Transitioning to the Net-Zero Supply Chain

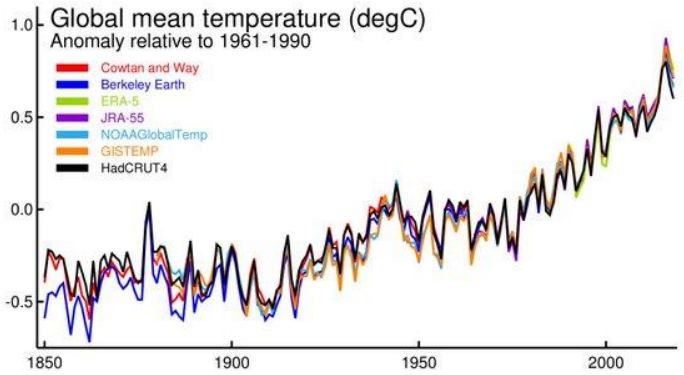
Professor Alan McKinnon

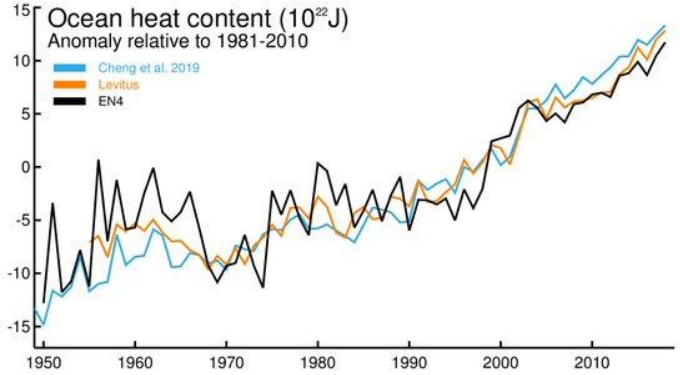
Kühne Logistics University
Hamburg

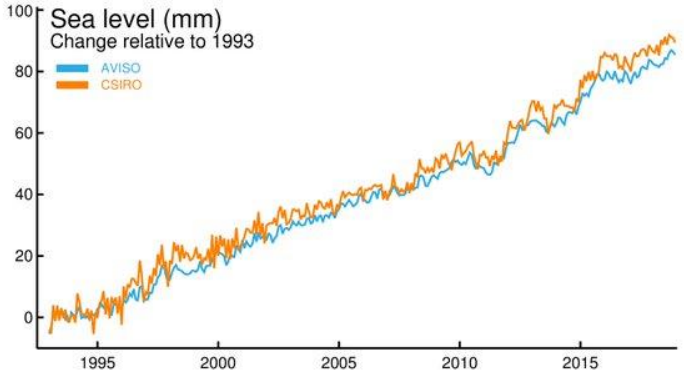
Cold Chain Live webinar

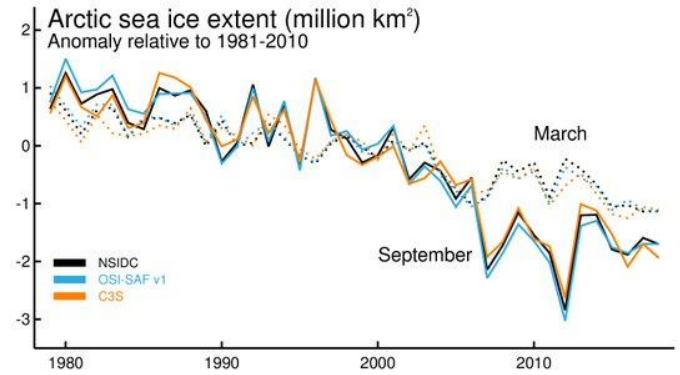
2 October 2020

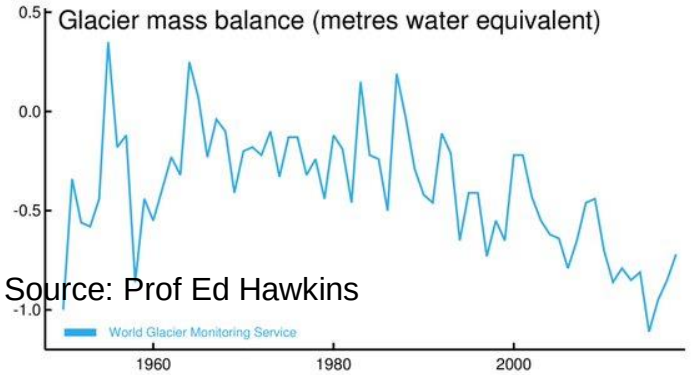
Steady Stream of Scientific Evidence

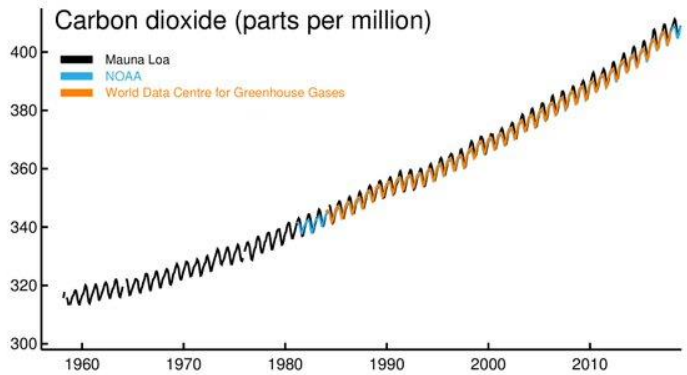






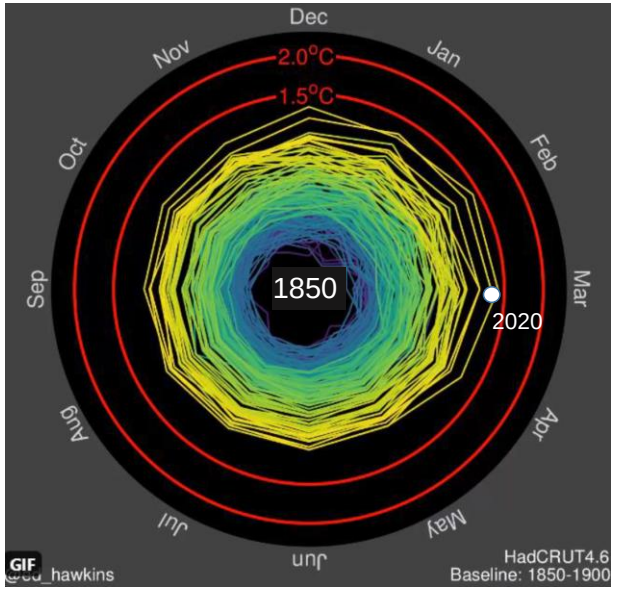






Source: Prof Ed Hawkins

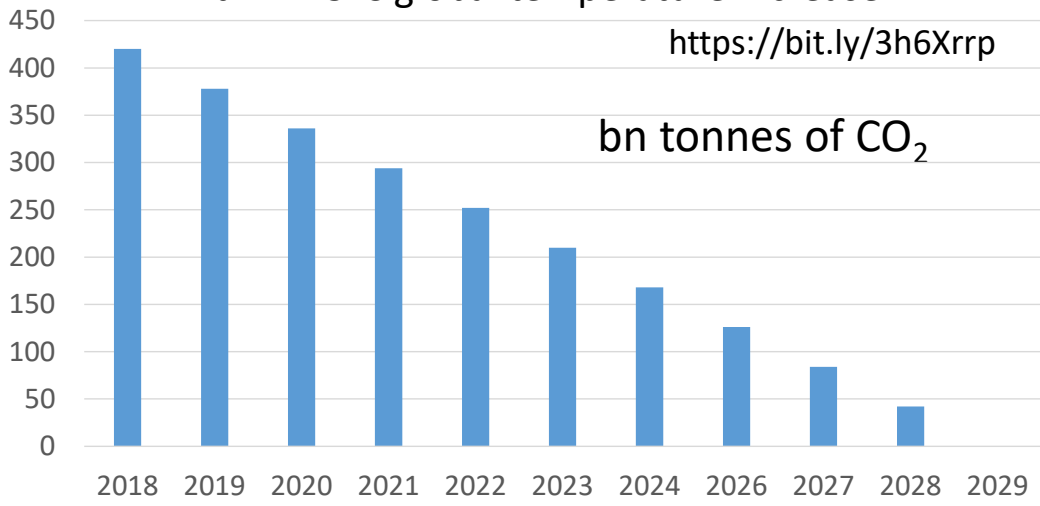
https://bit.ly/3hku2LB



global temperature changes relative to 1850-1900 mean

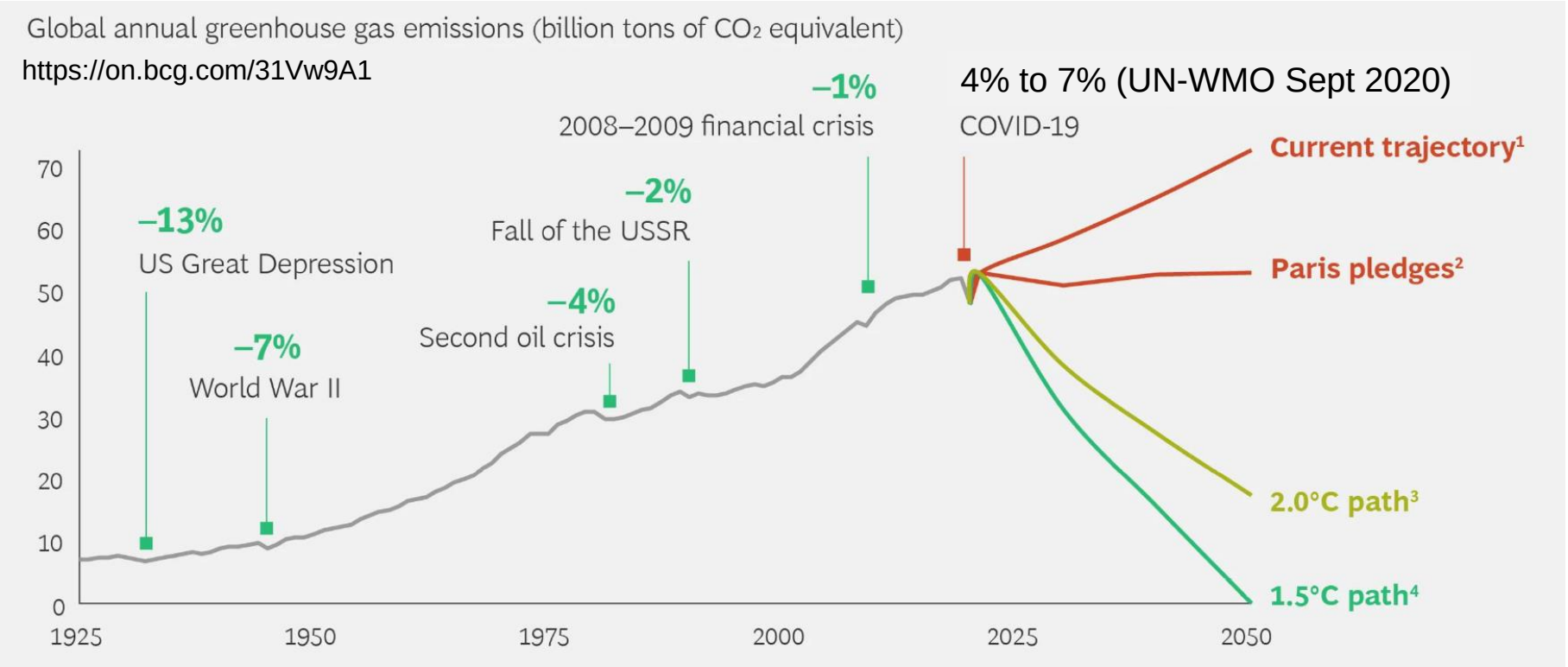
Remaining CO_2 budget to have 2/3 chance of staying within 1.5°C global temperature increase

https://bit.ly/3h6Xrrp



(assuming continuing annual emission rate of 42 Gt CO_2)

Global CO_2 emissions: *historic trends and future pathways*



CO_2 emissions from transport to be reduced by 90% between 2015 and 2050

Europe to be the world's first carbon neutral continent by 2050

Bhutan
Costa Rica
Fiji
Iceland
Japan
New Zealand
Norway
Singapore
Switzerland
UK

Non-EU Countries committed to being net zero by 2050 or earlier

Definition of a Net Zero Supply Chain

Net Zero

'achieving a state in which the activities within the value chain of a company result in no net impact on the climate from greenhouse gas emissions. This is achieved by reducing value chain greenhouse gas emissions, in line with 1.5°C pathways, and by balancing the impact of any remaining greenhouse gas emissions with an appropriate amount of carbon removals'.

Science Based Targets / CDP (2019)
https://bit.ly/3ihiNmy

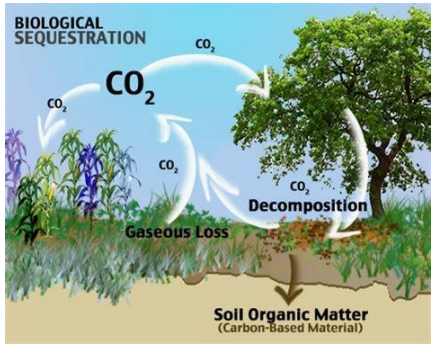
- carbon insetting
- carbon offsetting
- negative emissions

carbon negative / climate positive warehouse

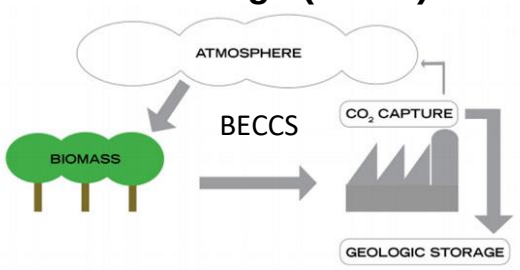
Supply chain

procurement
product sourcing
supplier relations
inventory management
order processing
materials handling
returns management
storage
freight transport

afforestation / rewilding



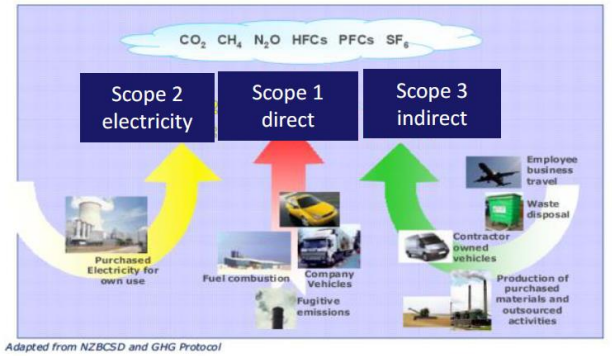
bio-energy carbon capture and storage (BECS)



carbon 'scrubbers'

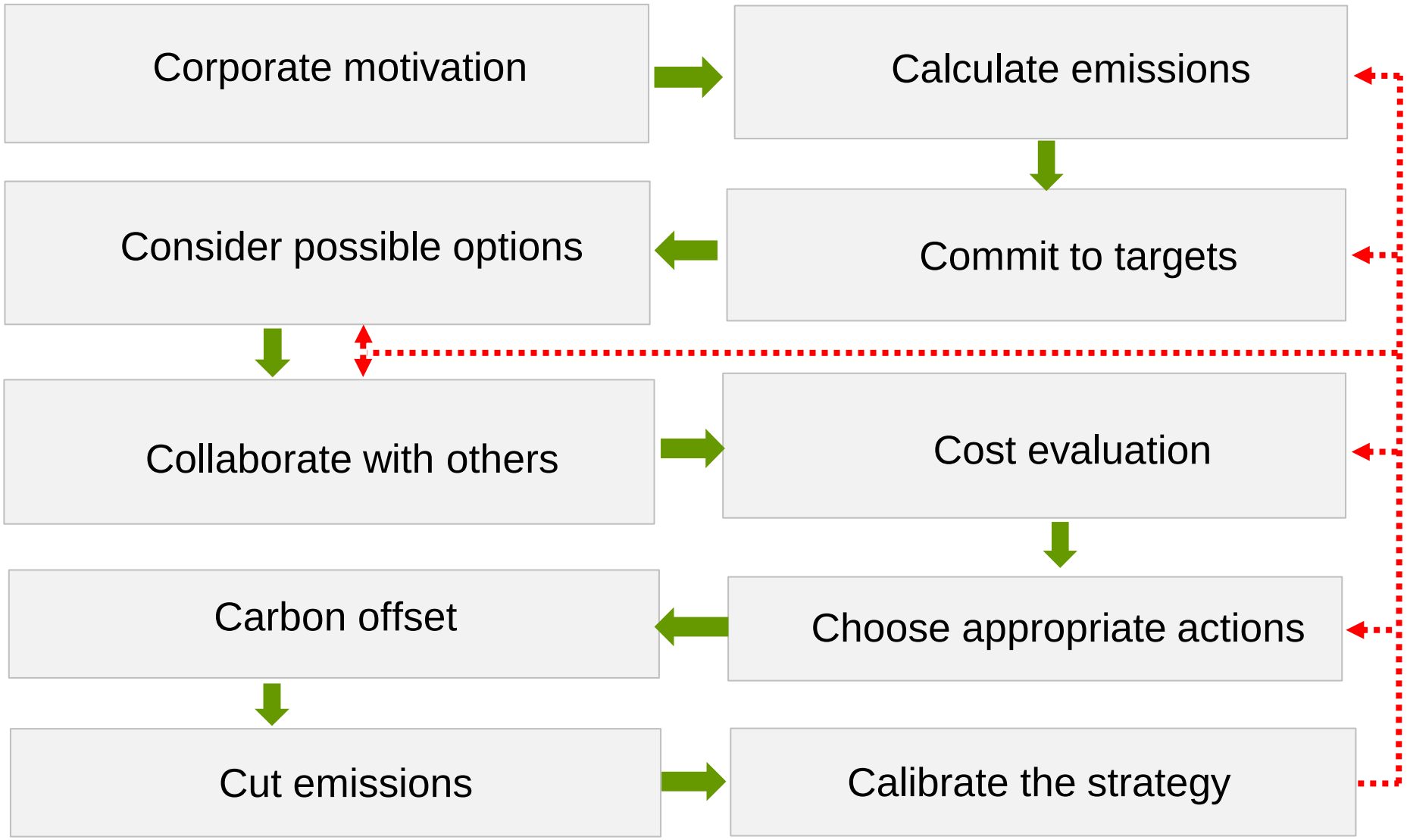
'green beaches'

carbon auditing of end-to-end supply chain



Developing a Decarbonisation Strategy for Logistics

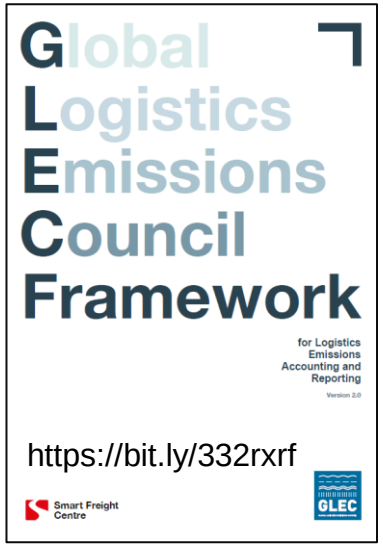
10 C approach

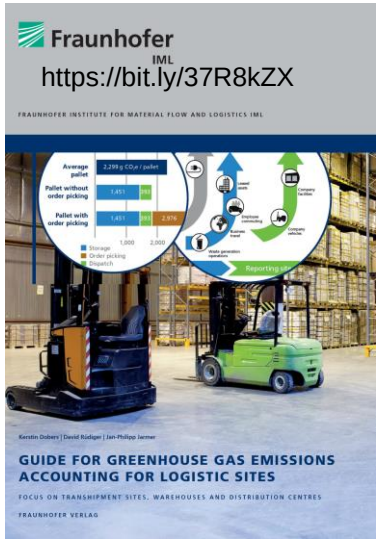


Source: McKinnon (2018) Decarbonizing Logistics

Calculate emissions

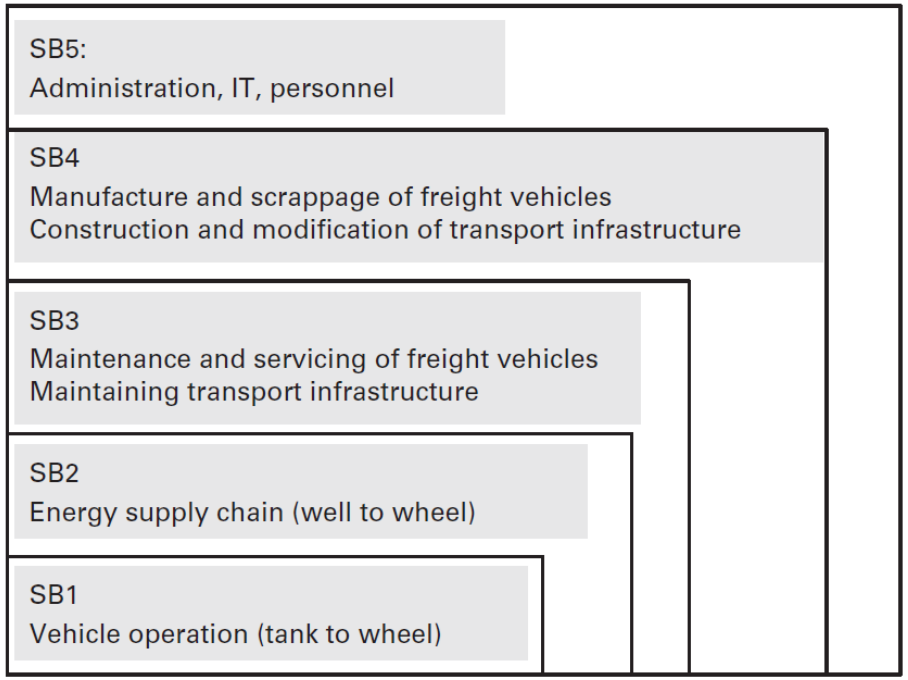
harmonizing logistics GHG measurement





increasing capability of logistics providers / freight forwarders to measure carbon emissions

extending system boundaries around calculation



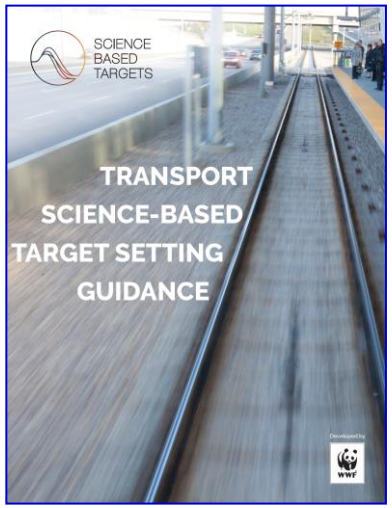
from carbon intensity to absolute emission reduction targets

Commit to carbon reduction targets

Setting corporate GHG reduction targets in line with evidence from climate science

https://bit.ly/2QXOS7T

978 organizations (Sept 2020)



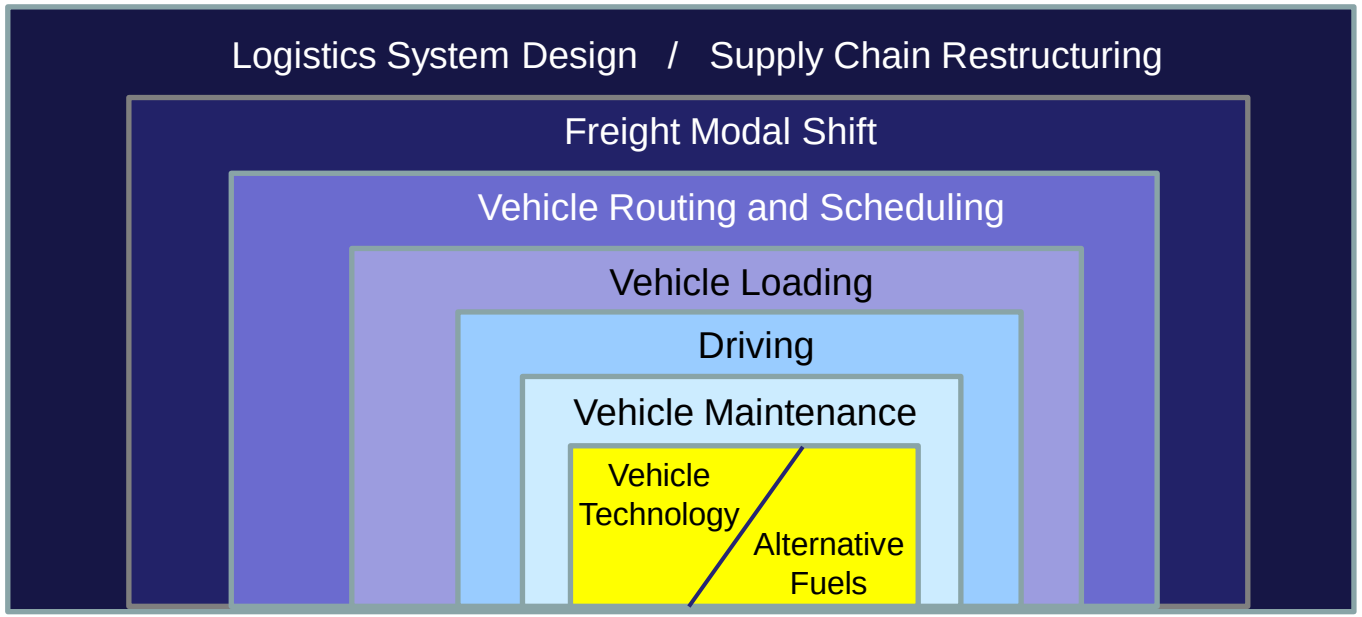
'piggybacking' on the targets of large logistics providers

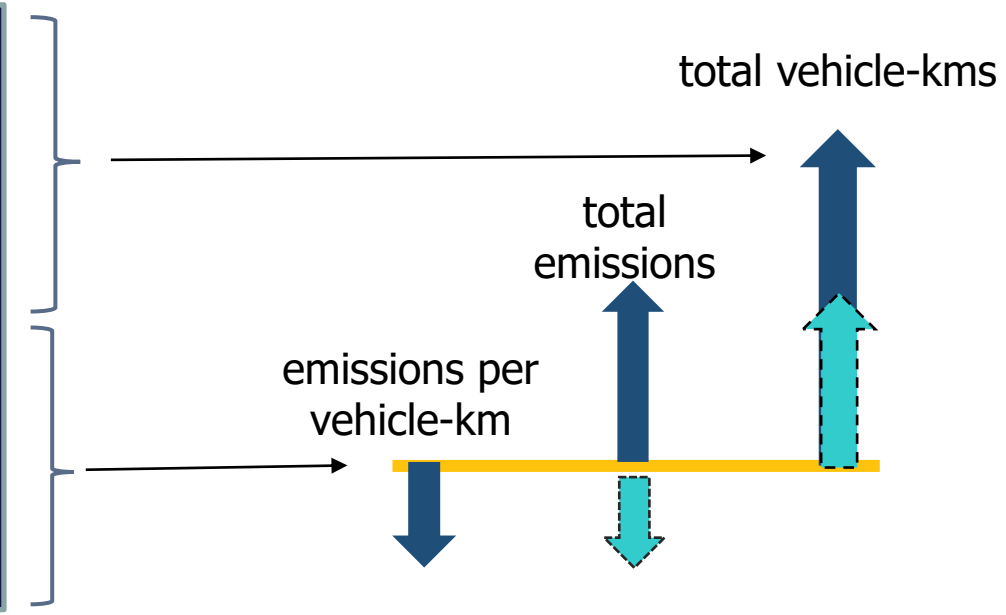
Consider possible options

1. Reduce the Amount of Freight Movement
2. Shift Freight to Lower Carbon Transport Modes
3. Optimise the Utilisation of Vehicle Capacity
4. Increase Energy Efficiency of Transport and Storage
5. Reduce the Carbon Content of Logistics Energy

cold chain emissions are more difficult to abate

- high growth in demand for refrigerated transport
- rail has small share of refrigerated freight market
- temperature-control constraint on backloading and load consolidation opportunities
- energy efficiency of refrigeration as well as propulsion
- fugitive emissions of refrigerant gases with high global warming potential





Decarbonising Road Freight Transport by 2050

Leveraging key freight parameters to achieve a 90% reduction in CO_2 emissions

scenario 1

transfer 30% of road tonne-kms to rail

80% reduction in carbon intensity of rail freight

+

25% improvement in efficiency of truck routeing

+

30% increase in loading of laden trucks

+

30% reduction in empty running of trucks

+

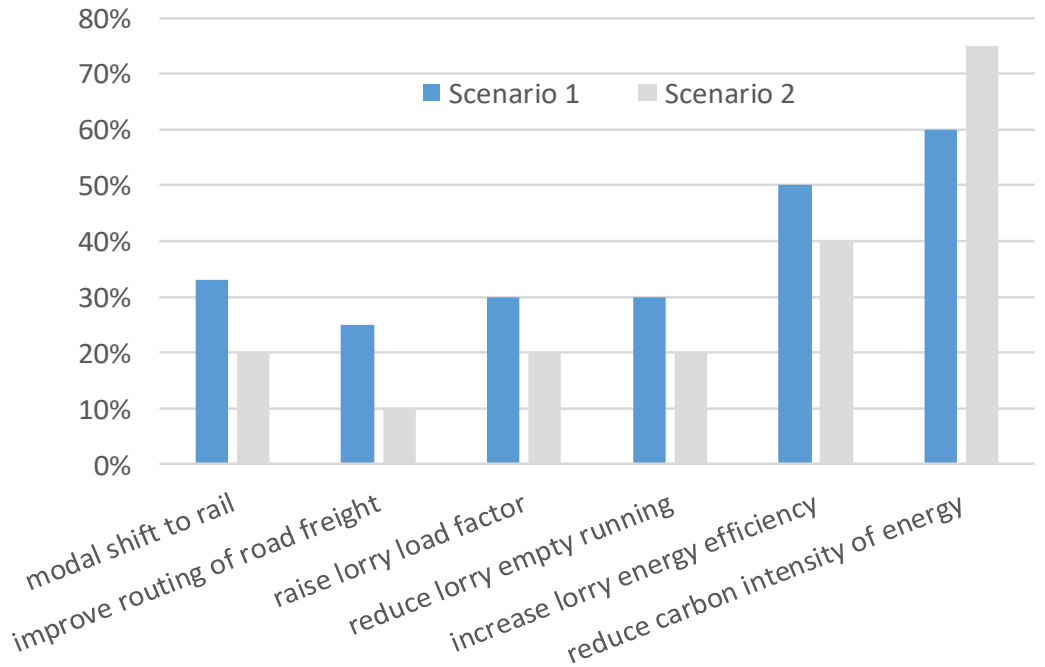
50% increase in truck energy efficiency

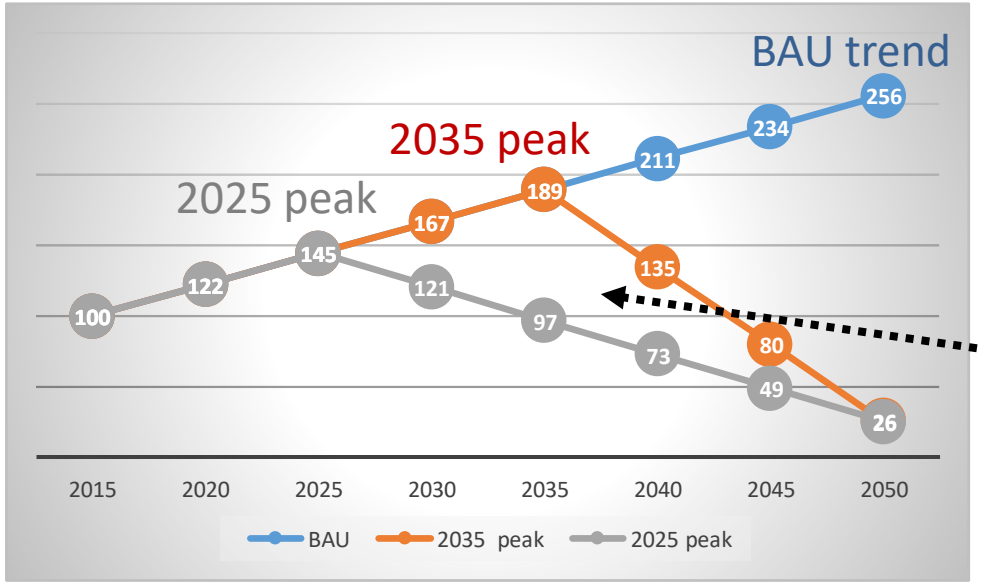
+

60% drop in carbon content of truck energy

⬇

90% reduction in carbon intensity





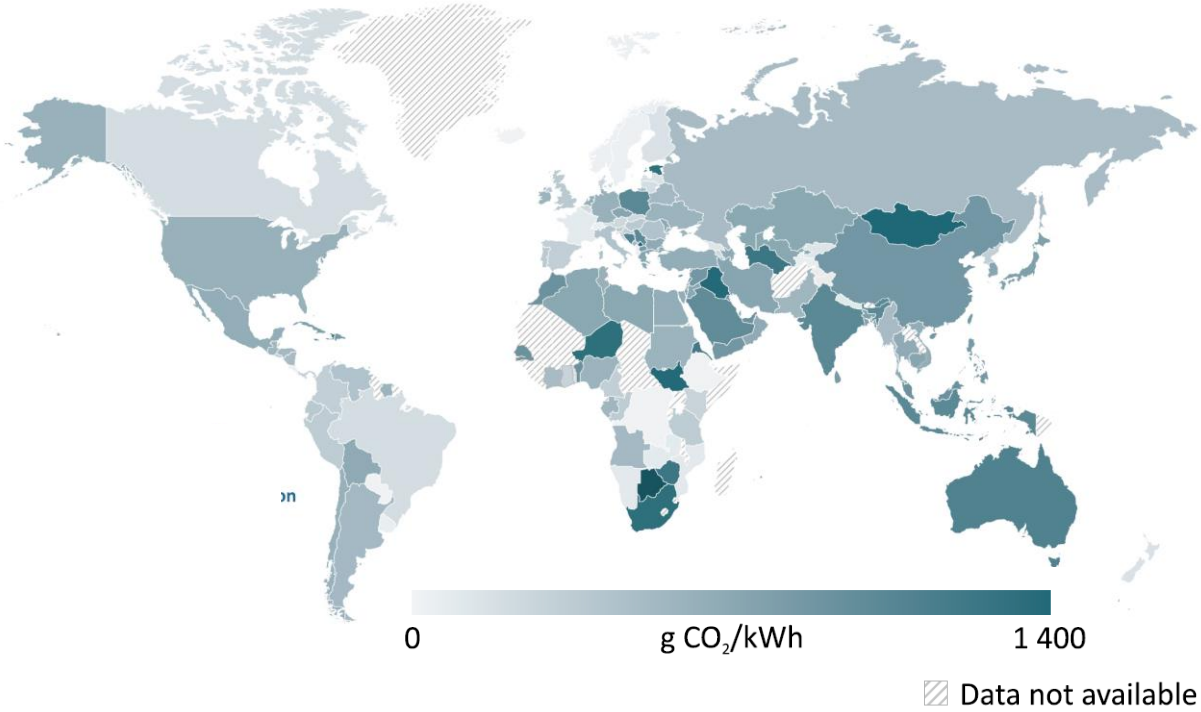
32% more CO_2 accumulated by 2050

Electrification Route to Zero Carbon Logistics

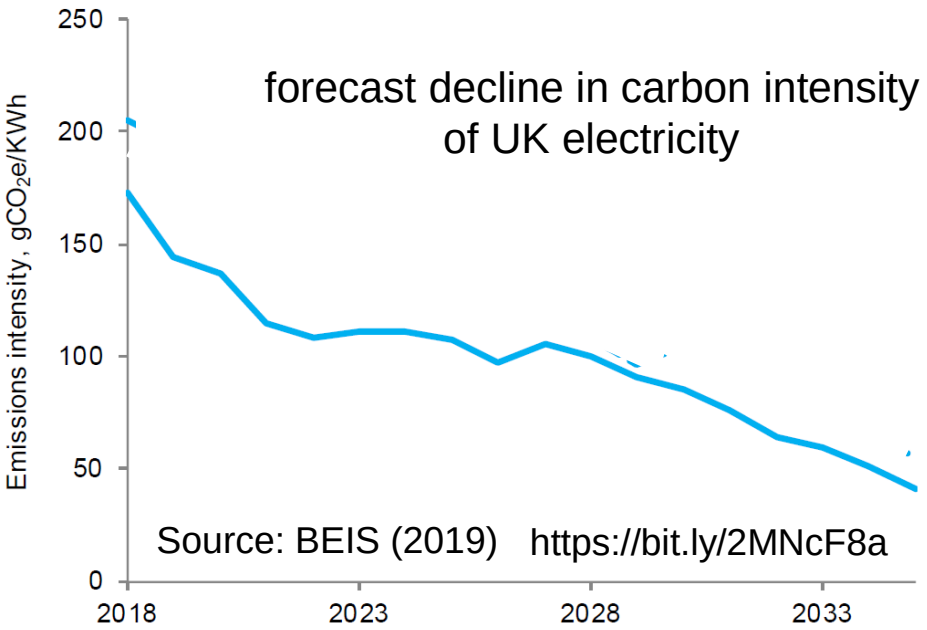
'There seems to be an implicit assumption around cooling…that much of the heavy lifting of emissions reductions will be achieved through decarbonisation of electricity' ('Doing Cold Smarter' report)
https://bit.ly/2EJv0CX

- Decarbonise electricity generation
- Electrify all logistical activities
- Ensure there is enough zero carbon electricity to meet demand

International variation in carbon intensity of electricity generation



Source: International Energy Agency (2019)



forecast decline in carbon intensity of UK electricity

Source: BEIS (2019) https://bit.ly/2MNcF8a

competing demands for low carbon electricity

charging new generation of electric cars

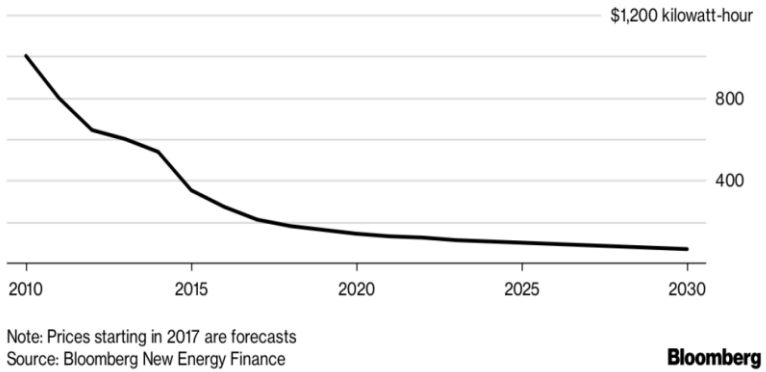
switch from fossil fuel heating to electric heating in homes

Powering Road Freight Transport with Low Carbon Electricity

local delivery operations

battery power

Cost of lithium ion battery pack

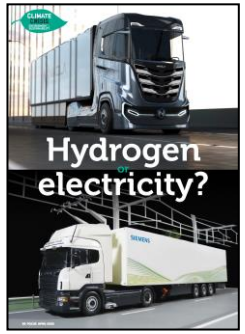


- narrowing price differential
- increasing delivery range
- expanding recharging network

long distance trucking

battery power

hydrogen fuel-cell truck



Logistics and Transport Focus April 2020

disagreement on weight, size recharging time for batteries

Sripad & Visvanathan, McKinsey etc

10-12 tonnes for US Class 8 truck
400 kW per hour charging time

Tesla, ETC, LBL etc

4-6 tonnes for US Class 8 truck
1600 kW per hour (Tesla)

Bossel, Cebon etc

energy losses so high it squanders low / zero carbon electricity

CCC, IDDRI etc

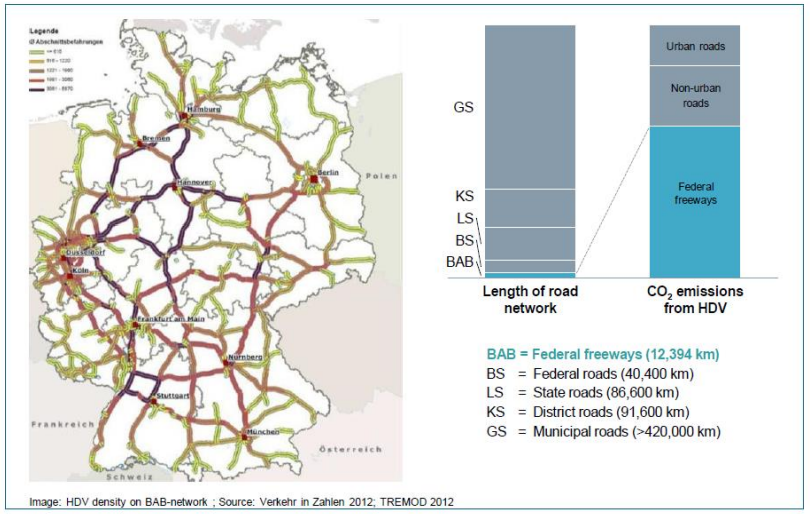
despite high energy losses, still viable decarbonisation option

ETC Energy Transition Commission
LBL Lawrence Berkeley Lab
CCC Committee on Climate Change
IDDRI Institute for Sustainable Development

Times editorial 24 September 2020

Highway electrification: *the e-Highway*

electrified roads: Trials in Sweden, Germany and the US



60% of heavy truck CO_2 emissions in Germany occur on only 2% of road network

89% of truck trips after leaving highway have a length of 50km or less.

smaller, lighter batteries for short-range feeder trips

Source: Siemens

Studies suggest 4000 km of German autobahn network be electrified by 2030 at relatively low CO_2 mitigation cost

https://bit.ly/3dT8qnN

Future powering of truck refrigeration units with electrical power from overhead catenaries?

Improving Energy Efficiency in the Road Freight Transport Sector

vehicle technology: *new build + retrofits*

fuel economy standards: *applied to trucks*

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Japan				Phase 1										Phase 2
U.S.			Phase 1					Phase 2						
Canada			Phase 1					Phase 2						
China	Phase 1		Phase 2						Phase 3					
EU														
India														
Mexico									Phase 1					
S. Korea									Phase 1					

VECTO

15% increase in CO_2 efficiency of new trucks in 2025 relative to 2019: 30% increase by 2030

Hashed areas represent unconfirmed projections of the ICCT

Updated from ICCT (2015)

truck fuel economy standards

upgrade fuel efficiency of ancillary equipment

refrigeration energy 15-25% of transport energy
https://bit.ly/3imbKt3

more efficient transport refrigeration units, better insulation, improved operational procedures, alternative refrigerants

vehicle operation: *IT , training, monitoring*

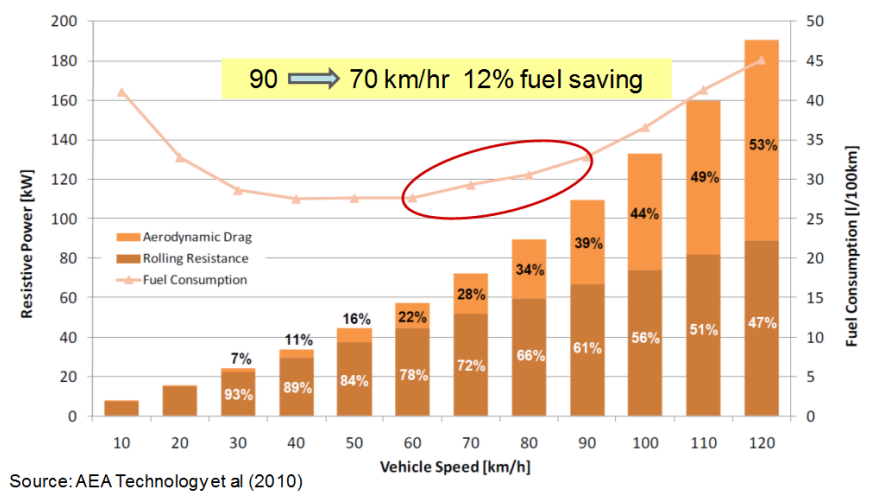
eco-driver training

telematic monitoring

platooning

automation

business practice: e.g. *deceleration*

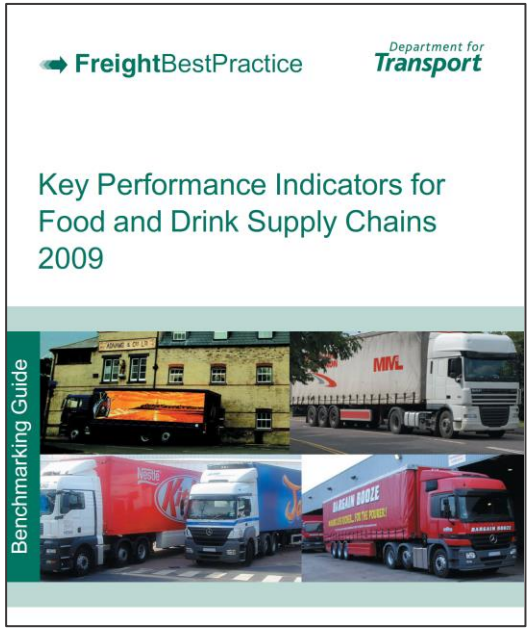


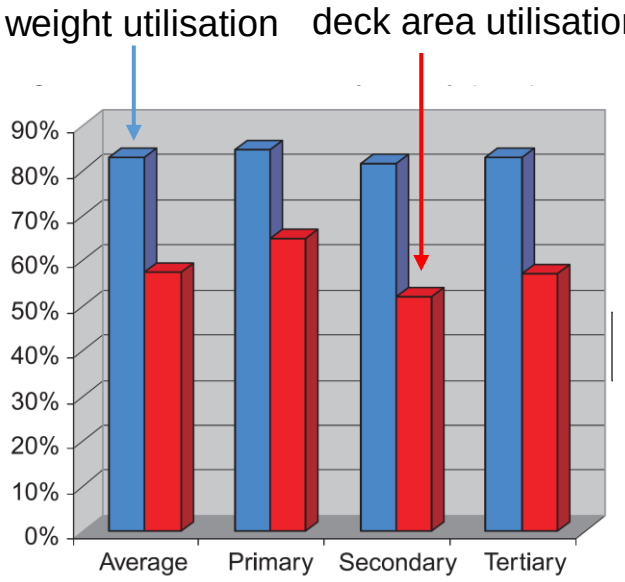
Source: AEA Technology et al (2010)

Wider case for ‘despeeding’ logistics?

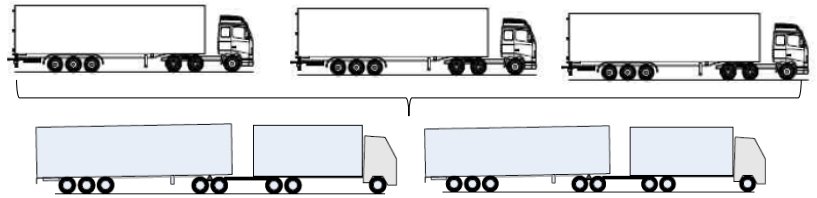
https://bit.ly/2AW0un9

Improving Asset Utilisation in Logistics





Relaxation of truck size and weight limits



Load consolidation cuts truck-kms, fuel use, emissions, accidents and labour demands

Net CO_2 savings even after allowance made for modal shift and induced traffic

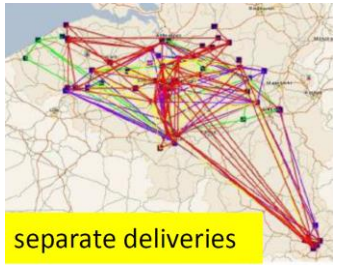
Deep decarbonisation needs greater sharing of logistics assets

Supply chain collaboration

e.g. Nestle and Pepsico in Benelux

kg CO_2 / tonne of product

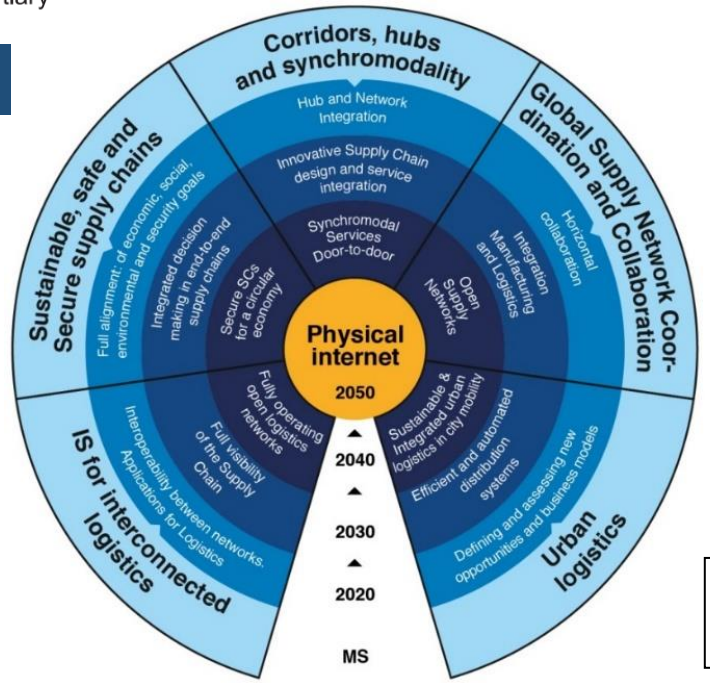
43.8



kg CO_2 / tonne of product

20.3

source: Jacobs et al (2014)



alice | Alliance for Logistics Innovation through Collaboration in Europe

A Framework and Process for the development of a

Roadmap towards Zero Emissions Logistics 2050

DECEMBER 2019

https://bit.ly/2MLyiWy

longer term contribution of Physical Internet to logistics decarbonisation

Impact of ICT developments / digitalisation on carbon intensity of freight transport?

Online freight procurement and optimisation

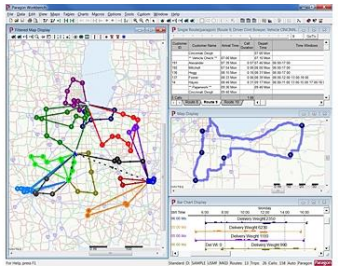
Upgrading of web platforms and software tools

Smart road infrastructure

https://bit.ly/2kJXWR6

Advances in vehicle routeing and scheduling

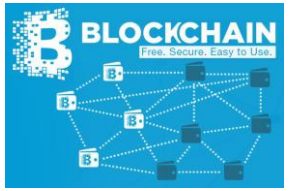
Big data, predictive analytics etc



Data pooling

cloud computing, software-as-a-service

Supply chain applications of Blockchain

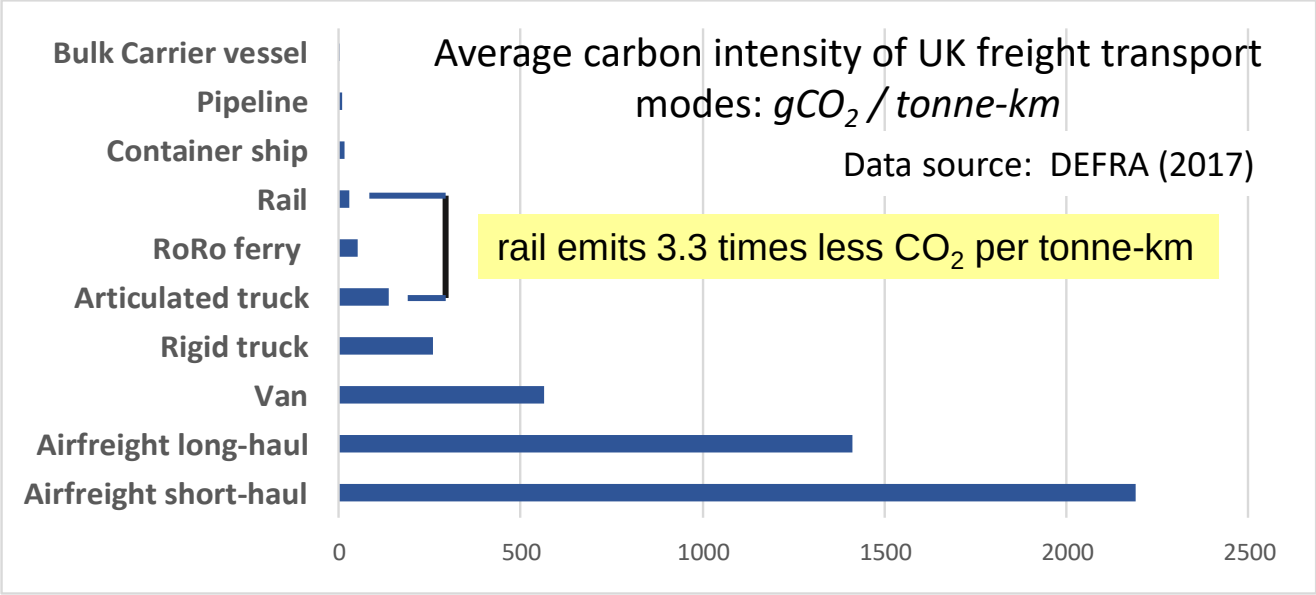


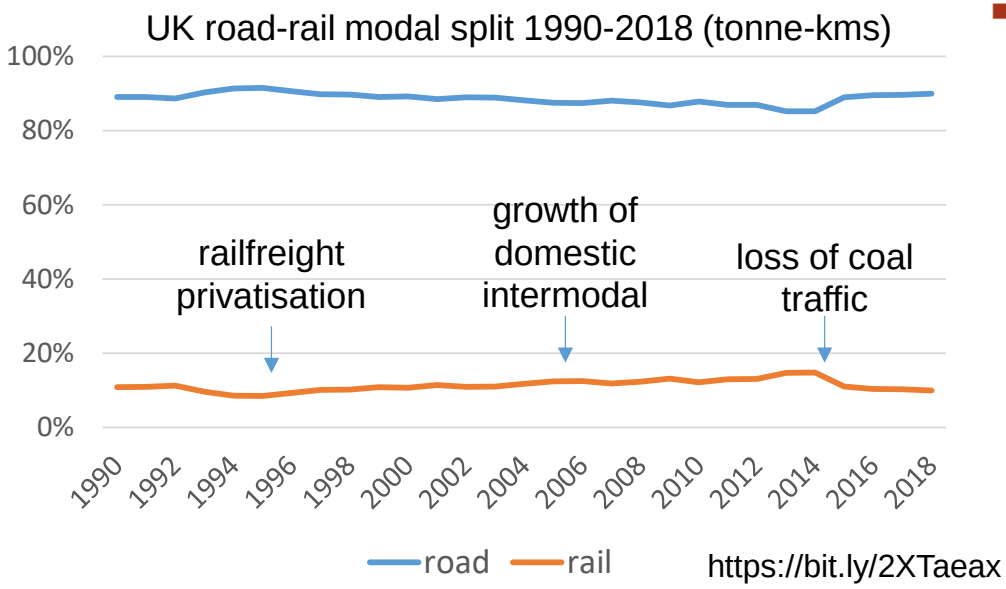
Intelligent connected vehicles

Internet of things

Consignment-level visibility and connectivity

Shifting freight to lower carbon models





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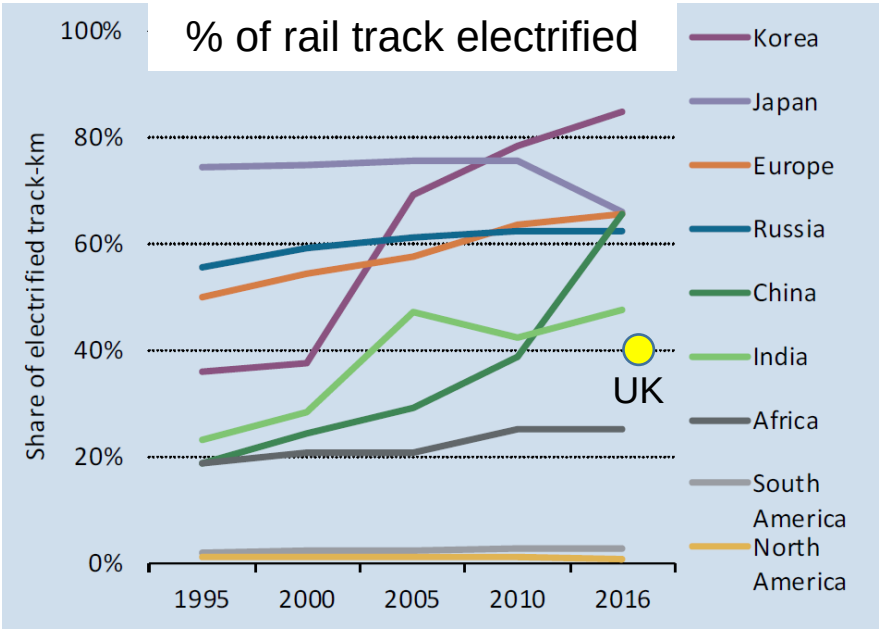


only 10% of UK railfreight electrically hauled

need to 'plug gaps' in electrified network for freight

https://bit.ly/30v0LYQ

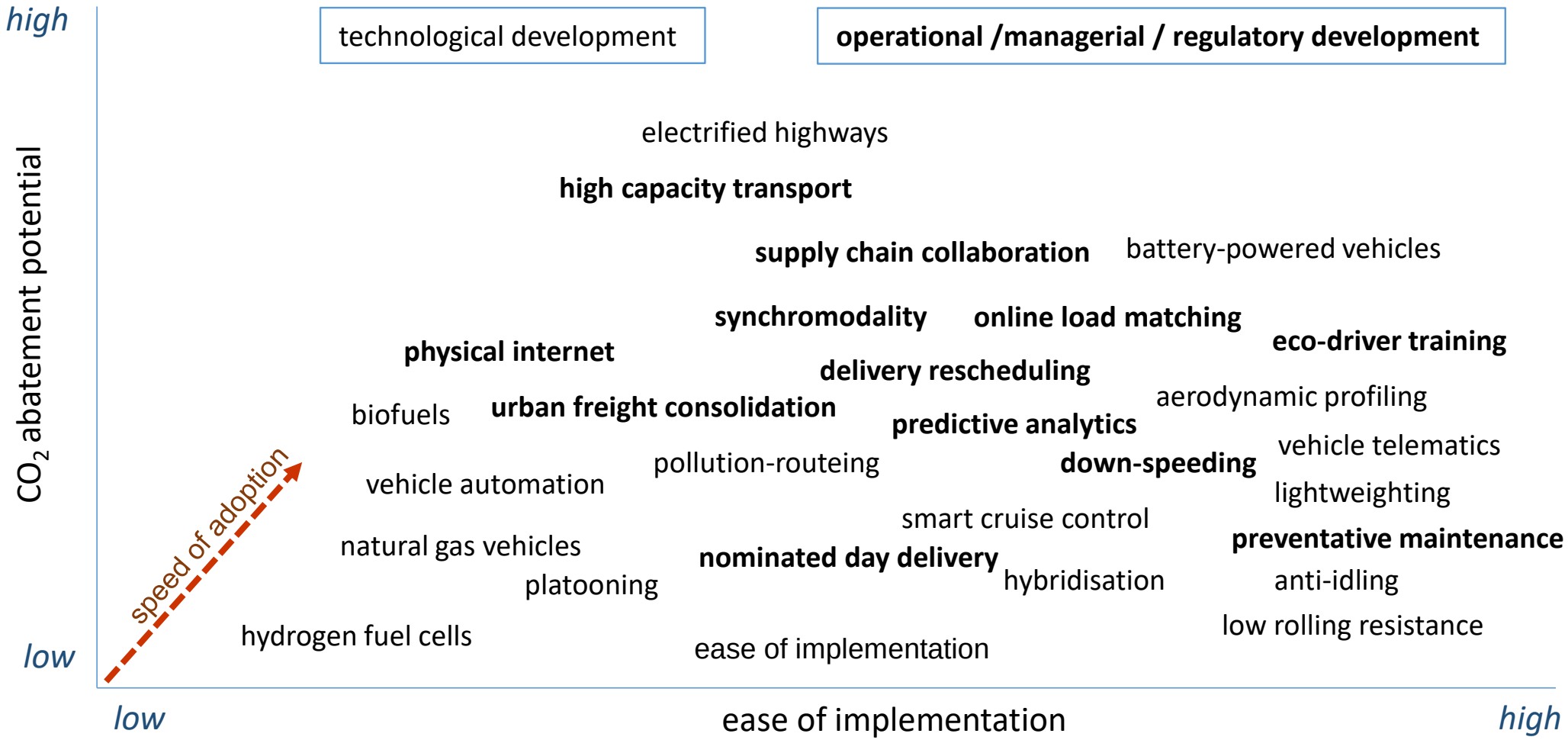
railfreight contribution to decarbonisation depends on:

- Infrastructural access and electrification
- locomotive renewal / retrofitting
- new business models / modal choice decision-making
- changing commodity mix

prospects of rail playing greater role in the cold chain?

https://bit.ly/3kZIGJd

Freight decarbonisation measures: *CO_2 abatement – implementation graph*



Technology and energy supply bias: *under-estimation of the possible logistics contribution*

Source: McKinnon (2018) '*Decarbonizing Logistics*'

Forget everything that I've just said about cutting CO_2 emissions……

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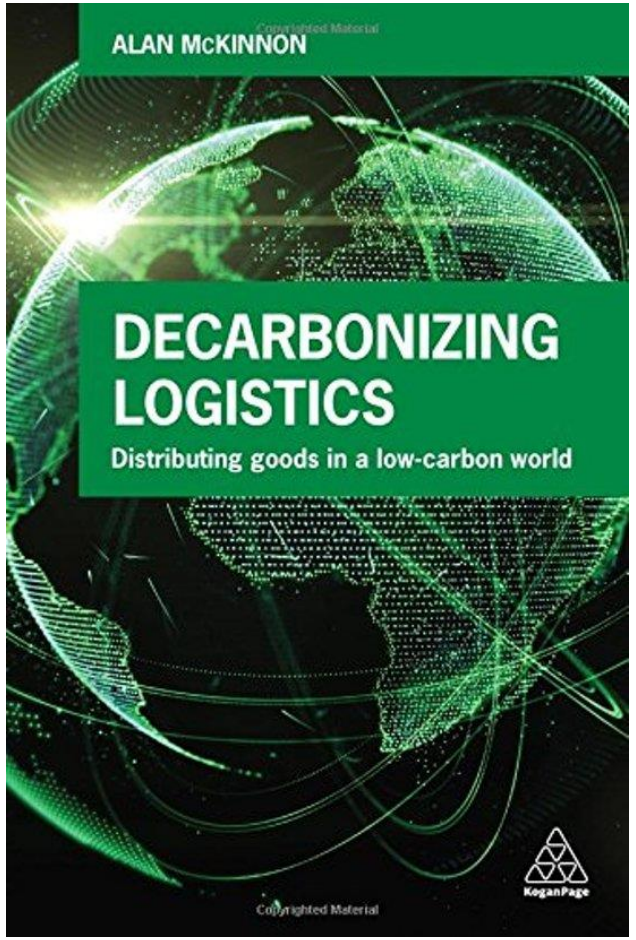

https://www.koganpage.com/product/decarbonising-logistics-9780749483807