



Greenhouse Gases EPA

2015 Performance Update

October 21, 2015





Polling Question

GHG EPA 2015 Achievements



- ✦ Launched Technology Working Groups aligned with key opportunity areas, allowing members to focus resources and launch projects.
- ✦ Advancing GHG emission reduction technologies in each opportunity area, including:
 - Molten Carbonate Fuel Cell,
 - Novel Carbon Capture technologies, and
 - Natural Gas De-carbonization.
- ✦ Seeking new emission reduction technologies through the use of new innovation tools, including:
 - NRG COSIA Carbon XPRIZE,
 - ‘ARCTIC Challenge Sprint’ for heat recovery technologies,
 - Mining and Extraction Reference Facility, and
 - New COSIA Challenge - Hot Water Production for Mining and Extraction

Greenhouse Gases EPA Ambition



Our Aspiration is to strive to...

Produce our oil with lower Greenhouse Gas emissions than other sources of oil.



Photo credit: Cenovus



Photo credit: Imperial

Greenhouse Gases EPA Opportunity Areas

Mining Opportunity Areas:

- Fugitive emissions, and
- Energy efficiency, Fleet, and Materials handling.

In Situ Opportunity Areas:

- Energy efficiency, and
- Steam demand reduction.

Cross Cutting Opportunity Areas:

- Carbon capture, storage and conversion; and,
- Low carbon heat and power.



EPA Portfolio Update



Category	Number	Cost
Completed projects in 2015	12	\$1.3M
New projects in 2015	16	\$19.6M
Total active projects in 2015	15	\$44.7M
Completed projects to date	21	\$2.9M
New technologies shared in 2015	17	\$45.3M
Technologies shared to date	133	\$245M

CO₂ Capture, Conversion and Storage

2015 CO₂ Capture, Conversion and Storage Activity

New: 3	Active: 3	Completed: 3
Value: \$17.8M	Value: \$37.65M	Value: \$369k

Successes

- Identified promising CO₂ capture technologies from hydrogen syngas, including supersonic anti-sublimation of CO₂.
- Launched NRG COSIA Carbon XPRIZE.
- Shell's Quest Carbon Capture Project completes CO₂ injection well tests, and official start-up to be celebrated in November.
- Completed studies on oxygen production and oxygen enrichment.

Learnings

- Early stage post combustion carbon capture technologies have the potential to reduce CO₂ capture cost.
- Oxy combustion requires continued research and development to reduce costs.

Future Opportunities

- Continue to advance transformative post combustion capture technologies.
- Conversion of CO₂ into useful products.



Low Carbon Heat and Power

2015 Low Carbon Heat and Power Activity

New: 2	Active: 1	Completed: 1
Value: \$529k	Value: \$450k	Value: \$79k

Successes

- Initiated engineering of 200 kilowatt molten-carbonate fuel cell with flue gas from steam generation.
- Investigated Natural Gas De-Carbonization to produce solid carbon for sequestration and carbon-free fuel for steam generation.

Learnings

- Molten-carbonate fuel cells have the potential to generate clean power, clean heat, and pure CO₂ suitable for sequestration, efficiently and cost effectively.
- Removing the carbon from natural gas before combustion should be pursued as a possible carbon capture technology.

Future Opportunities

- Accelerate the development of molten-carbonate fuel cells with carbon capture technology.
- Advance early stage natural gas de-carbonization technologies.
- Identify and advance other promising low carbon heat and power technologies, including:
 - biomass gasification to synthetic natural gas.



In Situ Energy Efficiency



2015 In Situ Energy Efficiency Activity

New: 9	Active: 3	Completed: 6
Value: \$1.2M	Value: \$1.1M	Value: \$679k

Successes

- Major focus on value added use of both low grade (60-80°C) and higher grade (200°C) heat.
- Advanced Resource Clean Technology Innovation Centre (ARCTIC) Challenge Sprint for Heat Recovery launched in October.
- Identified emerging technologies for low grade waste heat recovery.

Learnings

- Waste heat recovery technologies do exist, however commercial technologies are capital intensive and novel technologies are very early stage or challenging to integrate.

Future Opportunities

- Pilot new waste heat technologies, including technologies to recover both heat and water from combustion flue gas.
- Deliver efficiency improvements by sharing energy efficiency best practices between COSIA members.

Mining Area Fugitive Emissions

2015 Mining Area Fugitive Emissions Activity

New: 3	Active: 2	Completed: 1
Value: \$1.2M	Value: \$1.14M	Value: \$185k

Successes

- Two workshops held with industry and multi-stakeholder subject matter experts to share research and project results for quantifying area fugitive emissions.
- Testing of new monitoring technologies and approaches at a COSIA member company site.
- Project underway to demonstrate satellite-based monitoring in 2016.
- Initiated study of unmanned aerial vehicles (UAV) integrated with ground-based sensors.

Learnings

- Approximately 30 known technologies across five different platforms to quantify fugitive emissions from area sources, each with its own benefits and drawbacks.

Future Opportunities

- Identify and demonstrate technologies that quantify fugitive emissions continuously with high accuracy, repeatability and reproducibility.
- Identify and demonstrate technologies that reduce fugitive emissions from mine faces and tailings ponds.



Mining Energy Efficiency, Fleet and Materials



2015 Mining Energy Efficiency, Fleet and Materials Activity

New: 3	Active: 3	Completed: 2
Value: \$223k	Value: \$4.4M	Value: \$198k

Successes

- Mining and Extraction Reference Facility available. Energy and material balance for a 200,000 bpd bitumen production
- New Hot Water Challenge released,
- Bi-fuel heavy haul trucks pilot underway, to quantify the benefits of LNG verses diesel.
- Study launched to identify alternative lower-energy ore handling technologies.

Future Opportunities

- Identify alternatives to existing hot water production technologies.
- Feasibility assessment of ore handling alternatives.
- Identify opportunities to reduce GHG emissions from mine fleet.
- Deliver efficiency improvements by sharing energy efficiency best practices between COSIA members.

New COSIA Challenge: Hot Water Production

- Seeking Hot Water Production technologies that:
 - Directly produce commercial scale (5,000 to 10,000 cubic metres per hour) of 40-90 °C hot water without using existing (or new) steam resources for heat exchange purposes.
 - Target up to 25 per cent reduction (cumulative or individually) in current energy requirements, or CO₂ emissions, for hot water production.
 - Can be considered for retrofit in existing operations.



2015 Highlighted Projects

Status	Project
Completed in 2015	Natural Gas De-Carbonization (Cenovus)
	CO ₂ Conversion Preliminary Technology Assessment (Canadian Natural)
Continued in 2015	Molten Carbonate Fuel Cells (Cenovus)
	Quest Carbon Capture and Storage (Shell)
	CO ₂ Capture from Syngas Streams – Assessment of Emerging Technology (Suncor)
New in 2015	NGR COSIA Carbon XPRIZE (ConocoPhillips)



Opportunities in 2016



- ✦ NRG COSIA Carbon XPRIZE - Conversion of CO₂ into useful products
- ✦ Continue to advance transformative post combustion capture technologies to reduce capture costs.
- ✦ Accelerate the development of molten-carbonate fuel cells for is situ operations.
- ✦ Pilot new waste heat recovery technologies for conversion to useful energy.
- ✦ Deliver efficiency improvements by sharing energy efficiency best practices.
- ✦ Identify and demonstrate technologies that quantify fugitive emissions from Mining operations.
- ✦ Identify alternatives to existing hot water production technologies to improving mining extraction efficiency.

