

A photograph of three large cruise ships sailing on a deep blue ocean under a clear blue sky. The ship in the foreground is the largest, with multiple decks and a complex superstructure. Two other similar ships are visible in the distance. The text is overlaid on the lower left portion of the image.

GREEN CRUISING

WHAT CAN WE DO TO REDUCE OUR
ENVIRONMENTAL FOOTPRINT?

Jyrki Ristimäki
ROYAL CARIBBEAN CRUISES LTD
June 14th, 2018

OUTLINE

Company presentation

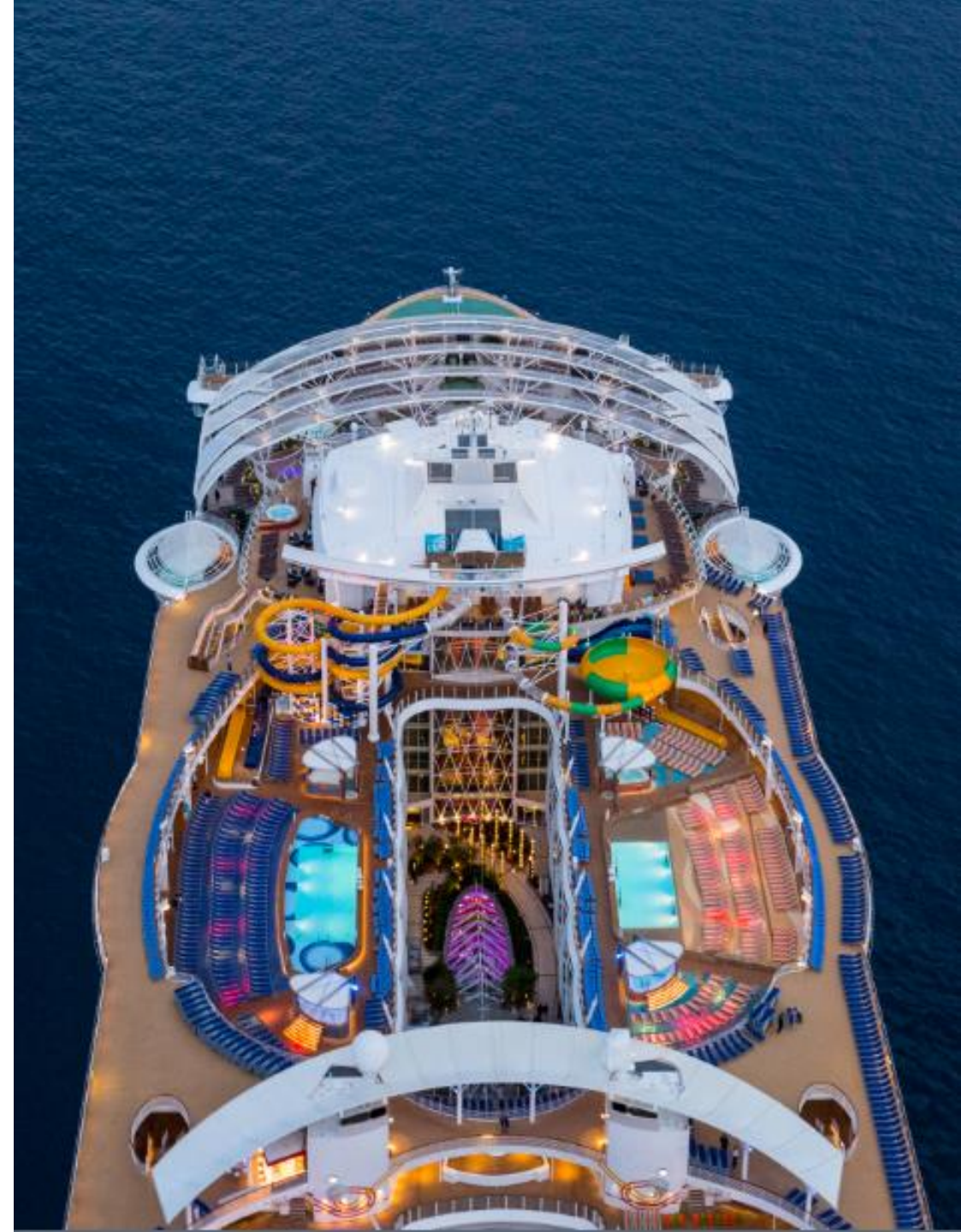
Our environmental vision & strategy

Operational policies

Emissions to air

Mitigation of emissions to air

Future



ROYAL CARIBBEAN CRUISES LTD

2ND LARGEST
CRUISE COMPANY

6 BRANDS
serving over
540
ports of call

\$8.8 billion total 2017 revenue

Six distinctive brands that share a vision anchored in excellence

Guests from
110
countries

5.8
MILLION
GUESTS PER YEAR

49
SHIPS
250,160
Guests

25.5
BILLION
Market Cap

Newbuilds
12 plus
Through 2022

\$11 plus
BILLION
Portfolio



VISION & STRATEGY



RCL's Environmental Code

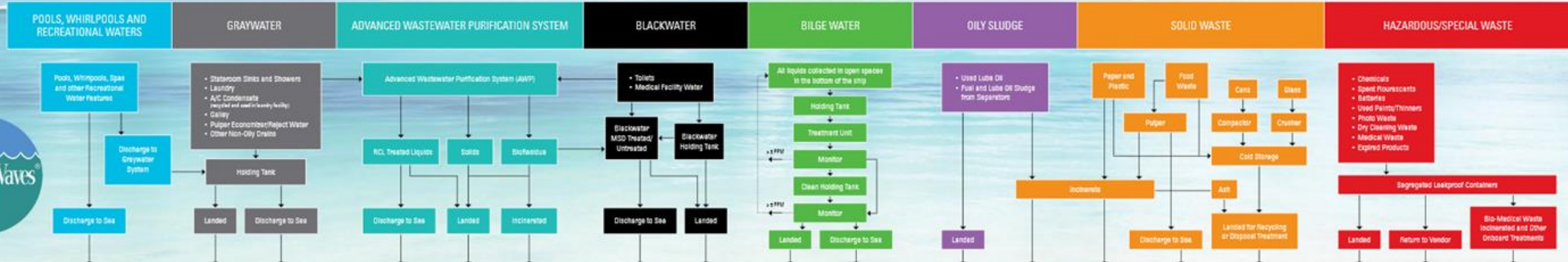
RCL is committed to protecting and conserving environmental resources, preventing pollution and continuously improving our environmental management.

Strategy will focus on three main pillars

- Minimizing Environmental Impact/Footprint
- Ensuring compliance and preparing the fleet to meet the requirements of future regulations and/or demands of our stakeholders
- Continuous Improvement, Innovation and Investment

OPERATIONAL POLICIES BEYOND THE MARPOL

WASTE STREAM OPERATIONS



Category	Operational Policy	Standards/Laws
Pools, Whirlpools and Recreational Waters	• Chlorinated beyond 4 nm and chlorinated beyond 12 nm or as defined by local restrictions • Discharge to Graywater System • Discharge to Sea	• Not regulated by MARPOL
Graywater	• Stateroom Sinks and Showers • Laundry • A/C Condensate (recycled and used in laundry facility) • Galley • Pulper Economizer/Reject Water • Other Non-Gray Drains • Holding Tank • Landed • Discharge to Sea	• To locally approved/licensed waste vendor • Not regulated by MARPOL
Advanced Wastewater Purification System	• Advanced Wastewater Purification System (AWP) • RCL Treated Liquids • Solids • Bioresidue • Discharge to Sea • Landed • Incinerated	• Treated beyond 2 nm meeting Flag State standards • Treated anywhere meeting IMO standards (subject to local restrictions)
Blackwater	• Toilets • Medical Facility Water • Blackwater MSD Treated/Untreated • Blackwater Holding Tank • Discharge to Sea • Landed	• Untreated beyond 12 nm • Treated beyond 2 nm meeting Flag State standards or • Treated anywhere meeting IMO standards (subject to local restrictions)
Bilge Water	• All liquids collected in open spaces at the bottom of the ship • Holding Tank • Treatment Unit • Monitor • Clean Holding Tank • Monitor • Landed • Discharge to Sea	• To locally approved/licensed waste vendor • Treated bilge less than or equal to 15 ppm while underway
Oily Sludge	• Used Lubricating Oil • Fuel and Lubricating Oil Sludge from Separators • Landed	• To locally approved/licensed waste vendor
Solid Waste	• Paper and Plastic • Food Waste • Cans • Glass • Paper • Compressor • Crusher • Cold Storage • Ash • Landed for Recycling or Disposal Treatment • Discharge to Sea	• Discharge comminuted less than or equal to 25 mm food waste outside special areas at least 2 nm • Discharge comminuted food waste inside special areas at least 12 nm • Discharge uncomminuted food waste at least 12 nm
Hazardous/Special Waste	• Chemicals • Spent Fluorescents • Batteries • Used Paints/Thinners • Photo Waste • Dry Cleaning Waste • Medical Waste • Expired Products • Segregated Leakproof Containers • Landed • Return to Vendor • Bio-Medical Waste Incinerated and Other Onboard Treatments	• To locally approved/licensed waste vendor • To locally approved/licensed waste vendor • In a MARPOL Type Approved Incinerator (except if installed prior to Jan. 1, 2000)



*Emergency discharges for the purpose of securing the safety of a ship, saving life at sea, or resulting from damage to a ship or its equipment are permitted provided that all reasonable precautions have been taken after the occurrence of the damage or discovery of the discharge for the purpose of preventing or minimizing the discharge.
**All RCL Ships are operated to meet all applicable shoreside and at-sea regulations and requirements, including those of RCL Corporate Policy, Flag Administrators, Port States, and local and international authorities.

EMISSIONS TO AIR

Two different challenges

Local
Global

Local

NO_x, SO_x & PM
MARPOL ANNEX 6
Local rules emerging

Global

CO₂
Global problem requiring Global solutions



NO_x, SO_x and PM

IMO MARPOL ANNEX VI

NO_x

SO_x & PM

Mandatory to comply

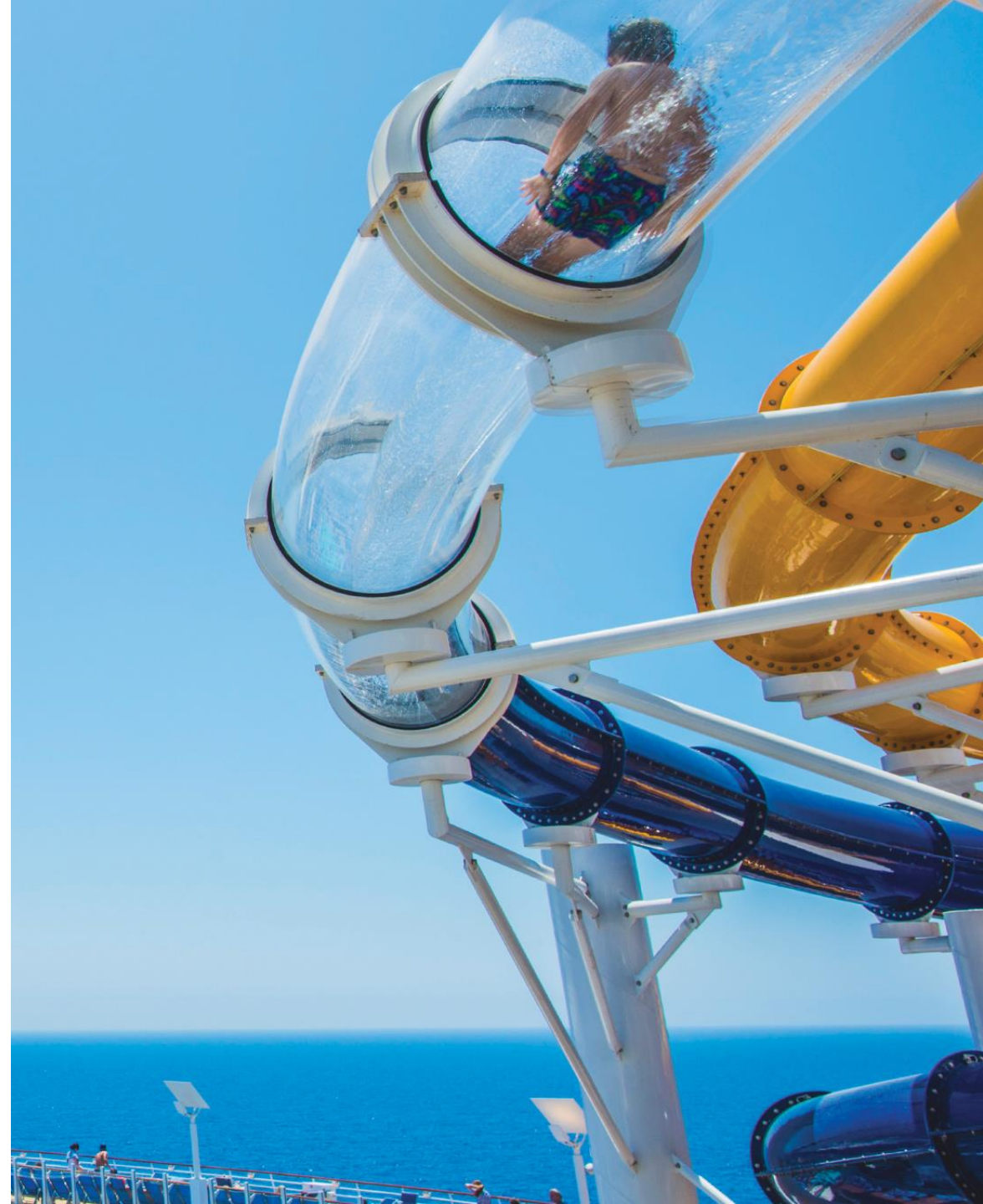
Engine setup, SCR, fuel sulphur / scrubbers

Local rules emerging

California, Venice, Norway...

Stepstones

Fuel (MGO, LNG, ?), scrubbers, SCR

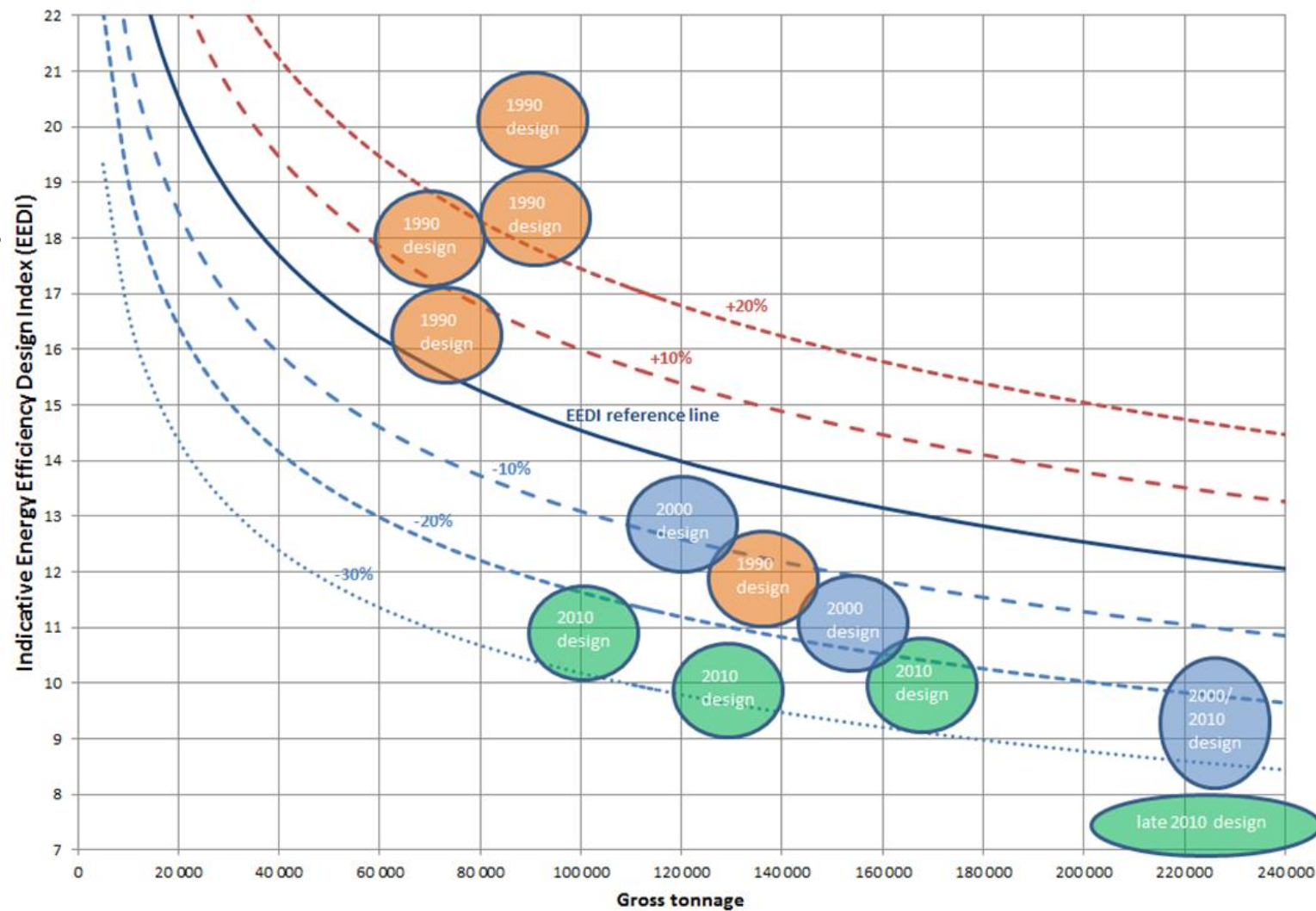


CO₂

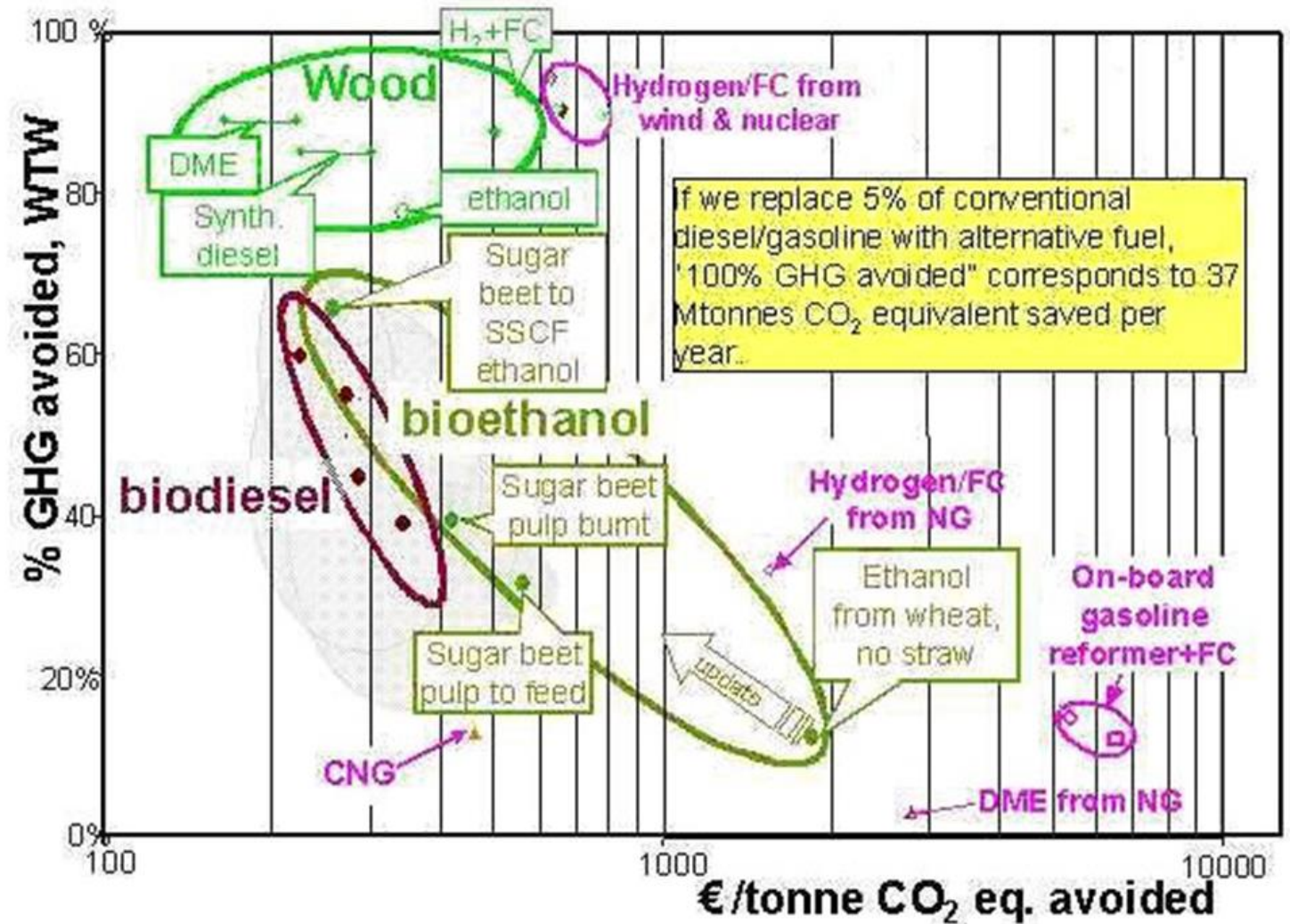
- Paris Agreement
- Initial IMO targets -50% reduction of GHG from shipping until 2050
- ➔ Challenging targets
 - ➔ 60% of our energy is consumed by propulsion
- Stepstones
 - Short term:
 - Increase in energy efficiency
 - Medium term:
 - Transition period? (e.g. LNG, Emissions trading)
 - Long term:
 - Sustainable fuels and new technology



DRIVING DOWN ENERGY USE (FLEET EEDI)



FUEL PATH FOR CO₂ MITIGATION



Source: <http://iet.jrc.ec.europa.eu/about-jec/jec-well-wheels-analyses-wtw>

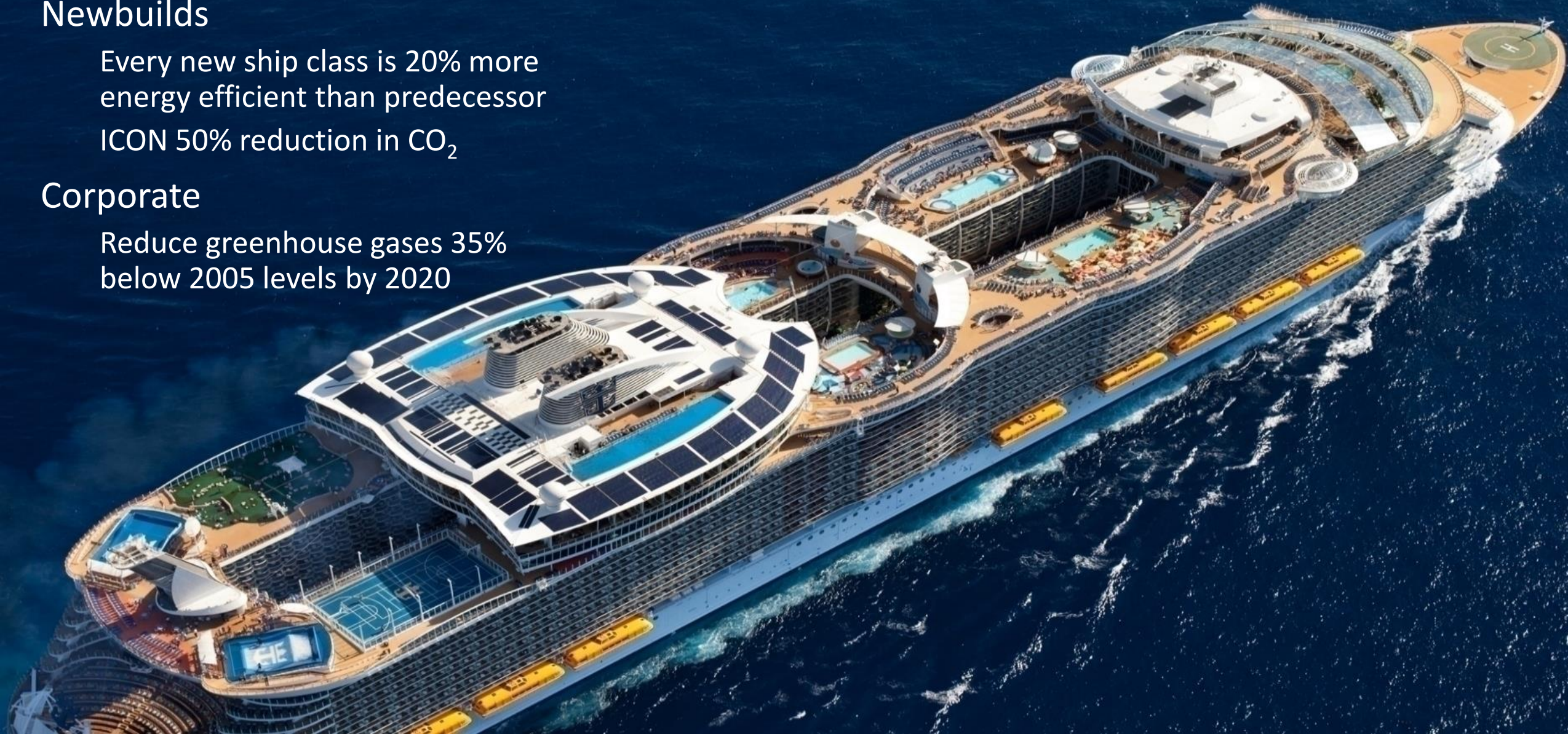
OUR TARGETS

Newbuilds

Every new ship class is 20% more energy efficient than predecessor
ICON 50% reduction in CO₂

Corporate

Reduce greenhouse gases 35% below 2005 levels by 2020



FUTURE

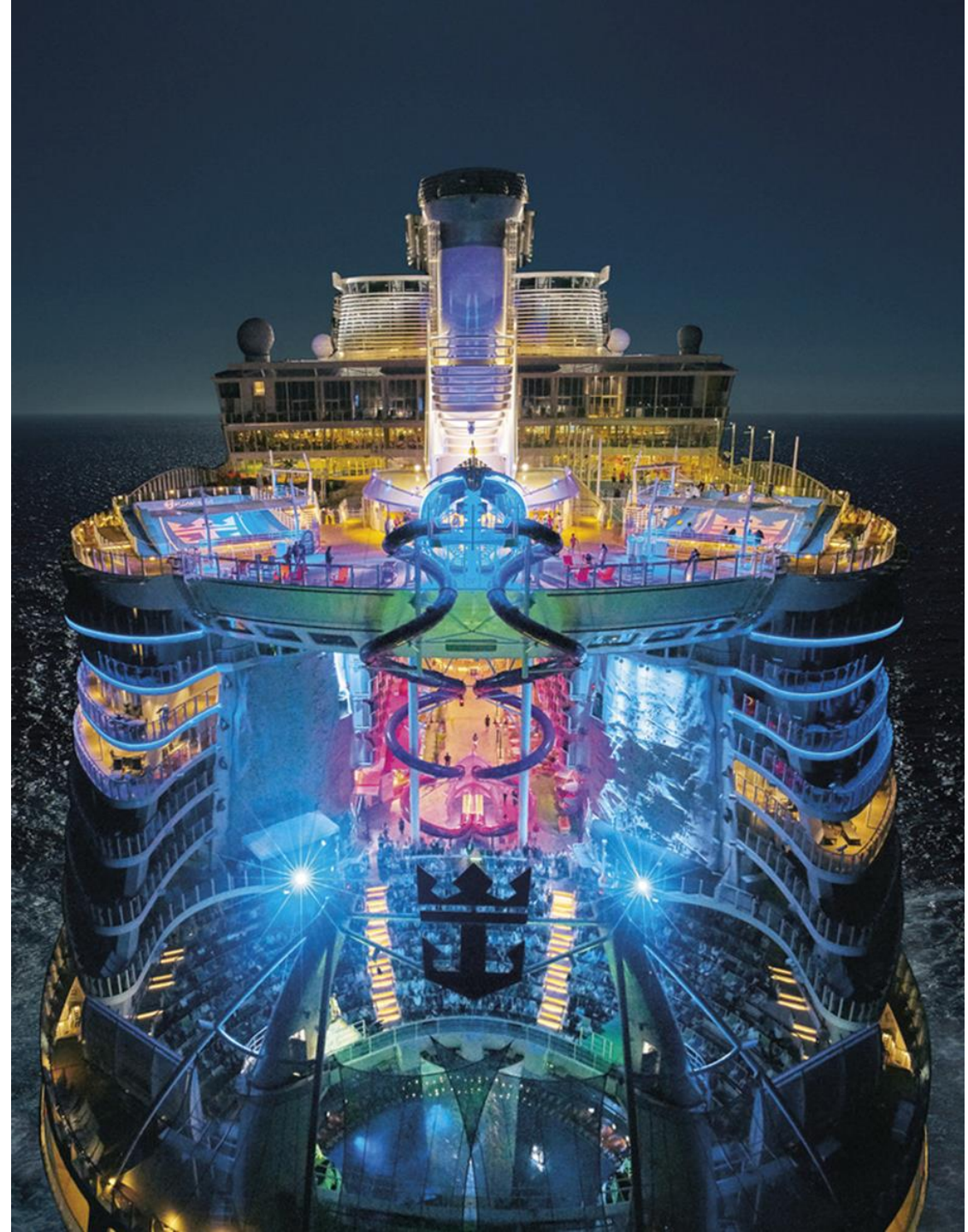
Fuel Cells

- Non conventional fuels used
 - Low flashpoint
 - Well to propeller CO₂ emissions / LCA
 - “Joint Research Centre - Well-to-Wheels analyses,” *European Commission*.
<http://iet.jrc.ec.europa.eu/about-jec/jec-well-wheels-analyses-wtw>.
 - CO₂ emissions highly dependent on the feedstock

Hybrid Solutions

- Batteries combined with power source
- Energy saving potential for typical cruise profile?

Potential in Newbuilds & Existing Fleet?



ELECTRIC & HYDROGEN



Large cruise ship energy consumption

Hotel: $10\text{MW} \times 24\text{h} = 240\text{MWh}$

Propulsion: $20\text{MW} \times 12\text{h} = 240\text{MWh}$

Total electrical energy 480MWh/day

Batteries

Weight of battery : >6200 tons

Size of battery: $\sim 10000\text{m}^3$

Hydrogen

50% efficiency: 960MWh/day hydrogen

➔ 30 tons/day H₂

➔ $\sim 6000\text{m}^3$ for 2 week autonomy

(vs $\sim 1300\text{m}^3$ for MGO)

An aerial photograph of a large cruise ship sailing through a tropical archipelago. The ship is moving from the bottom center towards the top right, leaving a white wake. The water is a vibrant turquoise color, and the islands are lush green with dense vegetation. The sky is blue with scattered white clouds. The text "THANK YOU" is overlaid in the center of the image.

THANK YOU