

**STRATEGIES FOR CONVERSION OF EXISTING KAKINADA SEA PORTS INTO
ECO-FRIENDLY/GREEN PORTS**

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Abstract

Ports play an important role in global transport of goods and people. They involve in many performers such as ship companies, truck companies, logistics companies, local authorities, etc., causing direct and indirect impact on natural environment. The existing regulations in India set up an environmental framework regarding the limits, precaution measures, emergency plans. Despite all efforts, the environmental issues are not properly addressed by existing legislation system and its enforcement. To overcome barriers, there are still smart and cost-efficient suggestions that could be adopted in order to improve their positive environmental impacts and move towards the idea of “Green Ports/Eco-friendly Ports” which not only meets environmental requirements but also raises their economic interests. In this connection, this paper discusses as to how to transform existing ports into Eco-friendly ports by innovative, eco-friendly and cost-efficient ideas to enhance the quality of environment and competitiveness. This study is mainly based on bibliography survey, in order to suggest improvements to move towards the idea of perfect Eco-friendly Green Port and also presents main characteristics that feature a Green port. Adopting and applying the idea of Green port would be more appropriate to shift the management practices towards overall Green behaviour and respect the environment.

Keywords: Ecofriendly/Green Ports, smart cities, sustainable development, Kakinada Sea ports.

1. Introduction:

India is the sixteenth largest maritime country in the world, with a coastline of about 7,517 km, harbouring at present about 12 major ports and 200 non-major and intermediate ports, strategically located on the world maritime route. The twelve major ports under the Ministry of Shipping handled a record 647.43 million tonnes (mt) of traffic in 2016-17, registering an annual growth rate of 6.79%, as against 4.32% last year. Non-major ports are

evolving faster than major ports and the contribution of non-major port's traffic to total traffic rose to 43.5 per cent in FY16 from 28.6 per cent in FY07.

The state of Andhra Pradesh (A.P.) is naturally endowed with 974 km coastline which is the second longest one in the country, and strategically located to enable it to become a natural gateway to the Eastern hemisphere. Besides one major port, administered under the Major Port Trusts Act, i.e. Visakhapatnam port, the state has so far declared 14 non-major ports for development, administered by the Director of Ports, Government of Andhra Pradesh (GoAP). The 14 ports are - Bhavanapadu, Meghavaram, Kalingapatnam, Bheemunipatnam, Gangavaram, Nakkapalli, Kakinada SEZ, Kakinada Port (Kakinada Deep Water Port and Kakinada Anchorage Port), S.Yanam Rawa, Narsapur, Machilipatnam, Nizampatnam, Vodarevu and Krishnapatnam. Of these ports, the Department of Ports, on its own, is operating the Kakinada Anchorage Port which has limited cargo handling operations. Of the 14 ports, 3 are already operating under PPP concessions by private investors, namely Gangavaram Port, Kakinada Deep Water Port and Krishnapatnam Port.

The A.P. state's ports handled 73 million tons of cargo in financial year 2015-16. The state of Andhra Pradesh is the second maritime state (after Gujarat) in terms of cargo handled by Non-Major Ports and the third maritime state (after Gujarat and Maharashtra) in terms of overall cargo handled including Visakhapatnam port trust.

Andhra Pradesh is the first amongst maritime states to recognize the imperative need for increased port infrastructure and the role that the private sector would be required to play. Andhra Pradesh has prepared a perspective developmental plan of ports according to which a cargo 200 MTs would be handled by 2019-2020. The state of Andhra Pradesh is well linked internally as well as to the rest of the World. The State is active in encouraging the private sector to improve the port infrastructure. The state has adopted a port led development strategy aligned with the development principles of the Sagarmala Project. A set of infrastructure projects have already been formulated as proposals under the Sagarmala Project. These include road and rail connectivity projects, logistics parks and also urban infrastructure projects in the neighbouring urban agglomerations.

Ports play an important role in the global transport of goods and people, and they involve in many performers such as ship companies, truck companies, logistics companies, local authorities, citizens, etc. causing direct and indirect impact on the natural environment. While ports and their associated activities drive economic growth, it is important for port authorities and states to actively work to minimize pollution levels and environmental damage. States

and communities where ports are located regularly deal with issues surrounding air quality, water quality and habitat degradation, among others.

To reduce the impacts on environment and to maintain the sustainability, Shipping Ministry's Maritime Agenda 2020, recognizes the need to develop green policies supported by incentives to encourage ports to implement green practices. But, India is currently considered as the 7th largest emitter of the global warming pollutants and it made a commitment to reduce its emission per unit of GDP 20 to 25% below 2005 by 2020.

To stay competitive in reducing the impacts on environment, Andhra Pradesh Port Authorities also had to modernize and upgrade port facilities as environmental friendly to meet the needs of the port users. However, the investment required and managerial capabilities will pose challenges to public and port authorities. In order to meet the challenges emanating from intense global competition, advancement information & communication technology, technological changes in shipping and related sectors coupled with stiff demands from trade, ports in India are required to gear-up themselves by modernizing the port infrastructure, enhancing the quality of service and increasing the productivity level on par with International standards. The objective of National Maritime Development Programme (NMDP) is also to upgrade and modernize the port infrastructure in India which will enable it to benchmark its performance against global standards.

Despite all efforts, the Environmental issues are not properly addressed by the existing legislation system and its enforcement. Some of the obstacles that have been identified and need to be overcome, are the mismanagement and insufficient communication and coordination between institutions and other stakeholders responsible for implementing the legislation in the port, the complicated and fragmented legislation, the high cost of environmental law enforcement and the insufficiently effective economic incentives and sanctions for environment protection. Even though there are barriers to overcome, there are still smart and cost-efficient suggestions that could be adopted in order to improve their environmental impact and move towards the idea of a Green Port.

2. Need of conversion of Kakinada Seaports into Green ports:

Kakinada - "*a city of Blues and Greens and Unique Culture*" is one of the 100 Smart cities selected by the Government of India. Hence, in future this city is going to be an eco-friendly city, it is essential for all Industries, Organizations and especially Ports to move towards the idea of Sustainable/Eco-friendly/Green development.

2.1 Kakinada Sea Port: One of the important non-major ports in Andhra Pradesh is the Kakinada Sea Port which is the main gateway port for the rich agricultural belt of East Godavari, West Godavari and Krishna Districts of Andhra Pradesh, located between Visakhapatnam and Chennai Ports. The advantageous position of Kakinada Port gives a unique opportunity to handle a mix of bulk, liquid, break bulk, containers, project cargoes & service offshore Oil & Gas exploration activities of Krishna – Godavari Basin. Kakinada Sea Port is a large complex comprising of Kakinada Anchorage Port, Kakinada Deep Water Port, Kakinada Fishing Harbour and Kakinada SEZ Port (Captive Port, under construction). The annual cargo tonnage of Kakinada port was 12.07 Million tones (2012-2013).

2.2 Ecological Significance of Study area:

The Kakinada Sea Ports is located in the fragile area where three categories of Ecosystems (*Marine, Riverine and Estuarine ecosystem*) existing in area of influence; and the port location is very nearer to the Eco Sensitive Areas i.e., Coringa Wildlife Sanctuary (CWLS), Sandspit (Hope Island) and part of the Kakinada Bay.

Coringa Wildlife Sanctuary, a paradise for the nature lovers is situated amidst mangrove forests of the Godavari region, which is the second largest mangrove formation in East Coast of India and is located at a distance of about 10km radius from the Kakinada Sea ports. Dynamic mangroves ecosystem (235.70 km²) of the Coringa Wildlife Sanctuary supports rich biodiversity such as Fishing Cat, Otter, Jackal, Estuarine Crocodile (locally extinct), Sea Turtle, Sea Gull, Pelican, Open-billed Stork, Grey Heron, Snipes, Flamingos on transit, to name only a few. Over 269 species of birds are found within and outside the wildlife sanctuary besides 137 species of Phytoplanktons, 73 species of Fungi, 9 Microorganisms, 81 species of Zooplankton, 126 species of Micro benthos, 28 groups of meio-benthos, 114 species of macro-benthos, 52 species of Foraminiferids, 14 species of Amphibians, 109 species of insects, 430 species of Fin-fish, 27 species of Reptiles, and 18 species of Mammals were recorded.

Rare, Endangered and Threatened Species have been reported from this region. Of the 440 threatened species recorded in India, 90 species have been recorded in this region which inclusive of 08 critically endangered species (fishes-4, birds-3 & turtle-1), 10 endangered species (fishes-4, birds-4, mammal-1 & turtle-1), 35 vulnerable species (fishes-28, birds-5, mammal-1, turtle-1 & sea grass-1) and 35 near threatened species (fishes-24, birds-10, mammal-1 & mangrove-1). These records highlight the national and global importance of

this region. The sea coast of sanctuary is the home of sea turtles which visit the Hope Island and Sacramento Island for breeding every year (Thulsi Rao *et al.*,2013).

The Kakinada Bay is enclosed on the eastern side by about 15 km long sand spit (natural formation), called Hope Island acts as a sort of natural break water and provides tranquillity to the ships anchored in Kakinada bay which makes Kakinada Port one of the safest natural ports in the Eastern Coast of India.

The region around the Kakinada Sea Port contains the significant physiographic features, most important natural habitats for in-situ conservation of biological diversity, including those containing threatened species of 'Outstanding Universal Value' from the point of view of science and Conservation. This region also Contain exceptional natural beauty and aesthetic importance of outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals. The region is an outstanding example of a traditional human settlement, especially land-use, or sea-use which is representative of a cultures, and human interaction with the vulnerable environment under the impact of irreversible change.

Weighing in the environmental perspective for sustained growth, the Ministry of Shipping has started 'Project Green Ports' which will help in making the Major Ports across India cleaner and greener. Even though the Kakinada port is not a major port but it is very important to move towards the idea of "Green port development to conserve the valuable and fragile Environment in the EGREE (East Godavari Riverine Estuarine Ecosystem) region" (Thulsi Rao *et al.*,2017).

2.3 Green Ports Concept:

The concept of the Green port is to integrate environmentally friendly methods in port activities, operations and management and also balances the relationships between port, transport activities, human beings, and nature. All the factors related to the construction and operation of the port should raise resource utilization efficiency, reduce the negative impact on regional environment, raise the environment management level and improve environment quality in the port area. There are a lot of suggestions that can be followed in order to transform a existing port into a green port. Such suggestions are to design a green logistics system that aims to minimize the negative impact in the port environment; to apply cleaner production which intends to minimize waste and emissions and maximize product output, for

example, by reusing waste; other suggestions are the ecological monitoring, the protection system, the ecological security management system and sustainable development of the ports, based on low resource consumption.

3. Strategies to be adapted for conversion into Green ports:

Ports are a major economic driver in countries across the Globe. They are also competitive environments, and are constantly vying for new business while maintaining current relationships. As more and more major National and International companies, manufacturers, retailers and cruise operators are looking to improve their environmental record, they will be examining how sustainable their entire shipping process is. Ports which are able to demonstrate their sustainable operations are likely to catch the eye of such organizations. These ports will be able to remain competitive in the global market and support local communities by creating and sustaining employment opportunities; improving local infrastructure; improving local air and water quality; and minimizing environmental degradation to habitats and wildlife. The following strategies and best practices available across the world are recommended.

3.1 Improve Wildlife – Marine Life:

A green port needs to conduct periodical analytical environmental studies about the surrounding natural (marine and land) ecosystem, taking account of the necessary initiatives to balance the port activities and the conservation of flora and fauna of the ecosystem. This would require environmental studies, not only to identify the species in the area, but also the possible damage caused by the port activities. The ports should monitor wildlife by tracking several indicators of habitat quality, including the abundance of birds and the number of fish species found in the harbour during periodic biological surveys. If the ecosystem is damaged, the ports must plan restoration programs that will contribute to the rehabilitation of the area and protect the ecosystem. The phenomenon of the disturbance of wildlife and marine life is reflected by the quality of the port aquatorium, the air quality, as well as the noise and light pollution. Any measure enforced to eliminate these problems interacts, in a positive way, to strengthen the balance of the ecosystem in and around the Kakinada ports.

3.2 Prevention of Air Pollution:

Strict policies for prevention of air pollution (due to fuel, old engines) shall be adopted/enforced by prescribing the emission limits for different pollutants. Along with regulatory mechanism, there are various solutions available to control air pollution at ports. Air emission is already spreading its wings damaging the environment and ports contribute major source of emission imposing health risks to the nearby communities. Ports need to take the initiatives addressing the root cause of the pollution for the sustainable development. Progress with bad health of the region is not preferred by any society. Hence more emphasis is to be given on the use of cleaner fuel and technology leading to improvement in air quality and public health. There is a need to develop green policies supported by incentives to encourage ports and to implement green practices. Jawaharlal Nehru Port Trust has already taken a lead in this regard. Green practices in the marine and port sector would need collaboration with other sectors (ex: air quality concerns). Hence, the ports must reduce the pollutant emissions (SO_x, NO_x, PM, Black carbon etc.,) which are caused by their operation activities. The first step is to apply stricter environmental strategies within the ports and the next step is to adopt good practices that have been proven to be effective and strengthen the environmental policies in the ports. Some of the measures for the control of emissions that contribute to the transformation into green ports are –

Easy and low cost approaches:

- a) Use of cleaner fuels such as Low Sulphur Diesels (LSD), biodiesel, and Fischer-tropsch diesel in all port equipments.
- b) Well-enforced idling time restrictions of the vehicles in the port area.
- c) Measures such as terminal gate improvements, simplifying trade procedures, designing logistic chain which produces less traffic and less air emission.
- d) Controlling temperature of bunker during storage or using scavenging agent to reduce emission during bunkering operations.
- e) Speed reduction, use of specially designed paints to reduce drag, and vessel assignment planning for harbour crafts.
- f) Formulation of green tariff for the vessels which are reducing speed and using distillate fuel in the port limits.
- g) Water curtains for the coal storage area to prevent the coal dust flying from the storage yard and spreading through the port.

Capital intensive approaches:

- a) Replacing or retrofitting cleaner engines for cargo handling equipments, vehicles, and harbour crafts.
- b) Repowering of the old, highly polluting locomotives and tugboats with several low emitting new engine options, including natural gas (NG) and hybrid battery-electric (Bailey & Solomon, 2004).
- c) Cold ironing for ships and port's tugs.
- d) Building of the infrastructure such as separate corridors for the cargo, widening of the roads, flyovers, improving intersection for the better traffic.
- e) VOCs for the oil installations, gas fill stations and bunkering barges in the port area.
- f) Use of renewable energy such as wind, solar power or biogas or alternative fuel such as natural gas or propane for the port's energy needs.
- g) Green curtains or Green Belts by tree plantation all around the port areas and in open area, because it contributes to reducing air pollution (mainly to mitigate the effect of CO₂ emission) and noise pollution
- h) **Upgrade/retrofit cargo equipment:** Equipment such as cranes, trucks and forklifts typically run on diesel fuel which can contribute to decreased air quality. By upgrading to newer equipment or retrofitting existing equipment to run on cleaner burning fuel, ports can significantly improve air quality by lowering emissions. (*For example, the Port of Los Angeles' efforts to reduce diesel exhaust have lowered particulate matter emissions by 77 percent and nitrogen oxides by 56 percent (Andrea Vitorino, 2014).* For cargo-moving equipment that cannot be upgraded, switching to higher grade diesel can make engines more efficient and lower emissions rates.

3.3 Reduce soil and sediment pollution:

Soil and sediments in ports have been contaminated by past industrial uses, illegal dumping, oil production and pollution entering the harbour through storm drains and rivers. The ports must manage any polluted material or source on land and in harbour sediments, so as to protect site workers, the port community and the environment, and to ensure that the pollution is not simply shifted elsewhere. The ports should make the necessary studies to plan the removal of the identified contamination in the ports' land and sediments. This plan should include monitoring the contaminated ground water at site around the port to ensure that it will not migrate to harbour waters. Moreover, they should conduct pre-construction surveys of

land, sediments, and building, so as to identify any hazardous waste and manage it appropriately.

3.4 Improve water quality:

Improper port maintenance and operations can impact water quality and local water ecosystems. Green ports plan projects to protect and improve the water quality by managing the activities that can cause water pollution. Major sea pollutants are ship wastes and leakages, in case of accidents or bad services of ships, and infrastructure inside the periphery of the port. Also, routine activities, such as ship discharge (ballast, sewage, and spillage) contribute significantly to water pollution. One of the biggest water quality issues ports face is contamination from ballast and bilge water. As ships discharge their ballast water, they can inadvertently introduce non-native species, which can pose a threat to local species and environmentally-sensitive habitats. Bilge water released to maintain stability can also pose threats to local marine life and habitats if it is contaminated with oil from machinery on-board ships. Reducing the amount of dredging needed can help lower turbidity and minimize the risk of unearthing buried pollutants.

The water quality shall be measured periodically via a set of parameters: transparency, pH, temperature, salinity, turbidity, suspended solid (SS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), sulfide (S₂), nitrogen (N), mercury (Hg), lead (Pb), zinc (Zn), phosphorous (P), Cadmium (Cd), cyanide (CN), Hydrocarbons (HC), density and types of phytoplankton and zooplankton are some of the more usual parameters that are measured to study the quality of the water (Saengsupavanich, 2009).

Every port should develop a Storm Water Pollution Prevention Program to manage storm water, including industrial, construction, municipal and development activities. Such programs could include regular cleaning of the paved roads that will result in the sewage drain. Moreover, all the contaminated water from the port surface must result in sewage drains which should be connected to the city's sewage treatment plant. Minimizing the amount of impervious surface at port facilities by using porous asphalt and concrete, as well as Green roofs, can reduce storm water runoff levels and thereby improve local water habitats (*For Example: The Port of Houston uses an additional strategy, storm water detention ponds, to prevent pollutants from contaminating Galveston Bay*).

The existing regulations regarding the ship discharges also contribute to minimize the pollution in the port aquatorium. The enforcement of the regulations is more than necessary

and stricter inspections are obligatory. A fine method to improve the water quality is by installing sensors that will inform the authorities in real time about the pollution risk and enable them to take the right measures without wasting any time.

3.5 Reduce energy consumption:

There is a significant energy consumption from the light at terminals, offices (computers, and other devices that, even in the “stand by” mode, consume energy) and the heating/ cooling devices and lighting used in the whole port’s infrastructure. A Green Port should enforce energy efficiency policies in order to reduce the energy consumption. New strategies should be planned and implemented, based on new forms of energy and, mostly, on the renewable ones (especially solar and wind). These strategies must focus on the installation, maintenance, usage and storage of renewable and eco-friendly forms of energy. Moreover, ports should conduct energy consumption studies, in the whole infrastructure areas of the ports, as well as in the locations outside their perimeters, so as to assess the caused damage and to enable them to incorporate energy efficiency studies to eliminate unnecessary energy consumption and change fixtures to become more cost-efficient. These studies will give them an overall estimation of the situation, so as to issue efficient policies to restrict ship/rail/truck/ infrastructure energy consumption and to decrease the illuminating areas outside the port properties perimeters, when they are not moving or, even, alter operation schedules to avoid light pollution during night hours (Corson,2008).

3.6 Use Shore-side Power to Replace Auxiliary Engines:

Another suggestion is to provide shore-side power to cruise ships which enables the ships to plug in their vessels resulting in zero air emissions, while a ship is connected to the port. This is the most advanced technique used only in four ports all over the world. Several successful cases have been implemented in different ports where shore-side electrical power has achieved significant reduction in CO₂ emissions: 99.5%, 85.0%, and 9.4% in Norway, France and the U.S., respectively (Hall,2010). In terms of the encouragement of such a system, a port tax discount (or differentiated tonnage tax) could be implemented for ships when they use shore-side power. An additional option is providing a source of renewable energy or natural gas to power ships, which can also lower the amount of emissions released.

3.7 Incentivize ships to use cleaner fuels:

Ports are not able to regulate what type of fuels ships can use, but they can create incentives for them to use cleaner burning fuels or more efficient engines. Such incentives can include reduced harbor usage fees.

3.8 Improve infrastructure connections:

As port activity continues to grow, roads and rail connections will be vital to ensuring efficient transportation of goods. While improving rail connectivity will allow for more organized movement of goods to and from the port, often times a simple solution, such as providing left-hand traffic signals for trucks leaving ports or providing at-grade rail crossings, can reduce bottlenecks and traffic jams. In some instances, diverting trucks from local roads and providing direct access from the port to highways can also reduce congestion.

3.9 Reduce Noise pollution:

Noise pollution within port areas is a complex issue due to different causes, affecting both harbour workers and the population living in the surrounding territories and Marine fauna. Hence the Noise Pollution is pointed out as the current top environmental priority by the Indian port sector. Green ports should draw their own policy or strategy by conducting noise abatement studies, issue policies regulating the activation of sirens, horns, vehicle warning “beepers”, and other sources of noise from port. Ports should determine effective source mitigation measures by carrying out technical sound measurements at a defined distance to the equipment, by an acoustic expert, in order to measure the states of the main operations, such as lifting, lowering, driving, and idling and to calculate, both the sound level of the equipment, and the operation state with the main influence. Defining the most essential factors makes it easier to plan the appropriate actions that must be carried on to reduce noise pollution.

It has been observed during our expeditions and also tracking the fish catches, marine mammals and Reptiles visiting to Kakinada seacoasts are very sensitive to anthropogenic sounds. The eco-sensitive area i.e., CWLS should be made aware of rise in ambient noise levels in the oceans. Education campaigns targeted at generators of noise in the marine environment should be implemented. This is especially important as establishing regulations and policies for many of the aforementioned measures of protection could take a long time. Industries, including commercial fishing, shipping, and tourism (whaleshark watching, excursion tours), should be targeted. Public education is also important. All of these entities should be educated on mitigation techniques, such as quiet ship technologies, and

adaptations, such as reducing speeds to lower noise generated from cavitations and adjusting activities around particularly sensitive periods for animals (e.g., breeding and migration times). Guidelines should be established for these methods to provide clear direction, and voluntary incentives for compliance should be strongly promoted.

3.10 Improve Weather Monitoring:

Another important issue that is not taken into account are the extreme weather conditions. In general, the weather conditions (among others, temperature, humidity, wind direction and intensity) play a crucial role in the port activities, because they can affect the labour productivity, the visibility at the terminals and in mooring procedures, the instantaneous air pollution in the port area (Contini *et al.*,2011), the possibility of accidents during the loading/unloading, transportation and storage of cargoes, or sensible products. As a final result, the weather conditions can cause financial losses of the port's incomings because of accidents, delays and productivity decreasing. This factor can play a more important role in the case of ports without bulwarks and is of crucial importance for them to be continually informed about the weather conditions (especially, the extreme ones), in order to protect staff, infrastructure and cargoes and, overall, the whole transportation chain from accidents and delays. It is important for modern green ports to establish weather station networks for analytic and continuous monitoring and models for weather forecasting. This will contribute, not only to the increase of reliability and the quality of the provided services, the staff and infrastructure safety, the overall agility of port activities, but also to the improvement of the infrastructure, in order to decrease or prevent impacts from extreme weather phenomena and accidents that, in the past, have led to many serious environmental disasters.

3.11 Modern Environmental Perspectives for Green Ports:

Geographic Information Systems (GIS) are well-known, widely spread, and used for monitoring of spatiotemporal characteristics, storage and analysis of data in many scientific fields. These systems are ideal for environmental monitoring, because they allow the implementation and integration of many different data sources and their automatic spatial analysis and modeling. More specifically, GIS applications are continuously developing for monitoring, analysis and modeling spatiotemporal changes of many parameters and phenomena, such as air pollution(Song & Lee, 2010; Tolga *et al.*,2010) coastlines (Mujabar,

2011) land use (Xu *et al.*,2011) and many others, integrating different data and techniques with reliable results. In recent years, GIS applications for monitoring causes and results of environmental changes, use remotely sensed data from polar-orbiting satellite sensors, improving the analysis and giving new perspectives to the environmental monitoring and modelling (Vemu,2011). Considering the above, GIS applications can be, not only a valuable tool for a continuous and accurate monitoring of environmental impacts of port activities, but a decision making system, planning strategies for sustainable port development.

3.12 Achieve Sustainability:

In order to achieve sustainability, sustainable practices should be implemented during the design and construction, the operations and, even, throughout the administrative management. The sustainable practices are aiming to reduce pollution, by all means and in all fields. One applicable sustainable practice is recycling. Each port can recycle everything, from plastic (bottles) and paper (newspapers, magazines) to tyres and computers. The ports must apply recycling policies and they must also reuse these materials. Other ways to achieve sustainability are to improve the air quality, to make energy and fuel efficiency improvements, such as using alternative sources of energy in the port, such as solar energy or hydroelectric power, or by replacing the port vehicles with alternative fuel vehicles. In addition, the ports should apply energy efficiency plans, such as the BMS (Building Management System), which controls the energy consumption in their building.

3.13 Recycling policies:

Reduce, Recycle all waste and also reuse within the port area.

3.14 Use of Renewable Energies:

The available energy sources, found in nature, are the wind, solar, geothermal and tidal and wave energy etc. Although there are so many, the difficult task is the conversion to electricity and the efficiency of the converting systems. The most preferable one to the Kakinada Sea ports is the solar energy. Examples of active solar techniques are the photovoltaic or solar panels, which convert the energy into electricity and passive solar, are orienting a building to the sun and designing spaces that naturally circulate. Today, the technology of designing photovoltaic panels is developing in a fast pace and growing rapidly. Solar panels are now more efficient, transportable and even flexible, making them capable for many applications and installations. A single solar cell does not provide enough power, but a combination of many in arrays makes them able of powering medium sized applications. It is

proposed the main port's building to be reconstructed as green building using solar panels in the roofs or in the windows.

3.15 Seek state and Central funding:

To help fund practices and upgrades like those above, ports can seek funding from state and central sources.

Example 1: The Port of Houston, received a \$66,500 Solid Waste grant from the Houston–Galveston Area Council and the Texas Commission on Environmental Quality to help fund projects to prevent litter, promote recycling and remove floating debris in channels. Under the Energy Policy Act of 2005, the Diesel Emissions Reduction Act (DERA) authorizes up to \$100 million each year for projects that reduce diesel emissions.

Example 2: The ports of Seattle, Hueneme, Tacoma and Los Angeles were four of six ports that recently received a total of \$4.2 million in DERA grants to help lower their emissions (Andrea Vitorino, 2014). The U.S. Environmental Protection Agency's National Clean Diesel Campaign (NCDC) also offers guidance and funding opportunities for projects looking to reduce diesel emissions by retrofitting diesel devices, replacing older vehicles and equipment and using cleaner fuels.

4. Policy options to green A.P. India's maritime sector:

As a responsible member in the IMO Council, India abides by international regulations and adheres to best practices. The following set of policy options are recommended in the hope that they will help and attain a balance between protecting the environment and ensuring that maritime activities meet their socio-economic needs:

- Develop a national strategy to green the maritime sector
- Strengthen linkages among relevant agencies.
- Include green clauses in maritime-related activities
- Increase R&D to green the maritime sector
- Providing incentives to encourage maritime industry players to go green.
- Foster close relationship between regulatory authorities and the private sector.
- Nurture adequate and trained manpower to work and operate in a green environment
- Promote coastal shipping as a cleaner, alternative mode of cargo transport.
- Align efforts to green the maritime sector with the national agenda

5. Conclusions:

This Paper is mainly intended to focus and move towards innovative, eco-friendly and cost-efficient ideas to promote Greenport concept by taking into account of current non-environmental friendly practices of the ports, as well as the current insufficient enforcement regarding the protection of the environment. Adopting and applying the idea of an Ecofriendly/Green port would be more appropriate to shift the management practices towards the overall Green behaviour and respect the environment. Therefore, this paper also presents the suggestions of how to transform existing non-environmental port into an ecofriendly/Green port and some of these suggestions may require advanced technology and funding, while others are cost-efficient and do not need special skills to apply them. The above mentioned ideas might be a small contribution to a big effort to save our gorgeous coastal and marine environments.

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