

Sustainable Energy Adoption Prospects for Gujarat's Inland Container Depots

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Abstract

Under the Indian Sub-Continent, India has the longest coastline advantage of 7,500 Kilometers and 14,500 Kilometers of potential navigable waters, which gives India immense opportunities for logistics development. The Government of India conceptualized the SagarMala Project in 2015 to develop ports and related infrastructure. Mr. Gadkari, Honourable Minister for Road Transport and Highways, India, had advised in 2017 that “Sagarmala and Bharatmala are two different programs. But, our efforts are to present it as a garland for the whole country”. Inland container depots can connect industries in the hinterland by offering multi-modal modes of transport like - railways, roadways, inland waterways transport and dedicated freight corridors connecting to seaports. As global economies strive for growth and industrial development, they also face environmental challenges. Global trade is largely handled by ocean shipping, which is a major contributor to emissions. India, being a developing economy and thriving towards industrialization has also committed to control the intensity of emissions.

Keywords: Shipping, energy mix, renewable energy, logistics, fossil fuel, policy, environment, greenhouse gas, emissions.

Introduction

Is it possible to have sustainable Inland Container Depots (ICD) in Gujarat? This paper presents a proposal for alternate and efficient energy implementation that makes sure businesses and the environment grow sustainably. Global trade is majorly reliant on sea shipping mode, which also happens to be substantially responsible for Carbon Dioxide (CO₂) and Nitrogen Oxide (NO_x) emissions

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(Chung-Shan Yang, 2018). Varese et.al.; (2022) discussed about assessing sustainability in ICD's operations which affect the environment. India is a fast-developing economy and logistics is one of the focus sector of Government of India (GOI) for offering sustainable growth with cost and infrastructure optimization. Projects like *SagarMala*, *Bharatmala*, Inland Waterways, and Dedicate Freight Corridors (DFC) have been initiated and are witnessing positive response from all business partners like railways, fleet operators, manufacturers, Export-Import (EXIM) houses, ICDs.

Significance of the study

As per the Union Minister for Environment, Forest and Climate Change, Mr. Bhupender Yadav, India is dedicated to reducing emissions intensity to net zero by 2070. This study discusses existing ICDs of Gujarat's environment, current energy usage and the path ahead for renewable energy adoption.

Statement of problem

Seaports are gateways for a nation's maritime trade; for landlock locations ICD's serve as gateways to seaports. There are three types of transportation from ICD:

1. Trucking services for EXIM houses
2. Railways network to transport cargo to seaport
3. Roadways network to transport cargo to seaport

The ICDs serve as a gateway for hinterland industries and cargo consolidators for multi-modal modes of transport. Substantial studies have been conducted on environmental sustainability considering seaports, and ocean carriers, leaving out sustainability aspects of ICDs in Gujarat. This paper aims to find out emissions issues and propose sustainable solutions for ICDs, which can lead to lesser environmental costs in the long run in line with GOI's emission commitments.

ICD's in Gujarat

Gujarat has the longest coastline advantage in India and cargo movement potential from seaports, connecting landlock locations of North India, Gujarat, etc. Major seaports in Gujarat are: Mundra, Kandla, Pipavav, Hazira, and small-sized / seasonal ports, which attract cargo from nearby industrial locations and hinterland locations of Gujarat and North India. Major

ICD's in Gujarat are - ICD Morbi, ICD Khodiyar, ICD Sanand, ICD Sachana, ICD Viramgam, ICD Dashrath, ICD Ankleshwar, ICD Sachin, ICD Varnama, ICD Tumb.

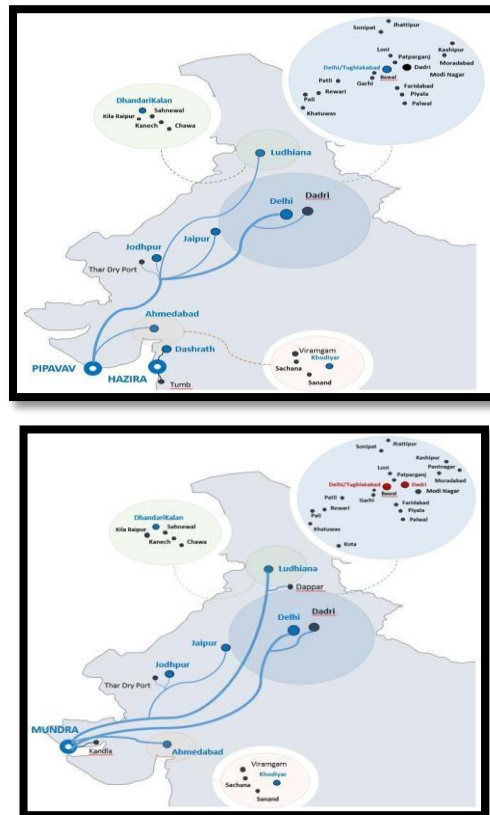


Image 1: ICD connectivity to seaports

Source: <https://www.cma-cgm.fr/static/IN/Attachments/Intermodal%20India%20Presentation%20-%20Imports%20MAY%202020.pdf>

The representation depicts the flow of cargo from industrial and ICD locations to seaports. India is dependent on fuel imports (Sarvanan and Jegan, 2015) to meet its energy demands. Logistics is one of the sectors where energy demand is observed to be growing with industrial and population growth (Mohapatra et.al, 2023). Energy demands are majorly fulfilled with non-renewable resources for commercial activities. Indian Railways scrapped coal

engine usage and relied on electricity for their operations. As India is looking forward to abiding by global agreements on reducing emissions, the Government and private sector understand the long-term positive impact of renewable energy resources and implementing its usage.

Energy Consumption in ICD

ICD is a massive land area which accommodates various bodies like customs custodian, shipping line container storage yard, crane operators, railway operations and other ground staff.



Image 2: ICD

Source: <https://www.thethardryport.com/wp-content/uploads/2018/05/about-img.jpg>

Energy consumption in ICDs can be identified as below:

1. Dry port operations building
2. Weighbridge
3. Cranes, forklifts, reach stackers, and hydra crane
4. Trucks and trailers

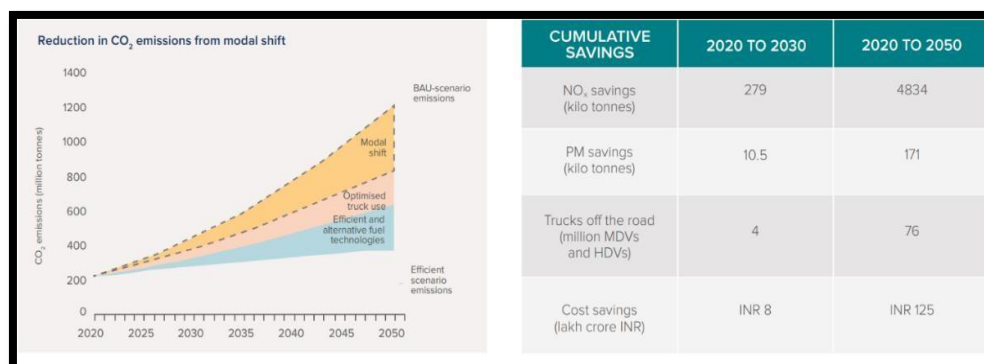
The Dry port operations building and weigh bridge accommodates personnel, physical documents, and electronics, consumes electricity from the government grid in respective ICD locations, and electricity generation from

thermal or hydro power. Equipments in ICD like cranes, forklifts, reach stackers, and hydra consume fossil fuel fuels like diesel. Trucks and trailers consume diesel for local city, port and internal vehicular movement. All these resources are finite and non-renewable. With rising population and energy demand globally, fossil fuels are depleting and found to have severely impacted the environment. Governments globally are implementing green energy initiatives for sustainable business growth and the environment. To implement greener initiatives, it is important to understand aspects of psychology and environmental considerations (Mohapatra et.al, 2023).

Background and importance of this study

This paper reviews energy consumption and sources required to run an ICD, electricity generation, emissions, and pollution issues with respect to Gujarat's ICDs and the need to achieve sustainability.

- a. GOI promotes sustainable development and growth programmes. A relevant example is Oil & Natural Gas Corporation (ONGC) that initiated a start up support for promoting new ideas for energy generation including but not limited to renewable energy.
- b. Rising issues of air quality, emissions, pollution and the finite nature of non-renewable resources have forced governments to consider alternate energy sources, where India is also an active participant.



Source: Freight Report NITI AAYOG, RMI, AND RMI INDIA, JUNE 2021

- c. GOI's initiatives - *Sagarmala*, *Bharatmala*, and DFC have focused on economic development with sustainability. Hinterland connections to seaports through ICDs act as EXIM activity centres for industries and a decongestion point for seaports by providing a systematic cargo flow. Below is an estimate of costs incurred and emissions in different modes of transport:

MODE	RAIL	ROAD	WATERWAYS	AIR	PIPELINE
Cost (INR/tonne-km)	1.6 ⁷⁸	3.6 ⁷⁹	2 ⁸⁰	18 (5 times the rate of road transport) ⁸¹	2 (equivalent to water transport cost) ⁸²
CO ₂ emissions (gm CO ₂ /tonne-km)	11.5 ⁸³	101 ⁸⁴	11 ⁸⁵	610 – 650 ⁸⁶	8 ⁸⁷
Route flexibility	✓✓	✓✓✓✓✓	✓	✓✓	✓
Timeliness/ quickness of transport	✓✓	✓✓✓✓	✓	✓✓✓✓✓	✓
Volume flexibility	✓✓		✓	✓✓	✓
Flexibility with respect to the type of goods	✓✓	✓✓✓	✓	✓✓	✓
Suitable use cases	Suitable for the long-haul of large, regular flows of low-to-medium-value density goods between fixed origin/destination points	Suitable for non-bulk goods moving over shorter distances and on corridors with lower transport volumes	Suitable for the long-haul of large, regular flows with less fragmentation along the coastline or navigable inland waterways	Suitable for high value goods in need of urgent delivery	Suitable for liquids and gases and any stable chemicals such as water, oil, natural gas, and biofuels

Source: Freight Report NITI AAYOG, RMI, AND RMI INDIA, JUNE 2021

Literature Review

There have been substantial studies regarding port, road and cargo ship emissions and sustainability, but limited studies have covered the sustainability aspect of ICD, including the Indian context. (Sriraman–2010); discussed benefits of Inland Water Transportation, like the economy of scale, less energy consumption, and eco-friendliness. A few challenges observed were high technology vessels, cargo commitments, infrastructure, siltation, irregular water flow, etc. Despite the policy framework announcement in 2002, IWT has picked a slow pace due to road/ rail infrastructure preference, less government interest, low commitments, and energy issues. Jawaharlal Nehru National Solar Mission (JNNSM) was launched on 11th January 2010 by GOI, as one of its eight missions under the National Action Plan on Climate Change (NAPCC-2008) (Kapoor et al, 2014). Authors identified that the path through solar is clearly towards full, clean, green energy, but there are technical barriers, policy barriers, and socio-economic and institutional challenges. (Núñez, et.al, 2016),

identified that all EXIM traffic moving to the port creates congestion and huge emission issues. Thus, inland dry ports serve as an economical alternative to handle cargo and connect smoothly hinterland manufacturers to ports. As per Chung-Shan Yang, (2018), maritime trade was cited as important and 90 per cent of global trade happens through sea routes. He discussed three types of pressures that can lead to adopting Green Supply Chain Management methods - Coercive, Normative & Mimetic. Garg and Kashav, (2020), discussed that Indian Railways (IR) have brought growth for the passenger as well as freight/logistics market, but over the years, it has failed to bring innovation and sustainability initiatives which has brought down its market share. With the *SagarMala* project, IR has a golden opportunity to revamp its strategy and create sustainable energy implementation and low-cost model for clients. The researcher considered three factors under sustainability in railways: environmental, social and economic factors. The findings of Hossain et al, (2023), discussed a decline in total energy consumption from oil-based freight transport, and net zero carbon can be achieved from electrification of road transportation sector. The Indian Road Transportation industry has emission control regulations specifically devised to control air pollution. The implemented policies' effects on CO₂, particulate matter₁₀ (PM), PM_{2.5}, NO_x, CO₂, volatile organic compounds (VOC) are co-benefits. India is facing severe issues of air pollution, especially particulate matter (PM).

Considering Indian environmental challenges, air quality index, and opportunities ahead, French company FM Logistic has shown interest in offering green vehicles for sustainable road transport in India, while India is seriously considering green transport and logistics.

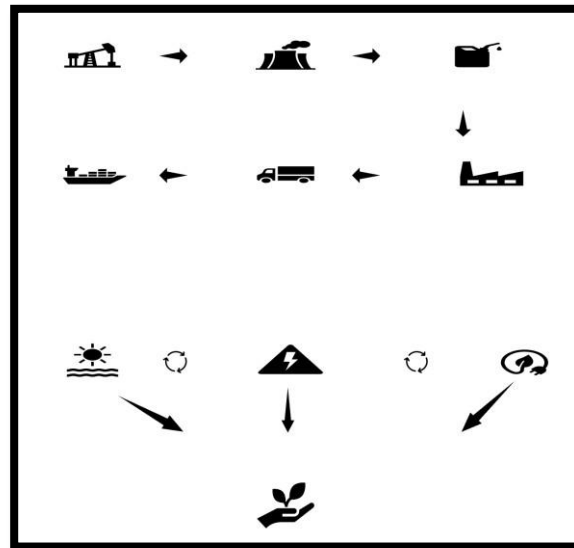
Methodology:

The research was conducted with the help of secondary sources of literature review of Indian and foreign scholarly articles, discussing aspects of sustainability in the logistics sector. A qualitative method was adopted for primary data collection from ICD managers of Gujarat via telephonic interview. 10 ICD managers were approached, out of which five responded, four were unavailable for response, and one cited reason for non-disclosure; the recorded response rate was approximately fifty percent. Four managers agreed to have a telephonic, audio-recorded conversation, and one manager requested to have a telephonic discussion without a telephonic audio-recorded response. The identity of managers has been masked due to confidentiality reasons.

Findings:

Past studies have covered aspects of sustainable development of seaports, vessels, and inland waterways, related to ecological, environmental, and psychological factors in the adoption of alternate sources of energy. Fewer studies were available about sustainable ICD development, which can be related to emission issues in the Indian context, as ICDs act as hinterland connections for EXIM houses to seaports. On the basis of the literature review and telephonic interview, the adoption of renewable sources of energy can be classified on the basis of:

- a. Psychological factor: the interview reflected respondents were inclined towards using renewable energy sources and implemented in consideration with board members/government approval.
- b. Cost factor: The respondents were concerned with shifting the cost of existing infrastructure and hesitant towards long-term investment. Government incentives were a motivating factor in maintaining existing prices with customers.
- c. Awareness factor: Two respondents were aware of the future of non-renewable sources of energy and the benefits in ICD's. Lack of awareness was found for renewable energy implementation programs, government incentives and partial awareness of promotional programmes.
- d. Willingness factor: The respondents were willing to shift from non-renewable to renewable energy sources. One ICD already has the majority of rail movements connecting to seaports, and almost all of them have paperless documentation.
Pictorial representation of current fuel consumption in shipping and modal shift to alternate fuel sources.



Graphical representation of finite sources usage and renewable resources availability and usage, original author representation June 30, 2023

It was observed for ICDs, that switching to renewable sources of energy would control emissions, and benefit society by: *a*) reducing GHG, CO₂, NO_x, and SO_x emissions *b*) offering a sustainable model across the supply chain *c*) creating and maintaining ecological balance. Inclination exists for adopting renewable energy sources, and implementation with directives would help boost the motivation of achieving a sustainable business model with programs of DFC, *Bharatmala*, and *Sagarmala*. One key observation was employment bias towards females, as all respondents were males.

Conclusion

On the basis of past relevant literature and qualitative study, this study concludes that there have been considerable studies conducted on sustainability in ports and sustainability in inland waterways but there was a lack of study on sustainable energy adoption in ICD of Gujarat. GOI has set targets for bringing down national logistics costs and promoting logistics programs, with a commitment to controlling emissions. Policies play a major role in giving

directives to government and private ICDs towards attaining sustainability; directives to a certain extent, they have been initiated in government offices, villages, etc., and have the potential to become acceptable amongst the masses, creating a positive psychological impact for a greener future. This study will help decision-makers in; the ICD and the Government; to understand and apply insights into a paradigm shift in energy source usage

Limitation

This study involves research only on ICDs, with managerial-level responses in the region of Gujarat, and the response rate was approximately fifty percent. Sustainable logistics model in Bharatmala related to ICD establishment & Government incentivisation and its effects could not be considered due to limitation of this study.

Scope for Future Research

Further research can be conducted on *Bharatmala*, and DFC projects as an extension of this study, which connects sustainable energy. This study also paves the way for a–cost-implication model study on sustainable energy adoption in the logistics sector.

Notes

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