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ORIGINAL ARTICLE

# Studies on the impact of road freight transport and alternative modes in Australia: a literature study

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**Abstract** The freight sector in Australia has been growing at an ever-increasing rate due to domestic and international demand for goods, commodities, and resources. Increased volume of traffic comes with increased greenhouse gas. Greenhouse gas impacts climate change and air pollution, increasing the risk of public health and safety. The European Union used Marco Polo to shift transit freight from road to sea, rail, and inland waterways to reduce the number of trucks on the road to lessen congestion, less pollution, and more reliable and efficient transport of goods. Fuel Tax Credit was similarly introduced in Australia to address some of these issues. It is now time to analyse the impact of these schemes. This paper is a systematic literature review using the Mixed Method Appraisal Tool and Critical Appraisal Skills Programme. Findings include using alternative modes of transport for long distances reduces carbon dioxide and the likelihood of using renewable fuels like electric and hydrogen fuel for trucks. However, research was limited on renewable fuels.

**Keywords** Carbon dioxide · Intermodal freight · Road fuel tax credit (FTC) · Marco polo programme · Environment · Risk to health and safety

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## 1 Introduction

The freight sector in Australia has been growing at an ever-increasing rate due to domestic and international demand for goods, commodities and resources. Increased volume of traffic comes with increased greenhouse gas pollution. Greenhouse gas impacts climate change, and this air pollution affects public health. Barnett (2014) suggested that "It's safe to say there is no safe level of air pollution". Pachauri and Meyer (2014) established that even though the Earth could remove 60% of atmospheric greenhouse gas concentrations via plants, trees, and oceans, 40% would still be lying dormant in the lower atmosphere. Furthermore, it is possible that 40% would still cause devastating consequences to the Earth's natural assets. These disasters may include altering the effects of:

- Precipitation and level of groundwater
- Amount of freshwater and marine species
- The intensity of acid rain
- Food crop failures due to drought, and
- The rise in sea levels caused by ice melting engulfing seaside and low-level land areas

During the 1990s, transporting freight by truck in and around Europe was the primary mode of transport causing major congestion, reduced economic efficiency and one of the main instigators of greenhouse gas by increasing carbon dioxide ($CO_2$) pollution. The Commission of the European Communities (2005) drafted an intermodal freight programme called Marco Polo, as it abided by the requirements of the Kyoto Protocol "of preventing "dangerous" human interference with the climate system". It aimed to shift freight transport from the road to sea, rail and inland waterways for reducing number of trucks on the road with

an aim to less congestion, less pollution, and more reliable and efficient transport of goods.

Australia believed it could abide by the Kyoto Protocol agreement by introducing a road freight, Fuel Tax Bill (C. o. 2006) credit (FTC) to address some of these issues. It worked in conjunction with the Greenhouse Challenge Plus Program (1995) that was voluntary business based. However, neither of the Bill's required long-distance road freight to be shifted to a less $CO_2$ emitter. It is now time to analyse the impact on these schemes. This paper covers literature review and discusses the findings of this review with focus on the impact of alternative modes of transport on the natural assets covering the environment and public health in general and Australia in particular.

Australia's department of Energy and Environment predicted that $CO_2$ emissions from the road transport industry through using articulated and rigid trucks, are expected to grow by 37 per cent, reaching "27 Mt $CO_{2\text{-}e}$ … [by 2030, from] … 20 Mt $CO_{2\text{-}e}$ in 2015" (Australia's emissions projections 2016). Nevertheless, the Paris Agreement requires a decrease, not an increase in $CO_2$ emissions. By Australia repealing its road FTC could be viewed as one possible way to reduce its truck $CO_2$ emissions, particulate matter, and encourage consumers to change their long-distance mode of transporting freight from road to rail.

Silverman et al. (2012) concluded from in-depth studies that were done on long-term workers, from both the road transport industry and rail industry, who were exposed with "light to moderate exposure to diesel exhaust, have found nearly a doubling of lung cancer risk" (Silverman et al. 2012). In 2014, China's Premier of the People's Republic of China, Li Keqiang, decreed in the Annual People's Congress a 'War on Pollution' by relocating industry and power plants to outer fringes, including the freight trucks that transport the goods. Nevertheless, during "much of December 2016 into January 2017 … [there was a] … prolonged period of choking smog that afflicted northern China" (Norcliffe and Gao 2018). The record-breaking heat wave that struck Europe in June 2019 demonstrates the -

"Increase in probability or intensity is largely due to human-induced climate change. … [and] … If human-induced climate change is making such events more likely, this may have important implications. … Heat waves are deadly, although this is not readily visible at the time. This risk is aggravated by climate change, but also by other factors such as an aging population, urbanisation, changing social structures, and levels of preparedness." (Oldenborgh, et al. 2019).

Australian Bureau of Statistics (2008) projected that Australia's population in 2056 could range from 30.9 to 42.5 million people. By the year 2056 eastern Australia could see its population grow by 60%, and at present, the amount of freight being transported between Melbourne and Brisbane is 74% by road and 26% by rail. Australian Rail Track Corporation concluded that with an increase in population comes "Greater environmental impacts as the freight task grows, with more congestion, carbon emissions and noise" (Australian Rail Track Corporation 2015).

Australian Bureau of Statistics concluded that "Australian Transport Economic Account, contributed approximately 7.4% ($122.3b) of GDP in 2015-16" (Australian Rail Track Corporation 2015). Furthermore, Australia's Bureau of Infrastructure Transport and Regional Economics (2017) calculated that the approximate domestic freight transported around Australia [see figure 1] was estimated to be 738 billion tonne kilometres travelled and equated percentages by mode during the 2015 /16 FY (2017)

- Rail – 413.5 btkm or 56.03 %
- Road – 213.9 btkm or 28.98 %
- Sea – 110.3 btkm or 14.95 %
- Air – 0.3 btkm or 0.04 %

A systematic literature review using the PRISMA protocol (Moher et al. 2009) [see figure 2] was conducted, to highlight important areas of concern regarding how the mix of the freight transport around the world is being changed using different types of modes to reduce greenhouse gas and to respond to climate change and adverse effect on natural assets and the risks to public health and safety.

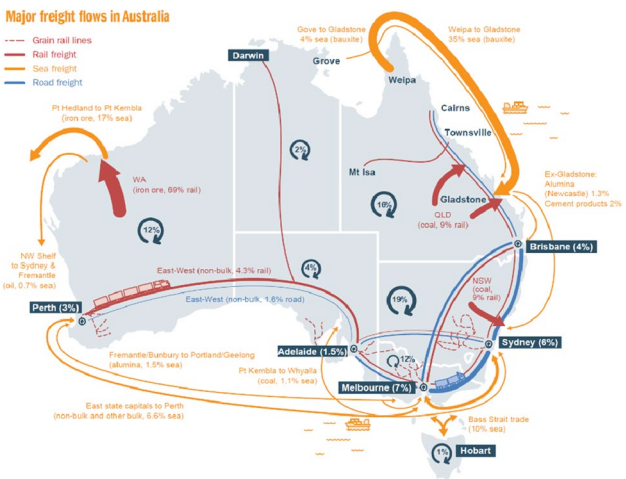


**Fig. 1** Australian freight movement (Delivering on freight,Canberra, 2019)

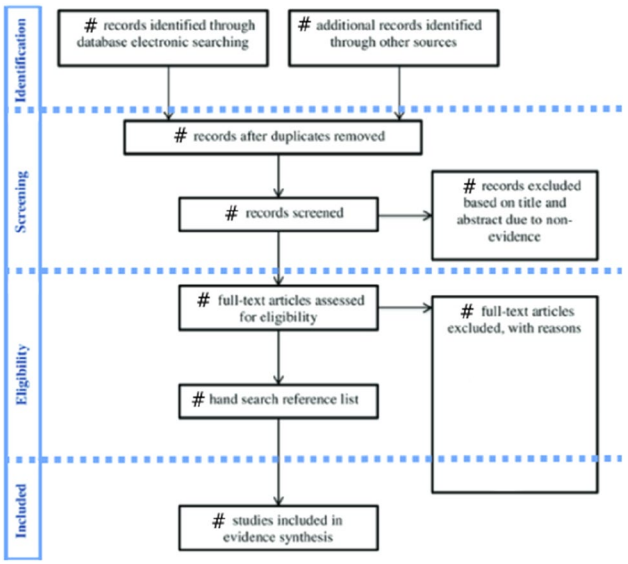


**Figure 2.** A PRISMA 4phase protocol flow diagram (Moher et al. 2009)

## 2 Methods

### 2.1 Source of data

The aim of this literature review is to better understand previous research findings by examining the relationship between the different modes of transport and how they work together in fulfilling the Paris Agreement, reducing residual risk and accident causation. This review aims to accomplish this by using Federation University Australia library seven key disciplinary databases for Engineering:

- ENGINE Australian Engineering (Informit),
- Engineering Collection (Informit),
- Engineering Source (EBSCO),
- Environment Complete (EBSCO),
- IEEE Xplore digital library,
- Scopus (Elsevier) and
- Web of Science.

At first total of 249 published articles were identified, between the years of 1969 and 2019, using the key words - **Modal shift** AND **Australia or freight** AND **Intermodal road-rail freight transport** AND **Fuel tax** AND **Intermodal freight**. Identification reduced the total of 249 down to 212. Screening (Review) reduced 212 down to 28. Screening (Full) reduced from 28 down to 5. External library databases (ScienceDirect (51), Taylor and Francis (26), SpringerLink (66)) were then checked using the same key words and review protocol, five more journals were found via ScienceDirect (1), Taylor and Francis (1) and Emerald Insight (3). A total of ten peer review journals were identified between the years of 2008 to 2018.

### 2.2 Quality appraisal

Crowe and Sheppard (2011) concluded that whenever a systematic literature review is being conducted, two critical appraisal tools should be used on the peer reviewed articles due to the different methods used to gather the required analytical data is wholly coherent. Therefore, this project used both the Mixed Method Appraisal Tool (MMAT) and Critical Appraisal Skills Programme (CASP) to ensure coherency [see Appendix 1].

### 2.3 Discovery questions

This review is interested in finding answers from fellow researcher/s original data regarding the following questions:

Q-1.How consensus arrived on the definition of intermodal?

Q-2.What were their raised issues or characteristics (social, environment or economical) regarding freighted transport?

Q-3.What are the gaps in knowledge and how will these gaps contribute *New Knowledge* for research addressing challenges in greenhouse gas and the risk to public health & safety due to the road freight sector?

A-1. Definition of multimodal / intermodal

Elbert and Seikowsky ( 2017) and Roso (2008) defined intermodal by combining both multimodal transportation under the United Nations (2019) Article 1. ""International multimodal transport" means the carriage of goods by at least two different modes of transport on the basis of a multimodal transport contract …' and the updated version of United Nations (2001) defined intermodal transportation as – "The movement of goods in one and the same loading unit or road vehicle, which uses successively two or more modes of transport without handling the goods themselves in changing modes." Where, Seguí, Puig, Quintieri, Wooldridge, and Darbra (2016) adapted their multimodal definition from the United Nations Article 1. with validation from the European Federation of Inland Ports (EFIP) that "An Inland port is a strategic multimodal node that includes at least a ship or barge terminal with connection with other ports (maritime terminal or inland port) before reaching the oceanic or sea trade" (Seguí et al. 2016).

A-2. Raised issues or characteristics (social, environment or economical) regarding freighted transport.

Key factors, in freight transport mix included: a cost effective, sustainable and reliable service with limited loss or damage to goods and environment. Kim, Nicholson, and Kusumastuti (2014) discussed that New Zealand would greatly benefit from the European Commission's Marco Polo

program aiming to reduce truck induced road congestion and $CO_2$ emissions by shifting transported freight to a greener mode, like railway, river or sea transport. The Marco Polo program aimed to annually remove from European roads, "20 billion tonne-kilometres of freight … equivalent of more than 700,000 trucks … travelling between Paris and Berlin" (Kim et al. 2014).

Findings from Vejvar, Lai, Lo, and Fürst (2018), Ramírez -Nafarrate, González-Ramírez, Smith, Guerra-Olivares, and Voß (2017), Elbert and Seikowsky (2017), Ghaderi, Cahoon, and Nguyen (2017), Patterson, Ewing, and Haider (2008), Roso (2008), and Seguí, Puig, Quintieri, Wooldridge, and Darbra (2016) are consistent on environmental $CO_2$ emission concerns and encouragement for intermodal shift away from freight trucks. Conversely, Pålsson and Sternberg (2018) discussed the intermodal shift from rail (low $CO_2$ emission) to trucks (high $CO_2$ emission) by introducing, longer, heavier trailers and trucks in Sweden. Swedish society are also requiring goods to be delivered quicker. Sweden introduced longer and heavier trucks and reduced the taxes for freight transported by road.

Vermeiren and Macharis (2016) analysed why shippers choose intermodal freight of 78 km between Antwerp in Belgium and Rotterdam in Holland for economic survival.

A-3. Level of intermodal study knowledge base covering Social, Environmental, and Economics focusing on impact on natural assets influenced by greenhouse gases and the risk to public health & safety along with access for freight and cost for transport.

### 2.4 Social

Roso (2008) derived from Woxenius, Roso, and Lumsden (2004) that population growth increases economic activity, which in turn increases road, rail and sea container freight. This increase places strain on the port's infrastructure, causing noise, pollutants and congestion. Productivity slows and port costs rise. Research shows that regulations and infrastructure were seen as the main issues addressing congestion or use of intermodal with land use and environment coming third and fourth. Nevertheless, the trucking industry felt obliged to shift the container freight in and out of the ports. However, if intermodal is given a chance of survival, governments need to recognise and improve its depleted rail industry. Roso (2008) encourages further studies (Australia and Overseas seaport intermodal terminals) on ways of improving intermodal movement of container freight from ship directly on to rail; as future freight by truck only between Port Botany and Enfield has many impediments as "truck volumes will triple resulting in congestion, delays, rise of air and noise pollution, as well as rise in financial and emotional costs with higher accident rates" (Roso 2008).

Vejvar, Lai, Lo, and Fürst (2018) conducted a 50 question qualitative interview that related to social, environment and economic viability regarding greener transport and logistics. They concluded from their data that, "cause, constituents, and control are the most important antecedents of institutional change" (2018). They also suggested that their study lacked external validity and encourage studies from larger institutional countries. Elbert and Seikowsky (2017) encouraged further study to help diffuse barriers between the road and rail facilitation cultures; especially with those that have the greatest impact in mode choice, including de-biasing strategies.

### 2.5 Environmental

Ramírez-Nafarrate, González-Ramírez, Smith, Guerra-Olivares and Voß (2017) reiterated, along with Rodrigue (2012), that as container ships become bigger, their hold of container freight increases, but there return visits are shorter, including their time for loading and unloading while in port. This places greater demand on the port's infrastructure, land for placement and stacking of containers, as well as the required infrastructure linking the port and its hinterland where containers are held short term. The trialling of their Truck Appointed System (TAS) technology reduced double handling, truck waiting times for un/load and reduced congestion. Congestion in and around the port, its hinterland and the linking roads increased costs in foreign trade and affects productivity.

Seguí, Puig, Quintieri, Wooldridge, and Darbra (2016) concluded that the European Federation of Inland Ports (EFIP) was "one of the three most environmentally friendly modes of transport along with rail and maritime transport". This was in line with the European Commission and the European Court of Auditors (United Nations 2019) who stated that "The EU aims at shifting traffic from roads to more environmentally friendly transport modes, including inland waterway transport, as there are potential benefits in terms of cost savings, reduced pollution and increased transport safety".

Seguí, Puig, Quintieri, Wooldridge, and Darbra (2016) researched on how to further enhance EFIP environmental performance by helping to accelerate its culture of reporting hazards, issues and cleaner environment within its inland ports and its waterways. They also encouraged further study into ways of strengthening its environmental reporting culture of inland ports that allows sustainable development and improvement. Pålsson and Sternberg ( 2018) encouraged further study from countries where modal shift has occurred with High Capacity Vehicles (HCV) operating, and establish the HCV full environmental effect.

### 2.6 Economical

Kim, Nicholson, and Kusumastuti (2014) used a sample survey with the majority choosing to transport freight in New Zealand by road, with rail being least chosen, from sea and air respectfully. There were three reasons for this: time, cost, as well as a 30 kilometre sea gap between the main islands. They encouraged more environmental freight transport studies for New Zealand to help change its freight mode policy to that of the European Union's Marco Polo program.

Vermeiren and Macharis (2016) instigated an analysis based on the survey of 32 shippers who stipulated that they were "looking for the most performing solution, mainly in terms of cost … [as] … economics overrule the savings in $CO_2$ emissions". They recommended further study in which trucks are utilised to their full economical potential by finding ways of improving scheduling by not only bringing a container to port but also having a container for the return journey. Elbert and Seikowsky (2017) and Ghaderi, Cahoon and Nguyen (2017) proposed that if intermodal is to work then governments around the world need to eliminate "all residual barriers between modes" (Elbert and Seikowsky 2017). This includes how best to increase long distance freight competition between road and rail, and ways to make rail a more than viable option.

Patterson, Ewing, and Haider (2008) encouraged further studies on ways to remove the bias of road freight intermodal carrier's inferiority even with a 20% increase in taxes for transporting freight by truck only. Pålsson and Sternberg (2018) concluded from their macro study workshops that switching from transporting freight from rail to road, may well reduce freight costs, however consideration needs to be made for the long term "negative environmental impact" (Pålsson and Sternberg 2018) including vehicle road demand and the congestion it brings.

## 3 Conclusion

Freight sector has been growing in ever increasing rate and transporting freight by trucks will remain due to access and economic reasons. However, significant opportunity exists for improvement by using alternative mode of transport for long distance deliveries by lesser $CO_2$ emitter modes (rail, barge, or ship) before the freight is transferred back to another freight truck for final delivery. This would allow freight trucks to only operate within 300km from the registered depot. To further reduce diesel emissions and adverse impacts on public health, freight trucks could be fuelled by electric, gas, or hydrogen.

Journals papers published between 2008 to 2018 reviewed in this paper, raised social, environmental, and economic issues regarding the need, demand and how best to transport freight throughout regions in countries around the world in general and Australia in particular. Road freight industry needs to further enhance its knowledge base regarding how best to utilise intermodal transport. Authors are currently working on the impact analysis of alternative modes of transport on the natural assets covering the environment and reducing the risk to public health and safety in Australia and findings will be published in the near future.

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**Declarations**

**Conflict of interest** The authors declare that there are no conflicts of interest.

# Appendix

## MMAT

| | | | SCREENING QUESTIONS | | 1. QUALITATIVE STUDIES | | | | | 4. QUANTITATIVE DESCRIPTIVE STUDIES | | | | | 5. MIXED METHODS STUDIES | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | First author | Citation | S1. Are there clear research questions? | S2. Do the collected data allow to address the research questions? | 1.1. Is the qualitative approach appropriate to answer the research question? | 1.2. Are the qualitative data collection methods adequate to address the research question? | 1.3. Are the findings adequately derived from the data? | 1.4. Is the interpretation of results sufficiently substantiated by data? | 1.5. Is there coherence between qualitative data sources, collection, analysis and interpretation? | 4.1. Is the sampling strategy relevant to address the research question? | 4.2. Is the sample representative of the target population? | 4.3. Are the measurements appropriate? | 4.4. Is the risk of nonresponse bias low? | 4.5. Is the statistical analysis appropriate to answer the research question? | 5.1. Is there an adequate rationale for using a mixed methods design to address the research question? | 5.2. Are the different components of the study effectively integrated to answer the research question? | 5.3. Are the outputs of the integration of qualitative and quantitative components adequately dealt with? | 5.4. Are divergences and inconsistencies between quantitative and qualitative results adequately addressed? | 5.5. Do the different components of the study adhere to the quality criteria of each tradition of the | COMMENTS |
| 2018 | Vejvar, Markus; Lai, Kee-hung; Lo, Chris K.Y.; Fürst, Elmar W.M. | Strategic responses to institutional forces pressuring sustainability practice adoption: Case-based evidence from inland port operations. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | | | | | | | | | Study may have lacked validity, as there case studies were of a Quantitative than Qualitative |
| 2018 | Palsson, Henrik; Sternberg, Henrik | LRN 2016 SPECIAL - high capacity vehicles and modal shift from rail to road: combining macro and micro analyses | Yes | Yes | | | | | | Yes | Yes | Yes | Can't tell | Yes | | | | | | Even without the total environmental effect, the study still showed there would be congestion and increase in CO2 emissions |
| 2017 | Ramírez-Nafarrate, Adrián; González-Ramírez, Rosa; Smith, Neale; Guerra-Olivares, Roberto; Voß, Stefan | Impact on yard efficiency of a truck appointment system for a port terminal. | Yes | Yes | | | | | | | | | | | Yes | Yes | Yes | Yes | Yes | Truck Appointment System (TAS) was tested at Port of Arica for export only. Import and other Port scenarios need to be analysed. Delays in transit were not added to (TAS) and this could have affected the outcome |
| 2017 | Elbert R., Seikowsky L. | The influences of behavioral biases, barriers and facilitators on the willingness of forwarders' decision makers to modal shift from unimodal road freight transport to intermodal road–rail freight transport | Yes | Yes | | | | | | | | | | | Yes | Yes | Yes | Yes | Yes | As the interviews were only conducted in German a bias has been shown, and non-German countries may have different results |
| 2017 | Ghaderi, Hadi; Cahoon, Stephen; Nguyen, Hong-Oanh | Evaluation of impediments to the competitiveness of the rail sector in Australia: Empirical research and evidence | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | | | | | | | | | Australia has only recently realised that for it to advance as a country of rail transportation, its governing states need to act not as Colonies but as one under policy, laws and standardisation of rail gauge. |
| 2016 | Vermeiren, Tom; Macharis, Cathy | Intermodal land transportation systems and port choice, an analysis of stated choices among shippers in the Rhine–Scheldt delta | Yes | Yes | | | | | | Yes | Yes | Yes | Yes | Yes | | | | | | To gain the full benefit of Choice-Based Experiment - end to end choice comparison, instead of competition between port to port choice. Is recommended |
| 2016 | Seguí, Xavier; Puig, Martí; Quintieri, Eugenio; Wooldridge, Chris; Darbra, | New environmental performance baseline for inland ports: A benchmark for the European inland port sector | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | | | | | | | | | This study created a benchmark survey / audit and has encouraged inland and sea ports outside of Europe to check, comment and improve their environmental performance |
| 2014 | Kim, Hyun-Chan; Nicholson, Alan; Kusumastuti, Diana | Freight Transport Mode Choice and Mode Shift in New Zealand: Findings of a Revealed Preference Survey | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | | | | | | | | | New Zealand is to small to have the equivalent EU Marco Polo programme as a barge is used to carry tucks 30km over the water between the two islands. Subsidy for rail and sea is recommended including reducing Timelines |
| 2008 | Patterson, Zachary; Ewing, Gordon O.; Haider, Murtaza | The potential for premium-intermodal services to reduce freight CO2 emissions in the Quebec City–Windsor Corridor | Yes | Yes | Yes | Yes | Yes | Yes | Yes | | | | | | | | | | | 20% Increase in trucks only freight costs may well sway bias to intermodal (rail). Intermodal (rail) could reduce CO2 by as much as 0.06Mt, though 50% reduction is contestable against current analysis |
| 2008 | Roso, Violeta | Factors influencing implementation of a dry port | Yes | Yes | | | | | | | | | | | Yes | Yes | Yes | Yes | Yes | Unless there is the removal of steadfastness / bias and re-education with psychological and behavioural regarding the privilege and not a right to use just road (TWU) via reducing road and increasing the forgotten rail infrastructure, then studies have shown that there would be a tripling in congestion and increase in CO@ emissions |

## CASP

| Year | First author | Citation | Did the review address a clearly focused question? | Did the authors look for the right type of papers? | Do you think all the important, relevant studies were included? | Did the review's authors do enough to assess quality of the included studies? | If the results of the review have been combined, was it reasonable to do so? | What are the overall results of the review? | How precise are the results? | Can the results be applied to the local population? | Were all important outcomes considered? | Are the benefits worth the harms and costs? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018 | Vejvar, Markus; Lai, Kee-hung; Lo, Chris K.Y.; Fürst, Elmar W.M. | Strategic responses to institutional forces pressuring sustainability practice adoption: Case-based evidence from inland port operations. | Yes | Yes | Yes | Yes | N/a | Study may have lacked validity, as there case studies were of a Quantitative than Qualitative | Data from own survey showing very strong evidence | Yes | Yes | Yes |
| 2018 | Palsson, Henrik; Sternberg, Henrik | LRN 2016 SPECIAL - high capacity vehicles and modal shift from rail to road: combining macro and micro analyses | Yes | Yes | Yes | Yes | N/a | Even without the total environmental effect, the study still showed there would be congestion and increase in CO2 emissions | Data from own survey showing very strong evidence | Yes | Yes | Yes |
| 2017 | Ramírez-Nafarrate, Adrián; González-Ramírez, Rosa; Smith, Neale; Guerra-Olivares, Roberto; Voß, Stefan | Impact on yard efficiency of a truck appointment system for a port terminal. | Yes | Yes | Yes | Yes | Yes | Truck Appointment System (TAS) was tested at Port of Arica for export only. Import and other Port scenarios need to be analysed. Delays in transit were not added to (TAS) and this could have affected the outcome | Data from own survey showing very strong evidence from the given test, however as recommended different scenarios are required to get a truer picture | Yes | Yes | Yes |
| 2017 | Elbert R., Seikowsky L. | The influences of behavioral biases, barriers and facilitators on the willingness of forwarders' decision makers to modal shift from unimodal road freight transport to intermodal road–rail freight transport | Yes | Yes | Yes | Yes | Yes | As the interviews were only conducted in German a bias has been shown, and non-German countries may have different results | Data from own survey showing very strong evidence | Yes | Yes | Yes |
| 2017 | Ghaderi, Hadi; Cahoon, Stephen; Nguyen, Hong-Oanh | Evaluation of impediments to the competitiveness of the rail sector in Australia: Empirical research and evidence | Yes | Yes | Yes | Yes | N/a | Australia has only recently realised that for it to advance as a country of rail transportation, its governing states need to act not as Colonies but as one under policy, laws and standardisation of rail gauge. | Data from own survey showing very strong evidence | Yes | Yes | Yes |
| 2016 | Vermeiren, Tom; Macharis, Cathy | Intermodal land transportation systems and port choice, an analysis of stated choices among shippers in the Rhine–Scheldt delta | Yes | Yes | Yes | Yes | N/a | To gain the full benefit of Choice-Based Experiment - end to end choice comparison, instead of competition between port to port choice. Is recommended | Own survey with 5 tests show Cost economics overrule CO2 savings | Yes | Yes | Yes |
| 2016 | Seguí, Xavier; Puig, Martí; Quintieri, Eugenio; Wooldridge, Chris; Darbra, Rosa Marí | New environmental performance baseline for inland ports: A benchmark for the European inland port sector | Yes | Yes | Yes | Yes | N/a | This study created a benchmark survey / audit and has encouraged inland and sea ports outside of Europe to check, comment and improve their environmental performance | The EU uses the results as a benchmark | Yes | Yes | Yes |
| 2014 | Kim, Hyun-Chan; Nicholson, Alan; Kusumastuti, Diana | Freight Transport Mode Choice and Mode Shift in New Zealand: Findings of a Revealed Preference Survey | Yes | Yes | Yes | Yes | N/a | New Zealand is to small to have the equivalent EU Marco Polo programme as a barge is used to carry tucks 30km over the water between the two islands. Subsidy for rail and sea is recommended including reducing Timelines | Data from own survey showing very strong evidence | Yes | Yes | Yes |
| 2008 | Patterson, Zachary; Ewing, Gordon O.; Haider, Murtaza | The potential for premium-intermodal services to reduce freight CO2 emissions in the Quebec City–Windsor Corridor | Yes | Yes | Yes | Yes | N/a | 20% Increase in trucks only freight costs may well sway bias to intermodal (rail). Intermodal (rail) could reduce CO2 by as much as 0.06Mt, though 50% reduction is contestable against current analysis | Prior argument, reason, or probability is based on an assumed principle or statistical facts from Gov survey, than observed facts | Yes | Yes | Yes |
| 2008 | Roso, Violeta | Factors influencing implementation of a dry port | Yes | Yes | Yes | Yes | N/a | Unless there is the removal of steadfastness / bias and re-education with psychological and behavioural regarding the privilege and not a right to use just road (TWU) via reducing road and increasing the forgotten rail infrastructure, then studies have shown that there would be a tripling in congestion and increase in CO2 emissions | NSW Gov & Sydney Port Coorporation data | Yes | Yes | Yes |

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