

Project Name:

Canfresh Organic Waste Recycle,

a clean solution to increase recycle rate and reduce GHG emission.

2018-07

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\*\* GHG Data based on Ontario Waste Management Association report, Dec. 2015

\*\* Costs and rates based on city of Ottawa, 2017. (Ottawa, Ontario)

## PART 1: Description of the Problem

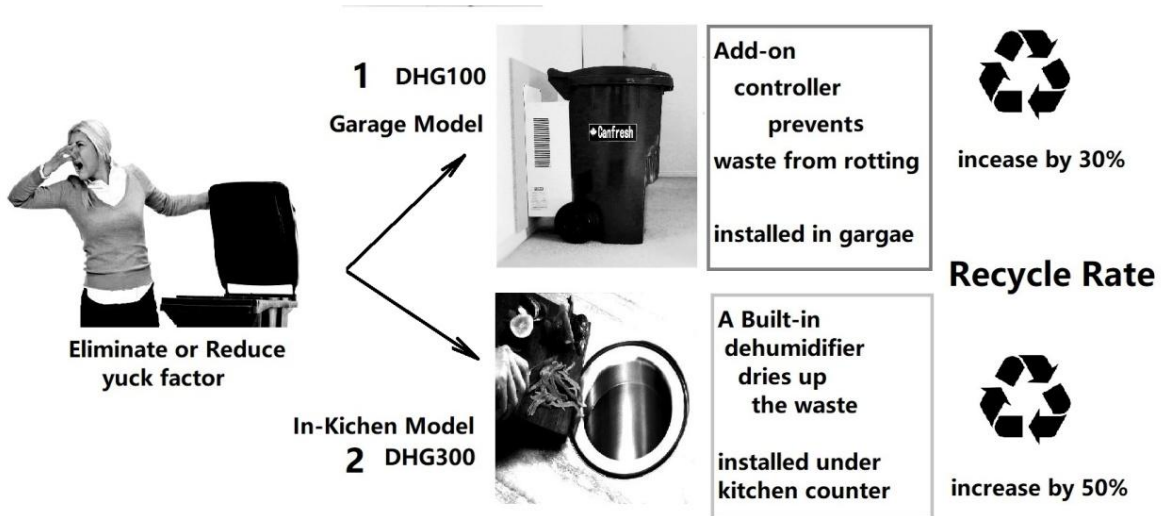
1. Canada has been working on organic waste recycling for over 10 years, but in 2017 the average **organic waste** recycling rate is still under 50%, and half or more organic waste still ends up in landfills.
2. In daily residential recycling practice, the "**yuck factor**" (odours, flies and maggots) of waste has held back more than 50% residents from participating in organic waste recycling program.
3. Most residents are positive in recycling, but some ( 58% or more) people still wrap up the organic waste with plastic bags, and let it go with landfill garbage, simply because it is **yuck**. This is the actual reason that why organic waste recycle rate (42%) is much lower in comparing to paper, plastic, glass and metals (over 90%).
4. On a daily basis, if the organic recycling is clean and easy as paper and plastics recycling, the recycle rate can be boosted to 70% -90% .
5. Ontario Residents generate **1.8 mega tonnes** organic waste each year (in weight).<sup>1</sup>
6. 1 tonne of organic waste may emits 1.85 tonne CO<sub>2</sub> eq in landfills. Organic waste landfills (residential, industrial and commercial ) account 4.0% of total GHG emission in Ontario.<sup>1</sup>
7. Only 42% of the waste is recycled or composted, and nearly **58%**, or **1.04 Mt** (in weight) ends up in landfills.<sup>2</sup> This will produces 1.93 mega tonnes CO<sub>2</sub> eq GHG emission.<sup>3</sup>
8. Residential organic waste accounts 1.14% of total GHG emission in Ontario<sup>4</sup>

### Notes:

- <sup>1</sup> This figure does not include leaf and yard waste, ICI and CRD waste.  
The average recycling rate is about 45% if leaf and yard waste is included.
- <sup>1</sup> Fig.2, Page 3, OWMA (Ontario waste management association) report, Dec 2015.  
Statistics Canada, CANSIM Tables 153-0043 and 153-0045.
- <sup>2</sup> Fig.2, Page 3, OWMA (Ontario waste management association) report, Dec 2015.  
Page 21, OWMA (Ontario waste management association) report, Dec 2015.
- <sup>2</sup> Of the **3.7 Mt** of food and yard waste generated in Ontario, (1.8 Mt organic waste and 0.7 yard waste from residential, 1.2 Mt organic waste from ICI and CRD). 1.4 Mt organic waste is being diverted to anaerobic digesters (200 Kt), on-farm digesters (175 Kt), open windrow composting (520 Kt) and contained composting (485 Kt), backyard composting (200Kt) is not included.  
  
At least **1.48Mt** (metric) organic waste ends up in landfill ( include leaf and yard waste, ICI and CRD ).  
The above figure portrays the estimated waste generation by type for Ontario and is based on a data from Statistics Canada, Waste Diversion Ontario, and industry sources for 2012-2014.
- <sup>2</sup> 45-55% residents use Green Bin, over 40-65% organic waste ends up in landfills, (page 13,14,15 Waste Watch Ottawa Report, 2017)  
52% residents use Green Bin, over 50% organic waste goes landfills, (Canfresh project, one by one Survey conducted in 2016, among 305 single house households in Nepean, Ottawa).
- <sup>3</sup> Organic waste GHG factor: food waste, 1kg in weight = 1.85Kg CO<sub>2</sub> eq . 1.0 metric tonne food waste =1.85 tonnes CO<sub>2</sub> eq .  
Table 1, Page 8, OWMA report, Dec 2015. and Table 1, U.S. Environmental Protection Agency,
- <sup>4</sup> Fig.1, Page 2, OWMA (Ontario waste management association) report, Dec 2015.

PART 2: Description of the Solution

1. Canfresh team has been working on collecting and storing solutions in organic waste recycling since 2014. Canfresh systems helps residents to divert more organic waste from landfills.
2. Eliminate or Reduce the **Yuck Factor** is the key technique used in Canfresh solutions.
3. This systems prevent organic waste from rotting or smelling, keep out of flies and maggots by sharp changing in humidity or temperature (DHG100), or low the humidity to under 30% (DHG300).
4. Canfresh Eco Recycle first time makes organic waste recycling as easy as **blue box** or **black box** recycling.
5. Canfresh **costs less** than using composting bags in daily operation.
6. Canfresh DHG100 is an **add-on equipment** based on the city green bin program.
7. Canfresh DHG300 is an **under counter system** designed for household kitchens.
8. Canfresh system does not change the habits people used to be in residential recycling routine.
9. The system can hold organic waste for 2-4 weeks.



### PART 3: Description of the Direct Benefits

1. Direct benefits from Canfresh Eco Recycle system.

All estimations based on **each** unit for one household of three persons, in 10 years' equipment life span.

- 1.1, Directly reduce GHG by up to 2.07 tonnes in weight (a increase of 50% recycle rate),  
that is **3.83 + 0.269 tonnes CO2 eq** in equipment life span.<sup>5, 7, 8</sup>
  - 1.2, Save **\$242** in direct landfill processing cost. ( \$118/ per tonne in weight) .<sup>6</sup>
  - 1.3, Save **\$548** in compost bags in 10 years. ( save 15-20 cents each day, compare with using compost bags )
  - 1.4, Store organic waste up to **2-4 weeks** , save collection and transportation costs.
  - 1.5, Clean and easy recycling. No odours, no flies, no maggots. A great improvement in living quality .
2. More cost-effective than most GHG reduction solutions, only **\$27.8 / per tonne CO2eq reduced**
  3. One-time equipment cost: \$52 / per tonne CO2eq **reduced** (in quantity over 10k units )<sup>7, 8.</sup>
  4. Comprehensive Cost (installation \$90, saving in landfills -\$242): **\$27.8 / per tonne CO2eq reduced.**<sup>6,7,8, 9.</sup>
  5. This cost is only about **1/3 to 1/10** of GHG reduction cost comparing to electric cars.

#### Notes:

<sup>5.</sup> 45-55% residents use Green Bin, over 40-65% organic waste ends up in landfills, (page 13,14,15 Waste Watch Ottawa Report, 2017)  
52% residents use Green Bin, over 50% organic waste goes landfills, (Canfresh project, one by one Survey conducted in 2016, among 305 single house households in Nepean, Ottawa).

<sup>5.</sup> Residential organic waste recycling rate is about 42% in Ottawa if leaf and yard waste not included.  
( Leaf and yard waste recycling rate is 90% to 95% in most cities ).

Source: Composting by households in Canada. Environstats by Iman Mustapha, Environment Accounts and Statistics Division.

<sup>6.</sup> Waste landfill cost, **\$118 - \$ 134** / each metric tonne in weight in Ontario. The Canadian Press · Posted: Oct 01, 2017  
( \*\* no verified official data source in landfill cost in 2018 )

<sup>7.</sup> Direct emission reduction1:  
1 unit Eco Recycle System for 1 household of 3 persons.  
Average organic waste generated annually: 138kg / person, 414kg / each household.  
Recycling rate increases from 42% to 92% after Eco Recycle deployed, landfills waste reduction: 207kg / year/ household.  
Total reduction in 10 years life span is **2.07 tonne in weight = 3.83 Tonne CO2 eq.** / per household

<sup>8.</sup> Direct emission reduction2:

Additional GHG reduction from replacement of chemical fertilize by organic fertilizer produced:

1 tonne food waste = 0.2 tonne organic fertilizer = 0.01 tonne chemical fertilizer = **0.13 tonne CO2 eq** GHG reduction.

Each Eco Recycle unit will further reduce **0.269 tonne CO2 eq** in 10 years life span.

<sup>9.</sup> Installation cost: **\$90 / per unit.**

**PART 4: Technology Readiness Level**

Canfresh was started in 2014.

Assessment	Basic Principles	Proof of concept	Patent	Mandate Regulations Ready	Prototype tested	In lab condition operation test	Actual operation environment test	Readiness percentage
1, DHG100	yes	yes	pending	yes*	yes	yes	yes	<b>90%</b>
2, DHG300	yes	yes	pending	no**	yes	yes	no	<b>80%</b>

DHG100: employ a mechanic dehumidification device to sharply change RH and T every 1 hour or every 2 hours.

DHG300: employ a semiconductor dehumidification unit to keep RH under 30%.

All system are designed in Canada and patents are pending.

\* Mandate Regulations applied: (DHG100)

- 1, UL SDT. 474
- 2, CSA SDT. C22.2. NO. 92
- 3, Energy Efficiency Valuation Canada:  
 $\geq 1.35L \text{ (water) / kWh}$   
 Natural Resources Canada EEV
- 4, Intertek certification: 4007884
- 5, Canada Patent App No. 2924886  
 US, 15/078177
- 6, Registered with Canada NRCan/RNCan, Natural Resources Canada energy efficiency data base
- 7, Canada Trademark registration: 1763924  
 US Trademark registration: 5130328

\*\* Mandate Regulations applied: (DHG300)

- 1, UL SDT. 474
- 2, CSA SDT. C22.2. NO. 92
- 3, Canada Trademark registration: 1763924  
 US Trademark registration: 5130328

## PART 5: Project Plan

### 1. Recently completed projects

	Projects and End User Conditions	Project Monitoring lasted time (in days )	Assessment / evaluation criteria
2016 2017	In residential kitchens DHG100	180 days	<input type="checkbox"/> 1, energy consumption <input type="checkbox"/> 2, recycle rate improvement <input type="checkbox"/> 3, odours <input type="checkbox"/> 4, noise <input type="checkbox"/> 5, user's experiences feedback
2016 2017	In offices DHG100	180 days	<input type="checkbox"/> 1, energy consumption <input type="checkbox"/> 2, recycling rate improvement <input type="checkbox"/> 3, odours <input type="checkbox"/> 4, noise <input type="checkbox"/> 5, user's experiences feedback
2017	In residential Garages DHG100	180 days	<input type="checkbox"/> 1, energy consumption <input type="checkbox"/> 2, recycling rate improvement <input type="checkbox"/> 3, odours <input type="checkbox"/> 4, vermin, flies, maggots <input type="checkbox"/> 5, user's experiences feedback
2017	Rain and sun shielded outdoor conditions. DHG100	120 days	<input type="checkbox"/> 1, energy consumption <input type="checkbox"/> 2, recycling rate improvement <input type="checkbox"/> 3, vermin <input type="checkbox"/> 4, safety <input type="checkbox"/> 5, user's experiences
2018	Demonstration Project	pending	Preparing for quantity (> 1000units ) demonstration project in communities.

### 2. Partnerships that are included as parts of the project

#### 3.1, **2000 households +** will be covered in this demonstration project in Nepean / Ottawa area.

Acting both as end users and project partners.

Detailed Project Agreements with community or selected families will be presented if necessary.

@ Single house ( DHG100 or DHG300)

@ Town house ( DHG100 or DHG300)

@ Apartment ( DHG300 only)

#### 3.2, Third Party Contractors ( to be decided)

3.2.1, Installation and maintenance work. ( may be covered by Canfresh Project Team)

3.2.2, Data collection. ( may be covered by Canfresh Project Team)

4. Anticipated start and end date and key milestones

Items	Deadline	Target / milestones
Build awareness in communities / residents, demonstration for end users	April, 2019	1, Flyers, emails, shows, meetings, advertisements, 2, Project Agreement with end users/ communities
Equipment Installation	2018--2022	1, How to use the Canfresh Recycle Bin 2, Q & A in daily recycling 3, Installation 2018-2019, 500units 2019-2020, 500units 2020-2021, 500units 2021-2022, 500units
Data , sample and collection	2019--2022	1, Recycling rate improvement 2, Residential recycling behaviour changes 3, User's experiences feedback 4, <u>Final cost evaluation: \$/ per tonne CO2 reduced</u>
Soft ware optimizing	2021	System efficiency improvement. Users' experience improvement.
Mechanical and hardware design optimizing	2021	Reliability and system efficiency improvement.
Scale and develop new models for commercial and industrial organic waste recycling	2022	1, Recycle system for waste in big volumes. customers: restaurants, catering places, hospitals, senior care centers.
Work out possible promoting, marketing, sales strategies and schedules with potential partners	2021	Get ready for: 1, prices, rebates, sales, distributors 2, installation service, 3, after sales services,
Ready for markets in Canada and USA	2022	Complete business models ready.

**PART 6: GHG Emission Reduction Potential and Outcomes**

1. Description of base case and baseline emission.

-----Two measurement units are used in the following : mega tonnes in weight / mega tonnes in CO<sub>2</sub>eq )

- 1.1, Total Ontario residential organic waste = **1.8 mega** tonnes in weight. ( 2013, leaf and yard waste no included)
- 1.2, Up to **58%** residential organic waste ends up in landfills = **1.04 mega** tonnes in weight in landfills. <sup>note 2</sup>
- 1.3, 1.04 mega tonnes in weight = **1.93 mega tonnes CO<sub>2</sub>eq** in GHG emission. ( if in landfills)
- 1.4, Every 10% recycle rate increased = **0.333 mega tonnes CO<sub>2</sub>eq** in GHG emission. ( Ontario Data)
- 1.5, Additional GHG reduction: ( not included in the following tables)  
Each 1 tonne (in weight) waste reduced = **0.13 CO<sub>2</sub>eq** reduction ( in replacement of eq. fertilizer)

2. Estimation of the annual GHG emission reductions (CO<sub>2</sub>eq) that the project is expected

	2020	2030	2050
30% recycle increased	up to 460 tonnes CO <sub>2</sub> eq annual @ 2000 households	0.092 mega tonnes CO <sub>2</sub> eq annual @ 0.4 million households	0.92 mega tonnes CO <sub>2</sub> eq annual @ 0.4 million households
50% recycle increased	up to 754 tonnes CO <sub>2</sub> eq annual @ 2000 households	0.151 mega tonnes CO <sub>2</sub> eq annual @ 0.4 million households	1.51 mega tonnes CO <sub>2</sub> eq annual @ up to 4 million households

GHG emission reduction based on each household (3 persons)/ per year

		CO <sub>2</sub> eq
1,	Total organic waste generated: 138kg / person, 414kg / each household. Ontario, per year	766kg CO <sub>2</sub> eq
2,	42% organic waste already recycled, that is 174kg / each household per year	322kg CO <sub>2</sub> eq
3,	50% recycle rate increase = 204kg recycle in weight	377kg CO <sub>2</sub> eq
4,	30% recycle rate increase = 124kg recycle in weight	230kg CO <sub>2</sub> eq



3. Cost-effectiveness evaluation

3.1, direct equipment and operation cost.

One-time Cost	1, landfills cost saving not included. 2, installation cost not included 3, chemical fertilizer replacement not included	cost per unit	Equipment Life Span
Operation Cost	\$0.022 / per tonne CO <sub>2</sub> eq reduced	210kWh /year	
Equipment Cost	\$ 55.09 / per tonne CO <sub>2</sub> eq reduced @ >100,000 units	\$211 / each	10 years
Equipment Cost	\$ 62.92 / per tonne CO <sub>2</sub> eq reduced @ 10,000 units	\$241 / each	10years
Equipment Cost	\$ 68.93 / per tonne CO <sub>2</sub> eq reduced @ <3,000 units	\$264 / each	10 years

3.2, comprehensive cost.

comprehensive cost	1, landfills cost saving \$118/ per tonne (w) included. 2, installation cost \$90/ per unit included 3, chemical fertilizer replacement 0.13 tonne CO <sub>2</sub> eq / per tonne organic waste included	cost / per unit	Equipment Life Span
Operation Cost	\$0.022 / per tonne CO <sub>2</sub> eq reduced	210kWh /year	
Cost @ 50% recycle increased	\$ 13.83 / per tonne CO <sub>2</sub> eq reduced @ >100,000 units	\$61 / each	10 years
	\$ 22.14 / per tonne CO <sub>2</sub> eq reduced @ 10,000 units	\$91 / each	10years
	\$ 27.74 / per tonne CO <sub>2</sub> eq reduced @ <3,000 units	\$114 / each	10 years
Cost @ 30% recycle increased	\$ 61.4 / per tonne CO <sub>2</sub> eq reduced @ >100,000 units	\$151 / each	10 years
	\$ 75.6 / per tonne CO <sub>2</sub> eq reduced @ 10,000 units	\$181 / each	10years
	\$ 82.9 / per tonne CO <sub>2</sub> eq reduced @ <3,000 units	\$204/ each	10 years

\* Direct emission reduction:  
1 tonne organic waste = 1.85 tonnes CO<sub>2</sub> eq GHG emission.

\*\* Additional GHG reduction  
Additional GHG reduction from replacement of chemical fertilize by organic fertilizer produced:  
1 tonne food waste = 0.2 tonne organic fertilizer = 0.01 tonne chemical fertilizer = **0.13CO<sub>2</sub> eq** GHG reduction.

\*\*\* Landfill cost  
50% recycle rate increase, 2.07 tonnes landfill cost saving: \$244  
30% recycle rate increase, 1.24 tonnes landfill cost saving: \$147

PART 7: Description of the GHG emission quantification **methodology** used for the estimations generated above.

- 1, Ontario residential organic waste = 1.8 mega tonnes in weight each year, 13million in total population.  
Each person generates an average of 138 kg organic waste in weight each year <sup>1</sup> .  
Each household of three generates  $138\text{kg} \times 3 = \underline{414\text{kg}}$  organic waste in weight each year.
- 2, GHG factor: 1 kg in weight = 1.85 kg CO<sub>2</sub> eq. ( factor =  $1.85\text{kg CO}_2 / \text{kg}$  or  $1.85\text{T CO}_2 / 1.0 \text{T}$  )  
( 95% residential organic waste is food waste, leaf and yard waste not included in this project )  
Electricity GHG factor: 1kWh electricity = 0.043 kg CO<sub>2</sub> eq. (factor =  $0.043 \text{ kg CO}_2 / \text{kWh}$ )
- 3, One Eco-Recycle unit for one household, an average of 3 persons / each household.  
Present recycled waste: 173.9 kg/ each household annually before using Eco Recycle. ( at 42% rate )  
Estimated recycle target: 380.9 kg/ each household annually after using Eco Recycle. ( at 92% rate )  
298.1 kg/ each household annually after using Eco Recycle. ( at 72% rate )
- 4, Energy Cost in operation ( data based on Ottawa climate conditions, 2016-2017 )  
0.7kWh /day @ 12°C, 1.4kWh/ day @26°C or higher, an average of 210kWh/ year, 2100kWh / 10 year.  
210kWh = 9.02kg CO<sub>2</sub> eq, ( each year )  
2100kWh = 90.3kg CO<sub>2</sub> eq = 0.0903 Tonne CO<sub>2</sub> eq. ( 10 years life span )
- 5, Cost / CO<sub>2</sub>eq reduced:  
Cost of each Canfresh equipment, each unit , \$211-\$264, @ 3k -100k units  
Cost saving in landfills, \$118/ per tonne waste landfill in weight.  
Cost of equipment installation, per unit, ( per household). \$90.

Notes:

- <sup>1</sup> This figure does not include leaf and yard waste, does not include ICI and CRD waste.
- <sup>1</sup> Fig.2, Page 3, OWMA (Ontario waste management association) report, Dec 2015.  
Statistics Canada, CANSIM Tables 153-0043 and 153-0045.
- <sup>1</sup> Page 21, OWMA (Ontario waste management association) report, Dec 2015.  
Of the 3.7 Mt of food and yard waste generated in Ontario, (1.8 Mt organic waste and 0.7 yard waste from residential, 1.2 Mt organic waste from ICI and CRD). 1.4 Mt organic waste is being diverted to anaerobic digesters (200 Kt), on-farm digesters (175 Kt), open windrow composting (520 Kt) and contained composting (485 Kt), backyard composting (200Kt) is not included.  
At least 1.48Mt (metric) organic waste ends up in landfill.  
The above figure portrays the estimated waste generation by type for Ontario and is based on a data from Statistics Canada, Waste Diversion Ontario, and industry sources for 2012-2014.
- <sup>2</sup> 45-55% residents use Green Bin, over 40-65% organic waste ends up in landfills, (page 13,14,15 Waste Watch Ottawa Report, 2017)  
52% residents use Green Bin, over 50% organic waste goes landfills, (Canfresh project, one by one Survey conducted in 2016, among 305 single house households in Nepean, Ottawa).
- <sup>3</sup> Organic waste landfill emission factor: food waste 1kg = 1.85 **CO<sub>2</sub> eq.** 1 tonne food waste = 1.85 tonnes CO<sub>2</sub> eq .  
Table 1, Page 8, OWMA report, Dec 2015. U.S. Environmental Protection Agency, “Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM)”, prepared by ICF International for the US EPA Office of Resource Conservation and Recovery, Washington, March 2015.
- <sup>3</sup> Fig.1, Page 2, OWMA (Ontario waste management association) report, Dec 2015.
- <sup>4</sup> 1.0T organic waste will be converted into 0.2T organic fertilizer. Each 1T chemical fertilizer = 50 kg organic fertilizer.  
SAAR <http://dx.doi.org/10.3329/sja.v15i2.35158>,  
EFFECTS OF ORGANIC AND INORGANIC FERTILIZERS ON LETTUCE AND SOIL PROPERTIES
- <sup>4</sup> GHG emission factor: chemical fertilizer, 1 kg = CO<sub>2</sub> eq in production process + CO<sub>2</sub> eq in soil nutrient = 13 kg CO<sub>2</sub> eq  
Fertilizers Europe, page 21, Energy efficiency and green house emission.  
35, D-48249 Dülmen, Germany Fertilizers Europe - European Fertilizer Industry Association, Reproduced  
Updated by permission of the International Fertiliser Society [www.fertiliser-society.org] from its Proceedings 639 (2008).

PART 8, Non- GHG benefits, ( based on Each Eco Recycle unit , 10 years life span)

1. Save **\$242** in direct landfill cost. ( \$118/ 1.0 tonne waste landfill in weight in Ontario) .<sup>6</sup>
2. Save 50% -75% cost in collection labours, save up to 50% cost in waste transportations.  
by making curbside weekly collection to bi-week or monthly .
3. Save over **\$548** cost in compost bags in 10 years. (one compost bag each day)  
save 15-20 cents each day compare with using compost bags in green bin program.
4. A great improvement in quality of living .  
Store organic waste up to **4 weeks** .  
Clean and easy recycle. No odours, no flies, no maggots.
5. Make organic waste commercial processing more efficient.  
by increasing recycling volumes, decreasing water or moisture content in the waste .  
when using Canfresh Eco recycle system.
6. Possibly create 2 job positions in Circular Economy for each **1000 units** Canfresh Eco Recycle deployed.  
( \$100,000 investment for each full time job position-year, installation + sales = \$200 )

Note 1,

- <sup>6</sup>. Waste landfill cost, **\$118 - \$ 134** / each metric tonne in weight in Ontario.  
The Canadian Press. Posted: Oct 01, 2017  
( \*\* no 2018 official data source acquired in waste landfill cost )
- <sup>6</sup>. Small sized compost bag: 20-30 cents each. 1-2 bags each day/ per household.

## PART 9, Performance monitoring approach and data collection strategy

Three categories of data will be sampled, collected and analysed in the project.

### 1, Choose participating households:

- 1.1, Single house, town house, apartment, signing project agreements with residents or community
- 1.2, Single house DHG100/300, , town house DHG100/300, apartment, DHG300 only
- 1.3, Installation: in garage, under counter in kitchen
- 1.4, Data collection period: 4 year

### 2, Organic waste recycling rate: ( on curbside collection day)

- 2.1 Households **with** the Eco Recycle system installed.
- 2.2, How much organic waste collected in the green box at the curbside collection day. ( W1)
- 2.3, How much organic waste is in the landfill box at the curbside collection day. ( W2)

Absolute Recycled =W1

Recycling rate R =  $W1 / (W1+W2)$

\* if W2. is not available in practical collection, the latest data from Waste Management Organization or Statistics Canada will be used.

\* W1= actual weight in normal condition. Coefficient factor is applied regarding waste humidity conditions.

### 3, End user experience feedback data collection.

- 3,1 convenience factor. 1-5
- 3,2 odour / flies / vermin factor. 1-5
- 3.3 preferred installation position. 1-2
- 3.4 preferred curbside collection schedule: weekly, bi-weekly, or monthly, 1-3
- 3,5 residents suggestions.
- 3.6 city garbage collection worker's suggestions.
- 3,7 preference in DHG100 or DHG300, 1-2

PART 10, Market Transformation Potential

1. There are more than **4 million** green bins (organic recycle) in using in Ontario. Waste-Free Ontario Act will make residential organic waste recycling a mandate in coming years.

But the existing green bin program does not work well (yuck factor and low recycling rate), the market demands for "clean, easy recycle" are potentially increasing, and will boost a new market in the coming 5-20 years.

10 million potential end users in Canada

100 million potential end users in USA.

2. Canfresh Eco Recycle is the most reliable and practical solution ready in market.
3. Canfresh will benefit environment, government and residents at the same time.

\*\*\*Environment / Government benefits:

3.1, A **1.66 mega tonnes** CO2 eq potential GHG direct reduction at a low cost of \$13-\$27 / per tonne CO2 eq. <sup>note 6.</sup>

3.2, All costs can be recovered by means of "**SCC: Social Cost of Carbon**". <sup>note 7</sup>

3.3, **7-8 k** potential full-time job positions (year) will be created in Ontario <sup>note 8.</sup> ( sales, installation and services)

3.4, Save **\$ 118 - \$124** / per tonne waste (w) in landfills cost.

3.5, Save garbage collection and transportation costs.

\*\*\*Residents Benefits:

3.5, Save \$55- \$73 in compost bag cost, per year, per household.

3.6, Make every day recycling easy, clean and healthy.

<sup>note 6</sup> Data from Ontario Waste Management report 2015.

<sup>note 7</sup> Social cost of carbon: \$ 78.4/ per tonne CO2 eq. in 2050, \$40.7 in 2016

<sup>note 8</sup> Based on the estimation of \$100,000 investment for each full time job position-year.

4. Cost-effectiveness 1: Unit cost vs. Number of equipment

Installation cost and sales (profit) cost included

**Each unit Costs = equipment cost \$ + installation cost \$90 + sales profit \$110**

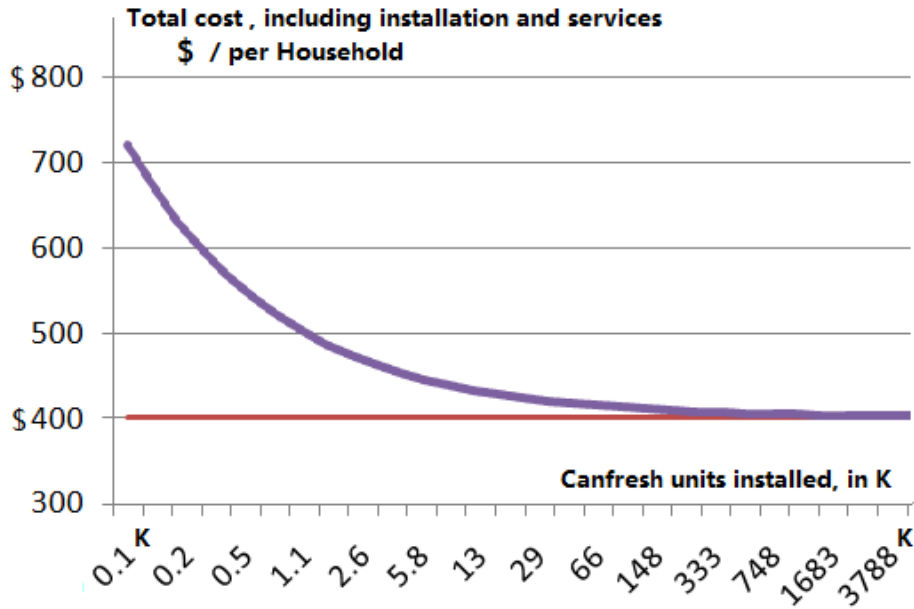
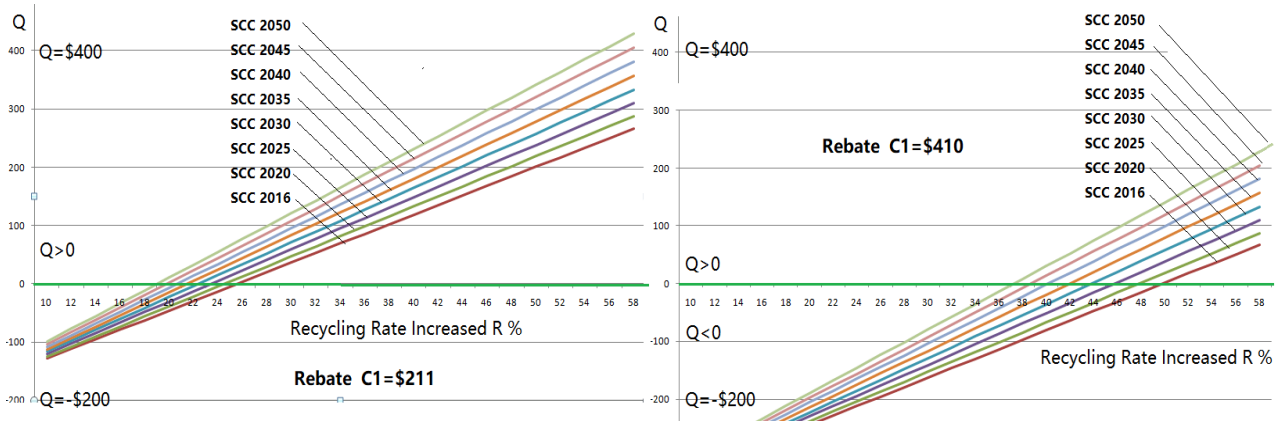


Fig.1, Canfresh costs (in \$) is related to the number of units installed. (in 1,000 units)

- \*\* Equipment cost: \$211-\$264, based on quantity.
- \*\* Installation cost, \$70-\$90 per unit. This will create new job positions in circular economy section.
- \*\* Estimated sales profit for distributors, \$100-\$120 per unit.  
This will create new job positions in circular economy section
  
- \*\* installation labor cost accounts 44% and more in total cost

5. Cost-effectiveness 2: comprehensive investment outcomes

Where, when  $Q > 0$ , the investments will make a positive outcome.



----- Fig. 2, Equivalent profit margins via Rebate \$ , based on different initial costs, Recycle rates and SCCs -----1\*

1\* Cost-effectiveness Q analysis are using following data:

- 1.1. Each Eco Recycle unit for one household of 3 persons. life span = 10 years.
- 1.2. 138kg / per person, annually residential organic waste generated.
- 1.3. Equipment cost \$ 211 each.
- 1.4. Direct reduction in landfill cost \$118 / per tonne waste landfills(w).
- 1.5. Estimated profit for distributors or sales, \$110 each sale. (business cost)
- 1.6. Installation cost \$90 per installation. ( when total > 2k units)
- 1.7. New job positions created: 2 full time job positions- year / every 1000 units. ( installation + sales = \$200/ per unit)

where in:

R = recycling rate increased , (baseline recycle rate is 42%, 2015)

SCC= social cost of carbon per tonne CO2 eq in Canadian dollars

Equivalence cost-effectiveness : Q

$$Q = \text{total equivalence benefits} - \text{total cost } C1$$

$$= \text{Landfill cost reduction } (\$118 \times 1.38 \text{ t} \times 3 \times R) + \text{Carbon cost recovery } (1.38 \text{ t} \times 3 \times R \times 1.85 \times \text{SCC}) - \text{total cost } C1 ,$$

$$Q = 488.52 R + 7.66 \times R \times \text{SCC} - C1$$

where:

C1= \$211..... direct equipment manufacture cost only

or C1= \$410..... equipment \$211+ installation cost \$ 90 + cost in sales ( sales profit) \$110)

Notes: SCC ( social cost of carbon central value ) in Canadian dollars

	2016	2020	2025	2030	2035	2040	2045	2050
Social Cost of CO2	\$40.7	\$45.1	\$49.8	\$54.5	\$59.6	\$64.7	\$69.7	\$74.8

Updated Canadian SCC Estimates for Period 2010-2050 , (2012, per tonne CO<sub>2</sub>, discounted at 3%). Social Cost of Greenhouse Gas Estimates, March 2016, Environment and Climate Change Canada, August 2015, the U.S. Environmental Protection Agency (USEPA)

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[https://www.youtube.com/watch?v=9\\_C0q0E9T0Y](https://www.youtube.com/watch?v=9_C0q0E9T0Y)