

# Supplementary Information

## IMAGE-materials: Dynamic material flow modelling in the IMAGE Integrated Assessment Model

### S1 IMAGE Regions

5 Table S1: IMAGE Regions abbreviations

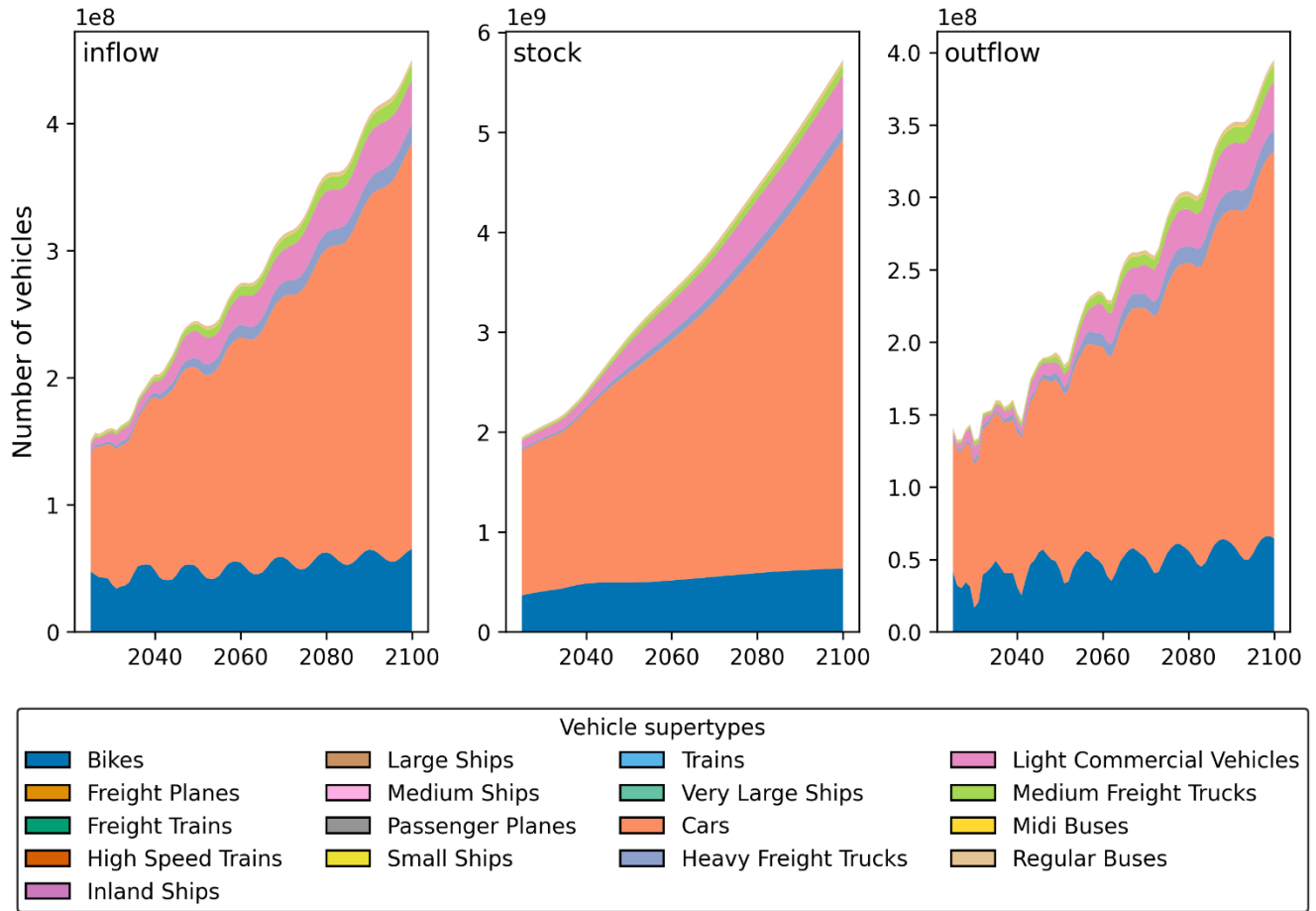
Abbreviation	Full Name
CAN	Canada
USA	United States of America
MEX	Mexico
RCAM	Rest of Central America
BRA	Brazil
RSAM	Rest of South America
NAF	North Africa
WAF	West Africa
EAF	East Africa
SAF	South Africa
WEU	Western Europe
CEU	Central Europe
TUR	Turkey
UKR	Ukraine Region
STAN	Central Asia
RUS	Russia
ME	Middle East
INDIA	India
KOR	Korea
CHN	China
SEAS	Southeast Asia
INDO	Indonesia
JAP	Japan

OCE	Oceania
RSAS	Rest of South Asia
RSAF	Rest of Southern Africa

10 All material required to understand the essential aspects of the manuscript such as experimental methods, data, and interpretation should preferably be included in the main text. Additional figures, tables, as well as technical and theoretical developments which are not critical to support the conclusion of the manuscript, but which provide extra detail and/or support useful for experts in the field and whose inclusion in the main text would disrupt the flow of descriptions or demonstrations may be presented as appendices. These should be labelled with capital letters: Appendix A, Appendix B etc. Equations, figures, and tables should be numbered as (A1), Fig. B5, or Table C6, respectively. Please keep in mind that appendices are part of the  
15 manuscript whereas supplements (see below) are published along with the preprint or journal article.

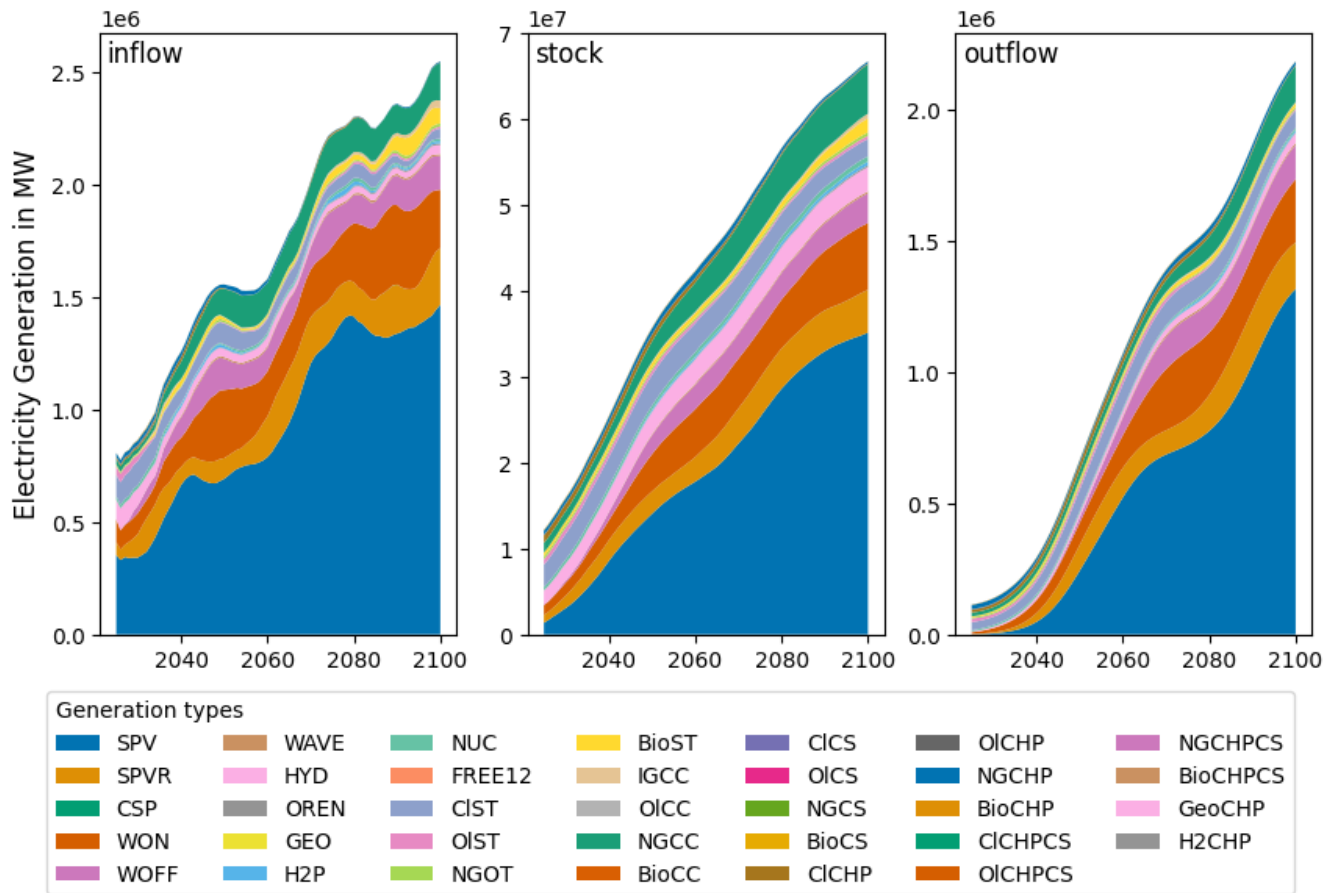
## S2 Additional inflow, stock and outflow figures per Sector

### S2.1 Vehicles



20 **Figure S1: SSP2 baseline product inflow, stock and outflow of vehicle superetypes, further subtypes is the disaggregation to engine types.**

## S2.2 Electricity Generation



25 **Figure S2: SSP2 baseline product inflow, stock and outflow of electricity generation in MW. The type abbreviations correspond to:**  
 30 **SPV – solar photovoltaic power (central), SPVR – solar photovoltaic power (decentral/residential), CSP – concentrated solar power, WON – wind onshore power, WOFF – wind offshore power, WAVE – wave power, HYD – hydro power, OREN – other renewables, GEO – geothermal power, H2P – hydrogen to power, NUC – nuclear, CIST – coal steam turbine, OIST – oil steam turbine, NGOT – natural gas open cycle turbine, BioST – biomass steam turbine, IGCC – integrated gasification combined cycle, OICC – oil combined cycle, NGCC – natural gas combined cycle, BioCC – biomass combined cycle, CICS – coal carbon capture and storage, OICS – oil carbon capture and storage, NGCS – natural gas carbon capture and storage, BioCS – biomass carbon capture and storage, CICHP – coal combined heat and power, OICHP – oil combined heat and power, NGCHP – natural gas combined heat and power, BioCHP – biomass combined heat and power, CICHPCS – coal combined heat and power carbon capture and storage, OICHPCS – oil combined heat and power carbon capture and storage, NGCHPCS – natural gas combined heat and power carbon capture and storage, BioCHPCS – biomass combined heat and power carbon capture and storage, GeoCHP – geothermal combined heat and power and H2CHP – hydrogen combined heat and power.**  
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### S2.3 Electricity Grid Lines

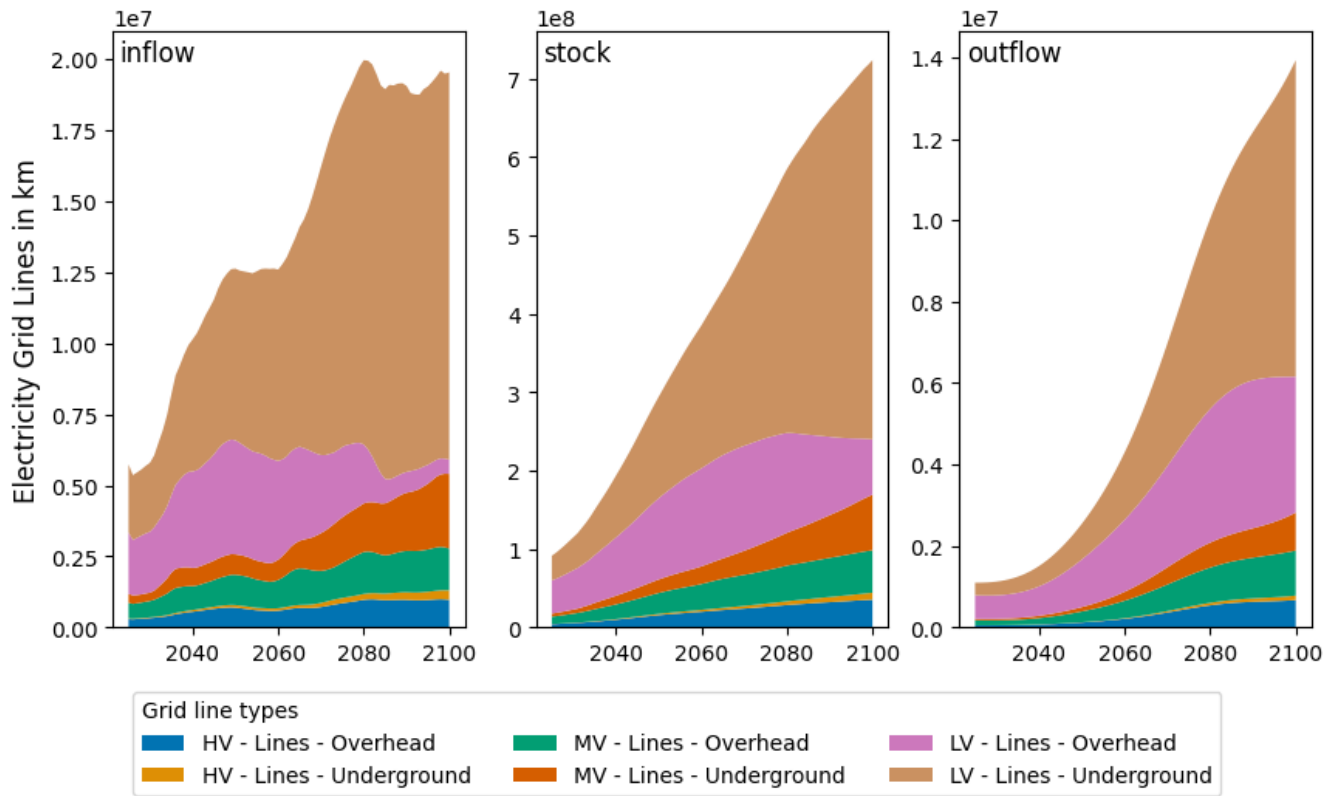
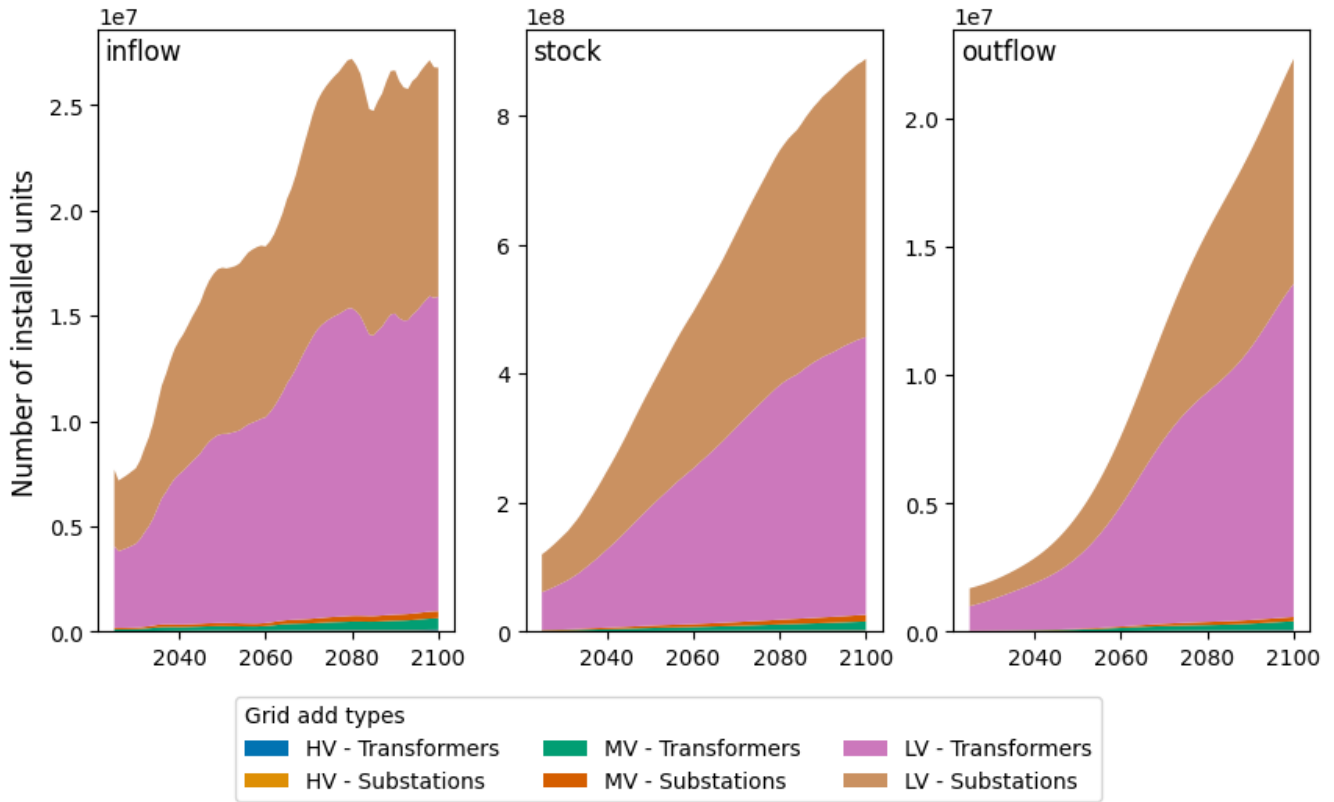


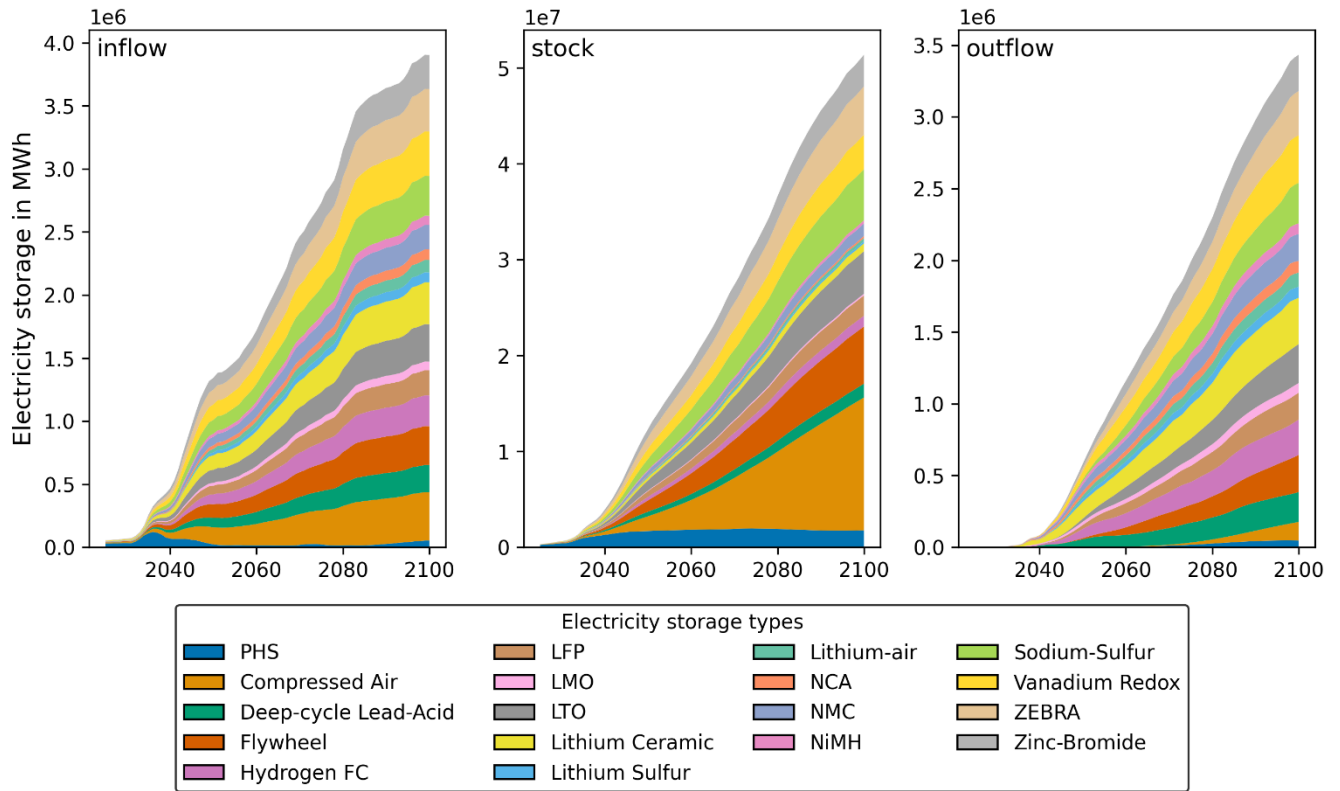
Figure S3: SSP2 baseline product inflow, stock and outflow of electricity grid lines in km

## S2.4 Electricity Grid Additions



45 **Figure S4: SSP2 baseline product inflow, stock and outflow of electricity grid additions such as transformers and substations in number of installed units. HV – high voltage, MV – medium voltage, LV – low voltage.**

## S2.5 Electricity Storage



50 **Figure S5: SSP2 baseline product inflow, stock and outflow of electricity storage in MWh. PHS: pumped hydropower storage, Hydrogen FC: hydrogen fuel cell, LFP: lithium iron phosphate battery, LMO: lithium ion manganese oxide battery, LTO: lithium titanium oxide battery, NCA: lithium nickel cobalt aluminium oxides battery, NMC: lithium nickel cobalt manganese oxides battery, NiMH: nickel metal hydride battery, ZEBRA: sodium nickel chloride battery**

### **S3 Product types split up per sector**

55 Below an extensive list of all

#### **S3.1 Buildings**

##### Residential

- Detached (urban and rural split)
- Semi-Detached (urban and rural split)
- 60 • Appartement (urban and rural split)
- High-Rise (urban and rural split)

##### Commercial

- retail +
- 65 • offices
- hotels +
- governmental +

#### **S3.2 Vehicles**

##### Passenger

- 70 • Bikes
- Passenger Planes
- Trains
- High Speed Trains
- Midi Buses (x engine types)
- 75 • Regular Buses (x engine types)
- Cars (x engine types)

##### Freight

- Freight Planes
- Freight Trains
- 80 • Small Ships
- Medium Ships
- Large Ships
- Very Large Ships

- Inland Ships
- 85 • Light Commercial Vehicles
- Medium Freight Trucks
- Heavy Freight Trucks

Engine subtypes

- Internal Combustion Engine (ICE)
- 90 • Battery Electric Vehicles (BEV)
- Plug-in Hybrid Electric Vehicles (PHEV)
- Hybrid Electric Vehicles (HEV)
- Fuel Cell Vehicle (FCV)
- Trolley (for busses)

95 **S3.3. Electricity**

Generation

- Solar PV (central)
- Solar PV (decentral/residential)
- CSP (concentrated solar power)
- 100 • Wind onshore
- Wind offshore
- Wave
- Hydropower (+ CHP)
- Other Renewables
- 105 • Geothermal (+ CHP)
- Hydrogen Power
- Nuclear
- Conventional Coal (+ CCS, CHP, CCS&CHP)
- Conventional Oil (+ CCS, CHP, CCS&CHP)
- 110 • Conventional Natural Gas (+ CCS, CHP, CCS&CHP)
- IGCC (coal integrated gasification combined cycle)
- OGCC (oil combined cycle)
- NG CC (gas combined cycle)
- Biomass/Waste (+ CCS, CHP, CCS&CHP)

- 115 • With CCS - carbon capture and storage and CHP - combined heat and power

Grid - All types for low, medium and high-voltage

- Overhead lines
- Underground lines
- Substations
- 120 • Transformers

Storage

- PHS (pumped hydropower storage)
- Flywheel
- Compressed Air
- 125 • Hydrogen fuel cell
- NiMH (nickel metal hydride battery)
- Deep-cycle lead-acid battery
- LMO (lithium ion manganese oxide battery)
- LTO (lithium titanium oxide battery)
- 130 • NMC (lithium nickel cobalt manganese oxides battery)
- NCA (lithium nickel cobalt aluminium oxides battery)
- LFP (lithium iron phosphate battery)
- Zinc-Bromide flow battery
- Vanadium Redox flow battery
- 135 • Sodium-Sulfur molten salt battery
- ZEBRA (sodium nickel chloride) molten salt battery
- Lithium Sulfur battery
- Lithium Ceramic battery
- Lithium-air battery

#### 140 **S3.4 Infrastructure**

- Paved road types (urban/rural)
- Unpaved road types (urban/rural)
- Parking types (urban/rural)
- Road bridges (urban/rural)
- 145 • Road tunnels (urban/rural)

- Rail lines
  - Rail bridges
  - Rail tunnels
  - High-speed rail
  - 150 • Urban rail
  - Obsolete roads (urban/rural)
  - Obsolete rail
  - Obsolete bridges & tunnels
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- 155 Infrastructure sub-types
- Motorway, primary, secondary, tertiary, local, pedestrian, bikepath, informal