2010 UNOLS GOAL

"Greening the Fleet – UNOLS should explore how to make the present and future fleet more environmentally sustainable. New and existing technologies and practices should be used in the construction, operation, and recycling of research vessels and UNOLS should take a leadership role in promoting a green U.S. research fleet, as we move forward in developing the academic fleet."

Greening the Research Fleet

January 10-11, 2012

Nicholas School of the Environment

Duke University

?????

THE UNIVERSITY OF RHODE ISLAND
GRADUATE SCHOOL OF OCEANOGRAPHY
THINK BIG WE DO

GREEN BOATS AND PORTS FOR BLUE WATERS

A Workshop to Promote Environmental Sustainability of Boats and Ports
April 8-9, 2014

Green Boats and Ports for Blue Oceans

Acknowledgements

11th Hour Sailing- Primary Sponsor

Jeremy Pochman, Co-Founder and Director

Rob MacMillan, Co-Founder and Advisor

Kate Neubauer, Program Manager

Additional support from Braemer Energy, Utilidata, UNOLS

UNOLS Activities and Highlights

- **Green Ships and Ports Workshop**, January 2014 – Hosted by GSO with support from UNOLS
- **UNOLS Annual Meeting**: October 21-22, 2014
  - Featured Speaker - Senator Sheldon Whitehouse
- **UNOLS Fleet News**: Three vessels will retire from the UNOLS Fleet at the end of 2014:
  - R/V *Knorr*
  - R/V *Melville*
  - R/V *Point Sur*
- **A new look for UNOLS** – visit our updated website <unols.org>!

Commercial Green Initiatives

January 10th, 2012

Bob Bowers; Maersk Line, Limited; rbowers@mllnet.com

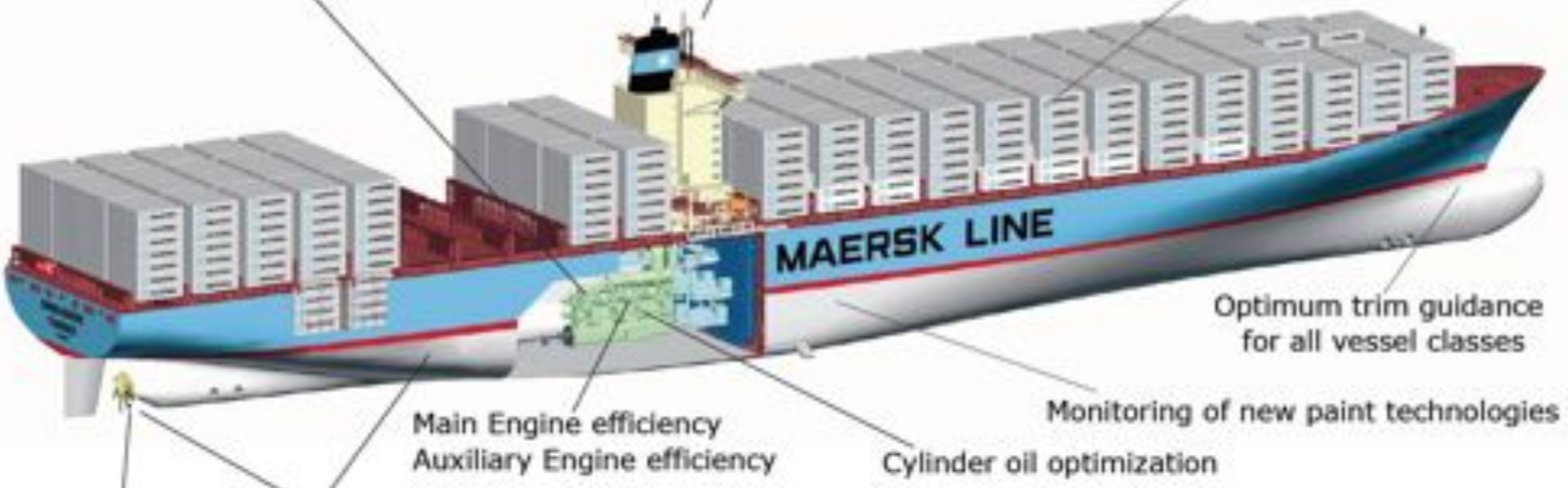
MAERSK LINE, LIMITED

Contents

- Ship emissions and regulatory developments
- Energy efficiency, CO2 reduction
- Air emissions and abatement – NOx and SOx
- Operational measures, logistics
- Alternative fuels

Five elements essential for sustainability

Marine Engineering **Innovation** **Vessel Performance** **Regulatory** **Business Case**



- *Waste heat recovery system*
- *Slow steaming and super-slow steaming*

Other Initiatives

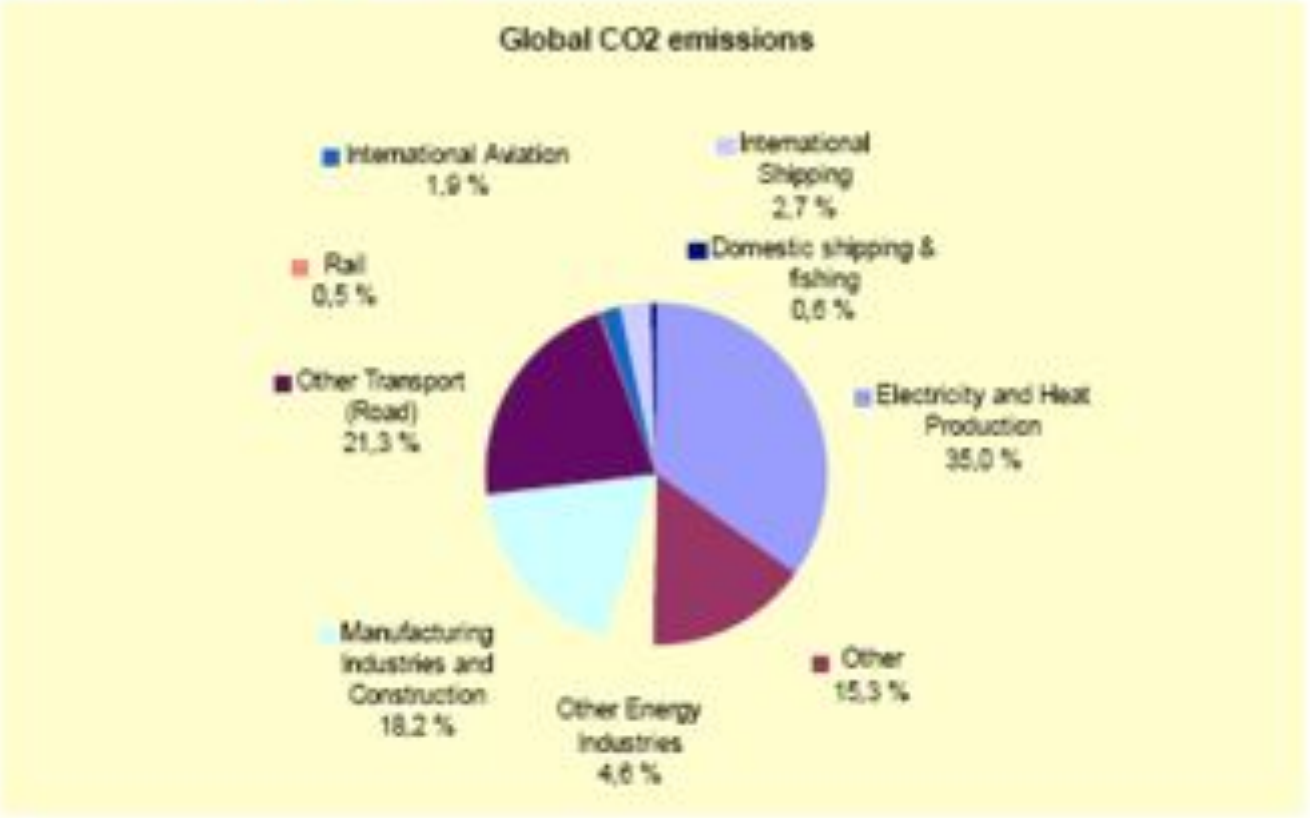
- *Alternative fuel tests*
- *New propulsion technologies*
- *ISO 14001 certified*
- *Crew awareness/engagement*
- *SOx scrubber studies*
- *QUEST: Low energy chilled containers*
- *Modified bulbous bow*
- *Ballast water optimization and treatment systems*

MAERSK LINE, LIMITED

Second IMO GHG Study 2009

Global CO2 emissions

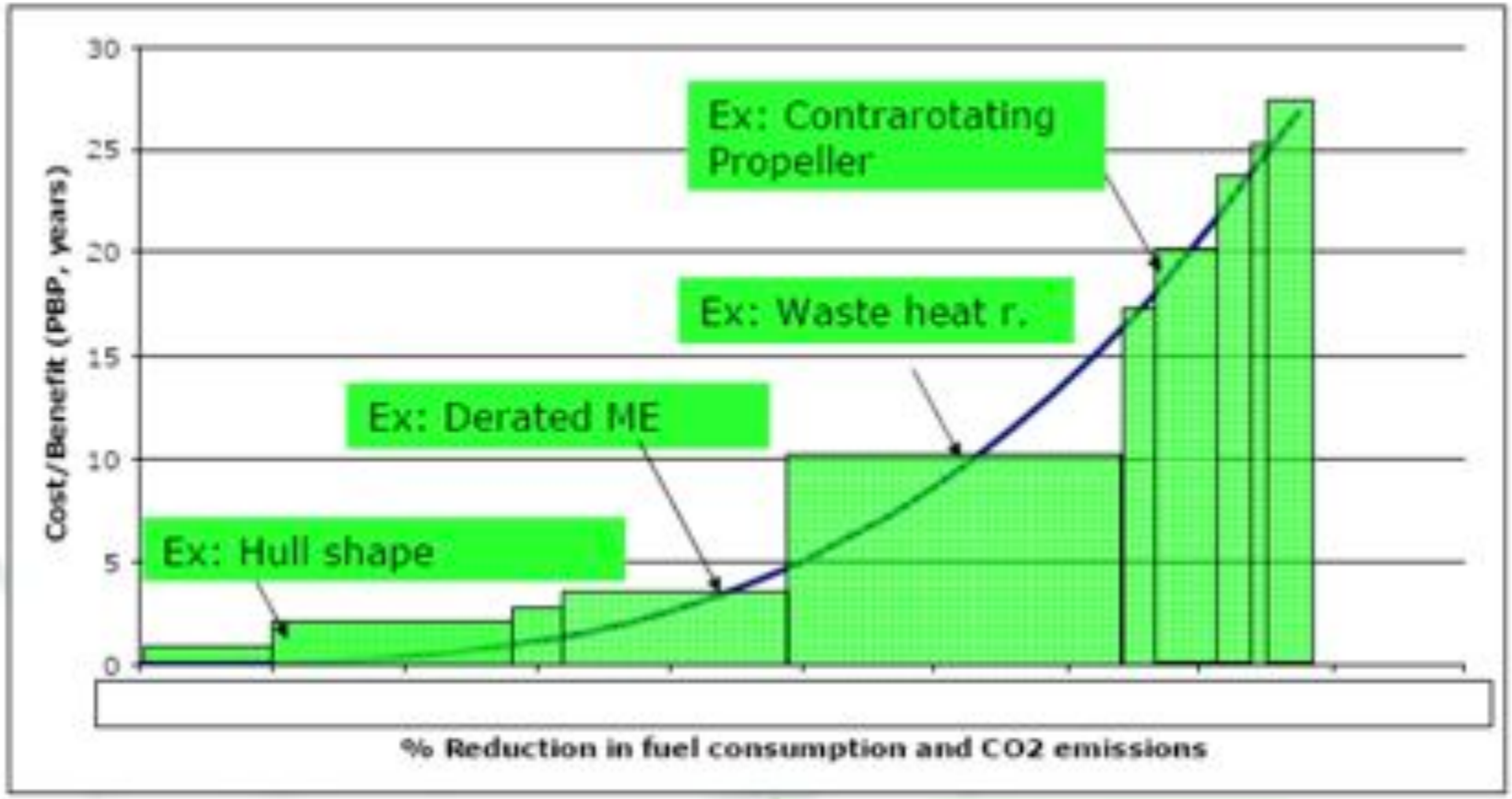
- International shipping: 2.7% of global emissions; domestic/coastal shipping: 0.6%
- CO_2: main GHG ships



MAERSK LINE, LIMITED

Eco-efficient ships: consider all relevant technologies.
Maximum benefit for business and environment

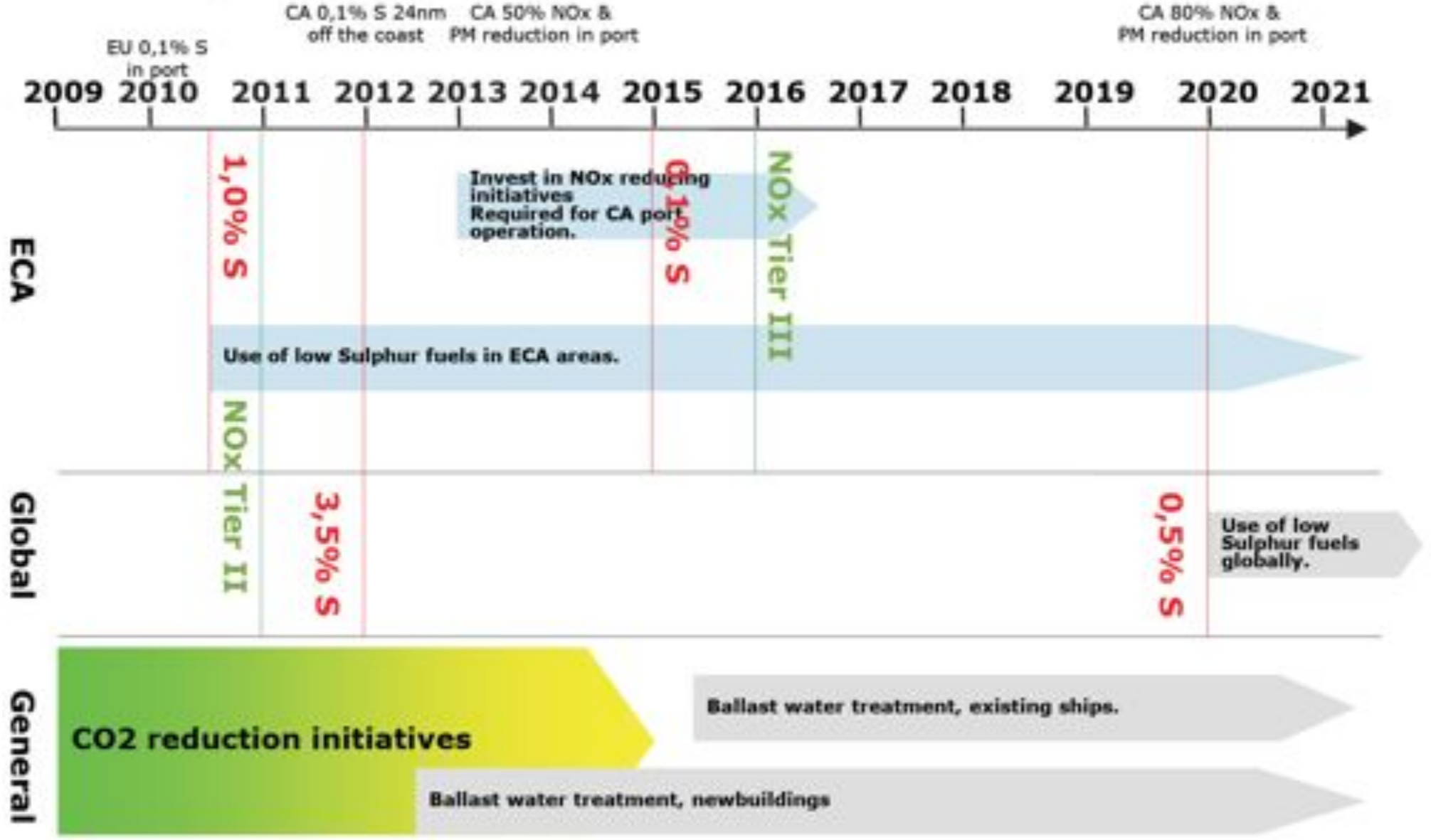
Example



A 'standard' ship → A 'green' ship

MAERSK LINE, LIMITED

Regulatory scene



MAERSK LINE, LIMITED

Innovation projects on the Maersk fleet

Maersk Attender
Crane pendulation

Thura Maersk
BWTS testing

Maersk Kendal
Ventilation optimization

Jeppesen Maersk
Auto-tuning of main engine

Emma Maersk
Aux. engine waste heat

Roy Maersk
CLT Propeller

Maersk Kalmar
Biofuel

Olivia Maersk
Air lubrication

Alexander Maersk
Exhaust gas recirculation

Gudrun Maersk
Main eng. cooling systems

Laura Maersk
HT Pump optimization

Maersk Ohio
Propeller boss cap fin

Maersk Belfast
Water based hydraulics

Arthur Maersk
Cylinder lube oil reduction

Clementine Maersk
CRS autologging and performance prediction

MAERSK
MARITIME TECHNOLOGY

FOSS

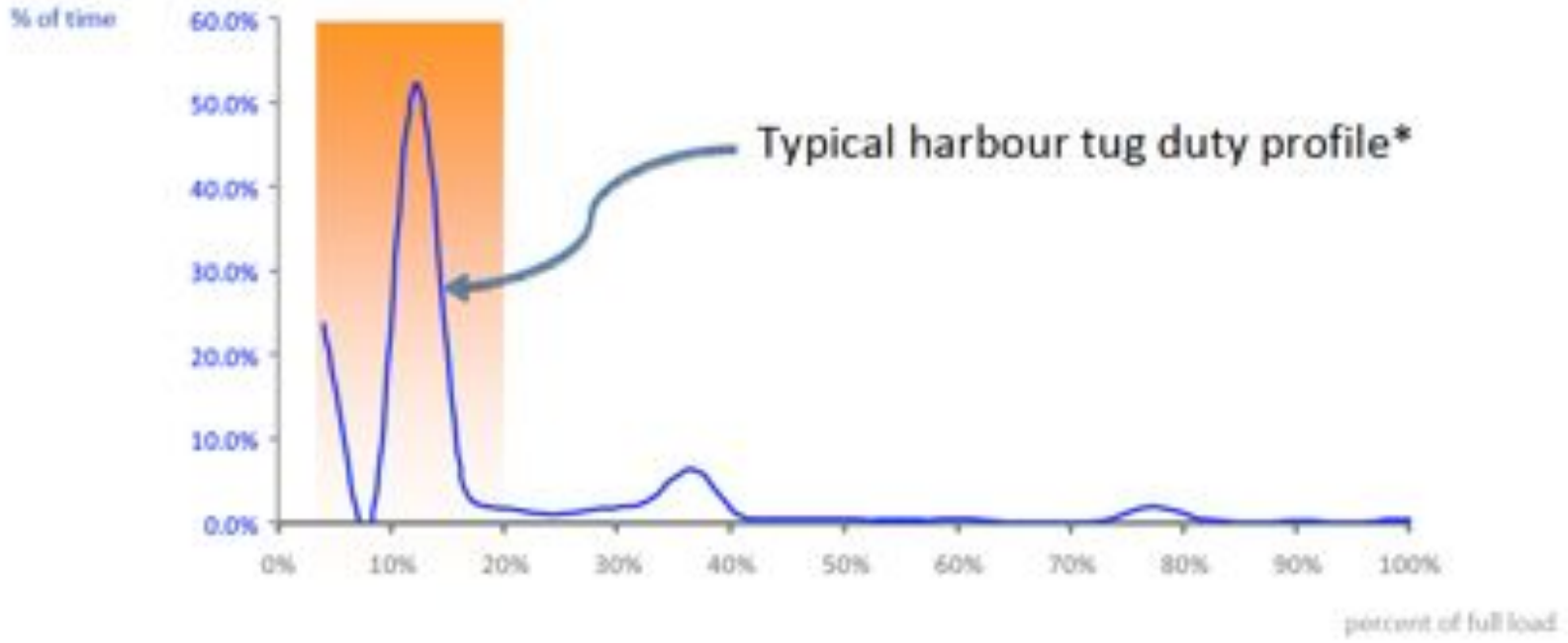
THE HYBRID SOLUTION

Power And Reliability In A Green Package

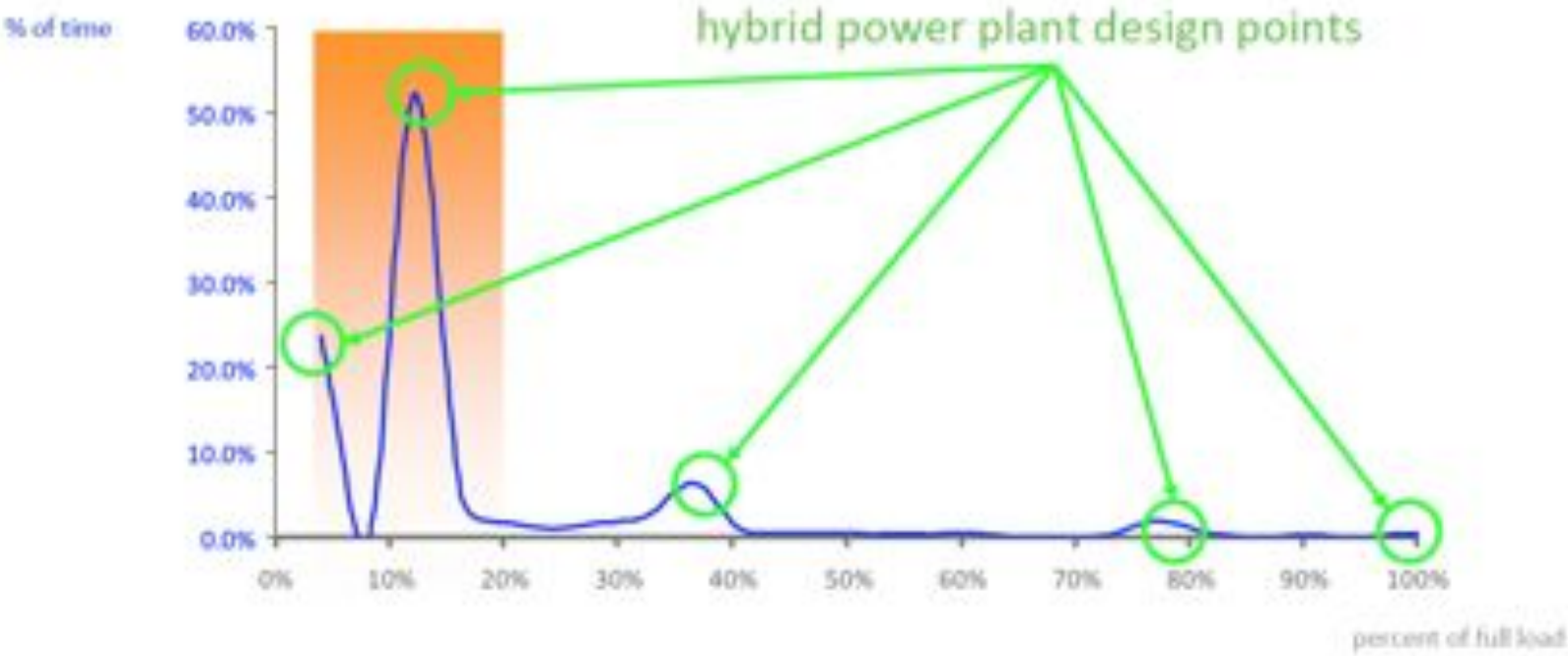
January 10, 2012

ASPEN KEMP & ASSOCIATES

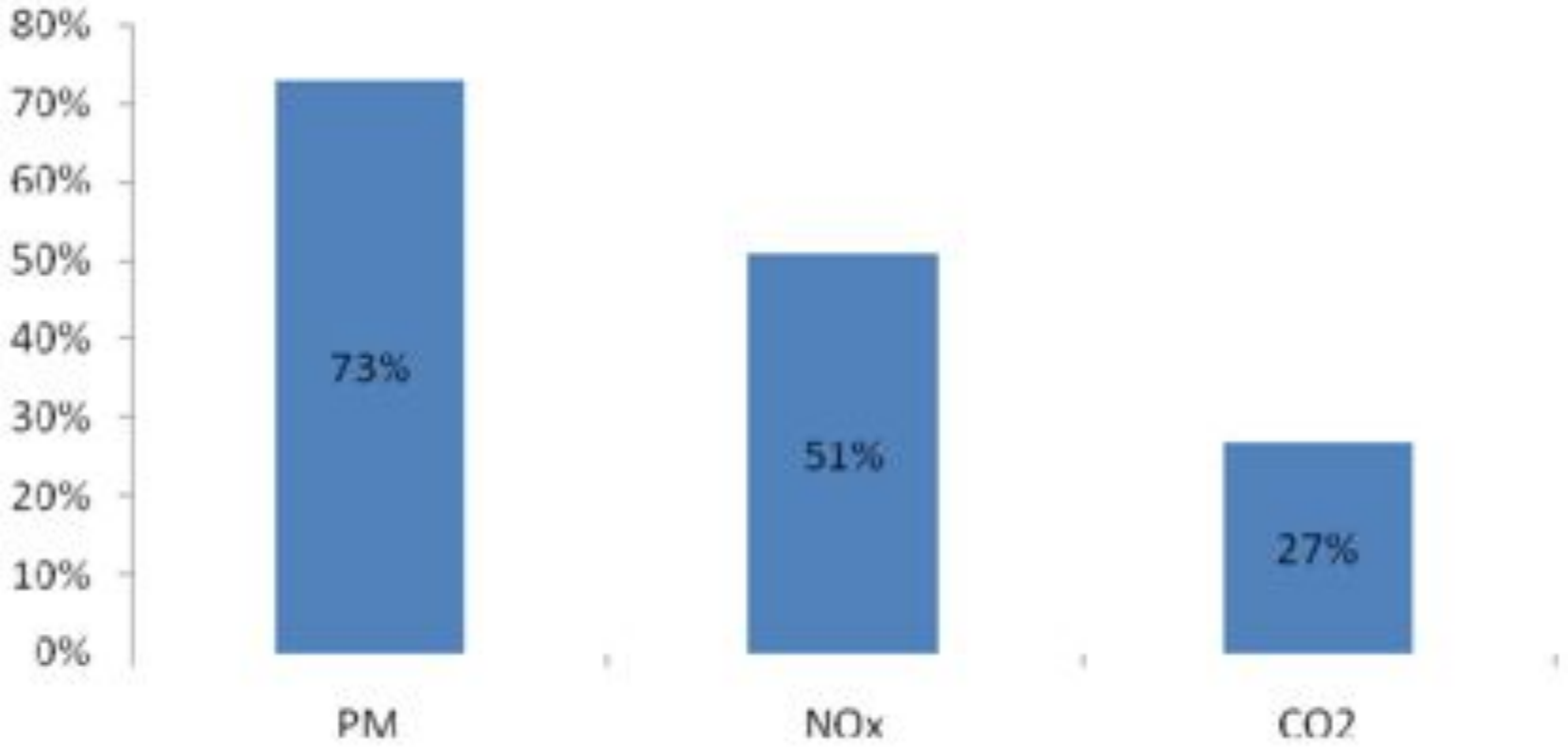
The Hybrid Tug Rationale



The Hybrid Tug Rationale

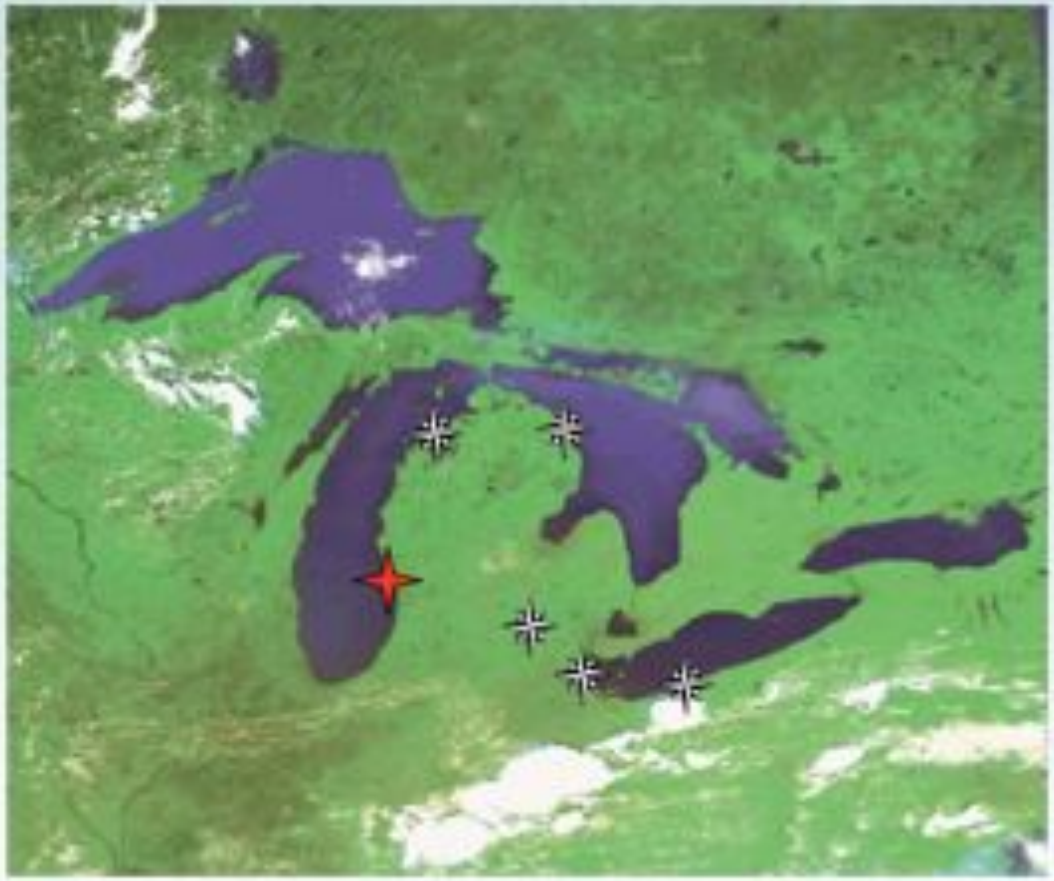


Hybrid Emissions Reductions



SOURCE: **California Air Resource Board Report**
Prepared by: **University of California – Riverside**
College of Engineering-Center for Environmental Research and Technology

Operational Experience
Bio-Fuels and Lubricants



Dennis Donahue
NOAA-GLERL
Marine Superintendent

B100 Operational Experience

11 years experience

LMFS – 160,000 gallons annually

Cost savings – 20 to 40%

OEM's – participate, validate

Crew assessment – "Non-issue", " Prefer B100"

Green Ship Working Group – 1M + gallons (B100) annually

Commercially viable – tug, research, fishing and tour-boat

2010-11 effort to transition expertise

- Federal Green Fleet Working Group (Non-tactical)
- MARAD
- Army Corps of Engineers

Typical Emissions Results

2005 Survey

Port /starboard full load tests – 4 vessels

Cummins 903, Detroit 12V71, Detroit 8-92, Cat 3508

Broad range in engine age, condition and time on B100

Averaged B100 Emissions Reductions as Compared to #2 Petroleum Diesel

Total Unburned Hydrocarbons	-77%
Carbon Monoxide	-48%
Particulate Matter	-59%
Nox	-7%
Sulfates	-74%
PAH	-66%

12.01.2012

KLÜBER LUBRICATION

your global specialist

Environmental Management Plan: Lubricants

Greening the Research Fleet Workshop

January 10-11, 2012
Nicholas School of the Environment
Duke University, Durham NC

Lubricating points on a typical offshore supply vessel.

KLÜBER LUBRICATION

On Deck:

- •Fairleads
- • Bearings on cranes, winches
- •Open gears on mooring winches
- • Open gears on anchor winches
- •Tooth racks, rail cranes
- •Steel wire ropes
- •Stern roller
- • Cranes
- • Hydraulic motors on winches
- • Open gears on fire monitors

Below Deck:

- •Main engines
- •Pumps
- •Compressors
- •Generators
- •Shaft Bearings

Below the Water Line

- • Stern tube
- • Controllable Pitch Propellers
- • Bow / stern thruster
- • Propulsion thruster
- •Rudder Bearings

Environmental Terminology

KLÜBER LUBRICATION

So, what is an "Environmentally Acceptable Lubricant"

Non-toxic, Non-bio-accumulating, and Biodegradable

- ***Primary*** *biodegradation*. is the alteration in the chemical structure of a substance, brought about by biological action, resulting in the loss of a specific property of that substance.

- ***Ultimate*** *biodegradation (aerobic)* is the level of degradation achieved when the test compound is totally utilized by microorganisms resulting in the production of carbon dioxide, water, mineral salts, and new microbial cellular constituents (biomass).

- ***Inherently*** *biodegradable* is a classification of chemicals for which there is unequivocal evidence of biodegradation (primary or ultimate) in Any test of biodegradability.

- ***Readily*** *biodegradable* is an arbitrary classification of chemicals which have passed certain specified screening tests for ultimate biodegradability; these tests are so stringent that it is assumed that such compounds will rapidly and completely biodegrade in aquatic environments Under aerobic conditions.

Portfolio of Lubricants Onboard Your Vessel

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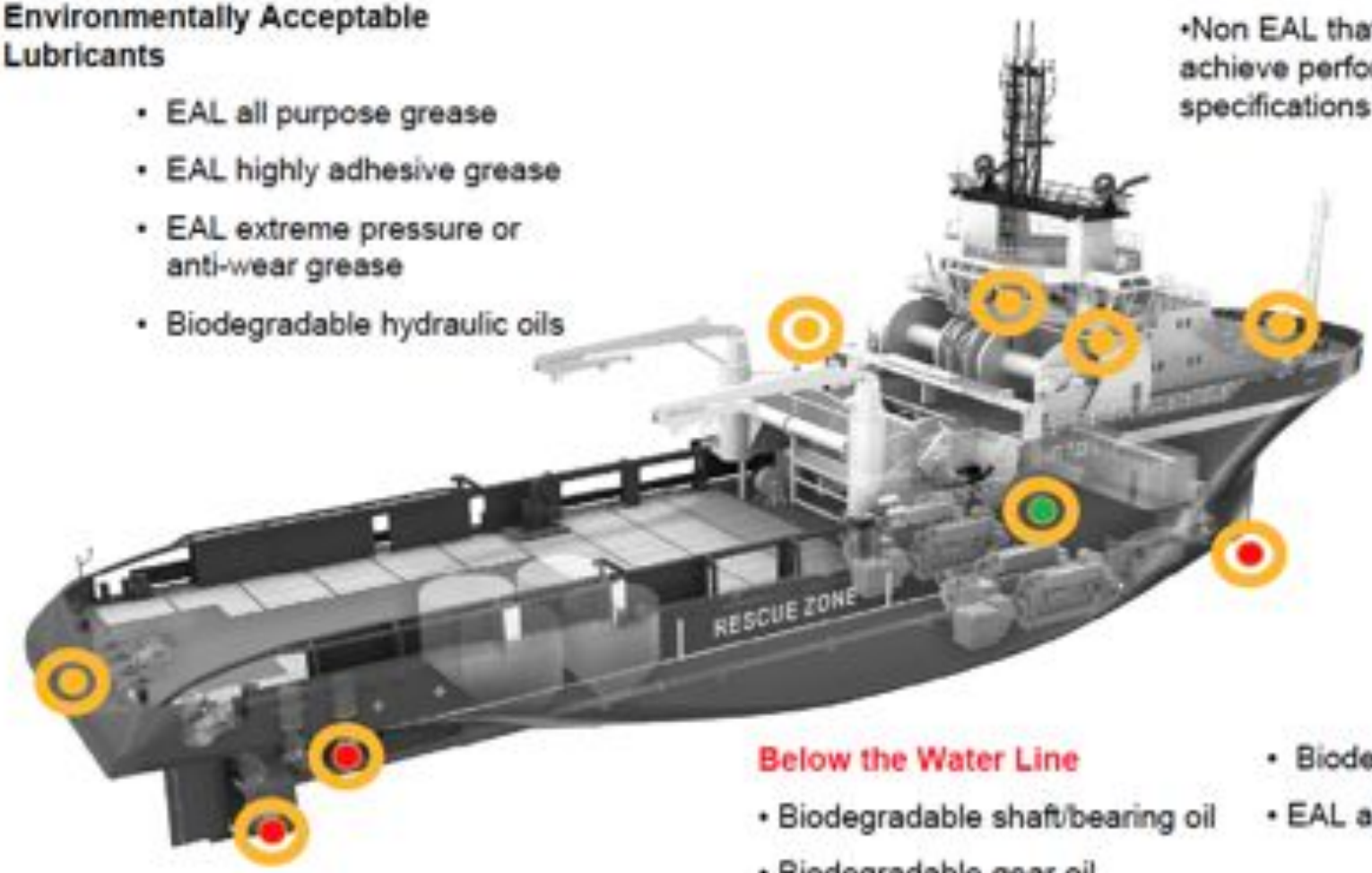
On Deck:

Environmentally Acceptable Lubricants

- EAL all purpose grease
- EAL highly adhesive grease
- EAL extreme pressure or anti-wear grease
- Biodegradable hydraulic oils

Below Deck:

•Non EAL that achieve performance specifications



Below the Water Line

- Biodegradable shaft/bearing oil
- Biodegradable gear oil
- Biodegradable hydraulic oil
- EAL anti-wear grease

ALARIS
COMPANIES

NEW GENERATION
Shipboard Energy
AND
Emissions Management

QUANTIFICATION • LIFE CYCLE ANALYSIS
VESSELS • OFFICES • FACILITIES • TERMINALS

MARITIME ENERGY MANAGEMENT

Method of quantifying and reducing energy consumption and cost and associated environmental footprint

ALARIS
COMPANIES

Three Components of Energy Management

- Baseline of Energy Consumption, Cost, and Emissions
- Energy Conservation Measures (ECMs)
- Shipboard Energy Efficiency Plan (SEEMP)

ALARIS
COMPANIES

ENERGY CONSERVATION MEASURES (ECMS)

Two Main Types of ECMs

- Operational: Culture and Policy Changes
- Technical: Equipment Upgrades

LESSONS LEARNED FROM GREENING CRUISE VESSELS

Jamie Sweeting
Vice President, Environmental Stewardship
and Global Chief Environmental Officer
Royal Caribbean Cruises Ltd.

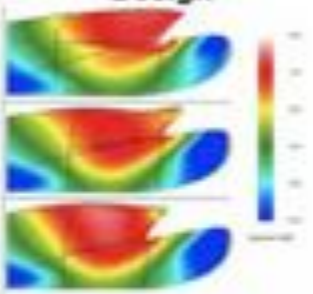
Optimize propulsion

Pod & Rudder / Propeller Design

Hull Coating & Maintenance

Speed, Route, & Trim Optimization

Advanced Bulbous Bow Design



Hull cleaning and maintenance

- Biofouling degrades underwater hull conditions
- Results in more power needed for propulsion to maintain service speeds
- Biofouling varies from region, ship speed and type of under water coat used

Waste Management

- One of the key principles of our environmental program, Save the Waves, is *Reduce, Reuse, Recycle*
  - We contract with suppliers to reduce packaging sources and use more sustainable materials
    - For example, we utilize larger containers with concentrated products to minimize waste, reduce packaging and transportation impacts (environmental & economic)
  - We recycle and reuse approximately 40% of all waste landed globally – upwards of 90% in S. Florida homeports.
  - All garbage is hand sorted and segregated onboard allowing the recycling of:
    - glass, paper, cardboard, aluminum and steel cans, scrap metal, incinerator ash, plastics, toner cartridges, wooden pallets, batteries, fluorescent lamps, electronics, plastic wrap and kitchen oil

THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Marine Community

SNAME
Marine Vessel environmental Performance Assessment (MVeP)

Presentation to: UNOLS 2012, Greening the Research Fleet
10 January 2012

Presented by: Timothy S. Leach, PE

MVeP is developing guidance for marine vessels to reduce and to measure their environmental impact

Mission Statement: "Provide a common technical basis for assessing environmental performance, so that marine vessel designers, builders, and operators can understand relative environmental impacts of design decisions and operational practices."

Objective and Approach

Objective: **Minimize** Marine Vessel Environmental Impact

Approach:

- Provide a **standard assessment methodology**
  - Best Practices, **guidance** to achieve excellence
  - **Team** Industry, Academia, Environmental Groups, and Regulatory Agencies for Practical Solutions
  - **Performance driven** metric
    - Use readily available data by monitoring
      Or calculation
  - SNAME Technical & Research Bulletin
- Encourage **voluntary** assessment
  - Recognize leaders and exemplary performance
  - Minimal administrative burden on applicants

Phase 3 Implementation
UNOLS

UNOLS Gains

- Method to compare performance of different vessels…
- or to compare same vessel over different time periods
- Identify better performers to emulate
- Means to demonstrate improvements made to others

Shared Goals

- Objective performance evaluation
- Reduce ocean research's environmental impact (ie. CO_2, NOx, PM)
- Reduce operation costs (ie. ⇑ fuel efficiency, ⇓ port & regulatory fees)

SNAME MVeP Gains

- Contained peer group to establish methods and baselines
- Funding partners

Gregory Marshall


I design great big yachts for VERY wealthy people

People who want to own "**Everything**"

Solar Reflective Paints:

Reduces the HVAC loads by 30% in average use

- Available in every color except Flag Blue
- No power to run it
- Cost similar to conventional paint
- Application can be done in any existing paint facility
- Can easily be retrofitted into existing vessel
- Cooler to the touch on decks etc
- Same warranty as conventional paint
- **.....And it is "Greener"**

Electrochromic Glass:

Reduces the HVAC loads by 30% or more in average use

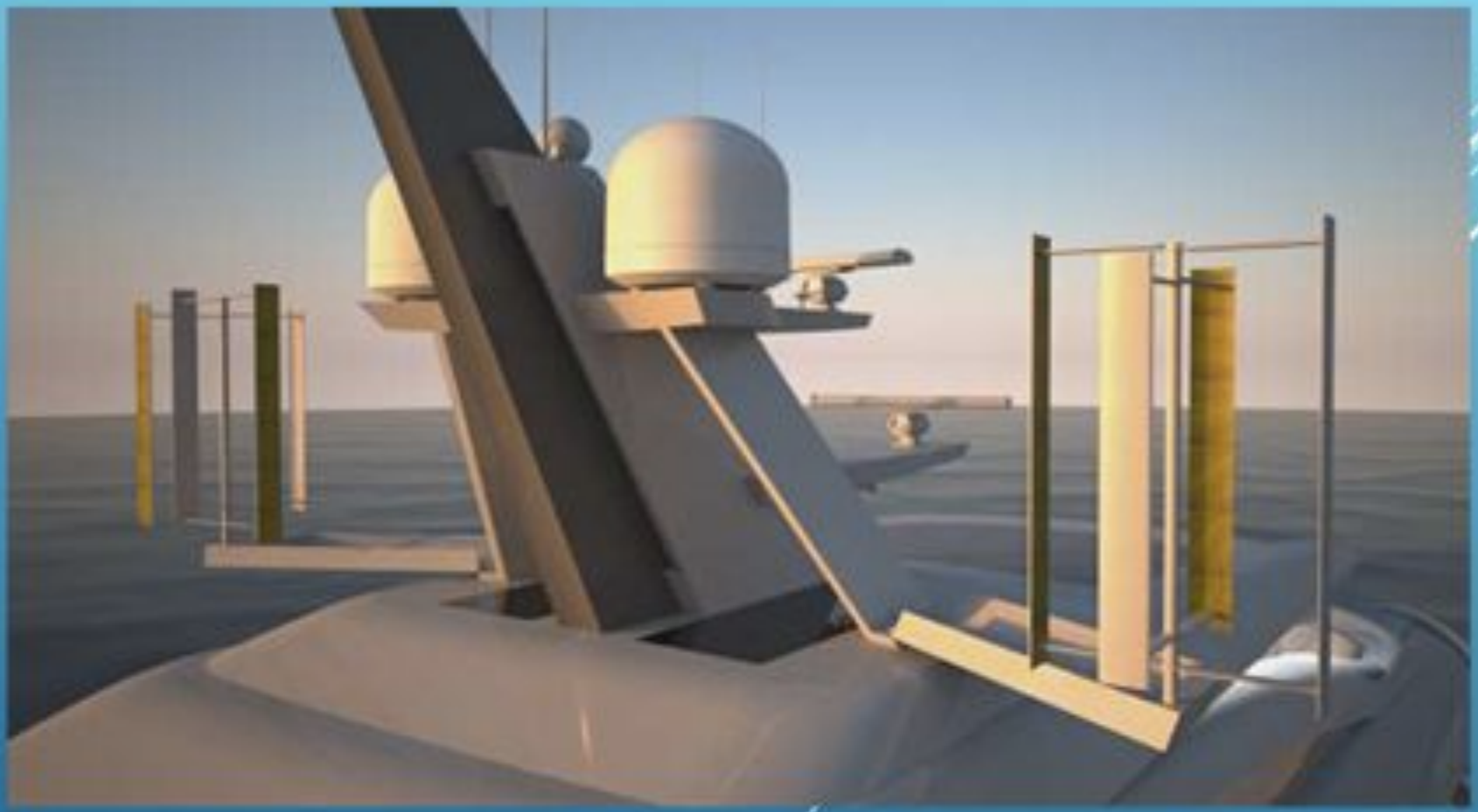
- Solid state system requires 1 watt of power to run
- Completely controls tint from 5% transmissionto 95% transmission
- Can eliminate the needs for blinds or in a yacht costly and complicated motorized blinds
- Reduces hot spots in the accomodation
- Costs about 30% more than conventional glazing
- Can easily be retrofitted into existing vessel
- .....And it is "Greener"

The use of Electrochromic glass reduces the heat load by 30%

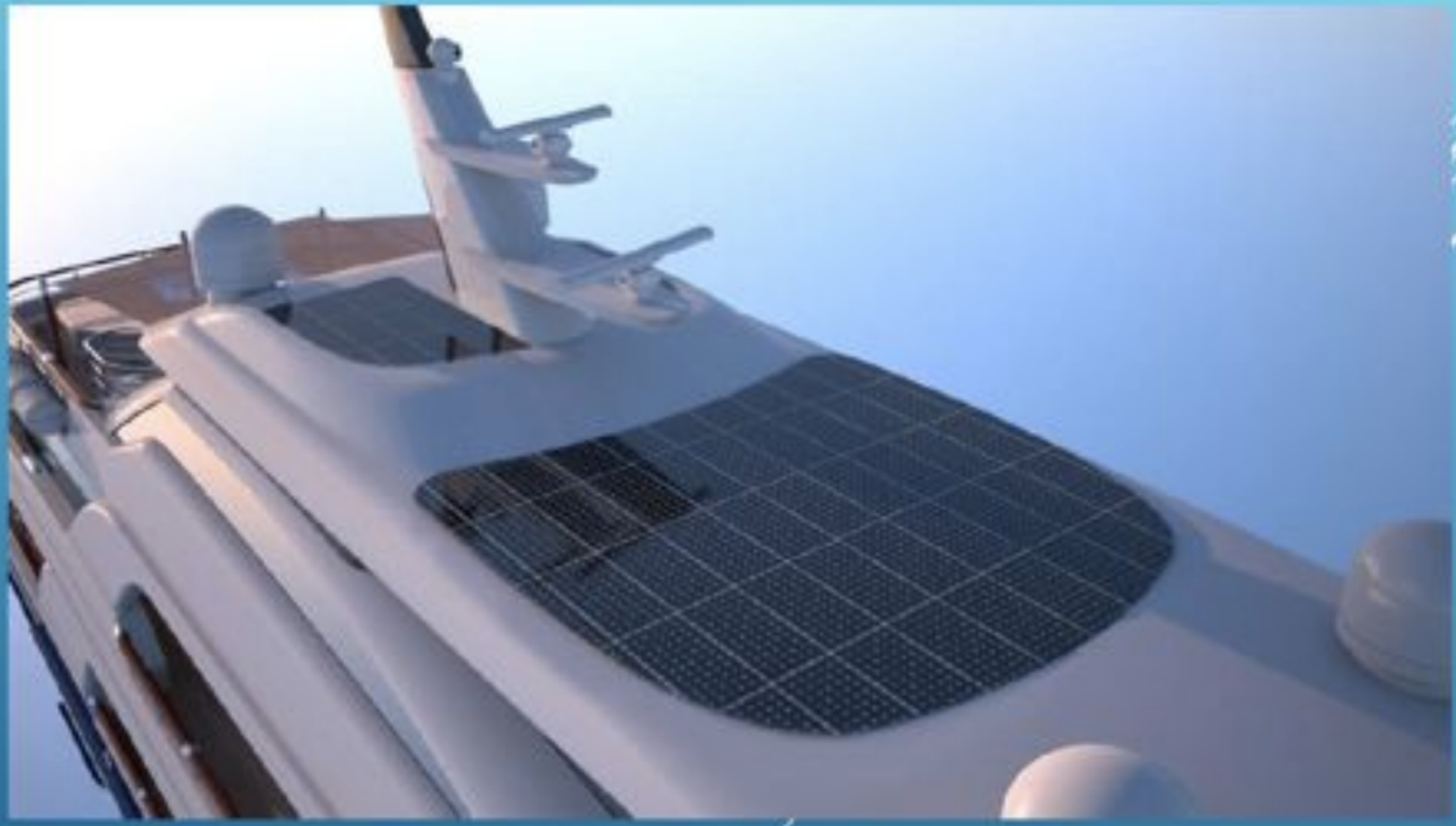
LED Lighting

A typical 200 foot yacht has more than 4000 light fixtures on board for interior exterior and underwater lighting

Switching from Halogen to LED saves approximately 78kw of power but also reduces the heat load in the vessel by another 15 percent



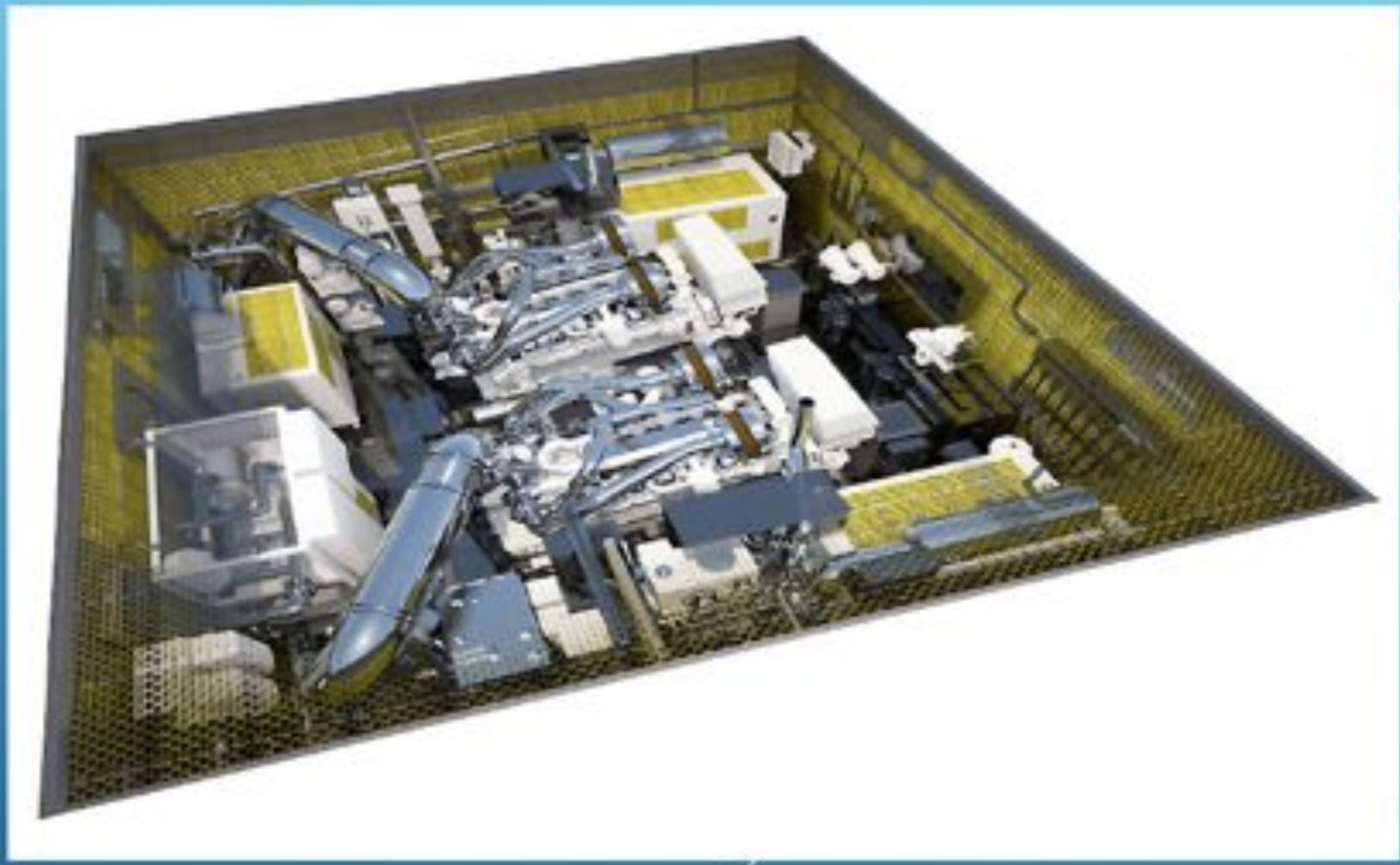
In a 73 meter (240 foot) yacht project we are integrating 2 x 10kw Wind Turbines that fold into the mast when not in use to make the structure more aesthetically pleasing



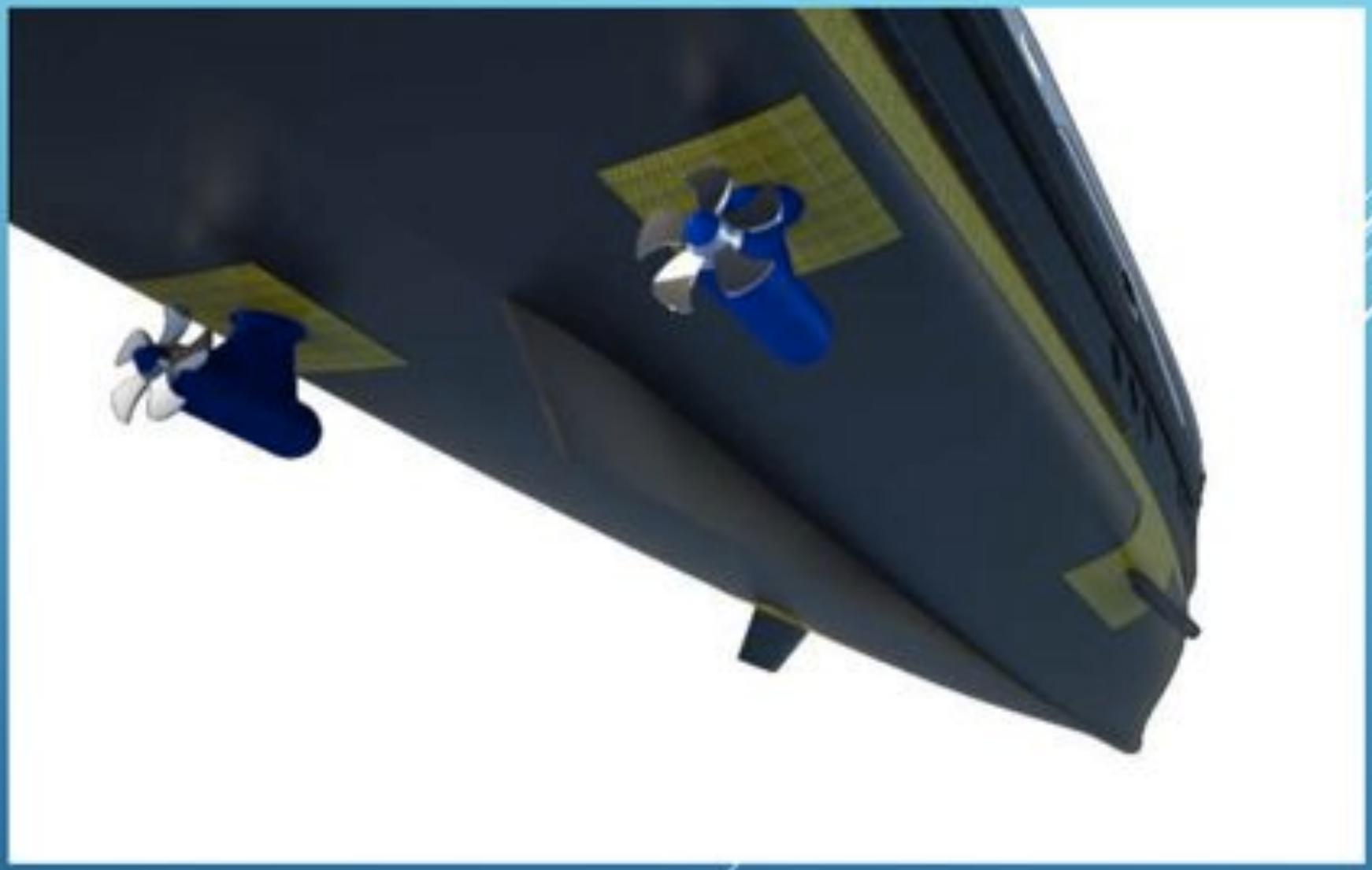
The same 73 Meter (240 foof) vessel has a solar array on the hardtop producing an additional 10kw of power

And a helipad that generates 16kw of power

Harvesting Noise energy



12 Kilowatts of power from the noise bouncing around in the Engineroom



Piezo tiles in the high vibration hull panels

And led to a self powered dancefloor on a 240 foot yacht

We attribute our survival…….and success almost entirely to a business strategy that integrates making a Better yacht first with being Greener as a pleasant by-product

At this point I do not think it would be commercially viable for us to go back to the way we used to build yachts prior to 2008. The clients simply do not want them

Moving toward resilience:
A research agenda for sustainable seaports

Austin Becker, PhD

Assistant Professor of Coastal Planning, Policy, and Design

Departments of Marine Affairs and Landscape Architecture

University of Rhode Island

GSO Graduate School of Oceanography

The University of Rhode Island College of the Environment and Life Sciences

Green Boats and Ports for Blue Waters

4-9-14

Fundamental shift...

1 year

5-10 yrs

My career (~35 years)

The rest of my life (~55 years)

My child's life (~100 years)

My grandchild's life (~105 years)

(P)Catastrophic events

Engineering & Design – 5 years

Permitting & Regulatory Process – 10 years

Construction – 10 years

Project Design Life – 50 years

Actual working life – >75 years

TODAY 2023 2050 2100 2150 2200

Time