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CHANGING WHAT'S POSSIBLE

REDEMY—Reducing Emissions of Methane Every Day of the Year

PROJECT DESCRIPTIONS

Massachusetts Institute of Technology – Cambridge, MA

Ventilation Air Methane Abatement via Catalytic Oxidation (VAMCO) with Machine-Learning Enhanced Sensing and Feedback Controls - $2,020,903

The Massachusetts Institute of Technology aims to develop a technology that will reduce methane emissions from ventilation air methane associated with coal mining. The complete system will include an inexpensive, abundant catalyst incorporated in a structure to enable high-flow rates in ventilation air, a new reactor design, and computer-enhanced sensor capabilities and controls to quantify emission reduction and ensure consistent operation. The unit can operate at much lower temperatures than competing technologies. Heat generated by the destruction of methane could be used to generate electricity at power-plant levels, offsetting operating costs and providing estimated payback periods from 6-11 years.

Marquette University – Milwaukee, WI

Prechamber Enabled Mixing Controlled Combustion of Natural Gas for Ultra-Low Methane Emissions from Lean-Burn Engines - $3,975,058

Marquette University will enable an innovative combustion technology for lean-burn (high air-fuel ratio) natural gas engines to potentially reduce the amount of methane slip – or methane in the inlet fuel stream that escapes to the atmosphere – to 0.25% of the inlet fuel stream. The 0.25% target would represent a 90% reduction from current levels. The best way to reduce methane slip is to avoid premixing the fuel and intake air. The proposed system aims to achieve a non-premixed, mixing-controlled combustion process with natural gas in a lean-burn engine through an actively fueled prechamber. This system could be retrofitted to existing lean-burn engines or as a new engine technology.

University of Minnesota – Minneapolis, MN

Plasma-assisted In-situ Reforming of Flare Gases to Achieve Near-Zero Methane Emissions - $2,141,876

The University of Minnesota aims to develop a non-thermal, low-temperature, plasma-assisted system for small, unmanned pipe flares. Flares safely dispose of waste gases by burning them under controlled conditions. The new system will incorporate in-situ flare gas reforming (i.e., reactive intermediate species production, such as hydrogen, acetylene, etc.), ignition, and flame stabilization. This plasma system is ideal for infrequently maintained pipe flares operating in remote sites due to its low cost, easy implementation, minimal maintenance, and low operating energy resulting from the plasma running on a solar-powered battery. The proposed technology will improve flare destruction and removal efficiency to ≥ 99.5% and eliminate 3.8–15.1 million metric tons of CO2 equivalent methane emissions per year from flare operation, representing a 28–72% reduction of existing emissions.

Cimarron Energy Inc. – Houston, TX

Flare and Control for Ultra High Destruction and Removal Efficiency - $1,000,000

Cimarron Energy Inc. aims to develop a cost-competitive flare and control system to achieve over 99.5% methane destruction and removal efficiency (DRE) from the current 98% DRE. The proposed system will include a novel flare apparatus to overcome all observed difficulties in achieving high DRE for flares, a microprocessor based electronic controller, and flow meters for high-pressure and low-pressure flare gas streams sent to the flare. The proposed system and its components can be integrated with the majority of flares used in upstream oil and gas production sites.

INNIO Waukesha Gas Engines – Waukesha, WI

Ultra Low Methane Slip Reciprocating Engine - $2,230,693

INNIO's Waukesha Gas Engines aims to develop new technology that will reduce methane slip by reducing the crevice volume in engine combustion chambers. This will broadly apply to all natural gas fueled lean burn engines, and can be retrofitted to a fleet of existing engines with little to no increase in budgeted costs. Emissions of regulated pollutants such as carbon monoxide, volatile organic compounds, and formaldehyde will be reduced, while nitrogen oxides will stay the same. This means no emissions re-permitting will be necessary after installation. The new technology will reduce operating costs and is similar to existing components, meaning no retraining will be required for support technicians.

Johnson Matthey – Audubon, PA

Catalytic Oxidation of Ventilation Air Methane- $4,346,015

Johnson Matthey is developing a Catalytic Oxidation METhane (COMET™) technology to address methane emissions from underground coal mine ventilation air methane (VAM) sources. The team will use cost-effective technology to achieve over 99.5% methane conversion efficiency at temperatures below 1112 ºF for methane concentration in the range of 0.1-1.6%, representing nearly all VAM sources in the U.S. Johnson Matthey will construct and install a demonstration unit that incorporates all safety features and monitoring equipment at an active underground coal mining site to validate the technology. The system's design will be modular and can be readily scaled up to 100x+ to attain commercial sizes.

Texas A&M Engineering Experiment Station – College Station, TX

Reducing Emission of Methane through Advanced Radical Kinetics and Adaptive Burning in Large Engines (REMARKABLE) - $2,824,814

Texas A&M seeks to reduce methane emissions from compressor station natural gas (NG) engines by improving lean-burn operation, thereby reducing exhaust methane and CO_2 emissions and maintaining low criteria pollutant emissions. The project team will develop a nanosecond non-thermal plasma-based ignition system capable of generating radicals, ions, and highly reactive intermediate species that result in rapid self-sustaining combustion, and a cyclic combustion control strategy that predicts and mitigates partial-fire and misfire cycles. The proposed work will demonstrate a working, field-tested, prototype plasma ignition system and model-based, feedforward combustion control system that would be transformative for large NG engines with potential for large-scale market adoption.

University of Michigan – Ann Arbor, MI

REMEDY using SABRE (Reducing Emissions of Methane Every Day of the Year using Systems of Advanced Burners for Reduction of Emissions) - $2,881,762

The University of Michigan proposes a novel system approach using state-of-the-art methods to eliminate methane emissions from oil and gas (O&G) flares, vents, and other equipment. The project will quantitatively characterize high- and low-volume methane sources at an actual O&G field site and demonstrate technology for their high-efficiency (>99.5%) methane conversion. This approach leverages site resources and customizes flare technology to match local equipment needs. The system is based on developing and demonstrating novel burner concepts to meet a range of gas conditions at O&G sites, including high- and low-pressure sources of methane emissions, high and low volumetric flow rates, and changeable wind speeds.

MAHLE Powertrain – Plymouth, MI

Methane Oxidation Catalysts for Lean-burn Natural Gas Engines - $3,257,089

MAHLE Powertrain aims to develop a complete aftertreatment package system for existing lean- and ultra-lean burn natural gas (NG) engines used for power generation. The system will significantly increase methane conversion efficiency and comply with future stringent nitrous oxide regulations. The project team's technology will consist of a novel methane oxidation catalyst (MOC) formulation capable of high conversion efficiencies at the lower exhaust temperatures in ultra-lean burn engines. Typical MOCs have diminished methane conversion efficiency at low temperatures, limiting their synergies with ultra-lean burn NG engines. The proposed MOC will use a hydrothermally stable formulation to promote high conversion efficiencies in low-temperature and high-water concentration environments.

Colorado State University – Fort Collins, CO

Lean-burn Natural Gas Engine System to Achieve Near-zero Crankcase Methane Emissions from Existing and Future Engine Fleet- $1,500,000

Colorado State University will develop technology to reduce methane emissions from lean-burn natural gas engines by reducing methane ventilation through the crankcase. Methane that leaks past the ring and valve seals during compression and combustion enters the crankcase and is usually vented to the atmosphere. The team proposes a system that would capture the crankcase methane, filter it, and reroute it back to the engine intake where it would be re-ingested and combusted. This would simultaneously reduce methane emissions and improve engine efficiency.

Precision Combustion – North Haven, CT

Destruction of VAM Using a Modular Catalytic Element System - $3,720,317

Precision Combustion proposes an innovative modular array to eliminate the release of ventilation air methane associated with coal production. Their technology combines (1) a short contact time, low thermal mass reactor design to achieve maximal total conversion in a small volume, (2) catalyst formulation and loading to minimize the required operating temperature of the catalytic oxidation, and (3) system design and architecture to maximize the degree to which released heat is retained and recirculated among elements. Computational fluid dynamics and thermal modelling will be used to optimize the modular structure to maximize heat transfer through conduction and from solid to gas.

Advanced Cooling Technologies – Lancaster, PA

Swiss-roll Flare Gas Incinerator - $3,300,000

Advanced Cooling Technologies (ACT) aims to scale up and improve a Swiss-roll combustor – or a combustor inside a spiral heat exchanger – for industrial flare applications. Standard flare burners allow approximately 2% of methane to slip into the exhaust. The Swiss-roll combustor recovers heat from the combustion products to fully combust the flare gas. The reactants' excess heat content significantly extends the range of flammable mixtures to provide a net methane reduction. ACT's complete solution will include an additively manufactured core and all required support equipment. A novel 3D printing method will be used to produce large-scale, complex geometry in a composite material that can withstand temperatures over 2500ºF.