SHORE POWER

Advancing Green Port Infrastructure for a Sustainable Future

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1. Background

Shipping is one of the major contributors to global emissions, but it allows countries and continents to shift production and consumption centres across the globe and allows consumers to choose from various options available across continents. Even when ships rest at berth, they continue to run auxiliary engines to maintain onboard operations and continue to emit, although with lessor intensity. Ship emissions at ports contribute significantly to local air pollution (NOx, SOx, CO_2, and PM). Shore power—also known as cold ironing (because it allows ship's iron to cool in absence of fuel burning) or Alternative Maritime Power (AMP), Shore to Ship Power, allows ships to plug into the local electricity grid, shutting down onboard diesel generators. This eliminates emissions at berth, reduces pollution load in the immediate vicinity and supports in decarbonization efforts and creates a win-win situation for all stakeholders connected with ships, ports, port city or locality etc.

The shore power or AMP becomes beneficial in overall sense if the alternate power comes from renewable sources, else the facility merely shifts the pollutant emission elsewhere. However, for the ports and terminals located in emission control areas, even the partial green shore power is beneficial in lowering the critical pollutants load in the emission control / critically polluted areas.

Shore power can be considered as an interim measure of carbon and harmful gases reduction during port stay of vessels, until development and commercialisation of green fuels for maritime transport. The ports have recognised it’s potential and had experimented with clean shore power for ships. However, shore power adoption has been a slow process due to multiple factors.

This article covers benefits, global implementation scenario, Indian efforts and benefits, opportunities and challenges for ports and ships, shore power beneficiaries, financial and regulatory implications, ships readiness, legal implications, etc.

2. Importance of Shore Power

2.1 Environmental & Public Health Benefits

- Reduces local air pollutants by up to 95%.
- Cuts CO_2 emissions during port stays by 30-60%.
- Eliminates onboard generator noise and vibrations.
- Improves port workers’ and nearby residents' health.
- Improves port and ship emission index
- Contribute in climate change mitigation.

2.2 Strategic Relevance

- Supports IMO GHG Strategy and EU Fit-for-55 Package.
- Facilitates compliance with Emission Control Areas (ECAs).
- Aligns with ESG reporting and Green Port operation goals.
- The California Air Resources Board (CARB) estimates a 55% reduction in cancer risk by 2031 due to shore power adoption.

3. Global Shore Power Scenario

3.1 Global Leaders in Shore Power

- **United States**: California mandates shore power under CARB regulations (since 2014); key ports include Los Angeles, Long Beach, Oakland.
- **Europe**: Norway, Sweden, Germany, and Netherlands lead in shore power deployment, particularly for ferries, cruise ships, and ro-ro.
- **China**: Major ports like Shanghai, Shenzhen, and Guangzhou have good shore power infrastructure covering large cargo and container vessels.
- **South Korea & Japan**: Government-supported programs and subsidies enabled a sustainable shore power infrastructure.

3.2 Current Global Status and Driver

In Asia, Chinese ports lead the journey, followed by Taiwan and Korean ports in providing AMP for commercial (ocean-going) vessels.

China

- **All 21 coastal ports** — approximately **84% of specialized berths** (e.g., container, cruise, ro-ro, LNG) have shore power access.
- **Shanghai (Yangshan)** — operates **16 MW** shore-power system catering to mega-container ships.
- **Shenzhen** — all container-terminal berths equipped, supported by government subsidies.
- **Qingdao** – all container berths equipped. **2680** (MWh) supplied as shore power.

Taiwan

- **Ports of Kaohsiung, Taichung, Keelung & Hualien** — Asia Cement Corporation retrofitted four cement carriers with shore power while at these ports; indicative of shore-power availability, though vessel-level application (energyasia.co.in).

- Specific berth capacities not stated, but system supports medium-size cement vessels.

Singapore

- **Jurong Port** (private multi-purpose terminal) shore-power for local operations like harbour craft, but **no shore-power berths for large oceangoing ships** yet.

Philippines (Subic Port)

- **Subic Bay** has planned to install shore power for container berths.

3.3 Shore Power Ready Ports

Region	Shore Power Ready Ports (approx.)	Key Highlights
Europe	60	Strong EU support, cruise & RO-RO focused
North America	20+	Regulatory-driven (California)
Asia	30+	Rapid expansion in China, Korea, Taiwan
India	10	Limited facility to cater harbour crafts, Govt vessels, OSVs etc.
Singapore (Jurong)	1	Limited facility for harbour crafts
Global Total	130+	Major ports investing; slow container terminal coverage

4. Shore Power Readiness of Indian Ports

4.1 Current Status

- Maritime India Vision – 2030 document highlights importance of shore power and advice following timelines for the ports and ships to utilise AMP:
    - All port crafts and ancillary vessels by 2023.
    - Indian vessels in coastal navigation by 2027
    - Vessels in international trade by 2029
- Major Indian ports have attained first stage of shore power targets and most of the ports have shore power facility for use by smaller vessels (harbour crafts, govt vessels, small- medium merchant vessels etc).

- Many ports (Mumbai, Kochi, Goa, Jawaharlal Nehru, Chennai, Kandla) has completed studies and pilots for cruise vessels, general cargo vessels & container vessels.
- Indian targets are more sustainable in balancing green power availability and technological standardisation.

4.2 Challenges for Indian Ports

- Electricity regulatory bottlenecks varying across different Indian states.
- High upfront capital required for providing shore power and high running cost in terms of increased load charges.
- Little guarantee of utilisation in absence of mandatory switchover to shore power on berth.
- Most ships calling Indian ports do not support AMP.
- Indian shipping fleet is comparatively older and making older ships shore power ready is a cost intensive and financially unsustainable, leading to reluctance of shipping fraternity in opting for retrofits.
- Electricity tariff uncertainty.
- These uncertainties can effectively be addressed by regulatory intervention by the Ministry of Ports, Shipping and Waterways.

4.3 Opportunities

- Growing injection of green power in Indian grid through solar and wind energy provide a better opportunity for ports to utilise grid power for AMP minimizing net air pollutant addition to the port environment and other ancillary benefits to ships.
- Tiered shore power approach with positive implementation enables substantial saving on oil import and processing cost, thus creating a national saving even if grid power is utilised.
- Regulatory support can push the drive and enjoy multiple benefits.
- Indian ships in coastal trade can increase their greening index, save money on fuel and auxiliary engine maintenance and contribute to the national efforts in reducing overall expenditure on fossil fuel import.
- In absence of mandatory reporting of ship emission in ports and coastal waters, actual load contributed by visiting ships to port cities and coastal areas remains

unquantified. However, data on total fuel consumed in these areas indicate substantial emission load to the receiving atmosphere. Thus mandatory AMP switchover shall contribute positively to the efforts of keeping the clean ambient air of Indian port cities.

4.4 Port Wise Proposed Capacity

Port	Terminal Type	Proposed Capacity (MW)	Power Type
Mumbai	Cruise	10	Green (Solar Mix)
Kochi	Container	5	Mixed (Grid)
Chennai	Ro-Ro	1.2	Blue (Gas-based)
Kandla	Bulk	0.8	Green (Wind Mix)
Jawaharlal Nehru	Container	74	Mixed (Grid)

5. Port and Ship AMP Compatibility

5.1 Auxiliary Power Requirements by Ship Type (at Berth)

Ship Type	Auxiliary Power (kW)	Fleet Shore Power Readiness (%)
Container Ships	1,000–3,000	30% (mostly > 8,000 TEU)
Ocean Cruise Ships	5,000–12,000	40%
Ro-Ro / Car Carriers	500–1,500	50%
Tankers (Oil/Gas)	300–1,000	<10%
Bulk Carriers	250–800	<10%
Ferries	500–2,000	60–70% (in Europe)

Shore-power readiness of newer builds (2020 onwards) more than 80%, means the ship has the technical capability to plug-in when the port infrastructure is available. However, it does not guarantee that the ship will plug in, whereas largely affected by connecting service quality, tariff, power quality etc.

Following factors are essential in ensuring that the shore power facility meets expected results:

- Compatibility of power supplied at terminal vs auxiliary power requirement of ships
- Technical compatibility of frequency and voltage
- Frequency of repeat calls
- Confidence of vessel on stable power supply of port
- Duration of port stay

Although specific power requirement varies from ship to ship, following broader indication shall be kept in mind while planning the shore facility. Similarly new builds increasingly feature onboard switchgear, transformers, and connectors (typically IEC/ISO/IEEE 80005 standards), whereas pre-2015 vessels mostly lack such facilities.

5.2 Shore Power Receiving Compatibility of Tanker Fleet

Current Compatibility Estimates

Tanker Type	Approx. Auxiliary Power Demand	Shore Power-Ready (%)
Crude Oil Tankers	300–800 kW	**<5%**
Product Tankers	250–700 kW	**<10%**
LNG/LPG Tankers	500–1,500 kW	**<15%**
Chemical Tankers	200–600 kW	**<10%**
Suezmax (Post-2024)	2000-4000 kW	≈100% (new builds)

Most existing tankers built before 2020 are not fitted with shore power infrastructure (e.g., switchboards, transformers, connectors compliant with IEC/ISO/IEEE 80005 standards). However, newer tankers are AMP ready. Retrofitting of tankers are technically possible but ship life and retrofit cost discourage it in absence any regulatory binding.

5.3 Challenges Specific to Tankers

5.3.1 Explosion Risk & Safety Regulations

- Tankers carry flammable and hazardous cargo, making electrical installations near vapour zones extremely sensitive.
- Shore power must meet stringent ATEX/IECEx safety standards and be installed in non-hazardous zones (Zone 0/1 separation).
- Connections typically need to be far aft or away from cargo manifolds.

5.3.2 Vessel Design Constraints

- Many tankers lack available space for onboard power conversion equipment (HV/LV switchgear, transformers).
- Retrofitting often exceeds $1 million and is complicated due to onboard hazardous zones.

5.3.3 Operational Profile

Tankers often have short port stays (12–24 hours) and irregular routing, reducing the ROI of shore power retrofitting. Oil terminals often lack shore power infrastructure and are focused on rapid turnaround. Similarly, cruise vessels also have very limited stay at non-home ports. Therefore, irrespective ship readiness and port readiness the actual plug-in does not become effective in way side ports.

6. Recommendations

6.1 Short-Term

- Making shore power mandatory for port stationed vessels and crafts, Indian registered and coastal trade vessels, followed by an audit mechanism.
- Regulatory intervention where ports should be treated as special entities enabled to draw and provide power to their visiting ships. Currently, a few states consider providing power by ports to ships at par with power distribution for industries and households. Whereas, in case of shore power, the service provided by the port is essential for sustainable operation of the port and connection remains temporary, and should not be equated with permanent power connections requiring power distribution licence to perform such function. Such regulatory hurdle discourages ports in proving shore power facilities and create indirect impact on ambient air as well as negative impact on economy favouring oil imports.
- Financial incentives in form of capital subsidies or low interest loans to ports for creating shore power facility.
- Include shore power as one of the criteria for Green-port certification standards.
- Analysis of shore power compatibility index for various types of ships calling at particular port or terminal.

6.2 Medium-Term

- Establish clear regulatory framework with power tariff rationalization.
- Promote use of renewable energy to feed shore power infrastructure.