SOLAR POWER FOR SMART PORTSGENERATING ENERGY AND PUBLIC ACCEPTANCE

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ABSTRACT:

The weather records in the last decade show continues global rise in temperature due to increase of CO2-emission. The main sources of CO2-emissionare burning oil, coal and gases to produce energy for industrial activities and transports. Rise of sea-level is a direct result of global warming.This endanger port infrastructure and operations overall the world. Smart Ports should gain from the continues development in using renewable and sustainable energy to save in operation costs and on the other hand to avoid operational problems expected in the future due to radical changes in sea-level. Furthermore,sea Ports face a public relations problem because they are seen as heavy consumers of energy. Generating renewable power on-site at the port terminals can improve public opinion of the ports. Some European sea ports have already implemented optimistic plans targeting high percentage renewably sourced electricity supply in the near future.

CLIMATE CHANGE INFLUENCES THE POTENTIALS OF RENEWABLE ENERGY

Changes in global sea level due to global warming endanger the existence of many coastal areas worldwide. Many coastal cities might disappear in few decades. The infrastructure of most sea ports will suffer serious damages. Development of renewable energy resources needs to be pushed forward to reduce global warming, thus help avoid these threats.

“Next to changes in sea ice, sea surface level changes are of high concern for many ports. Changes in regional sea level are determined by changes in global sea level as well as in local wind and pressure patterns and geological processes. Although the size of global sea level change is under debate, the total effect is anticipated to be larger in the southern and south-eastern part of the Baltic Sea, while the northern part will be less affected due to postglacial uplift. Adaptation measures for port facilities need to take into account regional differences. Where the sea level rises significantly, flooding might damage port infrastructure, equipment, and cargo. Ports in the southern Baltic Sea region, for example in Poland and Germany, might need to install additional protection schemes such as levees, seawalls, storm water drainage or dikes, and raise wharf levels. The largest

port in Poland, the port of Gdansk, is located in one of the most flood prone areas of Poland. However, this region has – similar to many other parts of the southern Baltic Sea region – long experiences with inundations. Flood protection schemes including storm gates, pumping stations, or storage reservoirs are present. In the future, not only maintenance of existing protection infrastructure, but also reconstructions incorporating anticipated climate change impacts will be necessary. Sea level rise also aggravates storm surges and has an even higher impact on those than increased wind speeds. An increase in extreme storm events and higher storm surges would challenge maritime traffic and it's maneuvering – especially in narrow port entrances such as the inland port of Gdansk". (1)

"As a gateway between ground and sea transportation, and asa business location for service and industry, ports are of greatsignificance for the regional and national economy. At the sametime, port structures are located in regions threatened by stormsand rising sea levels. Due to highly interdependent value chains,weather related disruptions in port operation can cause seriouseconomic damage. Thus, adaptation to possible climate impactsseems like an obvious task for port authorities." (2)

FACTS AND FIGURES

Back in June of 2014, Germany reached a significant milestone and national record by satisfying more than 50 percent of its electricity demand with 23.1 gigawatts of solar power– which was half of the entire world's production at the time. In fact, they broke three national solar records that week. With 35 GW of solar PV capacity, the country actually generated more solar energy the week before, hitting 24.24 GW, but because of demand variances they were able to achieve this impressive feat with less.

In addition to solar, more recently, Germany reportedly satisfied 78 percent of its electricity demand with renewable sources. Wind and solar generated 40.65 GW of power as of July 25. When combined with 4.85 GW from biomass and 2.4 GW from hydropower, their total renewable power production reached 47.9 GW, which occurred at a time when peak power demand was 61.1 GW.

It's important to note, however, that Germany's level of renewable energy production on that red-letter day isn't constant or even common. In 2014 overall, renewable energy accounted for approximately 31 percent of Germany's electricity consumption. Solar power in particular contributed about 6.9 percent, which is still nothing to shake a stick at. (3)

The government of Mecklenburg Western Pomerania – GERMANY Targets 100 percent Energy Supply through renewable energies by the year 2050.

Federal state of Schleswig-Holstein - GERMANY plans a 100 percent renewably sourced electricity supply already by 2020

In China 30% of the total installed power is coming from renewable energy sources. It should reach 50% in 2050. Germany targets 80% in 2050.

In the coming 15 years, Asia Pacific will add as much power capacity as the rest of the world, an average of U.S. $ 252 Billion a year.

Morocco is building the largest concentrated solar power plant in the world using CSP mirror technology with up to 8 Hours storage capacity for power generation at night. USA federal government is investing more than $500 million in developing new energy storage technologies for PV power generation. (4)

SOLAR POWER FOR SUSTAINABLE SEA PORTS

Sea Ports are attractive locations for sustainable energy production. A medium-sized terminal of 150 acres (60.7 ha) offers as much as two acres (0.8 ha) of roof space.

Sea Ports face a public relations problem because they are seen as heavy consumers of energy. Generating renewable power on-site at sea portswill improve the image of sea ports which make them gain public acceptance. We, marine engineers, must play our roll in the global efforts to save the future of our earth as well as the future of our next generations. In China 30% of the total installed power is coming from renewable energy sources. It should reach 50% in 2050. Germany targets 80% in 2050.

WHERE CAN SOLAR PANELS BE INSTALLED IN SEA PORTS?

1- On the roof of warehouses and cold storage and other port's facilities:
   - A medium-sized terminal of 150 acres (60.7 ha) offers as much as two acres (0.8 ha) of roof space.
   - Warehouses can support the added weight of PV panels without requiring structural reinforcement.
   - Canopy structures can be topped with PV panels or solar heaters.
   - Solar panel topped larger canopies over wheeled reefer parking stalls produces electricity while reducing power demand by providing shade for the reefers
   - Reefer racks used in straddle carrier terminals could be equipped with PV topped shade canopies.

- Dock cranes also offer space for PV panels.

Fig. 1.Solar PV panels on the roof of warehouses and cold storage facilities

2- on the roof of terminals and administration buildings

Fig. 2.Solar PV panels on the roof of terminals and administration buildings

3- Roofing of public facilities such as parking lots and bus stops with solar modules

Fig. 3. Solar PV panelsOn top of Parking Lots

4- Roofing of walkway and sheds
5- Cladding of Facades
6- Electric Car Tanking stations
7- Gates and barriers for Garages and special areas
8- Parking Meters
9- Street lights with intelligent smart control systems

EXAMPLES OF SUSTAINABLE SEA PORTS.

1- The ports of Copenhagen and Malmö might be an example of good practice. In 2001, these two ports joined all their operations into one company and one legal entity. For the first time in history, two ports from two different countries are merging together.

   Climate change impact studies were conducted and the current protection level is high. Additionally, Copenhagen is elected as the European Green Capital of 2014, honoring its efforts in regard to environmental protection, including climate change mitigation and sustainable transport. Denmark and Sweden show that international cooperation can bring economic benefits on the one hand and facilitate climate change adaptation and mitigation measures on the other hand. The EU Baltic Sea Region Strategy highlights that adaptation strategies are needed to cope with the inevitable consequences of climate change. The project Baltadapt (Baltic Sea Region Program 2007-2013) is developing a transnational climate change adaptation strategy for the Baltic Sea region, focused on the sea and the coastline and certain sectors such as

infrastructure including ports, but also tourism, fisheries, and biodiversity. The project facilitates a knowledge-brokerage process on climate change adaptation between research and policy, thus contributing to improved institutional capacity. (1)

This will help decision makers in the Baltic Sea Region to tackle the consequences of climate change. (www.baltadapt.eu).

2- Hamburg sea Port

Fig. 4. The port of Hamburg

Hamburg started developing eco-friendly technologies several years ago, the objective being to harmonies economic objectives and ecological concerns.
The port will become a “flagship port” for renewable energies.
Wind farm sites
Buildings owned by the HPA, will be leased to Solar power operators
biomass energy: own biogas plant
Energy efficiency and smart energy: energy consumption is being brought in line with the energy produced from renewable sources
Cross-company use of waste heat
Smart Storage systems of energy derived from renewable energies

3- Port of Rotterdam

Fig. 5 The admin. Building of the port of Rotterdam

In 2014 a large solar panel park was opened on the roof of the RDM Scheepsbouwloods

Solar panels have also been installed on the cold storage facility of Kloosterboers Delta Terminal.

A total of 1800 solar panels with capacity of 450kWp, annual yield of 430,000 kWh, making Kloosterboer largely self-sufficient for their energy needs.

The installation saves140 tons of CO2 on an annual basis helping in reducing global warming.

Port Vision for 2030, is to meet 30% of energy needs using sustainably generated power.

The Port Authority is developing a solar park, but the greatest potential for solar energy lies with the companies operating in the port.

Rotterdam's port area could develop into a solar park covering more than 100 hectares.

4- Groningen Seaports, The Netherland

Fig. 6. Groning Sea Port

New PV Project at the port of Groning consisting of 123.000 PV Panels of 30 MWpon 30 Hectares
The construction is planned to Start in the spring of 2016 and will be completed by the end of the year.
The panels will have East – West orientation of mounting offering more efficient use of land plot and better production profile over the course of the day.
The Port's authorities employ a Green energy power mix from biomass, wind turbines, Solar energy & hydro power. 90 wind turbines generating 276 MW have been mounted inside the port area. This group of sea ports in the Netherlands is planned to be the logistics hub of the Netherlands' offshore wind industry.
It is also a potential site for geothermal applications (5)

EXAMPLES OF USING SOLAR POWER ON BOARD SEA VESSELS

1- M/V "Auriga Leader" Owner: Tokyo-based shipping company, NYK Line. World's First Cargo Ship Propelled (in part) by 328 Solar Panels completion of the vessel on December 19, 2008 Energy from 328 panels is helping to power the ship's thrusters, hydraulics and steering gear, providing about 10 percent of the ship's total electricity usage.

Fig. 7. M/V "Auriga Leader"

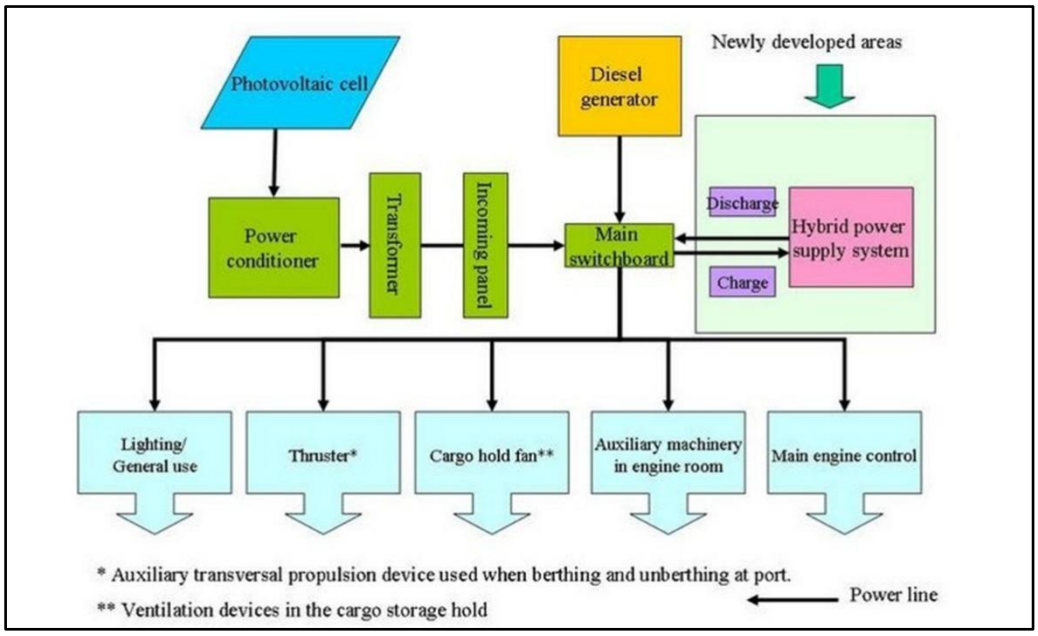

Fig. 8. The hybrid power supply system

2- MS Turanor Planet Solar

MS TûranorPlanetSolar, known under the project name PlanetSolar, is the largest solar-powered boat in the world. The vessel was designed by LOMOcean Design, built by KnierimYachtbau in Kiel, Germany, and launched on 31 March 2010.

The 31-metre boat is covered by 537 m2. of solar panels rated at 93 kW, which in turn connect to one of the two electric motors in each hull. There are 8.5 tons of lithium-ion batteries in the ship's two hulls. The boat's shape allows it to reach speeds of up to 14 knots. The hull was model tested in wind tunnels and was tank tested to determine its hydrodynamics and aerodynamics. The boat was designed to be used as a luxury yacht after the record attempt was finished. It is currently being used as a floating marine research laboratory by Geneva University.

Fig. 9. View of the three hulls boat.

The boat is registered in Switzerland and was financed by a German entrepreneur. Construction cost was €12.5 million. The name Tûranor, derived from J.R.R. Tolkien's novel The Lord of the Rings, translates to "The Power of the Sun"

In May 2012, it became the first solar electric vehicle ever to circumnavigate the globe.The world's largest solar-powered ship, has docked at Abu Dhabi Marina, near ADNEC (Abu Dhabi National Exhibition Centre) to help celebrate the World Future Energy Summit 2012, and to highlight the role solar energy is playing in energy sustainability.

Crossed the Atlantic in 22 Days completely silent. (6)

3- PLASTIC POLLUTION SOLUTION

The concerned citizen who came up with the idea of using solar energy to power barges to recover plastic waste is Wolfgang Flatow, from Queensland, Australia. Not only did he have the idea, but he is championing the concept and is actively seeking to raise the profile of the plastic waste problem in our oceans.SEAVAX: The ocean plastic pollution solution put to operation in April 2015. Probably the biggest threat to our oceans is climate changes. That is a massive challenge that SEAVAX cannot begin to scratch, but at least this robot will prove again that solar powered transportation can be put to practical use (7)

Fig. 10. Floating robot for cleaning plastic pollution

ROLL OF SMART GRIDIN SMART SEAPORTS

Integrate renewable energy generation in the main grid of the port is not the sole key to a smart grid. Management of generation according to real load and decrease network losses might be a shorter road to efficient grid. For example; using voltage regulation to help power flow between HV and MV, using new energy storage technologies (storage of heat, fly-wheel and chemical reactions not electricity) or Innovative cost-saving Batteries (Iron, sulfur, Sodium and magnesium) Cost saving and less inflammable will lead to a smart grid.

Decrease network losses (example: Disconnecting circuit breaker (DCB) with fiber optics current sensor (FOCS) to integrate different substation functions into a single component) might add more efficiency to the grid.

Involving consumers in the process either by making grid records available to him or giving him opportunities to invest in generation and distribution of energy within the port, will increases grid efficiency.

Using Central cooling for port's administration buildings or cold stores saves 50% of electric power consumption of cooling and air-conditioning facilities.

CONCLUSION

Smart Sustainable Ports using Renewable Energy and smart grids is an Invest in the future.

More Renewable Energy decreases CO2 emission. This will lower Global Warming dramatically. It is not only for the purpose of saving in the cost, but also

to avoid danger of sea level rising and consequent damages for port infrastructures.

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