to contribute to environmental conservation efforts.

04 Aydın Çıldır Airport Feasibility

Aydın Çıldır Airport - Türkiye

The Valuation of Emissions in the Aydın Çıldır Airport Feasibility Study



The Valuation of Emissions in the Aydın Çıldır Airport Feasibility Study

Carbon Footprint of Travel Per Kilometer

Travel Mode	Carbon Footprint (gram)
Rail	41
Air	255
Petrol car	192
Diesel car	171
Bus	28

Source: https://ourworldindata.org/travel-carbon-footprint

Year	Aydın Çıldır-İstanbul Air Passenger Traffic	The Air Passenger Traffic Shifted from Adnan Menderes Airport to Aydın Çıldır Airport-İstanbul Airports	The Air Passenger Traffic Shifted from Road Transport to Aydın Çıldır Airport-İstanbul Airports	The Distance Between Aydın and İstanbul (untolled road, km)	The Distance Between Aydın and İstanbul (tolled road, km)	The Distance Between Aydın and İstanbul (air route, km)	Total Emission on the Aydın-İstanbul Air Route (shifted from road, gram)	Total Emission on the Aydın-İstanbul Road Route (gram)	Total Emission Cost (Total price of carbon= 51$/ton, TL)
	İ1	İ2=İ1 x 0,585	İ3=İ1 x 0,415	İ4	İ5	İ6	İ7=İ3 x Unit Emission per Air Passenger x İ6	İ8=İ3/2 x Unit Emission per Car Passenger x İ4 + İ3/2 x Unit Emission per Bus Passenger x İ5	İ9=(İ7-İ8)/1.000.000 x 51 x 8,3903*Price Escalation Factor
2025	349.353	204.371	144.981	722	569	375	13.863.846.664	10.654.320.855	2.600.930
2026	363.794	212.820	150.975	722	569	375	14.436.944.168	11.094.744.414	3.177.278
2027	378.236	221.268	156.968	722	569	375	15.010.041.672	11.535.167.973	3.875.225
2028	392.677	229.716	162.961	722	569	375	15.583.139.176	11.975.591.531	4.719.598
2029	407.118	238.164	168.954	722	569	375	16.156.236.680	12.416.015.090	5.740.177
2030	421.560	246.612	174.947	722	569	375	16.729.334.184	12.856.438.649	6.972.664
2031	436.001	255.061	180.940	722	569	375	17.302.431.688	13.296.862.208	8.459.843
2032	450.443	263.509	186.934	722	569	375	17.875.529.192	13.737.285.767	10.252.956
2033	464.884	271.957	192.927	722	569	375	18.448.626.696	14.177.709.326	12.413.357
2034	479.325	280.405	198.920	722	569	375	19.021.724.200	14.618.132.885	15.014.474
2035	493.767	288.854	204.913	722	569	375	19.594.821.704	15.058.556.444	18.144.149

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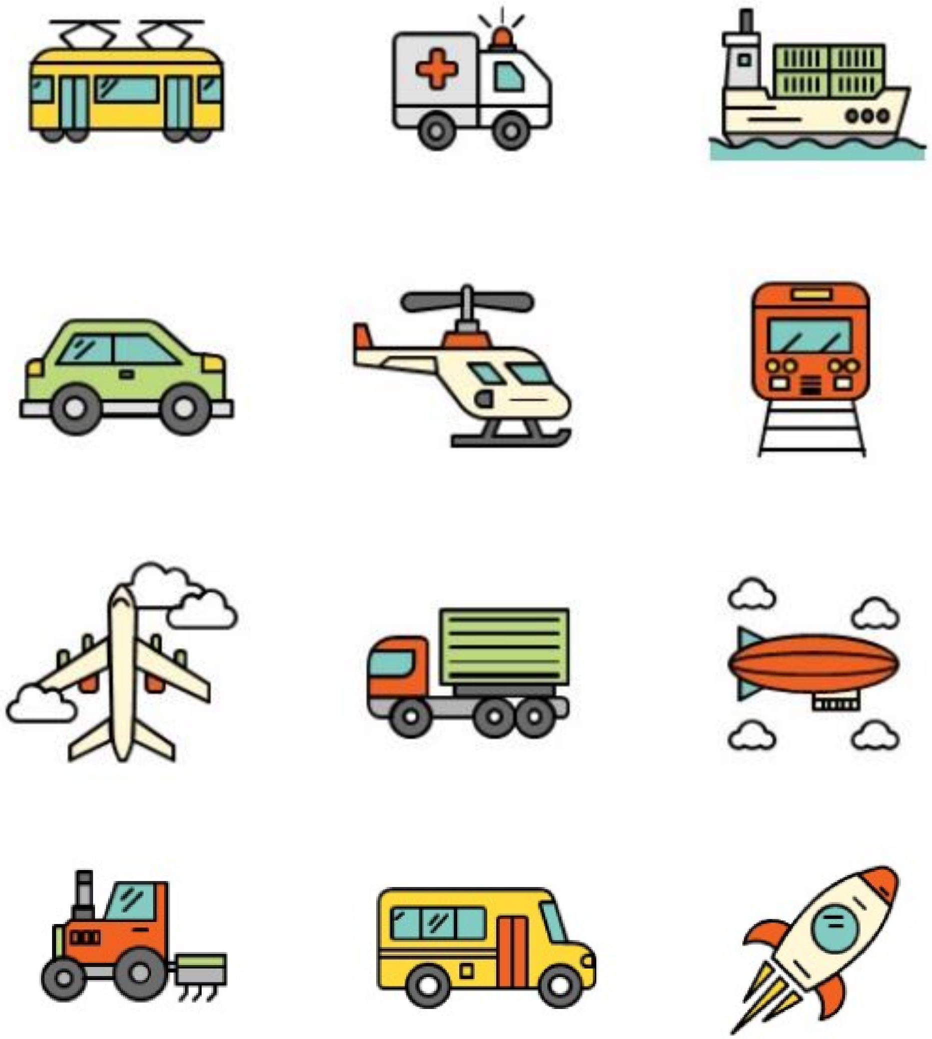
Global Trends – United Kingdom Case Study

12.10.2023



Measuring the Environmental Impacts of Transport Infrastructures in OIC Member Countries Project

Global Trends – United Kingdom Case Study

Contents

01 A Quick Look at the Transport-Environment Linkage in the UK

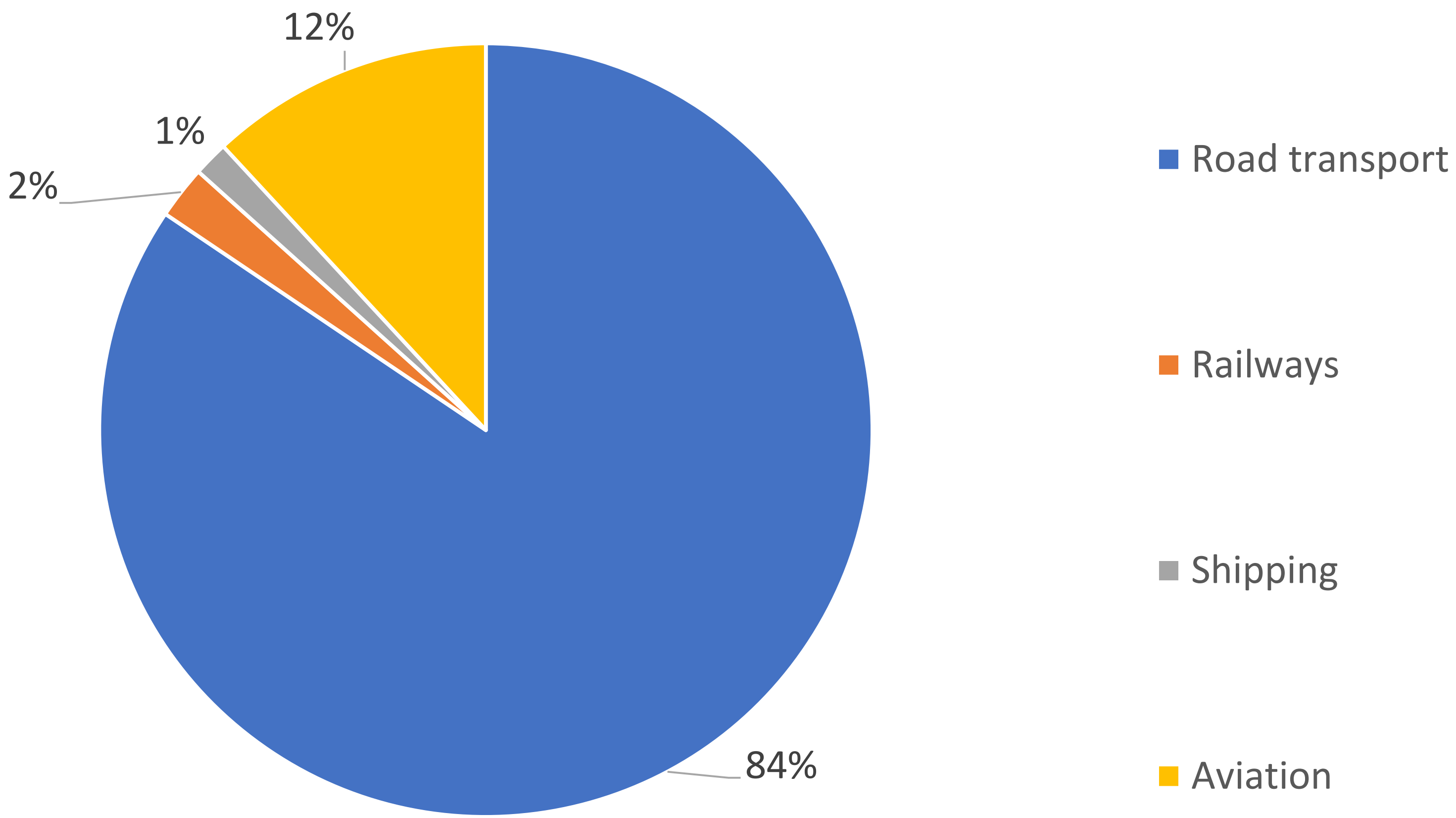
A Quick Look at the Transport-Environment Linkage in the UK

WHY The UK?

- Lots of quantitative guidance/worksheets on the environmental impacts of transport
- Leading country in terms of congestion charging and low emission zone schemes
- A good example/benchmark from Europe

A Quick Look at the Transport-Environment Linkage in the UK

Energy use by Mode of Transportation (2021)



02 The Major Guidelines, Handbooks, Programs and Methodologies

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts

Appraisal Summary Table Impacts

Category of impact	Impacts that are typically monetised	Impacts that can be monetised but are not reported in the AMCB table	Impacts that it is currently not feasible or practical to monetise
Economy	• Business users and private sector providers (including revenues)	• Reliability impact on business users • Wider Economic Impacts	
Environment	• Noise • Air quality • Greenhouse gases	• Landscape	• Townscape • Historic Environment • Biodiversity • Water environment
Social	• Commuting and other users • Accidents • Physical activity • Journey quality	• Reliability impact on commuting and other users • Option and non-use values	• Security • Access to services • Affordability • Severance
Public Accounts	• Cost to broad transport budget • Indirect tax revenues		

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts

Summary of environmental values and land value uplift (20/21 prices)

Value	Description	Low	Central	High	Unit
Air pollution (NOx)	National average damage cost values	£681	£7,120	£26,995	per tonne of pollutant
Air pollution (PM2.5)		£17,716	£81,847	£253,474	
Air pollutant removal by vegetation	Welfare/health benefit of reduced air pollution from vegetation	£17	-	£931	per hectare (various land covers
Noise	Marginal change in road noise levels	£13	-	£227	per 1 decibel
Noise reduction by vegetation	Average road noise damage costs avoided for households benefiting from noise mitigation by urban woodland	-	£96	-	per household
Nature based recreation	Welfare value of outdoor recreation sites	£48	-	£120,067	per hectare (various land covers)
Physical health benefits from nature	Indicative health savings/ benefits from every physically active visit to green space	£3.36	-	£14.34	per marginal physically active visit to greenspace
Local amenity	Average additional value per property within 100m - 500m of accessible green or blue space	£1,538	£3,076	£9,471	per property (capital value)
Visual amenity	Average price premium for a property with a view over green or blue space	-	£6,164	-	

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts

Summary of environmental values and land value uplift (20/21 prices)

Value	Description	Low	Central	High	Unit
Loss of amenity	Welfare cost from significant litter accumulation in residential areas	£20	-	£76	per household
Water availability Industry	Industry average present value lifetime social cost of providing water supply	-	£5.7m	-	mega litre per day
Water quality	Improvement in water quality status	£22,000	£25,400	£29,500	per km
Flood damage	Typical damage per property from a flood event	£8,000	-	£45,000	per property (flooding at different water depths)
Flood regulation (woodland)	Avoided water storage costs from woodland water storage in flood catchments	£97	-	£242	per hectare (woodland)
Nature based carbon reduction (peatland)	Carbon reduction value of restoring eroded peatland	£497	-	£5,297	per hectare (peatland)
Soil erosion	Average indicative cost of soil erosion (production, water quality, flood risk)	£130	-	£211	per hectare of average erosion
GHG values	Target consistent value	£121	£241	£362	per tonne CO2

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts

Workbooks and Worksheets Provided by Transport Analysis Guidance

- Air quality valuation workbook
- Local air quality workbook
- Biodiversity worksheet
- Greenhouses gases workbook
- Historic environment worksheet
- Landscape monetisation workbook
- Landscape worksheet
- Noise workbook
- Noise workbook-aviation
- Townscape worksheet
- Water environment worksheet

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts (NOISE)

Example for a Rail Project

- Opening year: 2025
- Forecast year: 2055
- Scheme type: Rail
- Current year: 2023
- Night noise impact: Yes
- Night noise (dB Lnight) modelling: No
- Opening year no. of households experiencing 'without scheme' and 'with scheme' noise levels:
  - 500 households experiencing 51-54 (dB Leq, 16h) without scheme and experiencing 69-72 (dB Leq, 16h) with scheme
  - 600 households experiencing 45-48 (dB Lnight) without scheme and experiencing 66-69 (dB Lnight) with scheme
- Forecast year no. of households experiencing 'without scheme' and 'with scheme' noise levels:
  - 580 households experiencing 48-51 (dB Leq, 16h) without scheme and experiencing 72-75 (dB Leq, 16h) with scheme
  - 700 households experiencing 54-57 (dB Lnight) without scheme and experiencing 66-69 (dB Lnight) with scheme
- Income base year: 2023
- Price base year: 2023
- Appraisal period: 30 years
- PV base year: 2023
- Outputs price year: 2023

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts (NOISE)

Example for a Rail Project

Noise Workbook - Worksheet 1

Proposal Name:	Test
Present Value Base Year	2023
Current Year	2023
Proposal Opening year:	2025
Project (Road, Rail or Aviation):	rail

Net present value of change in noise (£):	-£8,651,772

*positive value reflects a **net benefit** (i.e. a reduction in noise)

Net present value of impact on sleep disturbance (£):	£0
Net present value of impact on amenity (£):	-£5,137,761
Net present value of impact on AMI (£):	-£1,771,396
Net present value of impact on stroke (£):	-£694,818
Net present value of impact on dementia (£):	-£1,047,796

Quantitative results

Households experiencing increased daytime noise in forecast year:	580
Households experiencing reduced daytime noise in forecast year:	0
Households experiencing increased night time noise in forecast year:	n/a
Households experiencing reduced night time noise in forecast year:	n/a

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts (AIR QUALITY)

Example for a Rail Project

- Opening year: 2025
- Forecast year: 2040
- Scheme type: Rail
- Current year: 2023
- Scheme type: Rail (average)
- Impact pathways or Damage costs: Damage costs
- Measured up to PM2.5 or PM10: PM2.5
- PM2.5 emissions without scheme (opening year): 50 tonnes
- PM2.5 emissions with scheme (opening year): 100 tonnes
- PM2.5 emissions without scheme (forecast year): 75 tonnes
- PM2.5 emissions with scheme (forecast year): 125 tonnes
- Income base year: 2010
- Price base year: 2010
- Appraisal period: 60 years
- PV base year: 2010
- Outputs price year: 2010

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts (AIR QUALITY)

Air Quality Valuation Workbook - Worksheet 3

Example for a Rail Project

Scheme Name:	Insert scheme name
Present Value Base Year	2010
Current Year	2023
Proposal Opening year:	2025
Project (Road/Rail or Road and Rail):	Rail (Average)

Overall Assessment Score:

Damage Costs Approach (Emissions)

Present value of change in NOx emissions (£):	£0
Present value of change in PM emissions (£):	-£54,412,370

Total Change

Total value of change in air quality (£):	-£54,412,370

*positive value reflects a **net benefit** (i.e. air quality improvement)

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts (GUIDANCE FOR BUSINESSES)

Example for a Freight Company

Primary Model: Fuel Consumed

- Assume that the fleet of a freight transport operator consists of 4 vehicle types.
- The first (Co small van), second (Rigid 7.5) and third vehicle (Rigid 22t) types used 52,500, 141,500 and 273,455 litres of diesel whereas the last vehicle type (Artic 38t) used 385,000 litres of fuel, 95% of which is diesel and the remaining is biofuel.
- Once the total litres used in terms of each fuel type is inputted for each vehicle type, the dedicated MS Excel Spreadsheet calculates the total tonnes of CO2 by vehicle (the orange row).
- Then using the Weighted CO2 per litre factor, which comes with the spreadsheet, the spreadsheet calculates the total weighted CO2 per litre for each vehicle type as well as the total primary method CO2, total primary method CO2 is equal to 2.106 tonnes.

Secondary Model: Distance Traveled

- In the case of the unavailability of fuel consumption data, distance traveled can be used.
- The distance traveled by these four vehicle types are as follow: 300,000 Km; 400,000 Km; 500,000 Km; 800,000 Km

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts (GUIDANCE FOR BUSINESSES)

Example for a Freight Company

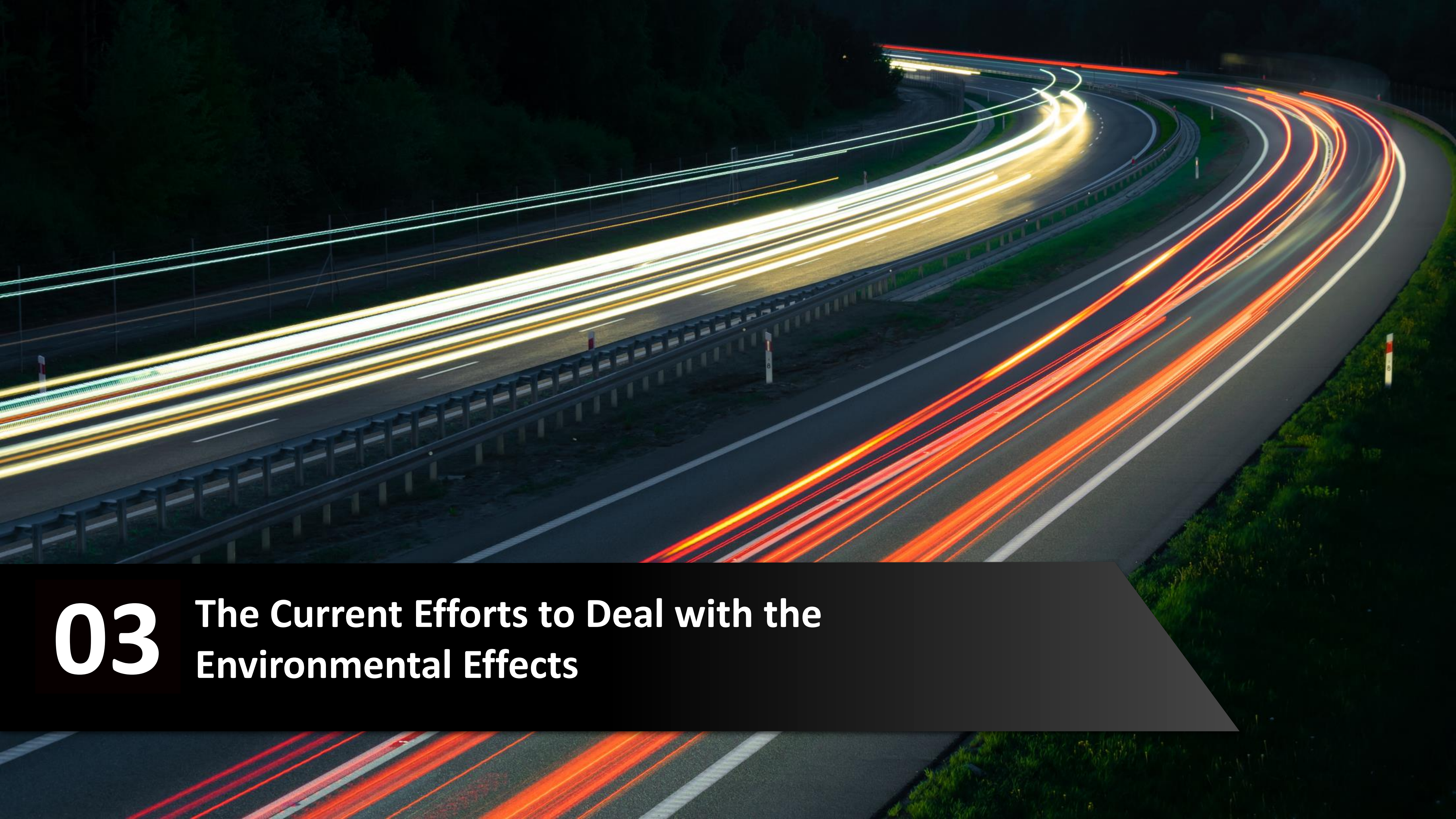
Primary (Recorded own Company) data		Veh type 1	Veh type 2	Veh type 3	Veh type 4
Road	Vehicle data	Co small van	Rigid 7.5	Rigid 22t	Artic 38t
	Total litres used	52,500	141,500	273,455	385,000
	Fuel mix data	% Used	% Used	% Used	% Used
	Diesel	100%	100%	100%	95%
	Biofuel	0%	0%	0%	5%
	Petrol	0%	0%	0%	0%
	Compressed Natural Gas (CNG)	0%	0%	0%	0%
	Liquid Petroleum Gas (LPG)	0%	0%	0%	0%
	Total tonnes of CO2 by vehicle	138.6	373.4	721.7	965.3
	Weighted CO2 per litre factor	2.6391	2.6391	2.6391	2.5071
	Weighted CO2 per litre factor	0.0000	0.0000	0.0000	0.0000
	Weighted CO2 per litre factor	0.0000	0.0000	0.0000	0.0000
	Weighted CO2 per litre factor	0.0000	0.0000	0.0000	0.0000
	Weighted CO2 per litre factor	0.0000	0.0000	0.0000	0.0000
	Total weighted CO2 per litre	2.6391	2.6391	2.6391	2.5071
	Total primary method CO2	**2,199**	**Tonnes**		

The Major Guidelines, Handbooks, Programs and Methodologies: Cost Benefit Analysis and Valuation of Environmental Impacts (GUIDANCE FOR BUSINESSES)

Example for a Freight Company

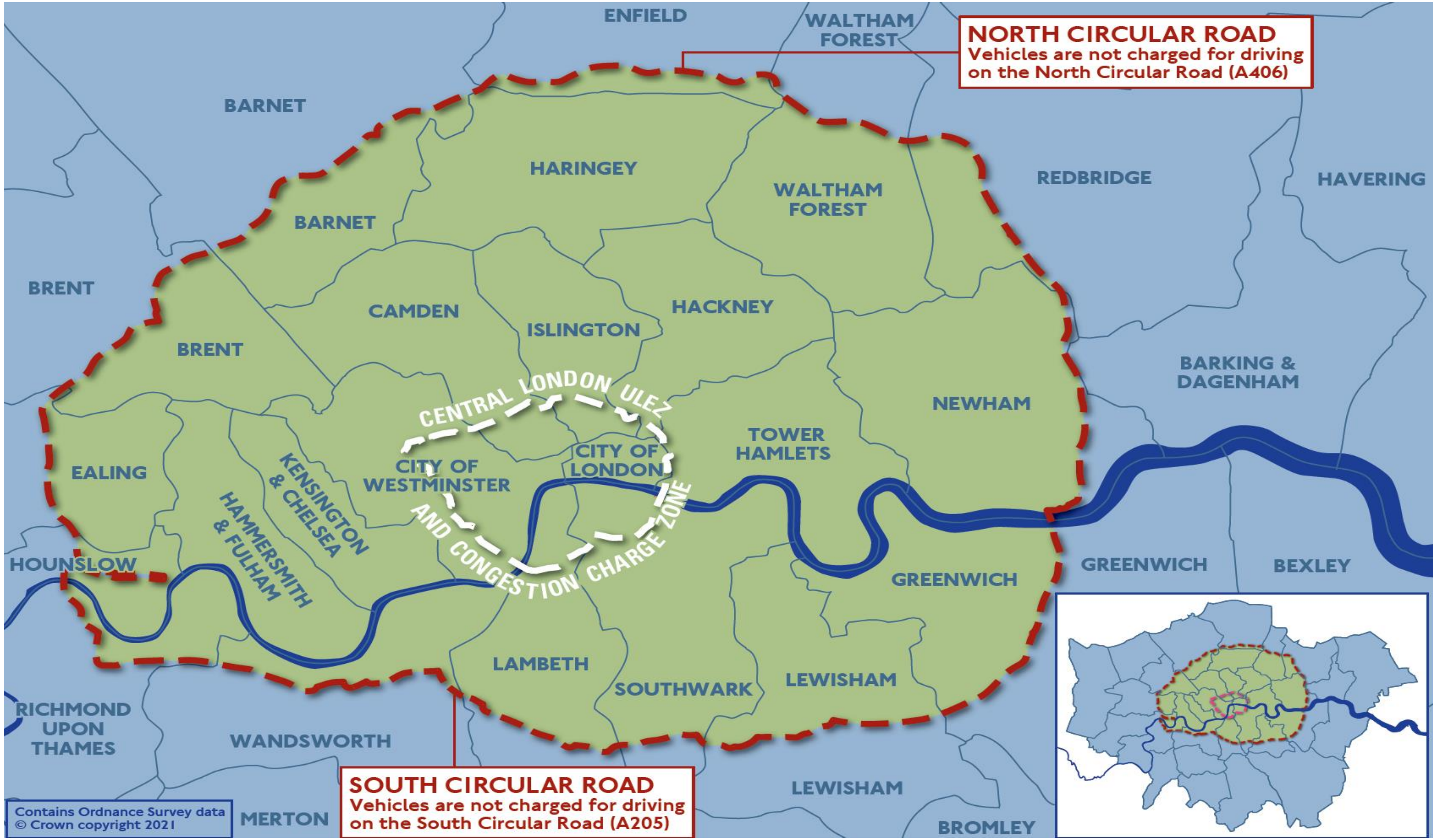
	Secondary (Default Defra / DfT) data	Veh type 1	Veh type 2	Veh type 3	Veh type 4
Road	Vehicle data	Rigid 3.5-7.5 T	Rigid 7.5-17 T	Rigid > 17 T	Artic'd >3.5< 33 T
	Total hauled distance Km's	300,000	400,000	500,000	800,000
	Total tonnes lifted	1.00	1.00	1.00	1.00
	Total tonne KM's	300,000	400,000	500,000	800,000
	Vehicle lading % mix				
	% at 0% laden weight	0%	0%	0%	0%
	% at 50 % laden weight	0%	0%	0%	0%
	% at 100 % laden weight	0%	0%	0%	0%
	% at UK Average % laden weight	100%	100%	100%	100%
	Total tonnes of CO_2 by vehicle	163.3	290.9	466.8	755.0
	Kg of CO_2 per Tonne KM @ 0%	0.5088	0.6578	0.7513	0.6741
	Kg of CO_2 per Tonne KM @ 50%	0.5530	0.7518	0.9162	0.8988
	Kg of CO_2 per Tonne KM @ 100%	0.5973	0.8457	1.0811	1.1235
	Kg of CO_2 per Tonne KM @ UK Ave %	0.5442	0.7273	0.9336	0.9437
	Total weighted CO_2 TKm CIF	0.5442	0.7273	0.9336	0.9437

Total secondary method CO_2 1,676 Tonnes



03 The Current Efforts to Deal with the Environmental Effects

The current efforts to deal with the environmental effects: London Low Emission Zone Scheme



The current efforts to deal with the environmental effects: London Low Emission Zone Scheme

Minimum emission standards for LEZ and ULEZ

	LEZ	ULEZ
Motorcycles, mopeds, motorised tricycles and quadricycles	-	Euro 3
Petrol cars, vans, minibuses and other specialist vehicles	-	Euro 4 (NOx)
Diesel cars, vans and minibuses and other specialist vehicles	-	Euro 6 (NOx and PM)
Vans, minibuses and specialist diesel vehicles	Euro 3 (PM)	-
HGVs, lorries, vans, buses/minibuses, coaches and specialist heavy vehicles	Euro VI (NOx and PM)	-

The flat daily fee is £12.50 for the LEZ scheme.

For the ULEZ scheme, the charges are listed below (Transport for London, 2023):

- £100 for vans or specialist diesel vehicles (over 1.205 tonnes unladen weight up to 3.5 tonnes gross vehicle weight) or minibuses (up to 5 tonnes) which do not meet Euro 3 standards.
- £100 for HGVs, lorries, vans and specialist heavy vehicles over 3.5 tonnes as well as buses/minibuses and coaches over 5 tonnes which do not meet Euro VI (NOx and PM) standards, but meet Euro IV (PM)
- £300 for HGVs, lorries, vans and specialist heavy vehicles over 3.5 tonnes as well as buses/minibuses and coaches over 5 tonnes which do not meet Euro IV (PM)

04 Lessons Learnt from the UK Case Study

Lessons Learnt

- Good governance leads to effective management and mitigation of environmental impacts
  - Regulatory framework
  - Detailed guidance
  - Easy-to-use worksheets
- Pricing schemes work

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Thank You.

Do you have any questions?

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