



# Generation, control and utilization of methane at Canadian landfills

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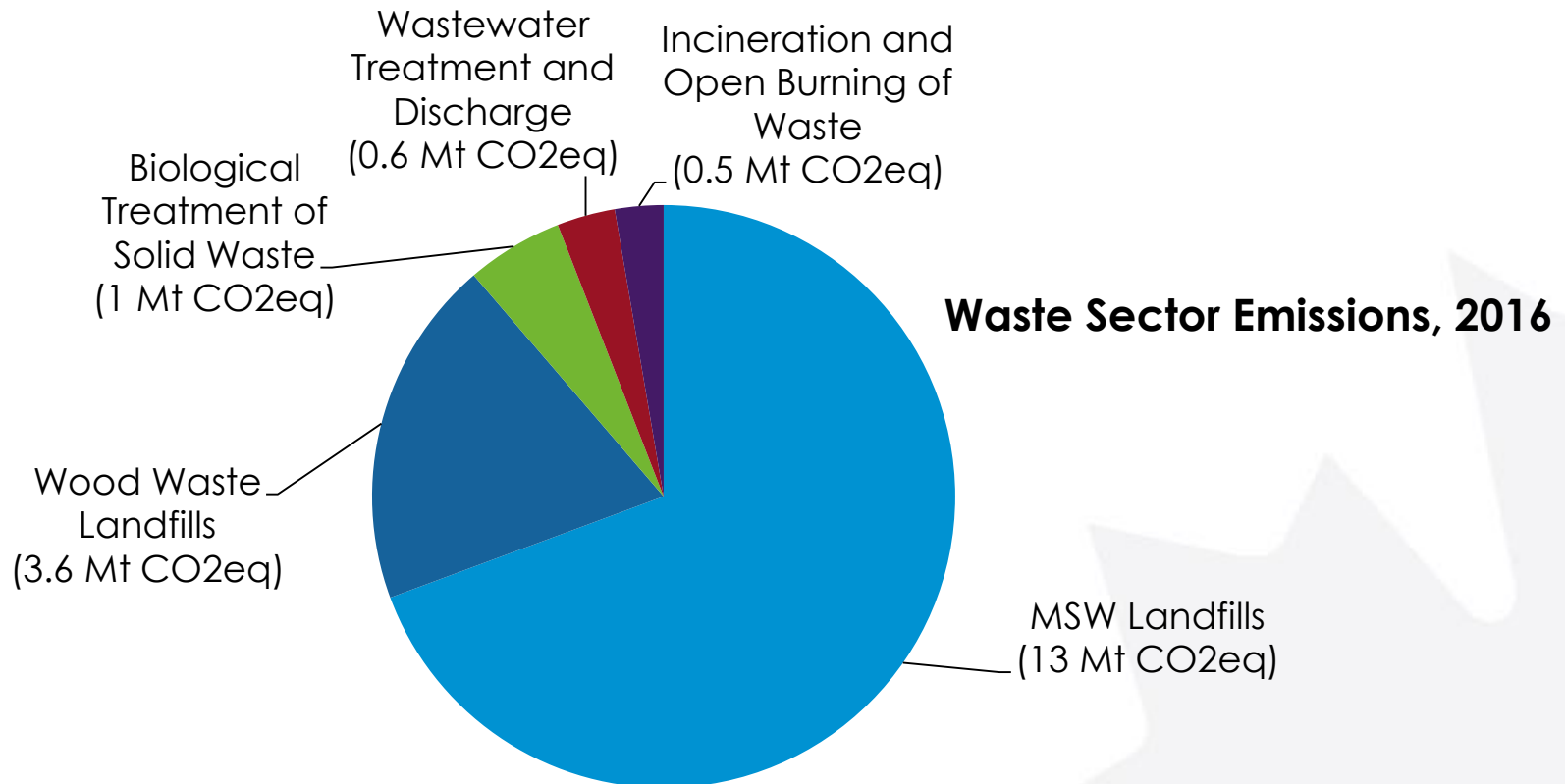
**Sue Fraser**

**Environment and Climate  
Change Canada**

**October, 2018**

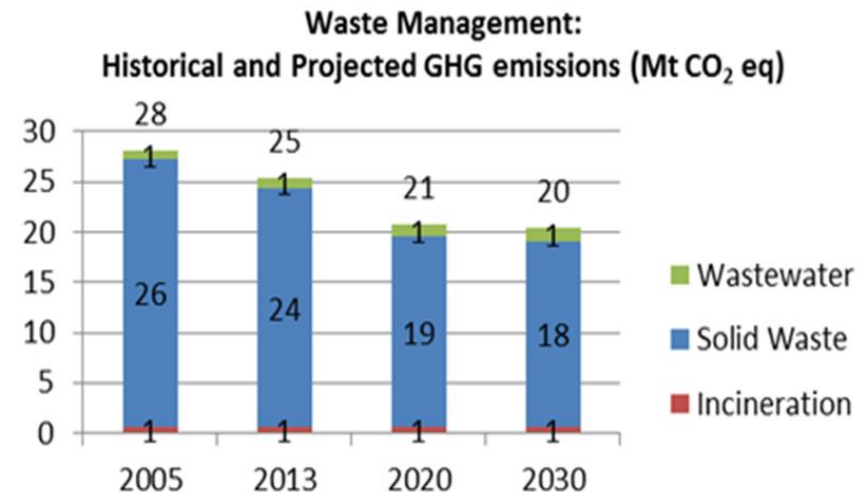
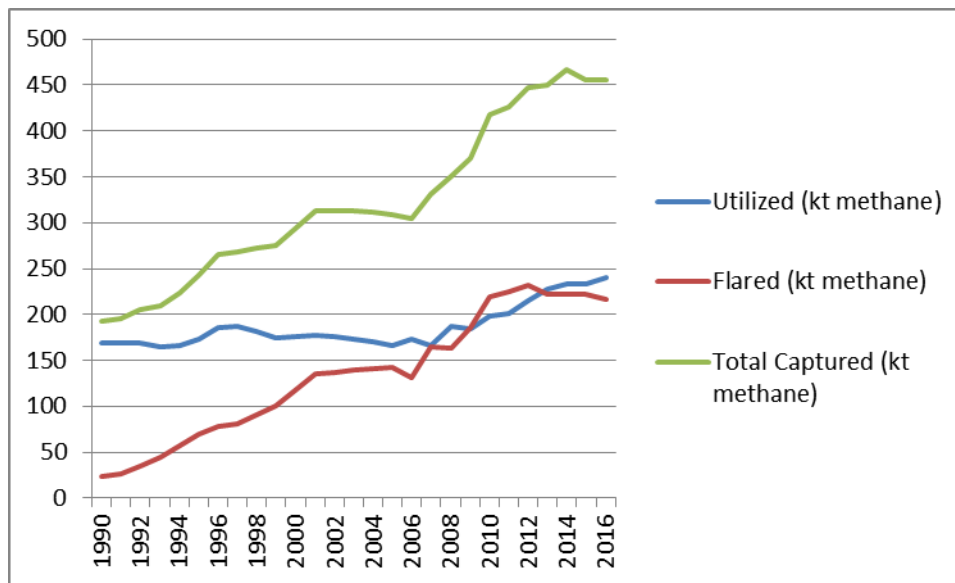
# Waste Sector GHG Emissions

- In 2016, about 3% of Canada's GHG emissions and 13% of methane releases (behind oil/gas – 44% and agriculture – 30%)
- 13 Mt CO<sub>2</sub>eq of landfill methane was emitted and 11.4 Mt CO<sub>2</sub>eq collected and either flared or utilized



# Waste Sector GHG Emissions (cont'd)

- Emissions from MSW landfills have been declining since 2005, with further declines projected to 2030:
  - Largely due to increased MSW landfill gas capture (44% of methane was captured in 2016, compared to 20% in 1990)
  - Emissions in 2030 expected to be 29% below 2005 level



# Commitments under Strategy on Short-Lived Climate Pollutants (July 2017)

“ECCC will develop measures to address methane from landfills in consultation with provinces and territories.”

- Measures identified in consultation with provinces and territories, requiring or incenting the capture of landfill gas
- A landfill gas (LFG) recovery initiative could further reduce methane from municipal solid waste landfills and accelerate the capture and utilization rate of landfill gas

“Consultations on strategies to reduce avoidable food waste, increase organics diversion, and increase recycling and reuse will begin in 2017.”

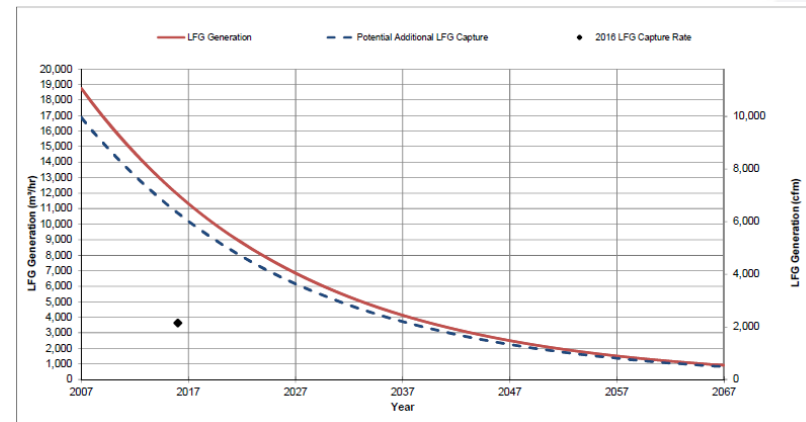
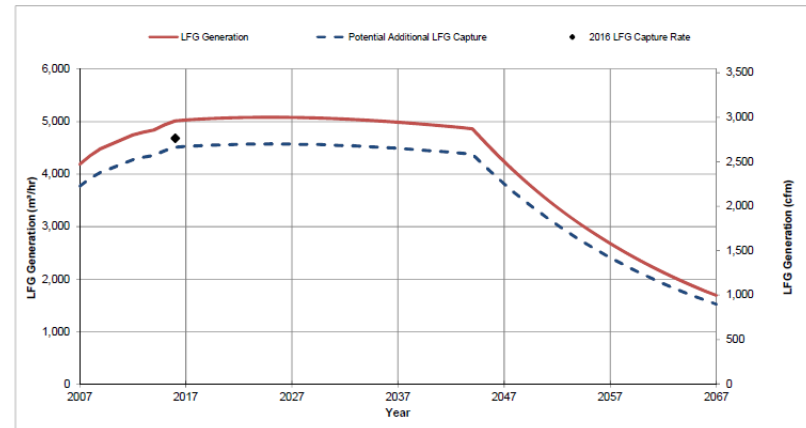
- Support the implementation of technologies and infrastructure to divert and manage organic waste as a long-term solution
  - Additional measures to be identified in collaboration with provinces and territories, and with input from stakeholders, could increase resource utilization and recycling, and move Canada toward a circular economy
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# ECCEC work to date under SLCP Strategy

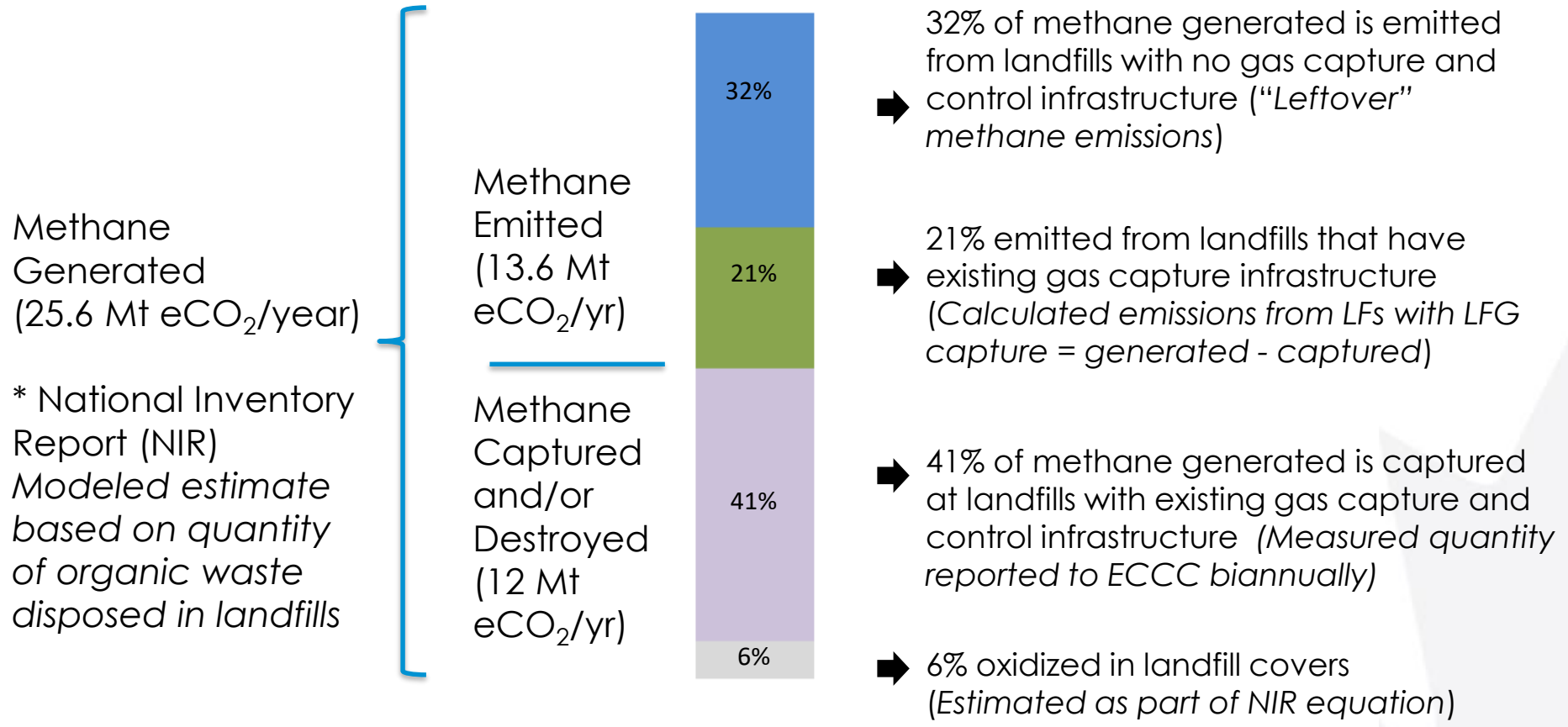
- Established an inventory of Canadian landfills
  - Range of available data, but documented over 3000 landfills in Canada
  - Methane generation modeled at ~150 landfills
- Assessment of additional infrastructure for capture of LFG at large landfills
  - Modeled methane generation at 80 landfills, collected information on current flaring/utilization
  - Landfill specific estimates of:
    - total costs and cost per tonne CO<sub>2</sub> for additional gas capture
    - total costs for utilization options
- Assessment of options for reducing methane emissions at small to medium sized landfills
  - Applicability of existing technologies
  - Cost estimate benchmarks
- Engaged provinces, territories and landfill owners to validate technical and other information

# Methodology and Data Sources

- Emissions modeled using first order decay – input parameters include annual waste disposed from opening to closure date; DOC (degradable organic carbon) same as National Inventory Report (NIR); k location specific
- Quantity LFG collected in 2016 (ECCC landfill questionnaires)
- Additional available methane calculation:
  - Open landfills - Assume 75% available for collection
  - Closed landfills – Assume 90% available for collection
  - Landfills collecting <75%(open) or <90% (closed) were assumed to be capable of collecting more methane



# National Methane Generation and Capture - 2016



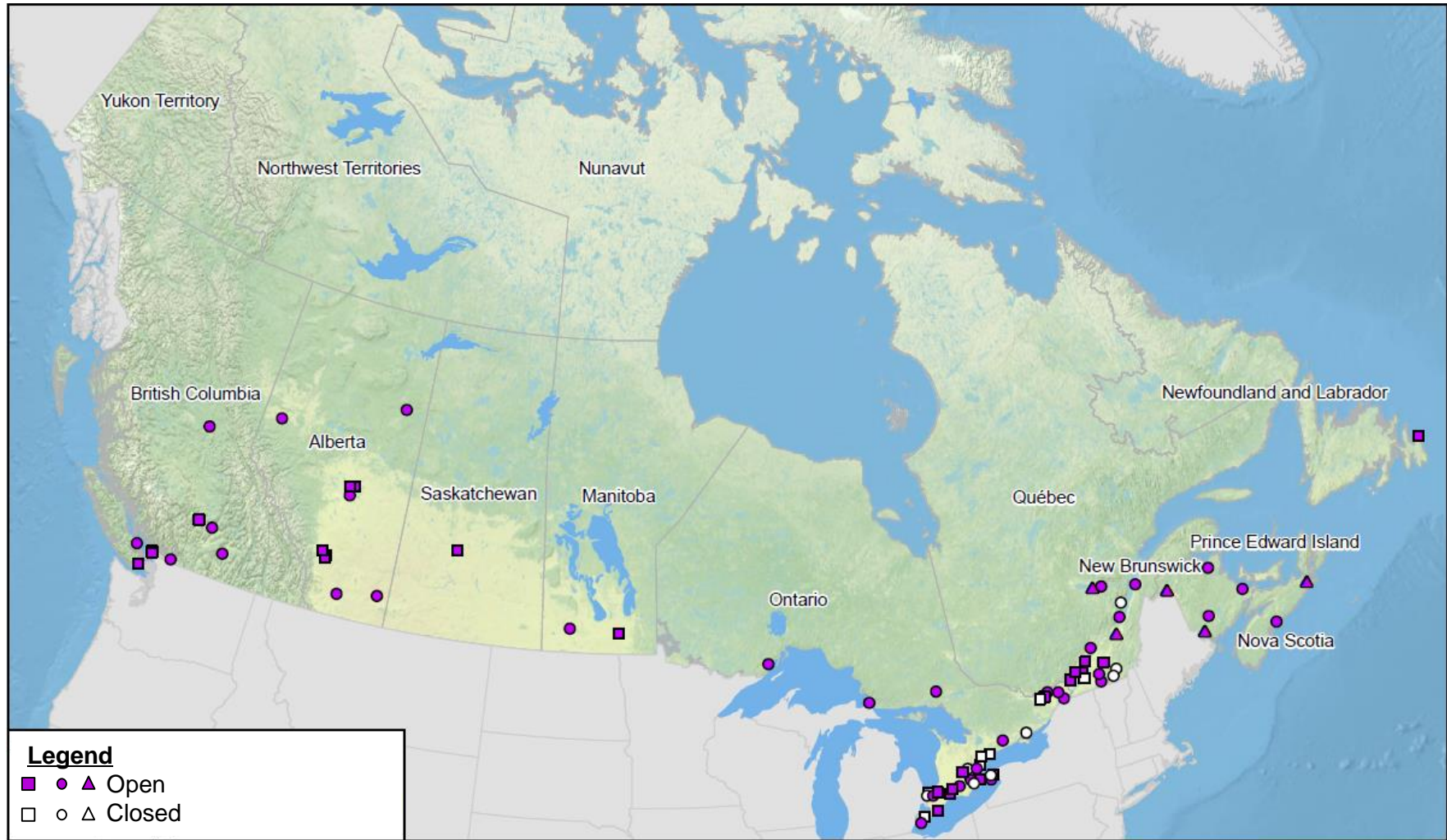
- There is significant uncertainty in actual quantity of landfill gas that is generated – NIR notes range of uncertainty is -40% to +35%

# Landfills in Canada – Quick overview

<b>Large</b>	<b>Medium</b>	<b>Small</b>
>40 kt waste disposed/year or >1 Mt capacity (pop. >50,000 people)	10-40 kt waste disposed /year or 100 kt - 1 Mt capacity (pop. > 12,000 people)	<10 kt waste disposed/year or <100 kt capacity (pop. < 12,000 people)
102 open 28 closed	105 open 43 closed	>3000 total – Open – ~1400 Closed – ~1700
102 public ownership 25 private	Primarily public ownership	Mix of municipal/ provincial/ federal/private ownership

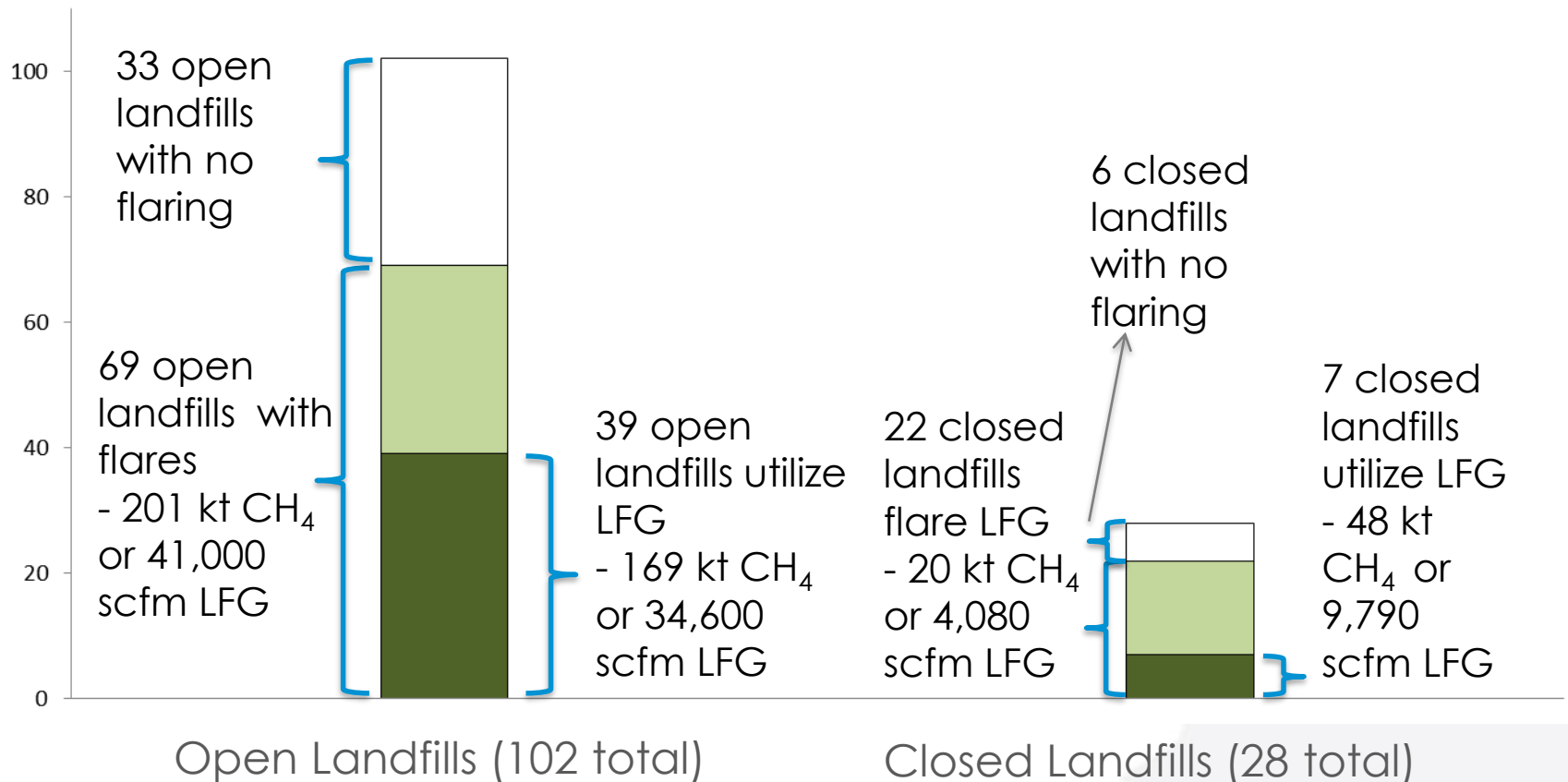


# Large landfill locations



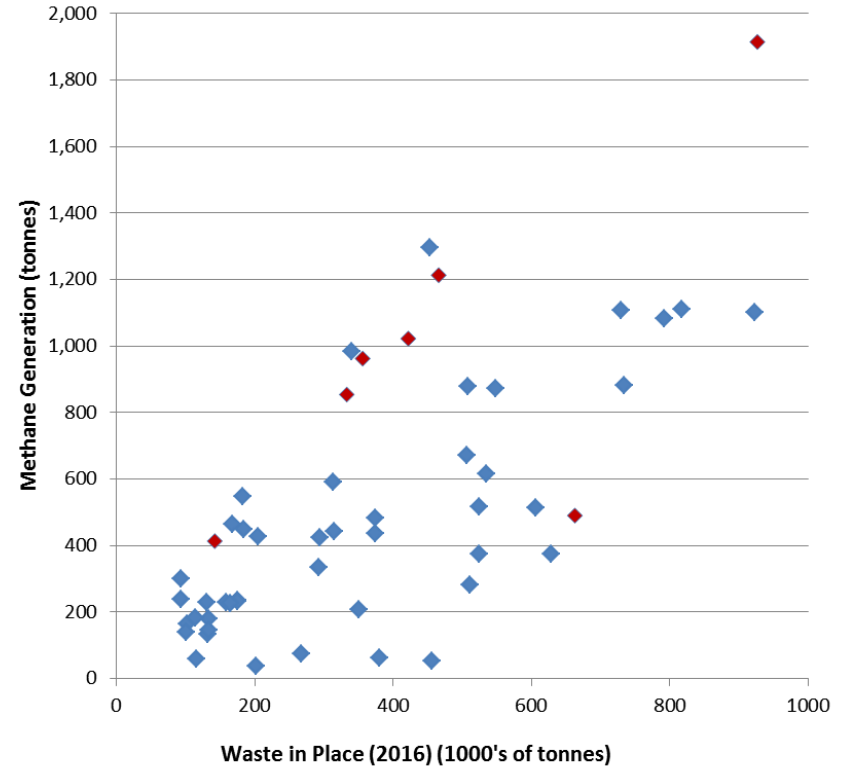
# LFG Capture and Utilization at Large Landfills

- Methane generation at individual landfills ranges from <1,000 to ~50,000 tonnes CH<sub>4</sub>/year
- LFG utilization projects include: direct fuel use, electricity generation and upgrading to transportation fuel and injection into natural gas pipeline
- Several biocovers - both pilot/demonstration and full scale



# LFG Capture and Utilization at Medium Landfills

- Methane generation highly variable and ranges from < 50 to 2,000 tonnes CH<sub>4</sub>/year
- 19 landfills have existing LFG recovery infrastructure
  - Commonly passive ventilation combined with flares (open/candlestick)
- 4 biocovers/oxidation beds
- 2 utilization systems identified
  - One pipeline, one direct use
- Medium size landfills of interest for future inventory work...



# Mitigating LFG Emissions at Small Landfills



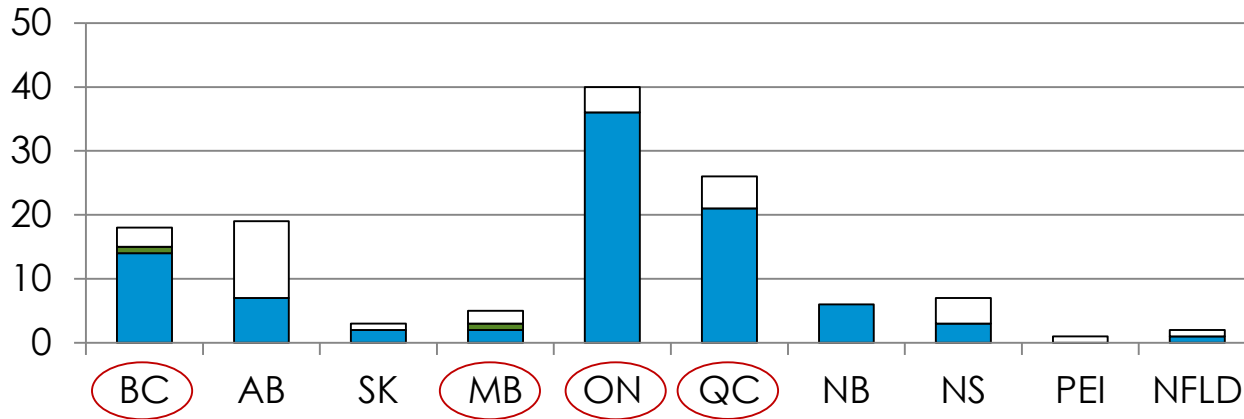
- Wide range in annual waste acceptance
  - 4 to 10,000 tonnes per year
- Range of methane generation
  - up to 650 tonnes CH<sub>4</sub>/year
- Have not identified any existing capture/control projects for small landfills in Canada

## Options for LFG Capture/Control

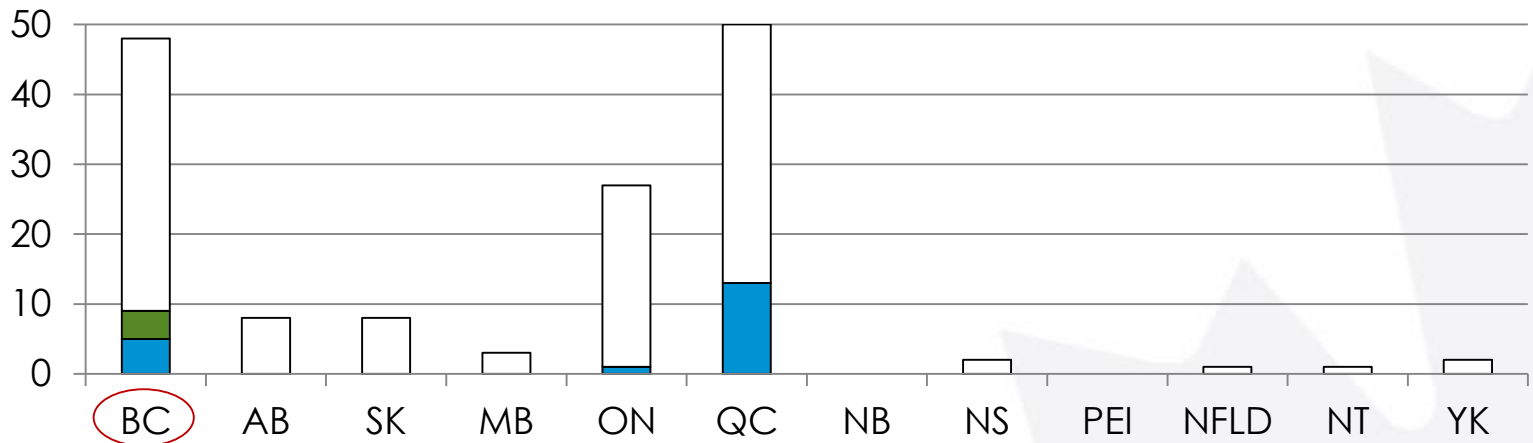
- Flares - Can be used where sufficient gas is present; passive ventilation and flares in limited use elsewhere
- Biocovers - Technology has been applied at several larger Canadian landfills

# Methane capture by province/territory

# Large Landfills (94/130 capture LFG or systems are under development)



# Medium Landfills (23/149 capture LFG)



■ LFs with GCCS   ■ LFs with biocover   □ LFs with no GCCS

○ LFG control and/or assessment required by regulation

# LFG Mitigation costs – Small & Medium LFs

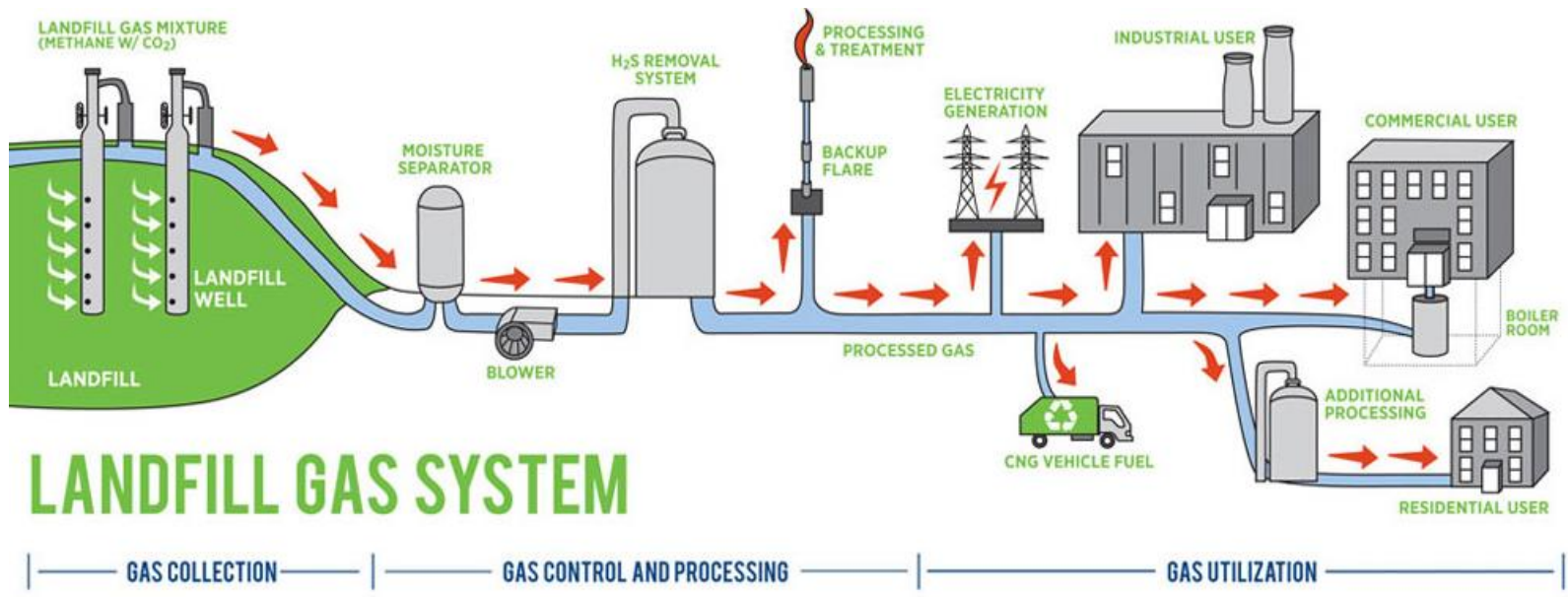
- Compared to other GHG reduction measures, landfill gas capture and flaring is relatively inexpensive
- Site specific analysis required, however, study on mitigation options for small/medium landfills in Canada identified following range of costs –

Mitigation Approach	Planning/ Permitting Costs	Capital Costs	Total Installation Costs	Annual O&M	Annual Monitoring	Total Annual Costs
Enclosed and Utility Flares – Open landfills	\$35-110K	\$0.7-7.4M	\$0.74 - 7.5M	\$160-230K	\$50K	\$230- 280K
Passive Venting/ Flaring – Closed landfills	\$15-25K	\$0.01-1.8M	\$0.025- 1.8M	\$0.5-90K	\$0.2-36K	\$0.7 – 130K

- Canadian landfills have been able to generate and receive compensation for carbon offset credits – following development of carbon price regulations to understand opportunities; further analysis to identify cost/tonne eCO<sub>2</sub> estimates for medium sized landfills

# LFG Utilization in Canada

- LFG utilization creates additional GHG reductions through offsetting fossil fuels:
  - Direct use on-site or at nearby site – 9 projects (mainly QC)
  - Electricity generation – 33 projects (BC, AB, SK, ON, QC, NB, NS)
  - Upgrading/injection into NG pipeline – 4 projects (QC and BC)
  - Upgrading to transportation fuel – 1 project (QC)



# How much LFG was available for utilization in 2017?

	Large Landfills	Small and Medium Landfills
Currently emitted - no LFG infrastructure	33 kt CH <sub>4</sub>	330 kt CH <sub>4</sub>
Currently emitted - LFG infrastructure could be expanded*	150 kt CH <sub>4</sub>	5 kt CH <sub>4</sub>
Currently flared	83 kt CH <sub>4</sub> (LFs with no utilization) 137 kt CH <sub>4</sub> (LFs with utilization)	3 kt CH <sub>4</sub>
TOTAL	~400 kt/yr CH <sub>4</sub> or ~82,000 scfm LFG  213 MW or 2,500 mmBtu/hr	~340 kt CH <sub>4</sub> or ~70,000 scfm LFG  182 MW or 2125 mmBtu/hr

\* Assumes additional available gas = 75% (open) or 90% (closed) of modeled gas generation



# Available funding for LFG capture and utilization

- LFG projects are eligible under various federal initiatives including:
  - [SD Tech Fund](#) (NRCAN)
  - Federation of Canadian Municipalities (FCM) – [Municipalities for Climate Innovation Program](#)
  - [Low Carbon Economy Fund](#) (ECCC) – Leadership and Challenge
  - Infrastructure Canada (INFC) – [Climate Change Mitigation Funding Sub-Stream](#)
  - [Federal tax incentive](#) for Clean Energy Equipment (CRA/NRCAN) -Accelerated Capital Cost Allowance

# Areas of future work

- Map of current and potential LFG capture/utilization locations in Canada
- ECCC questionnaire for large/medium sized landfill owners – Spring 2019
  - update inventory and basis for NIR “quantity LFG flared/utilized”
- Foundational study on best practices for measuring and monitoring LFG emissions – Winter 2019

# Thank you!

- For further information, please contact:

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