



VIRTUAL

New Efficiencies From Waste Heat

2020

AICHE® SPRING
MEETING &
16TH GLOBAL
CONGRESS
ON PROCESS
SAFETY

AUGUST 17-21, 2020



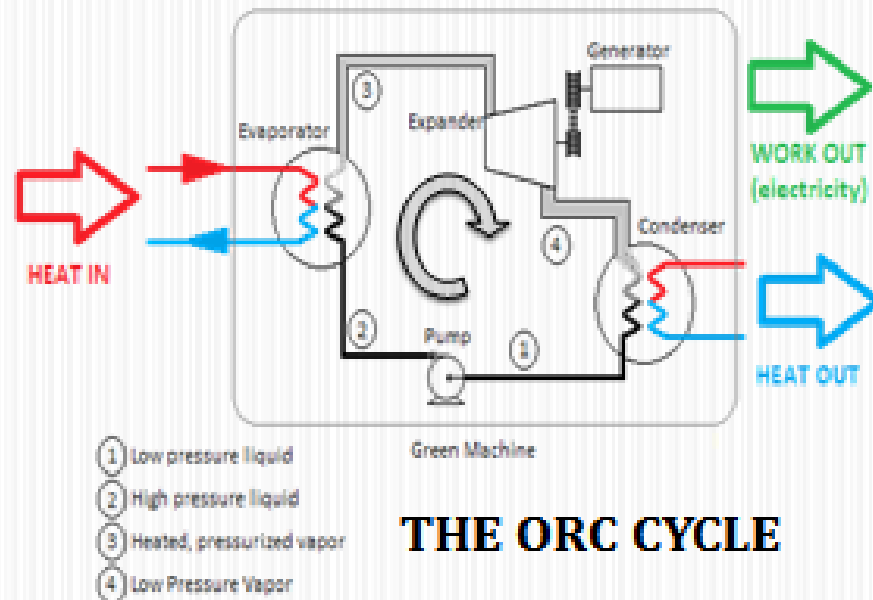
HEAT IS POWER
LET'S CAPTURE IT



The 15,000 MW Opportunity

How it Works

ORC SYSTEM OVERVIEW



THE ORC CYCLE

-**HEAT IN:** Heat enters ORC via hot water stream, transferred into system through evaporator where working fluid changed from liquid to vapor.

-**HEAT OUT:** Heat leaves ORC via cooling water stream, heat transferred through the cooling water stream changing vapor back to liquid

-**WORK OUT:** Work is provided via shaft output from expander, and converted to electricity by a generator.

-**IMPORTANT:** 90% of the heat input into the ORC passes through the machine to the cooling side.

Fuel/Emission Free Power from Waste Heat



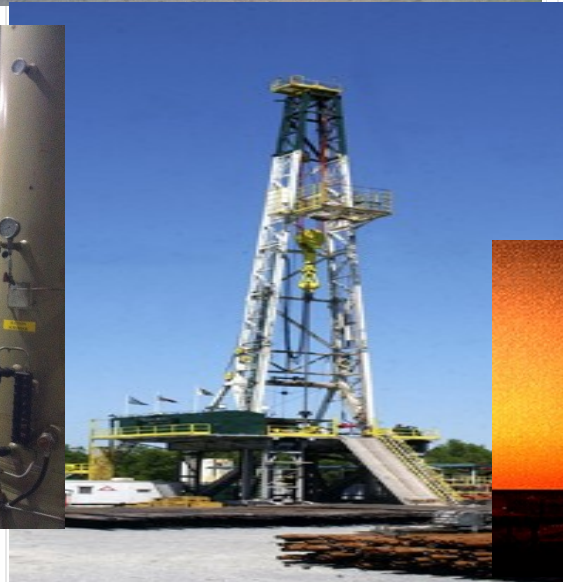
Solar Thermal



Internal Combustion Engines



Compressed Gas Cooling



Co-produced Water



Flare Gas to Power

Radiator Replacement for Stationary Engines

Avoid Radiator Expense on new projects
Offset ORC Capex by 20-30%



Benefits:

- *Complete Engine Radiator Replacement*
- *10% - 12%+ Improved Fuel Efficiency*
- Easily Transportable
- Limited Site Construction
- Payback 2-3 years (diesel)

“The Radiator with a Payback”

Video at <https://youtu.be/fca0faX8R84>



Guantanamo Bay, Cuba
Containerized 1.1MW Cummins Genset/ORC

*1.1 MW Cummins Genset and
Exhaust Gas Heat Exchanger*



POWER+ ORC cools engine/makes power

JW Connection



Beneficial Use of Flare Gas



Partners:

Environmentally Friendly Drilling Systems Program,
HARC, Hess Corp., Dept. of Energy



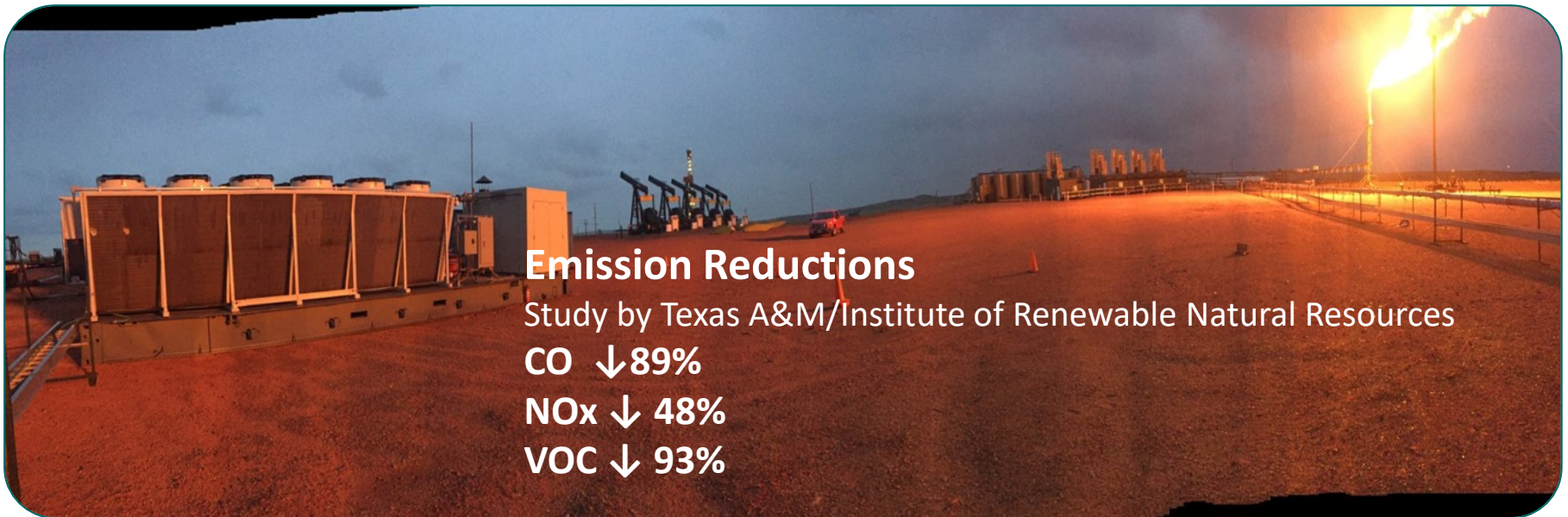
Emission Reductions

Study by Texas A&M/Institute of Renewable Natural Resources

CO ↓ 89%

NOx ↓ 48%

VOC ↓ 93%



Power From Produced Water in 6 hours



Business Values are Changing

2020 Letter to CEO's

“Last year BlackRock voted against or withheld votes from 4,800 directors at 2,700 different companies.....we will be increasingly disposed to vote against management and board directors when companies are not making sufficient progress on sustainability-related disclosures and the business practices and plans underlying them.”

Larry Fink, Chmn. and CEO - **BLACKROCK**

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