

DRIVING CLEAN TRANSPORTATION AT PORTS

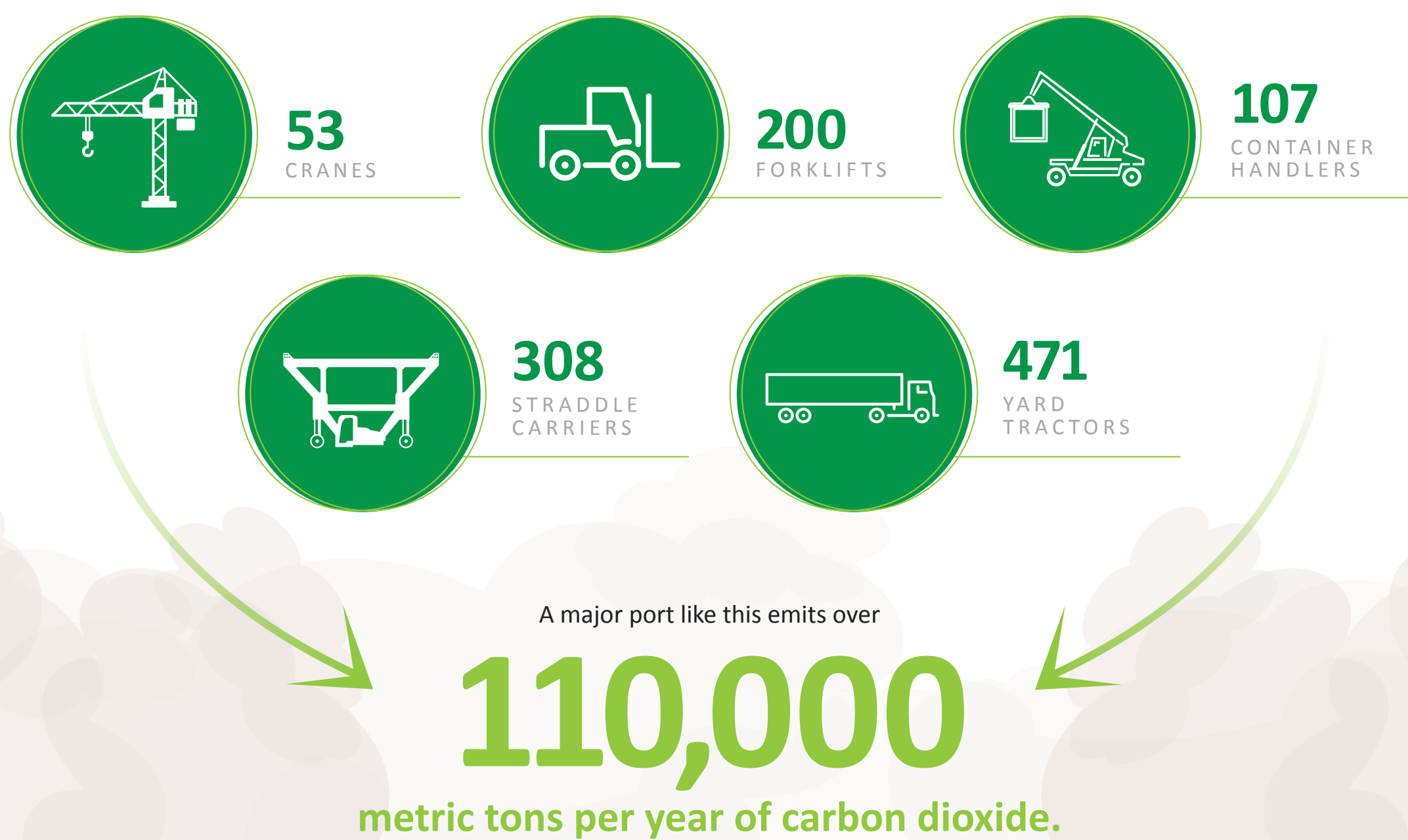
PORTS TODAY



Shipping ports are drivers of the global economy. They create jobs, provide entry points for goods and enable the export of products around the world.

But ports are also the source of air pollution and CO₂, compounded by emissions from vehicles and vessels that enter and leave the port.

A typical port looks like this.



HYDROGEN AT PORTS

It's time to envision a greener port of the future using hydrogen fuel cells to power emission-free vehicles and equipment.

The International Maritime Organization has established a goal of reducing greenhouse gas emissions by 50 percent by 2050 – and eventually to phase them out entirely. Many ports have more ambitious goals.



Hydrogen fuel cells at ports

Improve
AIR QUALITY

Reduce
CO₂ EMISSIONS

Increase
ENERGY EFFICIENCY

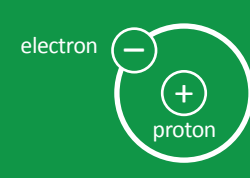
Reduce
AMBIENT NOISE

Fuel cells make vehicle electrification practical and possible.

They run on hydrogen, which is essentially portable electricity – and like electricity, can be produced renewably.

- + Fuel cell vehicle range is longer than for battery vehicle counterparts
- + Sustained performance at cold ambient temperatures
- + Greater payload capacity than for battery-only electric vehicles - comparable to diesel
- + Zero tailpipe emissions and quiet operation as trucks travel through nearby communities

Hydrogen is abundant, simple, clean



Hydrogen stores energy



HYDROGEN IS PORTABLE ELECTRICITY

Hydrogen is electricity...



...with the convenience of fuel



You can refuel a fuel cell electric vehicle in about the same amount of time as a diesel vehicle.

Hydrogen offers similar fueling logistics as diesel.

HYDROGEN



1,500 kg/day

10 minutes

30' x 50'

3.75 MW

\$

Zero-Emission Infrastructure Comparison

CAPACITY
Fleet of 21 Container Handlers, 39 Forklifts, 45 Yard Tractors

DISPENSER / CHARGER TIMES

REAL ESTATE

ELECTRICITY DEMAND

5 Dispensers

COST

30-40 Charging Stations

ELECTRICITY

348.75 MWh/day

50 minutes or longer

20-30X

150 MW

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WE CAN BEGIN RIGHT NOW

Converting to hydrogen could **eliminate** up to

9,600,000 gallons of diesel use annually at a large port.

Emission-free fuel cell powered port equipment is a big step toward creating the ports we need, and better air quality for our communities.



Vehicle or Equipment	Annual Diesel Usage	CO ₂ equivalent/yr
Rubber Tire Gantry	18,496 Gallons	188 Tons
Empty Container Handler	9,768 Gallons	99 Tons
Laden Container Handler	14,581 Gallons	143 Tons
Yard Tractor	5,217 Gallons	53 Tons
Straddle Carrier	14,690 Gallons	149 Tons
Forklift	1,676 Gallons	17 Tons