The Role of Farmers as Agents in Policy Effectiveness

Understanding Framers’ Priorities and Diversity

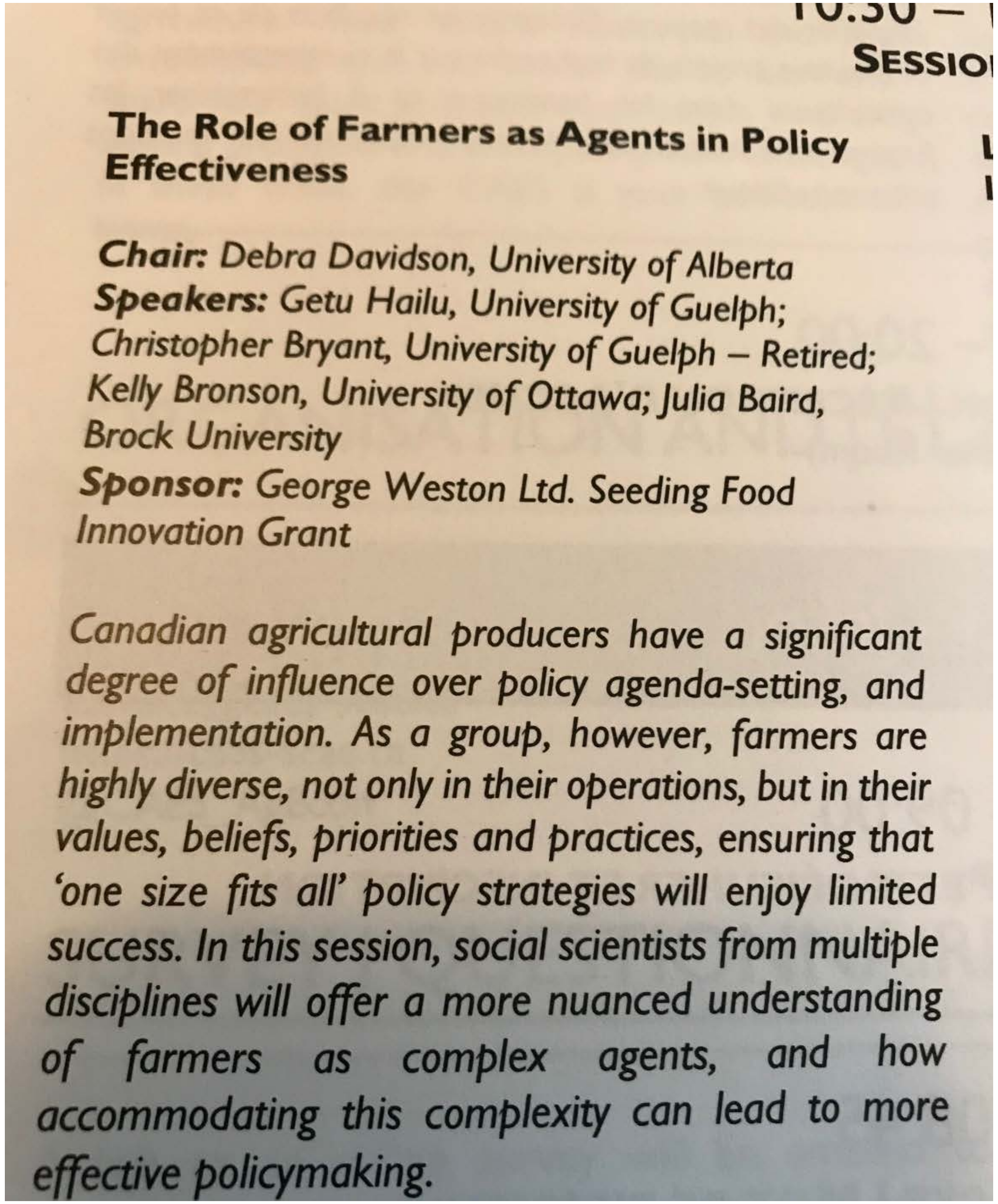
Getu Hailu

Ninth Annual Canadian Agri-Food Policy Conference
February 14, 2019

Agri-Environmental Policy and Programs

UNIVERSITY of GUELPH
ONTARIO AGRICULTURAL COLLEGE
DEPARTMENT OF FOOD, AGRICULTURAL AND RESOURCE ECONOMICS

Homework



10:30 –

SESSIO

The Role of Farmers as Agents in Policy Effectiveness

Chair: *Debra Davidson, University of Alberta*
Speakers: *Getu Hailu, University of Guelph; Christopher Bryant, University of Guelph – Retired; Kelly Bronson, University of Ottawa; Julia Baird, Brock University*
Sponsor: *George Weston Ltd. Seeding Food Innovation Grant*

Canadian agricultural producers have a significant degree of influence over policy agenda-setting, and implementation. As a group, however, farmers are highly diverse, not only in their operations, but in their values, beliefs, priorities and practices, ensuring that 'one size fits all' policy strategies will enjoy limited success. In this session, social scientists from multiple disciplines will offer a more nuanced understanding of farmers as complex agents, and how accommodating this complexity can lead to more effective policymaking.

Government Policy Objectives

- **Farmers**
  - Achieve acceptable income
  - Reduce income instability
  - Improve competitiveness

- **Consumers**
  - Provide safe and high quality food at fair prices
  - Assure food security
  - Contribute to energy security

- **Society at large**
  - Protect natural environment & biodiversity
  - Preserve cultural landscapes
  - Contribute to the viability of the rural areas

Government policy objectives fall under …

- Addressing issues relating to equity and income distribution, or

- Correcting of market failures
  - e.g., environmental concerns

The Effectiveness of Government Farm Policy and Programs

Issue: Slow adoption of farming practices / technologies.

- Understand farmers' **behavior** (*i.e.,* an action or a set of actions)
  - **Priorities (incentives)**
    - e.g., Green technology must be superior in terms of the firms' private incentives – **efficiency gain, cost savings**

- Recognize the **diversity** in motives, performance, preferences and perceptions of farmers.

ELLEN AIRHART SCIENCE 06.09.17 07:00 AM

CANADA IS USING GENETICS TO MAKE COWS LESS GASSY

Our obsession with cows is causing almost 10% of global warming emissions

By Roberto A. Ferdman • September 27, 2013

Methane emissions from cattle are 11% higher than estimated

Bigger livestock in larger numbers in more regions has led to methane in the air climbing faster than predicted due to 'out-of-date data'

▲ A sharp rise in methane pollution could jeopardise the
Graham Turner for the Guardian

Emissions of the greenhouse gas methane from livestock are larger than previously thought, posing an additional challenge in the fight to curb global

NEWS

California regulates cow farts

By Associated Press September 21, 2016 | 8:49am

New Swiss Cow Food to Fight Climate Change

Saturday, 6 October, 2018 - 08:30

Cows. Illustrative. (photo credit: REUTERS)

London - Asharq Al-Awsat

A Swiss company has produced a new feed to cut the emission of methane from cattle.

FINANCIAL POST

NEWS • INVESTING • MARKETS • PERSONAL FINANCE • FP TECH DESK • FP COMMENT • ENTREPRENEUR • EXECUTIVE • FI

California is making dairy climate friendly

View Editorial: Reducing dairy methane emissions is a serious ed challenge, and California is leading the way

What did we do?

- **Data:** Survey of **dairy farmers** across Canada
- Contingent valuation method

- Willingness to pay (*ex ante*) for **genomic information to identify and select traits** for:
  - **increased feed efficiency and**
  - **reduced methane emissions.**

Kate Jones, Getu Hailu, Yu Na Lee, David Worden

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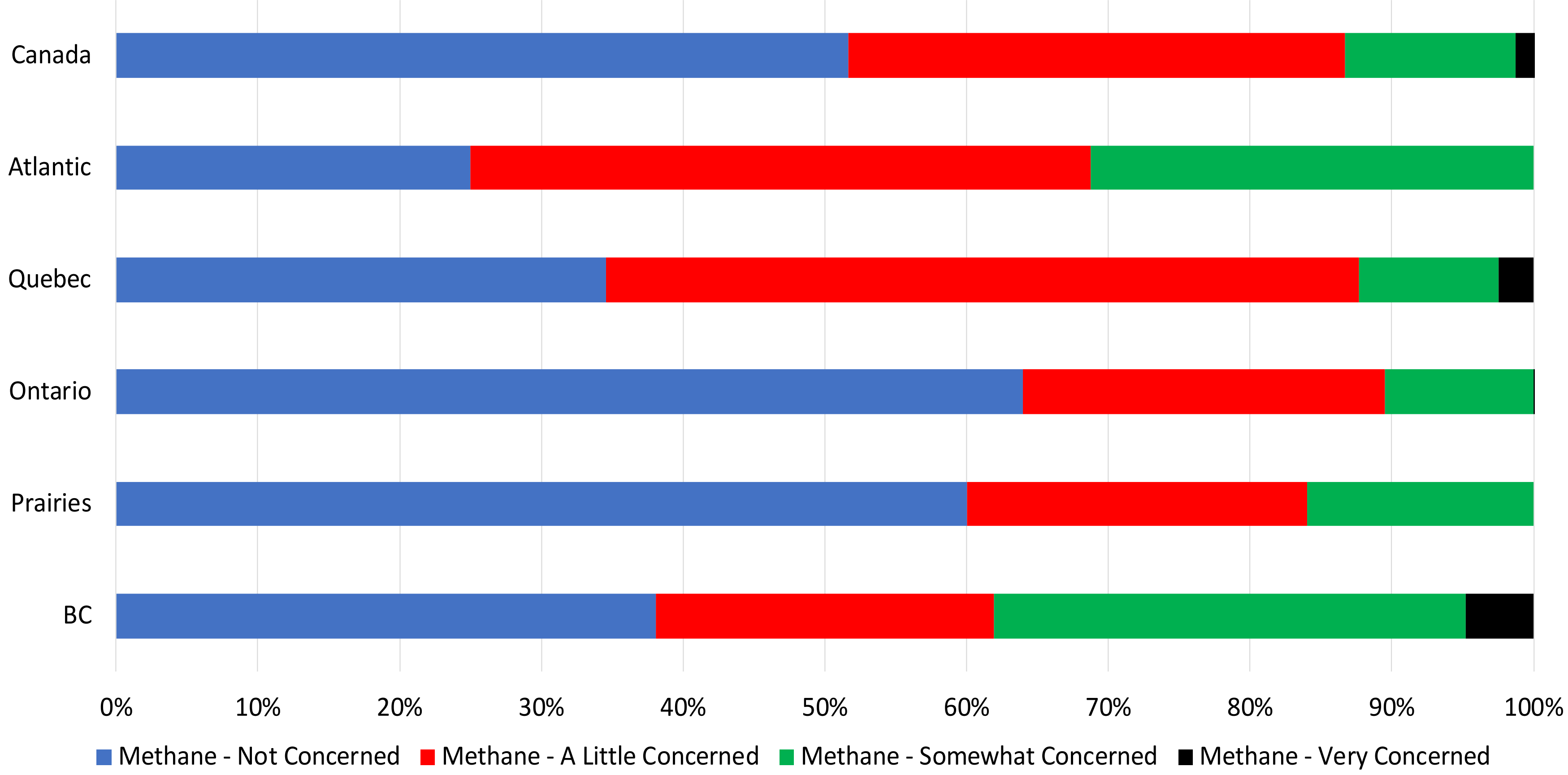
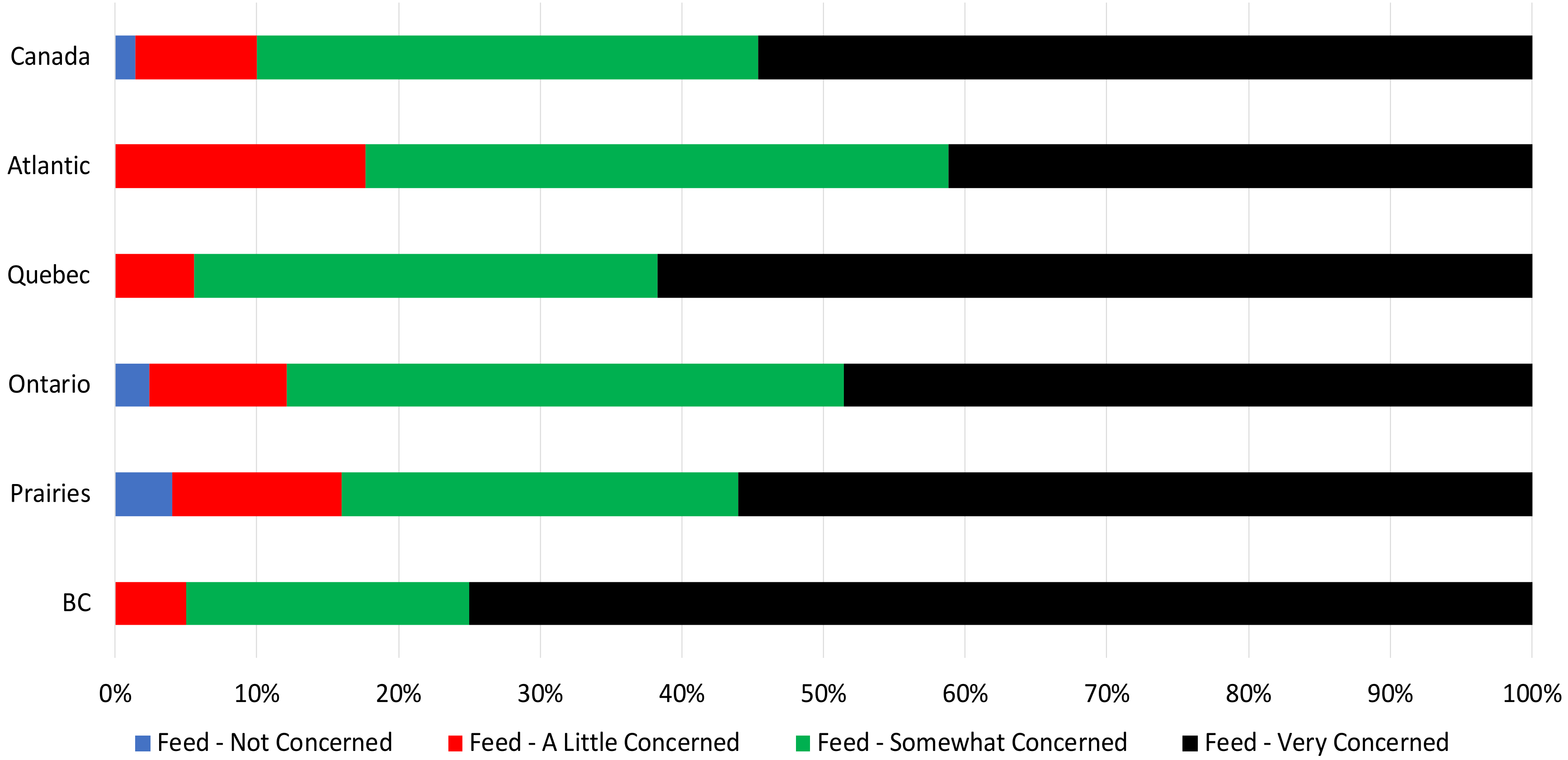
How concerned are you about the methane emissions from your herd?



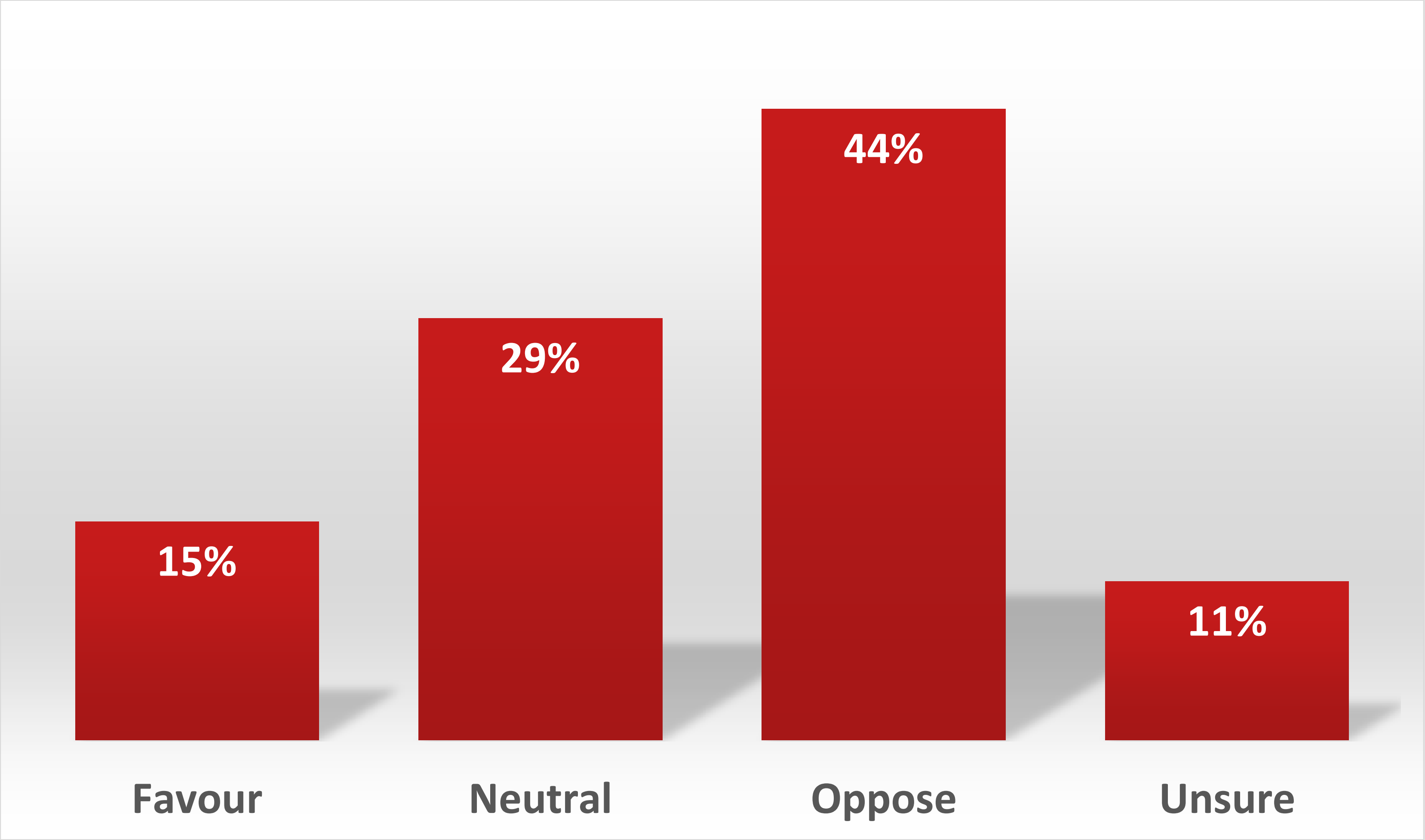
- 51% of farmers reported being not at all concerned with their herd’s greenhouse gas emissions.

How concerned are you about the cost of feed for your herd?



- 54% of farmers reported being very concerned with the cost of feed.

Do you support the Government of Canada using policies to put a price on carbon emissions?



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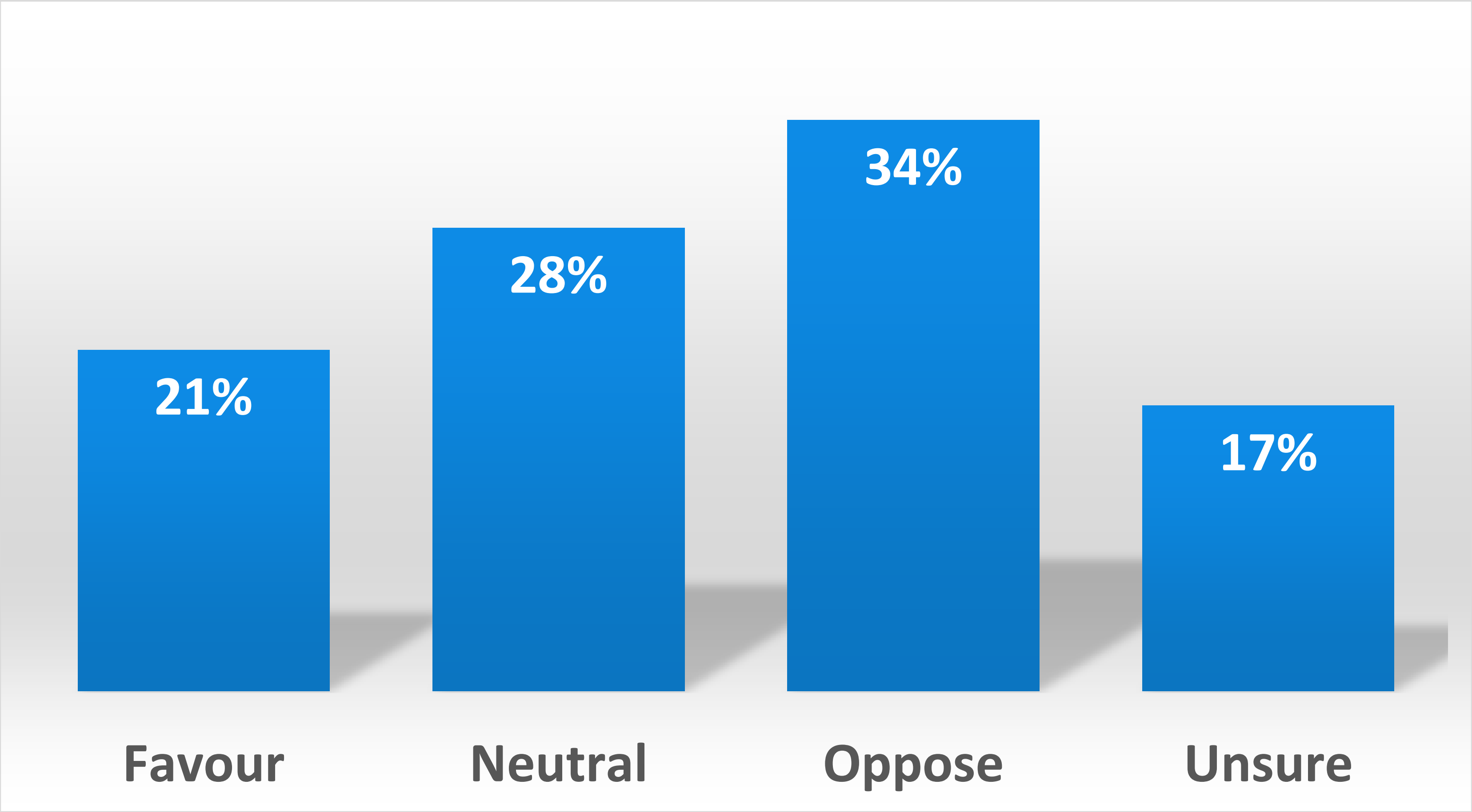
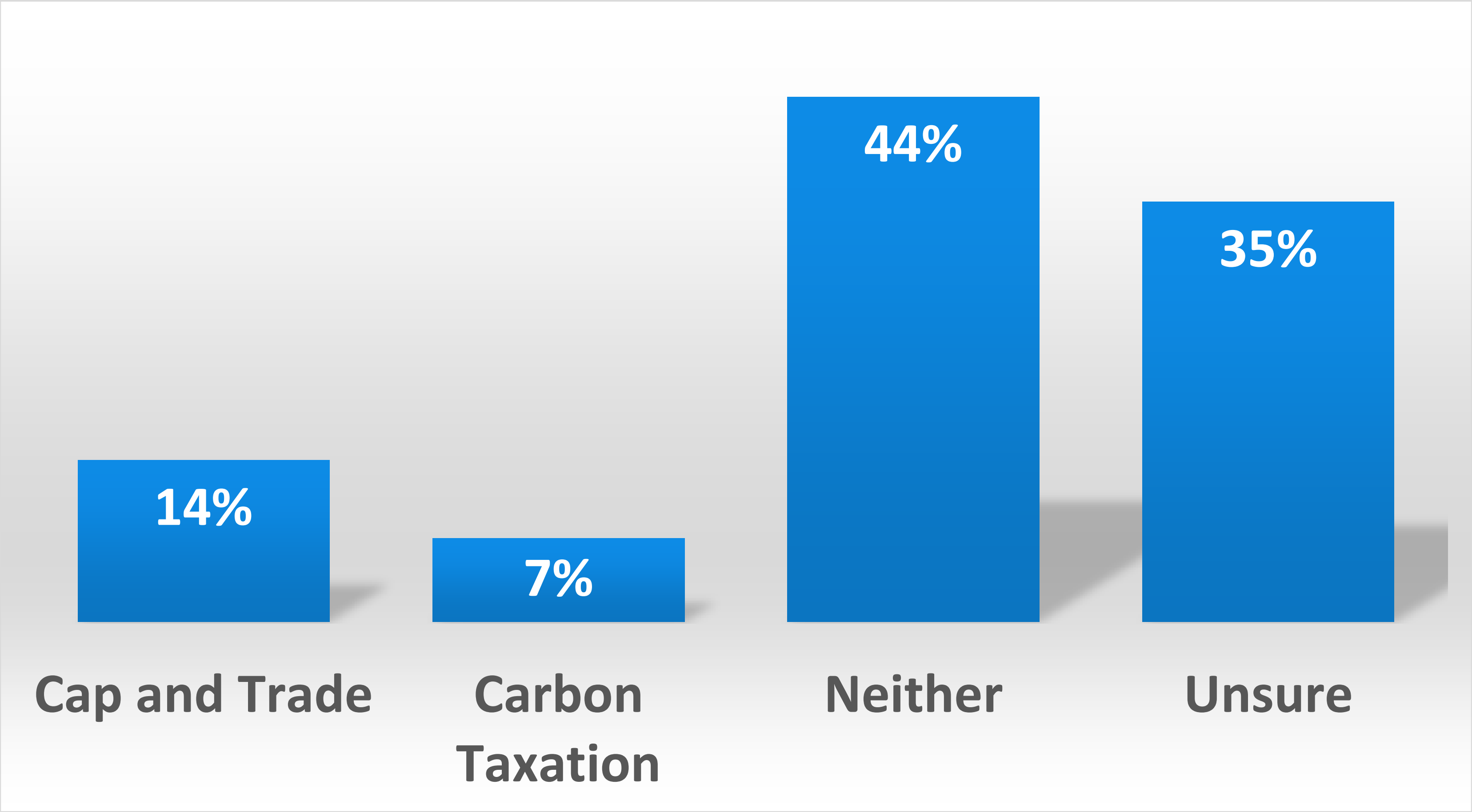
Do you support carbon pricing policies if it would provide a new revenue stream to your operation?



Which policy do you prefer to be used to address climate change?



Contingent Valuation Example

Scenario 1: Straws for artificial insemination are available for purchase and if used for all future inseminations it is estimated to **decrease the herd's feed requirement by 5%** (in adult life). In this scenario, you do not genotype any heifers for feed efficiency.

Would you pay $10 extra per straw for this semen?	☐ Yes →	If yes, would you buy it if it cost $15 extra per straw? ☐ Yes No ☐
	☐ No →	If no, would you buy it if it cost $5 extra per straw? ☐ Yes No ☐

2% → 5%, 8% (if used in combination with genotyping heifers)

$ 10 → $20, $30, $40, $50, $60

Mean Willingness to Pay

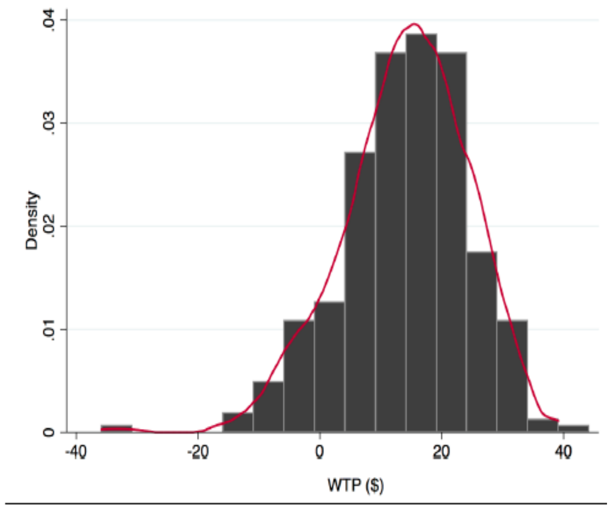
- **For a 5% reduction in feed intake the mean WTP is $14.26**

- **For a 5% reduction in methane emissions the mean WTP is ~$0**

- When the traits are combined both a reduction in feed intake and a reduction in methane emissions leads to a mean WTP of $17.06

Findings: Distribution of WTP

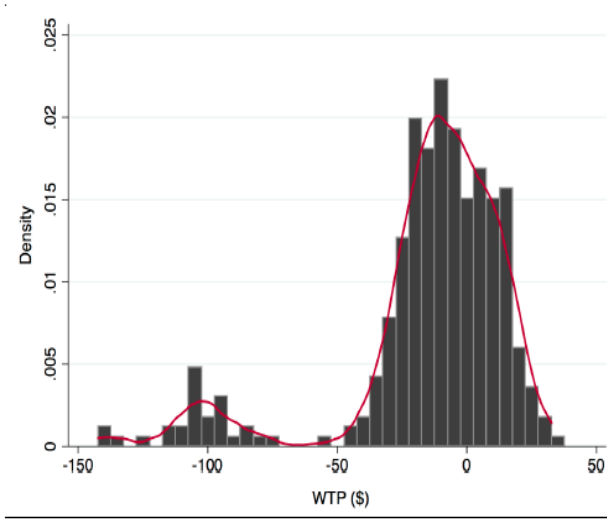
Increased Feed Efficiency



(a) Scenario 1 - AI: FE

WTP ≅ $14

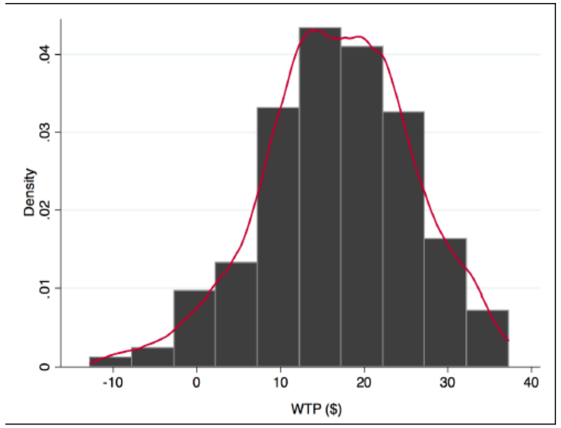
Reduced Methane Emissions



(b) Scenario 2 - AI: RME

WTP ≅ $0

Both



(c) Scenario 3 - AI: FE & RME

WTP ≅ $17

Takeaways

- Adoption of genomic technologies:
  - **Incentive Compatibility**:
    - Private financial benefit to farmers but few incentives to meaningfully reduce or halt their GHG emissions.
    - Technologies such as genomics provides a win-win opportunity.
    - Targeted investment in practices that reduce cost or increase efficiency of resource uses could **see a quicker** adoption.

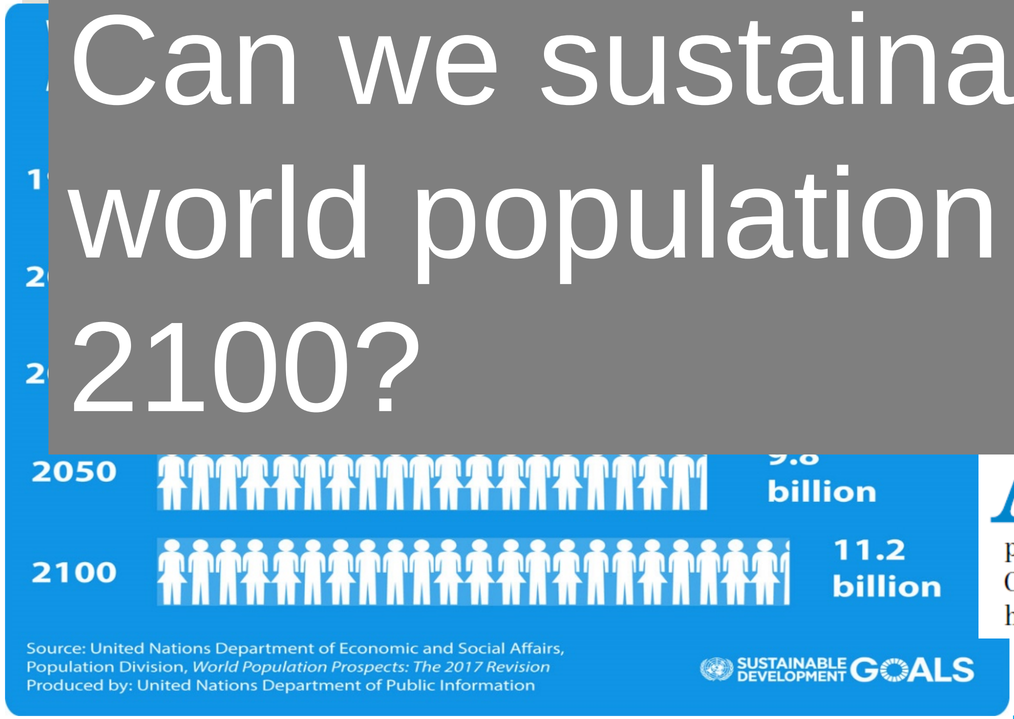
Takeaways

- Investment in Science and Innovation
  - Crucial for the profitability, sustainability and competitiveness of the agri-food sector.
  - Well-funded national mechanisms that promote (or speed up) research in and adoption of genomics for environmental attributes.
  - The Living Laboratories Initiatives.

World population to hit 9.8 billion by 2050, despite nearly universal lower fertility rates – UN

To meet demand, agriculture in 2050 will need to produce almost 50 percent more food, feed and biofuel than it did in 2012. This FAO estimate takes into account recent United Nations (UN) projections indicating that the world's population would reach 9.73 billion in

Can we sustainably feed a world population of 11 billion in 2100?



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14,

A … levels of anthropogenic emissions of greenhouse gases (GHGs) are now at their highest in history (Porter *et al.*, 2014). Agricultural production and its effect on land use are major sources of these emissions. Charting environmentally sustainable pathways for agricultural development has a central role to play, therefore, in mitigating climate change.

58% Increase in Global Dairy Demand by 2050 (FAO, 2011)

Can we sustainably feed a world population of 11 billion?

Looking ahead, the core question is whether today's agriculture and food systems are capable of meeting the needs of a global population that is projected to reach more than 9 billion by mid-century and may peak at more than 11 billion by the end of the century. Can we achieve the required production increases, even as the pressures on already scarce land and water resources and the negative impacts of climate change intensify? The consensus view is that current systems are likely capable of producing enough food, but to do so in an inclusive and sustainable manner will require major transformations.

Economics & the Environment

"*We can absolutely make substantial progress* ***protecting the environment*** *and do it* ***without giving up the chance to sustain growth***." – Paul Romer

The Economist | Topics | Current edition | More

The 2018 Nobel prizes

The Nobel prize for economics is awarded for work on the climate and economic growth

Paul Romer and William Nordhaus share the glory

Business and finance ›
Oct 8th 2018

Thank you.

Getu Hailu, Professor

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GenomeCanada

Ontario Genomics

Alberta milk

Canwest DHI

Agriculture and Agri-Food Canada

DAIRY at GUELPH CANADA'S DAIRY UNIVERSITY

Ontario Ministry of Agriculture, Food and Rural Affairs

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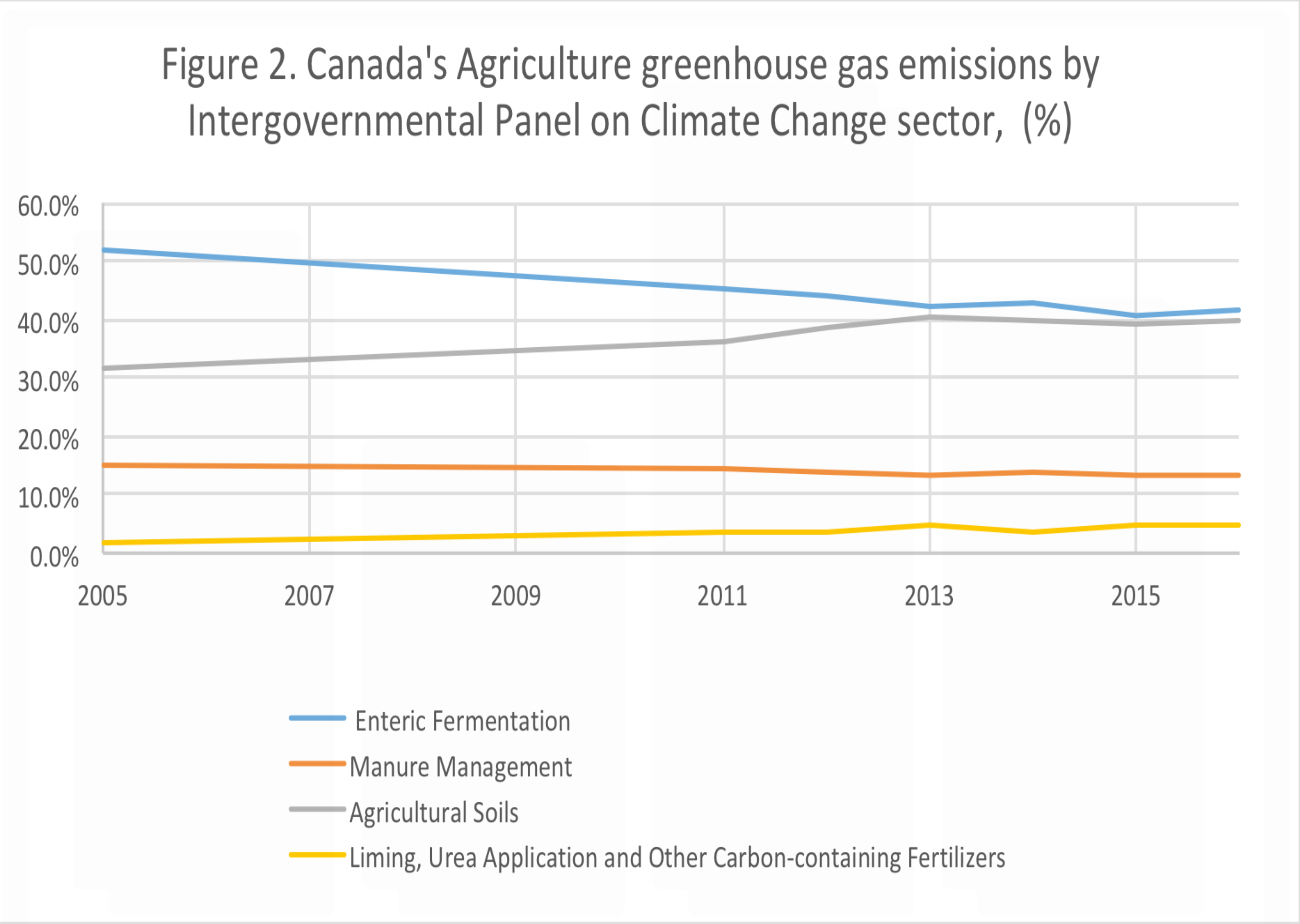
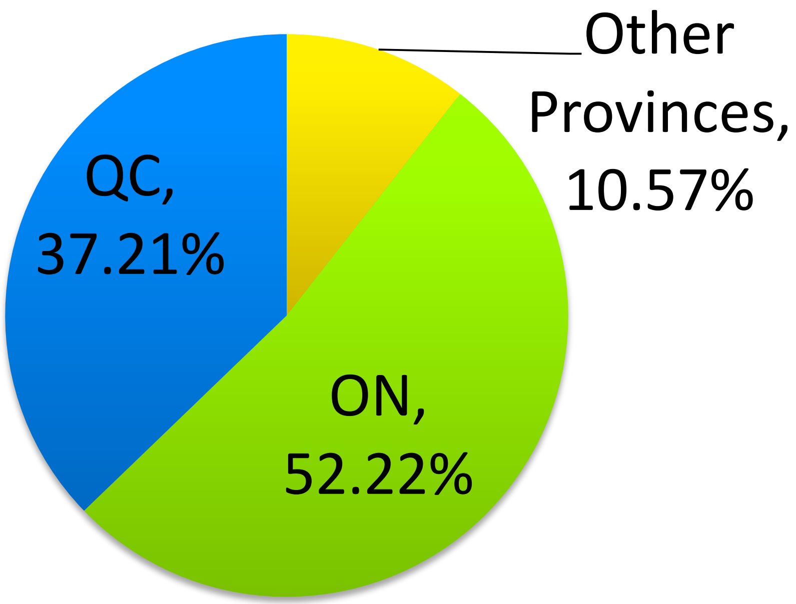
APPENDIX

- Survey distributed to **5775** dairy farmers across Canada.
  - Canwest Dairy Health Initiative (3500, Summer 2017)
  - Valacta (2275, Fall 2017)
- Survey was distributed in both **English** and **French.**
  - **Online and paper copies**
- 480+ surveys received across Canada (8.4%).
- Contingent valuation method to assess willingness to pay.

Thesis: https://bit.ly/2PsRCaS



Source: Environment Canada and Climate Change, 2017


Other Provinces, 10.57%
QC, 37.21%
ON, 52.22%

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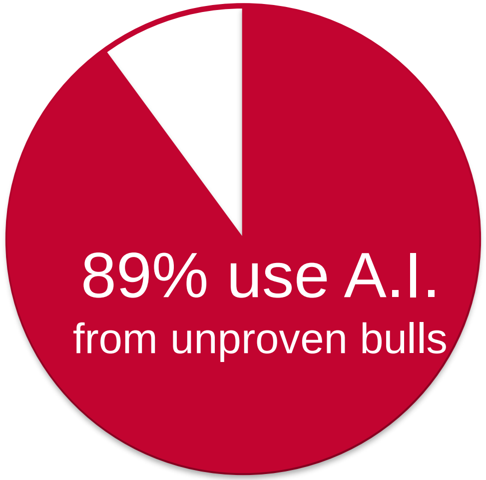
	☐ No ➔	If no, would you buy it if it cost $5 extra per straw? ☐ Yes No ☐

		Sample Size	Mean WTP	Lower bound	Upper bound
Scenario 1: AI - FE	Without control variables	430	$14.07	$10.98	$17.16
		319	$14.46	$11.03	$17.89
	With control variables	319	$14.26	$10.95	$17.57
Scenario 2: AI - RME	Without control variables	422	-$3.73	-$9.61	$2.16
		311	-$4.17	-$11.25	$2.90
5% feed reduction	With control variables	311	-$14.79	-$844.84	$815.26
Scenario 3: AI - FE & RME	Without control variables	429	$15.96	$12.92	$18.99
		317	$16.91	$13.53	$ 20.29
5% feed reduction	With control variables	317	$17.06	$13.75	$20.36
Scenario 4: GT - FE & RME	Without control variables	424	$13.30	$9.18	$17.42
		301	$14.85	$10.07	$19.63
5% feed reduction	With control variables	301	$14.18	$9.52	$18.84
Scenario 5: AI & GT - FE & RME	Without control variables	428	$29.84	$26.72	$32.94
		302	$30.98	$27.36	$34.60
5% feed reduction	With control variables	302	$30.71	$27.11	$34.30

Notes: Lower Bound and Upper Bound refer to the 95% Confidence Interval; AI: straw of artificial insemination; GT: genotyping test; FE: feed efficiency trait; RME: reduced methane emission trait; With control variables : $WTP = \hat{\alpha} + \hat{\beta}x$; Without control variables : $WTP = \hat{\alpha}$.

8% feed reduction

DATA DESCRIPTIONS: *PRIOR EXPERIENCE WITH TECHNOLOGY*



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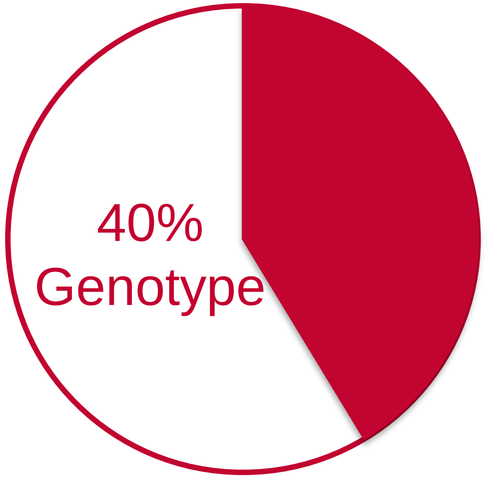

Average cost per straw of artificial insemination (2016) = **$35**

Average cost per genotyping test = **$50**

Contingent Evaluation

Double-bounded dichotomous choice questions were used to elicit willingness to pay for five different scenarios:

Scenario	Trait	Method
1	Feed efficiency (FE) only	Artificial Insemination
2	Reduced Methane Emission (RME) only	Artificial Insemination
3	FE and RME	Artificial Insemination
4	FE and RME	Genotyping Test
5	FE and RME	Artificial Insemination and Genotyping Test

Starting Bid: $10, $20, $30, $40, $50, $60

With $5 incremental follow up bids

Reduction: 2% vs. 5% vs. 8%

Empirical Framework

$$WTP_i(x_i, u_i) = x_i'\delta + u_i$$

Where x_i is a vector of individual-specific explanatory variables
δ is a vector of parameters to be estimated
u_i is an error term that is assumed to be normally distributed with a mean zero and constant variance of σ^2

Dependent Variable: amount ($) extra per straw of artificial insemination or genotyping test individual is willing to pay

Main Independent Variable: farmer's concern about greenhouse gas emissions (i.e., methane) from their herd:

(1) *Not at all concerned*

(2) *A little concerned*

(3) *Somewhat concerned*

Dummy variable:
Some concern (1)
vs.
Not at all concerned (0)

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Other Independent Variables

Variable	Form	Expected Sign
Concern – feed cost	Categorical: 1 - 4	+
Belief in Genomics*	Continuous	+
Knowledge – AI, GT	Discrete: 0, 1	+
Prior Experience – AI, GT	Discrete: 0, 1	+
Herd Size	Continuous	+
Age	Categorical: 1-7	-
Gender	Discrete: 0, 1	?
Years Dairy Farming$^{(2)}$	Continuous	+ / -
Education	Discrete: 0,1	+
Risk Tolerance*	Continuous	+
Social Interactions	Continuous	+
Geographic Locations	Discrete: 0, 1	?
Trust in Breed Company	Categorical: 1-7	+
Financial Structure	Discrete: 0, 1	?

*created with principal component analysis; GT: Genotyping Test; AI: Artificial Insemination.

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Mean Willingness to Pay

AI: FE AI: RME AI: FE & RME GT: FE & RME AI & GT:

FE & RME

Empirical Model	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Model 1 - A	$14.26	-$14.79	$17.06	$14.18	$30.71
Model 1 - B	$13.94	-$5.35	$16.25	$13.86	$30.09
Model 2	$14.42	-$15.11	$16.99	$14.10	$30.66
Model 3	$14.28	-$15.32	$17.04	$14.13	$30.57
Model 4 - A	—	—	$16.56	$14.25	—
Model 4 - B	—	—	$17.45	$14.08	—

(1) Positive Willingness to Pay for Feed Efficiency (FE)

(2) Negative Willingness to Pay for Reduced Methane Emissions (RME)

(3) Positive Willingness to Pay for FE and RME

(4) WTP for FE and RME > WTP for FE

Marginal Effects on Mean Willingness to Pay

	Scenario 1 AI: FE	Scenario 2 AI: RME	Scenario 3 AI: FE & RME	Scenario 4 GT: FE & RME	Scenario 5 AI & GT: FE & RME
GHG Emissions (d) - *A little concerned*	6.908*	14.46***	7.899**	7.451	1.944
	(3.620)	(5.417)	(3.635)	(4.885)	(4.336)
GHG Emissions (d) - *Somewhat Concerned*	14.82***	22.19***	8.414*	8.315	0.779
	(4.724)	(7.241)	(5.011)	(6.927)	(6.108)
GHG Emissions (d) - *Very concerned*	9.345	25.66**	19.85**	12.34	5.181
	(10.41)	(11.99)	(10.08)	(12.68)	(12.44)
Feed Costs (d) - *A little concerned*	5.765	10.34	2.121	-18.14	4.452
	(12.65)	(16.50)	(13.09)	(17.38)	(15.02)
Feed Costs (d) - *Somewhat concerned*	6.453	-10.40	7.272	-13.61	7.857
	(11.97)	(16.14)	(12.47)	(16.26)	(14.21)
Feed Costs (d) - *Very concerned*	14.65	1.162	8.287	-11.99	8.552
	(11.93)	(15.76)	(12.49)	(16.31)	(14.26)
Belief in Genomics	2.223*	4.713**	1.823	6.964***	6.381***
	(1.146)	(1.992)	(1.162)	(1.676)	(1.466)
Age	0.211	2.204	-4.037**	-5.671**	-2.595
	(1.939)	(2.942)	(1.963)	(2.697)	(2.293)
Quebec (d)	-0.142	10.79**	-0.717	-5.211	-0.485
	(3.702)	(5.417)	(3.845)	(5.241)	(4.751)
Atlantic (d)	1.980	8.752	4.416	29.21**	16.15
	(8.415)	(13.05)	(8.861)	(11.75)	(11.65)

Hypothetical Savings

Feed Cost Savings:

	Without Technology	With Technology					
		2% Reduction		5% Reduction		8% Reduction	
	Cost/Cow/Year	Cost	Savings	Cost	Savings	Cost	Savings
Feed ration only	\$426.36	\$417.83	**\$8.53**	\$405.04	**\$21.32**	\$392.25	**\$34.11**
All purchased feed	\$1127.07	\$1104.53	**\$22.54**	\$1070.72	**\$56.35**	\$1036.90	**\$90.17**
Total feed costs	\$2400.98	\$2352.96	**\$48.02**	\$2280.93	**\$120.05**	\$2208.90	**\$192.08**

Notes: *all purchase feed* cost includes the cost of dairy ration, protein supplements, salt and minerals as well as any other purchased feeds; *All feed costs* accounts of *all purchased feed* and the average cost of feed grown on farm which includes: bulk grain and forage purchases, seed cost, fertilizer cost, herbicide and pesticide cost, labour cost, fuel and lubricants, field machinery repairs, and land rent.
Source: Ontario Dairy Farm Accounting Project (ODFAP) - 2016

Mean WTP ≈ \$15.00

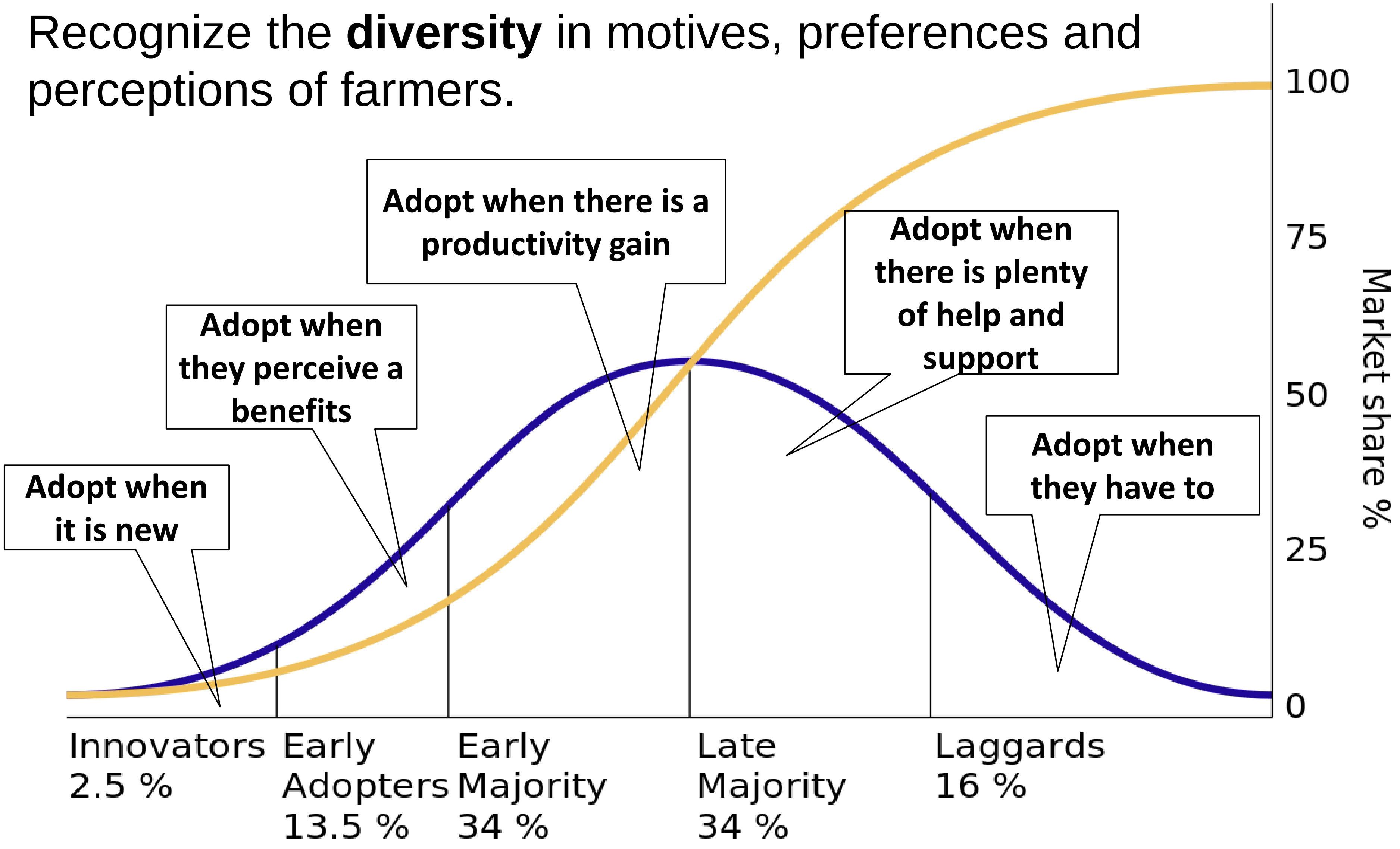
Carbon Tax Savings:

Carbon Tax	Without Technology			With Technology								
				2% Reduction			5% Reduction			8% Reduction		
\$ CO_2e/ton	CH_4/c/y	CO_2e/c/y	\$/c/y	CO_2e/c	\$/c/y	Savings	CO_2e/c	\$/c/y	Savings	CO_2e/c	\$/c/y	Savings
\$10	0.130	2.73	\$27.30	2.675	\$26.75	**\$0.55**	2.594	\$25.94	**\$1.37**	2.457	\$24.57	**\$2.73**
\$18	0.130	2.73	\$49.14	2.675	\$48.16	**\$0.98**	2.594	\$46.68	**\$2.46**	2.457	\$44.23	**\$4.91**
\$30	0.130	2.73	\$81.90	2.675	\$80.26	**\$1.64**	2.594	\$77.81	**\$4.10**	2.457	\$73.71	**\$8.19**
\$50	0.130	2.73	\$136.5	2.675	\$133.77	**\$2.73**	2.594	\$129.68	**\$6.83**	2.457	\$122.85	**\$13.65**

Notes: $C0_2$e: Carbon dioxide equivalent; \$ $C0_2$e/ton: Price of carbon dioxide equivalent per tonne; CH_4/c/y: total amount (in tonnes) of methane an average milking cow produces per year; $C0_2$e/c/y: total amount (in tonnes) of carbon dioxide equivalent an average milking cow produces per year; \$/c/y: The hypothetical tax amount a farmer would have to pay per cow per year; Savings: the difference in the \$ of emissions tax a farmer would have to pay per cow per year, compared to if they had not adopted genomic selection for the selection FE and RME traits.
Source: Boadi et al. (2004), Canadian National Inventory Report (2015), Environment and Climate Change Canada (2017)

Mean WTP ≥ 0

Recognize the **diversity** in motives, preferences and perceptions of farmers.



Early Maturing Corn Variety in Ethiopia

- Issue – climate change and crop failure
- Existing technology
  - Mature in ~ 7 months; very tall
- Climate Smart Variety
  - Mature in 3 month; higher yield; short; drought resistance;
  - Limited/slow adoption, and differences within each group

Use of Maize Stover

Grain Maize

- Food
- Sale

Use of Maize Stover

- Animal feed
- Fuel
- Construction
- Sale

Farmers are prudent (far-sighted, not imprudent), not simply slow.

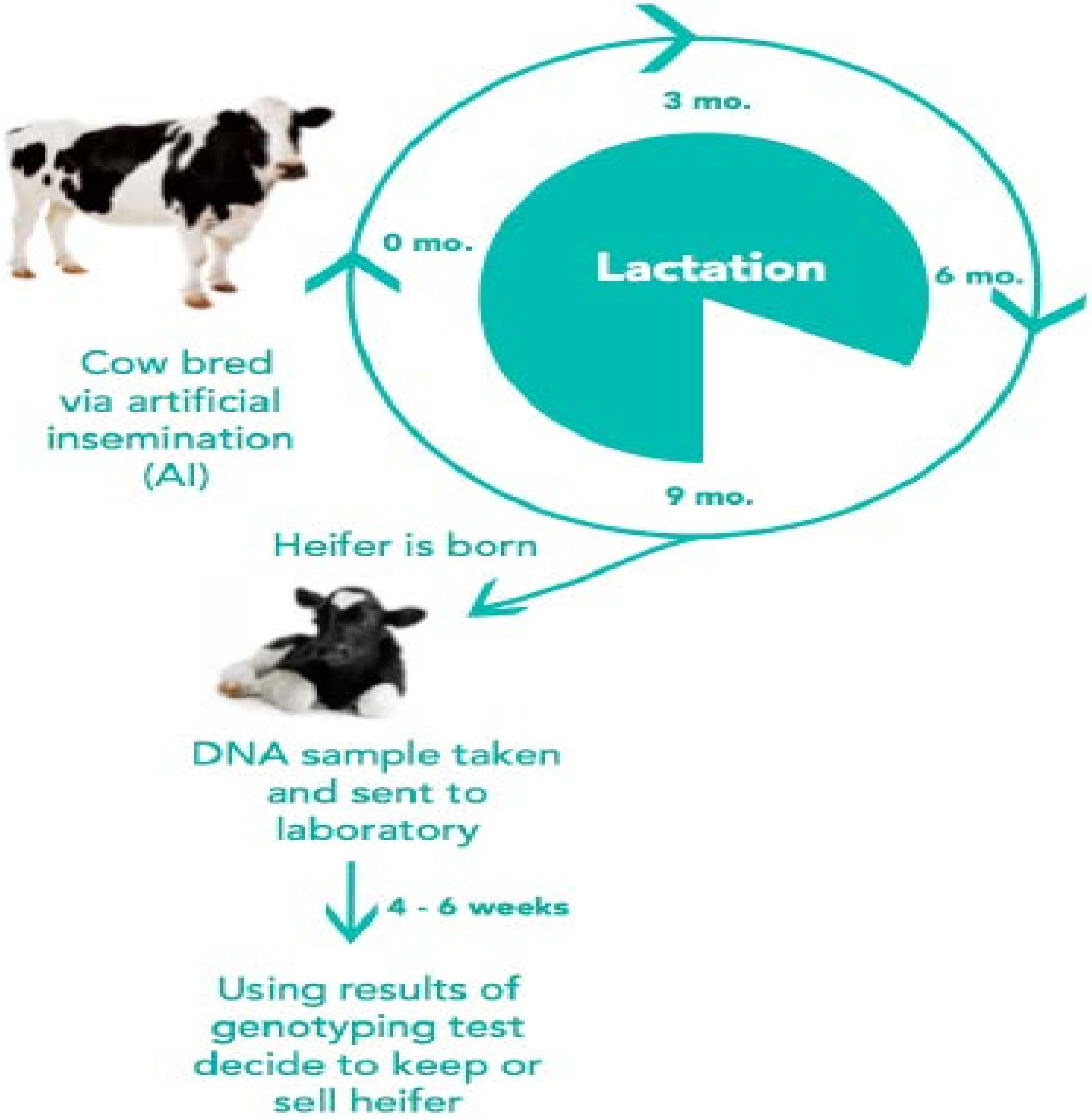
Economic Analysis of Increasing Feed Efficiency and Reducing Greenhouse Gas (GHG) Emissions through Genomics in Canada's Dairy Industry

Kate Jones, Getu Hailu, Yu Na Li, David Worden
Food, Agricultural & Resource Economics

University of Guelph
Contact: ghailu@uoguelph.ca

Canadian Agricultural Policy Research Network (CAPRN) Seminar,
October 11-12,2018, Ottawa, Ontario

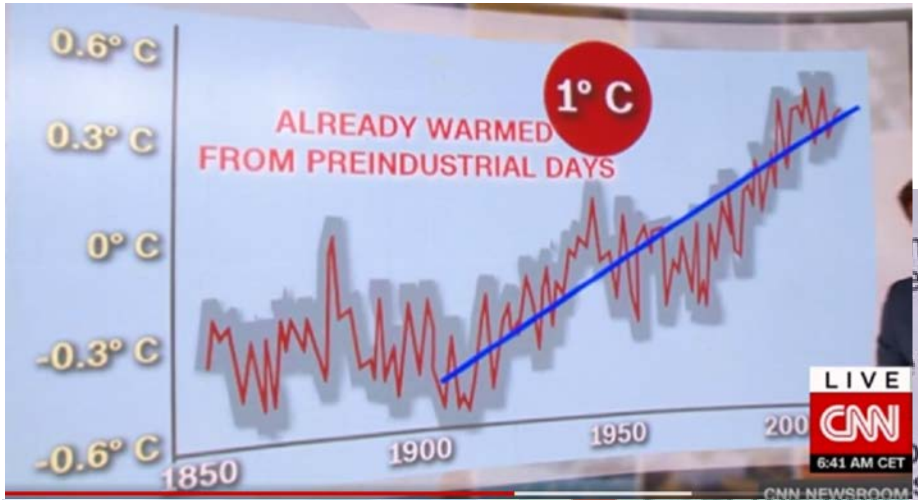
University of Guelph
Ontario Agricultural College
Department of Food, Agricultural and Resource Economics


3 mo.
0 mo.
Lactation
6 mo.
Cow bred via artificial insemination (AI)
9 mo.
Heifer is born
DNA sample taken and sent to laboratory
4 - 6 weeks
Using results of genotyping test decide to keep or sell heifer

World has less than a decade to control global warming, U.N. scientists warn

By Chris Mooney and Brady Dennis
The Washington Post
Oct 8, 2018 Updated 8 min ago

Intergovernmental Panel on Climate Change, IPCC, Chair Hoesung Lee, center, and other leaders hold a press conference in Incheon, South Korea, Monday, Oct. 8, 2018. (AP Photo/Ahn Young-joon)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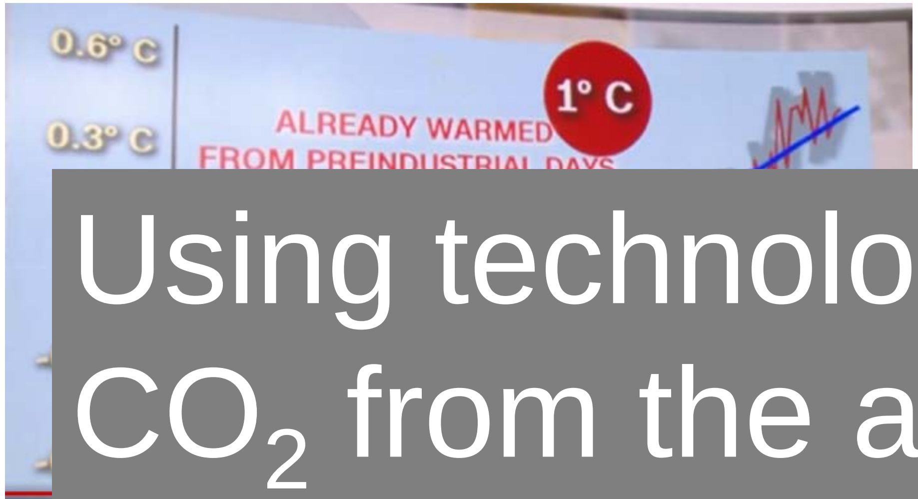
1° C
ALREADY WARMED
FROM PREINDUSTRIAL DAYS
1850
1900
1950
LIVE
CNN
6:41 AM CET


TORNADOES
HURRICANES
DROUGHT
HEAVY RAIN EVENTS
COASTAL FLOODING
HEAT WAVES
LIMITED EVIDENCE
STRONG EVIDENCE
STRONGEST EVIDENCE


LIVE
CNN
KOSPI ▼ -8.23
CNN NEWSROOM
2030: CO2 emissions cut by
45%
2050: CO2 emissions cut by
100%
ogy to remove CO2
sphere

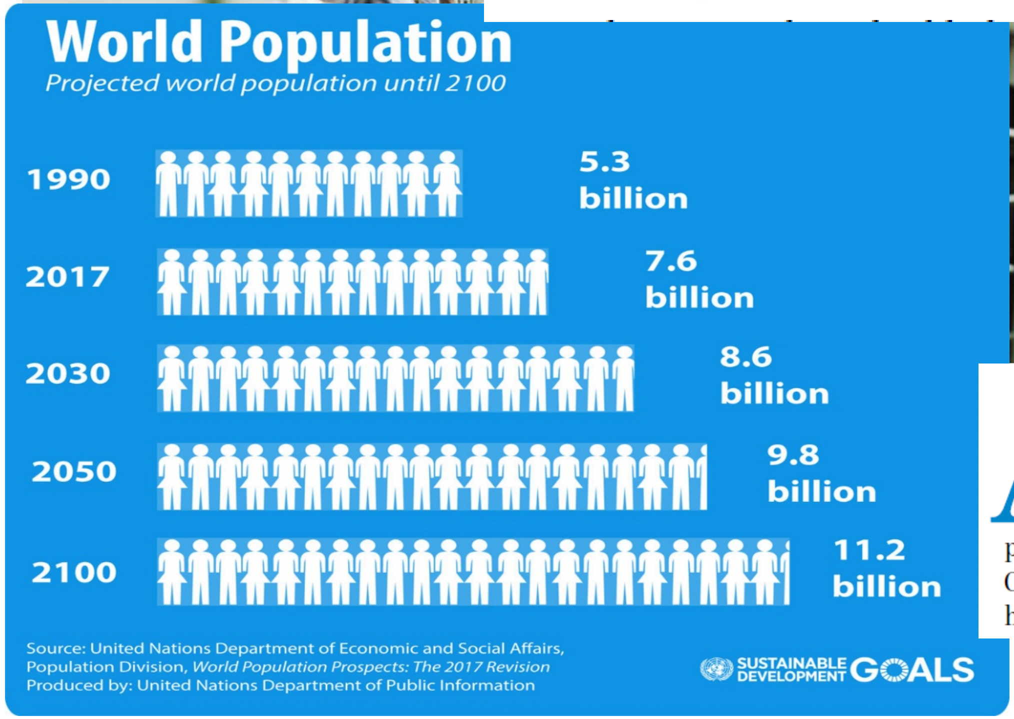
- Farmers are prudent (far-sighted, not imprudent), not simply slow.



Using technology to remove CO_2 from the atmosphere.

World population to hit 9.8 billion by 2050, despite nearly universal lower fertility rates – UN

To meet demand, agriculture in 2050 will need to produce almost 50 percent more food, feed and biofuel than it did in 2012. This FAO estimate takes into account recent United Nations (UN) projections indicating that the world's population would reach 9.73 billion in 2050.[1] In sub-Saharan Africa and South Asia, agricultural output would



According to the most recent assessment report of the Intergovernmental Panel on Climate Change (IPCC), published in 2014, levels of anthropogenic emissions of greenhouse gases (GHGs) are now at their highest in history (Porter *et al.*, 2014). Agricultural production and its effect on land use are major sources of these emissions. Charting environmentally sustainable pathways for agricultural development has a central role to play, therefore, in mitigating climate change.

Can we sustainably feed a world population of 11 billion?

Looking ahead, the core question is whether today's agriculture and food systems are capable of meeting the needs of a global population that is projected to reach more than 9 billion by mid-century and may peak at more than 11 billion by the end of the century. Can we achieve the required production increases, even as the pressures on already scarce land and water resources and the negative impacts of climate change intensify? The consensus view is that current systems are likely capable of producing enough food, but to do so in an inclusive and sustainable manner will require major transformations.

58% Increase in Global Dairy Demand by 2050 (FAO, 2011)

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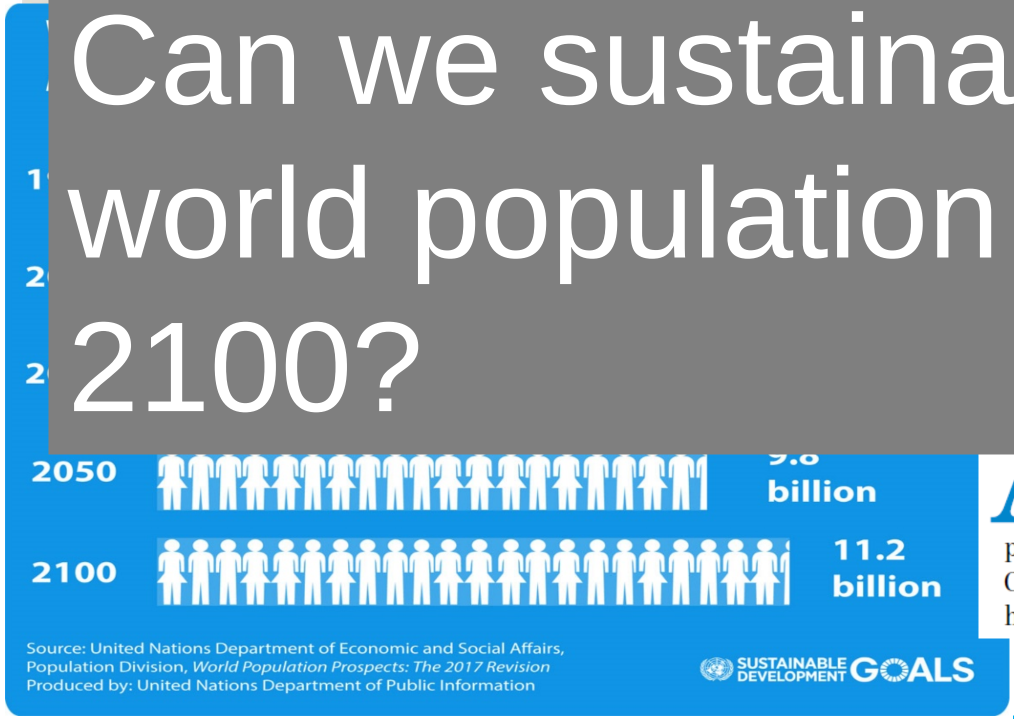
Can we sustainably feed a world population of 11 billion in 2100?



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14,

A levels of anthropogenic emissions of greenhouse gases (GHGs) are now at their highest in history (Porter *et al.*, 2014). Agricultural production and its effect on land use are major sources of these emissions. Charting environmentally sustainable pathways for agricultural development has a central role to play, therefore, in mitigating climate change.

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58% Increase in Global Dairy Demand by 2050 (FAO, 2011)

ELLEN AIRHART SCIENCE 06.09.17 07:00 AM

CANADA IS USING GENETICS TO MAKE COWS LESS GASSY

Our obsession with cows is causing almost 10% of global warming emissions

By Roberto A. Ferdman • September 27, 2013

Methane emissions from cattle are 11% higher than estimated

Bigger livestock in larger numbers in more regions has led to methane in the air climbing faster than predicted due to 'out-of-date data'

▲ A sharp rise in methane pollution could jeopardise the
Graham Turner for the Guardian

Emissions of the greenhouse gas methane from livestock are larger than previously thought, posing an additional challenge in the fight to curb global

NEWS

California regulates cow farts

By Associated Press September 21, 2016 | 8:49am

New Swiss Cow Food to Fight Climate Change

Saturday, 6 October, 2018 - 08:30

Cows. Illustrative. (photo credit: REUTERS)

London - Asharq Al-Awsat

A Swiss company has produced a new feed to cut the emission of methane from cattle.

FINANCIAL POST

NEWS • INVESTING • MARKETS • PERSONAL FINANCE • FP TECH DESK • FP COMMENT • ENTREPRENEUR • EXECUTIVE • FI

California is making dairy climate friendly

View Editorial: Reducing dairy methane emissions is a serious ed challenge, and California is leading the way

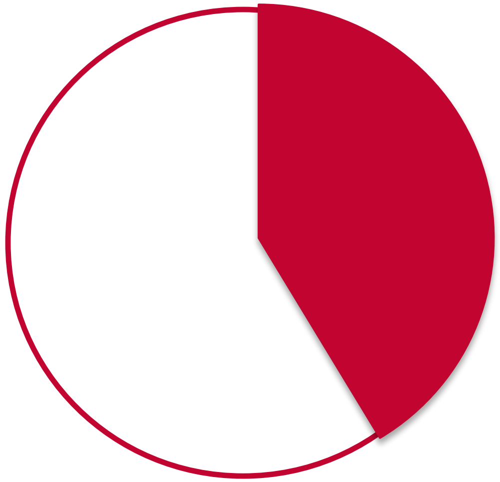
UNIVERSITY of GUELPH

ONTAR
AGRICU
DEPARTMENT
AND RESOUR

Prior Experience with Technology

Average cost per straw of artificial insemination (2016) = **$35**

VS.

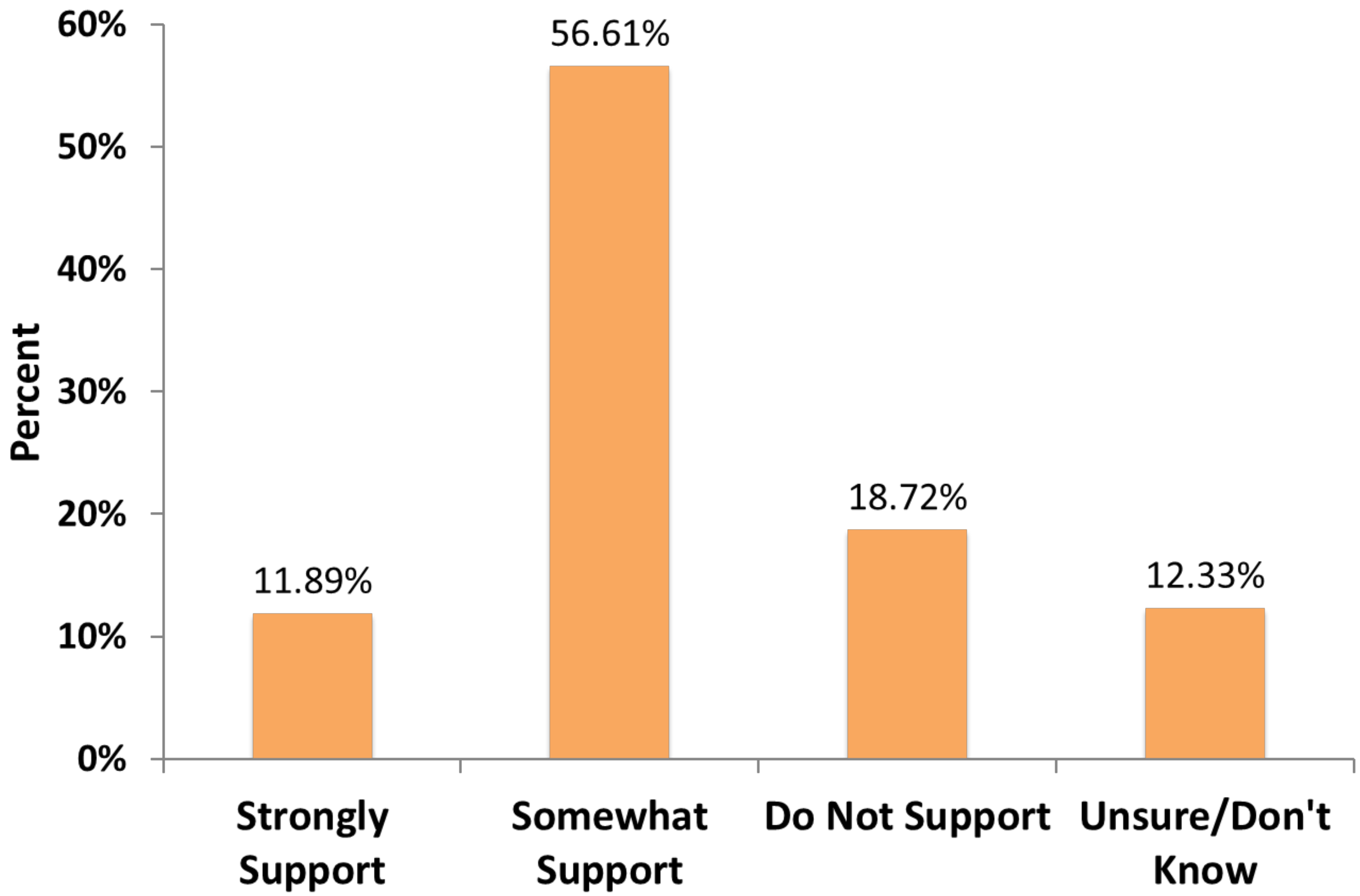


40% Genotyping

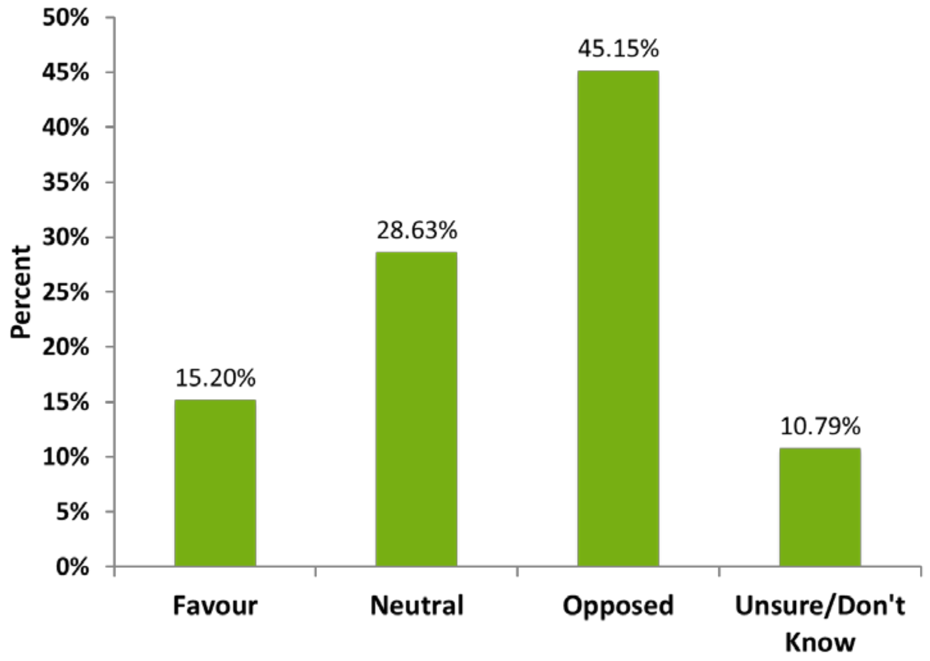
Average cost per genotyping test = **$50**

Genotyping is the process of determining differences in the genetic make-up (genotype).

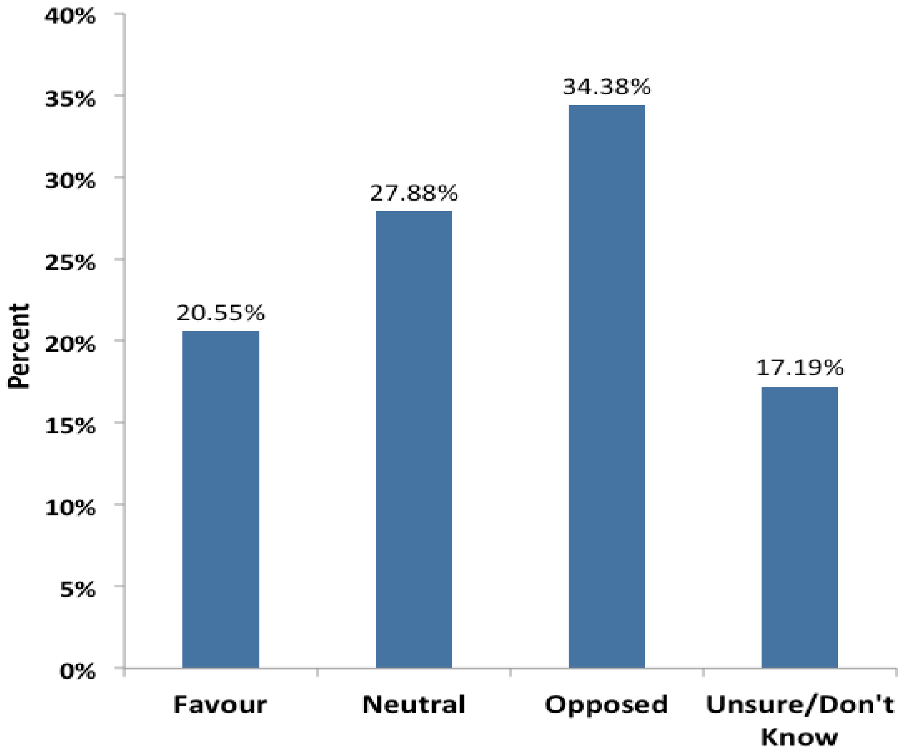
Do you support the Government of Canada addressing climate change with environmental policy?



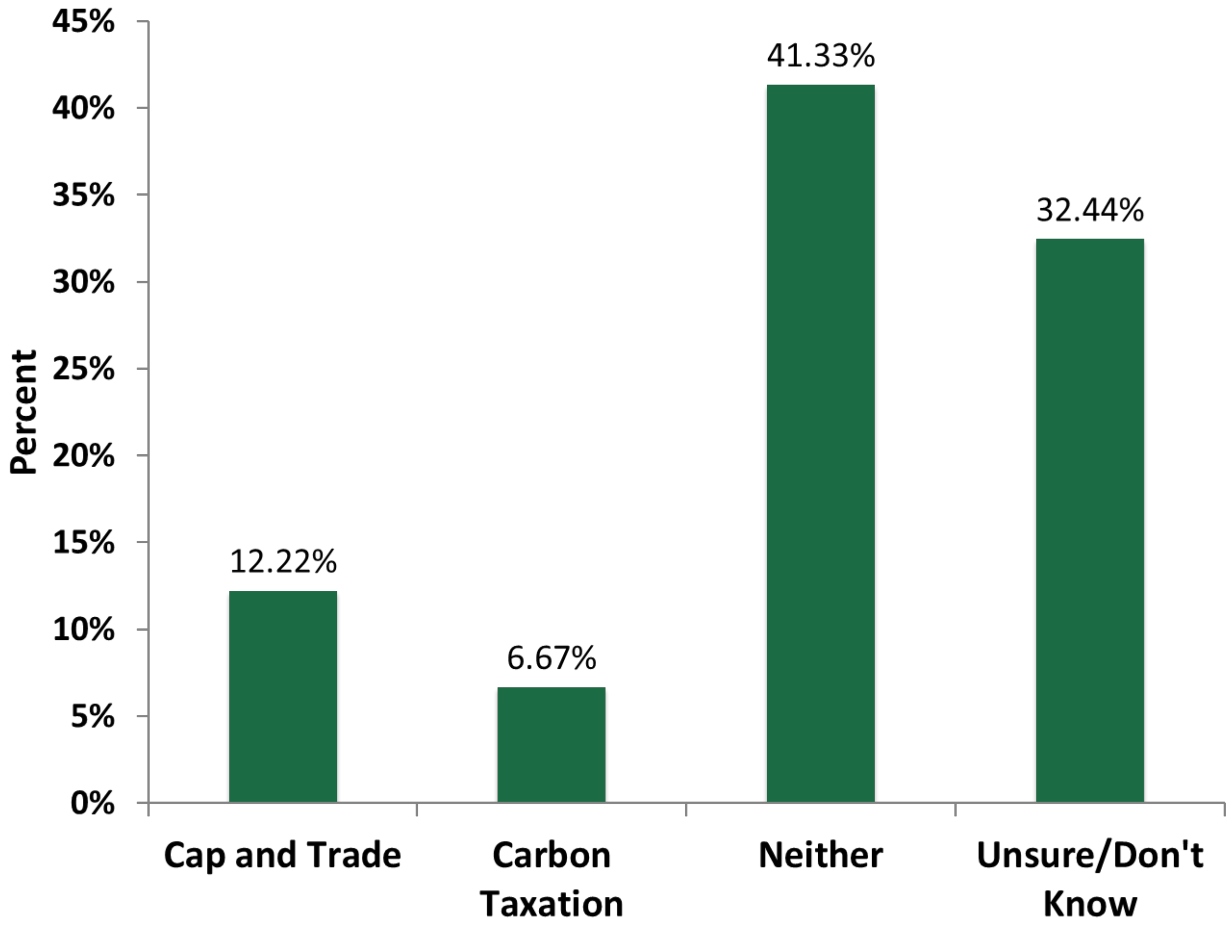
Do you support the Government of Canada using policies to put a price on carbon emissions?



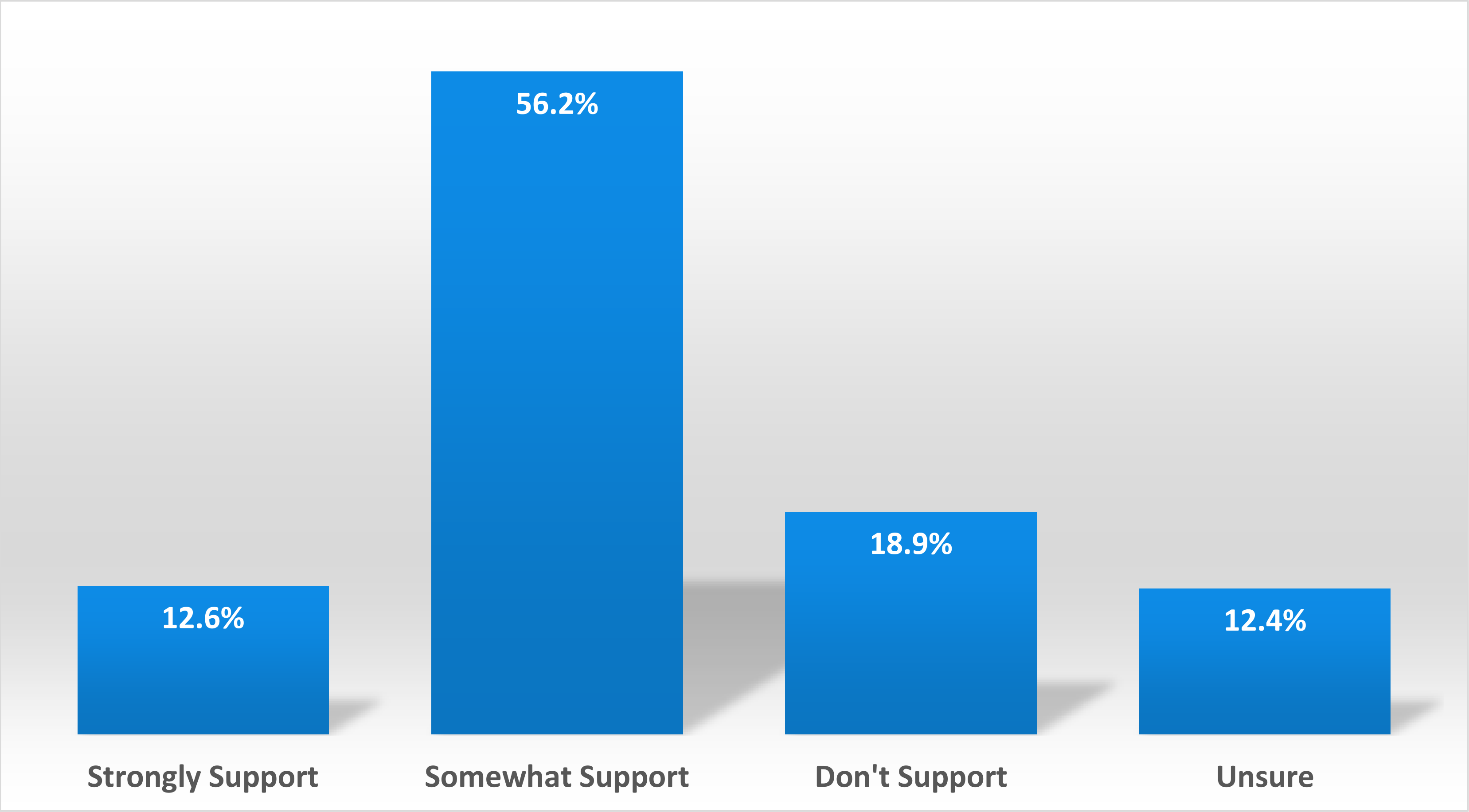
Do you support carbon pricing policies if it would provide a new revenue stream to your operation?



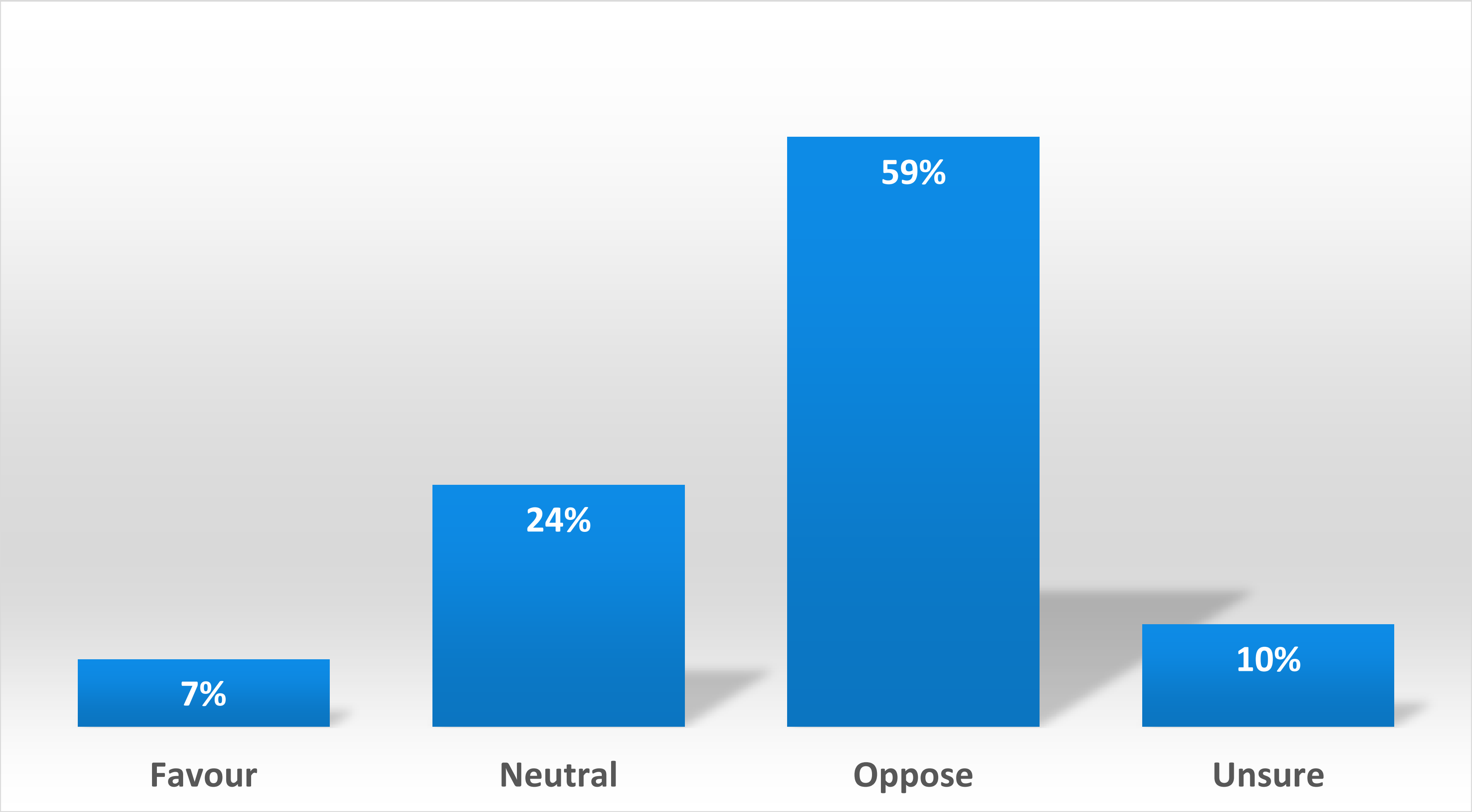
Which policy do you prefer to be used to address climate change?



Do you support the Government of Canada addressing climate change with environmental policy?



Are you in favour, neutral, or oppose the proposal to limit methane emissions from farms?



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DEPARTMENT OF FOOD, AGRICULTURAL AND RESOURCE ECONOMICS