



Characterization and Management of Food Waste in North America



GHGs, Environmental and Socio-Economic Impact



complex world | CLEAR SOLUTIONS™

Sources: Tetra Tech, 2016

Content

- Environmental Impacts
 - Greenhouse Gas Emissions
 - Wasted Energy
 - Wasted Water
 - Wasted Cropland
 - Wasted Fertilizer
 - Biodiversity Loss
- Socio-Economic Impacts
 - Wasted Calories
 - Wasted Money
- Greenhouse Gas Emissions from Implementation Scenarios



Environmental Impacts

Greenhouse Gas Emissions

Energy

Water

Land

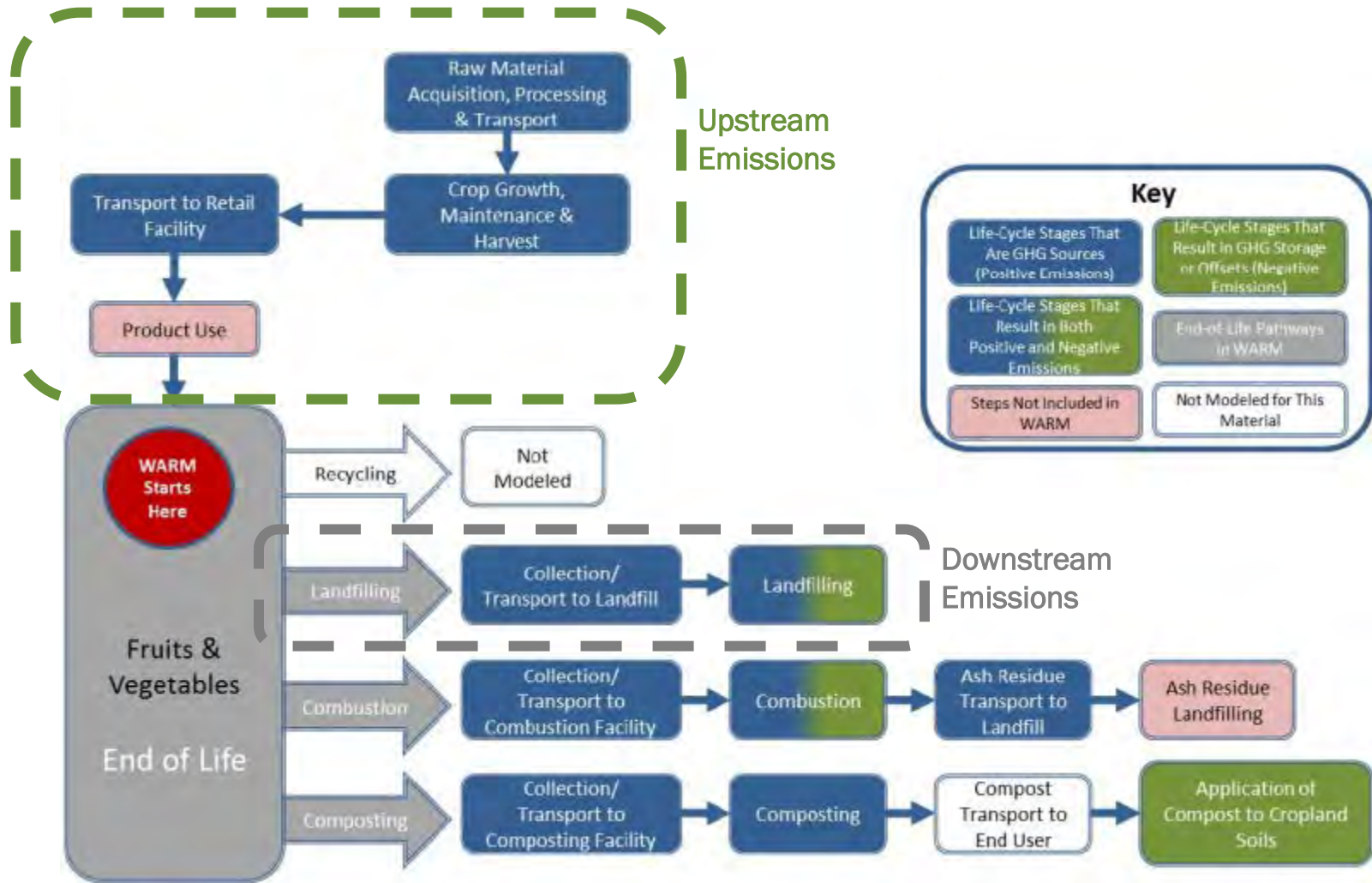
Fertilizer

Biodiversity

Quantification of Greenhouse Gas Emissions

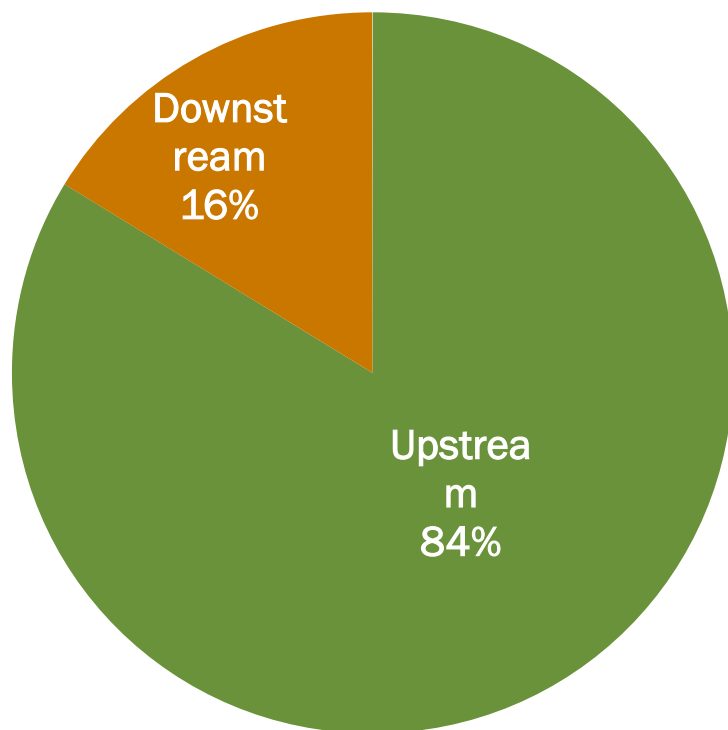
- Greenhouse gas (GHG) emissions can be quantified through inventory or life-cycle assessment approach
 - Inventory: Focus on methane generation in landfills, reported by country to the Intergovernmental Panel on Climate Change
 - Life-cycle assessment: Modeling **upstream and downstream** GHG emissions for the life-cycle of food that is wasted
 - **Focus of this presentation on life-cycle GHGs**
- Waste Reduction Model (WARM) tool developed by the US Environmental Protection Agency (EPA) was used to calculate life-cycle GHGs for all three countries, with emission factors adjusted where possible for Canada and Mexico
- WARM outputs may not accurately reflect the situation in non-US countries

Sources of Greenhouse Gas Emissions



Source: Adapted from EPA 2015

Upstream versus Downstream Greenhouse Gas Emissions



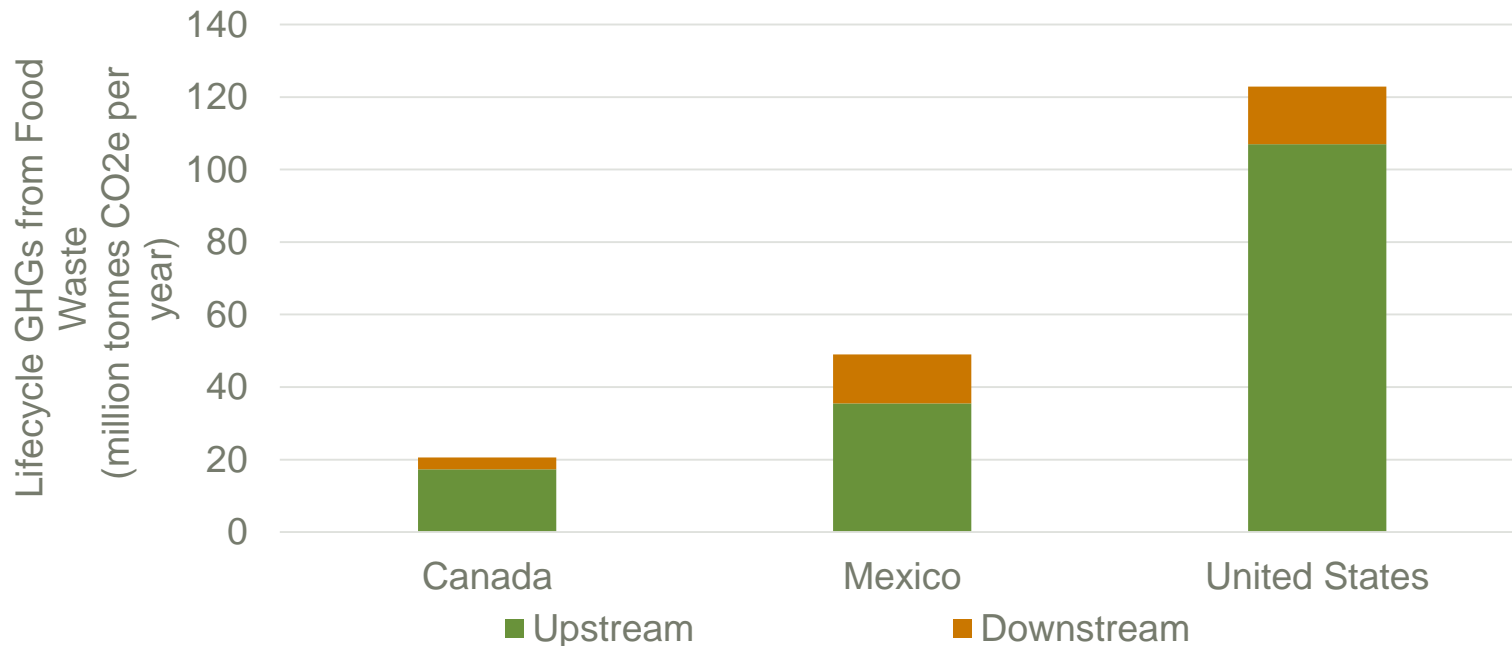
Upstream: 4 tonnes carbon dioxide equivalent (CO₂e)/tonne of food wasted

Downstream: 0.8 tonnes CO₂e/tonne of food wasted

Source: Emission factors based on the US EPA's WARM tool (EPA 2015) from weighted average emission factors from 5 food groups (beef, poultry, grains, fruits and vegetables, dairy products). Upstream emissions excludes product use. Downstream emissions only include landfilling.

Lifecycle GHGs from Food Waste

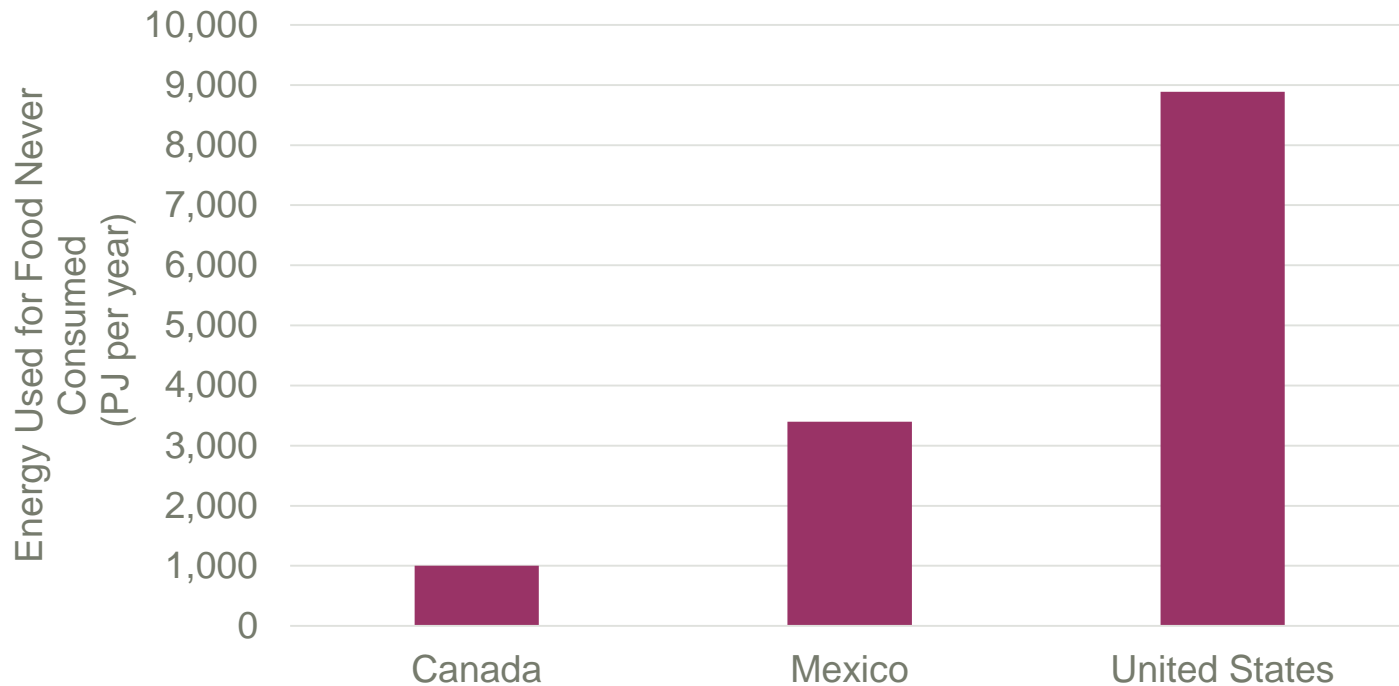
- 192 million tonnes CO₂e/year of GHGs from food waste in North America, equivalent to **41 million cars driven for a year**
- 160 million tonnes CO₂e/year from upstream emissions alone, equivalent to **34 million cars driven for a year**



Source: Emission factors based on the US EPA's WARM tool (EPA 2015). Includes lifecycle GHGs for food waste currently destined to landfill. WARM outputs may not accurately reflect the situation in non-US countries.

Wasted Energy

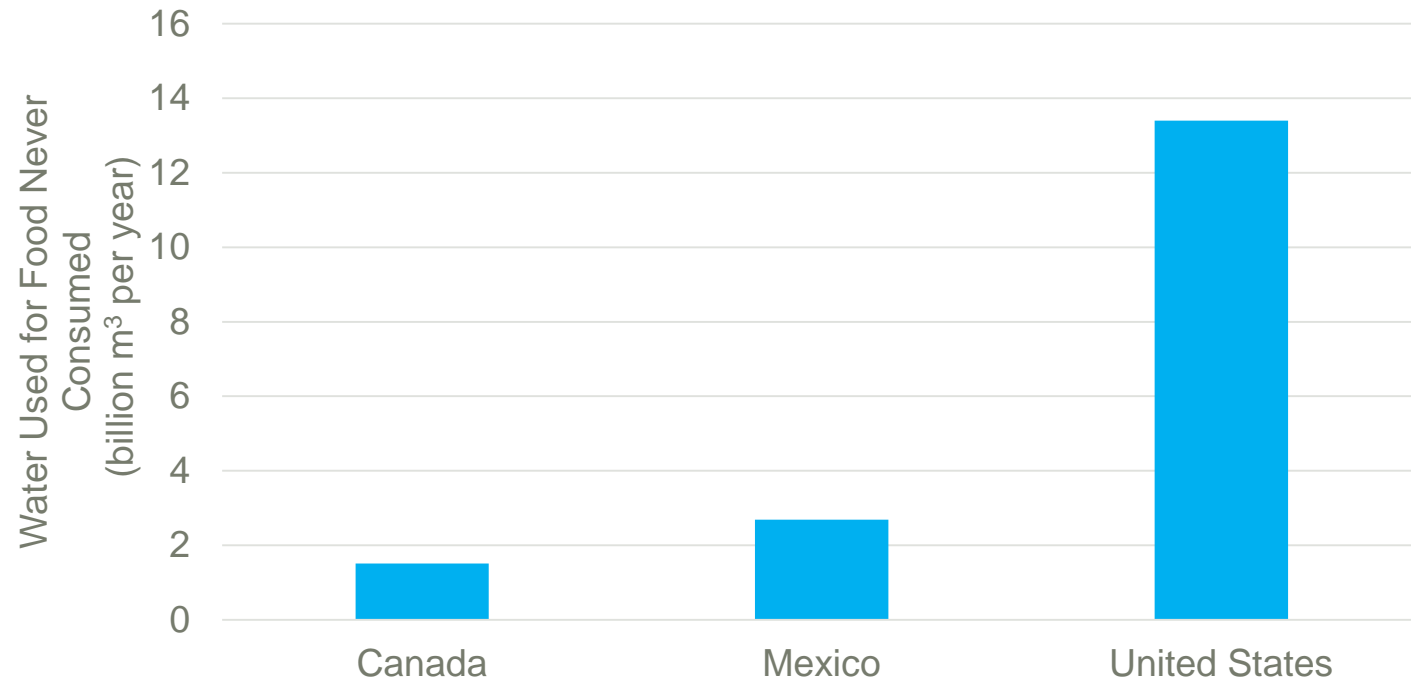
- 13,000 PJ (1 petajoule = 10^{15} joules) of energy used per year for food that is produced but never consumed in North America, equivalent to **powering 274 million homes in a year**



Source: Based on embedded energy in food waste for the United States from Cuellar and Webber (2010), extrapolated for North America.

Wasted Water

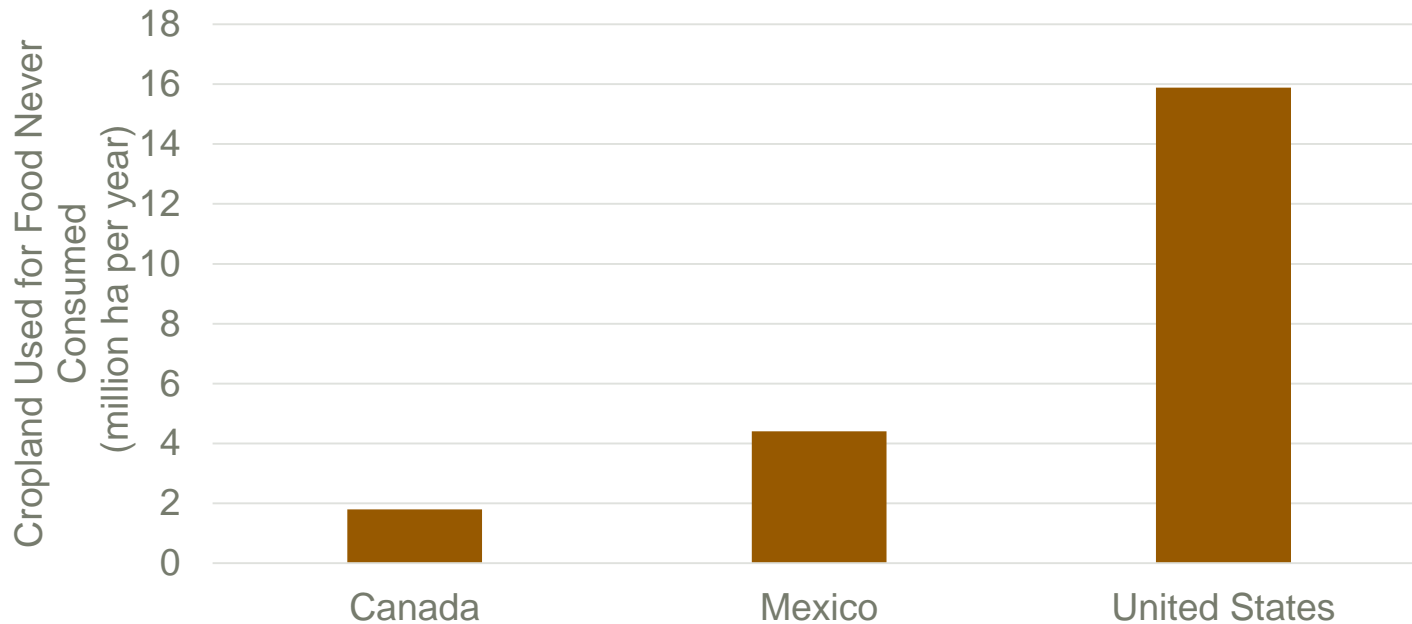
- 18 billion m³ of water used per year to grow food that is produced but never consumed in North America, equivalent to filling **7 million Olympic-sized swimming pools**



Source: Based on per capita wastage of water from food loss and waste by country region from Kummu (2012).

Wasted Cropland

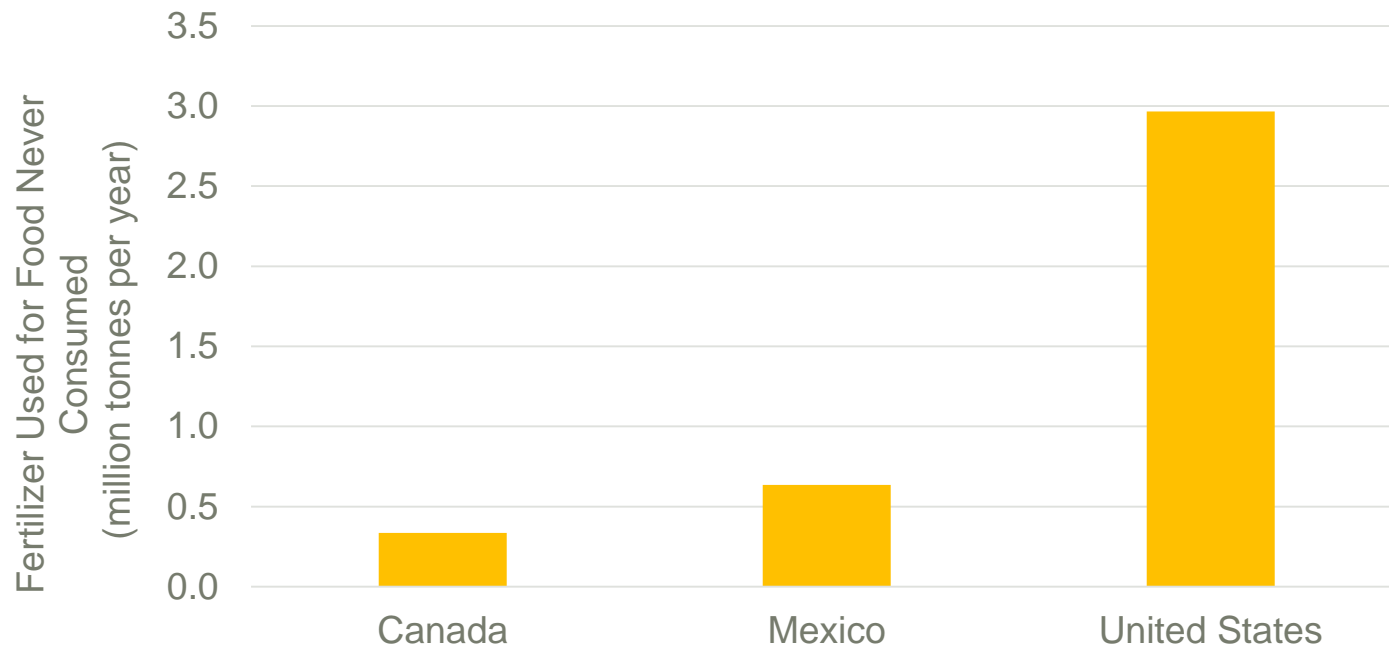
- 22 million hectares of cropland per year used to grow food that is produced but never consumed in North America, enough to cover the **entire state of Utah**



Source: Based on per capita wastage of cropland from food loss and waste by country region from Kummu (2012).

Wasted Fertilizer

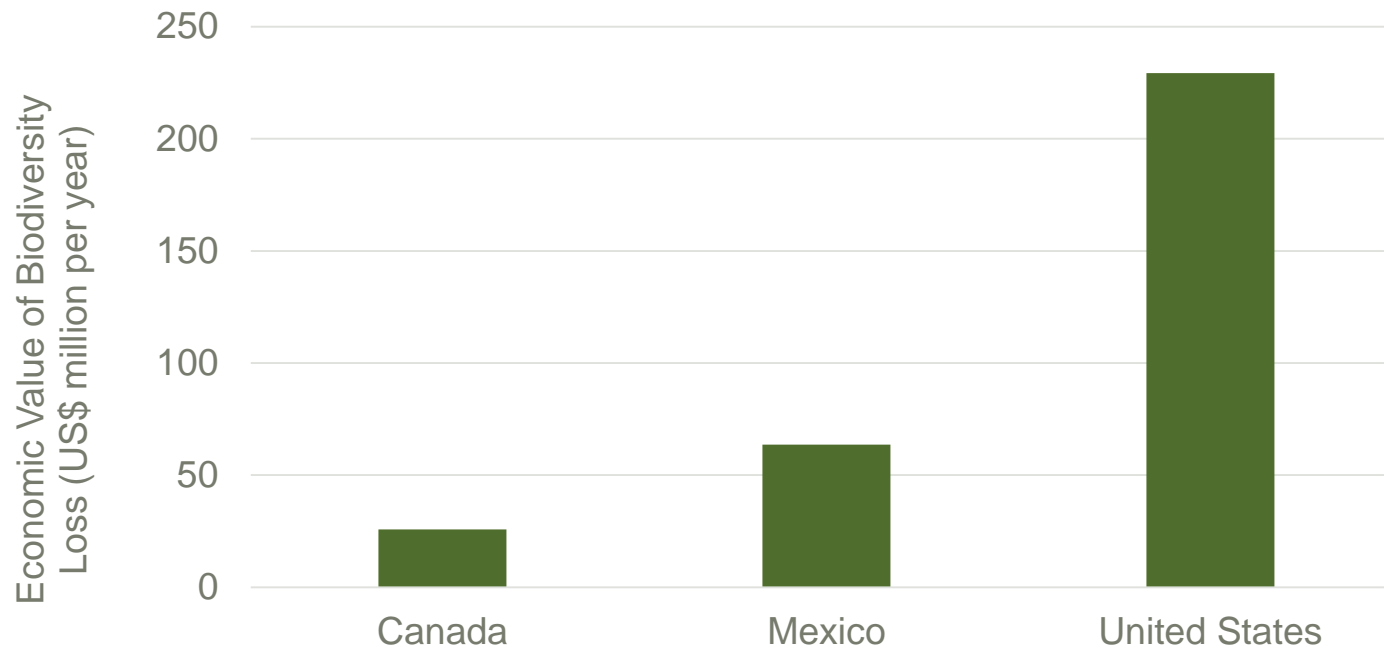
- 3.9 million tonnes of fertilizer per year used for food that is produced but never consumed in North America, enough to **cover arable land the size of the state of Chihuahua for a year**



Source: Based on per capita wastage of fertilizer from food loss and waste by country region from Kummu (2012).

Biodiversity Loss

- Equivalent economic value of biodiversity loss from food that is produced but never consumed in North America is approximately US\$318 million per year



Source: Based on per hectare dollar values of nitrogen eutrophication, phosphorus eutrophication and pesticide impacts from FAO (2014), extrapolated for North America based on wasted cropland.

Socio-Economic Impacts

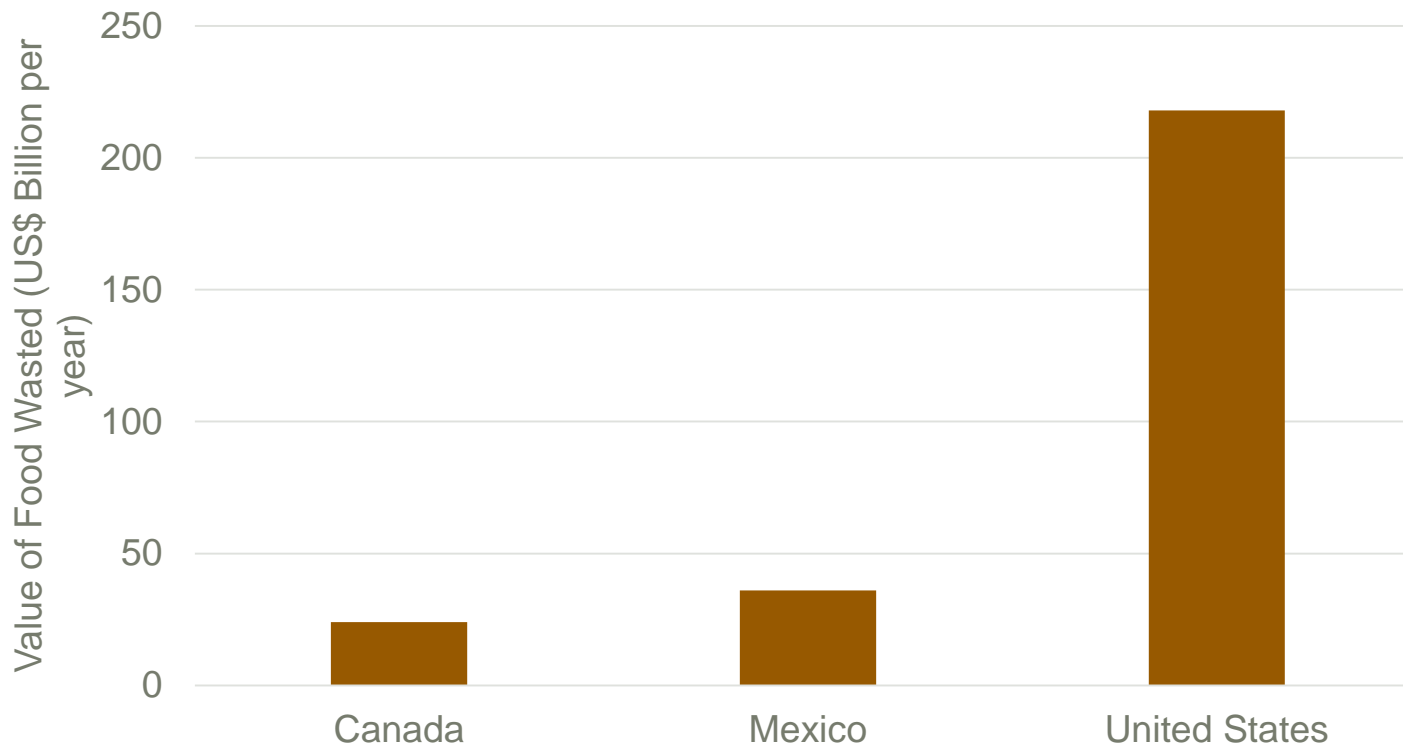
Money

Calories



Wasted Money

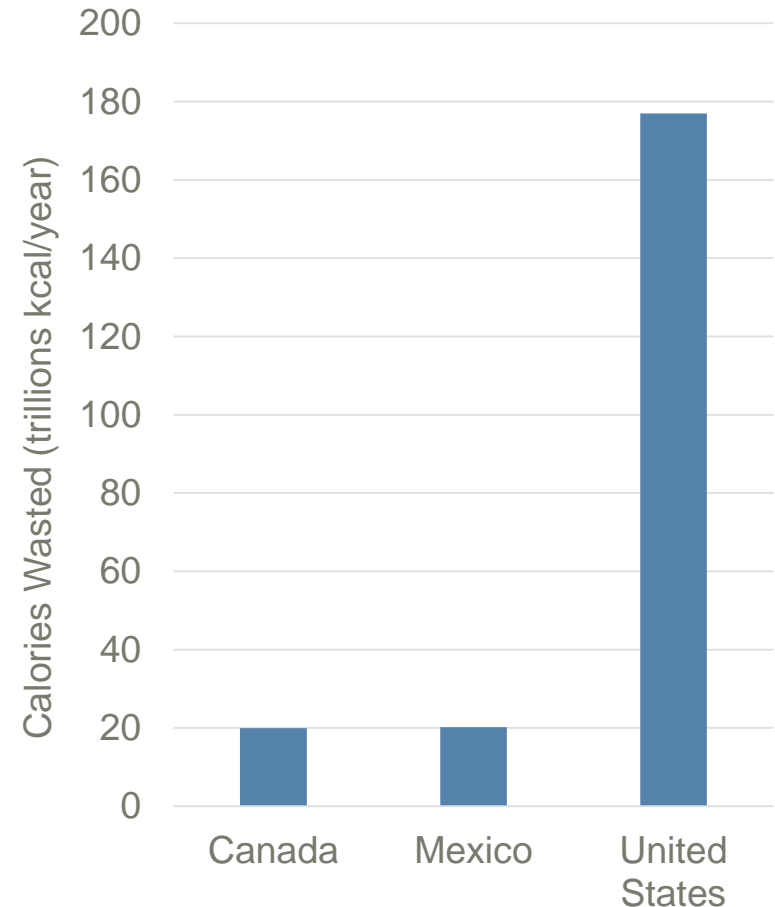
- The value of food that is produced but not consumed in North America is approximately US\$278 billion per year



Source: Gooch et al. (2014), Aguilar (2016), ReFED (2016)

Wasted Calories

- Current Rates of Food Insecurity in North America (by % of population)
 - Canada: 8% (StatsCan 2015)
 - Mexico: 23% (CONEVAL 2014)
 - United States: 13% (USDA 2016)
- Food-insecure population across North America is approximately 72 million
- The calories in food that is never consumed in North America is approximately 220 trillion kcal per year, enough to **feed 260 million people in one year**



Source: Based on per capita kcal lost from food waste from WRI (2013).

Implementation Scenarios

Assumptions

Greenhouse Gas Emissions



Potential Lifecycle Greenhouse Gas Reduction Scenarios

- **High Implementation**
 - 50% reduction in edible food waste at retail, foodservice, consumer, processing and distribution
- **Limited Implementation**
 - 20% reduction in edible food waste at retail, foodservice, consumer, processing and distribution
- **Business As Usual**
 - No changes to amount of food waste generated and disposed of

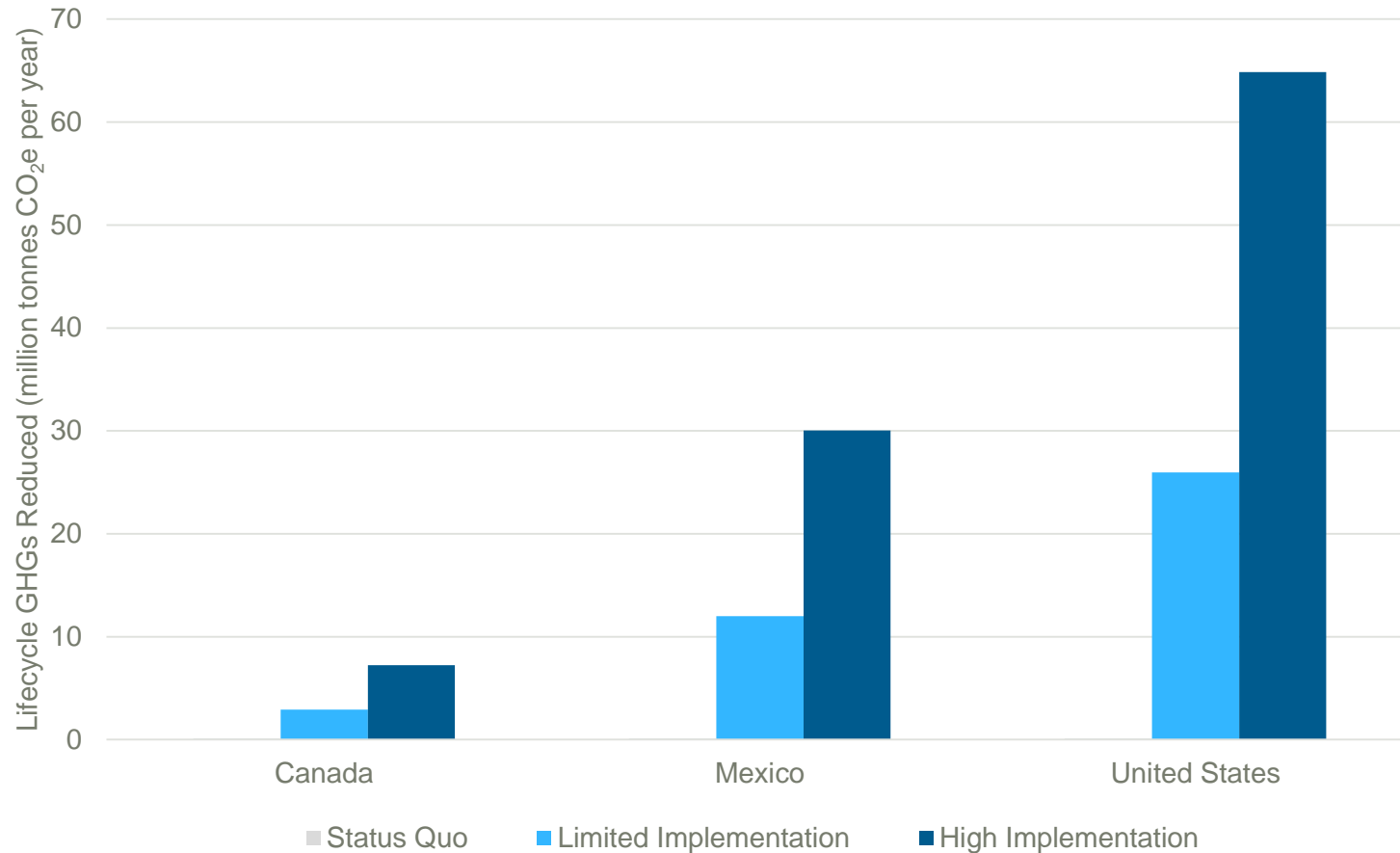


Source: StopWaste.Org, 2016

Scenario Assumptions

Country	Canada	Mexico	United States
Total Food Waste (million tonnes/year)	18	31	161
Food Waste in Post-Harvest/Distribution/Retail/Food Service (million tonnes/year)	5	16	43
Edible Food Waste in Post-Harvest/Distribution/Retail/Food Service (million tonnes/year)	3	11	28
Food Waste Reduced by High Implementation Scenario (million tonnes/year)	1.5	5	14
Food Waste Reduced by Limited Implementation Scenario (million tonnes/year)	0.6	2	6

Potential Reduction of Greenhouse Gases



Source: Emission factors based on the US EPA's WARM tool (EPA 2015). Includes lifecycle GHGs for food waste currently destined for landfill. WARM outputs may not accurately reflect the situation in non-US countries.



Thank you

Questions?

Tetra Tech Project Team