Green Energy and Technology

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Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport

Springer

Green Energy and Technology

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ISSN 1865-3529 ISSN 1865-3537 (electronic)
Green Energy and Technology
ISBN 978-3-030-96673-7 ISBN 978-3-030-96674-4 (eBook)
https://doi.org/10.1007/978-3-030-96674-4

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The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

To all those affiliated at the University of Aberdeen whose contribution to saving the planet takes us closer each day.

Acknowledgements

This research was carried out under the UK Energy Research Centre (UKERC) as part of the ADdressing Valuation of Energy and Nature Together (ADVENT) and UKERC-4 funded projects. Funding was received from the Natural Environment Research Council (NE/M019691/1), UK, and the School of Biological Sciences, University of Aberdeen, UK.

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Abbreviations

AIS	Automatic identification system
BEV	Battery electric vehicle
BRT	Bus rapid transit
CCS	Carbon capture and storage
CFB	Conventionally fuelled bus
CFT	Conventionally fuelled train
CFV	Conventionally fuelled vehicle
CNG	Compressed natural gas
CO_2	Carbon dioxide emissions
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
DAC	Direct air capture
EB	Electric bus
ES	Ecosystem service
ET	Electric train
EU	European Union
EV	Electric vehicle
FC	Fuel cell
GDP	Gross domestic product
GHG	Greenhouse gas
H_2	Hydrogen
HB	Hydrogen bus
HEV	Hybrid electric vehicle
HFO	Heavy fuel oil
HSR	High-speed rail
HT	Hydrogen train
HV	Hydrogen vehicle
ICAO	International Civil Aviation Organization
ICE	Internal combustion engine
ICEV	Internal combustion engine vehicle
IEA	International Energy Agency
IMO	International Maritime Organization

IPCC	Intergovernmental Panel on Climate Change
ITF	International Transport Forum
LCA	Life cycle assessment
LNG	Liquefied natural gas
N_2O	Nitrous dioxide
NC	Natural capital
NCC	Natural Capital Committee
NDC	Nationally determined contribution
NHSR	Non-high-speed rail
NO_x	Nitrous oxide
OCED	Organisation for Economic Co-operation and Development
PEM	Proton-exchange membrane
PEMFC	Polymer electrolyte membrane fuel cell
PHEV	Plug-in hybrid electric vehicle
PM	Particulate matter
QRA	Quantitative risk assessment
SDGs	Sustainable development goals
SMR	Steam methane reform
SO_x	Sulphur dioxide
TDM	Travel demand management
TOCs	Total cost of ownership
TVG	Train à Grande Vitesse
UAV	Unmanned aerial vehicles
UF	Utility factor
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
WFH	Work from home
WLTP	Worldwide Harmonized Light Vehicle Test Procedure

Chapter 1
Introduction

Abstract To reduce greenhouse gas (GHG) emissions and meet Paris Agreement targets, nationally determined contributions have been made by every country in the world. Many countries are aiming for a net zero emission target, however, net zero has been defined differently country to country making unified emission reductions more difficult. Transport and energy generation remain the two largest global emitting sectors and substantial transformation will be required to meet emission reductions. Internal combustion engine vehicles for personal use remain the highest emitting transport type, which has led to governments and policymakers introducing legislation to ban and phase out their sale over the coming decades in favour of low carbon alternatives, including electric and hydrogen fuelled vehicles. Although electric and hydrogen transport are considered 'zero emission' at their point of use, their true environmental impact is determined by the source of the electricity used to 'fuel' these vehicles. Therefore, an integrated and interdisciplinary approach to meet net zero will be required as there will need to be trade-offs between GHG emission reductions, climate regulation and the potential impact upon ecosystem services. By integrating alternative fuels and encouraging travel behaviour to support public transport, which has a lower level of emission per person per kilometre travelled, there is the potential to have a significant impact on emission level reduction. Taking into consideration experience from different countries that have successfully implemented pathways towards low carbon transport, lessons can be learnt from the best policies and decarbonise both the transport and energy sectors.

1.1 General Introduction

The transport sector remains a focal point of any debate regarding energy conservation due to the current reliance on the fossil fuel industry for both passenger and freight road, rail, sea, or air travel [1]. One proposed solution to mitigate global transport greenhouse gas (GHG) emissions is to develop and deploy cleaner low carbon technologies [2], including low emission fuelled transport such as electric and hydrogen alternatives. As personal vehicles are the largest contributor to land-based transport type for emissions, focus is often placed here. However, studies

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K. G. Logan et al., *Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport*, Green Energy and Technology,
https://doi.org/10.1007/978-3-030-96674-4_1