PROCESS ECOLOGY™

Multi-Level Techno-Economic Analysis Model for the Identification of Optimal Emission Mitigation Strategies

Marcelo Mathias

Process/R&D E.I.T.

#engineering4sustainability

Sustainable Energy

Who We Are:

- Founded in 2003, Calgary, AB
- We help our clients identify solutions that improve environmental and economic performance of operations
- Extensive experience in process modelling and optimization, emissions management and software development
    - Regulatory/ ESG reporting
    - Evaluation of emissions mitigation technologies
    - Process/ supply chain analysis and optimization with GHG implications

Unit, facility or systems analysis

What We Do:

Emissions Estimation and Management

Process Ecology can help you ensure compliance with air emissions regulations and ESG reporting while finding opportunities to reduce emissions and cost (- 60 operating companies in Western Canada)

Process Engineering and Simulation

Our team of process simulation and optimization engineers supports the Upstream and downstream Oil & Gas sector maximize the profitability of their assets.

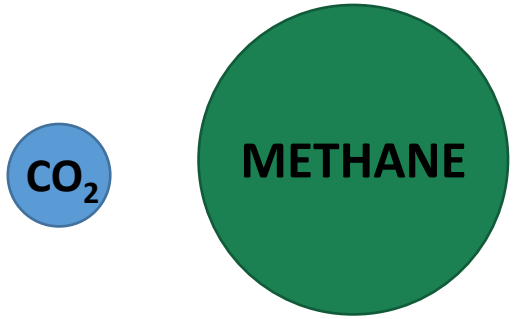
Decision support software and tools

We develop innovative simulation and optimization software tools that help identify better solutions to industry's most challenging problems

Methane Mitigation

Methane is a prominent greenhouse gas with high global warming potential (GWP)

There are currently numerous initiatives underway to accurately measure and mitigate methane emissions.



x28 CO_2 Global Warming Potential

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About Pledges Media Resc

Global Methane Pledge

Fast action on methane to keep a 1.5 future within reach

Global Methane CHALLENGE

The Global Methane Challenge is an international campaign to catalyze ambitious action around the world to reduce methane emissions and highlight policies and technologies being used to recover and use methane. The Global Methane Challenge is open to all public- and private-sector organizations interested in showcasing their actions to address methane emissions.

Learn more

This video features an overview of the Challenge and highlights several stories. A full list of Challenge participants is presented at the end of the video.

EDF ENVIRONMENTAL DEFENSE FUND

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EPA United States Environmental Protection Agency

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CLIMATE & CLEAN AIR COALITION TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

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SHORT-LIVED CLIMATE POLLUTANTS OUR WORK OUR PARTNERS RESOURCES FOR ACTION NEWS & EVENTS

Resources for action

Benefits and costs of mitigating methane emissions

Global Methane Assessment key findings

EMISSIONS OPPORTUNITIES BENEFITS SOLUTIONS

Reducing human-caused methane emissions is one of the fastest, most cost-effective strategies to reduce the rate of warming and contribute to global efforts to limit temperature rise to 1.5°C.

MORE INFORMATION

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FINANCIAL TIMES

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Cut methane by half over next decade to fight global warming, UN warns

Reduction would be the most effective action in the near term.

All services Public engagement Initiatives Ne

Reducing methane emissions

Methane emissions in Alberta will be reduced by 45% by 2025.

UN environment programme 50 1972-2022

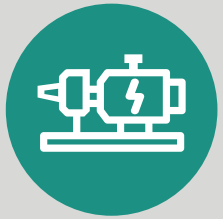
Who we are Where we work What we do

Mitigation Pathways Challenge


Flare

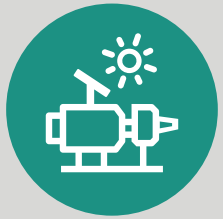

VRU


Rod Packing Replacement


Gas Pump Replacement


LDAR


High Bleed Replacement


Chemical Pump Replacement


On Site Power


AFR

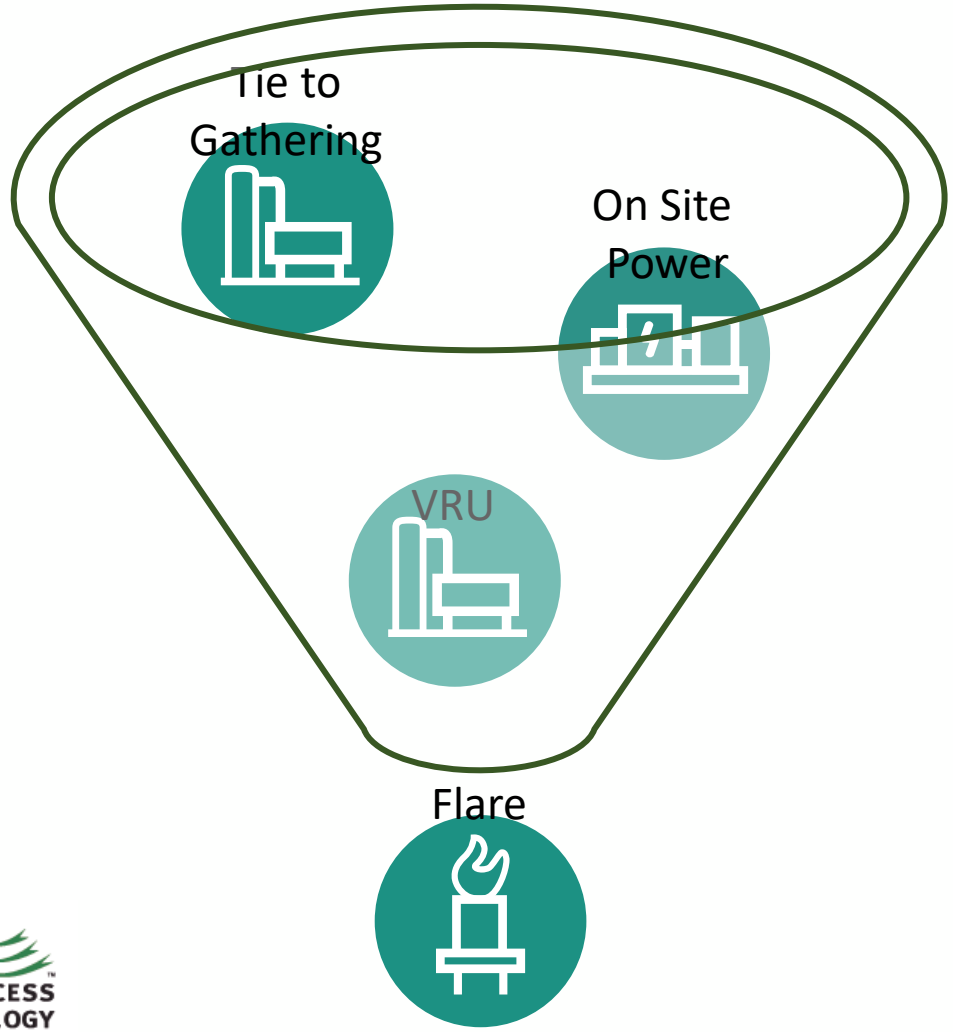

Tie to Gathering

Compressed N2


Virtual Pipeline

The Oil & Gas sector has a range of proven technologies at its disposal to effectively mitigate methane emissions

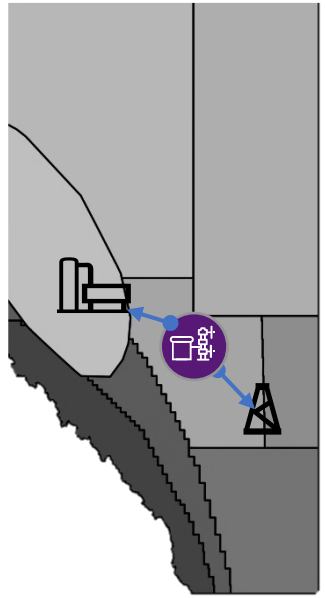
Mitigation Pathways Challenge



You **can't** apply them all!!!

Throughput		
Oil	2,437.75	bpd
Gas	1.19	MMSCFD
Water	118.3	bpd

Abatement Technologies Options	
Distance to LNG Market (km)	300
Option 1	
Distance to Gathering System (km)	0.211117398
Tie-in Pressure (kPag)	3968
Distance to Power Source (km)	2.8846
Distance to Labor Pool (km)	236.7815206



Each facility has its own constraints

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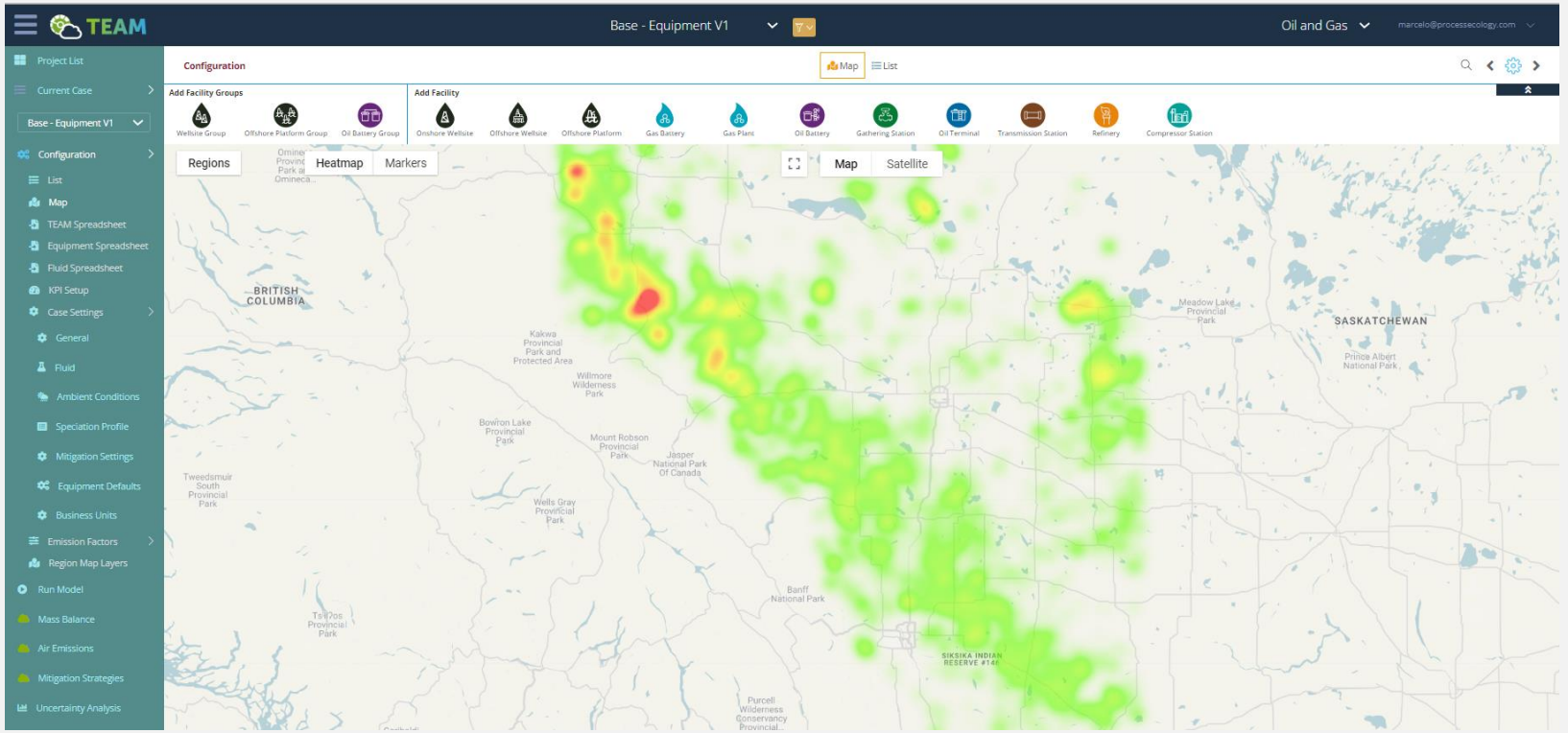
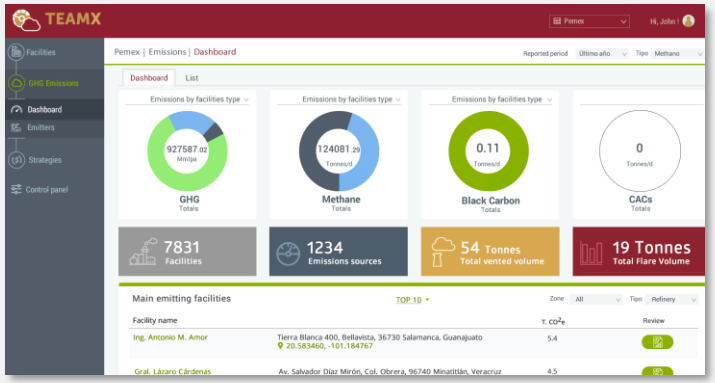
What is TEAM (Techno Economic Analysis Model)?



TEAM is a web tool that helps the oil and gas sector evaluate and optimize strategies for reducing both short-lived climate pollutants (SLCP) and greenhouse gas (GHG) emissions. Considering facility-level constraints and local economic factors.

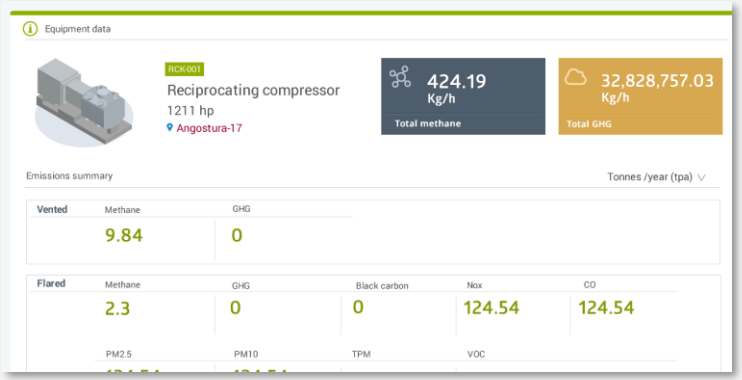
Emissions Profiles

System-Wide Summary



Facility Summary

Equipment Summary

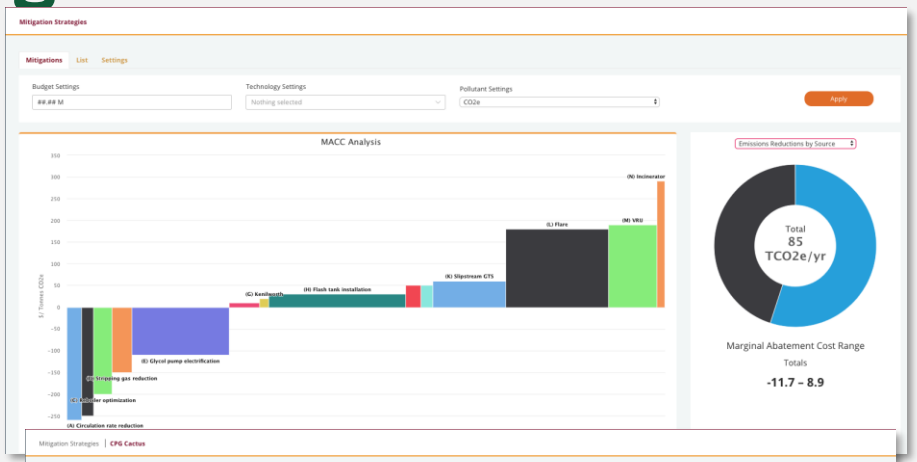


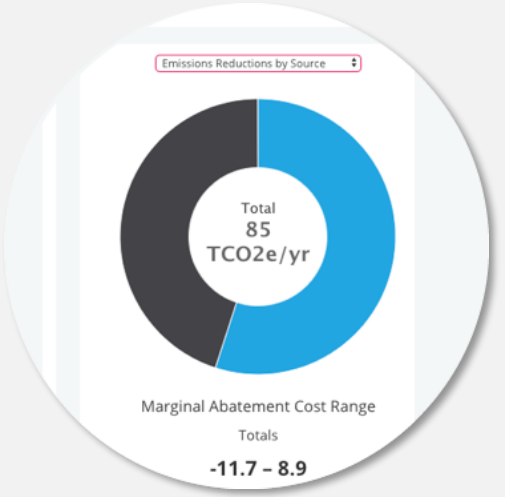
Mitigation Strategies

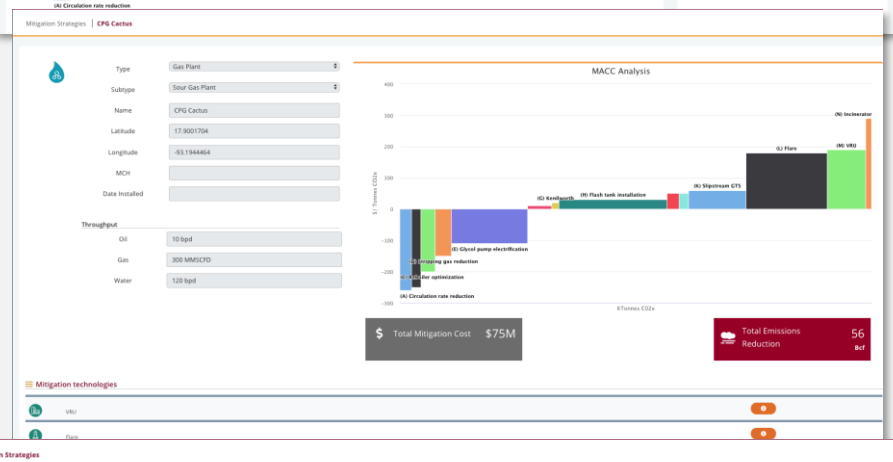
System-Wide Summary

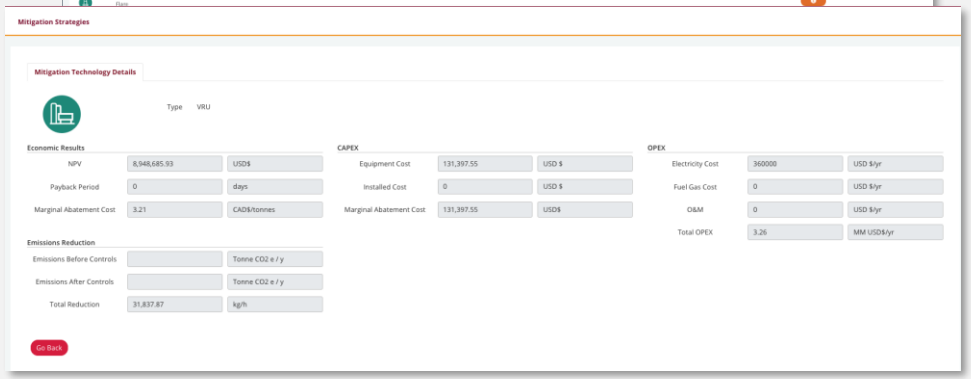
Facility Summary

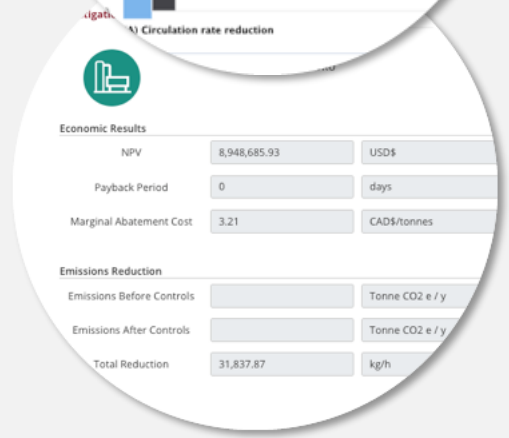
Technology Summary



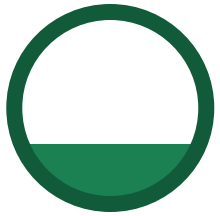


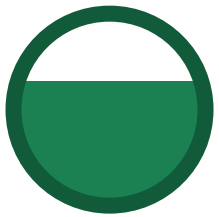


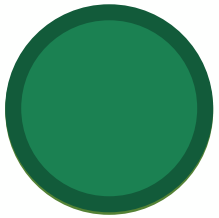




Why TEAM







Approach	Description	Pros	Cons
Generic	Assumptions based on simplified “typical” facility models	Quick and easy to implement	Difficult o apply to specific facilities, assumes ideal conditions
TEAM	Tailored technical and economic analysis, flexible models, interactive interface	Balances need for detail with available resources	Requires setup
Specific	Highly detailed analysis of facility and emissions	Provides maximum detail and accuracy	Can be costly and time-intensive, may lack robustness in certain scenarios

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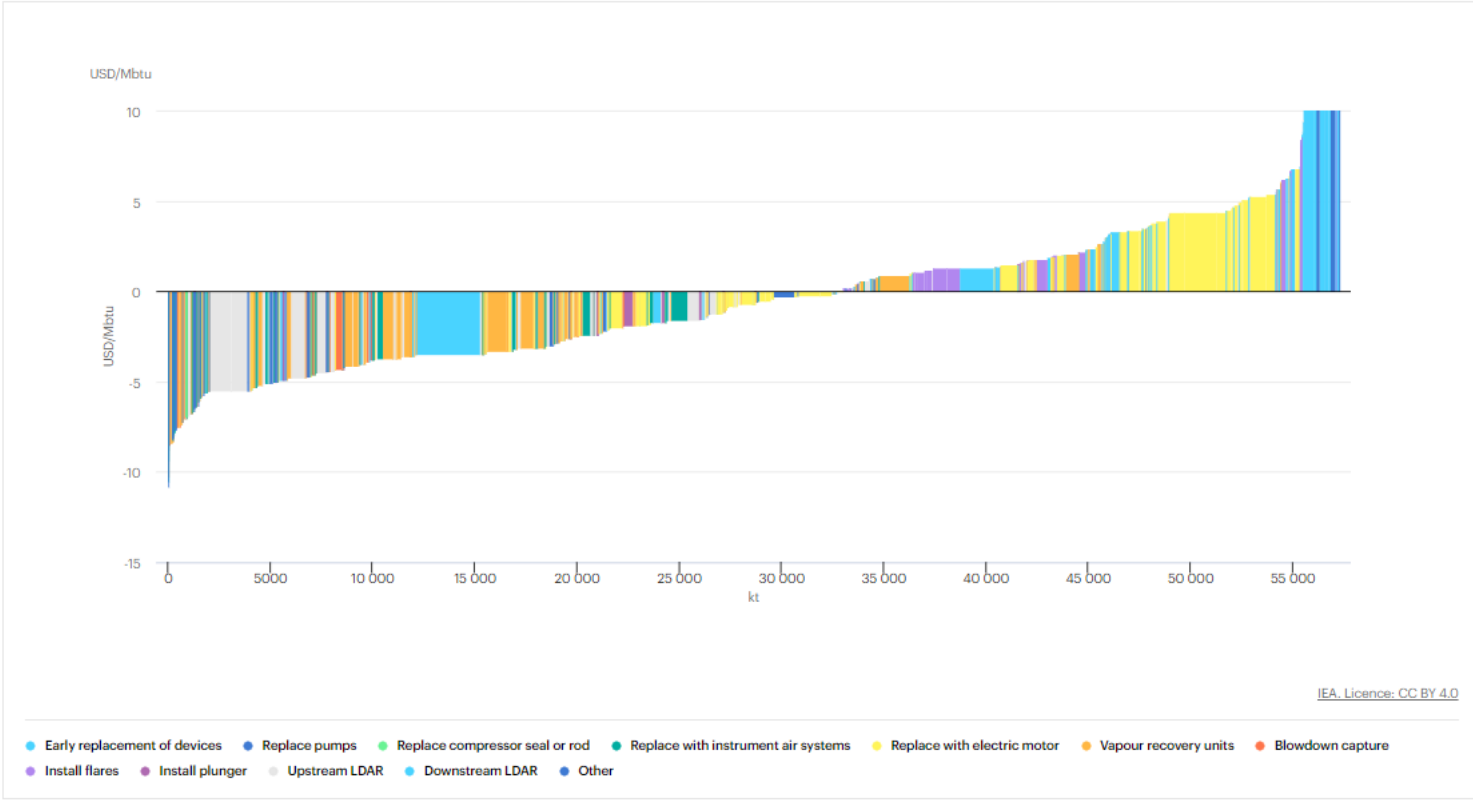
TEAM Approach

Marginal abatement cost curve for oil and gas-related methane emissions by mitigation measure, 2021

Last updated 26 Oct 2022

Download chart ↓ Cite Share



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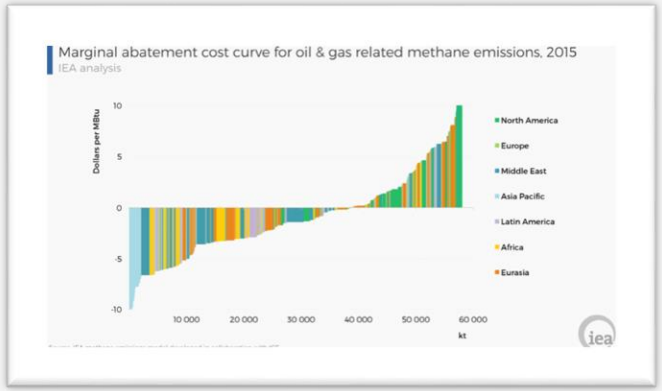
TEAM Approach

Conventional MACC

Relies on emission factor and "typical" facility configurations

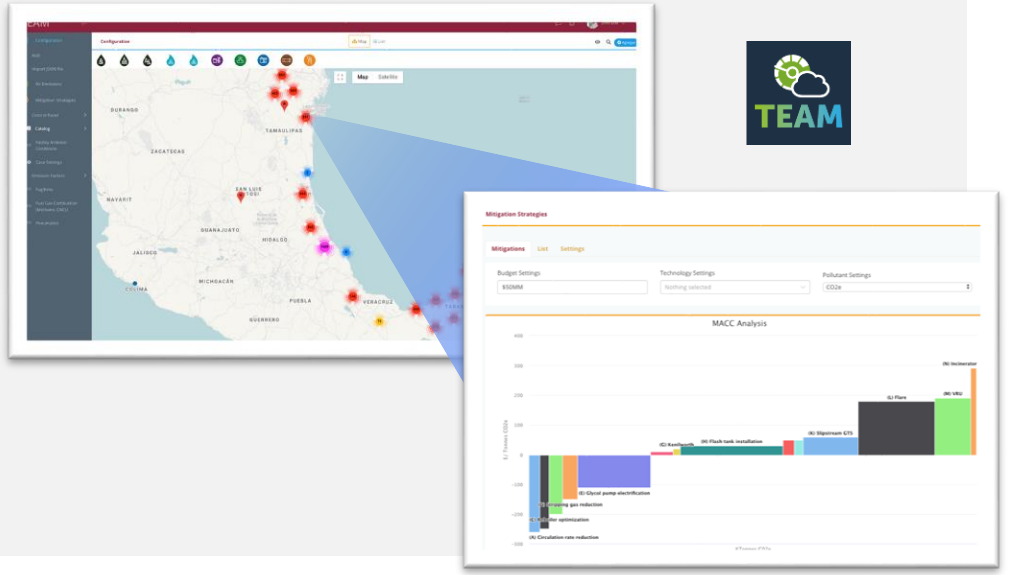
Difficult to evaluate technology penetration and emissions reductions for specific regions



TEAM Approach

Detailed bottom-up inventory. Geospatially-resolved. Detailed engineering models. Includes the specific constraints of each facility

Rigorous techno-economic analysis of mitigation opportunities and their emission reduction potential in a single integrated environment.



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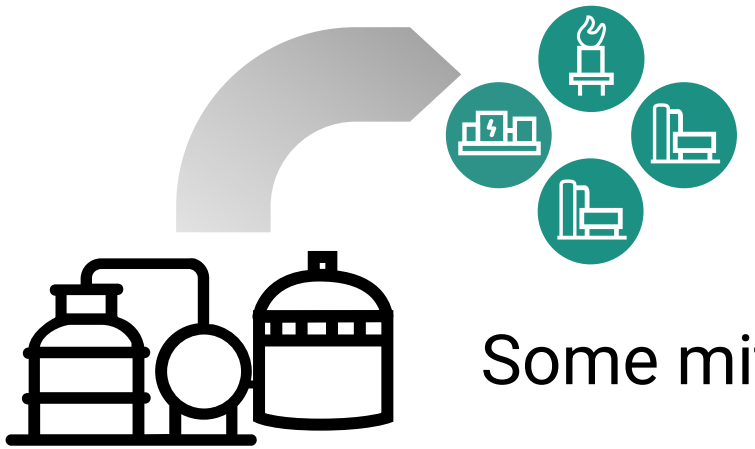
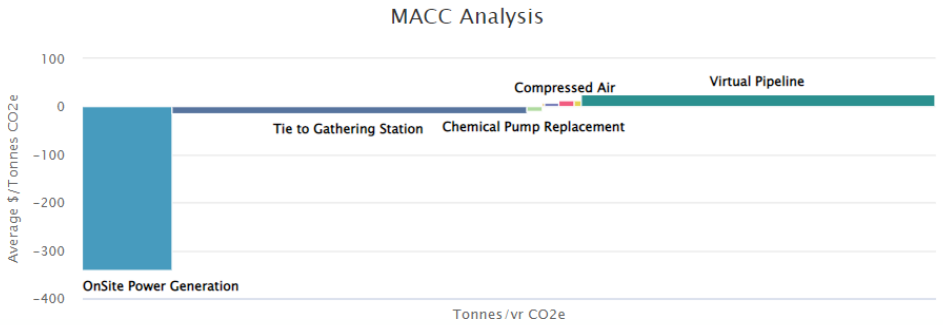
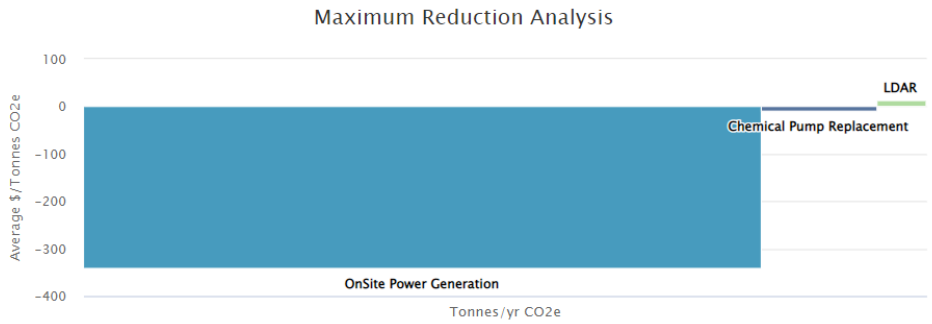
TEAM Approach to MACC





Some mitigation technologies are mitigating the same volume

TEAM has developed powerful algorithms that review the MAC for these technologies and selects the best one for each facility



This Allows you to analyze how much emission you can feasibly mitigate

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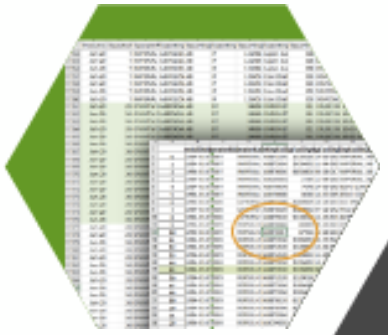
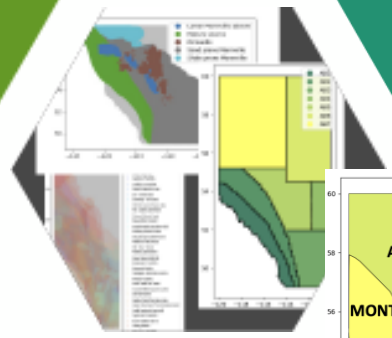
TEAM
In Action

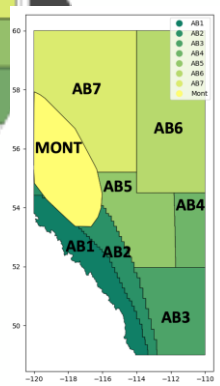
TEAM Current Set-Up



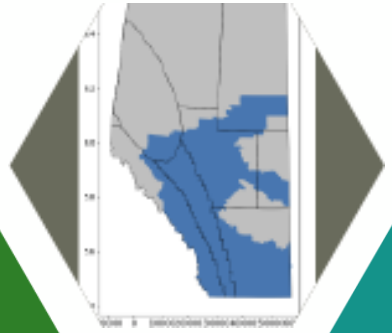
PETRINEX DATA
01

ALBERTA REGIONS
02

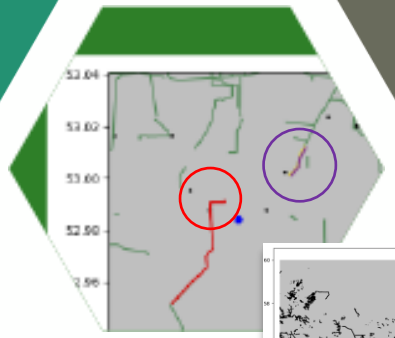


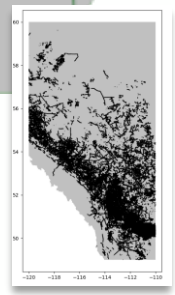


OIL BATTERY EXAMPLE
03



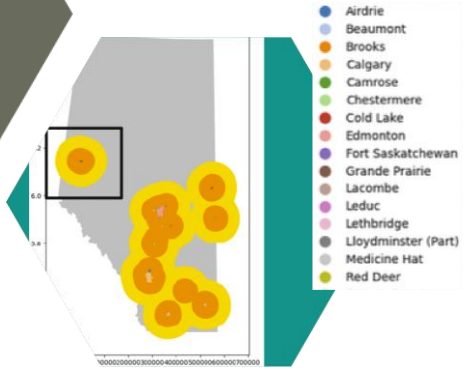
TIE IN TO GATHERING
04





ONSITE POWER GENERATION
05

DISTANCE TO QUALIFIED LABOR POOLS
06



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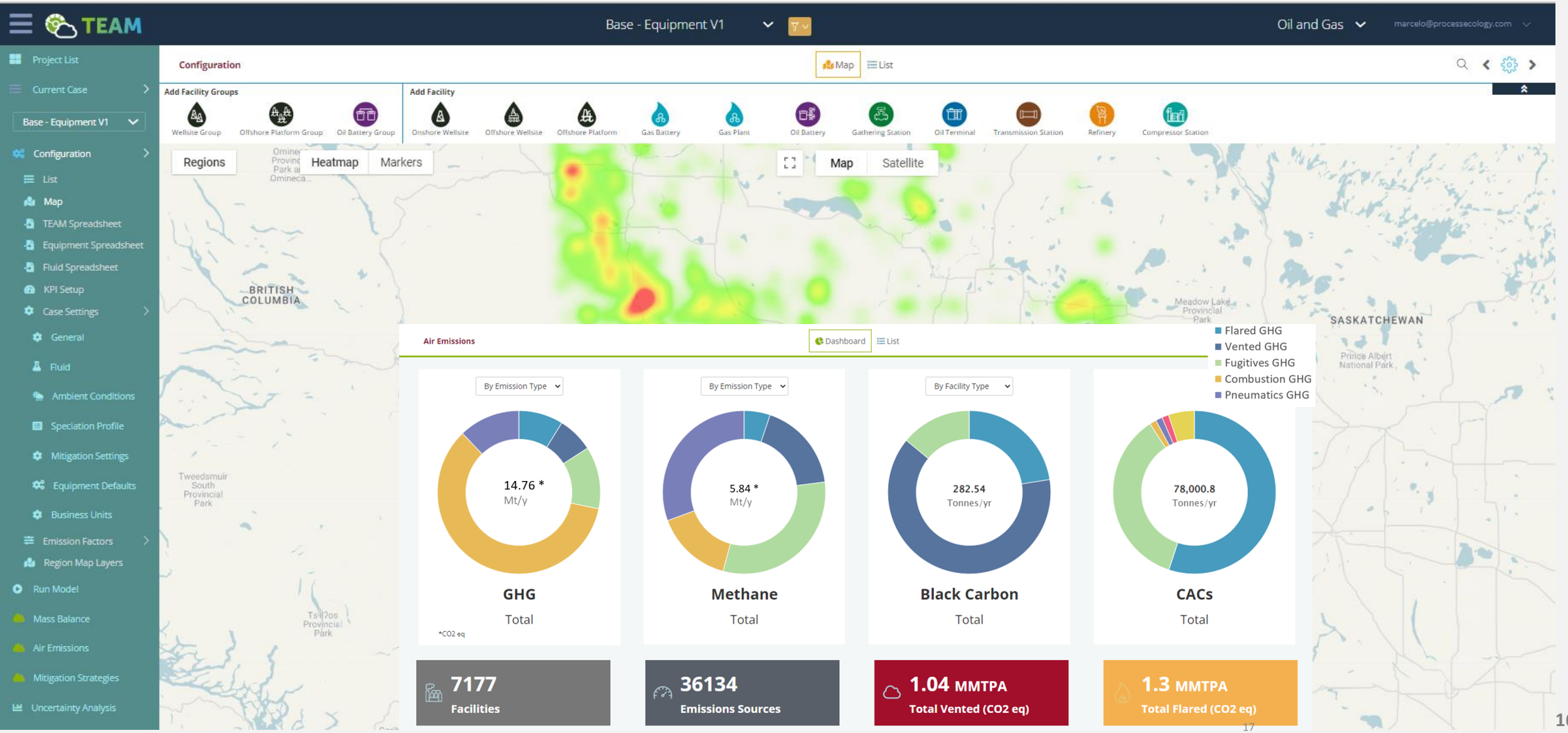
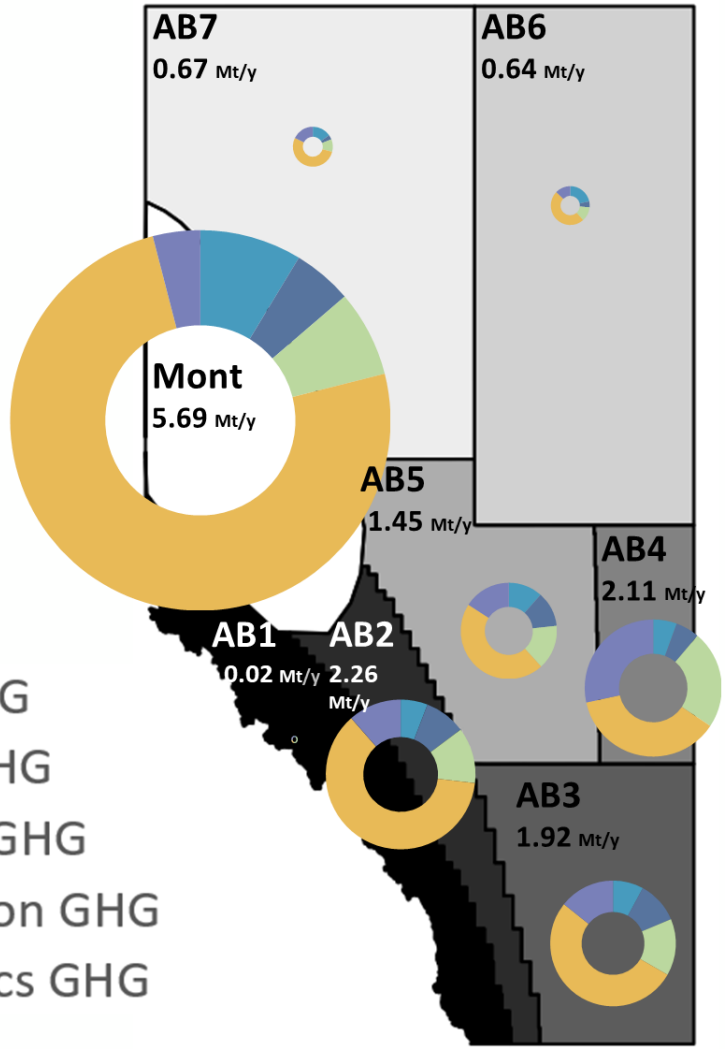
TEAM Alberta Model



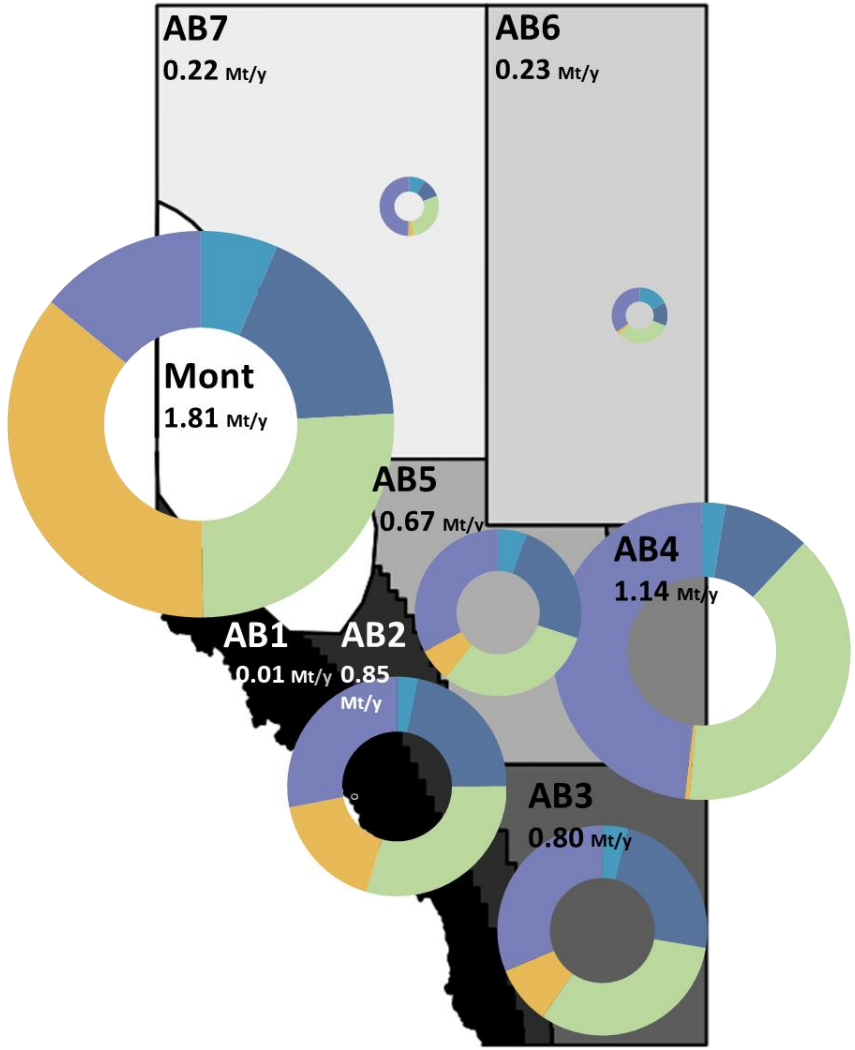
Regional Emissions Breakdown by Source Type

TOTAL GHG (CO2e)



- Flared GHG
- Vented GHG
- Fugitives GHG
- Combustion GHG
- Pneumatics GHG

TOTAL METHANE (CO2e)



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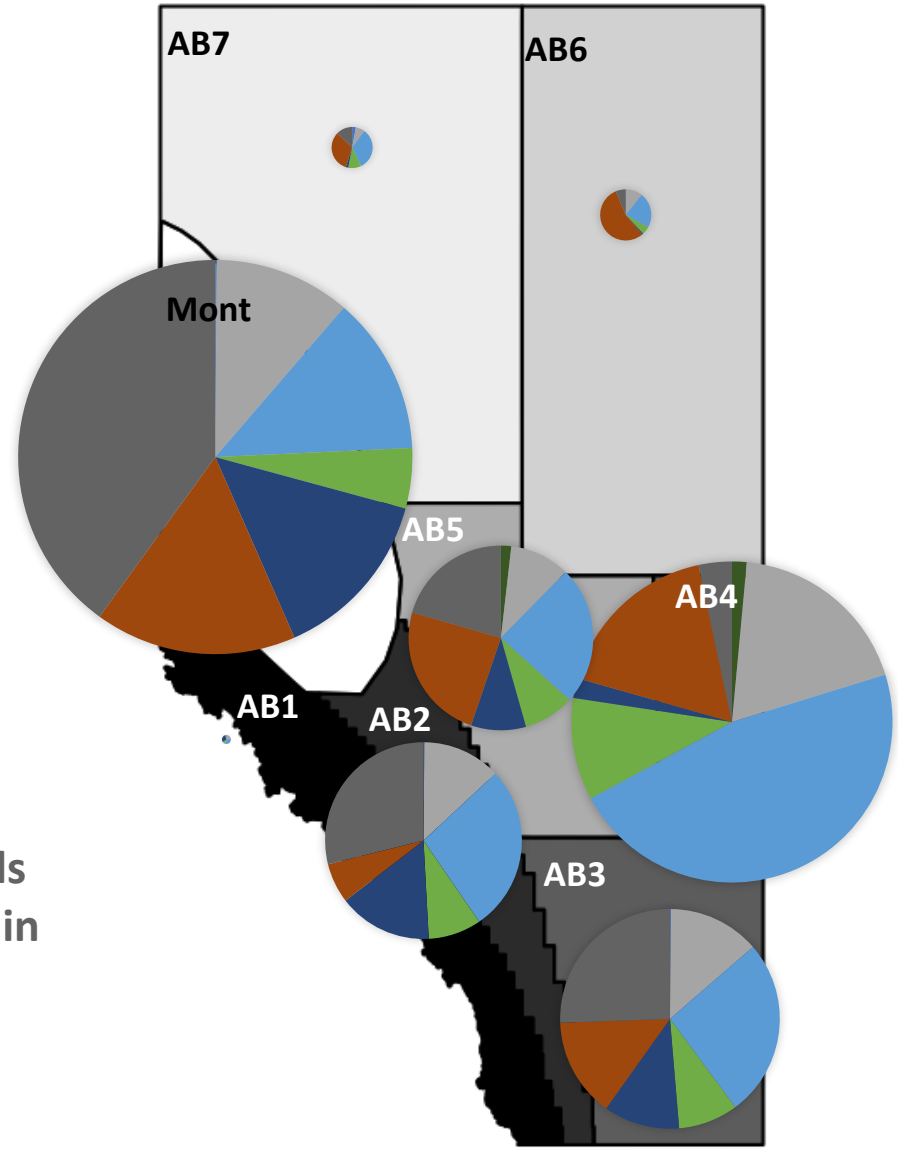
Regional Mitigation Breakdown (MAC < 50$/tonne CO2e)

RELATIVE EMISSION REDUCTION



Flare

LDAR

Replace Chemical Pumps

Replace High Bleed Pneumatic

Rod Packing Replacement

Tie to Gathering

VRU

Size of the pie chart corresponds to the total emission reduction in the region.

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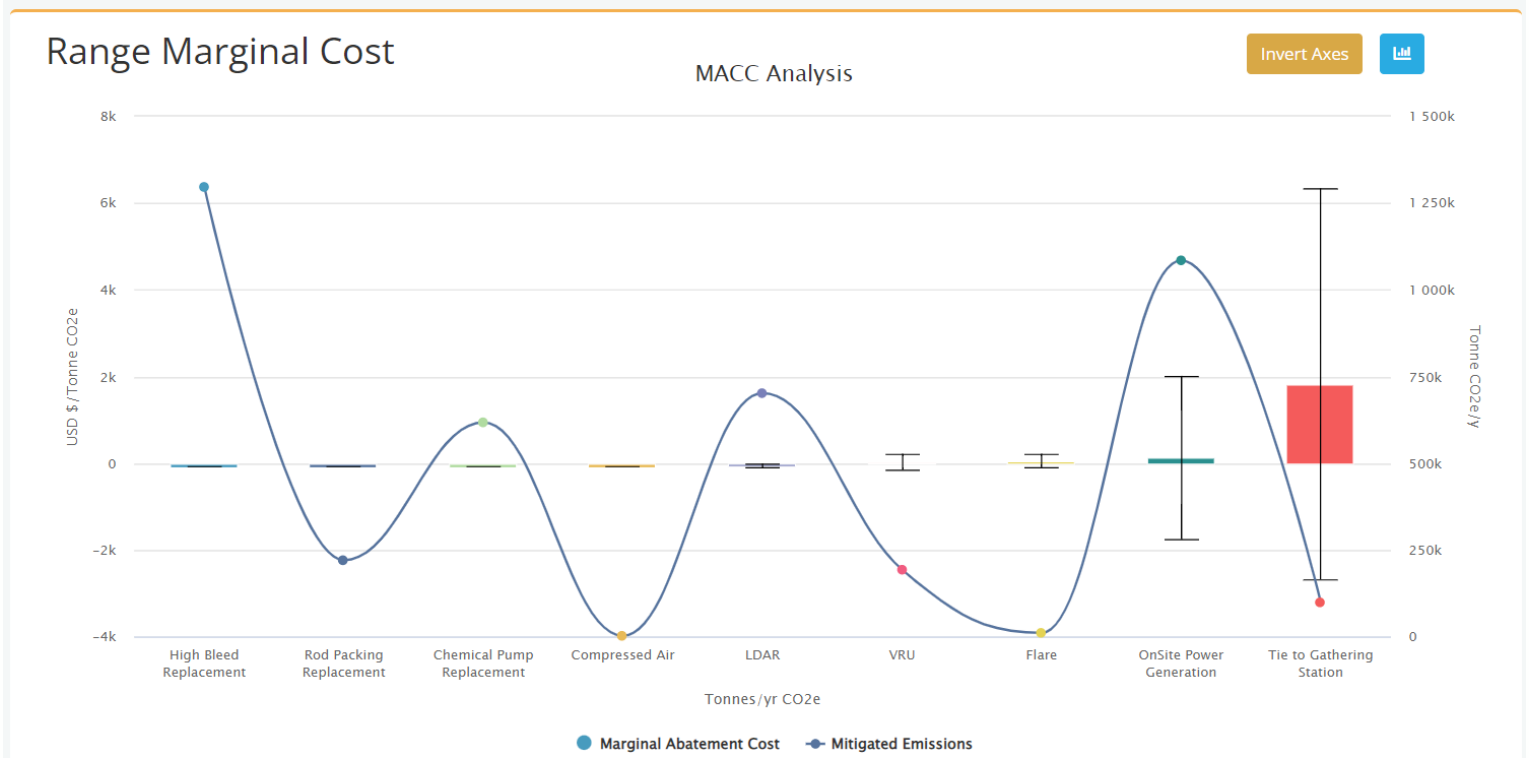
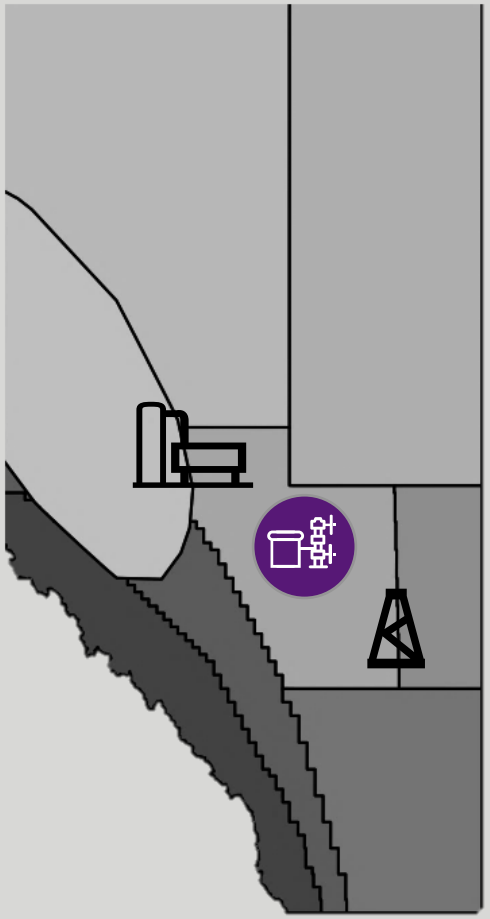
Conclusion

Key Findings:

- The replacement of pneumatic devices and chemical pumps remains a significant opportunity for reducing emissions.
- Tying in to gas gathering systems has high potential for mitigating emissions, especially in areas like AB4.
- Applying Vapor Recovery Units (VRUs) to facilities should be prioritized wherever feasible, particularly in the Montney Region.
- **Each facility is unique and cannot be generalized as "generic".**



Conclusion



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Abatement Technologies Options

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Option 1

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Tie-in Pressure (kPag)	3968

Option 2

Distance to Gathering System (km)	0.211117398
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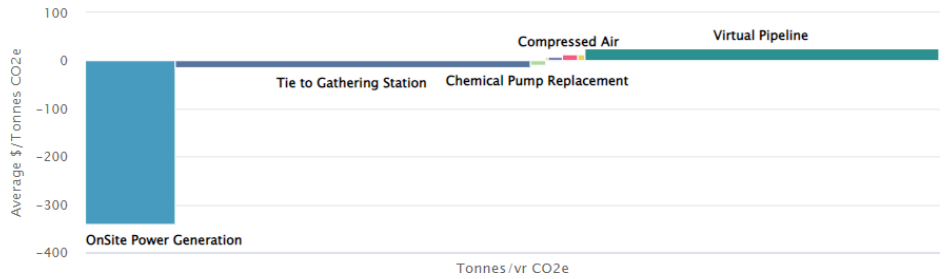
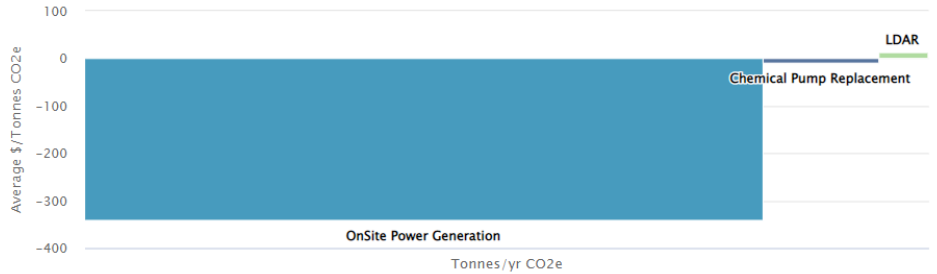
Distance to Power Source (km)	2.8846
Distance to Labor Pool (km)	236.7815206

MACC Analysis



Maximum Reduction Analysis



Future Work – Model Improvements

- Expand the facilities in the Alberta base case
  - Wells, compressor stations, and gas batteries
  - Transmission systems
- More mitigation technologies
  - On-site hydrogen blending
  - Natural gas decarbonization
  - Carbon capture (Amine, MCFC)
  - Customizable technology
- Baseline emissions from equipment to incorporate mitigations required by regulations (LDAR, Rod packing replacement)

Thank You

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