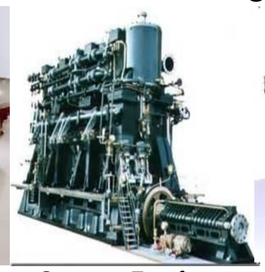
Solar Power for Marine Propulsion – What is Stopping Us?
by C. Maheshwar

Historical Development of Marine Propulsion

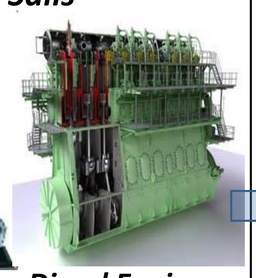
Oars

Sails

Screw Propellers



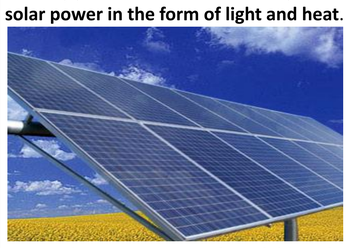
Steam Engines



Diesel Engines

Solar PV power for Ship propulsion

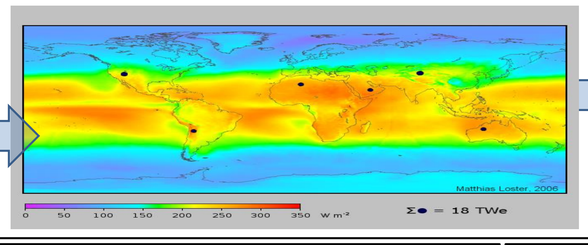
Actively pursued due to availability of abundant and unhindered solar power in the form of light and heat.



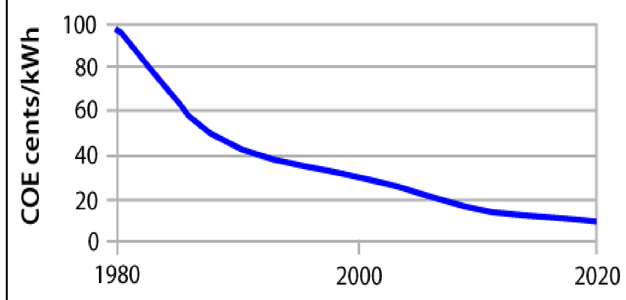
Why solar power?

- Depleting Fossil Fuels
- Growing Environmental Concerns
- Ever increasing Cost of Fossil Fuel
- More stringent enforcement of fuel quality regulations like SECA requirement

- Insolation: Measure of Available Solar Power in KWh/ m²/day
- Typical Insolation Values : 4KWh/m²/day in the North Europe to 6.5 KWh/m²/day in sunniest regions of US
- Sahara Desert: 8.3 KWh/m²/day



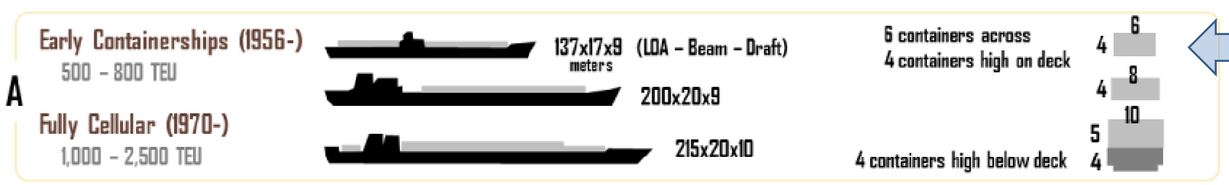
PV Cost of Energy



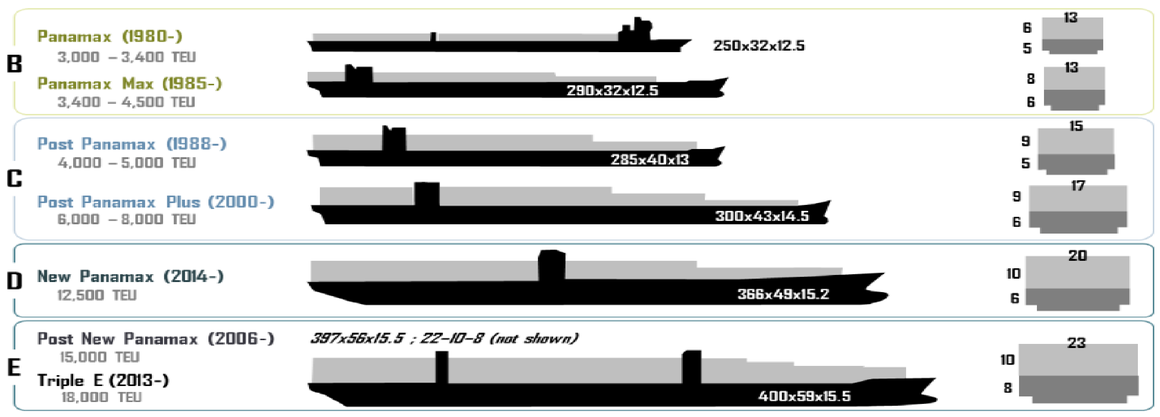
Cost of Solar PV Power

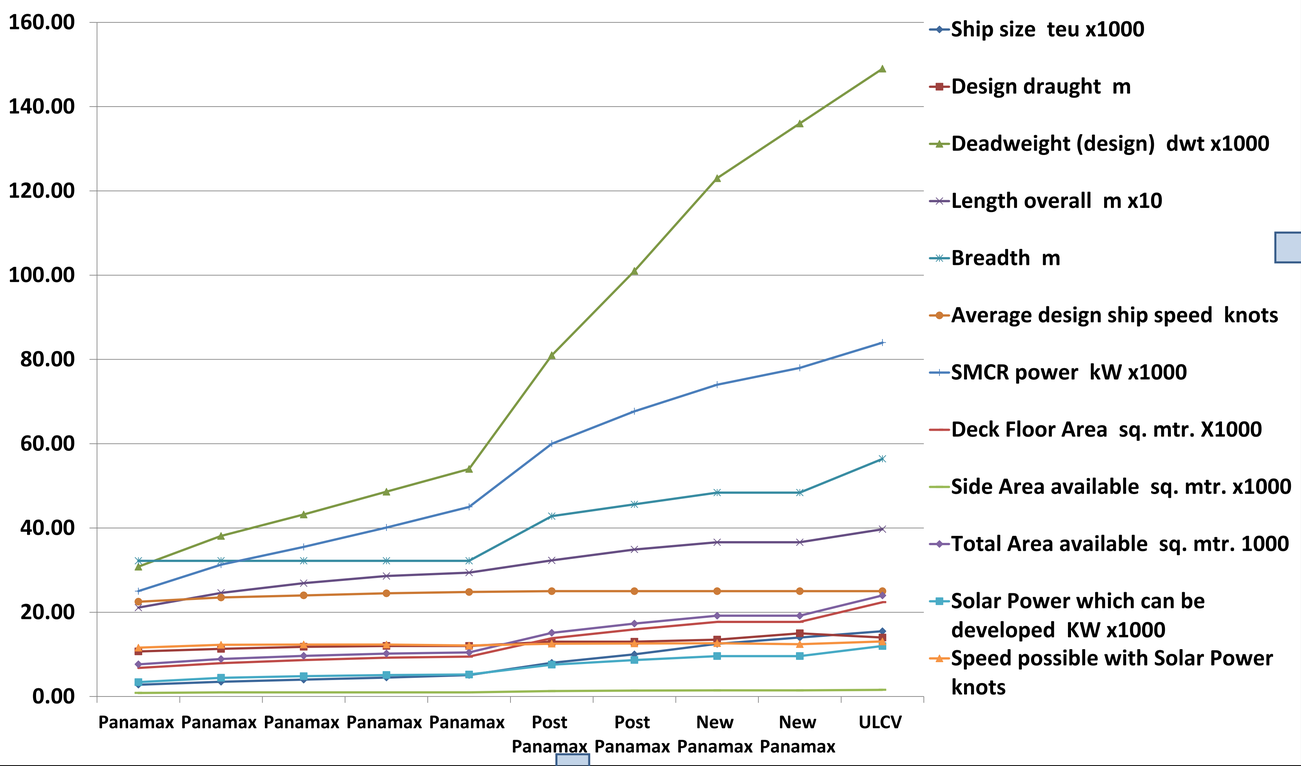
- 5,500 US$ per KW for a 23 KW grid connected solar PV system
- 7,500 US$ per KW for a stand alone smaller system
- The bigger the system, the lower the cost.
- Moore's Law can be rewritten for Cost of Solar PV energy. It can be stated that the Cost of Solar PV power will halve every decade.
- Though presently the cost of power generation from fossil fuel (15 ct/Kwh) is less than solar PV power, it is predicted that in the near future, with the increasing acceptance of solar PV energy on land, the cost of PV panels would certainly fall sufficiently enough to compete and eventually win over the fossil fuel.

CONTAINER VESSELS- SMALL CRAFTS AND FEEDERS



CONTAINER VESSELS- PANAMAXES AND ULCVS





Calculation of Available Areas for Solar Panels

- Available Data: Design Draft; Scantling Draft; Design Deadweight; Scantling Deadweight; Breadth; Length Overall; Length Between Perpendiculars
- Deck Area= Length X Breadth
- Side Area= 2 X Freeboard X Length
- Freeboard = Depth – Design Draft
- Depth = Scantling Draft /0.85

Power Generated from Solar PV Energy on board?

Assumptions:

- Box structure
- Unhindered and continuous deck space and ship sides

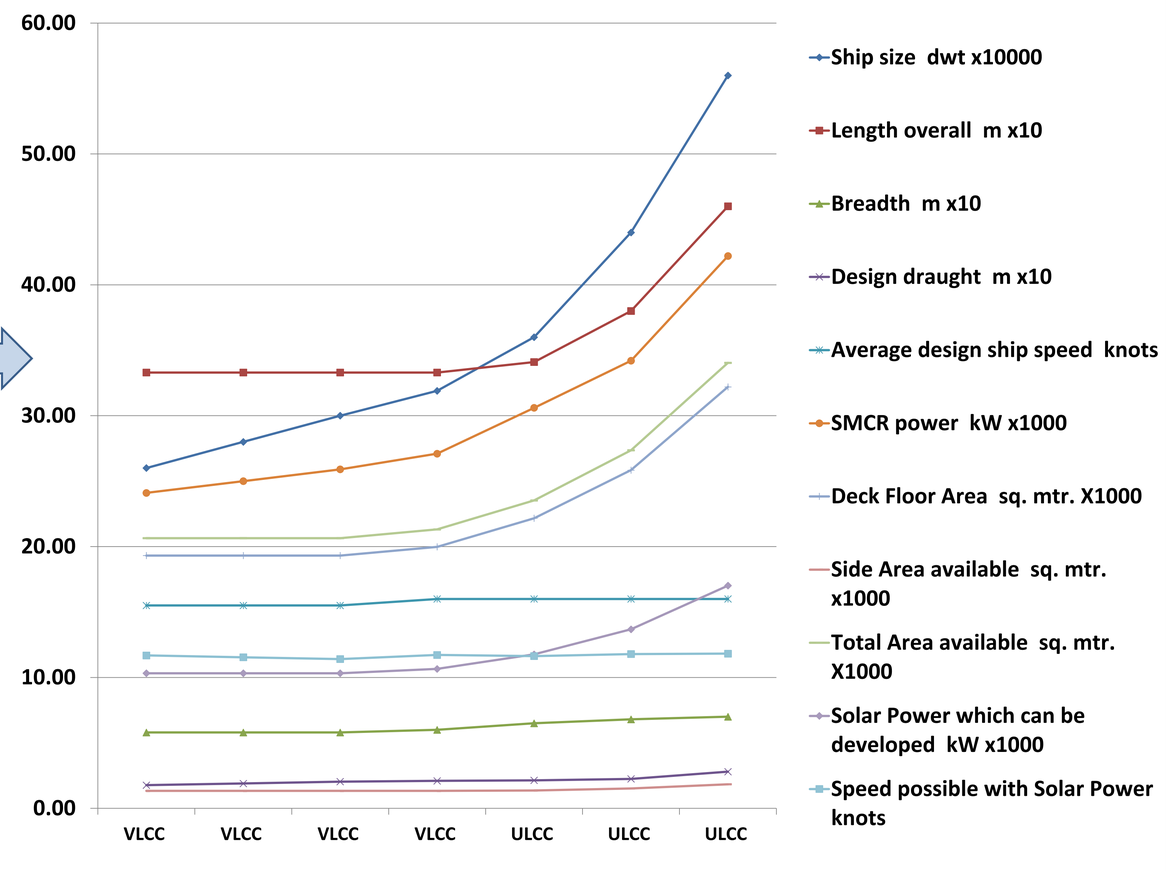
Estimate:

It is estimated that every Sq mtr of area can generate 0.5 KW of electric power using Solar PV Cells at about 15% efficiency.

SMALL TANKERS

TANKERS-PANAMAXES AND SUEZMAXES

TANKERS-VLCCS AND ULCCS

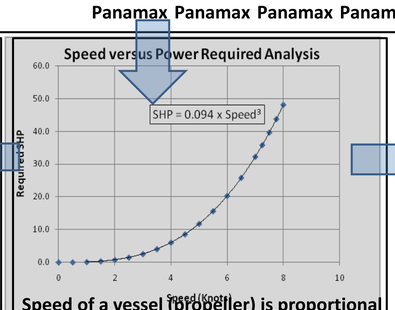


Case 1 - Small Container Vessel: For a small container vessel of 400 teu capacity with design speed of 15 knots with SCMR power of 3,000 KW, if we are able to generate 1134 KW from solar PV panels fitted on the deck and the shipsides, the speed can be over 10 knots, all other conditions being constant.

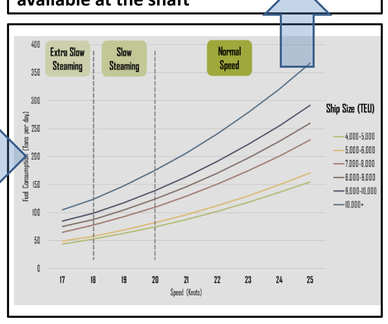
Case 2 – Largest Possible Container Vessel (future design): For a large container vessel of 18,000 teu with a design speed of 25 knots with a SCMR power of 91,500 KW, we will be able to generate 12,684 KW from solar PV panels fitted on the deck and the shipsides, the speed can be over 12.5 knots, all other conditions being constant.

Case 3 - Small Tanker: For a small tanker of 5,000 dwt with design speed of 14 knots with SCMR power of 2,340 KW if we are able to generate 1000 KW from solar PV panels fitted on the deck and the shipsides, the speed can be over 10 knots, all other conditions being constant.

Case 4 – Large sized Tanker (ULCC): For a large tanker of 560,000 dwt with a design speed of 16 knots with a SCMR power of 42,200 KW, we will be able to generate 17,020 KW from solar PV panels fitted on the deck and the shipside, the speed can be over 12 knots, all other conditions being constant.



Speed of a vessel (propeller) is proportional to the cube root of the effective power available at the shaft



Slow Speed Operation of Ships

- The present cost concerns and environmental concerns are forcing the shipping industry to adopt the new concepts of slow steaming of the vessels.
- At slower speeds, the fuel consumption and the emission of the engines are much lower than at high speeds.
- All the new yard deliveries of the vessels are being equipped with slower speed engines with lower fuel consumption and emissions.
- Even older vessels are retrofitting their engines with slow speed components.
- With solar PV panels used for power generation, vessels can be run at 50-75% of maximum speed, the figure varying from the type of the ship and size of the ship.
- Running ships at 50-75% maximum speed is perfectly acceptable in these days making Solar PV panels as the preferred means of main propulsion and power generation on merchant vessels.

Maintenance of Solar Panels.

There is no maintenance required for the panels other than regular surface cleaning

Power generation in night and cloudy conditions: Till the technology permits generation and storage of additional power during sunny periods and release during non sunny periods, the present day Diesel engines could continue to be used for propulsion power during night and cloudy conditions.

Power for propulsion during rough weather conditions: Before the onset of rough weather, propulsion power could be changed over to Diesel Engines and switched power to Solar PV power when conditions clear.

Regulatory Regime

The merchant marine industry is overburdened by the innumerable new regulations to control global warming, SOx emissions, NOx emissions, special areas, etc. The ship staff is working overtime to comprehend and to ensure compliance, but inevitably they get into trouble with the authorities. By the time, one has ensured compliance with one regulation, a new one is already in place forcing designers to go back to the drawing board. It is time to think out of the box and look for a different solution.

Economical Operation of Ships

Fuel constitutes about 50% of the operational cost of a ship. If we are able to dispense with diesel engines and the associated fuel storage systems, it would be much more economical to run ships than it is today with fossil fuels. We also save on the deadweight and volumetric cargo space giving us more cargo carrying capacity. Also there is a substantial saving on manning costs.

Undoubtedly, Solar power is the marine fuel of the future and perhaps offers an out of the box solution to the problems facing the marine industry and the world at large

The Road Travelled So Far - Auriga Leader & Turanor PlanetSolar

The car carrier equipped with the new solar power system

A small step for Man, but a giant leap for Mankind.