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Background

The Impact of Ship Emissions	
# of Ocean-Going Vessels 55,000	Ships anchored off-shore use their auxiliary engines, to power essential on-board functions, including refrigeration, lighting and instruments
Ave # of Containers per ship 15,000	
Pollution per ship equal to 50,000,000 cars	This has substantial implications for port side communities from increased particulate matter (PM) emissions, as well as contributions to smog-forming oxides of nitrogen (NOx).
Ports of Long Beach & Los Angeles produce 100,000,000 Tons/Day	
Emissions from 15 mega-ships = to all cars world-wide	California adopted collaborative plans to curb emissions set goals to establish zero-emission cargo-handling equipment by 2030.

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Alternatives

The California maritime market has the most pressing need for the capture and control technology . California is the first state to regulate ship emissions and requires some ships while at berth (At-Berth Regulation) to control emissions.

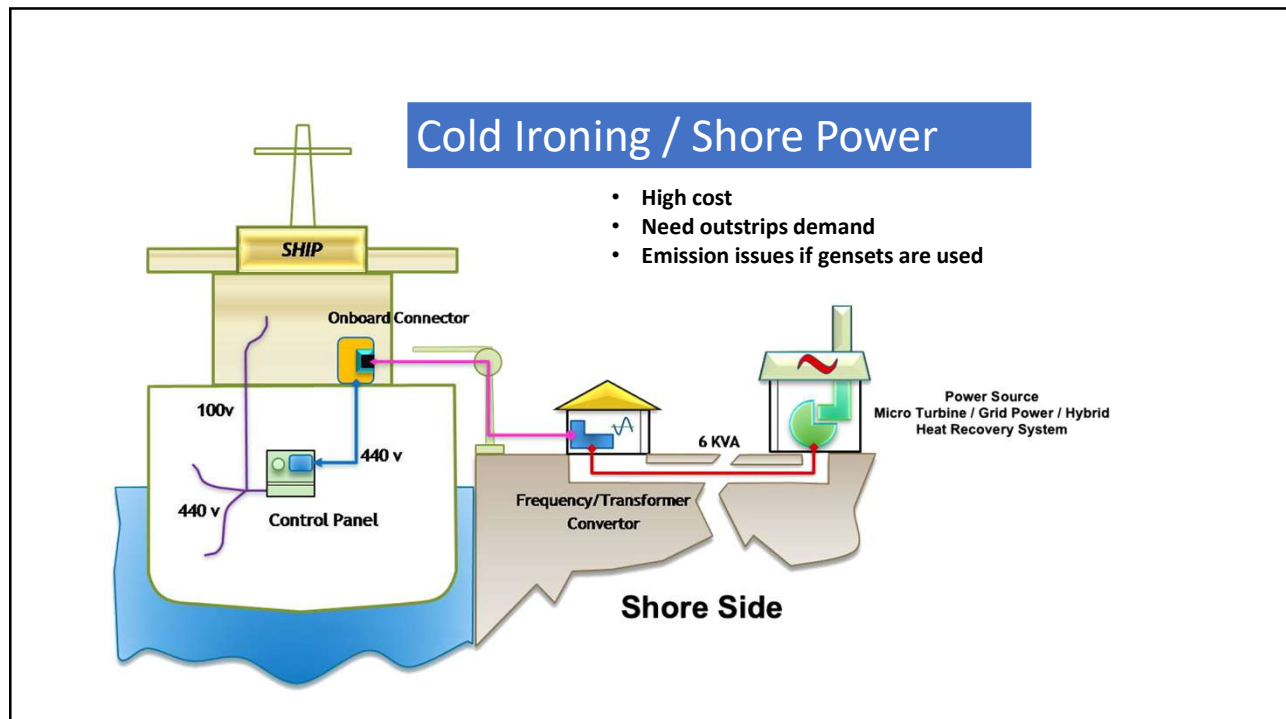
Fleet operators are given two options to limit their air emissions:

- 1) **shut down their auxiliary engines and “plug in” to a port’s electrical grid (also known as “shore power” or “cold ironing”)**
- 2) **use an alternative technology system that has been approved by CARB to capture and treat the auxiliary engine exhaust.**

These requirements will only become more stringent and, as usual, the rest of the world will follow California’s lead.

There are large penalties for non-compliance in California.

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ERaaS-Emission Reduction as a Service

- NEXT GENERATION TECHNOLOGY
- GREATEST OPERATIONAL FLEXIBILITY
- CUSTOMER COMPLIANCE & SAVINGS
- CARB COMPLIANCE
- DEPTH OF EXPERIENCE



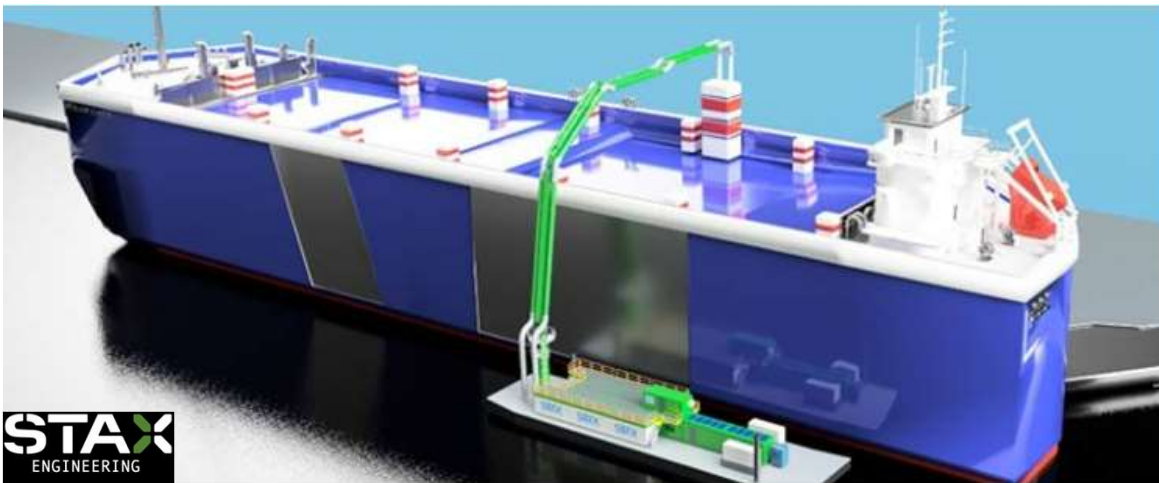
T. F. HUDGINS[®]
INCORPORATED
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HJS
Emission Technology

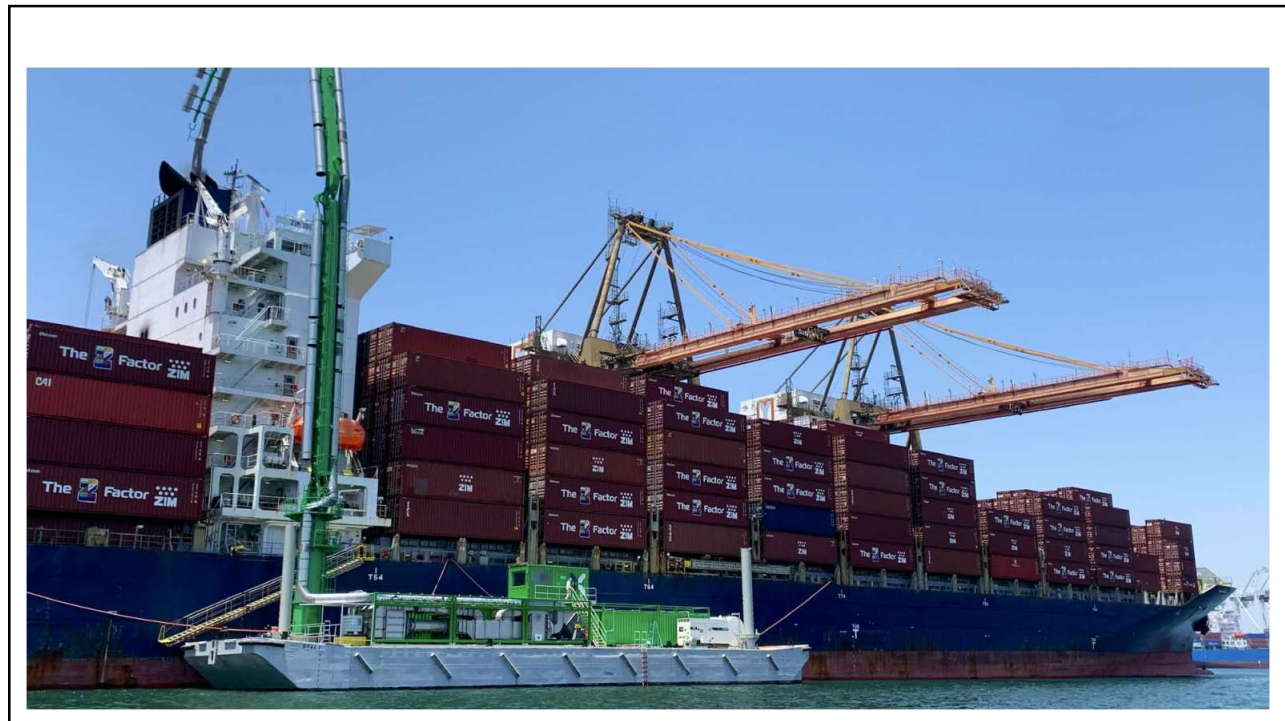
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STAX Engineering Capture and Control Technology

STAX Engineering has a patented treatment system will allow vessels to comply with California regulations and facilities that rely on backup generators to avoid expensive lawsuits at substantially lower costs than any alternative technology. This technology also delivers the most efficient, cleanest method to date.

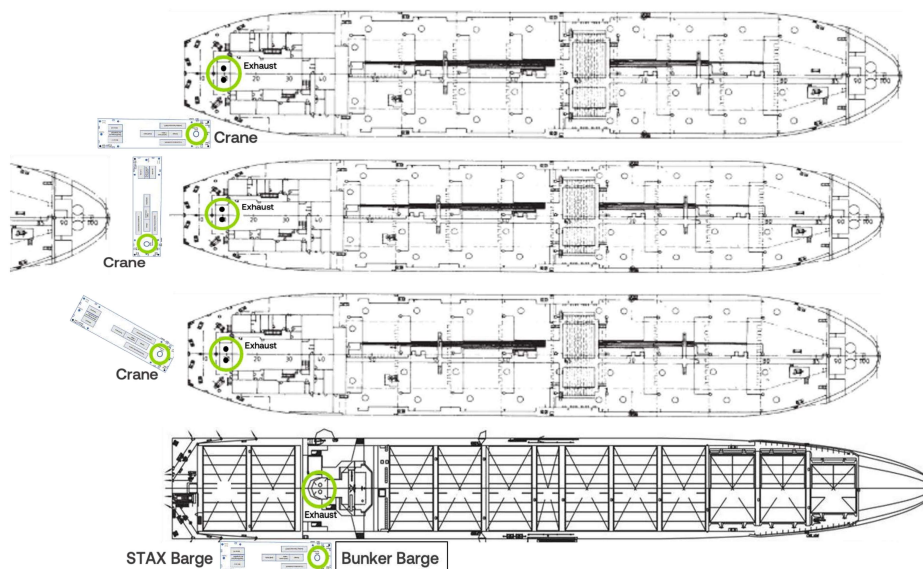


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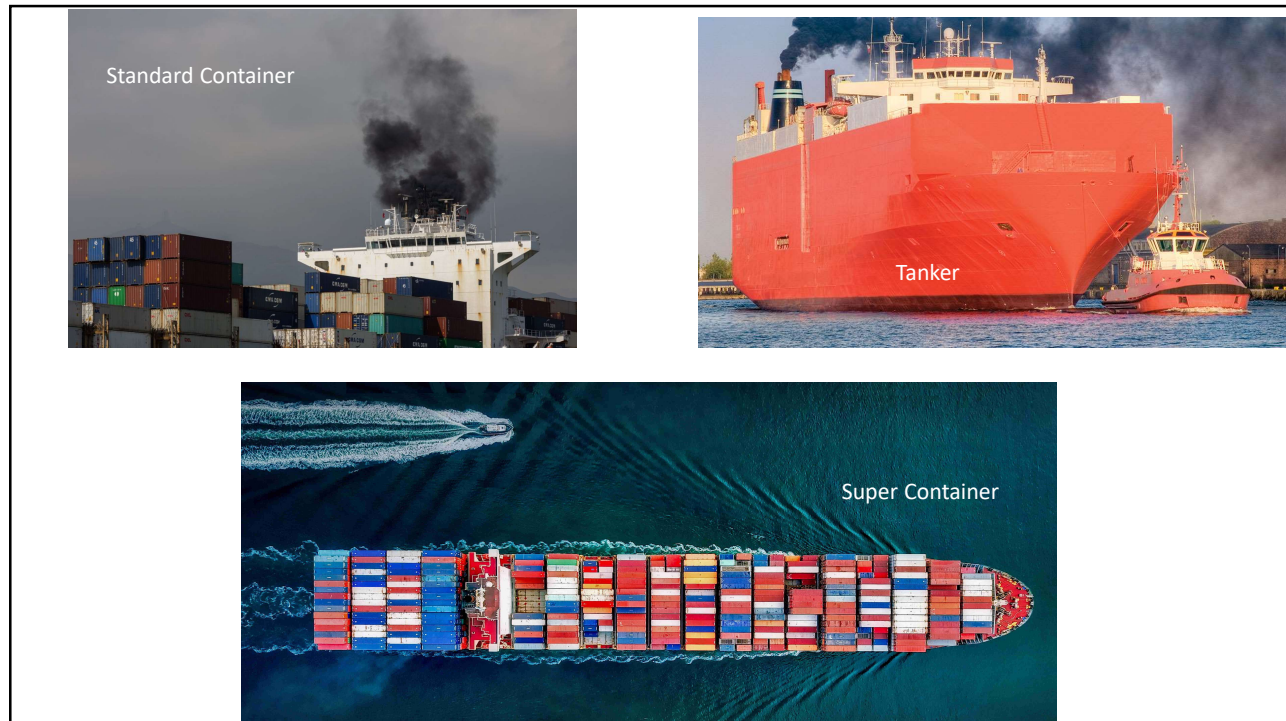


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Adapts to a variety of configurations



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Every Aspect of the system is GREEN

SELF-PROPELLED

Spuds for anchoring the barge into position

LOW GREENHOUSE GAS (GHG) MICROGRID POWER SYSTEM

H2 Fuel Cell / H2 Tanks (Intended for emissions system operations)

Renewable Diesel Gensets (Intended for propulsion)

Battery Storage (Intended for peak power and when not in use)

On-board Solar (Intended for when not in use – charges battery)

Shore power (Charges battery = plug-in hybrid)

XCAP EXHAUST CAPTURE SYSTEM

Multiple exhaust capture hoods and ducting

Remote connection

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Capture & Control System

STAX consists of a modular technology that is adaptable to every unique application.

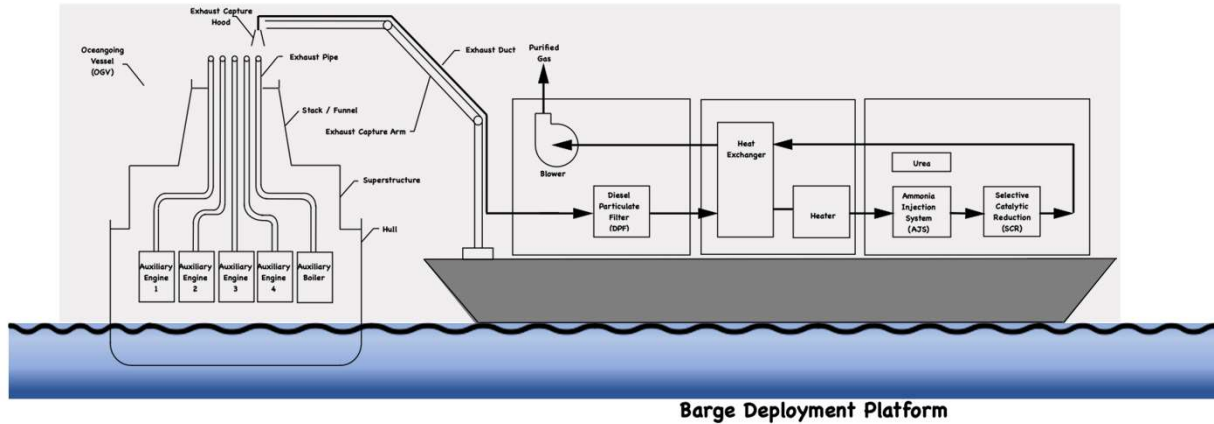
Each application consists of modular containers: **STAXbox**

Diesel Particulate Filter (DPF)

Selective Catalytic Reduction System (SCR)

Reactive Organic Gas (ROG) elimination system

3 X 20-foot containers



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Filter Selection

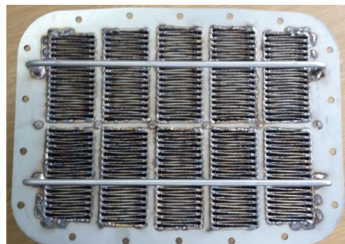
Sintered metal filters were selected due to

- High mechanical strength
- DPM capture efficiency >99%
- Cleanability
- Long life

Inlet



Outlet



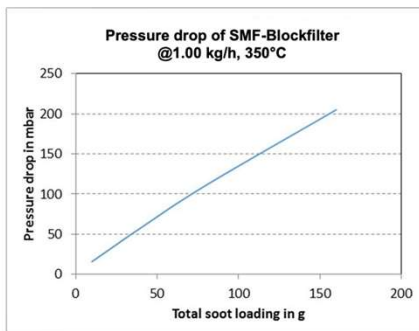
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STAXbox DIESEL PARTICULATE FILTER (DPF)

DPF SPECIFICATIONS

During operation, the DPF curtails PM emissions (20-300nm)
 $\geq 97\%$ (by particle count) an average of all operating points

During regeneration, ($< 3\%$ of time) the DPF curtails $\geq 70\%$



Block Filter Module

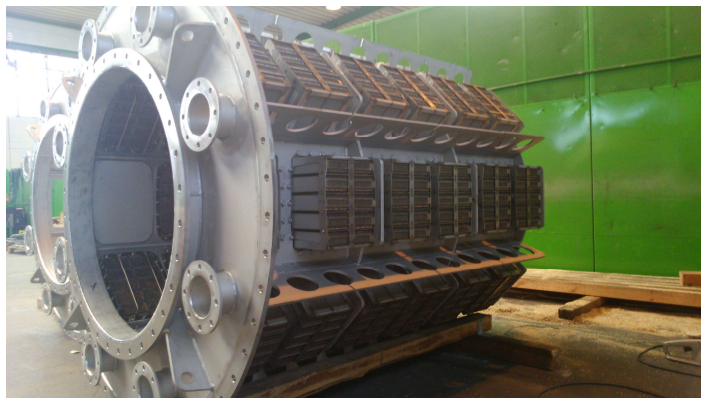


Cleanability

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DPF

Sintered metal

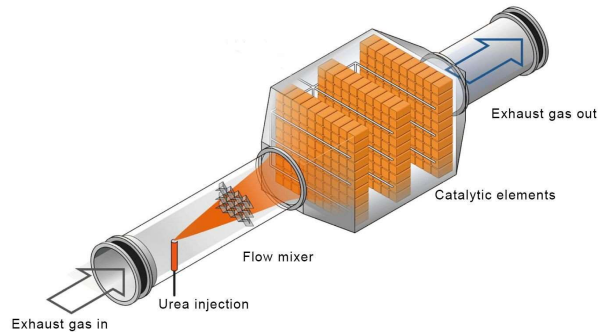


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STAXbox SELECTIVE CATALYTIC REDUCTION (SCR)

SCR DESIGN

- Standard, proven, design
- Urea injection (low risk, low hazard)
- Designed for 98% NO_x reduction (to be certified in CARB testing)



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Results

OVERALL EMISSION REMOVAL EFFICIENCY OF 98%

NO_x
PM_{2.5}
DPM
ROG - New requirement Updated CARB regulation

CARB Verification is in progress

The STAX overall effectiveness is higher than all current CARB-approved technologies.

This effectiveness translates to a lower cost per ton of emissions reduced, thereby making STAX the most competitive technology for reducing at-berth emissions, especially for "other" ship types.





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