

# DECARBONIZING INTRAREGIONAL FREIGHT SYSTEMS WITH A FOCUS ON MODAL SHIFT

## TOPICAL REVIEW

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# SURFACE FREIGHT GHG EMISSIONS

## Motivation:

- Road freight 7% of total energy-related GHG emissions [IEA, 2017]
- Difficult to decarbonize

## Reduction strategies [McKinnon, 2016]:

- 1) reducing the demand for freight transport
- 2) improving vehicle use and loading
- 3) increasing the efficiency of freight vehicles
- 4) reducing the carbon content of fuel used to transport freight
- 5) **shifting freight to low carbon-intensity modes**



Picture: own

# MODAL SHIFT

- **Difference in carbon intensity:**  
rail < water < road
- **Often multimodal or intermodal**
- **Long-haul freight**
- **Freight activity: tonne-km**
- **Freight activity dataset (157 countries of which 75 road)**
- **World modal split: 60:40 (road:rail)**

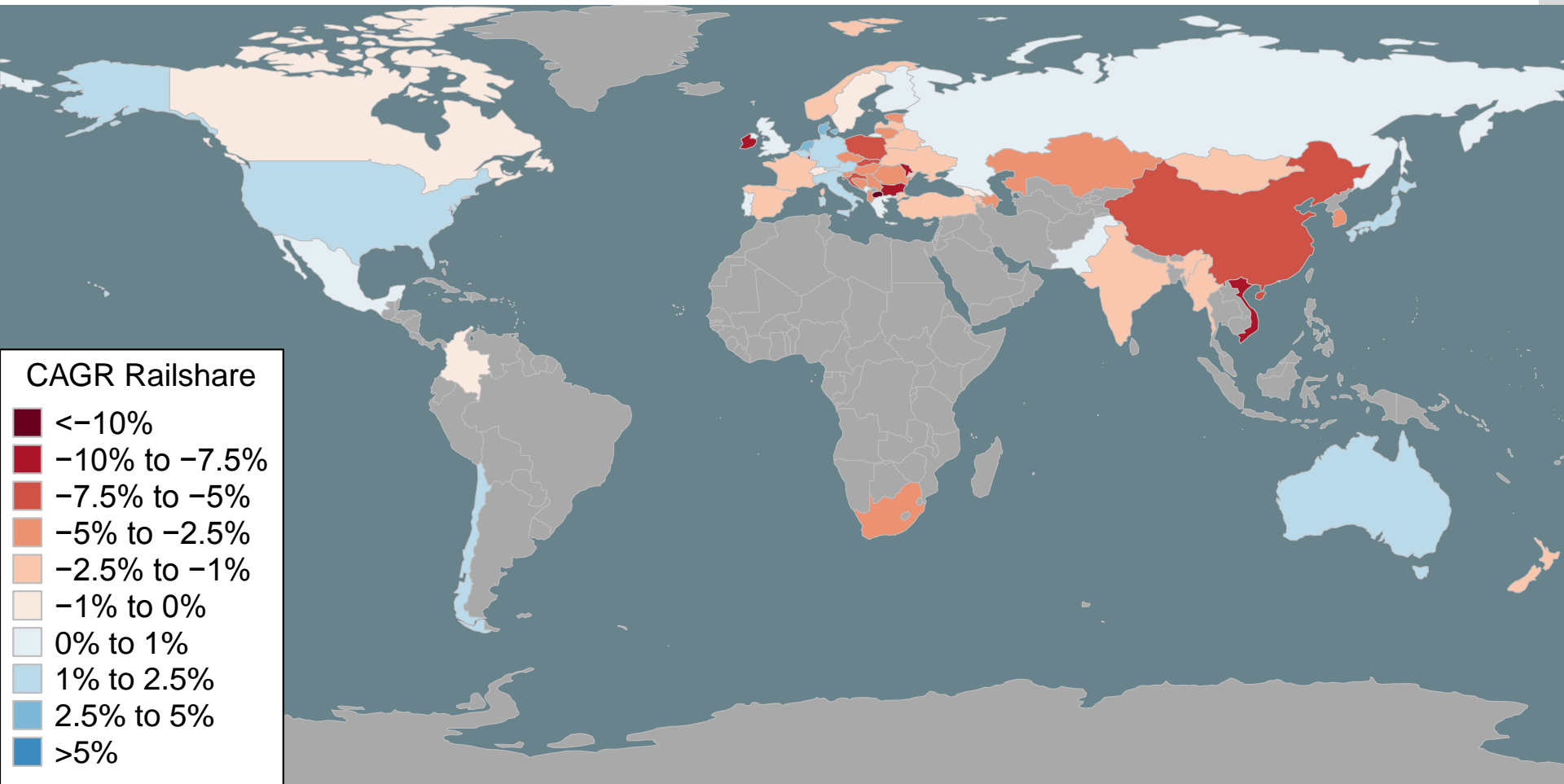


Picture: Wikimedia Commons

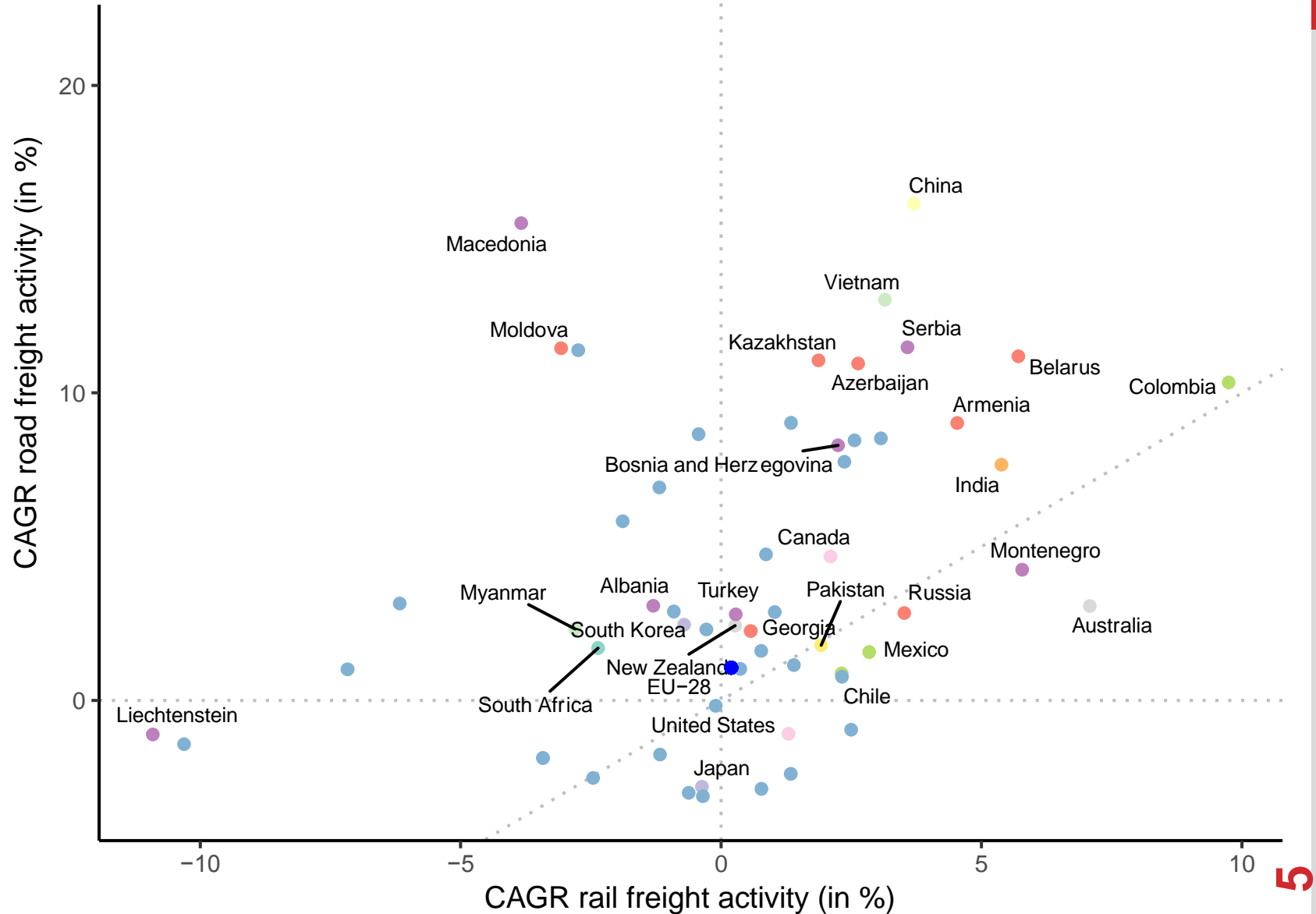
# MODAL SPLIT TRENDS

Growth rate of rail share of total land transportation (tonne-km)

red → share of rail decreased since 2000



# COMPOUND ANNUAL GROWTH RATES (CAGR)



# **MODAL SHIFT STRATEGIES**

- **INFRASTRUCTURE INVESTMENTS**
- **INCENTIVES**

# INFRASTRUCTURE INVESTMENTS

- 1. Shorten transit time on rail and intermodal and increase reliability**
- 2. Improve other quality of service attributes: frequency, safety, specialized handling**
  - Infrastructure investment in multimodal connectivity: for example intermodal terminals and dry ports
  - Intermodal operations research and planning
  - Information and communication technology (ICT) (container tracking, intelligent transport systems, logistics market places)
  - Integration of services between modes (*sychromodality*)

# INCENTIVES

## 1. Address distorted pricing

- GHG pricing and internalizing external costs
  - Motor fuel taxes
  - Road user charges / tolls
- Labor rules
- Truck size and weight regulations
- Regulation and subsidies of low-carbon freight modes

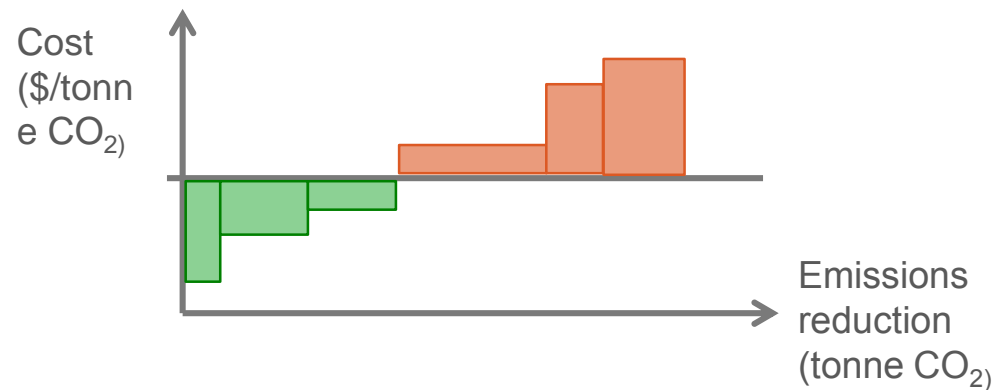


**MOST IMPORTANT QUESTIONS FROM REVIEW**

# **RESEARCH NEEDS**

# HOW MUCH CO<sub>2</sub> EMISSIONS CAN WE REDUCE WITH MODAL SHIFT?

- Some regional and national estimates and targets exist
- Systematic analysis of the possible GHG emissions reductions and costs – globally
- Marginal GHG abatement cost curve for road freight w/ modal shift and ICTs



# WHICH POLICIES WORK? AND WHERE?

- Empirical evidence for success or failure of modal shift strategies
- Problem: policies widely underused (except in EU)
- No uniform approach to modal shift around the world
  - Rail systems unique
  - Road freight more similar (private, fragmented), but different degrees of technical and operational development
  - Infrastructure investments in less developed vs. incentives in more developed freight markets [Liedtke & Murillo 2012]
- Construct effective policy packaging
- (Adverse) interactions with other decarbonization strategies

# HOW TO ENCOURAGE LOW-CARBON FREIGHT IN DEVELOPING COUNTRIES?

- Developing countries high growth rates in freight transport - mostly road
- Freight important economic driver
- Inland freight transport is large cost factor in international trade
- Competitive advantage of road: low entrance barrier, low wages, little regulation (or enforcement)
- Leapfrogging possible by constructing low-carbon freight systems?

Picture: Standard  
<https://www.standardmedia.co.ke/business/article/2001294214/how-sgr-has-hit-city-s-economy>



# WILL THE DECLINE IN COAL HURT RAIL?

## **Coal:**

- Most important commodity for rail in many countries
- Current and possible future decline in coal consumption in North America, Europe
- Increase in Asia

## **Coal decline in North America:**

- can result in track closures, stranded infrastructure assets,
- can free up rail or water capacity

## **Other disruptive changes in commodity demands**

# HOW DO WE GET MORE AND BETTER DATA?

- Dataset national freight activity: 152 rail, 75 road (83% GDP), 51 water
- Data obtained through surveys
- Standardized survey (Common Questionnaire for Inland Transport Statistics, UN Economic commission for Europe, ITF Eurostat)
- My current research: counting trucks on satellite images (with machine learning)



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*Environmental Research Letters*, 13(8), 083001.

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