DECARBONIZING INTRAREGIONAL FREIGHT SYSTEMS WITH A FOCUS ON MODAL SHIFT

TOPICAL REVIEW

L. H. Kaack, P. Vaishnav, M. G. Morgan, I. L. Azevedo and S. Rai

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
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)
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 (*synchromodality*)
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 CO₂ 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)
ACKNOWLEDGEMENTS

• Center for Climate and Energy Decision Making (CEDM) through cooperative agreement between the National Science Foundation and Carnegie Mellon University (SES-0949710)

• Participants in a CEDM Workshop on decarbonizing freight in February 2017

CONTACT

Lynn Kaack
PhD Candidate
E-mail: kaack@cmu.edu

ADDITIONAL REFERENCES


Liedtke G and Murillo D G C 2012 Assessment of policy strategies to develop intermodal services: the case of inland terminals in Germany Transp. Policy 24 168–78