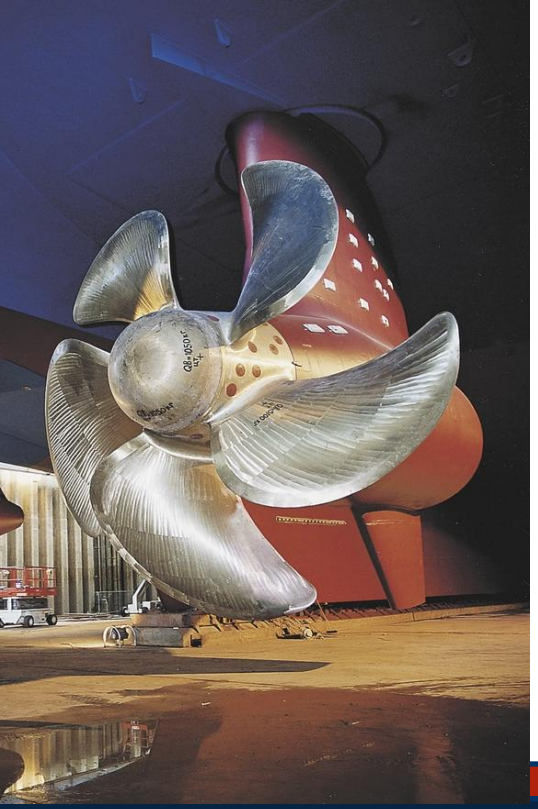


Hightech Afloat

Efficiency in Ship Design

Gijs Streppel MSc.

Sales & Design Department

MEYER WERFT

PAPENBURG 1795

23 September 2013

Bernard Meyer

Family Meyer

MEYER NEPTUN

NEPTUN WERFT

ROSTOCK 1850

MEYER WERFT

PAPENBURG 1795

- LASERZENTRUM MEYER WERFT
- ROHRZENTRUM MEYER WERFT
- AKADEMIE MEYER WERFT

One shipyard – two locations


NEPTUN
WERFT


JOS.L.MEYER PAPENBURG

Cruise ships

Ships: 36 (+6)

River cruise ships

Ships: 32 (+14)

Research ships

Ships: 0 (+1)

Gas tankers

Ships: 56

Island ferries

Ships: 29

Ferries / Cruise ferries

Ships : 32

Passenger ships

Ships: 24

Livestock carriers

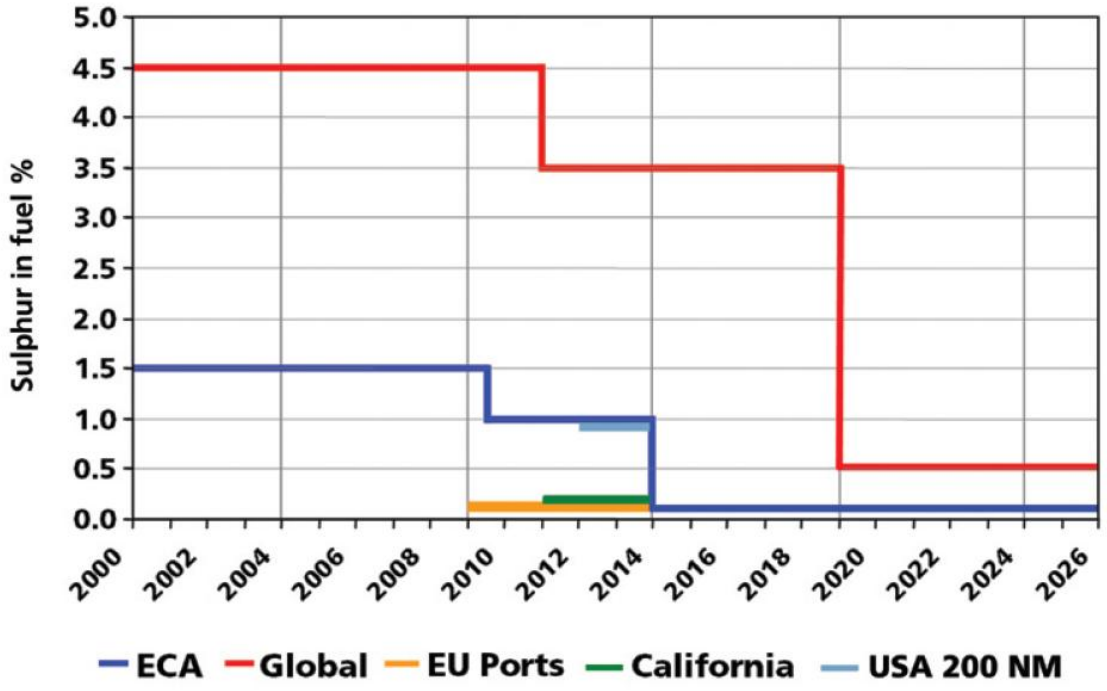
Ships: 27

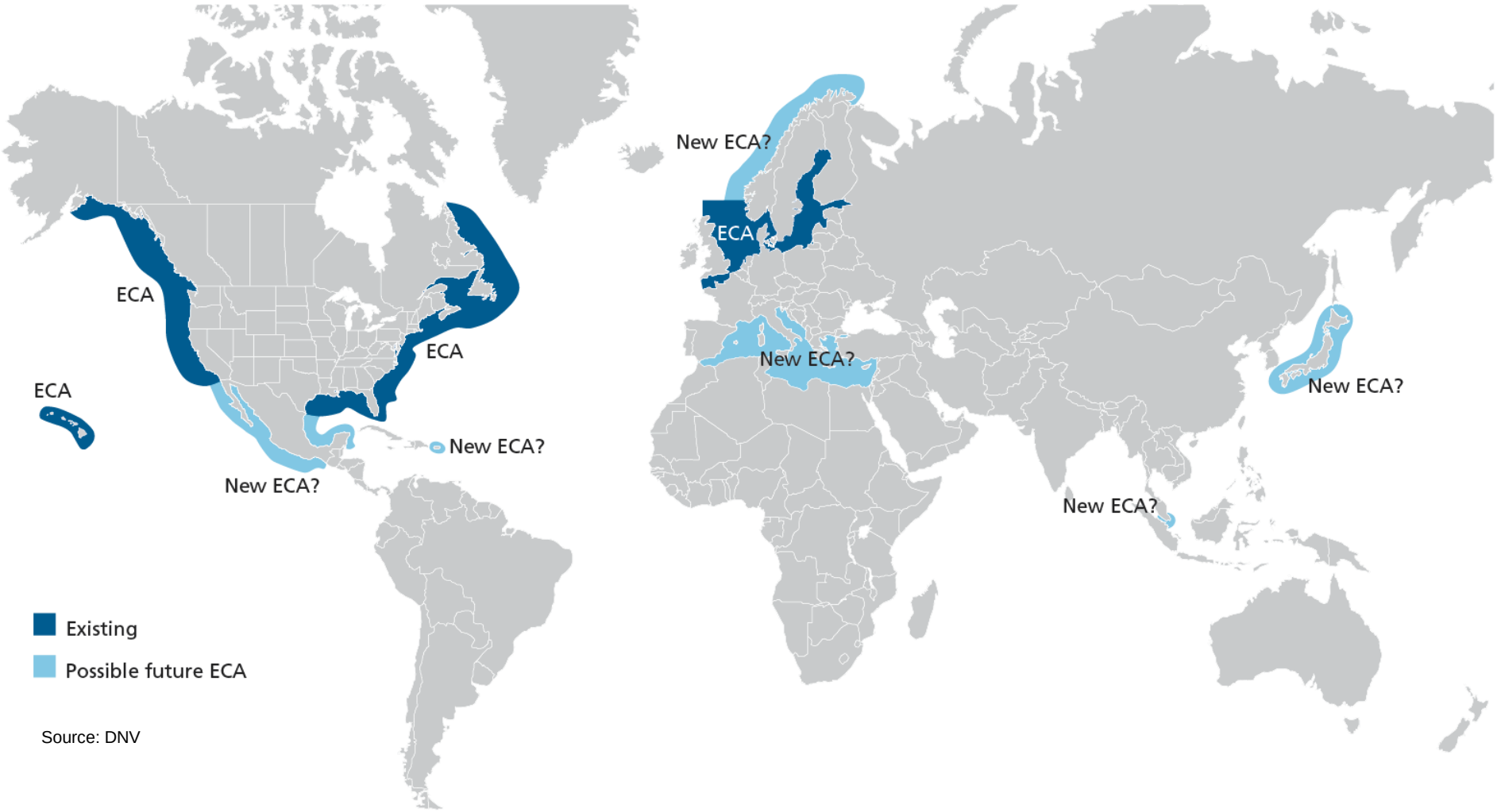
Container ships

Ships: 4

Fuel sulphur cap	Area	Date of implementation
Max. 1% S in fuel	SECA Areas	1 July 2010
Max 3.5% S in fuel	Globally	1 January 2012
Max. 0.1% S in fuel	SECA Areas	1 January 2015
Max. 0.5% S in fuel	Globally	1 January 2020

- ✓ MARPOL Annex VI – Decision of MEPC 58 and 59
- ✓ Exhaust Gas Cleaning allowed as alternative



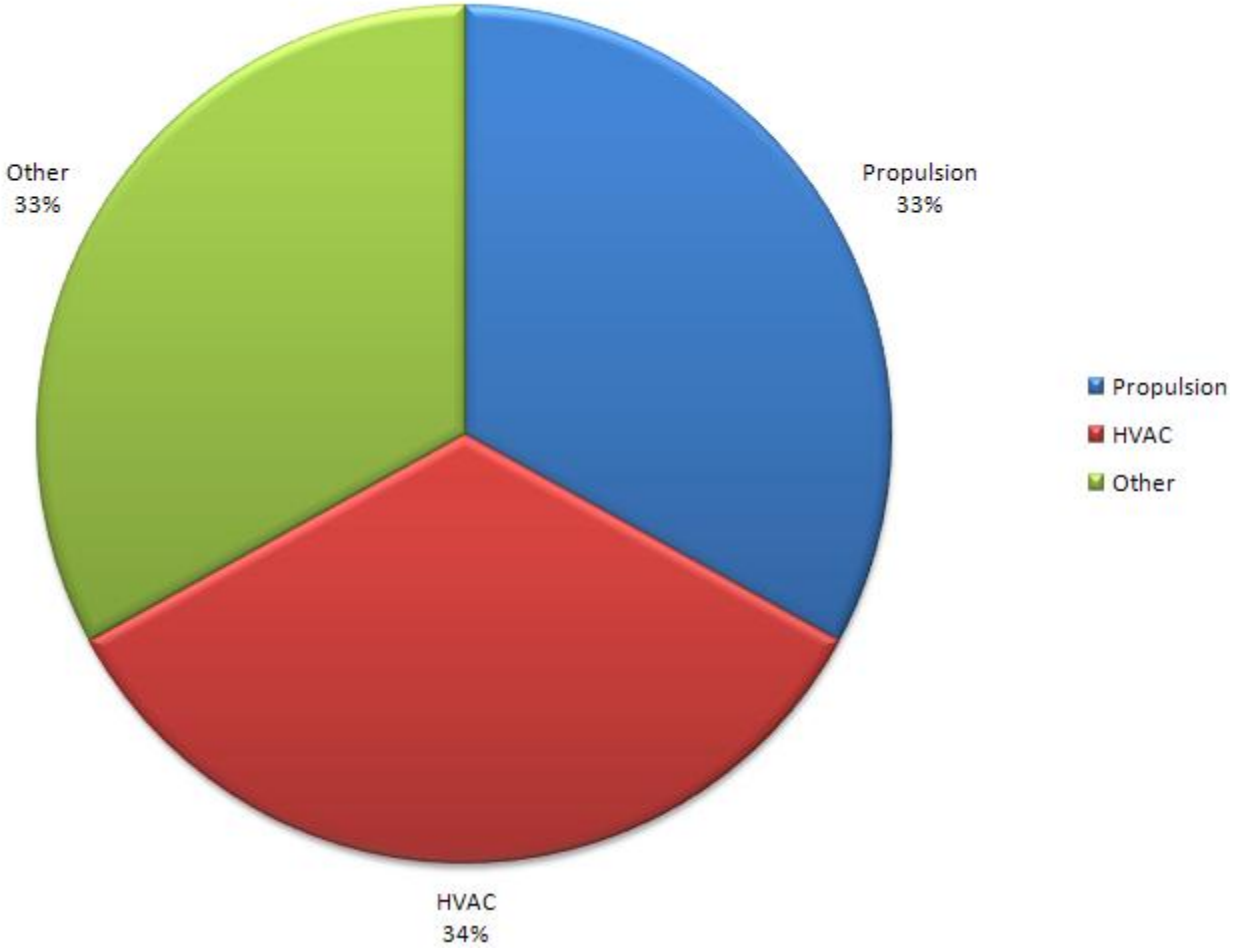

New ECA?
ECA
ECA
ECA
ECA
New ECA?
New ECA?
New ECA?
New ECA?
New ECA?
Existing
Possible future ECA

Source: DNV

- Scrubber | wet systems
  - Up to 97% SOx reduction
  - Cleaning of exhaust gasses with sea water and chemicals
  - 1-5% of engine power consumption
  - >80% of order book equiped with scrubber
- Scrubber | dry systems
  - Up to 97% SOx reduction
  - Absorbative material like calcium hydroxide $CaOH_2$ needed
  - 1-3% of engine power consumption
- Catalyst
  - Catalyst reduces NOx, only possible with dry scrubber due to exhaust temperature
  - 1-3% of engine power consumption

Electrical power demand on a cruise vessel including propulsion in %

Figures are based on an average of a complete cruise



- Careful planning of voyage
- Keep ship speed at same level

– Example

  - New York – Nassau → 950 nm
  - Ship: 23 kn, 32,000 kW
  - 48 h time according to itinerary

– Alternative 1

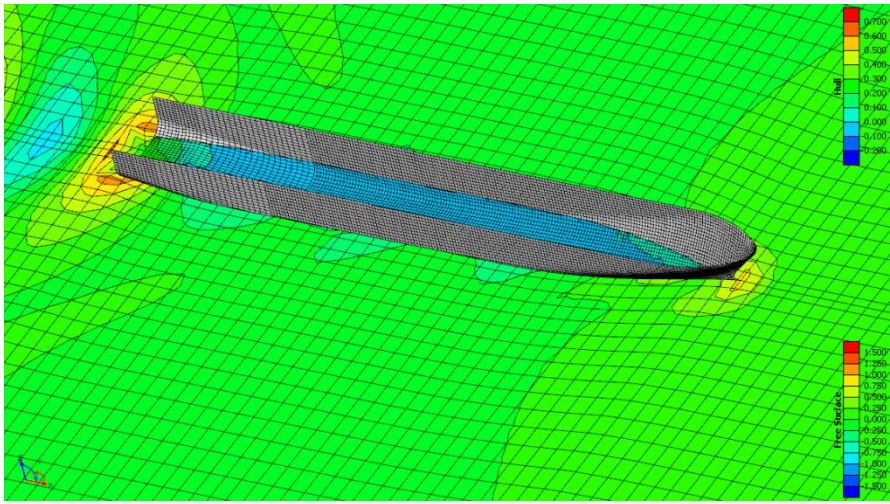
  - 38 h, speed 23 kn
  - 10 h, speed 7.6 kn
  - Fuel consumption 220 t

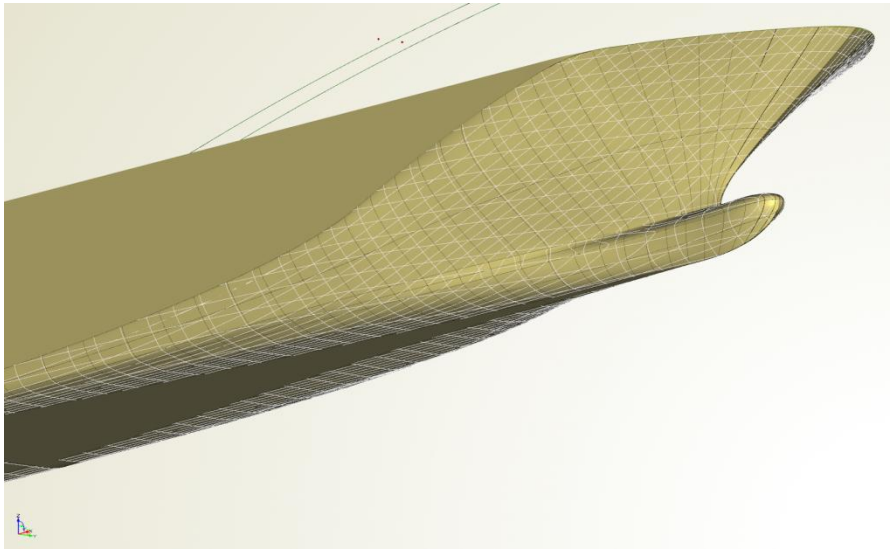
– Alternative 2

  - 38 h, speed 21 kn
  - 10 h, speed 15.2 kn
  - Fuel consumption 170 t

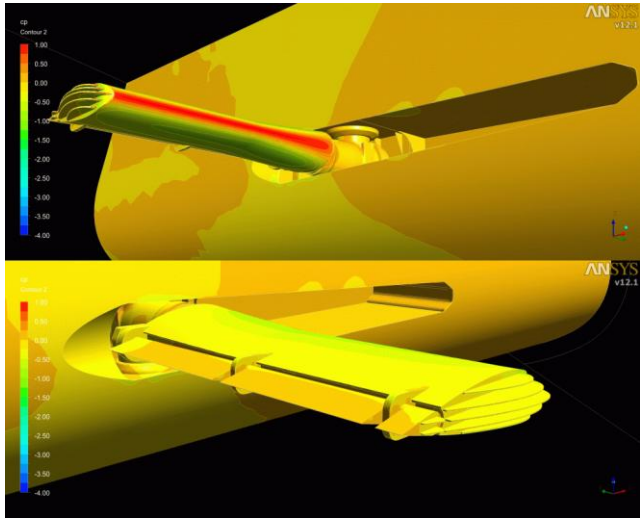
✓ **22% fuel saving**

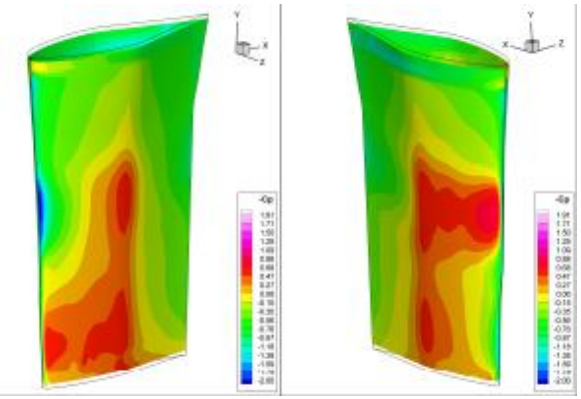
- Potential Flow CFD calculations
  - Early design stage:
    - Getting an insight of areas for possible improvements
    - Getting an insight of possible design limitations (hard points)
  - Close to contract:
    - Parametric model to calculate several 1000 hull shapes
    - Hard points fixed for optimization
    - Potential flow CFD as judgement for every single shape
    - Judgement of best result by experience of naval architect
- RANSE CFD calculations

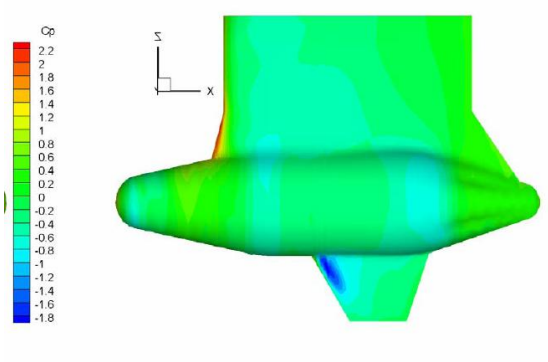


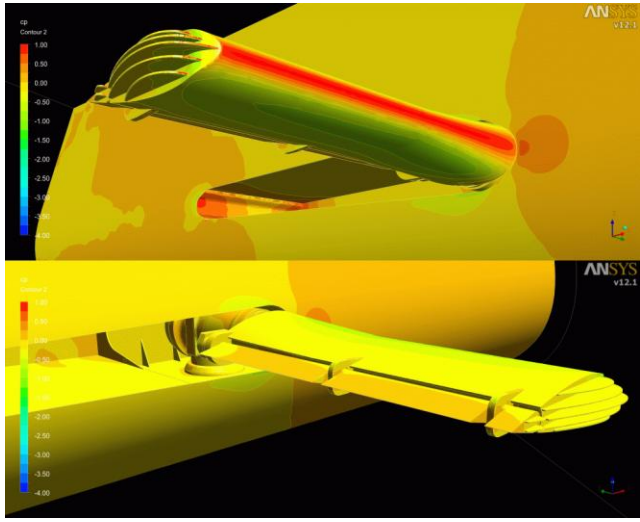


- Optimization of appendages
- Only possible with RANSE CFD
  - Position and form of brackets to reduce disturbance of propeller inflow
  - Use of twisted rudder to regain rotative energy
  - Form of pod housing
  - Turning direction of stabilizers

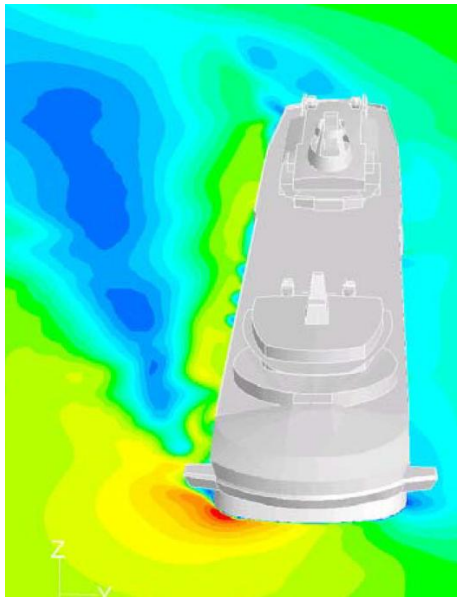


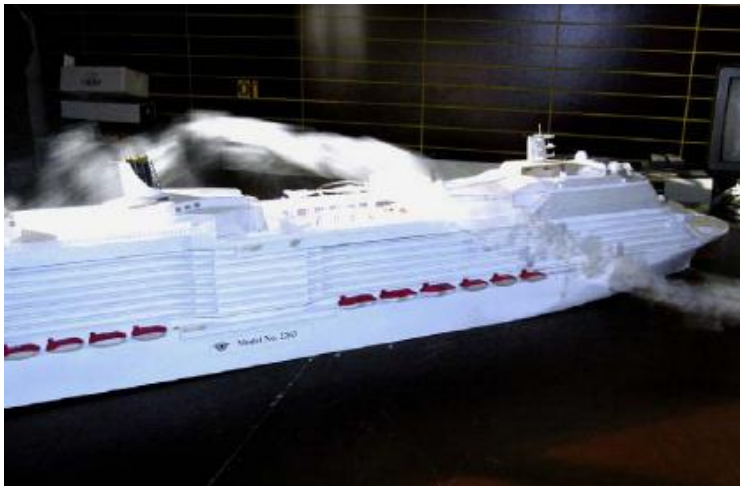






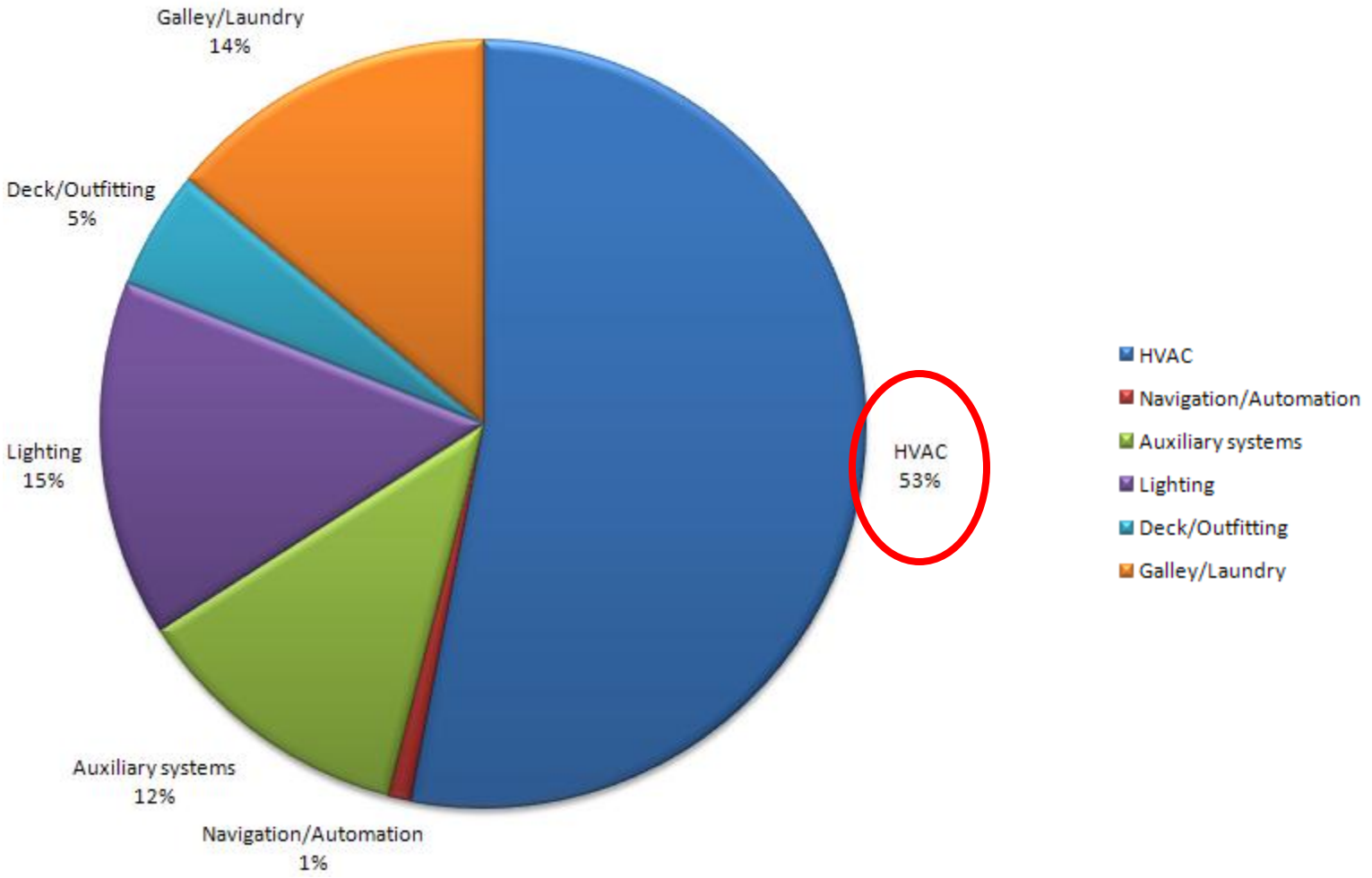
- Model testing
  - Resistance due to water:
    - Calm water efficiency
    - Efficiency in operational conditions
  - Resistance due to wind:
    - Manoeuvring capability
    - Passenger comfort



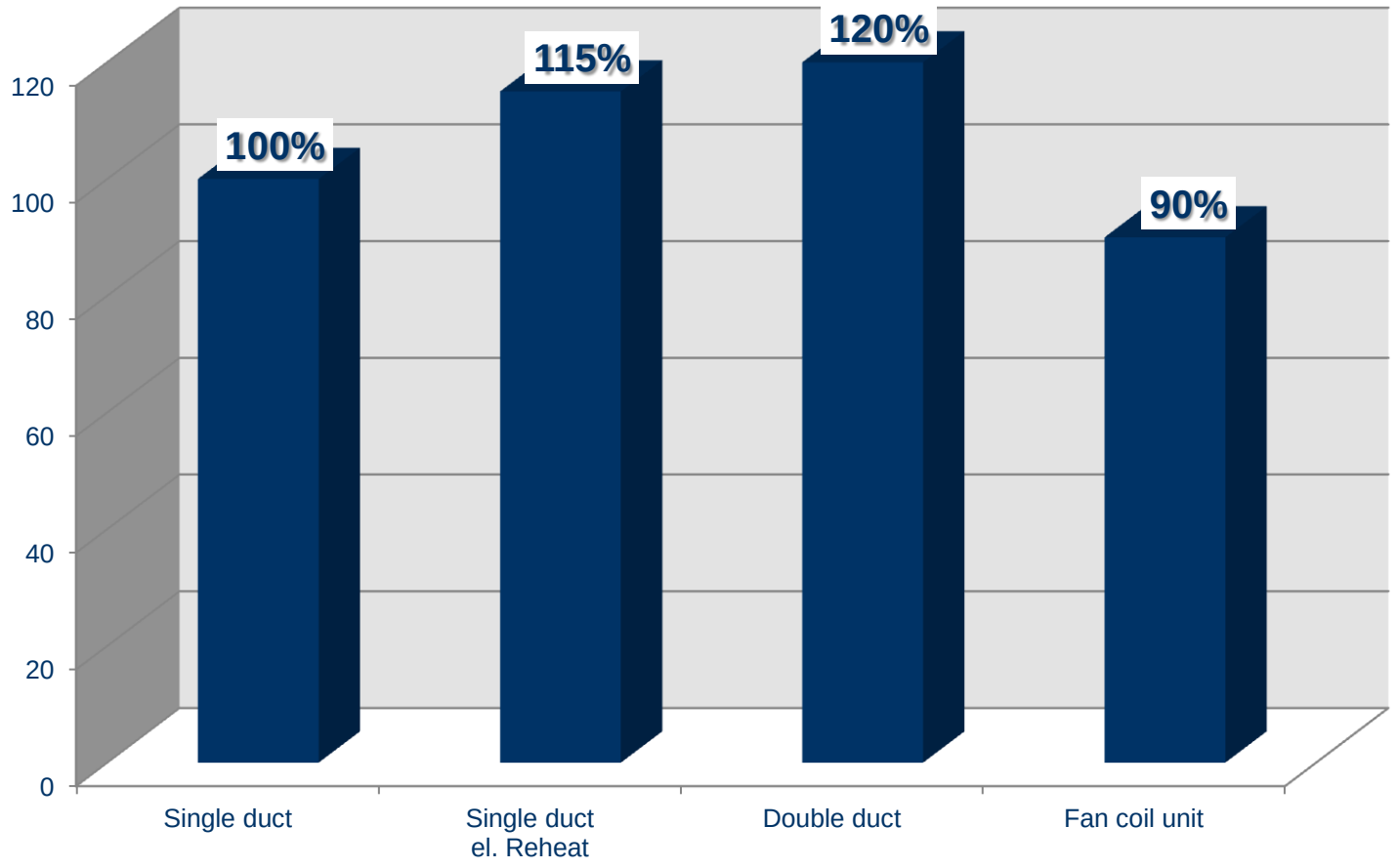


Electrical power demand on a cruise vessel without propulsion in %

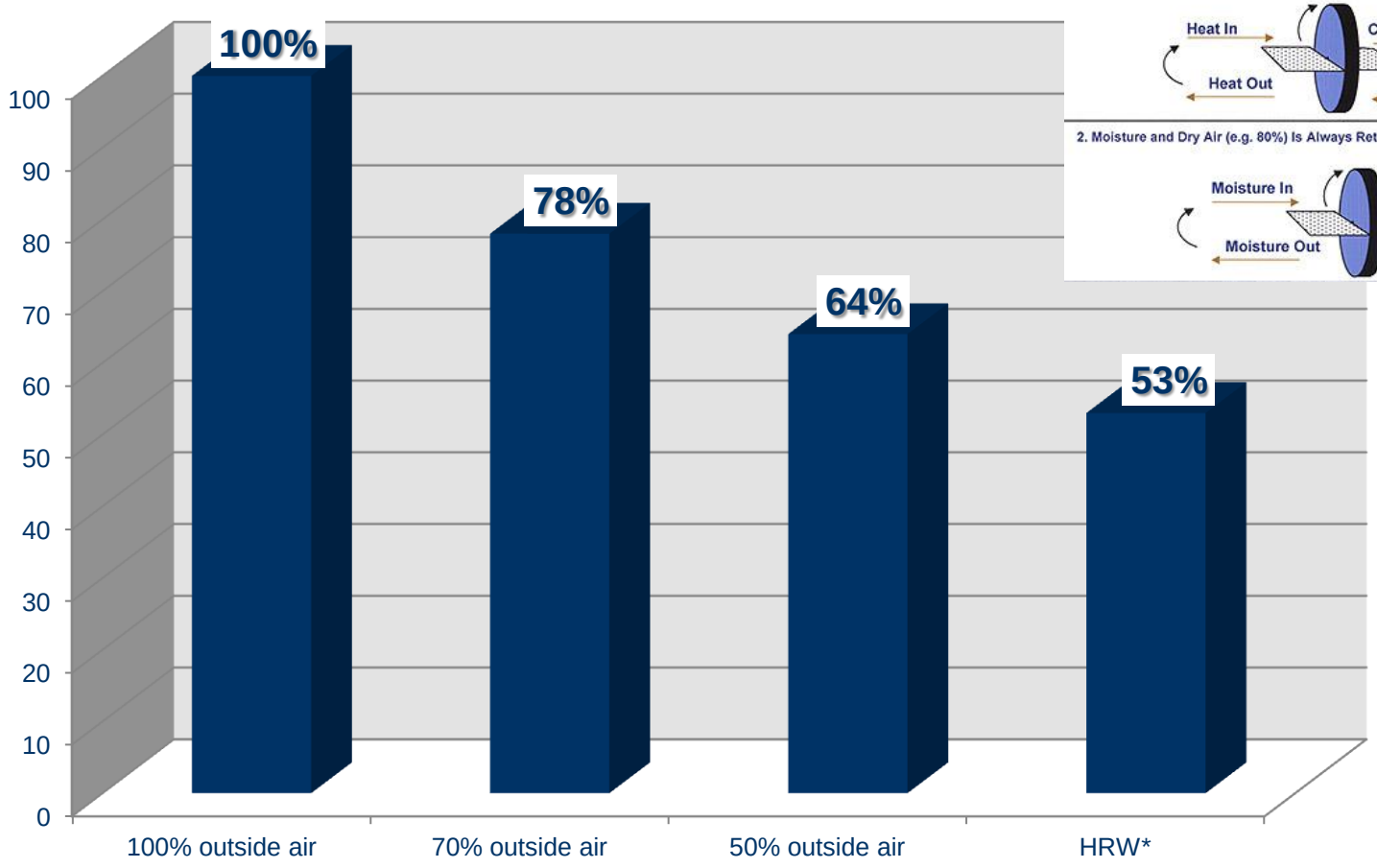
Figures are based on an average of a complete cruise

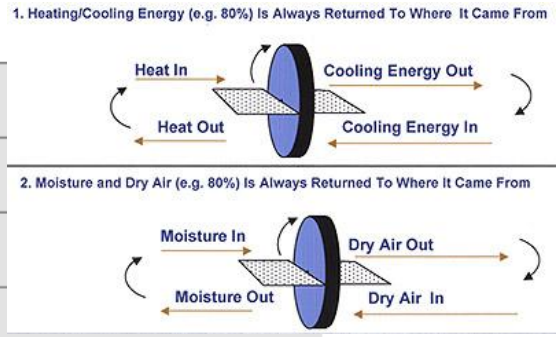


Comparision energy consumption for cabin systems



Comparision energy consumption for energy recovery options in %



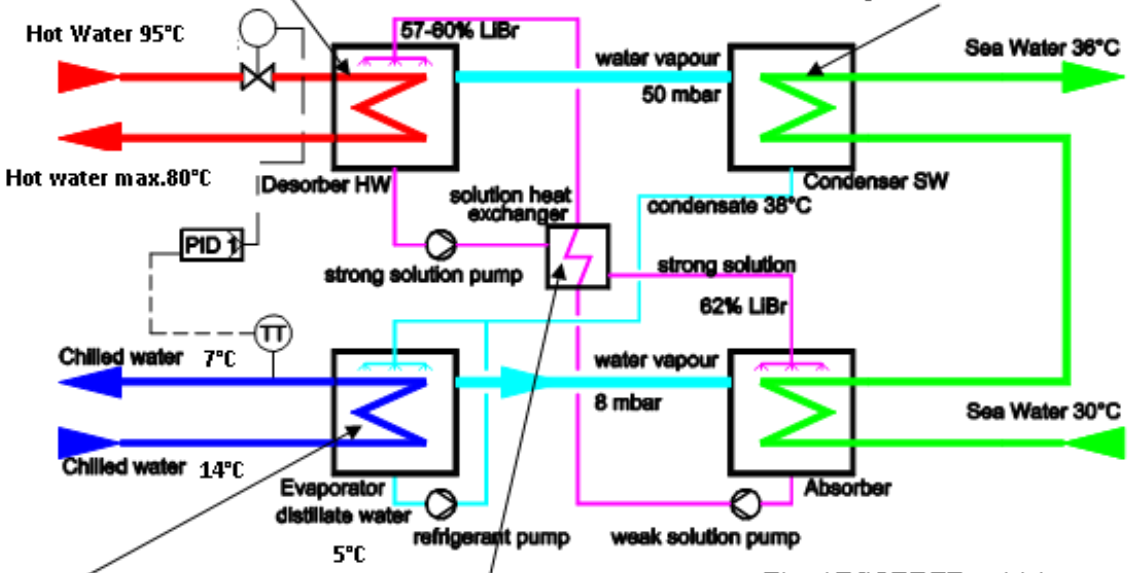


*Efficiency will be reduced during lifetime

- Absorption refrigeration unit: use of heat to make „cold“

The **DESORBER** or **GENERATOR,** which represents the "discharge" side of the thermal compression system. The refrigerant I s boiled off the solution at higher pressure (approx. 55 mbar absolute) and temperature (60-65°C).

The **CONDENSER** where the compressed refrigerant vapour is condensed. The liquid refrigerant then flows to the evaporator.



The **EVAPORATOR** where the refrigerant evaporates at low pressure (approx. 9 mbar absolute) and low temperature.

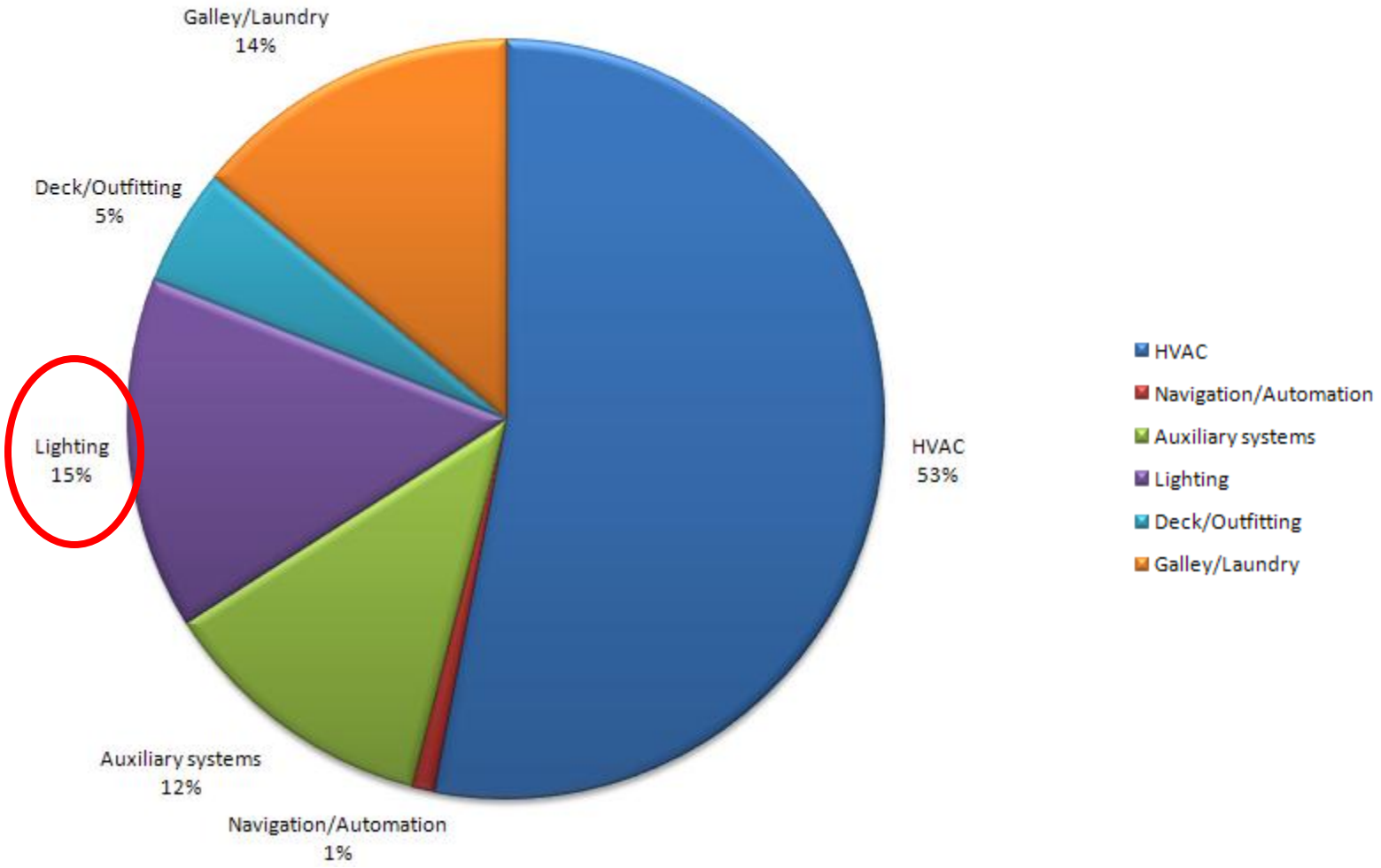
The **SOLUTION HEAT EXCHANGER** improves the coefficient of performance of chillers by recovering the sensible heat from strong solution and preheating the weak solution.

The **ABSORBER**, which represents the "suction" side of the thermal compression system. The refrigerant vapour is absorbed by a strong solution (approx. 60% salt).

After absorption of the refrigerant, the diluted "weak" solution (approx. 55% salt) is conveyed back to the generator by a small pump.

Electrical power demand on a cruise vessel without propulsion in %

Figures are based on an average of a complete cruise

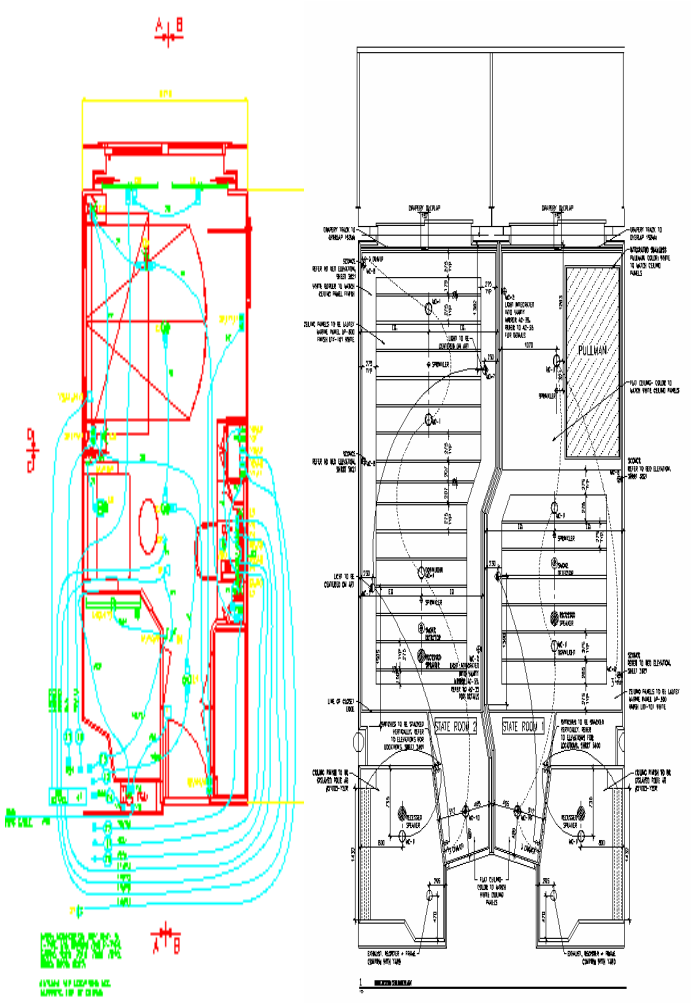


- Dimming to 80% not visible with human eye
- Use of energy saving lights like LEDs
- Programming of light intensity
- Motion sensors

- More lights, less power

Stateroom Lighting

Amount		Description	Power		Power Total	
2001	2008		2001	2008	2001	2008
3	4	Downlight	13	13	39	52
2	1	Mirror Light	14	11	28	11
2	2	Luminare	30	28	60	56
1	2	Wall Washer	20	35	20	70
2	2	Wall Scone	60	13	120	26
1	1	ohter	60	26	60	26
11	**12**				**327**	**241**



Power reduction approximately 26%

- Radiance of the Seas
  - 90000 GT
  - 2112 Persons
  - Built 2001

Same Speed

Same Power Consumption

- Celebrity Solstice
  - 122.000 GT
  - 3365 Persons
  - Built 2008

35 % larger

up to 25% less propulsion power per passenger

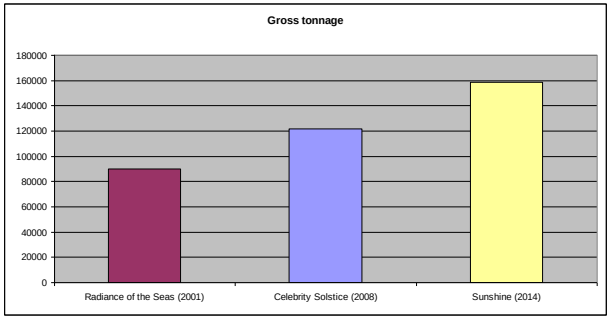
30 % larger

up to 30% less propulsion power per passenger

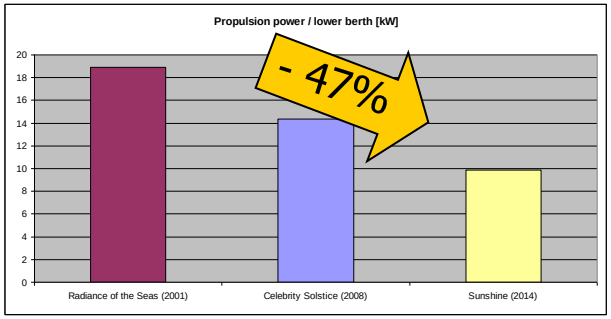
Radiance of the Seas
- delivered 2001
- 90.090 GT
- 2.112 lower berth

Celebrity Solstice
- delivery 2008
- 122.000 GT
- 2.112 lower berth

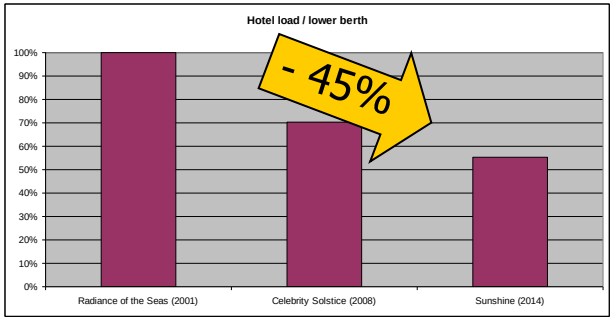
Sunshine
- delivery 2014
- 168.000 GT
- 4.148 lower berth



Ship size (gross tonnage)



Propulsion power / lower berth



Hotel load / lower berth

Energy saving: Hull form and propulsion

Machinery systems

Air conditioning plants

Lighting

Insulation

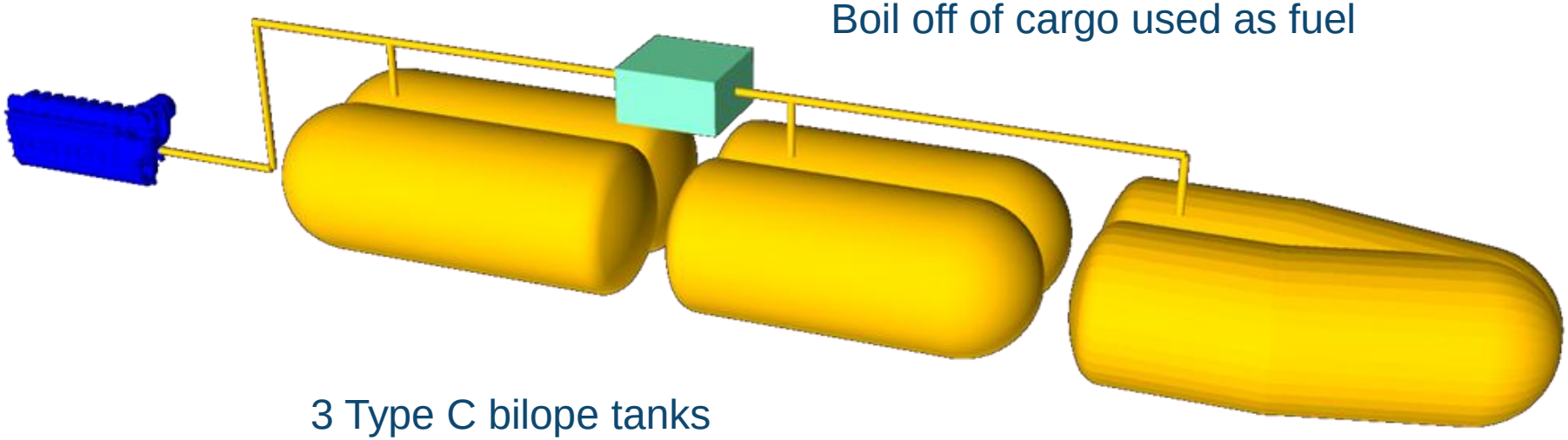
…

- Solar panels
  - 470 m² installed on Celebrity Solstice Class
- Fuel cells
  - Under investigation
  - Still too big, too heavy and to expensive for too less power
  - High power cells not available for maritime use
- Dual fuel
  - Already in use on e.g. local ferries and freight vessels
  - Designs for cruise vessels available

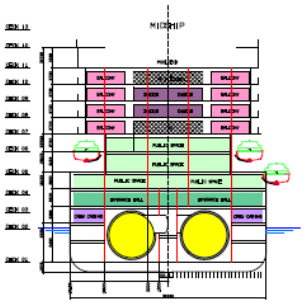
- Optimized for trade
- LNG fuelled from own cargo tanks

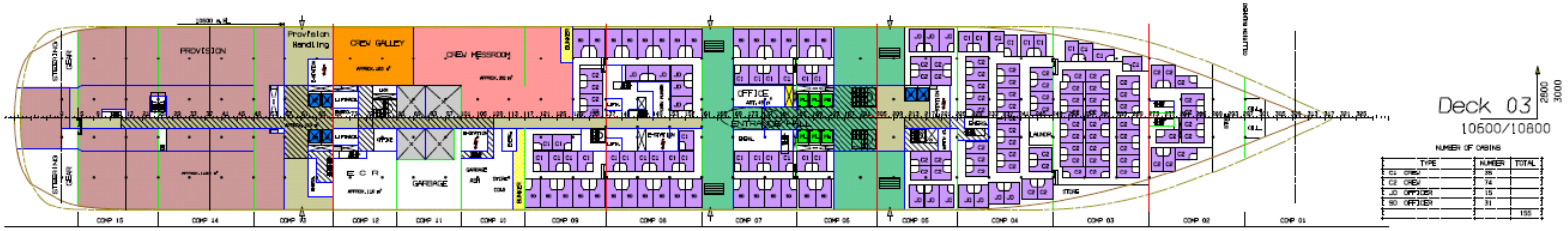
1x Wärtsilä 8L50DF main engine
2x 6L20DF aux. generators

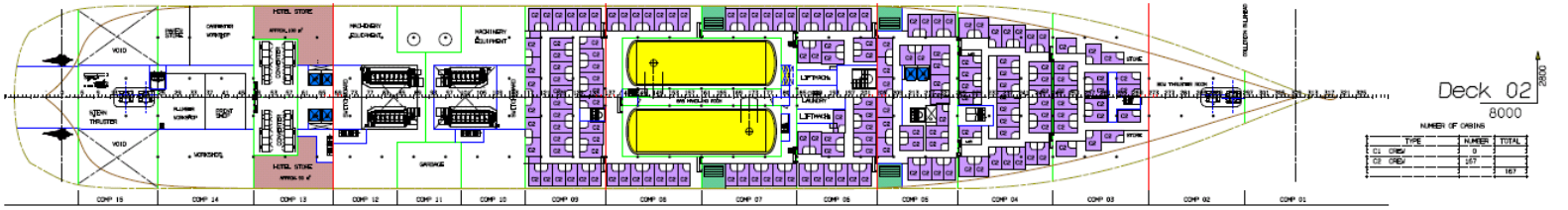
Fuel Gas Plant
Boil off of cargo used as fuel

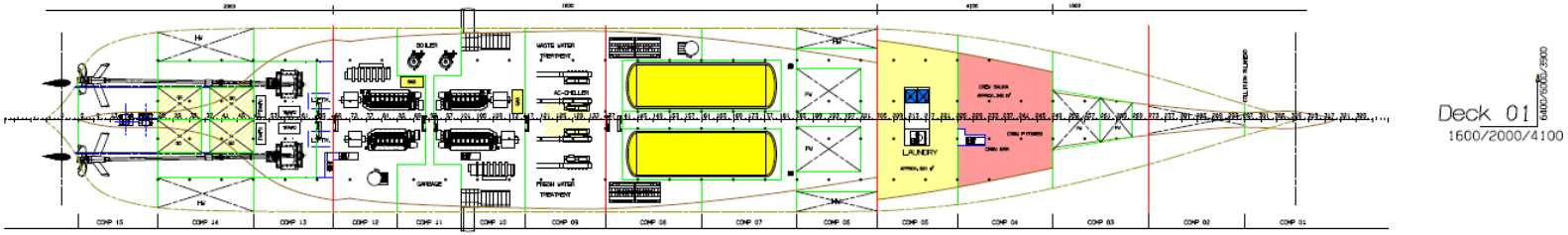


3 Type C bilope tanks
15,600 m³ capacity




Provision Handling
CREW GALLEY
CREW MESSROOM
OFFICE
E C R
GARBAGE
Deck 03
10600/10800
NUMBER OF CABINS


Deck 02
8000
NUMBER OF CABINS


LAUNDRY
Deck 01
1600/2000/4100




Thank you! Sales and Design Department, 23 September 2013