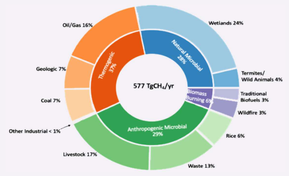
OXIPERATOR

The Solution for Weak Methane

DE-FOA-0002616 iM4 Technologies
DOE OFECM NETL Award Number: DE-FE0032286

Carnegie Mellon University · Colorado State University · UC Davis University of California · Prabhu Energy Labs · U.S. Department of Energy · National Energy Technology Laboratory

"Methane is a ripe target for climate action because it traps 84 times more heat than the same amount of CO2 over 20 years. Methane has more than doubled since preindustrial times and accounts for about half the 1.1°C of global warming to date." – Science.org (2 Nov 2021)



More than half of annual global methane emmissions are "weak", escaping at concentrations far too low to ignite, less than 2%

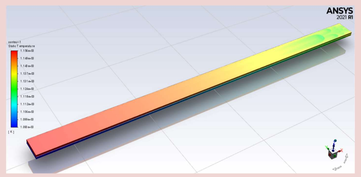
This NETL-funded project will demonstrate oxidation of methane slip from a lean burn engine. There are fifty thousand such large lean burn engines in the US.

The Design and Engineering of 100cfm Prototype

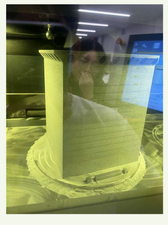
Heat transfer calculations provided by Czero utilizing Thole Corr.

Ansys Fluent/Chemkin simulations, flow distribution CFD, and CAD design by UC Davis

3D additive manufacturing engineering by Carnegie Mellon and Kaiser Aluminum



3D Printing with High Temperature Alloys



3D print with Haynes® 282® alloy of reactor provided by Carnegie Mellon

3D print with Inconel® 625 of recuperator done by Kaiser Aluminum

The Team

KAISER ALUMINUM
Mike Begarney, PhD — Chief Scientist — 3D Printing

Czero
Chris Turner, PE — VP of Engineering — Engineering Support

Prabhu Energy Labs
Edan Prabhu — CEO and founder
Monica Prabhu — Commercialization & Communications
Robinson Huang — Project Manager

American Bureau of Shipping
Xi-Ying Zhang, PhD — Sr. Engineer — Future

Colorado State University
Daniel B. Olsen, PhD — Professor Mechanical Engineering
Andrew Huonder — Graduate Research Assistant — Engine Testing

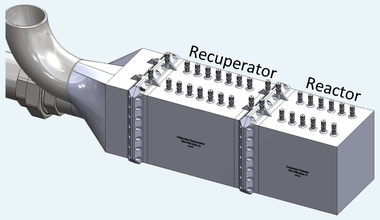
UC DAVIS
Vinod Nrayanan, PhD — Professor Mechanical Engineering
Aref Aboud — R&D Engineer
Harsimar Kullar — Graduate Student
Timothy R. Levering — R&D Engineer
Yongjing Zhao, PhD — Project Scientist
Testing (CalTestBed funded)

UC DAVIS
Vinod Nrayanan, PhD — Professor Mechanical Engineering
Erfan Rasouli, PhD — Associate R&D Engineer
Ines-Noelly Tano — Graduate Student
Oxiperator Design (NETL funded)

Carnegie Mellon University
Anthony Rollett, PhD — Professor Material Science & Engineering
Nicholas Lamprinakos — Research Assistant
Junwon Seo — Graduate Student
Milly Yu-Tsen Yi — Graduate Student
Metallurgy and 3D Printing

Sub-Awardee · Sub-Awardee · CalTestBed · Sub-Awardee · Sub-Awardee

Developing the world's only self-sustaining oxidizer capable of destroying weak methane at concentrations as low as **0.3%**



NO additional fuel

NO catalyst

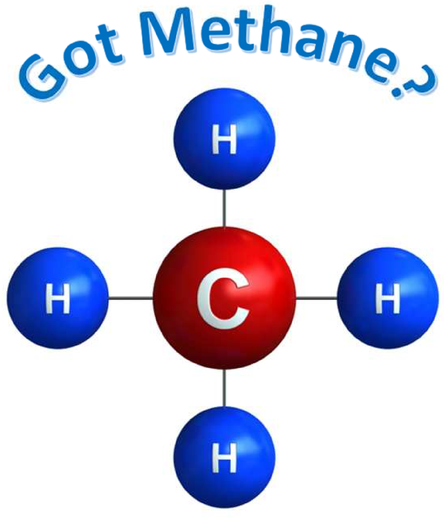
Power from only 1.5% methane in air

Our Mission

To be the world leader in harnessing weak methane emissions

Our Vision

If just 10% of wetlands methane could be tapped, the power generated would exceed all wind and solar



Special Thanks to all our industry supporters and partners:

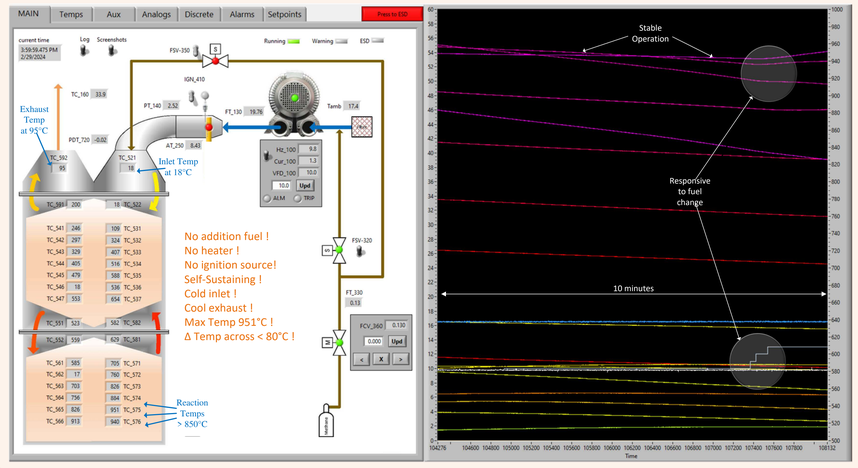
PTAC Petroleum Technology Alliance Canada · CCIA Colorado Cleantech Industries Association · NGIF Industry Grants · Alberta Upstream Petroleum Research Fund · CalTestBed · Global Methane Initiative

The Testing

Oxiperator tests carried out at Western Cooling Efficiency Center's STEEL testing facility at UC Davis.

Test conducted on Feb 29, 2024, demonstrated stable Oxiperator operation at **0.5%**, with evidence for success at lower concentrations (see HMI below)

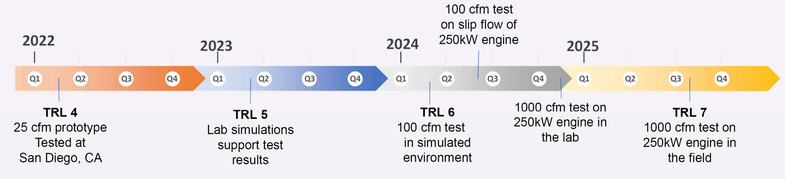
Current modifications to Oxiperator being implemented for upcoming tests targeting operation at 0.3% CH4 concentration



Next Steps

Test 100cfm Oxiperator on exhaust slip stream of a Cummins QSK19G lean-burn engine at the Colorado State University's Engine & Energy Conversion Laboratory

Scale up to 1,000 cfm, 3,000cfm, 10,000 cfm, and more for larger lean burn engines



Industries and Methane Emission Sources

Oil & Gas :	methane slip from lean-burn engine slip, flares, abandoned wells, vented gas
Coal :	mine ventilation air methane (VAM), drainage, abandoned mine methane
Waste :	landfill gas (LFG), waste water treatment emissions, anaerobic digesters
Wetlands :	marshes, swamps, permafrost, lakes

Renewable Power from 1.5% or stronger methane by combining with a gas turbine