



# Flare Gas Recovery in the Bakken



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# EFD Program

*A collaborative effort*

*Industry – Academia - Government*

*Environmental Organizations*

*Providing unbiased science to  
identify, develop and transfer  
critical, cost effective  
technologies for safe and  
environmentally friendly drilling.*



# EFD Program

*A collaborative effort*

*Industry – Academia - Government*

*Environmental Organizations*

*Providing unbiased science to identify, develop and transfer critical, cost effective technologies for safe and environmentally friendly developments.*

## SPONSORS



## MANAGEMENT TEAM



## ENVIRONMENTAL ORGANIZATIONS



## COLLABORATORS



## ALLIANCE MEMBERS





# EFD-Objectives

- Address environmental and societal issues in oil and gas operations
- Reduce footprint of operations in environmentally sensitive ecosystems

*“No other organization in the oil and gas area has ever been able to successfully link this broad spectrum of stakeholders, providing opportunities for communication between groups that normally do not communicate very well “ -- RigZone*



# EFD Projects

## Core

- EFD Scorecard
- EFD- TIP program
- Coastal Impacts  
Technology Program
- Environment 24/7

## Supplemental

- Powered by Natural Gas  
(PBNG)
- Flaring Issues, Solutions  
and Technologies
- Dopefree Pipe
- FracFocus Webinar  
Training



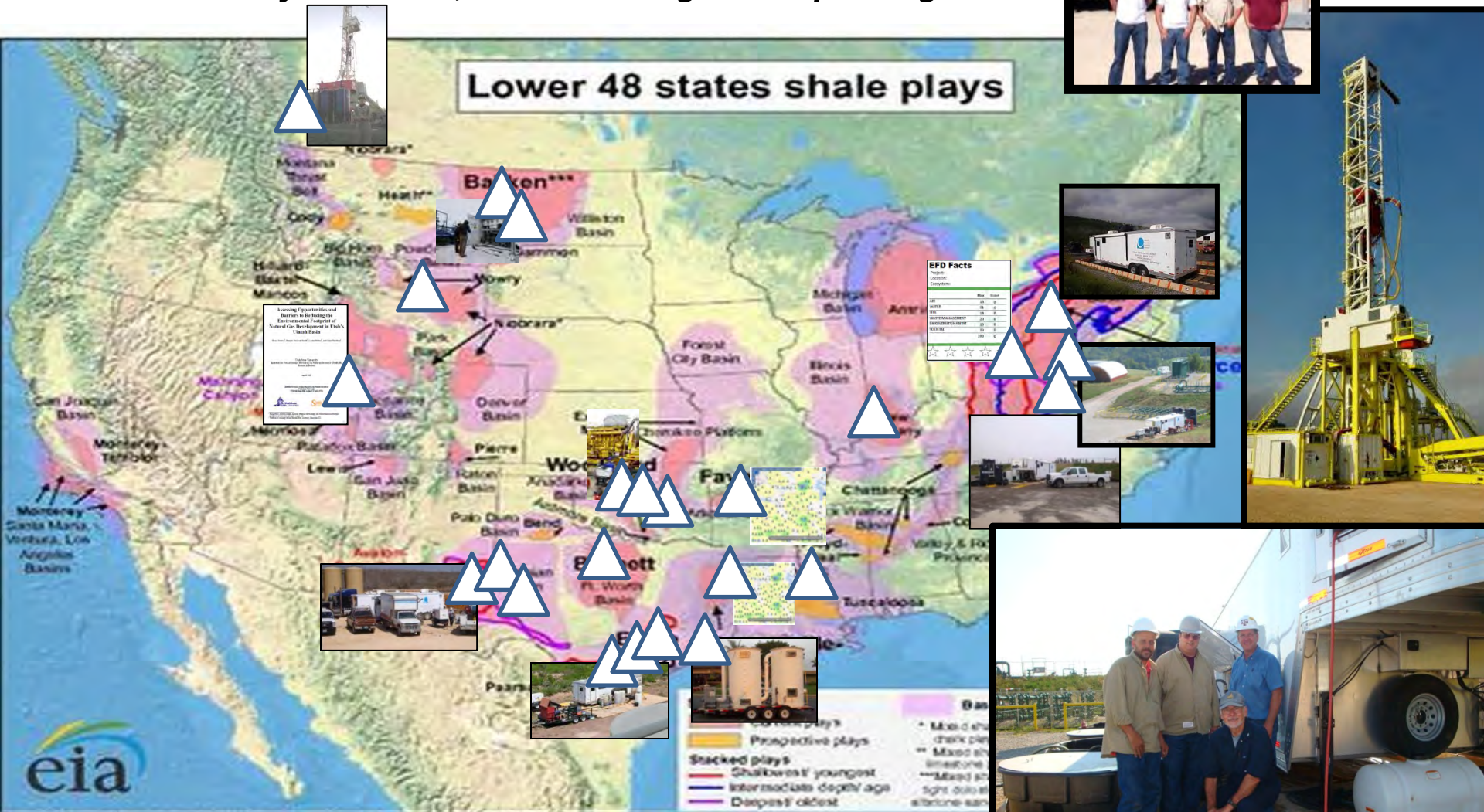
# EFD- Technology Integration Program

- Speed the commercial development of technology developed through RPSEA programs
- Create an organizational structure to build a network of regional centers to facilitate deployment of cost effective solutions
- Perform **field trials** and evaluate results
- Document case studies and enhance sustainability



# EFD Field Trials Program since 2012

Focuses on *field trials, documenting* and *reporting*.



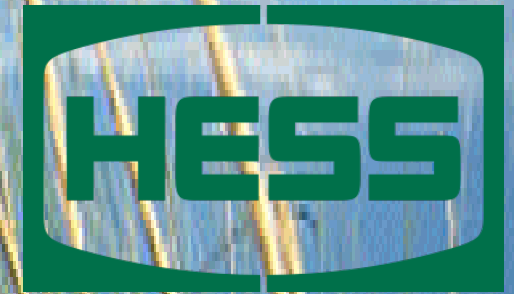


# Bakken Flare Gas Mitigation using Power Plus Generator – EFD Goals

- Demonstrate ability of the equipment to produce electricity from flare
- Demonstrate that electricity production does not interfere with well operations
- Determine emissions offset and prove technology works



# *Oil and Gas Flare Reduction Field Trial Cost Effective Methane and VOC Reduction*

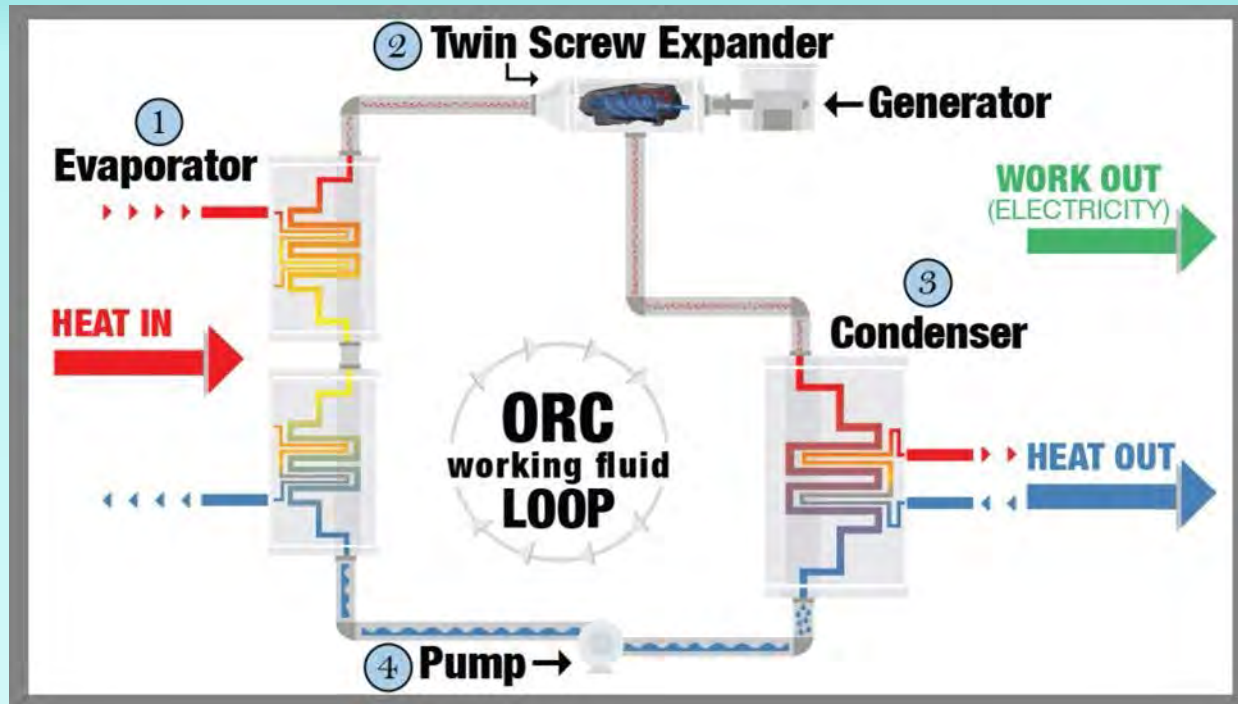


# Low Temperature Waste Heat to Power



**THIS IS SMART POWER®**

# Organic Rankine Cycle = Waste Heat to Power

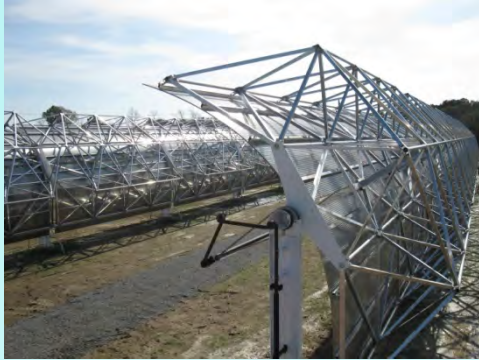


- Recover heat from hot water flow to boil working fluid
- Use pressure of expanded working fluid to spin a drive shaft connected to a generator

# GCGE Commissions First Post R&D Green Machine SMU 6.18.08



# GCGE Makes Emission Free Electricity



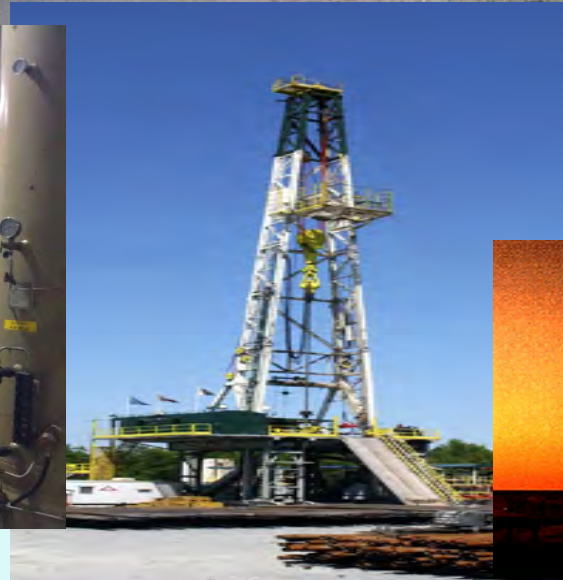
Solar Thermal



Internal Combustion Engines



Compressed Gas Cooling



Co-produced Water



Flare Gas to Power

# GCGE 1st to Make Power From Produced Water

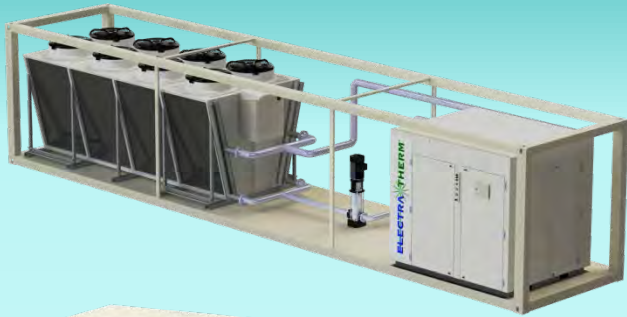
## Denbury Resources Oil Well, Mississippi



# Engine Installation in Oil & Gas



# Available Models

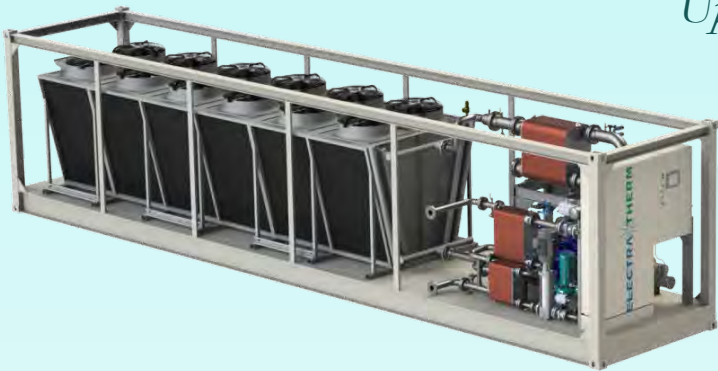


**Power+ 4200**  
*Up to 35kW*



**Power+ 4400**  
*Up to 65kW*

**Power+ 6500**  
*Up to 110kW*



## Range of need:

- 15 - 110kW output
- Up to 250°F
- Plug & Play
- Robust & Reliable



# The Challenge

BEFORE THE INDUSTRIAL COMMISSION  
OF THE STATE OF NORTH DAKOTA

CASE NO. 22058  
(CONTINUED)  
ORDER NO. 24665

IN THE MATTER OF A HEARING CALLED ON  
A MOTION OF THE COMMISSION TO  
CONSIDER AMENDING THE CURRENT  
BAKKEN, BAKKEN/THREE FORKS, AND/OR  
THREE FORKS POOL FIELD RULES TO  
RESTRICT OIL PRODUCTION AND/OR  
IMPOSE SUCH PROVISIONS AS DEEMED  
APPROPRIATE TO REDUCE THE AMOUNT OF  
FLARED GAS.

ORDER OF THE COMMISSION

THE COMMISSION FINDS:

(1) This cause originally came on for hearing at 9:00 a.m. on the 22nd day of April, 2014.

(2) North Dakota Industrial Commission (Commission) Order No. 24392, signed May 14, 2014 continued the decision in this matter for an additional ninety days.

(3) This hearing was called on a motion of the Commission to consider amending the current Bakken, Bakken/Three Forks, and/or Three Forks Pool field rules to restrict oil production and/or impose such provisions as deemed appropriate to reduce the amount of flared gas.

This special hearing was scheduled to address the Commission's newly-adopted policy on reducing gas flaring. The policy goals were to reduce the flared volume of gas, reduce the number of wells flaring, and reduce the duration of flaring from wells.

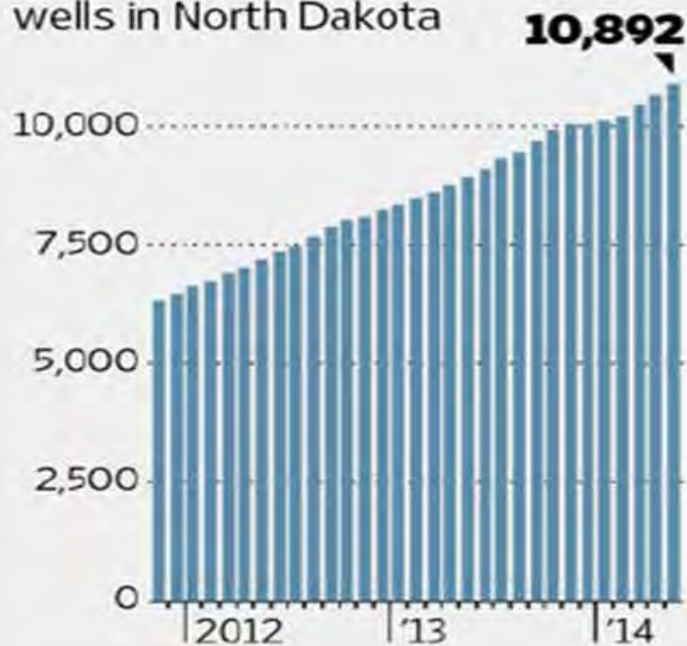
Action items to reach the policy goals included requiring Gas Capture Plans for increased density, temporary spacing, and proper spacing cases; requiring Gas Capture Plans for all applications for a permit to drill; schedule semi-annual meetings with midstream gas gathering companies to gauge the effect of Gas Capture Plans, production curtailments, contracts, and service interruptions; dedicate information technology resources to develop a web-based pipeline incident report form to better assess right-of-way issues; direct the Pipeline Authority to track flaring on/off the Fort Berthold Indian Reservation and report capture status versus goals; and docket this hearing to review and revise Bakken, Bakken/Three Forks, and/or Three Forks Pool rules governing production curtailment.

# The Challenge

## Fuel Overload

In North Dakota, the hunt for more oil has produced surplus gas. Natural gas is burned off, or 'flared,' where there are no—or overloaded—pipelines.

Number of producing wells in North Dakota



Source: North Dakota Industrial Commission

Monthly flaring ratios in N.D.



The Wall Street Journal

# Our Solution:

Eliminate flare, make power for well Opps.



Gas to Boiler



kW Output



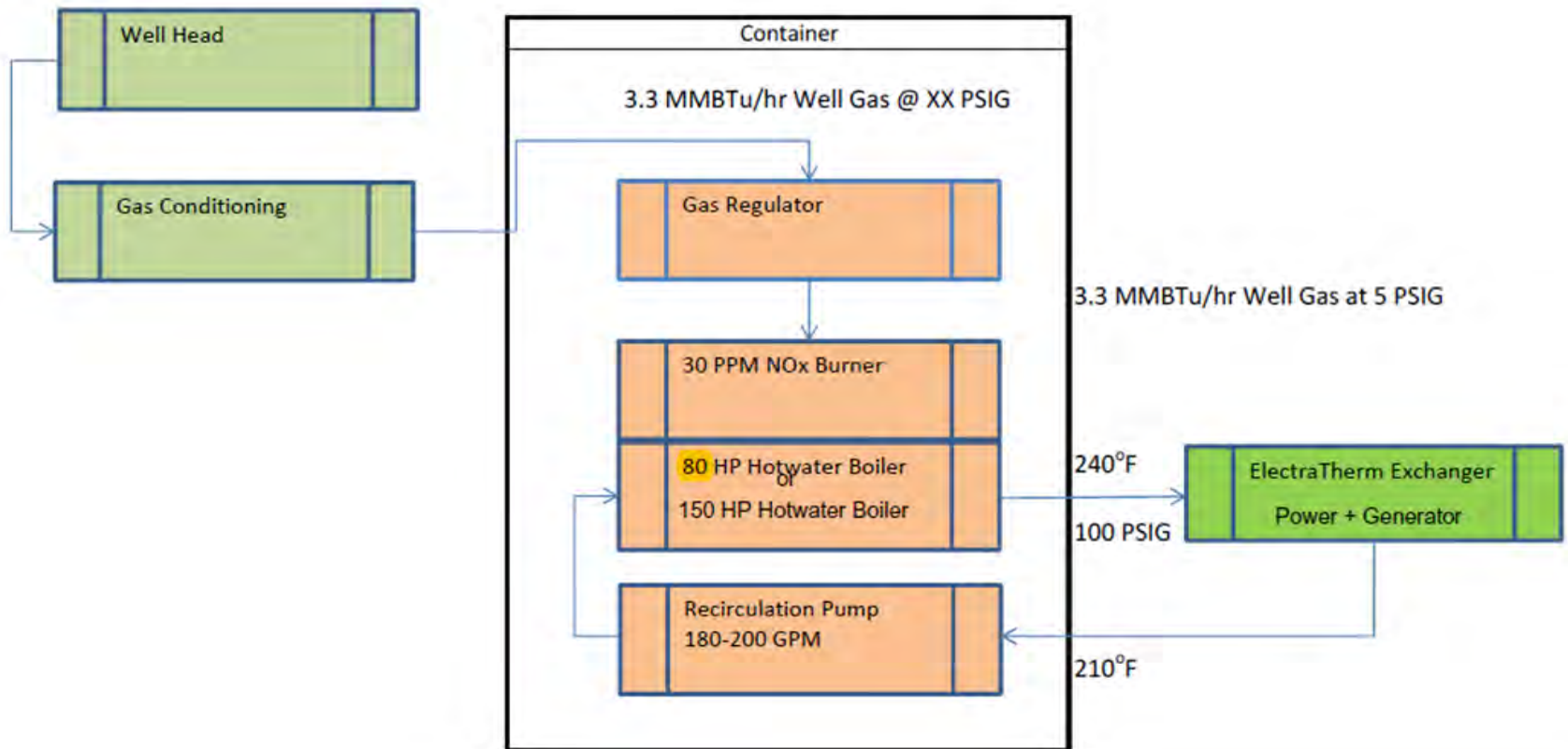
Reduced Flaring



# The Solution:

## Gas Fired Low Emission Boiler + ORC

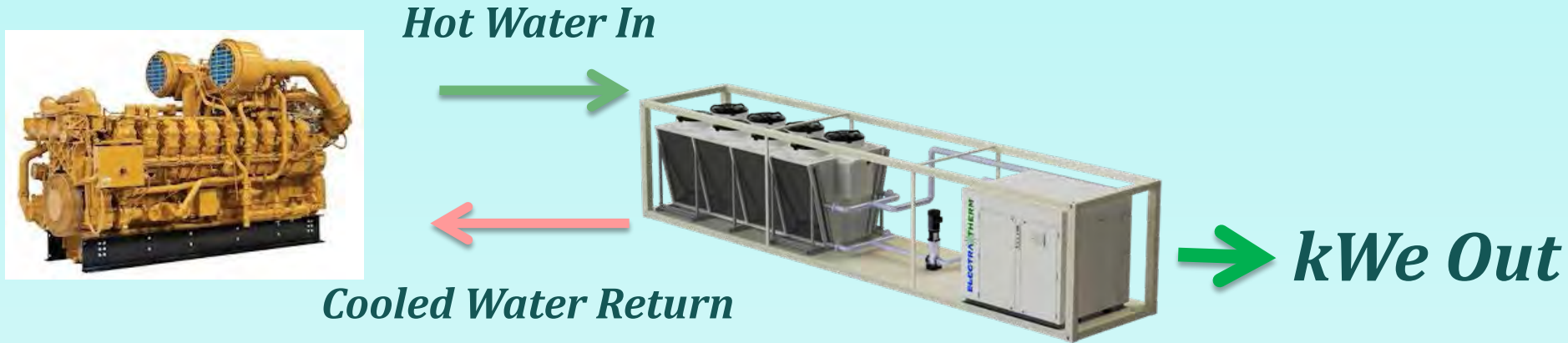
Project ElectraTherm  
Site Reno  
Date 5/1/2015



# ElectraTherm Power+ ORC on Test Cell



# Other Solutions: Reciprocating Engines

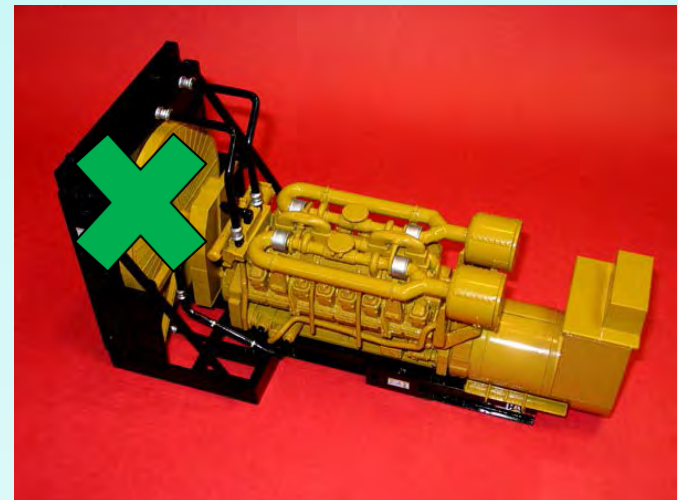


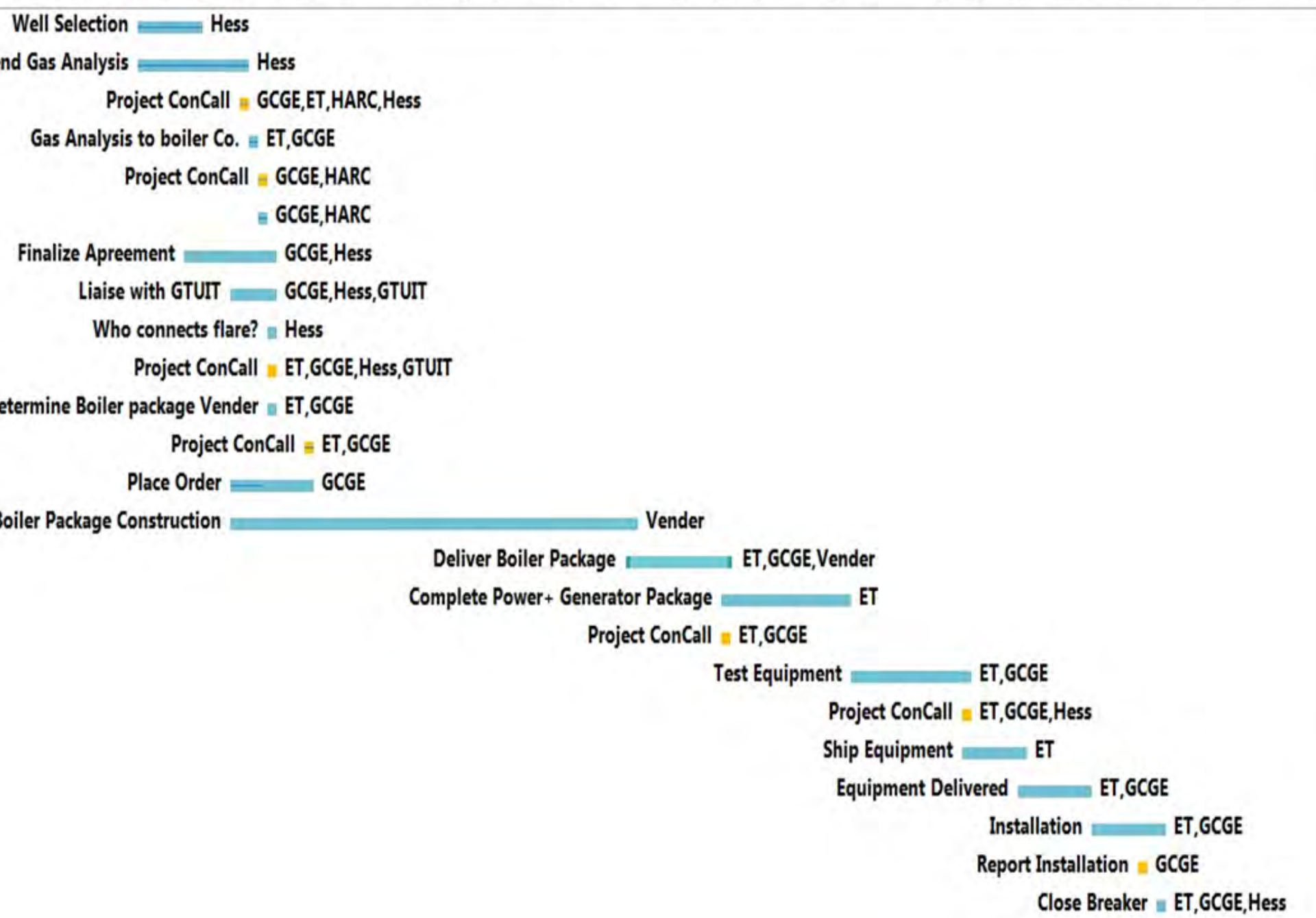
**Produce More Power & Reduce Cooling Fan Load**

Waste heat from engine jacket water or combination  
exhaust & jacket water

# Radiator with a Payback

- **Avoid** Radiator Expense on a Greenfield Project
- **Offset** ORC Capex by 20-30%
- **Decouple Engine from Cooling**  
Net Shaft H.P. to Engine = 5-6%
- **Value of kWe:**  
Instead of using power from the







# Key Takeaways

*What are the benefits of eliminating a flare?*

- *Flare is not burning*
- *Reduced emissions*
- *Compliance with state and Fed flaring requirements*
- *Methane optimization*
- *Renewable energy = potential incentives*
- *Added efficiency when Reciprocating engines used*



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