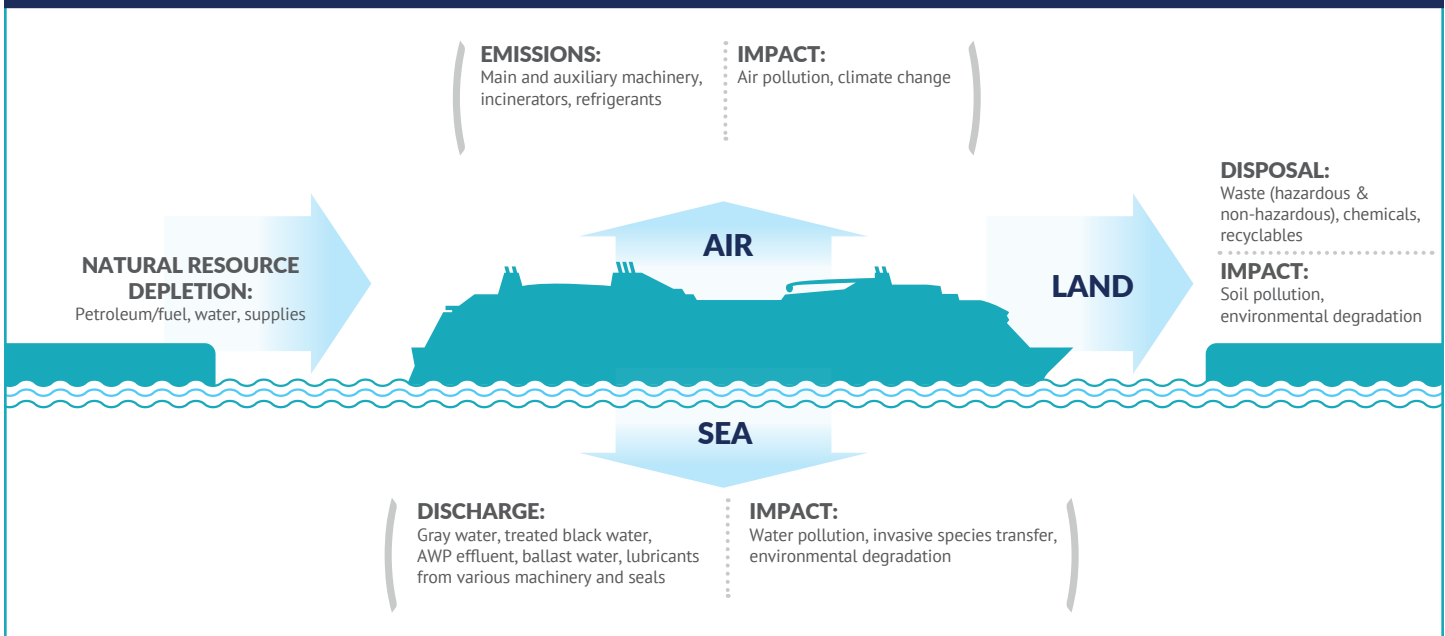


# Energy and Air Emissions

Our company generates a significant amount of emissions from our operations. Naturally, reducing our emissions of greenhouse gases and other air pollutants becomes a critical part of our environmental stewardship strategy. That strategy is fundamentally connected to ISO 14001 - the leading international environmental management standard.

**ROYAL CARIBBEAN INTERNATIONAL WAS THE FIRST CRUISE LINE  
TO USE ISO 14001 FOR ALL ITS SHIPS**

## SIGNIFICANT ENVIRONMENTAL IMPACTS

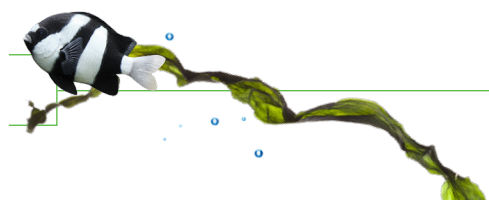


Meeting ISO 14001 enables us to target our greatest impacts to land, air, and sea



### SAVE THE WAVES

Since 1992, Save the Waves has evolved from a simple focus on reducing, reusing and recycling waste to a company-wide philosophy that is integrated into our daily onboard operations and meets our Above and Beyond Compliance and Continuous Improvement principles. Our Save the Waves program and subsequent goals provides us with a structure to maintain our commitment to continuous improvement. It also provides the umbrella under which each officer, staff and crewmember signs a pledge to uphold his or her responsibilities to protect the environment.



## WE MINIMIZE AIR POLLUTION FROM OUR SHIPS IN THREE MAIN WAYS:

### 1. Reducing Energy Use

The single largest energy demand on a ship is the propulsion required to push it through the water. Over the years, our goal of improving energy efficiencies across the fleet has resulted in the designing and building of the lowest-emissions ships in the shipping industry. For example, our newest ship, *Harmony of the Seas* emits 25% less carbon dioxide (CO<sub>2</sub>), per person, per day, than ships built eight years ago.

Together with our suppliers, we have developed the podded propulsion system found on our newest ships by enhancing the hydrodynamic design of the units that are often more efficient than traditional propeller-type systems.

Learnings such as these are retrofit when possible on our existing ships. The propulsion plants on the Vision class, for example, have been upgraded to a more efficient integrated rudder-propeller system during scheduled drydocks and have resulted in improved propulsion efficiency of 5 to 10%.

### WE ALSO CONTINUE TO PILOT SEVERAL SOFTWARE SOLUTIONS TO HELP GUIDE AND MONITOR EFFICIENT SHIP OPERATIONS

#### These efforts include:

- > Due to hydrodynamic improvements and speed management measures on 29 ships and HVAC and mechanical upgrades on 21 ships, we estimate nearly 50,000 metric tonnes in emissions have been avoided
- > 95% of our emissions are from fuel consumption
- > 52% reduction in emissions from refrigerant consumption per APCD since 2008

#### AIR LUBRICATION INITIATIVE

Our first complete Air Lubrication System launched with the introduction of *Quantum of the Seas* in 2014. It was the result of years of testing and a partial installation onboard *Celebrity Reflection*. The system's goal is to reduce the amount of energy needed to propel the ship by pushing out a coat of microscopic bubbles aimed at reducing the ship's frictional resistance as it sails. We continue to explore future fullscale installations onboard existing ships and potential new builds.

### 2. Emissions Abatement Technologies

In addition to focusing on energy reduction and efficiency, we believe that it is important to evaluate and invest in alternative abatement technologies for fossil fuel exhaust emissions.

Advanced Emissions Purification, more commonly known as exhaust gas cleaning, or scrubbers, relies on water to clean or scrub sulfur dioxide, and oxides of nitrogen emissions before they are released into the air. Since 2014 we have made significant investment in the deployment of five AEP systems on new ships and the retrofitting of 19 ships fleetwide. AEP systems remove 98% of the sulfur dioxide emissions generated by the ships' diesel engine.

The massive undertaking will position our company ahead of forthcoming International Maritime Organization emission standards, in addition to ensuring compliance with existing European Union standards.

The decision to install AEP systems instead of switching to a fuel with a lower sulfur content will ensure that RCL's ships can be compliant everywhere they sail, as availability of lower-sulfur fuels may prove limited. Additionally, AEP systems assist in reducing greenhouse gas, oxides of nitrogen and particulate matter emissions.

### 3. Alternative Fuels and Renewable Energy Sources

Although the selection of commercially available and practical, clean technologies continues to be limited for marine applications, we are actively researching and assessing progress on technologies such as solar and wind power, biofuels, natural gas, fuel cells, biomass and shore power to determine their efficiencies and viability for the future.

Since 2000, we have equipped eight of our ships with gas-turbine engines which burn cleaner fuels and emit less air pollution. And our Icon-class of ships, set to be delivered in 2022 will be powered by LNG (liquid natural gas) and fuel cells.

