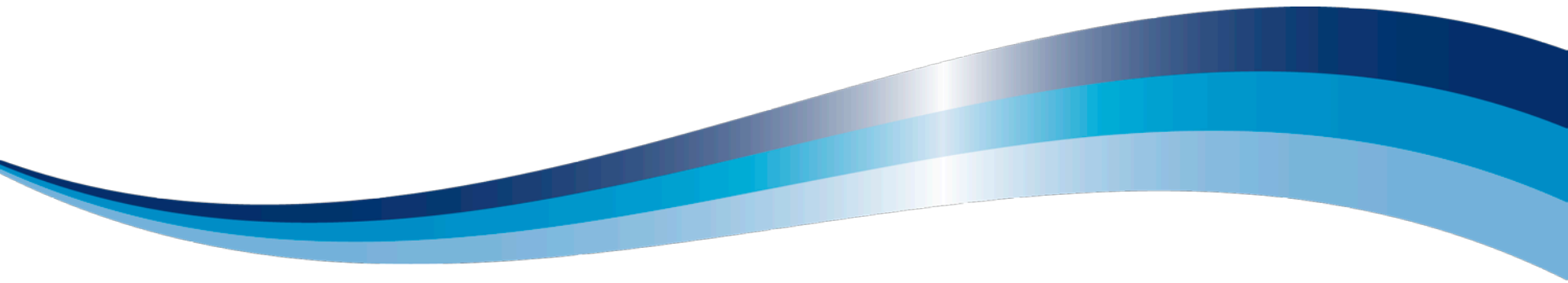


International Carbon Flows

14 November 2011

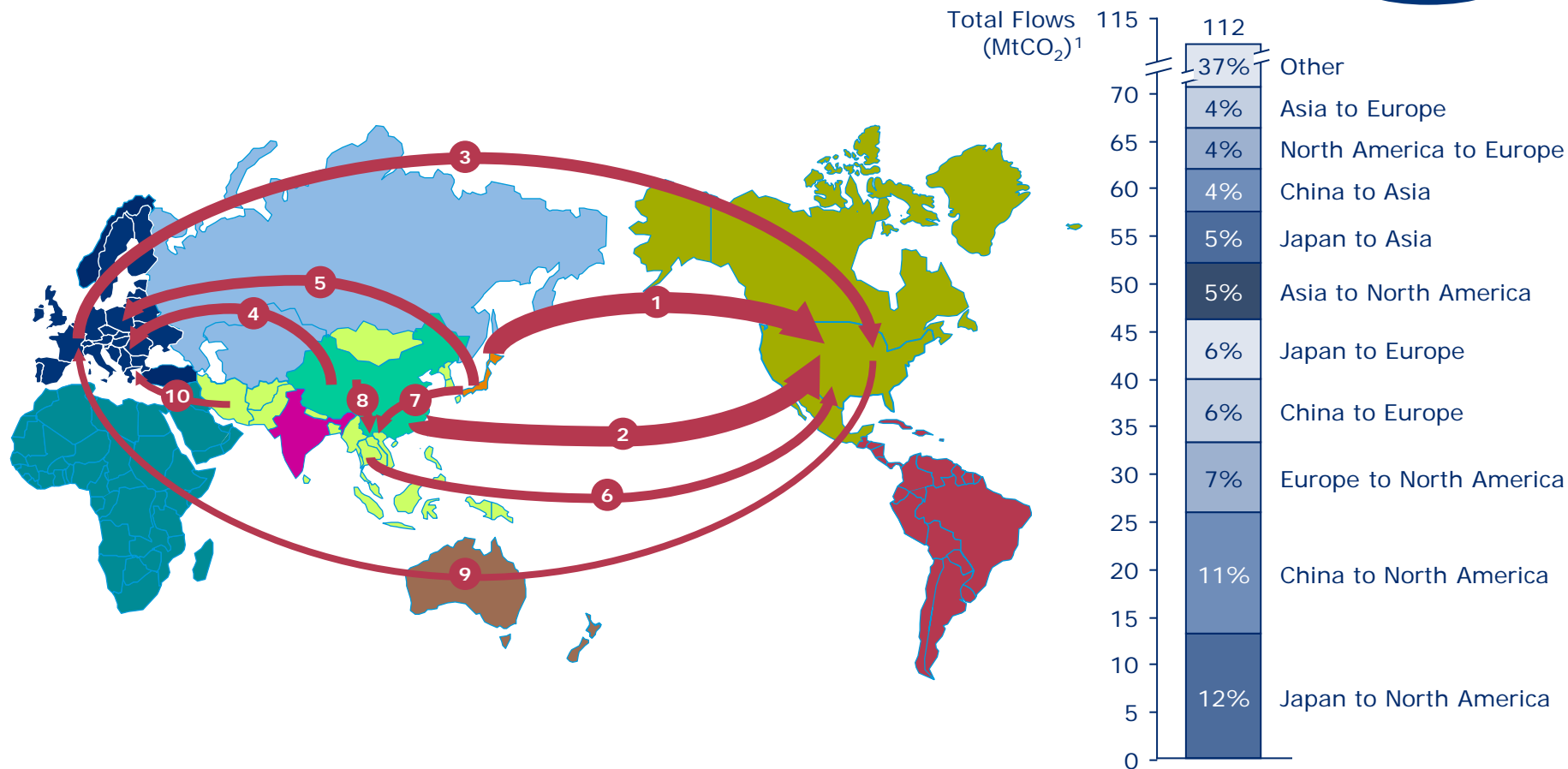
Eric Lounsbury

LowCVP/IMechE Life-Cycle Seminar



Top 10 regional bilateral flows of emissions embodied in motor vehicles

112Mt CO₂

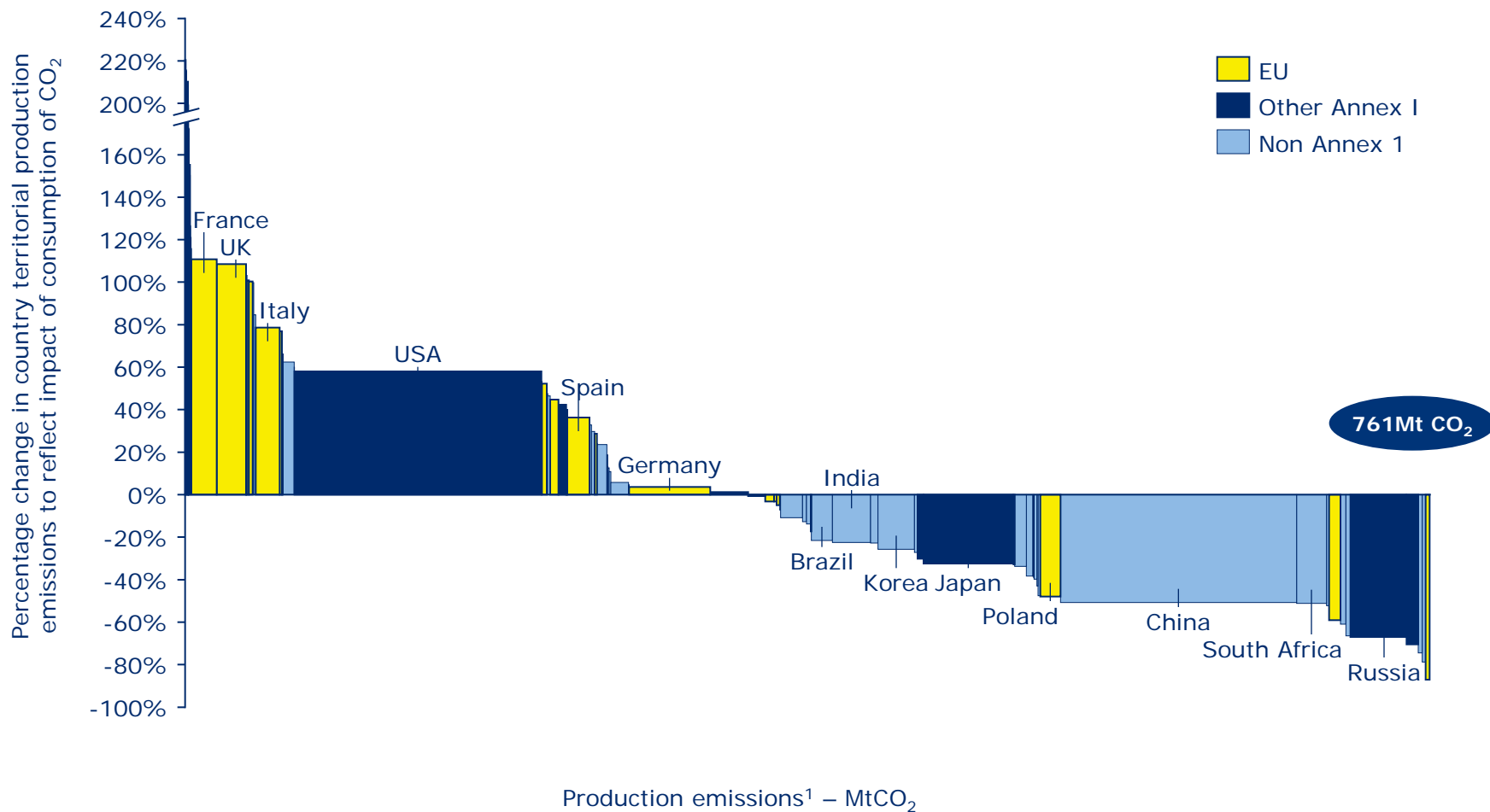


1. Includes scope 1 - Direct emissions generated by OEM, Scope 2 - Allocated Electricity and Scope 3 - Other emissions associated with auto production

Note: Excludes intra regional flows; Includes bilateral flows only (ie, does not include emissions generated upstream in other regions)

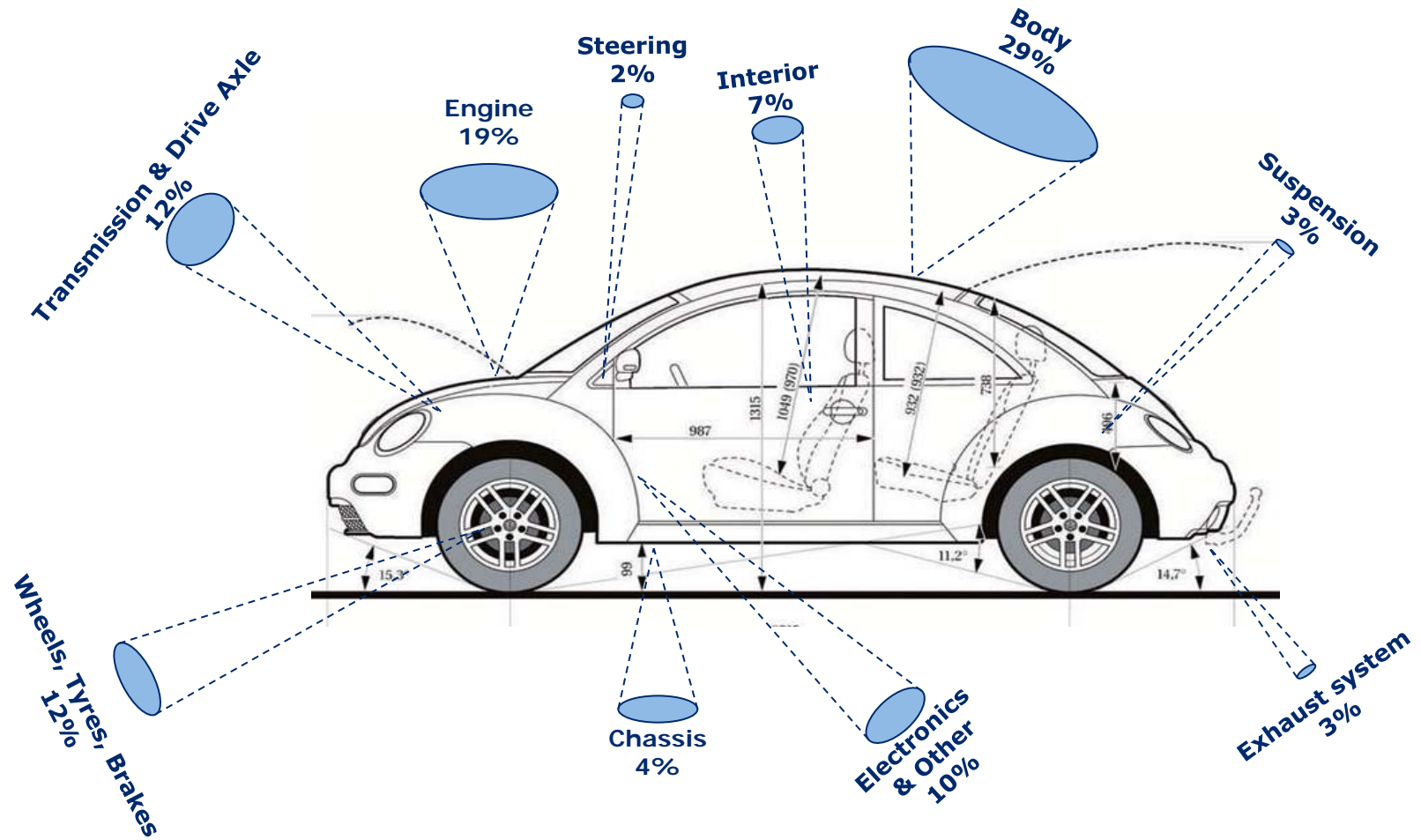
Source: Carbon Trust Analysis; CICERO / SEI / CMU GTAP7 EEBT Model

A consumption perspective materially changes the view of automotive emissions



1. Not just emissions arising in the automotive sector, but all those that arise in all sectors to satisfy global automotive consumption
 Source: Carbon Trust Analysis; CICERO / SEI / CMU GTAP7 MRIO Model

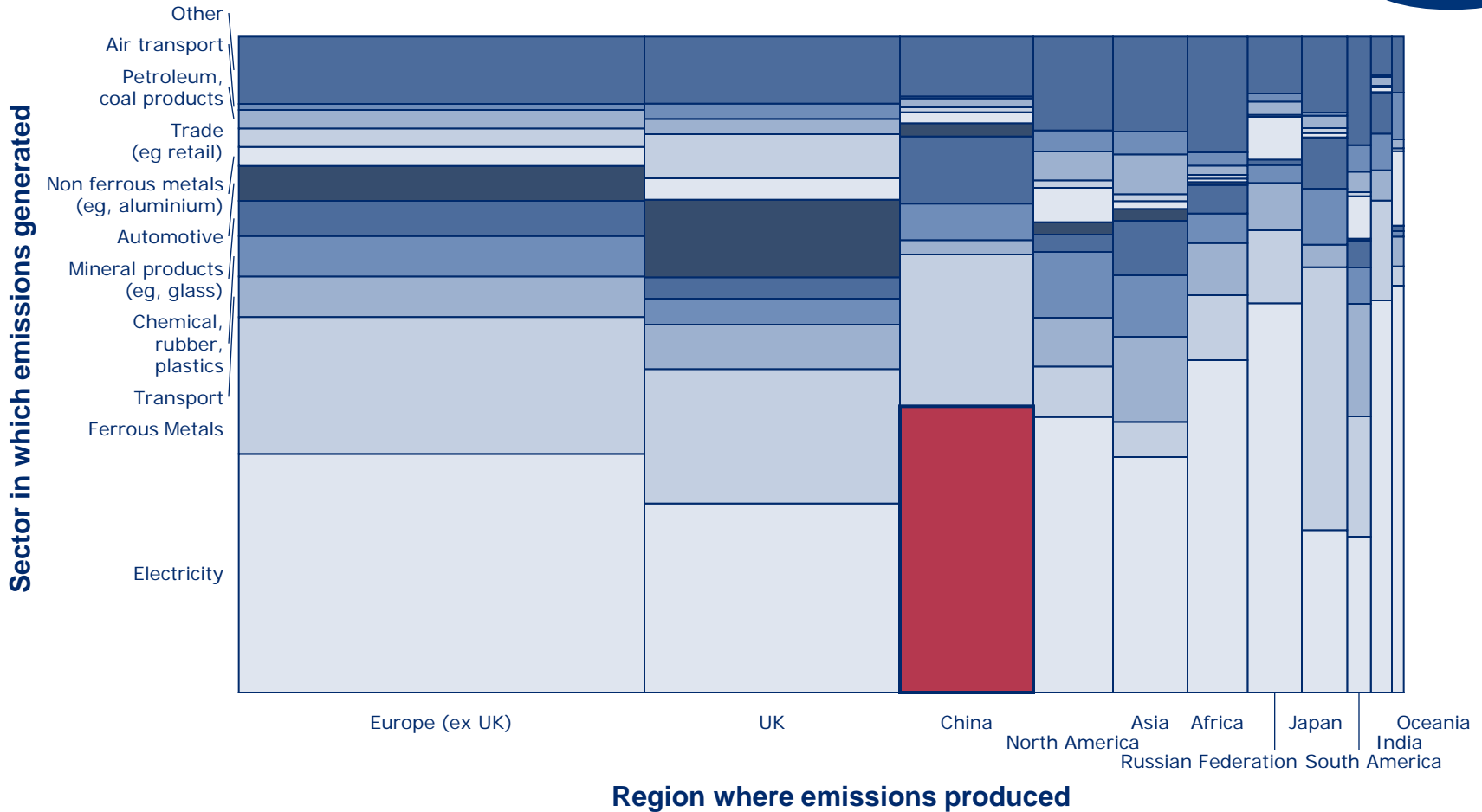
Distribution of embodied emissions in a typical car



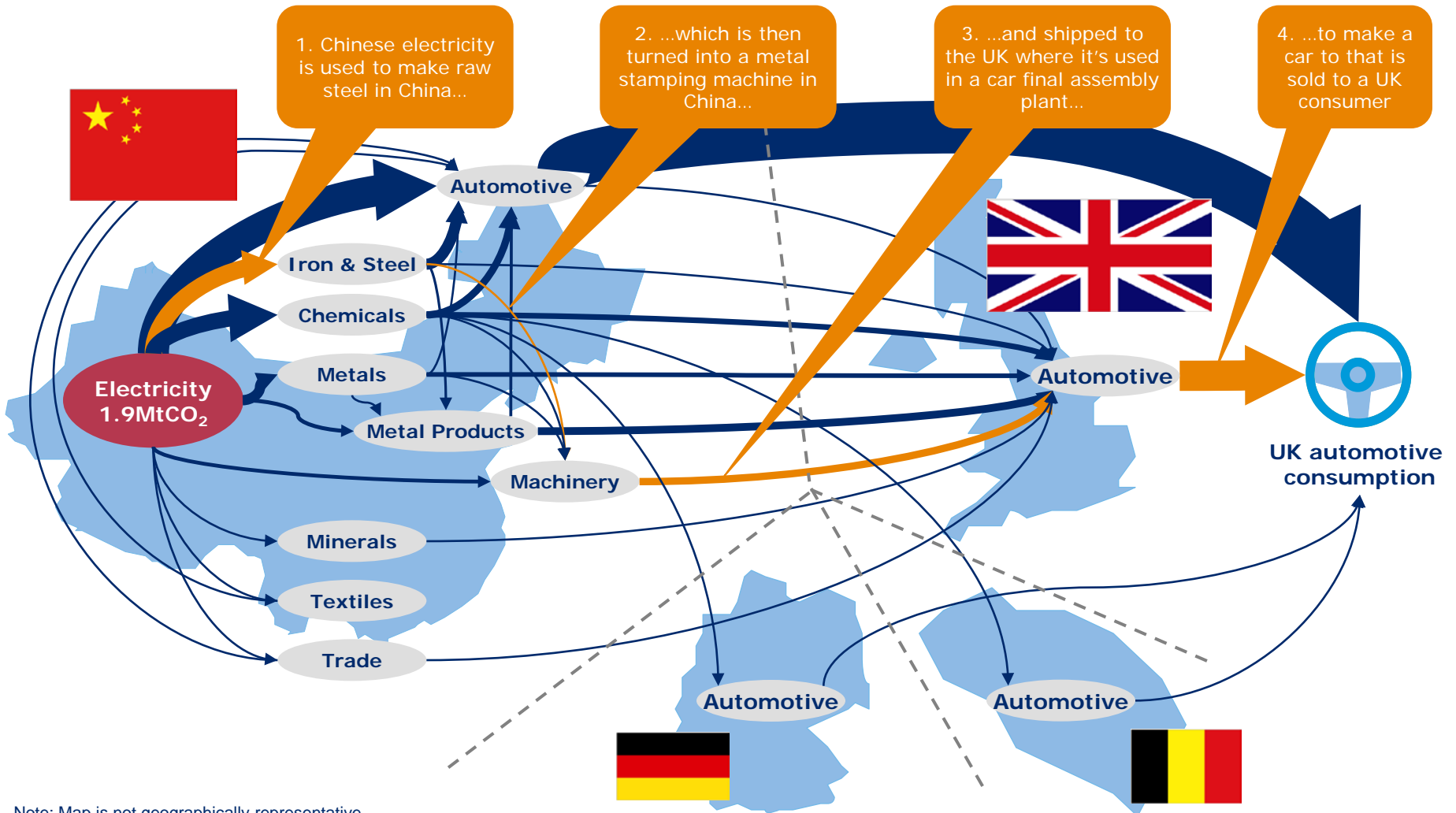
Note: Emissions embodied in materials only
Source: Carbon Trust; BCG Analysis

Emissions to satisfy UK automotive consumption

37Mt CO₂



Case study on flow of Chinese electricity emissions to UK cars



Note: Map is not geographically representative

Source: Carbon Trust Analysis based on structural path analysis (SPA) of automotive global flows data from CICERO / SEI / CMU

Up to 80% of a vehicle's total emissions occur in use phase

Majority of emissions from production not from OEM plants, but from supply chain and raw materials



Emissions

Lifecycle emissions of current global production ~2-3 bn tCO₂e per year (4-7% of global GHG emissions)

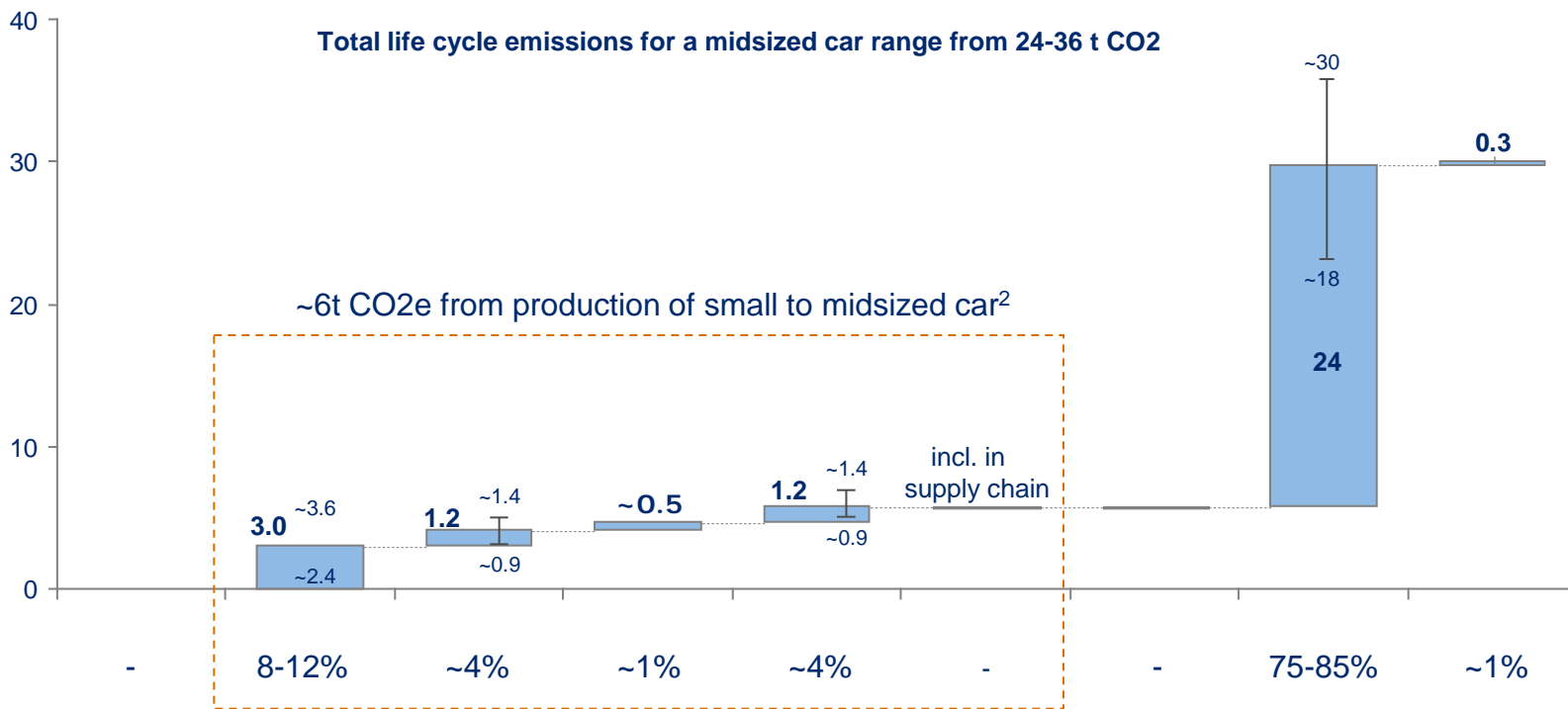
Value Chain



t CO₂e per vehicle

Total life cycle emissions for a midsize car range from 24-36 t CO₂

Emission baseline standard compact car¹

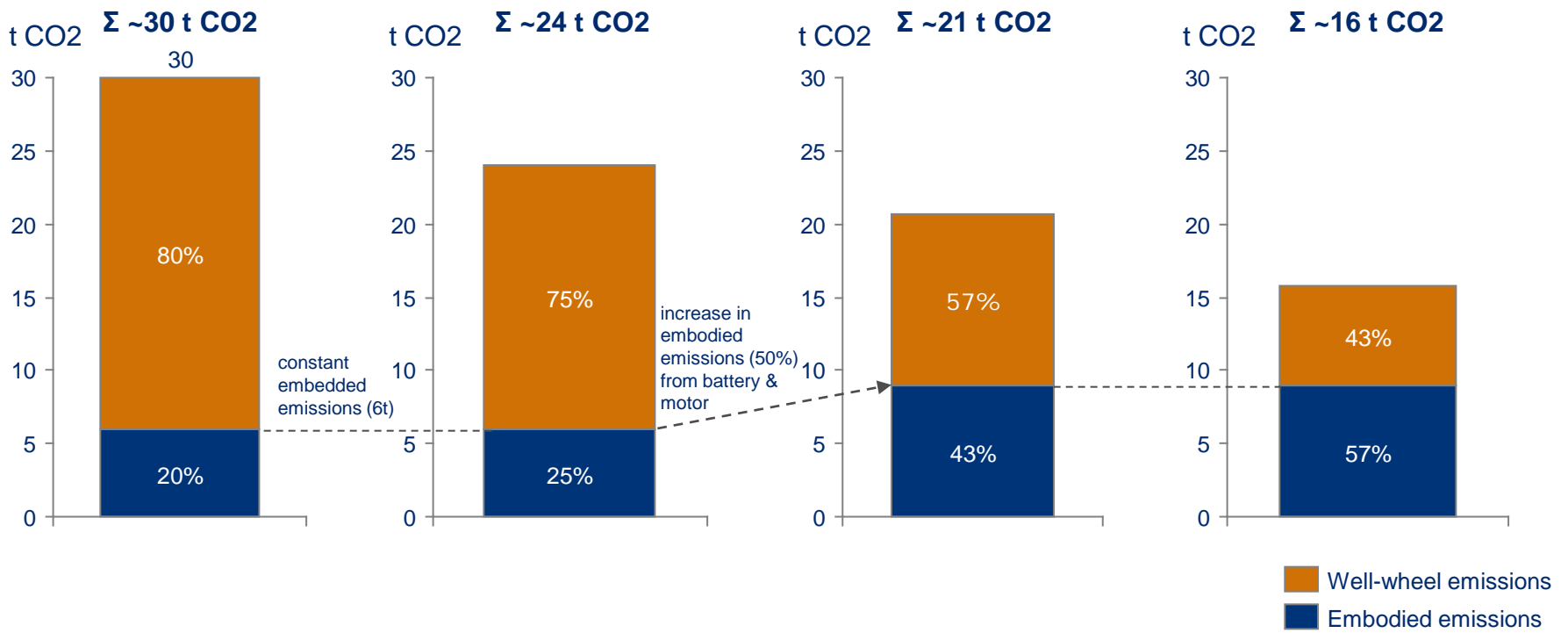


% of total emissions

¹ Absolute emission data based on Environmental Commendation Volkswagen Golf VI ² Up to ~10t / car embedded and 80t in-use emissions for large premium vehicles (eg. Mercedes S-Class)
Source: BCG Analysis based on Life cycle Analysis publications from several OEM (Daimler, Volkswagen, Toyota)

The potential evolution in the relative importance of embedded emissions compared with in-use

<p>2009 Average car (160g/km)</p>	<p>2009 Efficient Diesel car (120g/km)</p>	<p>2010 Plug-in Hybrid¹ (78g/km)</p>	<p>2015-20 Electric car² (45g/km)</p>
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Note 1: Vehicle assumed to drive 150,000km over its lifetime
 1. Assumes ICE used 50% of the time and generates 89gCO₂/km and electric motor for other 50%. Emissions of electric motor based upon grid factor of 450g/kWh and motor efficiency of 15kWh/100km
 2. Emissions of electric motor based upon grid emissions intensity of 300g/kWh and motor efficiency of 15kWh/100km
 Source: Carbon Trust and BCG Analysis based on data from International Energy Agency, Automotive Manufacturers and Ricardo

Further information:

International Carbon Flows
www.carbontrust.co.uk/icf

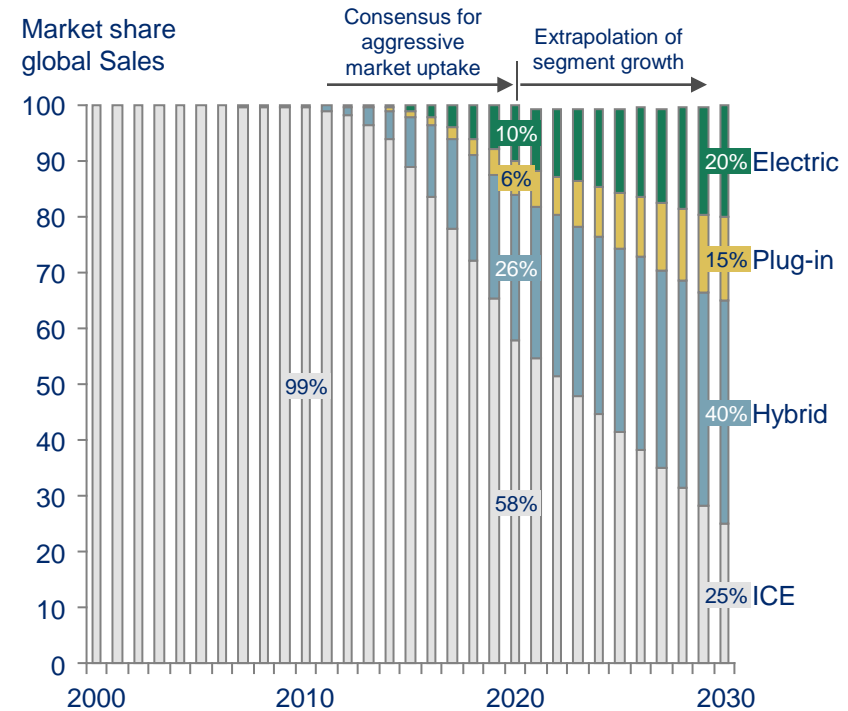
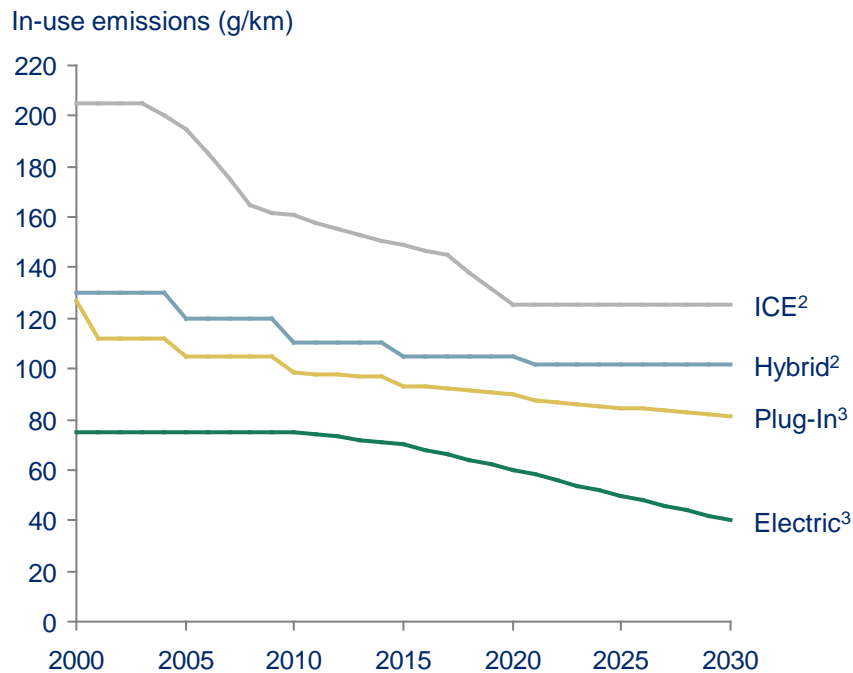
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Forecasted evolution of in-use emissions in cars

Well to wheel emissions by technology

Uptake of new technologies under "optimistic" scenario



1. Extrapolated based on BCG's 2020 expectation in the case of an accelerated uptake of new propulsion technologies
 2. Assumes phase in of biofuels from 0.5% in 2010 to 10% in 2020 to 20% in 2030
 3. Based on decarbonisation of grid over time
 Source: BCG Propulsion Model; publicly available information