DIRECT CONTACT STEAM GENERATION (DCSG)

LOWER GHG ENHANCED OIL RECOVERY

CORPORATE PRESENTATION– Q1 2021

GERI HISTORY AND DCSG DEVELOPMENT

Robust design,
validated in the field

2014
Initial DCSG and
System Design

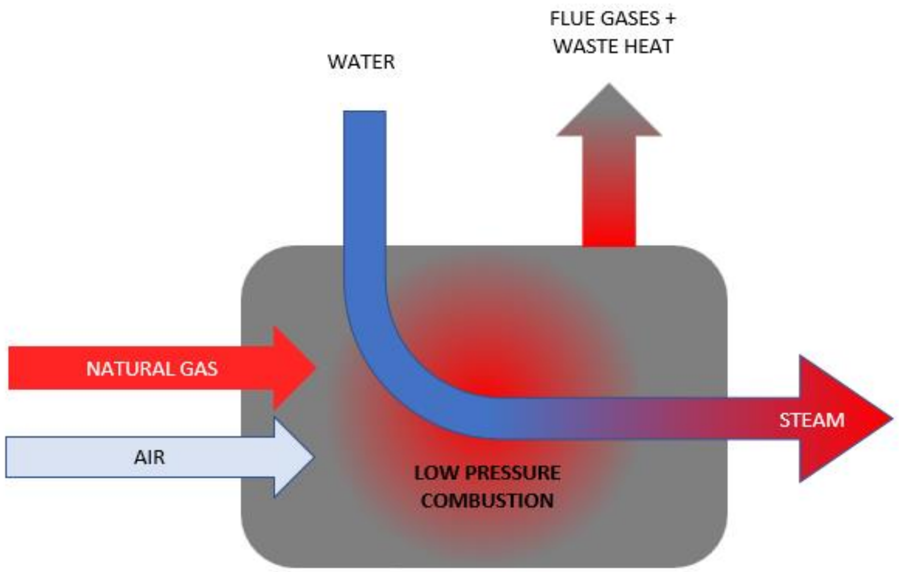
2015
Lab Testing
Early Field Tests

2016 - 2019
Field Testing

2020 - Commercial
Deployment

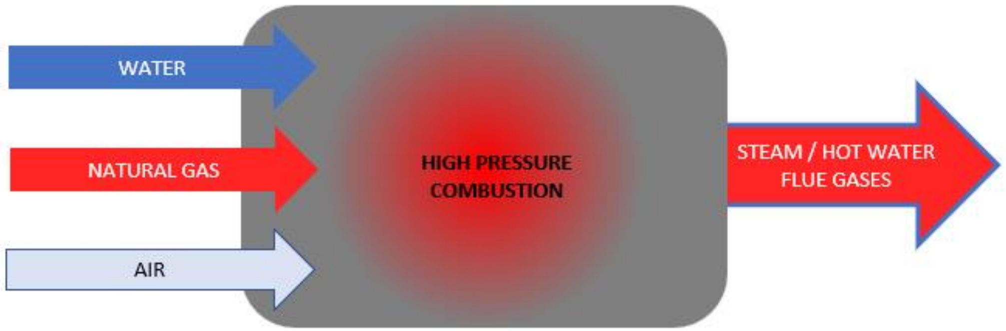
CONVENTIONAL STEAMING VS DIRECT CONTACT STEAM GENERATION

Conventional Steam Generation (OTSG)
Two Closed Flow System

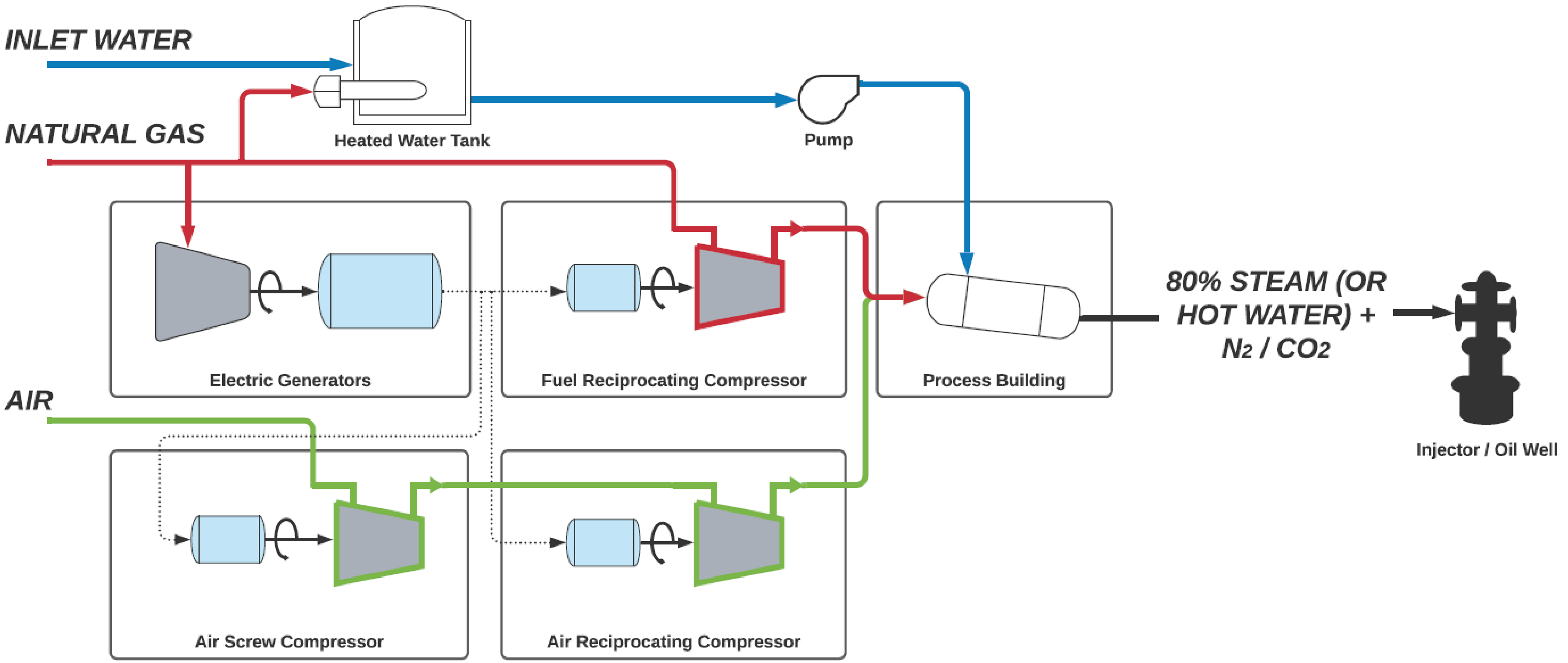


Direct Contact Steam Generation (DCSG)
Single Closed Flow System

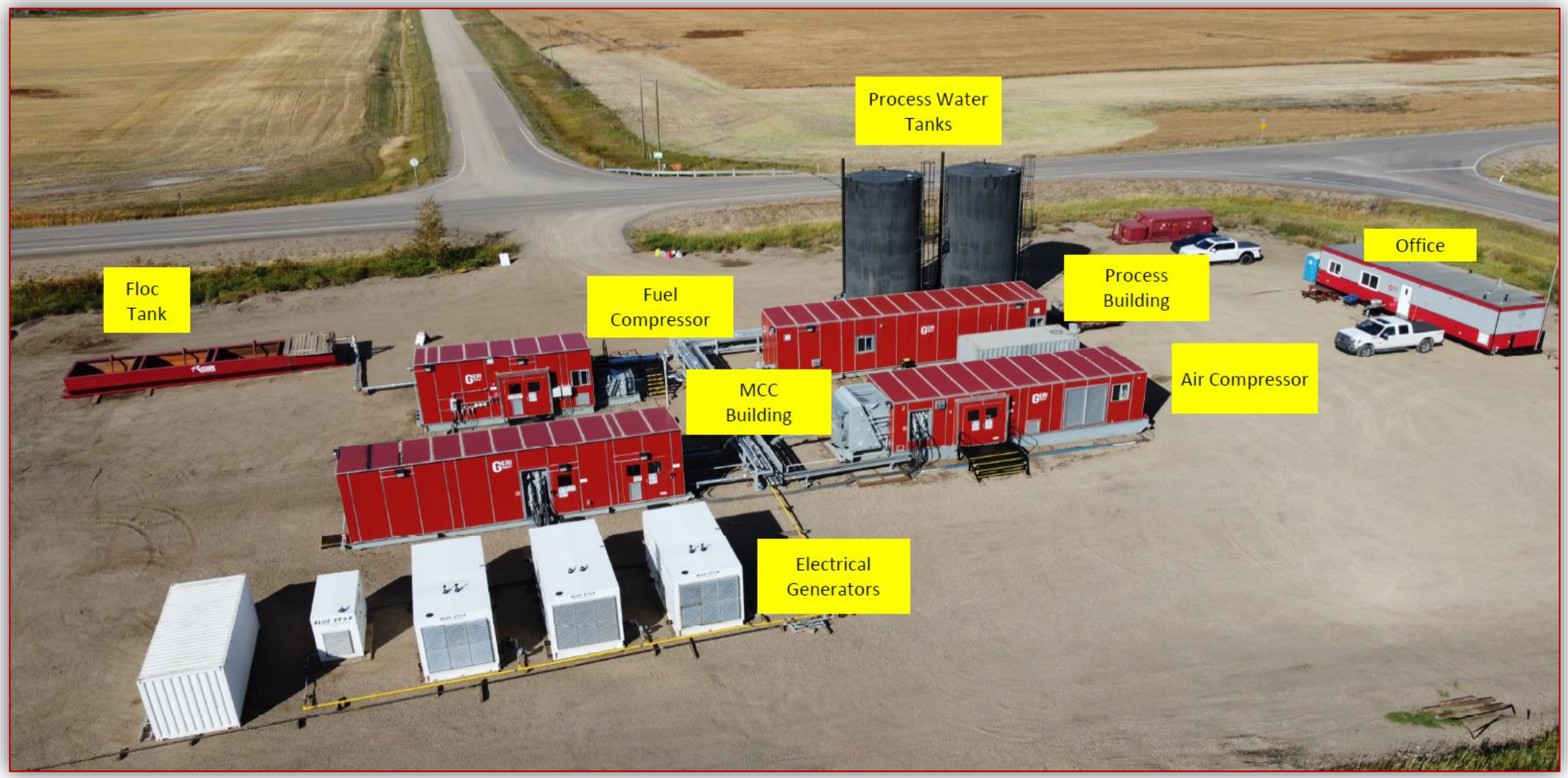
No Emissions To Atmosphere



DCSG PROCESS FLOW DIAGRAM



GERI DCSG PROCESS EQUIPMENT



GERI's DCSG fits within a standard well lease

DCSG TOOL PERFORMANCE TESTING - SEPT 2021

- Unit 2 Improvements
  - Move-in, setup, commission time/cost/manpower reduced by 20% (additional improvements forthcoming)
  - Sustained power level capability – 10.5 GJ/hour
  - Flexible, full-tested PLC/software enhancements ("commercial grade")
- DCSG Improvements (Steam-side)
  - Tested Tool Power Rate – 11 GJ/hour*
  - Projected Tool Power Rate – 12.5 GJ/hour
  - Increased component longevity
  - Steam Quality – 80%
  - Ignition → Full power time reduced from 45 minutes to 6 minutes
- DCSG Improvements (Hot-water)
  - Tests done with Produced water
  - Capability of 430 m3/day at 8.5 GJ/hour. Higher rates possible with minor Tool reconfiguration
  - No Tool scaling or wear & tear

Commercial Ready

* *Upper limit of site equipment/gas supply*

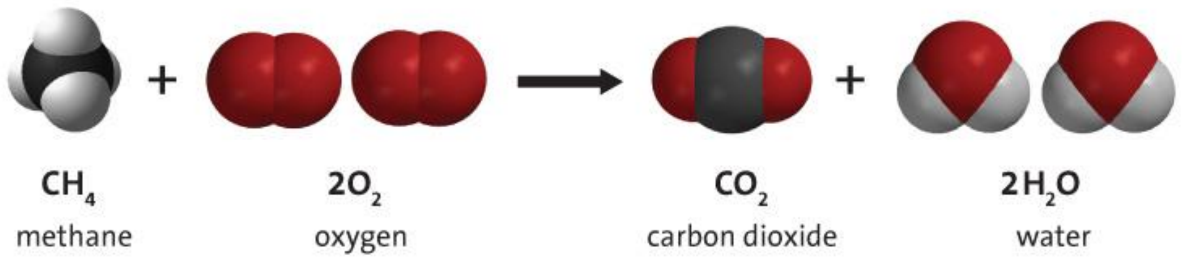
UNIT 2 CAPABILITIES

Injection Conditions			Inlet rates			Outlet rates		
Heat rate	10.5	GJ/hr	Water	86.4	m^3/d	N_2	52.0	e^3m^3/d
Pressure	7200	kPaa	Air	65.7	e^3m^3/d	CO_2	6.9	e^3m^3/d
Temperature	251	°C	Fuel	6.4	e^3m^3/d	Water (l)	19.6	m^3/d
						Water (v)	77.2	m^3/d
						Quality	80.0	%

DCSG BENEFITS

EOR – RESERVOIR (IMPROVED SOR)

- Reduced oil viscosity and improved relative permeability (Kr) to oil and gas through thermal heating (steam)
- Re-pressurization of reservoirs through N_2 and CO_2 injection
- CO_2 retention / sequestering within the reservoir (lower GHG emissions, oil swelling, viscosity reduction)

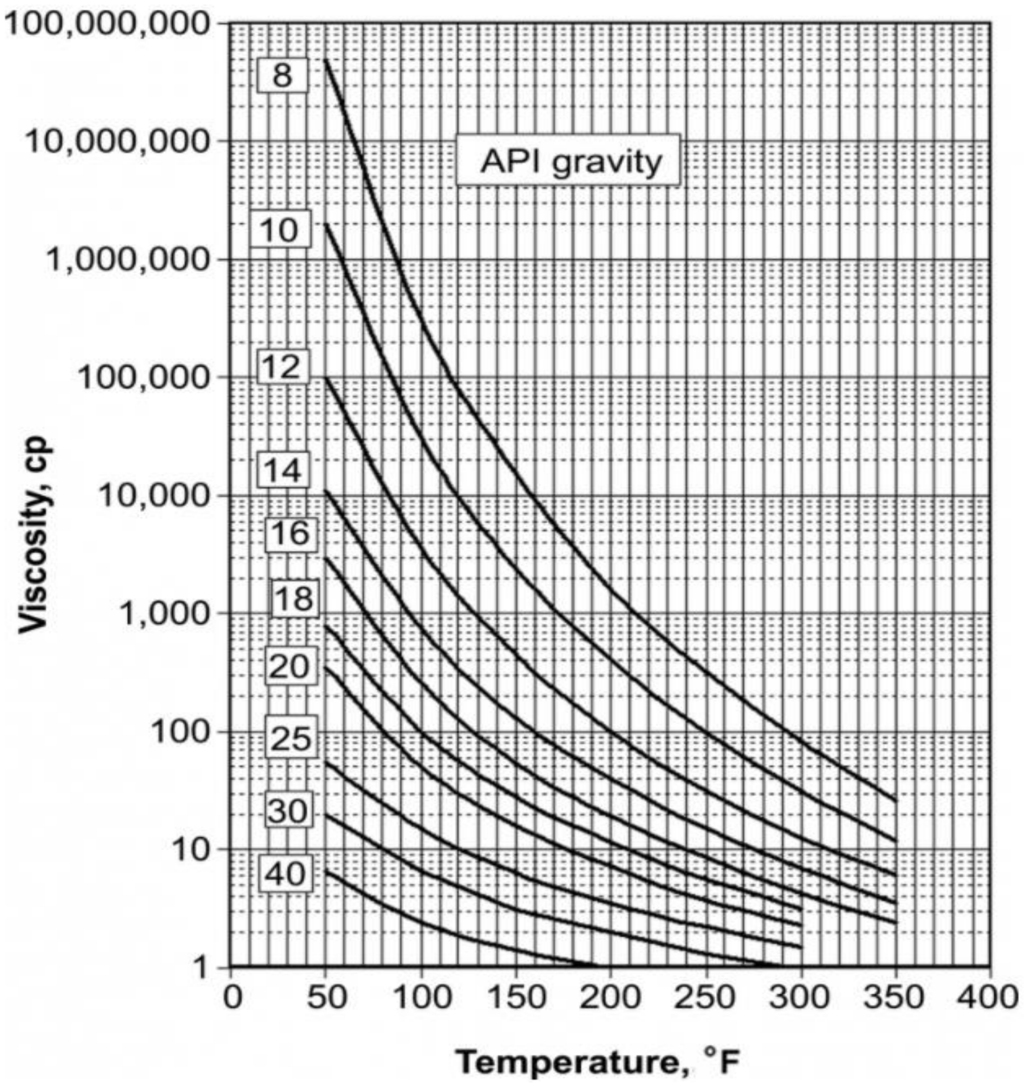


OPERATIONAL

- **Portable** and readily deployed to existing well leases
- Releases 16% - 65% fewer GHGs vs Once Through Steam Generation (OTSG)
- Consumes 11% - 50% less fresh water than OTSG
- Annular Cooling loop allows for steaming of non-thermal wells

OIL AND TEMPERATURE

- The viscosity of oil has a logarithmic relationship with temperature



A little bit of heat goes a long way!

GERI's technology adds pressure as well as heat

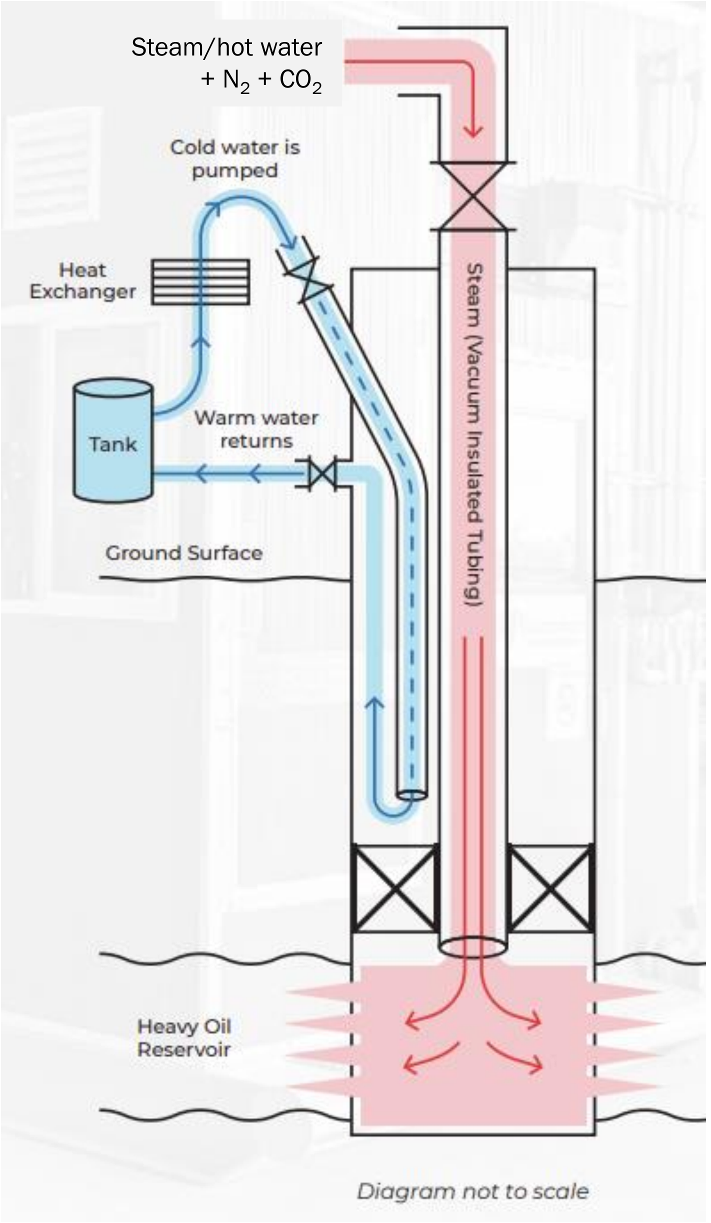
STEAM AND FLUE GAS STUDIES

Numerous studies and field implementations have shown that flue gas materially improves oil recovery

- AN EOR APPLICATION @ LIAOHE OIL FIELD IN CHINA - May 2001
  - Flue gas injection in combination with steam increases overall recovery factors from 20%-30% to 50%-60%
- TECHNICAL AND ECONOMIC FEASIBILITY STUDY OF FLUE GAS INJECTION IN AN IRANIAN OIL FIELD - July 2015
  - Flue gas increases oil recovery by 11%
  - Flue gas recovery is also greater than CO_2 injection and N_2 injection when the same amount of CO_2 and N_2 present in the flue gas is injected separately
- LABORATORY STUDY ON STEAM AND FLUE GAS CO-INJECTION FOR HEAVY OIL RECOVERY – SPE 165523 – JUNE 2013
  - Flue gas helps keep the pressure behind the front more stable
  - Co—injection of steam with flue gas accelerates the start of oil production, with recoveries up to 79%
- FLOW CHARACTERISTICS OF STEAM AND GAS PUSH IN PRESENCE OF THIEF ZONES OVERLYING OIL SANDS DEPOSITS – APPLIED SCIENCES MDPI – SEPT. 2017
  - Nitrogen in flue gases can act as an insulating layer at the top of the formation limiting steam chamber growth into thief zone

GERI ANNULAR COOLING LOOP*

- Injection stream from 90°C - 240°C
- Provides the ability to steam non–thermally cased and cemented wellbores
- Testing** has shown maximum annular temperatures of 60º C (typical operating range 30°C -45º C)
- Operates as a closed loop water system with the ability to add additional cooling water if necessary



* Patent Pending
** Observed in our Lloydminster Pilot Projects

GERI'S DCSG INJECTIONS – WELL PERFORMANCE TO DATE

5-20-49-27W3, Lloydminster, Saskatchewan, Canada – Vertical Well,

- 2 cycles @ 4.5 MMBTU/hr for 20 days/cycle
  - Average injection pressure ~ 825 psi
  - Steam Quality 65%

Mervin area, Saskatchewan, Canada – Vertical Well

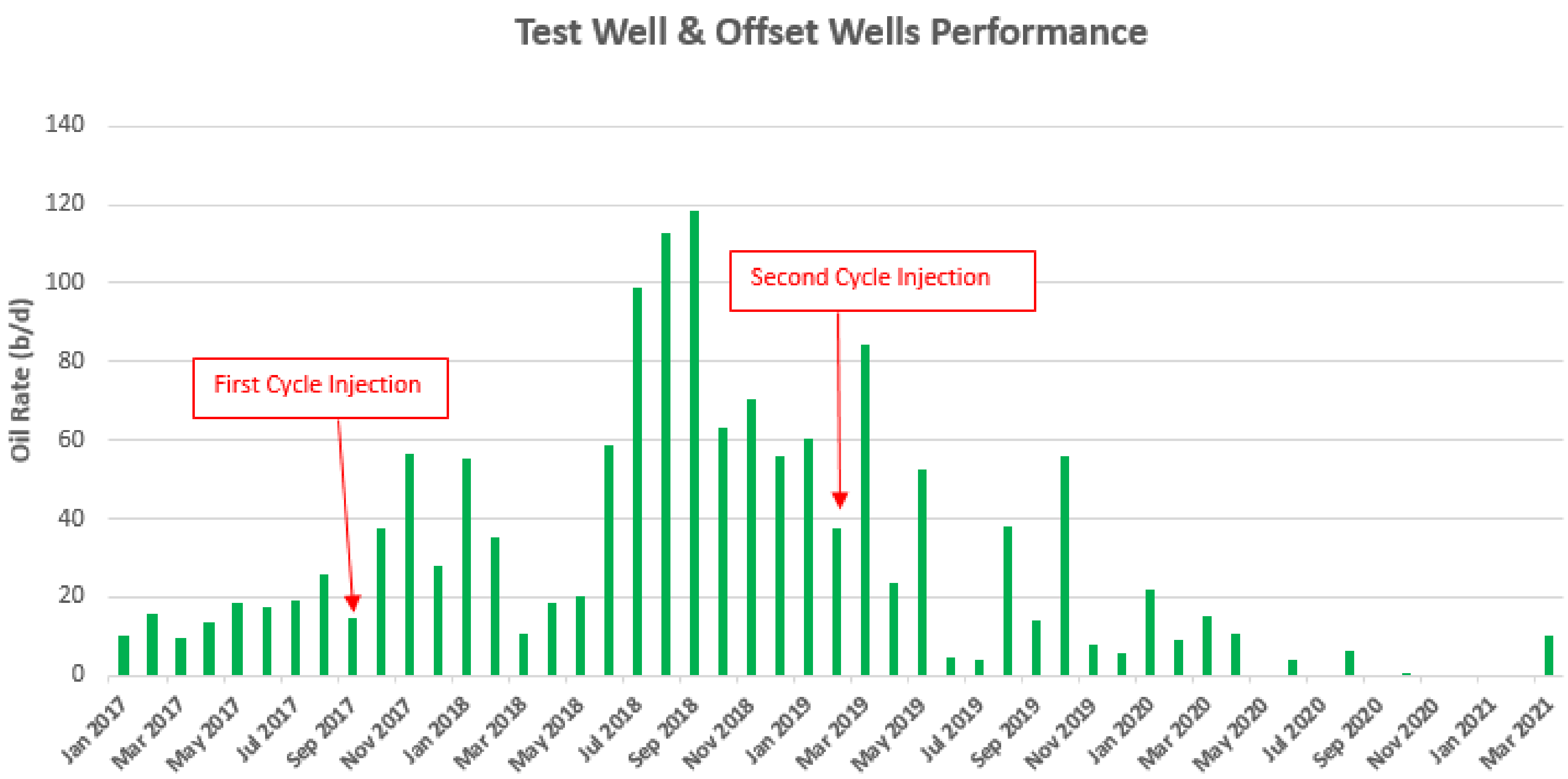
- 1 cycle @ 6 MMBTU/hr for 20 days
  - Average injection pressure ~ 800 psi
  - Steam Quality 65%

Morgan area, Alberta, Canada – Horizontal Well

- 1 cycle @ 8.3 MMBTU/hr for 18 days
  - Average injection pressure ~ 725 psi
  - Steam Quality 72-84%

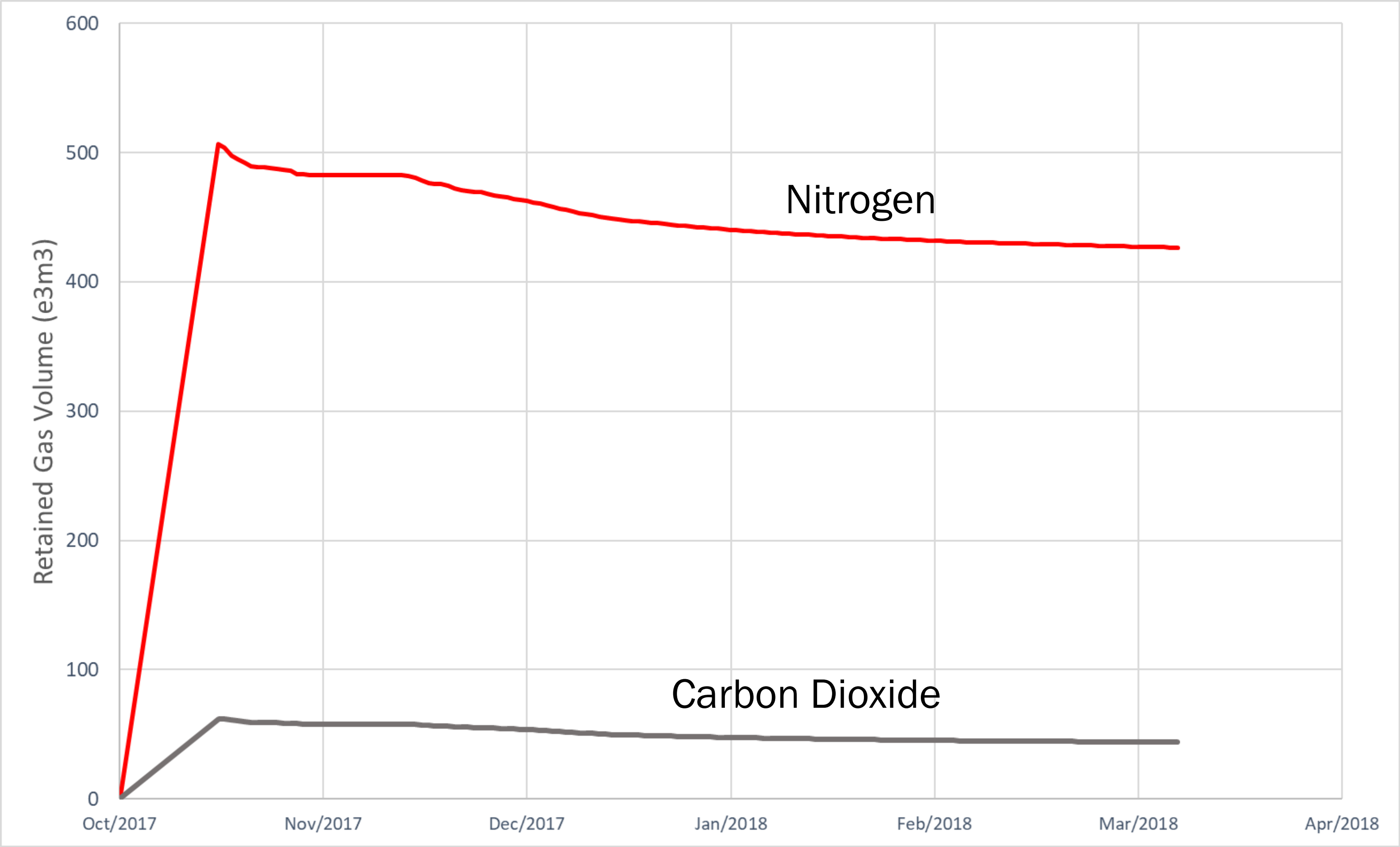
Field tested in Sparky, Waseca, and Lloydminster formations (API range 11 – 16, and oil viscosity range 2,000 cp – 25,600 cp)

5-20-49-27W3 AREA PRODUCTION RESULTS



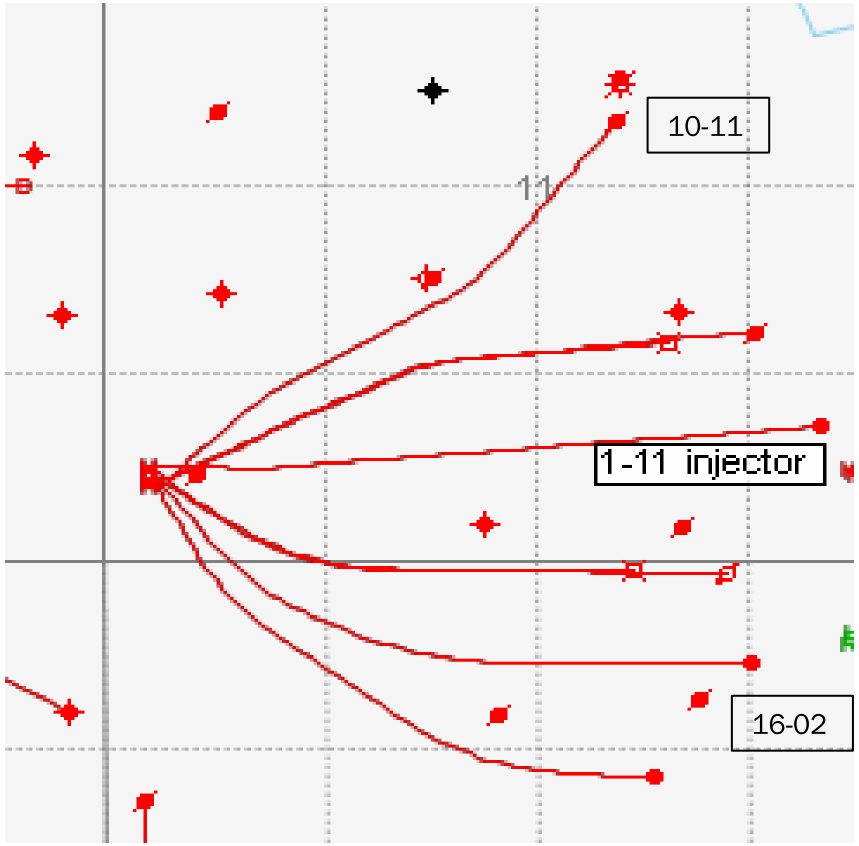
- Total of 18,000 bbls of incremental oil production from two cycles
- Cum SOR of 0.58 (independently verified by Saskatchewan Research Council)

5-20-49-27W3 WELL – FIRST CYCLE
GAS RETENTION / SEQUESTERING



70% of the CO_2 has been sequestered

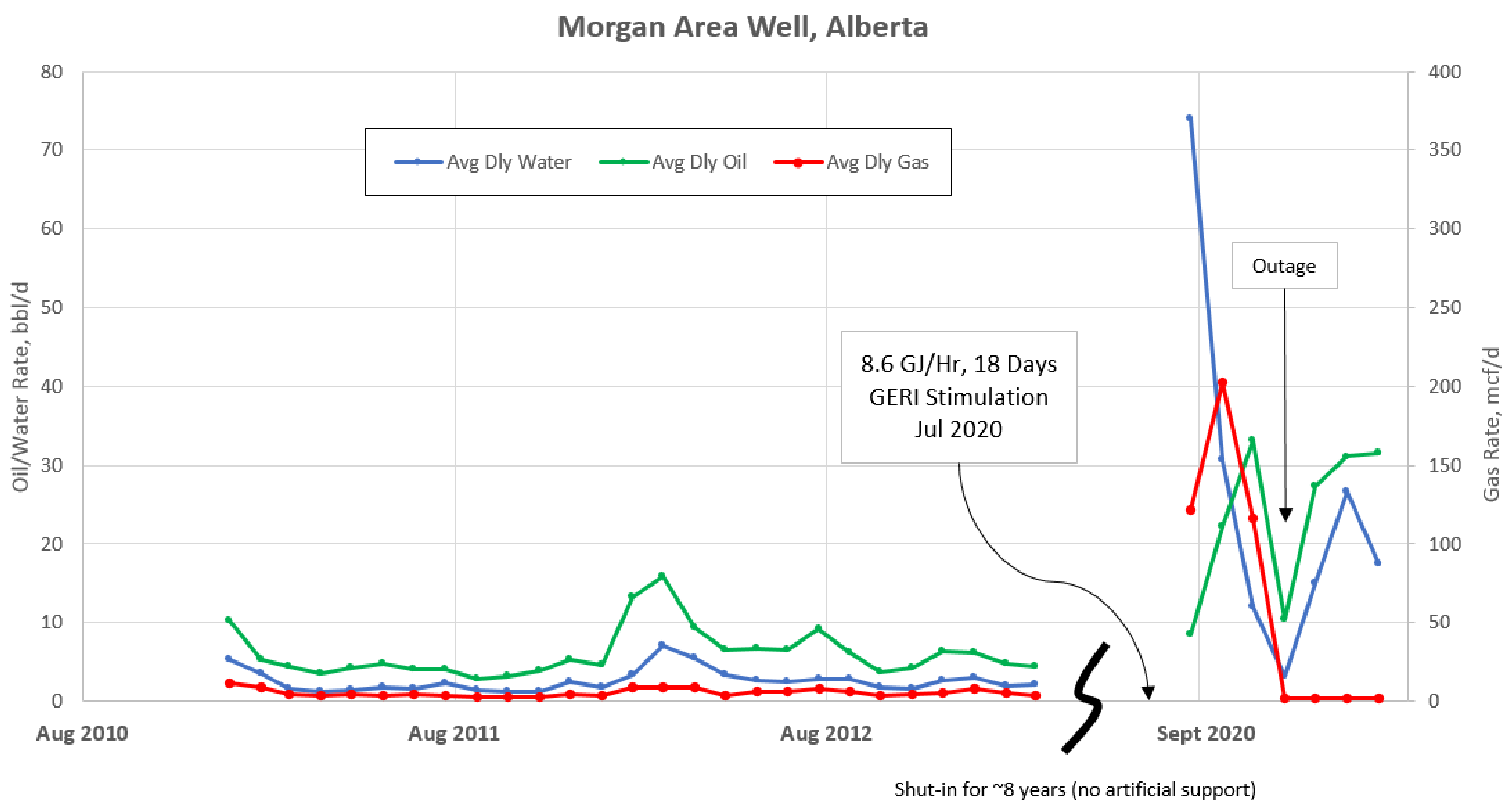
MORGAN PROJECT AREA



- SOR = 3.19 (Pilot well only)
- SOR = 1.55 (Offset wells included)
- Production up to October 2021 from AccuMap

* 10-11 and 16-02 were restarted to capture benefits from offset production

MORGAN AREA PRODUCTION RESULTS



GHG QUANTIFICATION AND MITIGATION

GHG evaluation addresses two distinct sources of emissions:

- GERI's DCSG direct emissions
- Well (production) emissions

GERI is committed to exceeding regulatory GHG requirements and goals

GERI: CARBON INTENSITY (CI)

- Study compares carbon from different Electrical sources.
- GERI's DCSG (using natural gas generation) resulting in up to 67% carbon intensity reduction vs. OTSG.
- Even at equal SOR, **GERI's GHG intensity is at least 16% lower (vs. once-through steam generation)**

	Source of Electricity Consumed			
	Natural Gas (gen.)	Alberta Grid	Good-as-best-gas	Solar
	t CO_2e/mbbl			
Project - GHG Emissions[1]	36	37	25	11
Baseline - GHG Emissions[2]	108			
Total GHG Emission Reductions (kg CO2e/bbl produced)	72	71	83	97
% Emissions Reductions @ SOR = 3.0	17%	16%	42%	74%
% Emissions Reductions @ SOR = 1.2	67%	65%	77%	90%

1 Project SOR= 1.2

2 Baseline SOR= 3.0

According to Orellana et.al. (Environ Sci Technol, 2018 Feb) the estimated median GHG emissions associated with bitumen production via cyclic steam stimulation (CSS) to be 77 kg CO_2eq/bbl bitumen (80% CI: 61-109 kg CO_2eq/bbl), and via steam assisted gravity drainage (SAGD) to be 68 kg CO_2eq/bbl bitumen (80% CI: 49-102 kg CO_2eq/bbl).

PRODUCER: CARBON INTENSITY (CI)

- Emissions as a result of Production.
- Nitrogen and Carbon Dioxide returned in associated gas produced.
- **A wide variety of scenarios depending on the location, equipment and mitigations strategy:**

GOR	N_2 Conc ($+CO_2$)	Methane Conc.	Carbon Intensity			
			Gas gathered to sales	Methane destruction (Thermal Oxidation)	Supplemented flare	Gas vented
scf/bbl	%	%	t CO_2e / mbbl	t CO_2e / mbbl	t CO_2e / mbbl	t CO_2e / mbbl
500	98	2.5	0	25.7	636.7	642.9
500	90	10	0	25.7	146.9	642.9
500	80	20	0	25.7	65.3	642.9
500	70	30	0	25.7	38.1	642.9
500	60	40	0	25.7	25.7	642.9
500	0	100	0	25.7	25.7	642.9

- **GERI is capable of analyzing CI for specific projects and assisting in implementing the best solutions.**

This table considers CO_2 emissions associated from methane venting/combustion only and does not include returned CO_2 in the produced stream

ADDITIONAL ENVIRONMENTAL BENEFITS

- GERI's DCSG uses less than half the fresh water compared to once-through steam generators (at 80% steam quality). At equal SOR, GERI requires 11% percent less water
- Air Quality (CACs): GERI's DCSG emits >50% less air pollutants (NOx SOx, PM2.5, VOC, CO) vs conventional steam process

- GERI can utilize produced water for hot water flooding (0% steam quality). Successfully tested with up to 10,000 ppm TDS