THE POTENTIAL IMPACT OF DECARBONIZATION MEASURES IN SHIPPING ON STATES

EQUITABLE MARITIME CONSULTING

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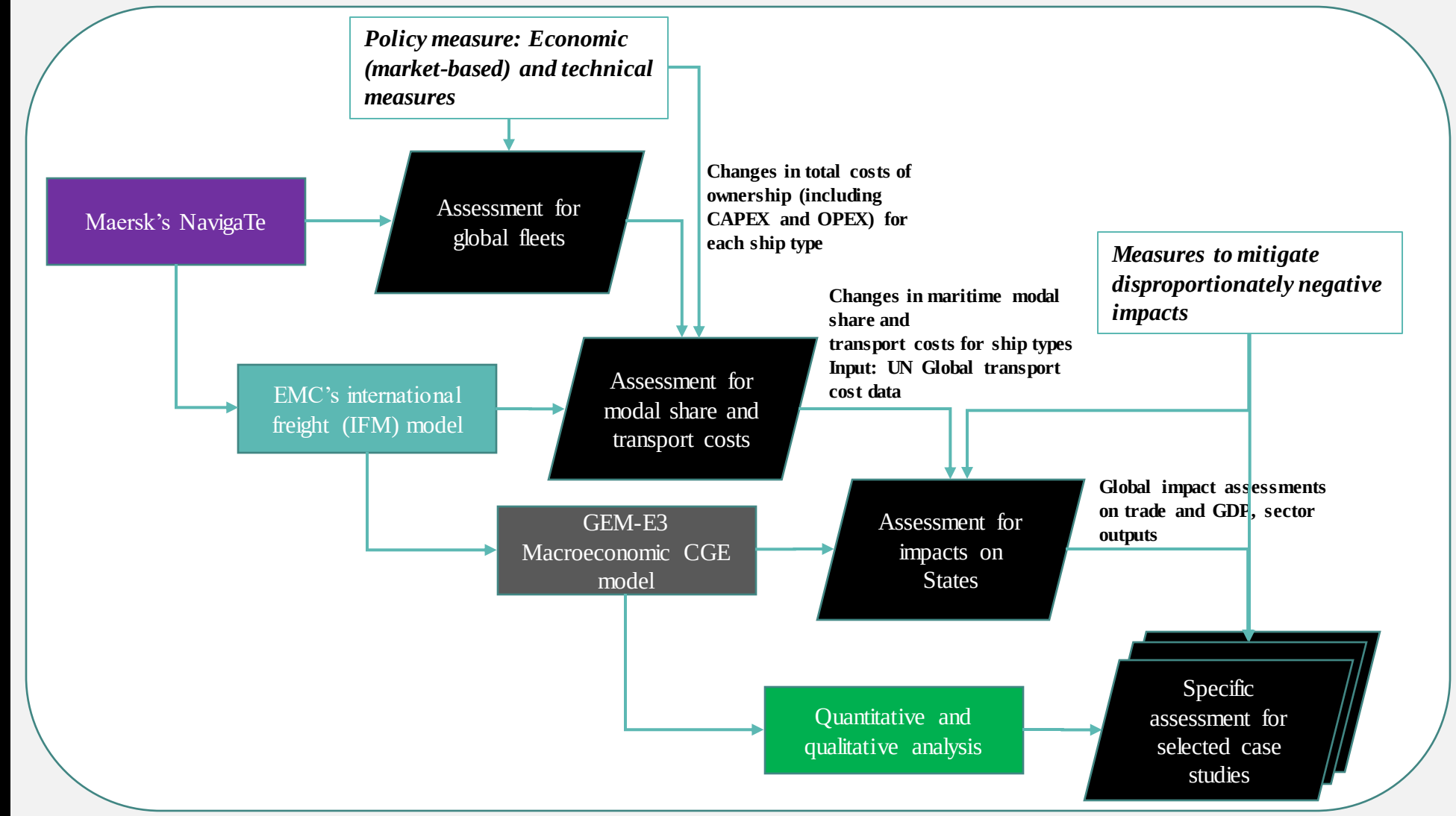
SCENARIO DESIGN

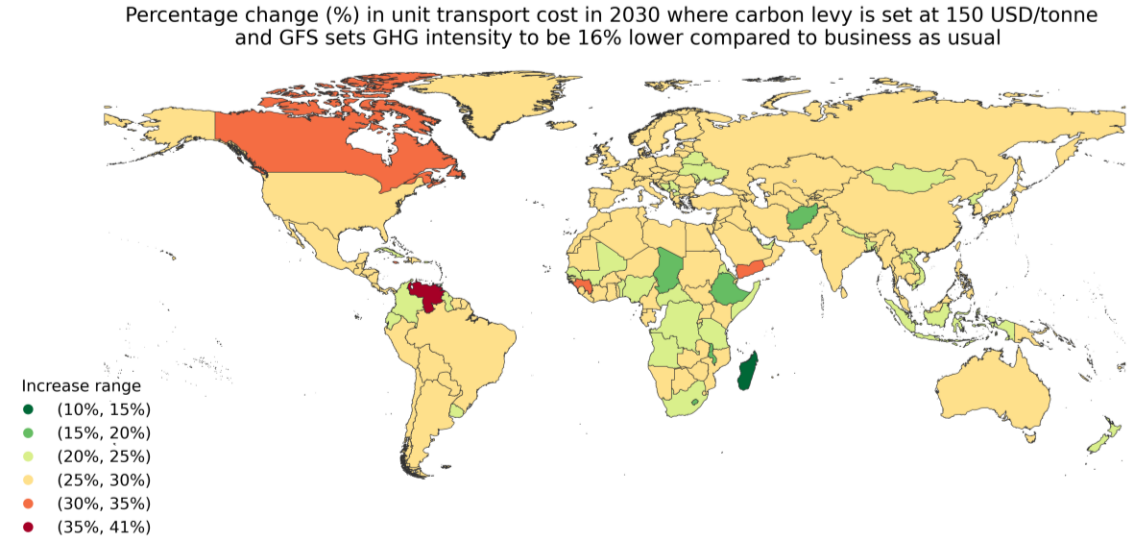
Code	Definition	Assumptions
0	Baseline	Short-term measures adopted at IMO (EEDI, EEXI, CII). CII reduction rate is increased by 2 percentage point per year from 2027 to 2030 in order to achieve the 2030 carbon. intensity target as in the comprehensive impact assessment. Economic outlook based on IMF, OECD long term projections for the non – EU economies. Climate scenario based on RCP 2.6.
Policy scenario	GFS + Carbon Levy with high 2040 reduction target	82% WTW GHG emissions reduction on 2008 levels by 2040. Carbon levy rate at 50 USD/tCO_2e before 2030, 150 USD/tCO_2e by 2030, and 200 USD/tCO_2e from 2030 until 2050.
Policy scenario + Revenue Recycling	GFS + Carbon Levy with revenue fully allocated to impact mitigation	100% of funds from the carbon levy allocated to impact mitigation measures, 50% in SIDS/LDCs and 50% in developing countries (other than SIDS/LDCs).

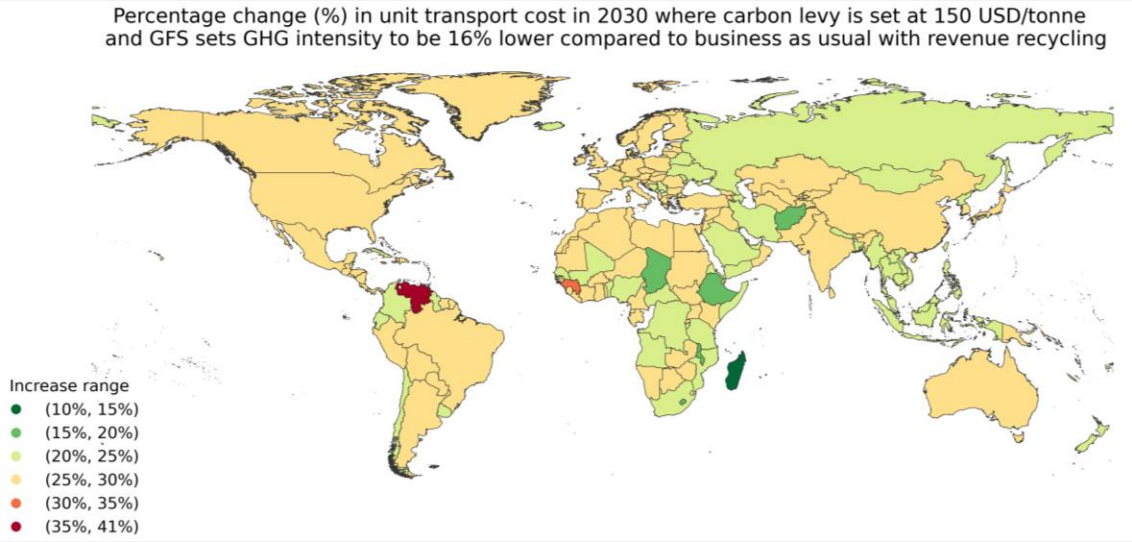
- We tested the impact of redistributing the revenues to mitigate the losses from increased transport costs in the form of state aid, improvement in port infrastructure, investment in zero carbon shipping **until 2050**

IMPACT ASSESSMENT METHODOLOGY: COMBINED FLEET-TRANSPORT-TRADE MODEL



IMPACT ON TRANSPORT COSTS BY 2030 WITH AND WITHOUT REVENUE RECYCLING

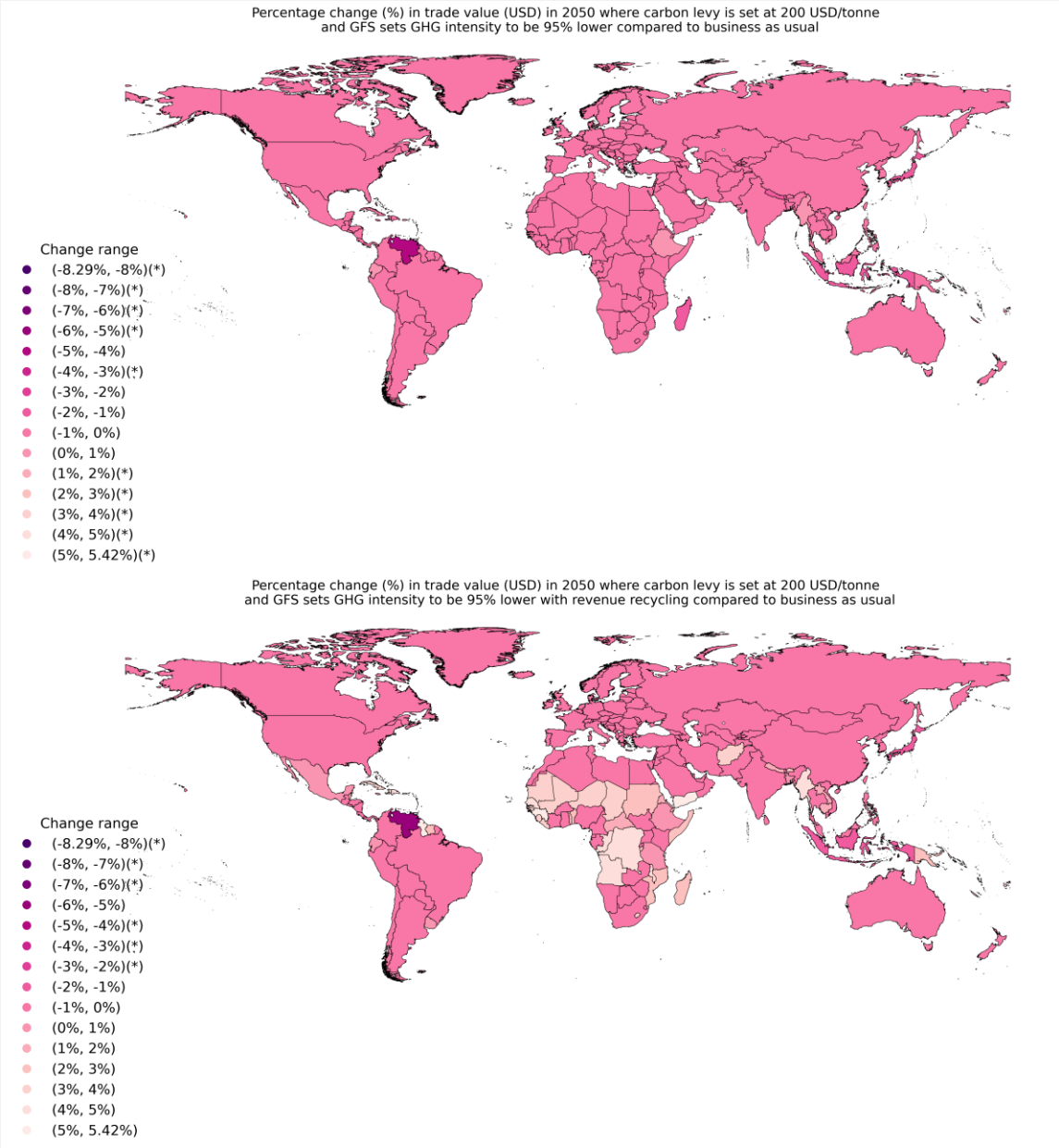




Increase in total cost of ownership	2030	2040	2050
Policy Scenario	29.1%	25.4%	5.9%

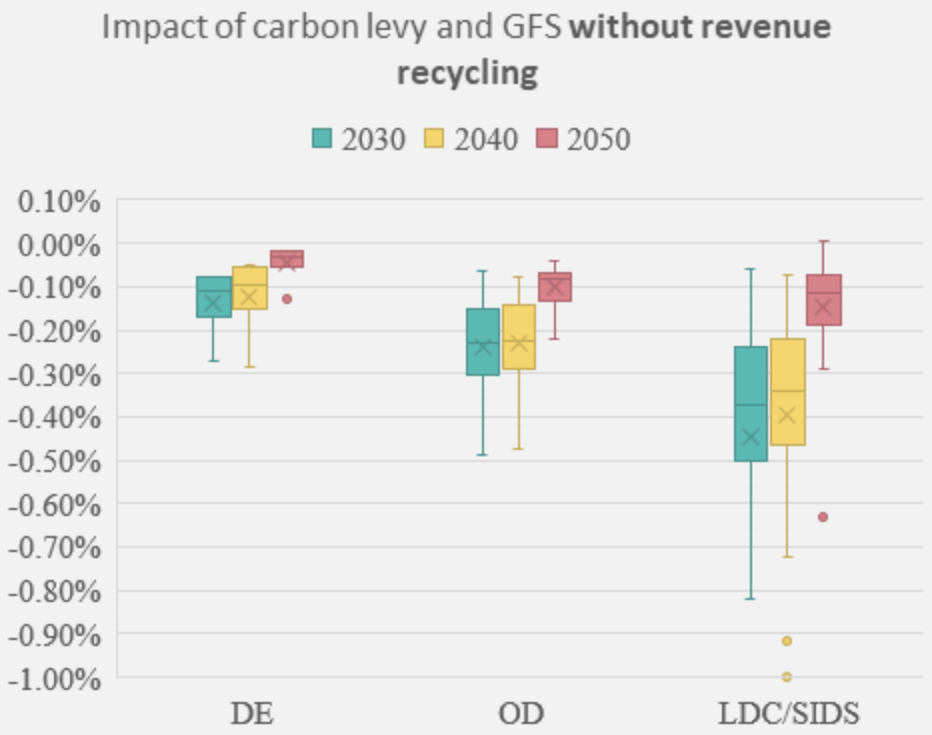
- A substantial shift in Canada's increase in UTC from the 30% - 35% to the 25% - 30% range.
- Russia experienced a noteworthy transition from (25% - 30%) to (20% - 25%).
- Several countries in the Middle East and Southeast Asia:
- Yemen, Saudi Arabia, Iran, Azerbaijan, Myanmar, Thailand, and Malaysia, also benefited from revenue recycling

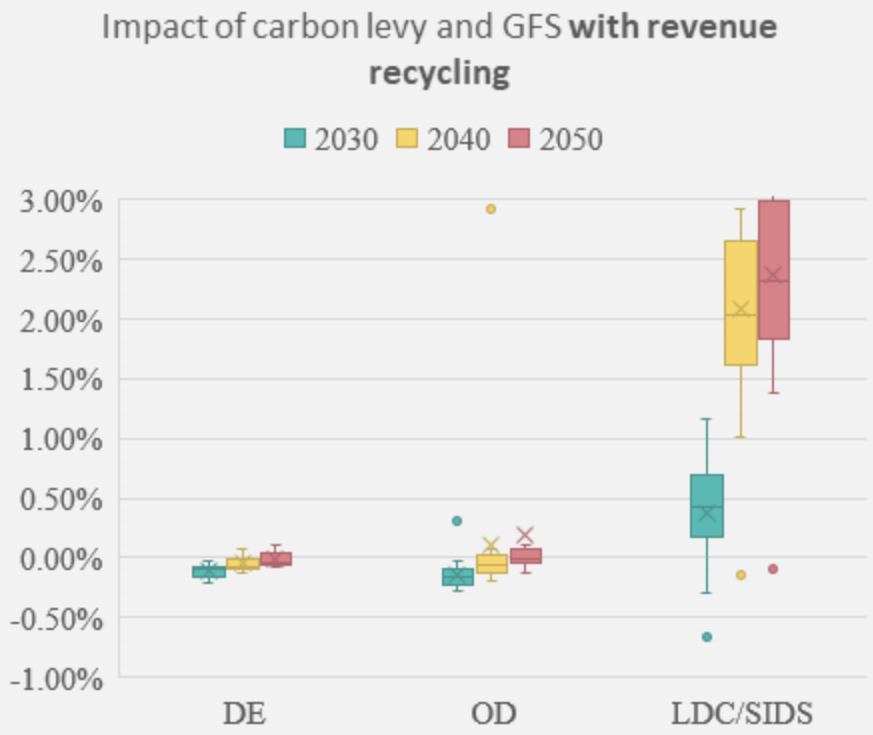
IMPACT ON EXPORT VALUES BY 2050 (IFM) WITH AND WITHOUT REVENUE RECYCLING



- By 2050 revenue recycling will provide **positive** impacts in export of **majority of African countries, and in least developed countries**
- Globally, negative reduction in export values will be **small** – within the range of 0– 2 percent.
- This is a significant mitigation from impacts seen in 2030
- Conclusions:
  - Allocation of revenues collected to countries will also affect the **competitive position of countries** in exporting their commodities
  - This, in turn, will also impact the trade and macro-economic indicators of importing countries
  - Depending on **how** revenues **can be distributed**, alleviation of negative impacts could be more **uniform** or **heterogeneous**.

IMPACTS ON GDP 2030-2050 – PRELIMINARY ANALYSIS





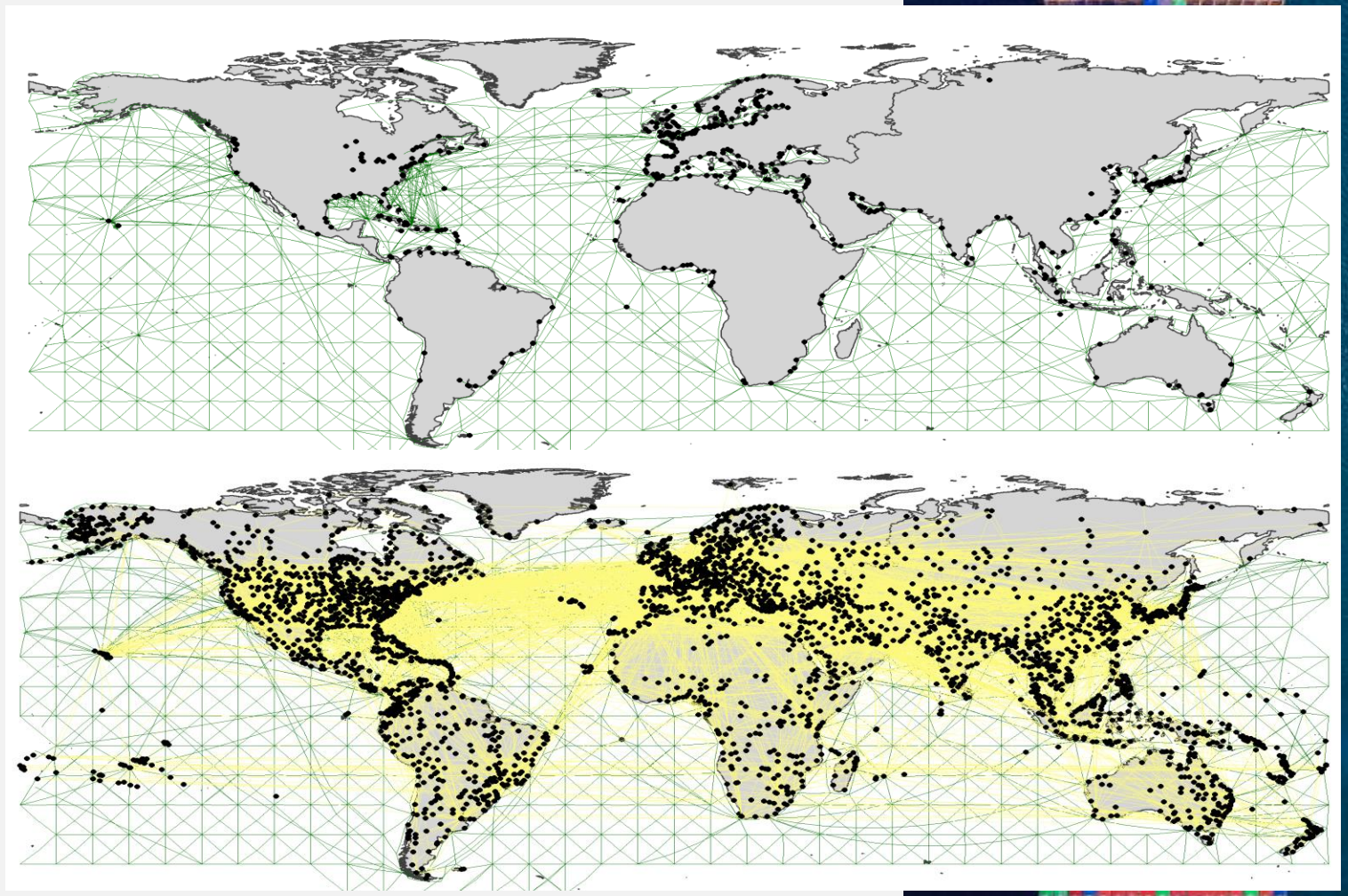
- DE: Developing and Emerging Economies
- OD: Other Developing Countries
- LDC/SIDS: Least Developed Countries/ Small Island Developing States
- **Carbon levy is increased gradually from 150 USD/tonne in 2030 to 200 USD/tonne by 2050**
- **Note: This analysis is carried out using a CGE model which aggregates several countries together to keep model complexity and running time manageable.**
- **GDP impact of individual countries will need to be modelled in disaggregate manner to be able to arrive at a more robust conclusion on impacts**

END OF PRESENTATION

GLOBAL MULTIMODAL NETWORK MODEL

Coverage

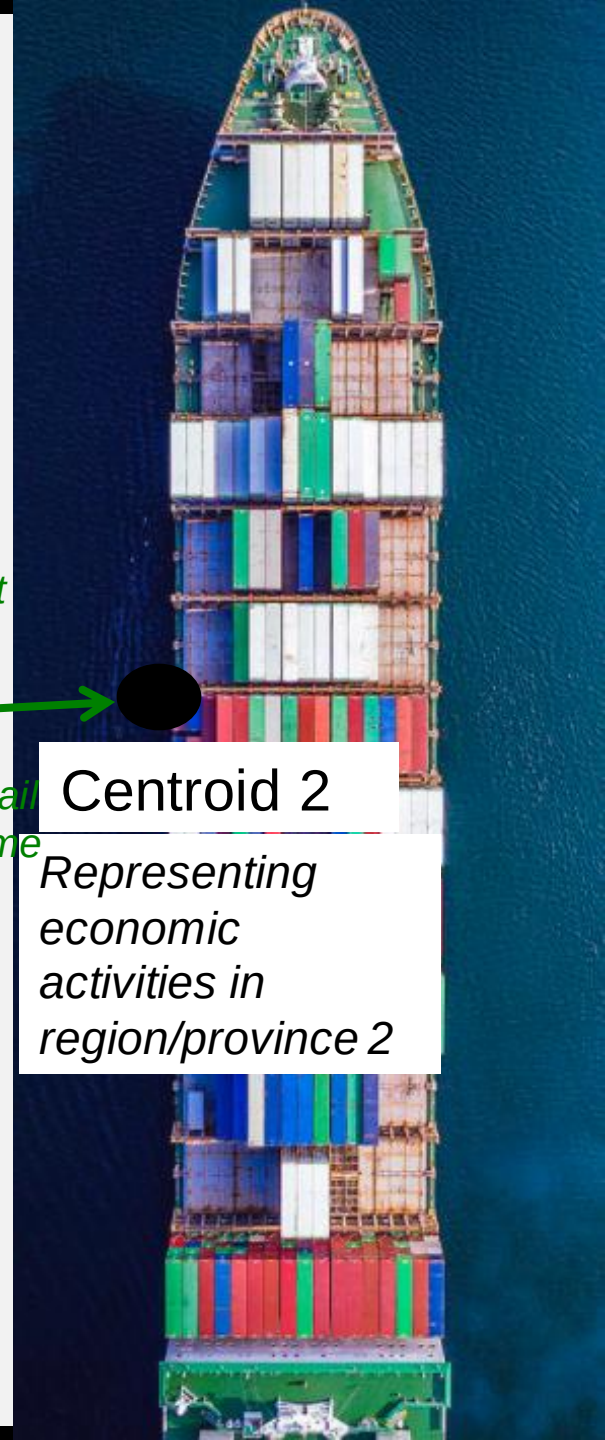
- Weight-value model, mode choice model, route choice model based on Multinomial logit models
- 226 countries worldwide
  - 20 SIDS (Small Island Developing Countries)
  - 47 LDCs (Least Developed Countries)
  - 15 LLDCs (Landlocked Developing Countries)
- Modes and routes
  a) Road (highways or main roads)
  b) Rail (station, network)
  c) Sea (ports, routes)
  d) Air (airports, commercial flights)
- Differential speeds by mode, infrastructure and continent
- Routable O-D network
- Includes dwelling times between modes
- Used to estimate travel distance and time for each mode

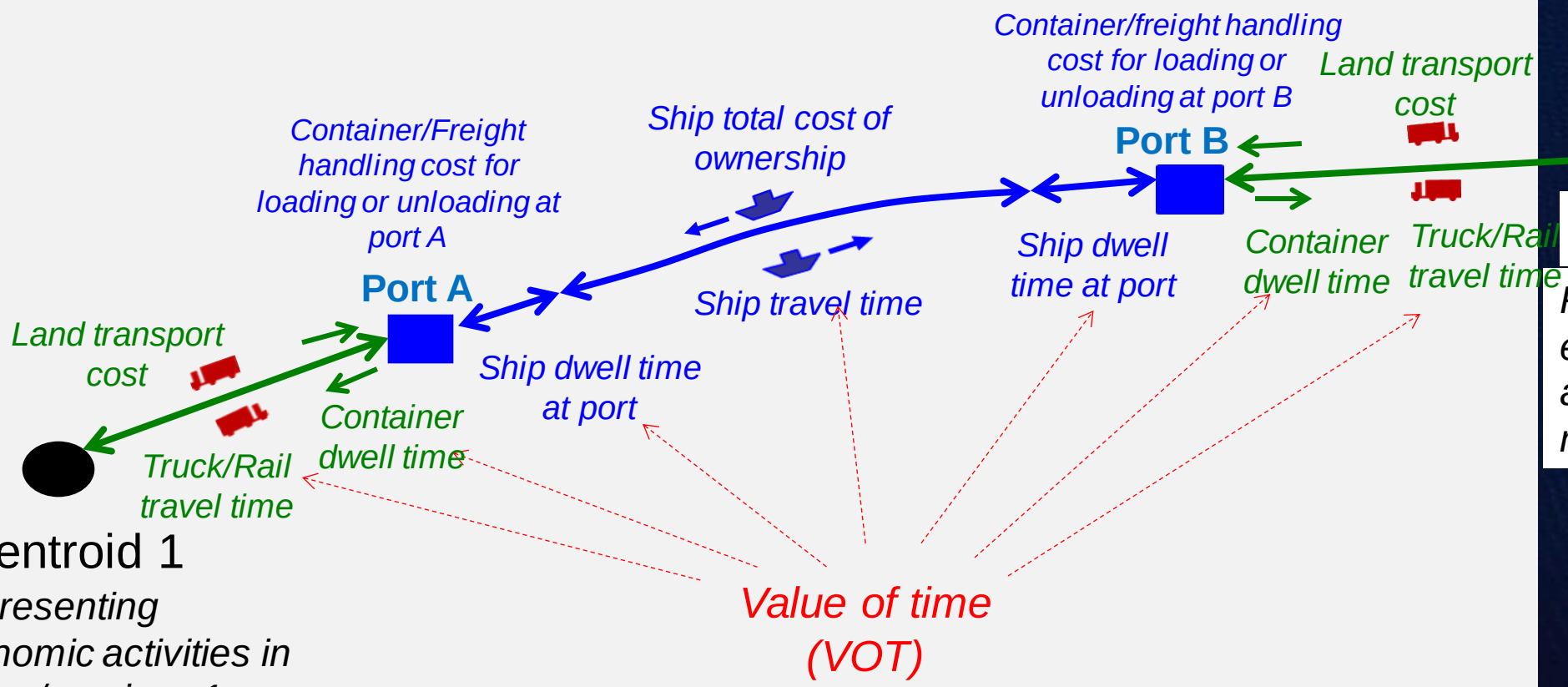


Source: ITF International Freight model
OpenStreetMap, OpenFlights, Sea Project, UCL

SCHEMATIZATION OF TRANSPORT CHAIN

- Based on trade between 431 zones worldwide, covering 226 countries
- Multi-modal chain determined by multiple routes which minimizes generalized transport costs, **data is obtained from UNCTAD/WB transport costs database**
- Implemented for the global network, this example: a multimodal maritime network





SUGGESTIONS ON ASPECTS THAT NEED TO BE TAKEN INTO ACCOUNT (1)

1. Align **baseline** trade scenario with the **Paris-aligned** trade projections

- Certain Shared Socio-Economic Pathways (SSPs) and Representative Concentration Pathways (RCP) scenarios will project **lower** trade of fossil-fuel based commodities

2. Take into account the **heterogeneous proportion** of maritime transport costs to the total logistics costs across routes worldwide

- Maritime transport costs is a fraction of total logistics/trade costs, routes with low port efficiency typically have higher fraction of port costs in the total logistics/trade costs.

3. Use modal share assumption in trade model based **on the most up-to-date database**

- Modal share assumption **will impact** transport costs and seaborn trade value calculation.
- In most economic trade model, GTAP database on modal share is used (which can be outdated or not accurate). This may need to be updated for better reliability

SUGGESTIONS ON ASPECTS THAT NEED TO BE TAKEN INTO ACCOUNT (2)

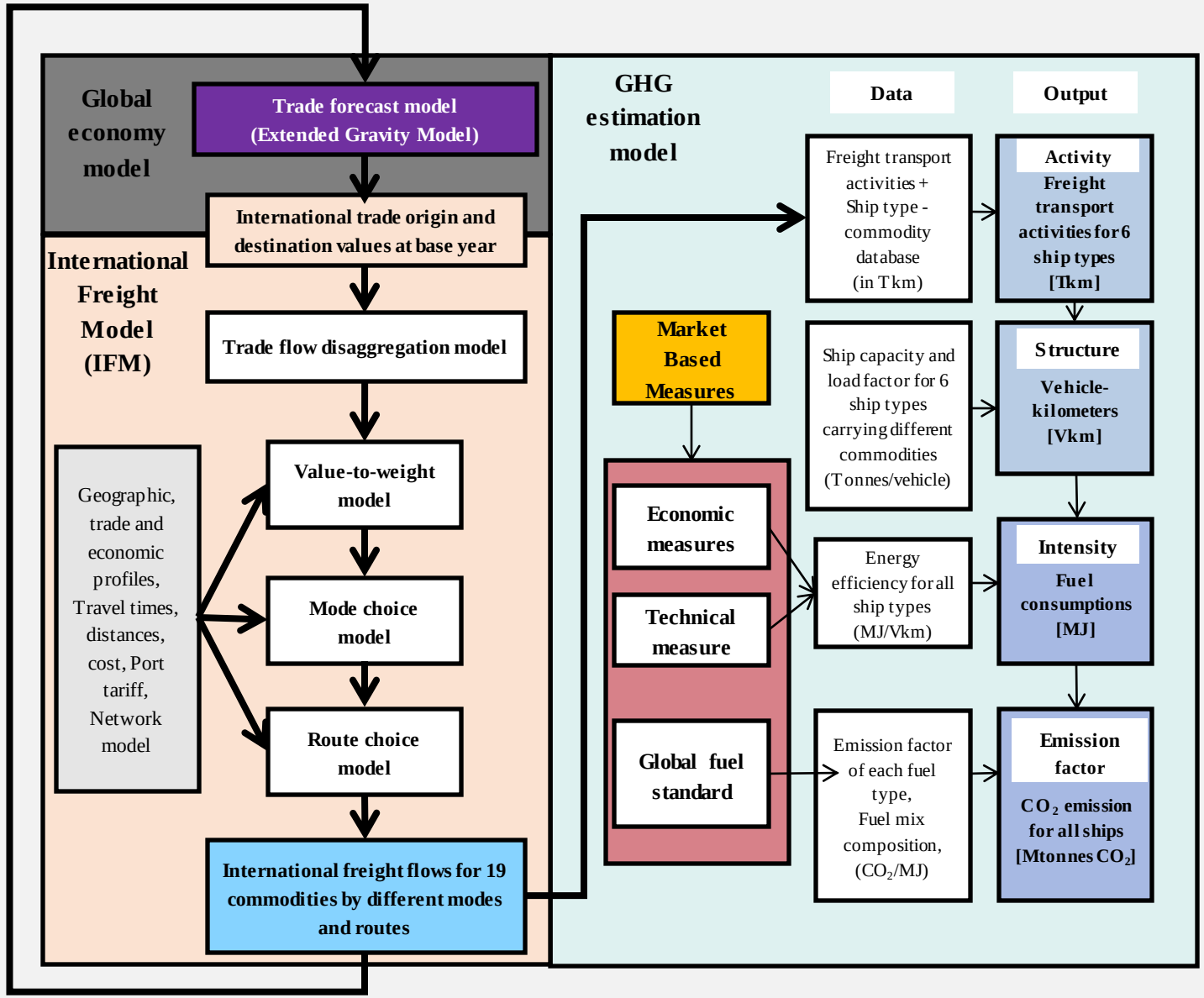
4. Take into account the impact of the measures on **Mode** and **Route** shift

- Shift from sea transport to other more polluting modes such as air transport **could** res in higher total emissions
- The implementation of economic measures (e.g. carbon levy) could induce shift in route and port choices which in turn could impact market of competing ports

5. Use as **granular disaggregation** as possible especially for SIDS and LDCs.

- There are many SIDS which are often aggregated under Oceania in GTAP while havi different socio-economic characteristics, and import and export commodities

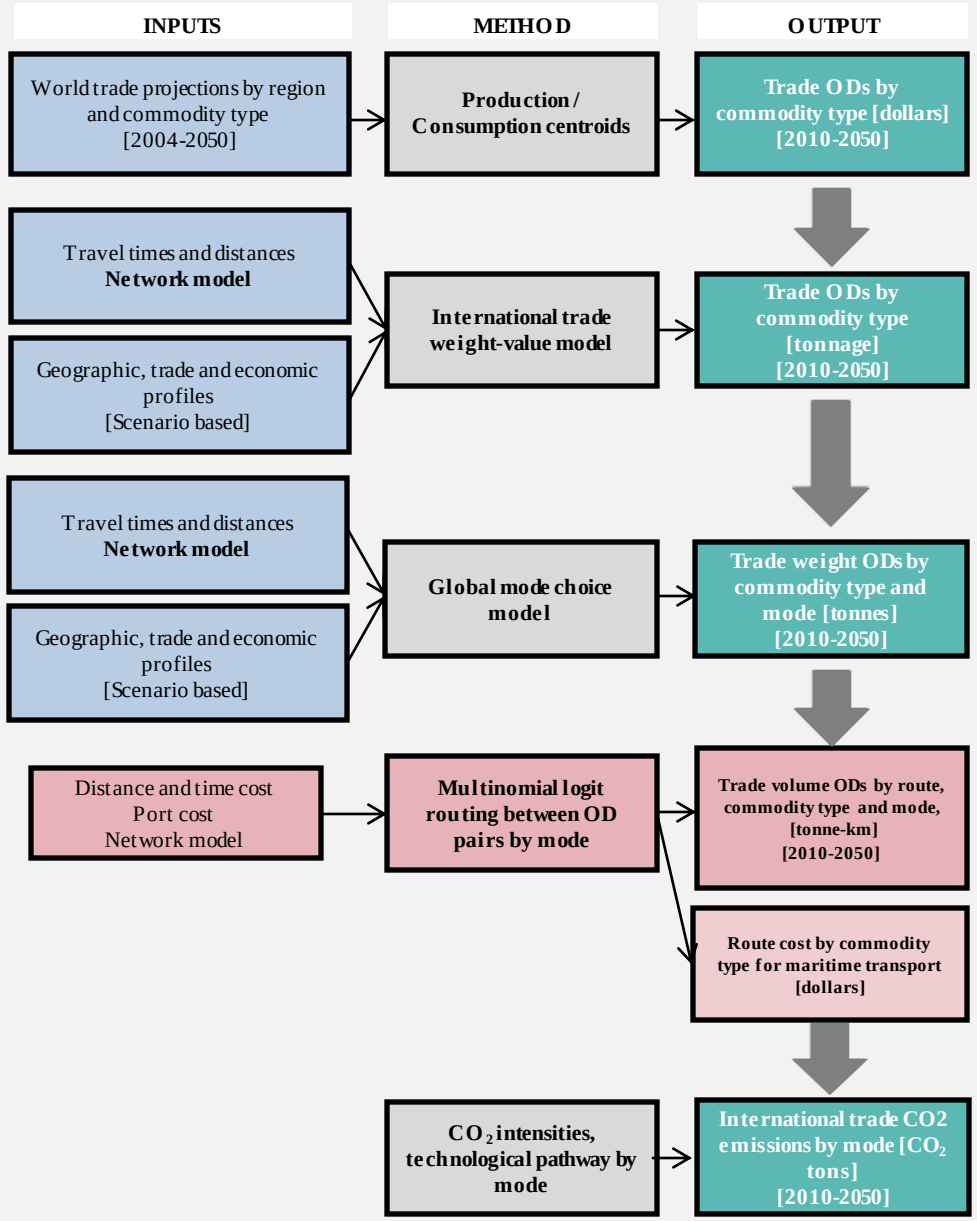
EMC'S TRADE, TRANSPORT, EMISSION MODEL



Combined models capable to assess impacts on:

- Transport costs
- Trade (Import and Export) volume
- Macroeconomic impacts such as GDP
- Shipping activity and connectivity
- GHG emissions from shipping activity
- Total economic costs of measures

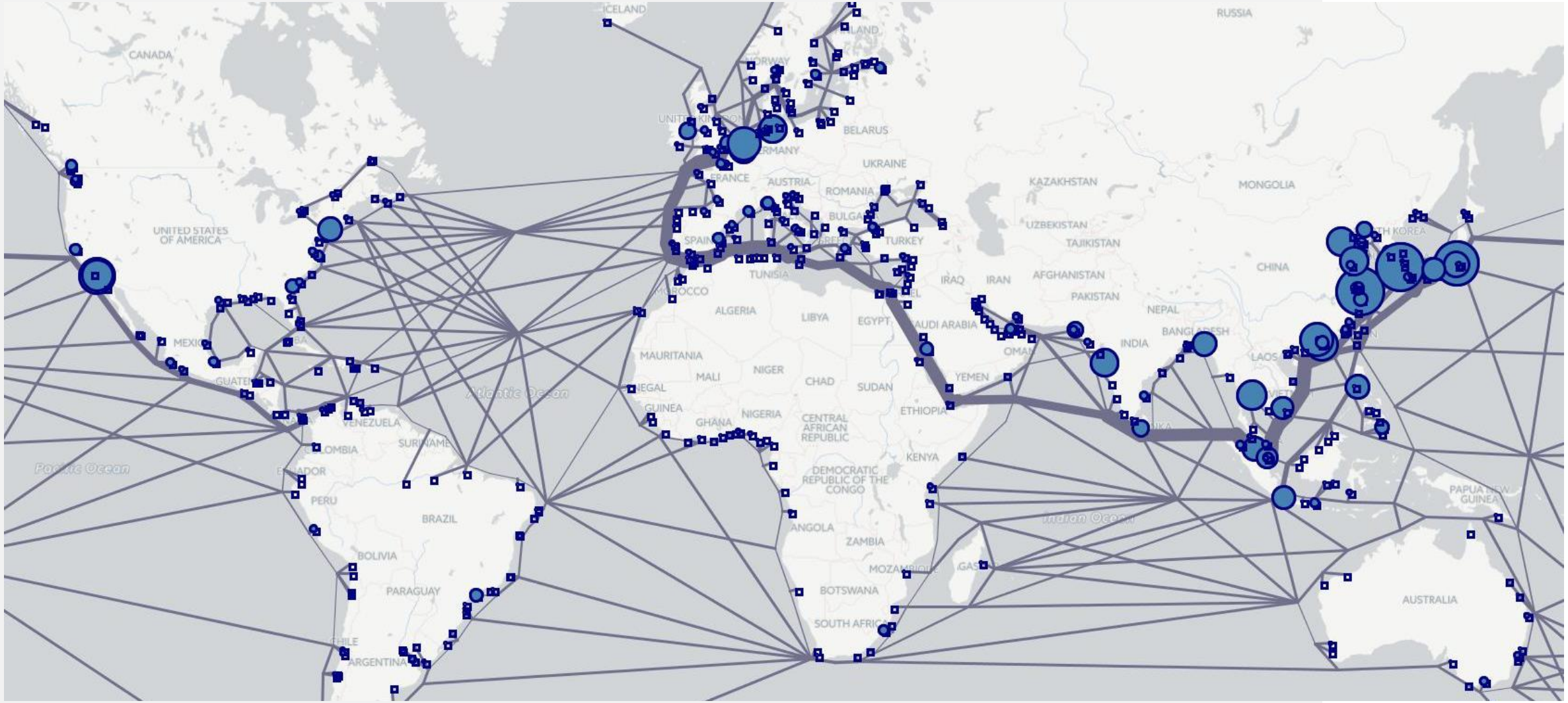
INTERNATIONAL FREIGHT MODEL



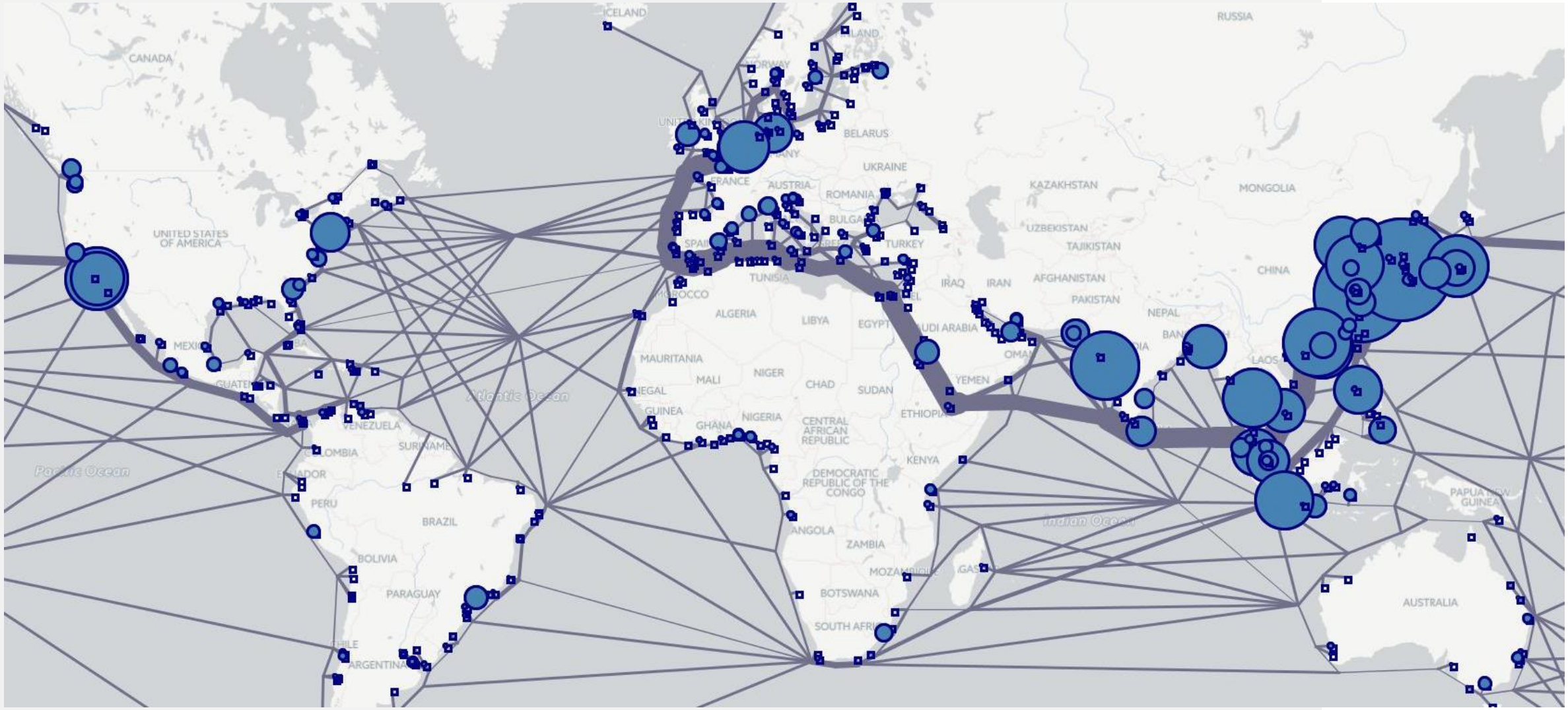
- Based on the classical 4-step freight transport modeling approach
- **226** Countries**, 431** origin/destination, **4** modes, and **19** commodities
- Based on OECD trade and GDP projections.
- Mode choice model is estimated based on the UNCOMTRADE database: Multinomial logit model for each commodity type.
- Weight-value model is estimated using the same database based on a regression model.
- Routing model is based on Multinomial logit choice model.
- Makes use of:
  - Cost information: Distance, time, language, trade agreement, contiguity, and fixed effects for different modes
  - Carbon intensity and technological pathways from IEA and UMAS
- The model is calibrated and validated at ports level (480 major ports).
- The model is implemented is in Java

IFM IS THE ONLY GLOBAL MODEL WHICH INCLUDES SIDS AND LDCS EXTENSIVELY

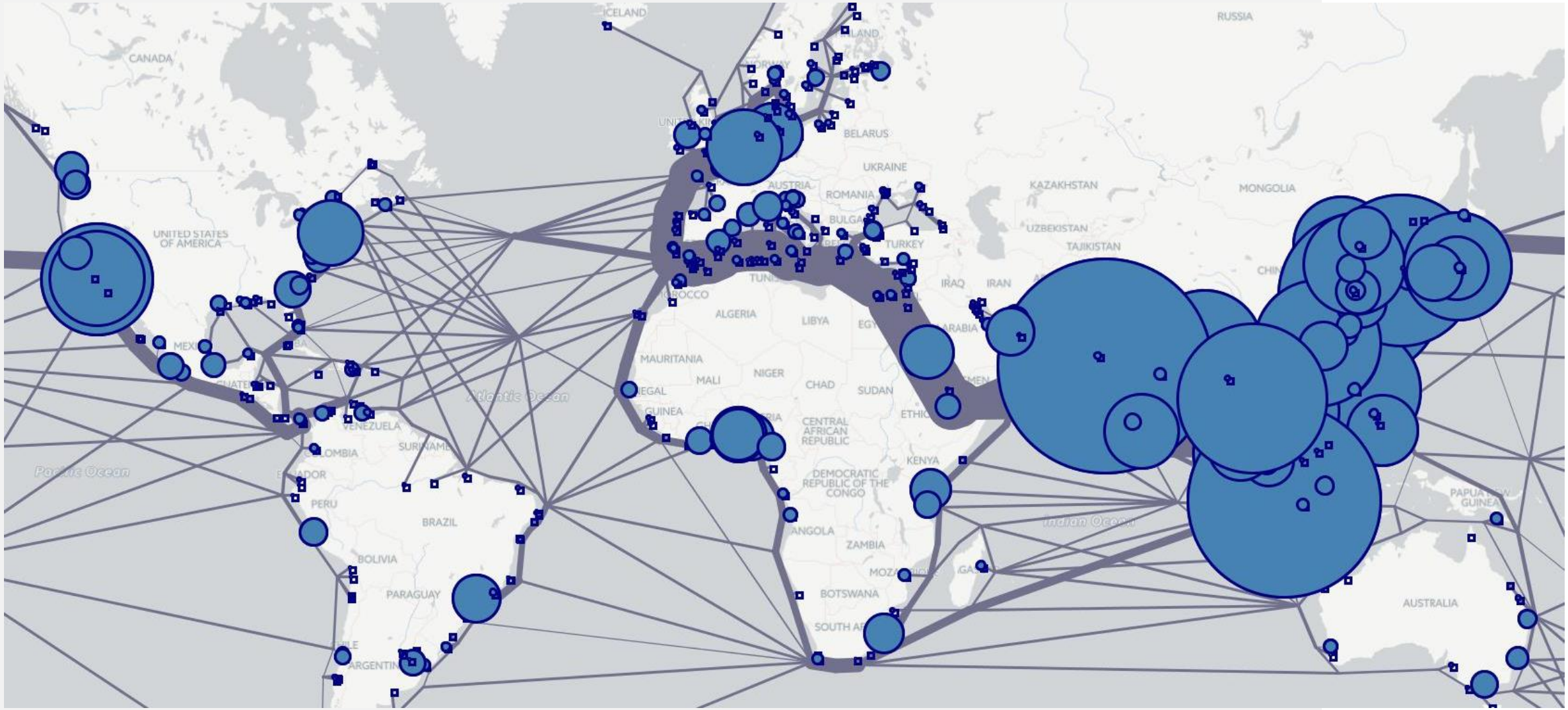
SID			LDC				LLDC	
JAM	MDV	BGD	CAF	MLI	SEN	TLS	TJK	MKD
MUS	CPV	KHM	LAO	COD	SDN	GNB	MDA	TKM
TTO	DMA	ETH	SLB	SOM	TZA	LBR	PRY	KGZ
BRB	FSM	GIN	MWI	UGA	YEM	MRT	AZE	BWA
KNA	FJI	HTI	NPL	SLE	ZMB	NER	BOL	SWZ
LCA	MHL	MOZ	TGO	BFA	MDG	KIR	MNG	
VCT	NRU	MMR	BEN	RWA	BDI	TUV	ARM	
BHS	PLW	AFG	ERI	SSD	COM		KAZ	
GRD	WSM	AGO	STP	VUT	DJI		UZB	
SYC	TON	TCD	BTN	LSO	GMB		ZWE	



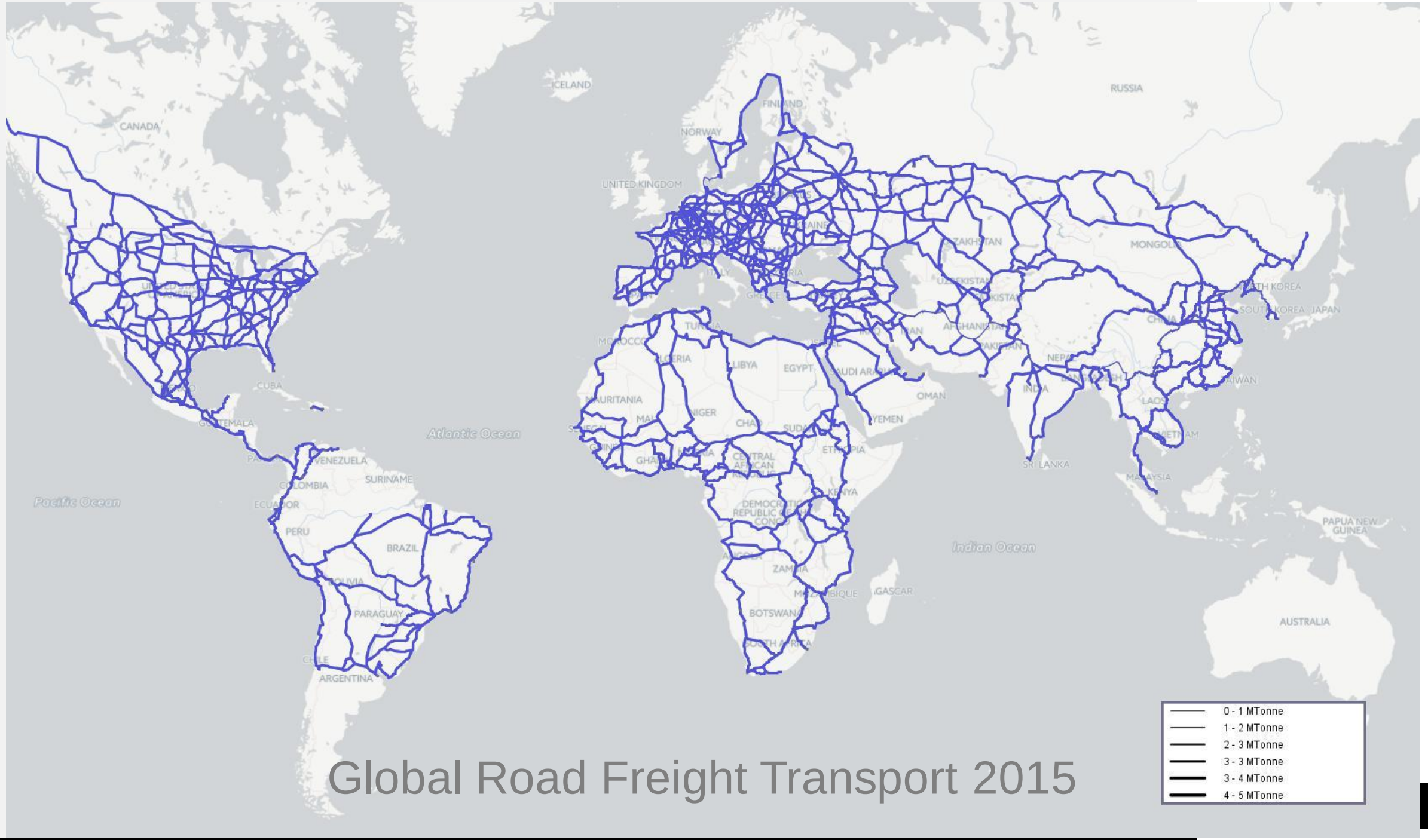
Global Maritime Freight Transport 2015



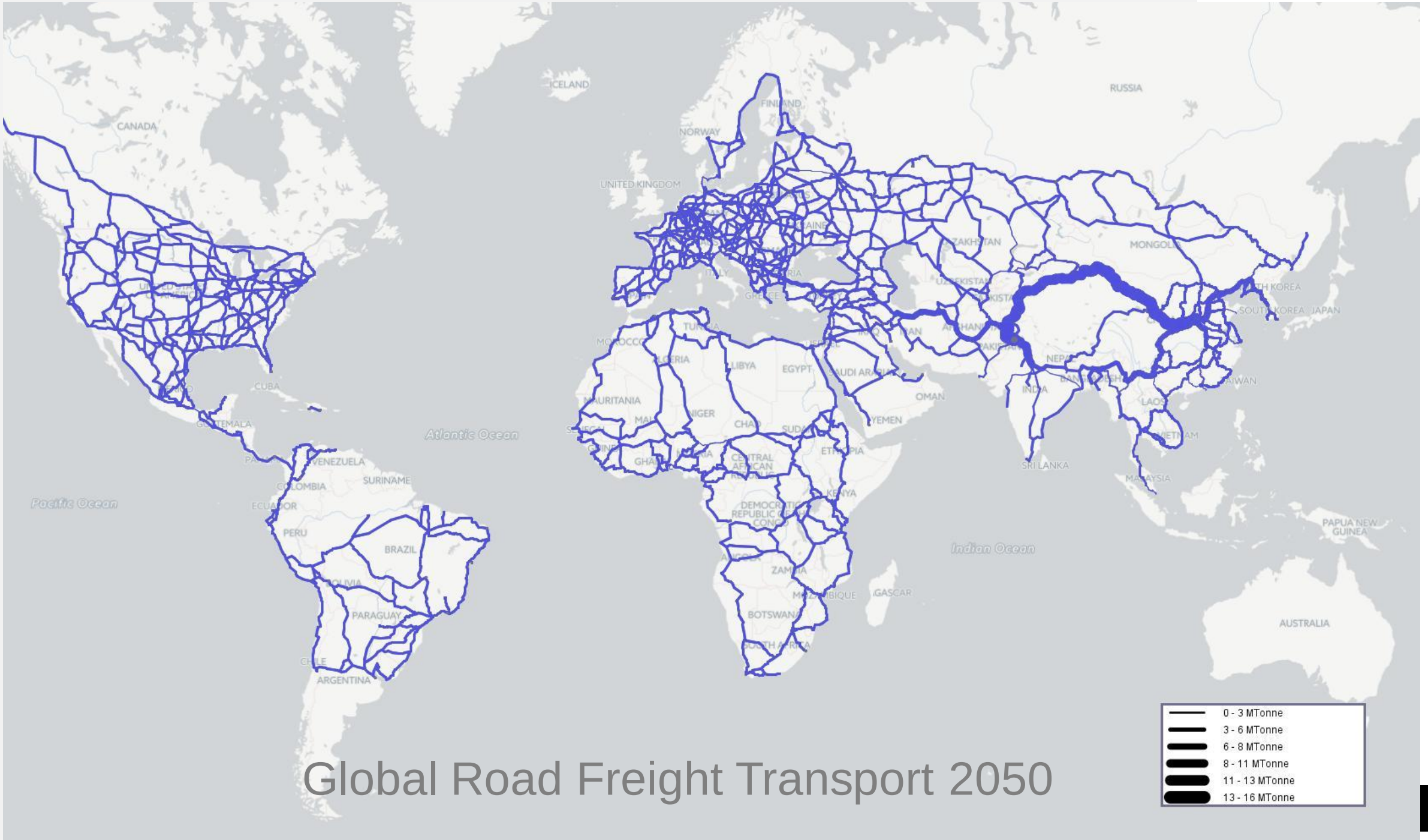
Global Maritime Freight Transport 2030



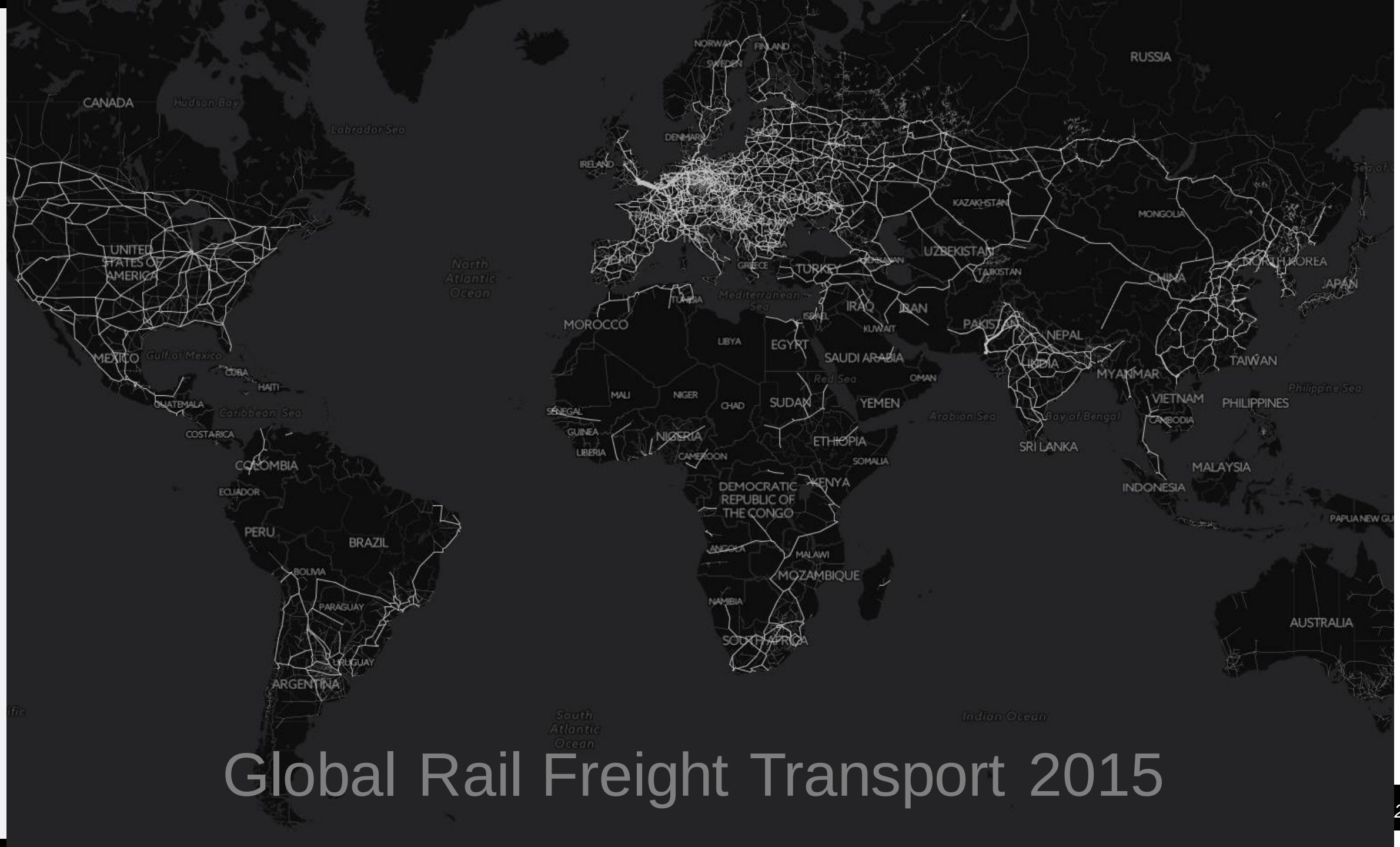
Global Maritime Freight Transport 2050



Global Road Freight Transport 2015



Global Road Freight Transport 2050



Global Rail Freight Transport 2015

Global Rail Freight Transport 2050