



# The Future of Livestock

Maritime Sheep Conference  
November 2021



**As heard by a farm boy in 1969:**

***“I’m behaving disgracefully. I have eaten animal flesh and I have enjoyed it. What is wrong with me?”***

**Spock**

**What will the future look like?**



# My background so you understand my perspective

- Grew up on a farm near Elora
- BSc Animal Science, MSc in Animal Breeding, University of Guelph
- OMAFRA (extension and management), 13 years
- Executive Director at Beef Farmers of Ontario, 5 years (Walkerton, BSE)
- Director of Operations at Agricorp, 4 years
- General Manager at AgSights, 11 years
- LRIC Director, 3 years; CEO for 2 years



**“Life can only be understood backwards but it must be lived forwards.”**



*J. HANE AND SON THRESHING OUTFIT LEUVAN* Lewvan, Saskatchewan, 1924

**“Different isn’t always better but better is always different”**

**“The best way to know the future is to create it”**

# LRIC: Why and How

## Why?

**Creating a robust future for the livestock value chain**

## How?

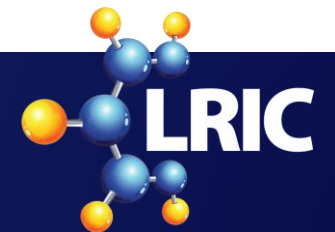
**Deliver value to members and government**

**Be the trusted intermediary between industry, government and academia**

**Provide a centralized hub for livestock research, innovation, networking and mentorship**

**Ensure a forward-looking focus**

**Demonstrate leadership that is positive, proactive and professional**





# LRIC: What

## **What?**

**Provide research management services.**

**Raise awareness of emerging issues and opportunities.**

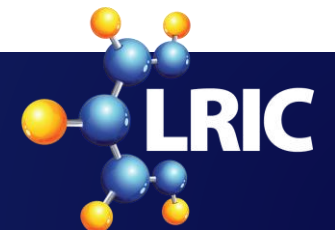
**Gather international insights and ideas.**

**Enhance the linkage between industry/ academia along the value chain.**

**Identify cross-sector research and innovation opportunities.**

**Provide leadership in best practices for the adoption of new technology.**

**Develop and deliver insightful, regular communications.**



## Founding Members

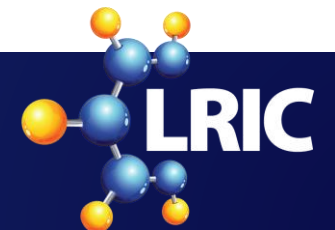
- **Beef Farmers of Ontario**
- **Dairy Farmers of Ontario**
- **Ontario Pork**
- **Chicken Farmers of Ontario**
- **Egg Farmers of Ontario**
- **Ontario Broiler Hatching Egg**
- **Turkey Farmers of Ontario**

## Partner Members

- **Ontario Sheep Farmers**
- **Veal Farmers of Ontario**
- **Ontario Aquaculture Association**
- **Equine Guelph**
- **Ontario Forage Council**
- **Meat & Poultry Ontario**
- **AgSights**
- **Be Seen Be Safe**
- **Alberta Innovates**
- **Alltech**
- **Elanco**
- **Grand Valley Fortifiers**
- **PigGen Canada**
- **CgFARAD**

## Additional funding

- **OMAFRA**
- **AAFC**



# Three Key LRIC Initiatives

**The BIG things... Horizon Series**

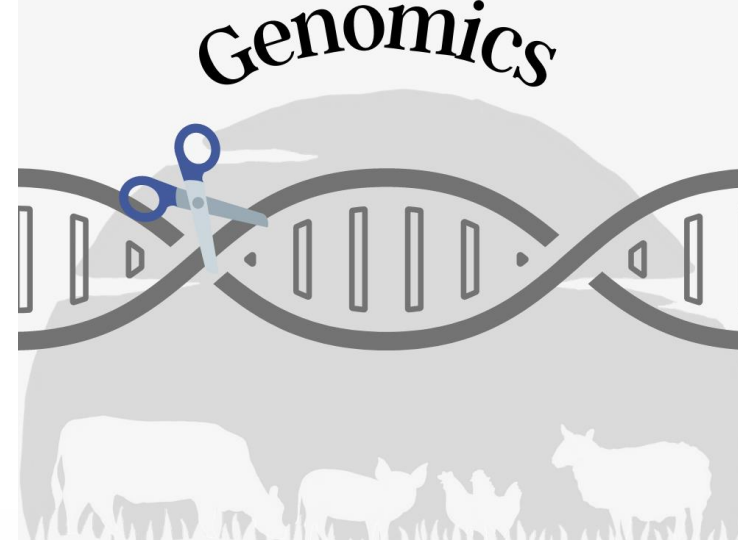
**Review of Ontario's Livestock Innovation System**

**“It's all about people”... Mentorship program**

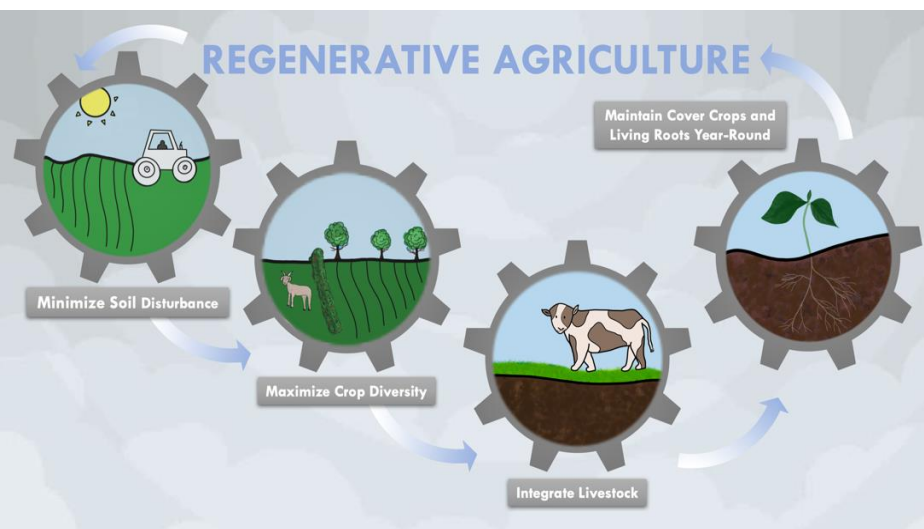




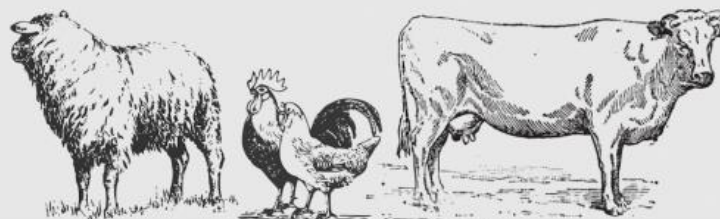
# Antimicrobial use & resistance *IN LIVESTOCK*



# Getting Research into Practice



# Livestock & *GREENHOUSE GASES*



# White Papers and Horizon Series Webinars

**Regenerative Agriculture**

**Antimicrobial use/AMR**

**Livestock and GHG**

**One Health**

**Genomics**

**GRIP**

**Livestock and Water Use**

**The future of livestock vaccines**

**Animal-free milk, eggs and meat**

**Rene Van Acker, Dean of OAC**

**Jean Szkotnicki, Past ED CAHI**

**Claudia Wagner-Riddell, U of Guelph**

**Heather Murphy. Professor, OVC**

**Steve Miller, Director, AGBU, Australia**

**Steven Roche, Acer Consulting**

**Andrew VanderZaag, AAFC**

**Shayan Sharif, OVC**

**Mike Von Massow, UofG**



# Improving the Innovation System

## Funding

- Government and Industry
- Facilities/Staff/HQP/ Projects

## Priorities

- Within & across sectors,
- Informed internationally, levels of specificity by topic & species

## Effective Program Management

- With corresponding rewards and penalties

## Extension

- Research results to application
- Knowledge Translation and Transfer (KTT), advisory services

## Commercialization

- Regulatory support, IP, Incubators, Start ups, Venture capital

**Research = Turning \$ into Knowledge**

**Innovation = Turning Knowledge into \$**



# Improving the Innovation System

**Stan Blade, Dean, U of Alberta**  
**Paul Dick, Vet**  
**Steve Miller AGBU, Australia**  
**Roberto Soares, CEVA**  
**Brian Lindsay, UK**  
**Jim White, Chair**

**Recommendations for:**

**LRIC**

**OMAFRA**

**University of Guelph**  
**Industry**

**“GRIP”**

**Funding**

- Government and Industry
- Facilities/Staff/HQP/ Projects

**Priorities**

- Within & across sectors,
- Informed internationally, levels of specificity by topic & species

**Effective Program Management**

- With corresponding rewards and penalties

**Extension**

- Research results to application
- Knowledge Translation and Transfer (KTT), advisory services

**Commercialization**

- Regulatory support, IP, Incubators, Start ups, Venture capital





## Mentorship program

✓ 9 across OAC, OVC, CEPS

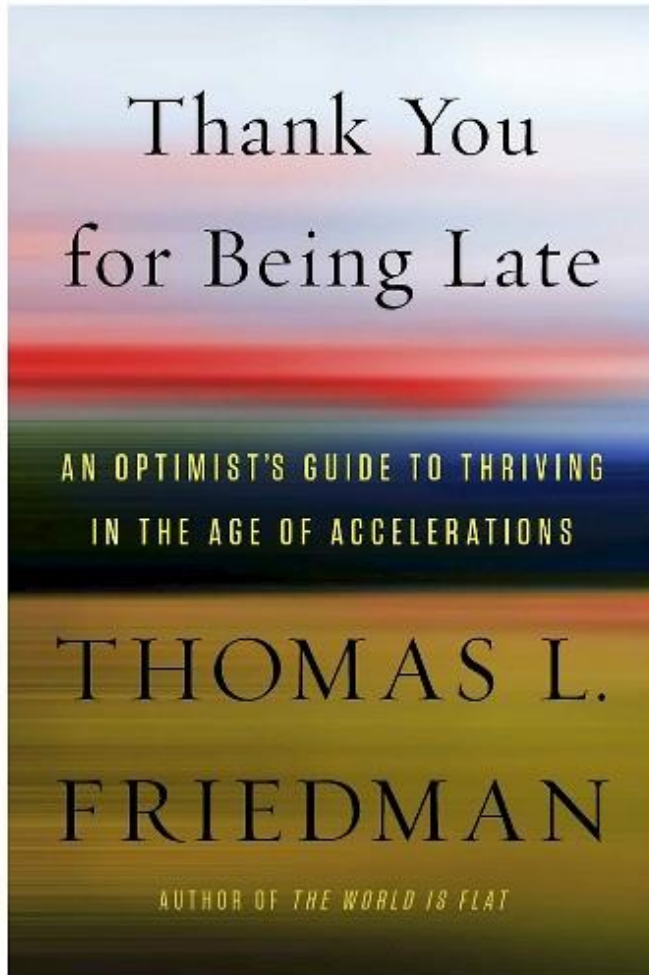
*“Innovation requires many things, including sound research rooted in industry needs; effective working relationships between faculty and industry; and effective technology transfer involving many organizations.”*

Get faculty well connected to industry...  
as quickly as possible.





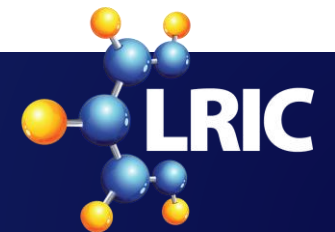
# The Future 1... Change



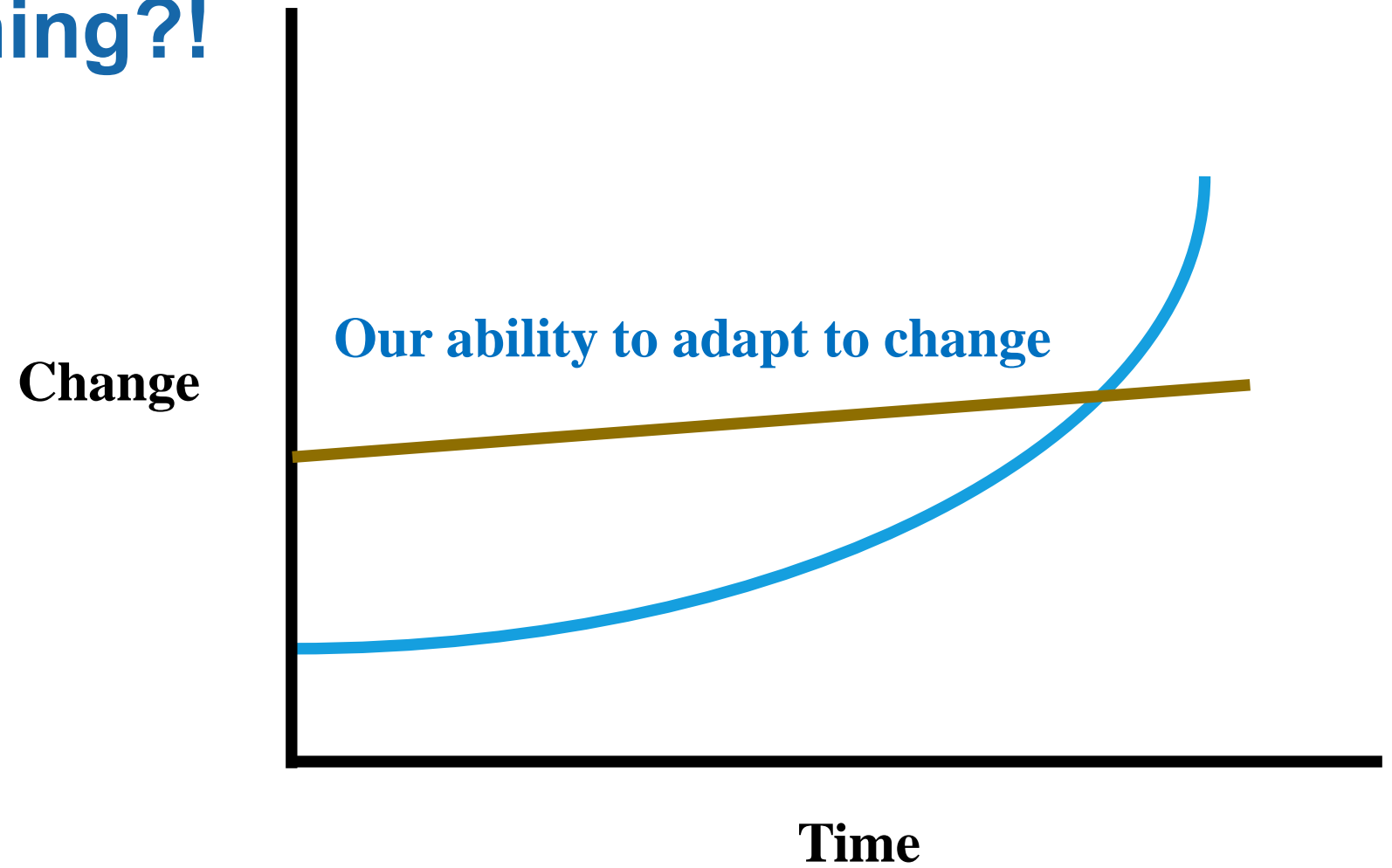
**Change**

**Moore's law; genomics;  
technology, etc**

**Time**

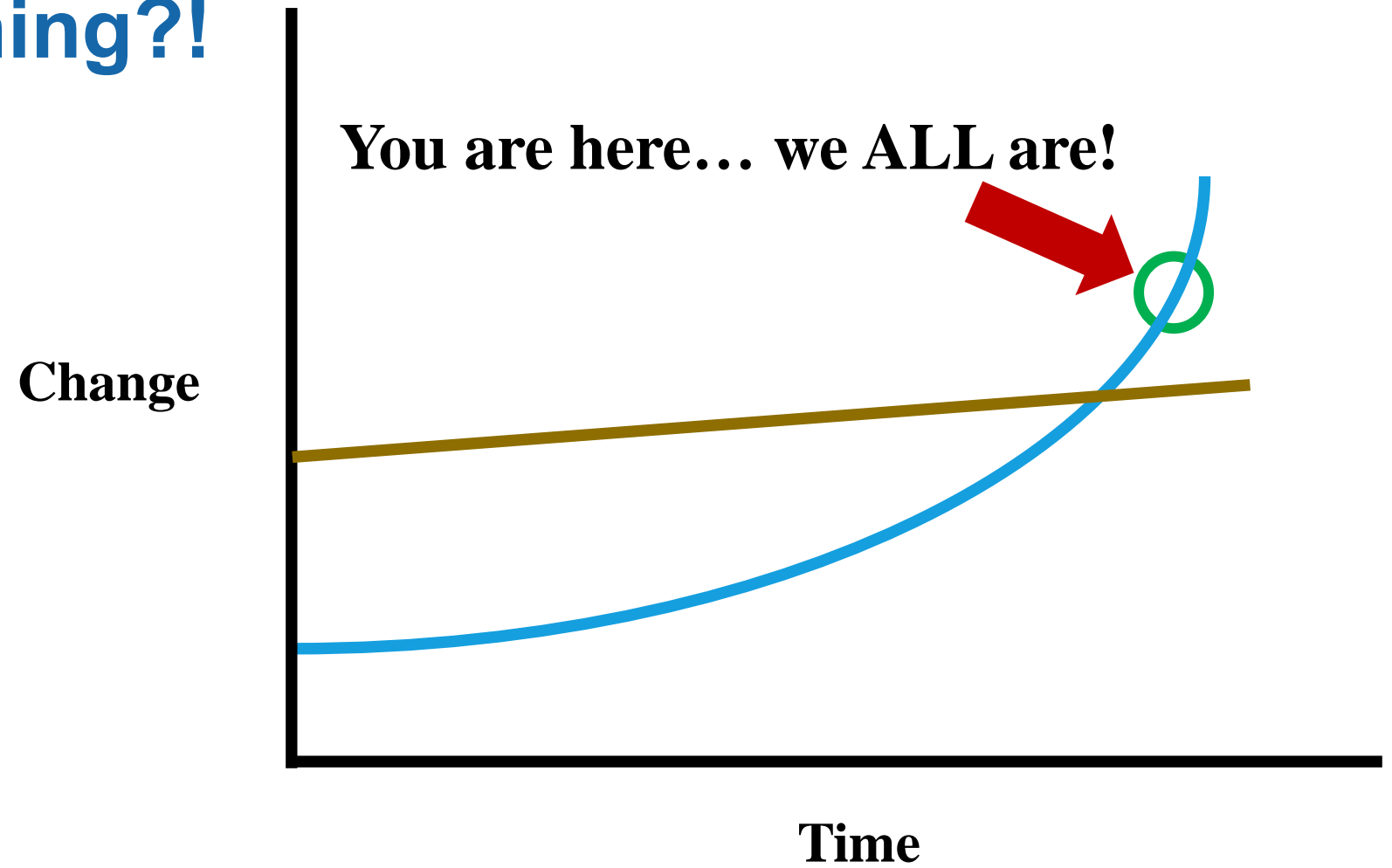


# What's Happening?!





# What's Happening?!



# So What?

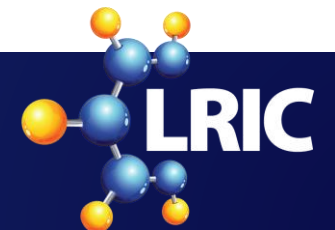
**People crave the “good old days”**

**Default to the simple answer**

**Frozen into inaction**

**We focus attention on the little stuff while the big stuff happens**

**Current structures (ministries, universities?, cannot keep up)**



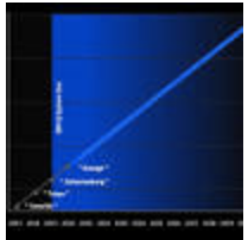
# The Future... 2: Quantum computing

quantum computer



Q All Images News Videos Shopping More Settings Tools

About 2,290,000 results (0.23 seconds)



## IBM Doubles Its Quantum Computing Power Again

Forbes - Jan. 8, 2020

IBM announced at CES 2020 that its newest 28-qubit quantum computer, Raleigh, achieved the company's goal of doubling its Quantum ...

Quantum computing boost for IBM but Bitcoin stays safe

Decrypt - 21 hours ago

CES 2020: IBM grows Q network collaborators and launches ...

ComputerWeekly.com - Jan. 9, 2020

Georgia Tech, IBM to Develop Software Stacks for Quantum ...

HPCwire - 21 hours ago

Daimler and IBM on how to build a better battery with quantum ...

TechRepublic - 22 hours ago

IBM's Quantum-Computing Service Tops 100 Customers

Blog - Wall Street Journal - Jan. 8, 2020

[View all](#)

**Moore's  
Law in  
action**

Your laptop, in one sec equals, by hand,  
3,932 years

Quantum computer, in same second equals  
31.7 billion years!

Now able to unravel complex puzzles

- Electricity loss in lines
- Molecules joining to create drugs
- Current research UofG proposals



# The Future 3... Genomics

MEGAN MOLTENI

SCIENCE 08.26.2019 06:00 AM

## Brazil's Plans for Gene-Edited Cows Got Scrapped—Here's Why

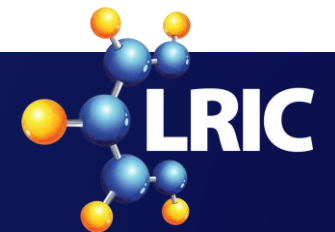


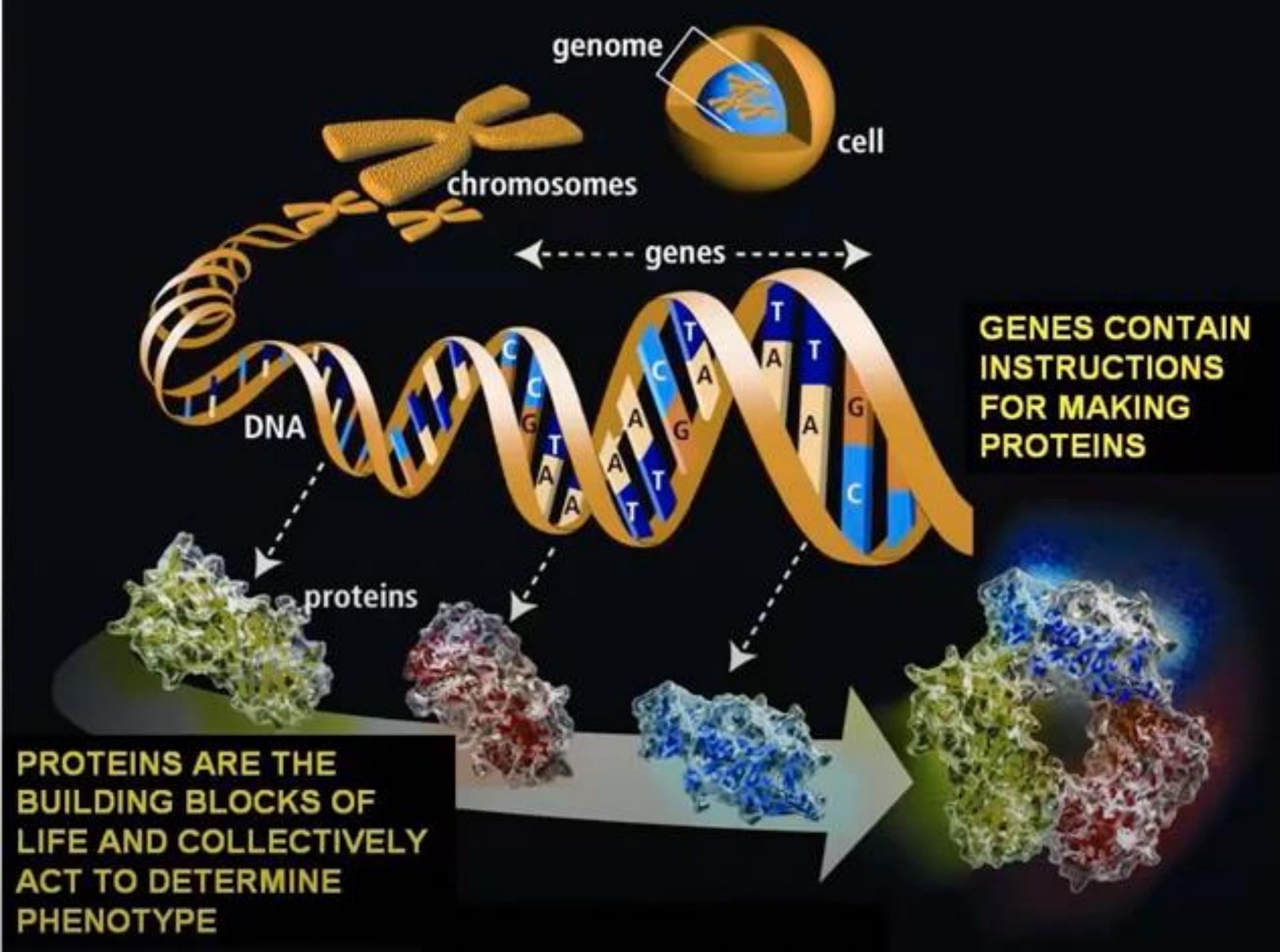
**Still early days, particularly some sectors**

**Benefits and risks are now becoming clear**

**Beware “bacterial debris”**

**Like nuclear energy... trust!**







# How might gene editing be used in breeding programs?



Target	Targeted Trait/Goal	Reference
Myostatin (MSTN) gene knockout	Increased lean muscle yield	Proudfoot et al., 2014
Intraspecies <i>POLLED</i> allele substitution	No horns/welfare trait	Carlson et al., 2016
Intraspecies <i>SLICK</i> allele knockout	Heat tolerance	Sonstegard et al., 2017
Diluted coat color	Heat Tolerance	Laible et al., 2020
Beta-lactoglobulin gene knockout	Elimination of milk allergen	Wei et al., 2018;
<i>CALPAIN</i> & <i>CAPASTATIN</i> allele substitution	Improved meat tenderness	Casas et al., 2006
Omega-3 (Fat-1) transgene	Increased omega-3 fatty acids	Wu et al. 2012
Prion protein (PRNP) knockout	Disease Resistance (Elimination prion protein)	Bevacqua et al., 2016
Insertion of lysostaphin/lysozyme transgene	Disease Resistance (Mastitis)	Liu et al., 2013 & 2014
CD18 gene edit	Disease Resistance (Bovine Respiratory Disease)	Shanthalingam et al., 2016
Insertion of SP110, NRAMP1	Disease Resistance (Tuberculosis)	Wu et al., 2015; Gao et al., 2017
Intraspecies SRY translocation	Increased % male offspring	Owen et al., 2021
NANOS gene knockout	Infertile males (for surrogate sire)	Ciccarelli et al., 2020

22:21 / 44:46 Van Eenennaam, A.L. 2019. Application of genome editing in farm animals: Cattle. In *Transgenic Research* 28: 93-100. V. Eenennaam 6/24/2021

# Gene editing of myostatin to obtain muscle cattle **versus** conventional breeding



Naturally-occurring mutation in Belgian Blue

Proudfoot C, et al. 2015. Genome edited sheep and cattle.

Transgenic Res. 2015 Feb;24(1):147-53.



25:17 / 44:46

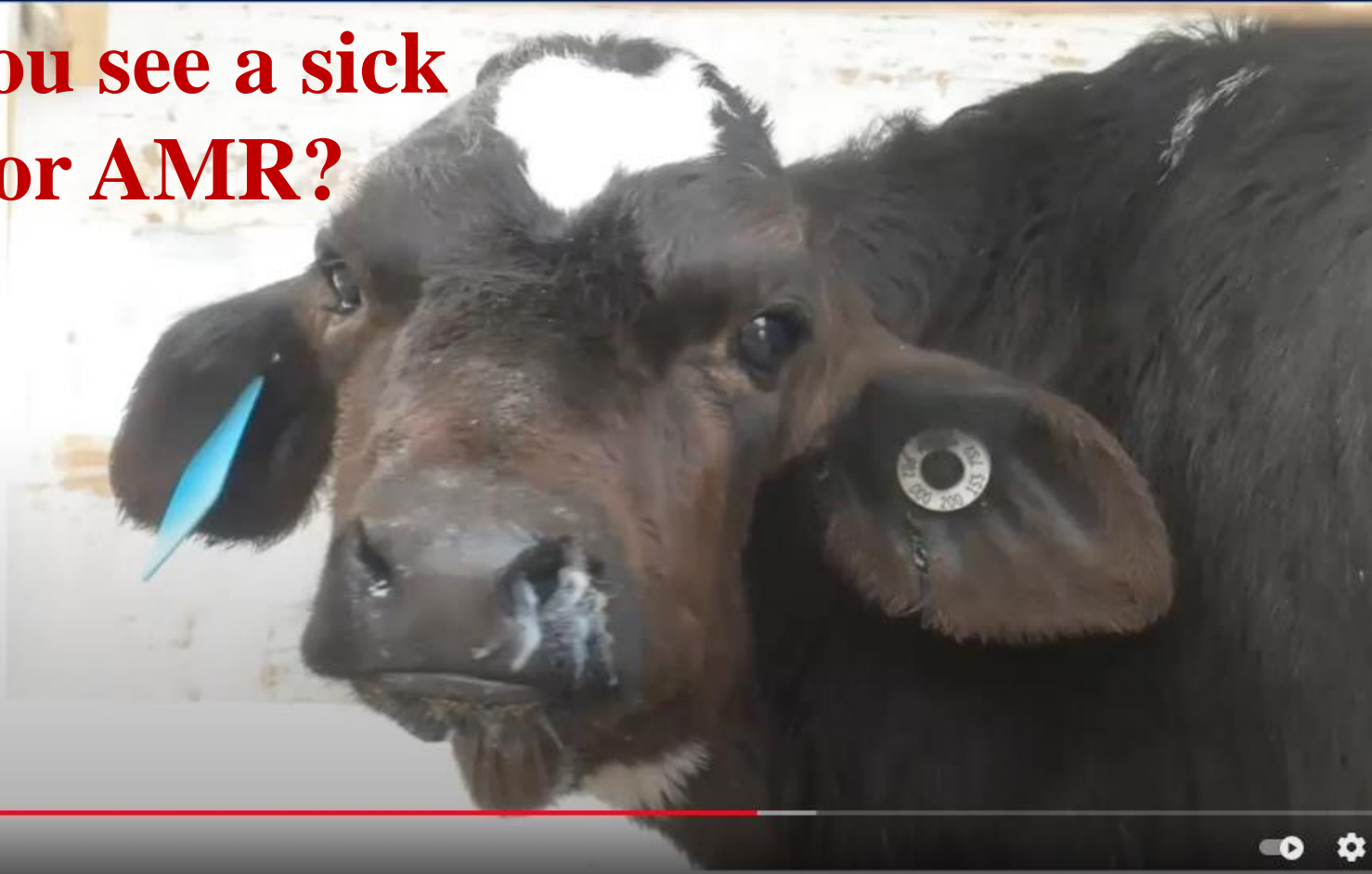




Genetic improvement (permanent, cumulative)  
as a solution to animal disease rather than  
antibiotics/chemicals



**Do you see a sick  
calf, or AMR?**



The book cover for 'The Gene' by Siddhartha Mukherjee features a light green background with a series of overlapping circles in yellow, red, and blue on the left side. The title 'THE GENE' is prominently displayed in large, bold, black capital letters.

# THE GENE

AN INTIMATE HISTORY

SIDDHARTHA  
MUKHERJEE

PULITZER PRIZE-WINNING AUTHOR OF  
THE EMPEROR OF ALL MALADIES

## Dire need for Society to understand Genetics!

**Mankind's understanding of genetics from 5,000 years ago to today (and a look to the future)**

**INFORMED discussion is in short supply**

**Under what conditions is GM, GE, BE OK?**

**When will there be GMO humans are on earth?**



# China convicts researcher who claimed to create world's first gene-edited babies



**There are 3 already!**

Scientist's actions sparked global debate over ethics of gene editing

The Associated Press · Posted: Dec 30, 2019 6:24 AM ET | Last Updated: December 30, 2019



Chinese scientist He Jiankui, who claims he created the world's first genetically edited babies, was sentenced Monday to three years in prison because of his research, state media said. (Anthony Wallace/AFP)

## Altered Inheritance

CRISPR *and*



*the Ethics  
of Human*



Genome

Editing

FRANÇOISE BAYLIS

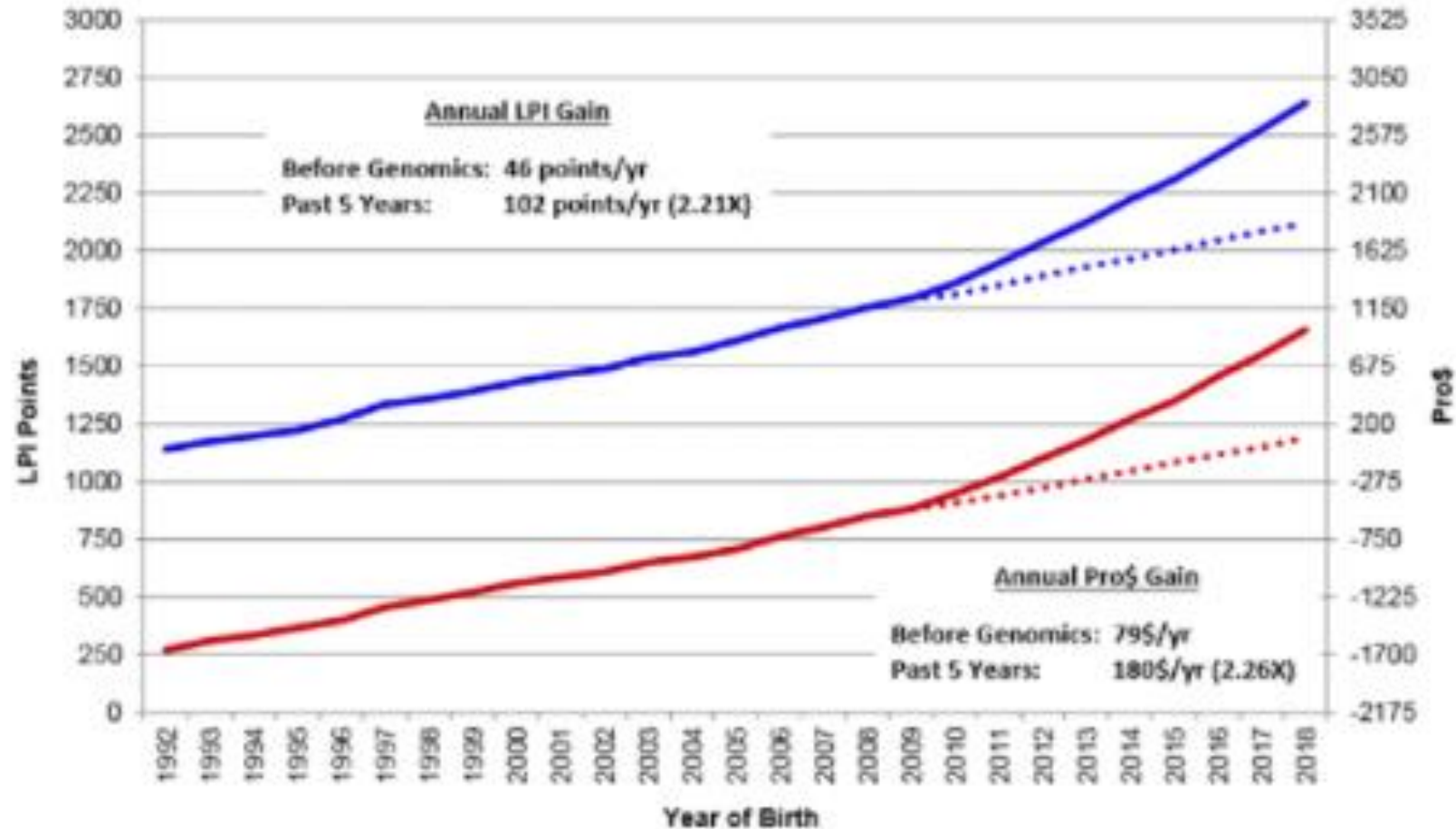


## Genomics impacts on livestock:

- Genetic evaluation earlier, before birth... shorter generation interval, faster progress
- Genetic evaluation on hard to measure traits like feed efficiency and health

### Dairy LPI Impact:

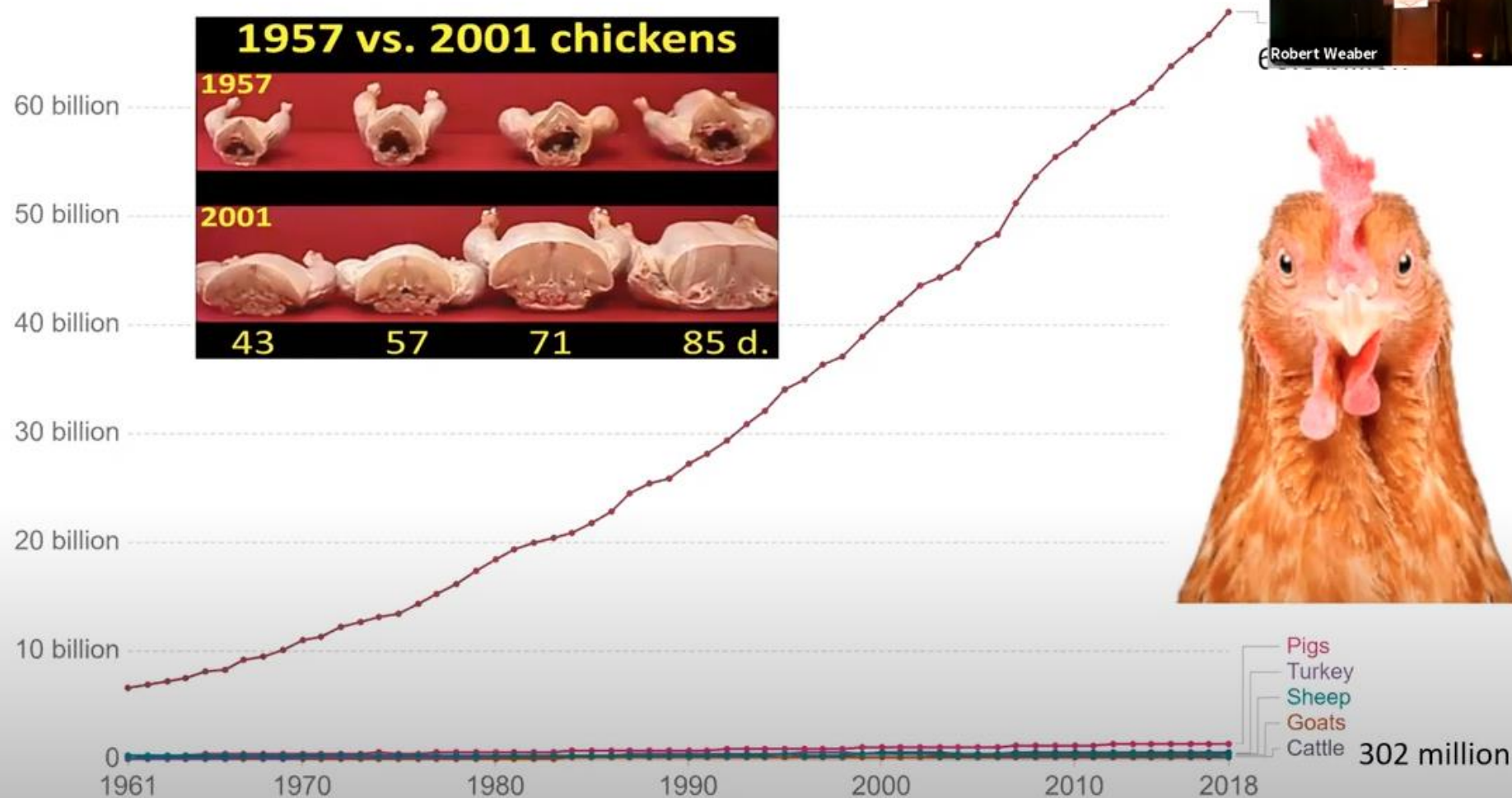
- Doubling the rate of gain
- Be sure you are going in the right direction!







# Number of animals slaughtered for meat, World, 1961 to 2018



Source: UN Food and Agriculture Organization (FAO)

Note: This is based on livestock production for meat (and therefore does not include dairy or egg production).

OurWorldInData.org/meat-production • CC BY

7:58 / 44:46

Van Eenennaam 6/24/2021

# The Future 4... Politics

**Leadership (national, provincial, sector, supply mgmt or not)**

**Consumer expectations (social license)**

**The cost of transparency = bureaucracy**





# The Future 5... Retail pull / Consumer demand

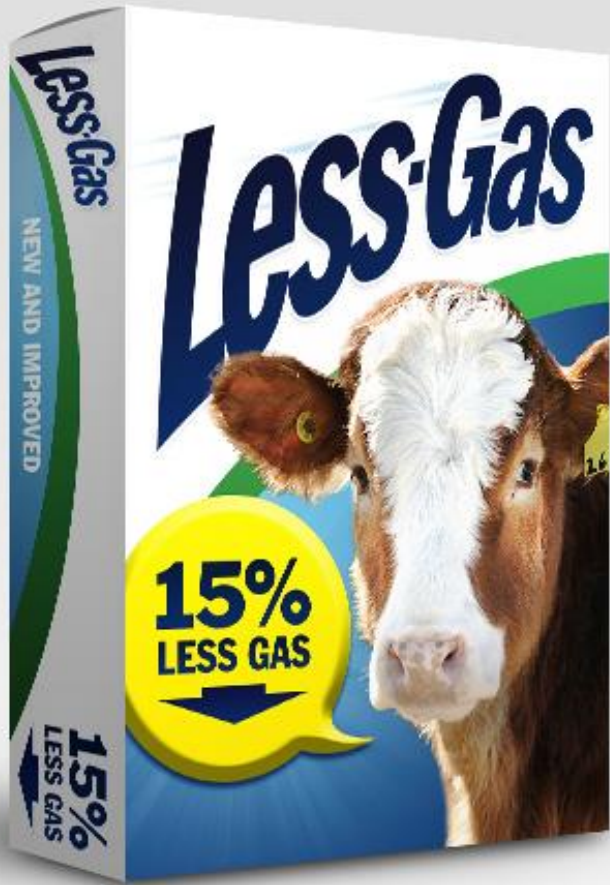


Today, McDonald's is announcing a [policy](#) to **reduce the overall use of antibiotics important to human health**, as defined by the World Health Organization (WHO), which applies **across 85% of our global beef supply chain**.

December 2018







In Canada, producing 1kg of beef now creates 15% less greenhouse gases than in 1981, due to improved production practices.



RAISE YOUR  
**BEEF IQ**  
@  
[beefresearch.ca](http://beefresearch.ca)

## LRIC Members

**Industry must have true, simple messages backed with sound holistic research.**



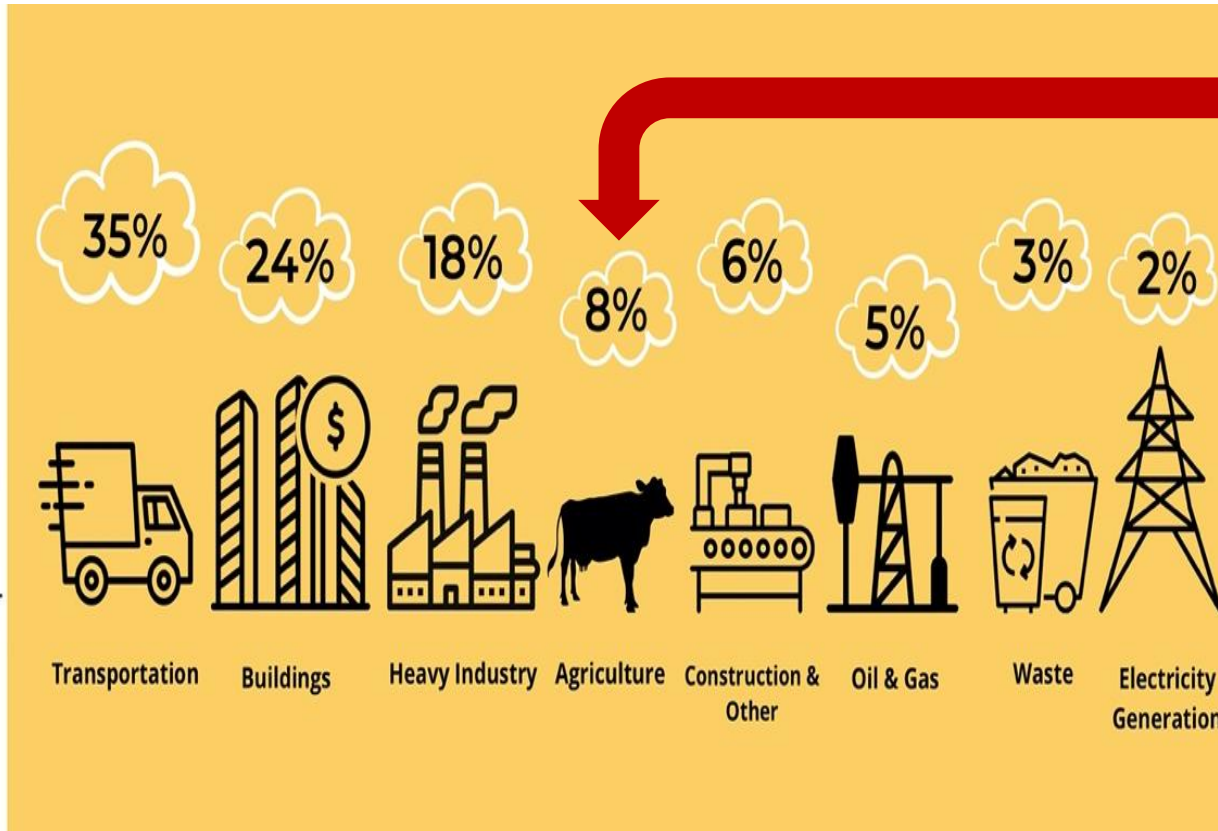
# The Story



**Simple and visual!**

# The Future 6... Climate Change

Total Ontario  
Greenhouse Gas  
Emissions by  
Economic Sector  
in 2018



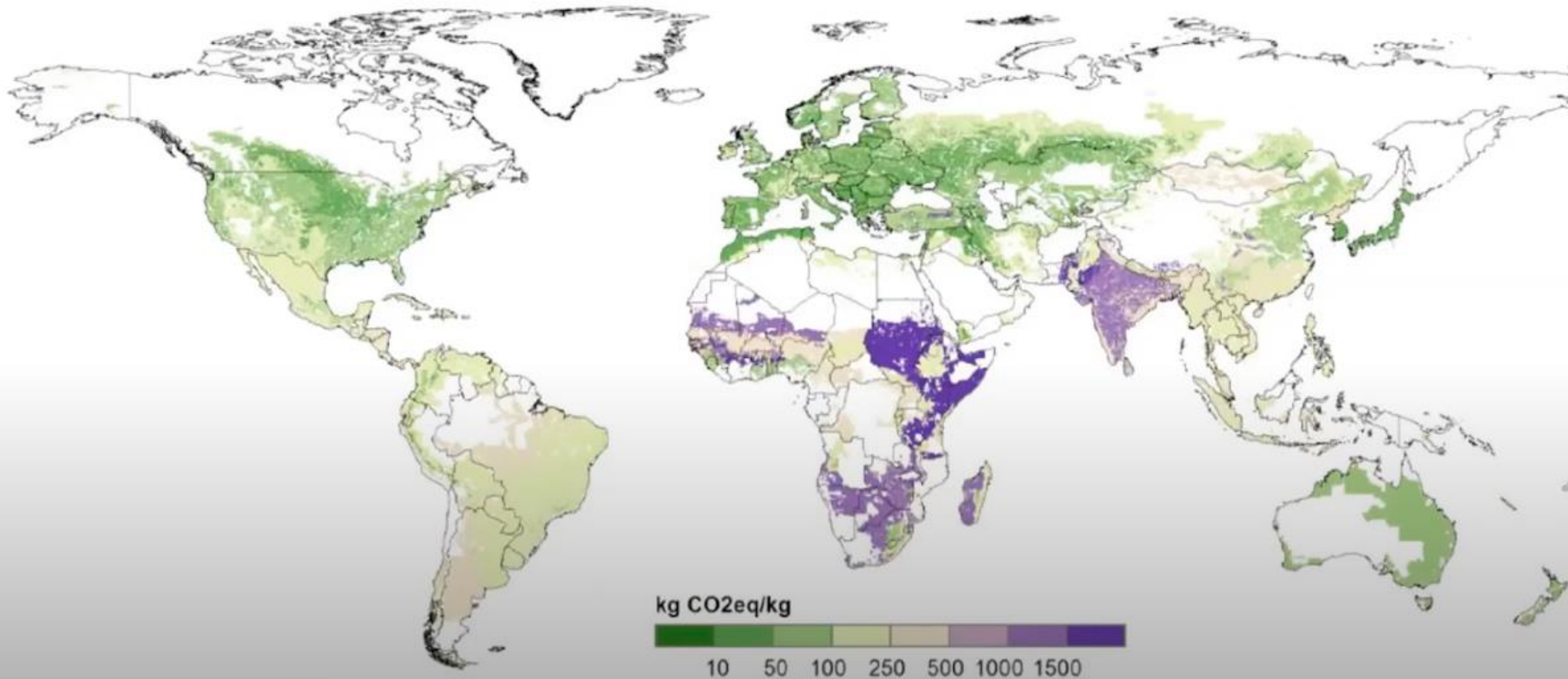
**Livestock is about 50% of this.**

**LRIC website: Summary of excellent video featuring Dr. Frank Mitloehner**

**Industry must adopt a philosophy of continuous improvement with respect to GHG**

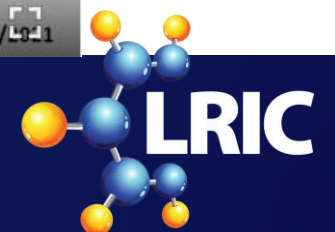


# Greenhouse gas emissions from beef production expressed CO<sub>2</sub> equivalents per kilogram of protein



Source: Herrero et al., 2013 PNAS 110: 20888-20893

Van Eenennaam, 13/10/21



# Canada's second-largest pension fund reveals new climate targets

By **Maiya Keidan**

Reading Time: < 1 minute

Published: September 28, 2021

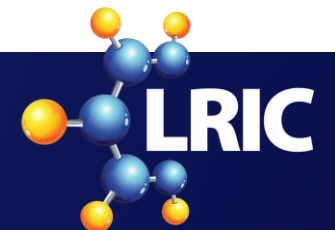
**Markets**

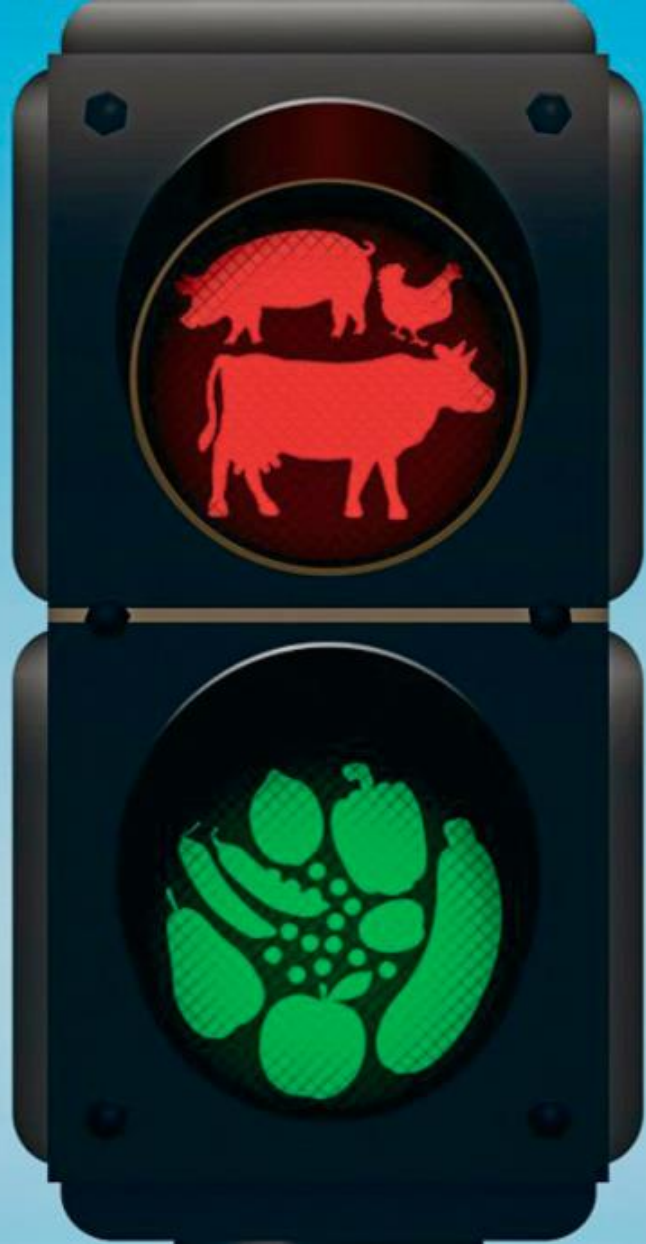


## Follow the Money

### Canada's No. 2 pension fund Caisse de depot et placement du Quebec (Sept 21)

- Plans to completely exit oil production by the end of 2022 and reduce carbon intensity by 60 per cent by 2030
- Plan to hold green assets worth \$54 billion by 2025 and dedicate \$10 billion to decarbonize carbon-emitting sectors
- Currently hold **\$390 billion** in assets
- Note the image!





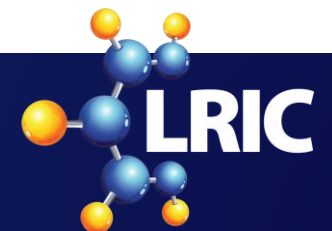
# International campaign calls for end to food animal use

Plant Based Treaty initiative asks national governments to transition away from food animal production

By **Doug Ferguson**

Published: October 7, 2021  
**News**

The initiative aims to get “10 million individuals, 10,000 organizations, 10,000 businesses and 50 cities to endorse the treaty by 2023, ahead of the global stocktake of the Paris Agreement,” said a statement by the campaign. The stocktake is a process to evaluate the world’s progress in achieving the climate agreement’s goals.





# The Future 7... Animal-Free Livestock Products

## Three Drivers:

- 1) My Health
- 2) Planet Health
- 3) Animal Welfare

**Livestock producers need to respond and show progress with these issues.**



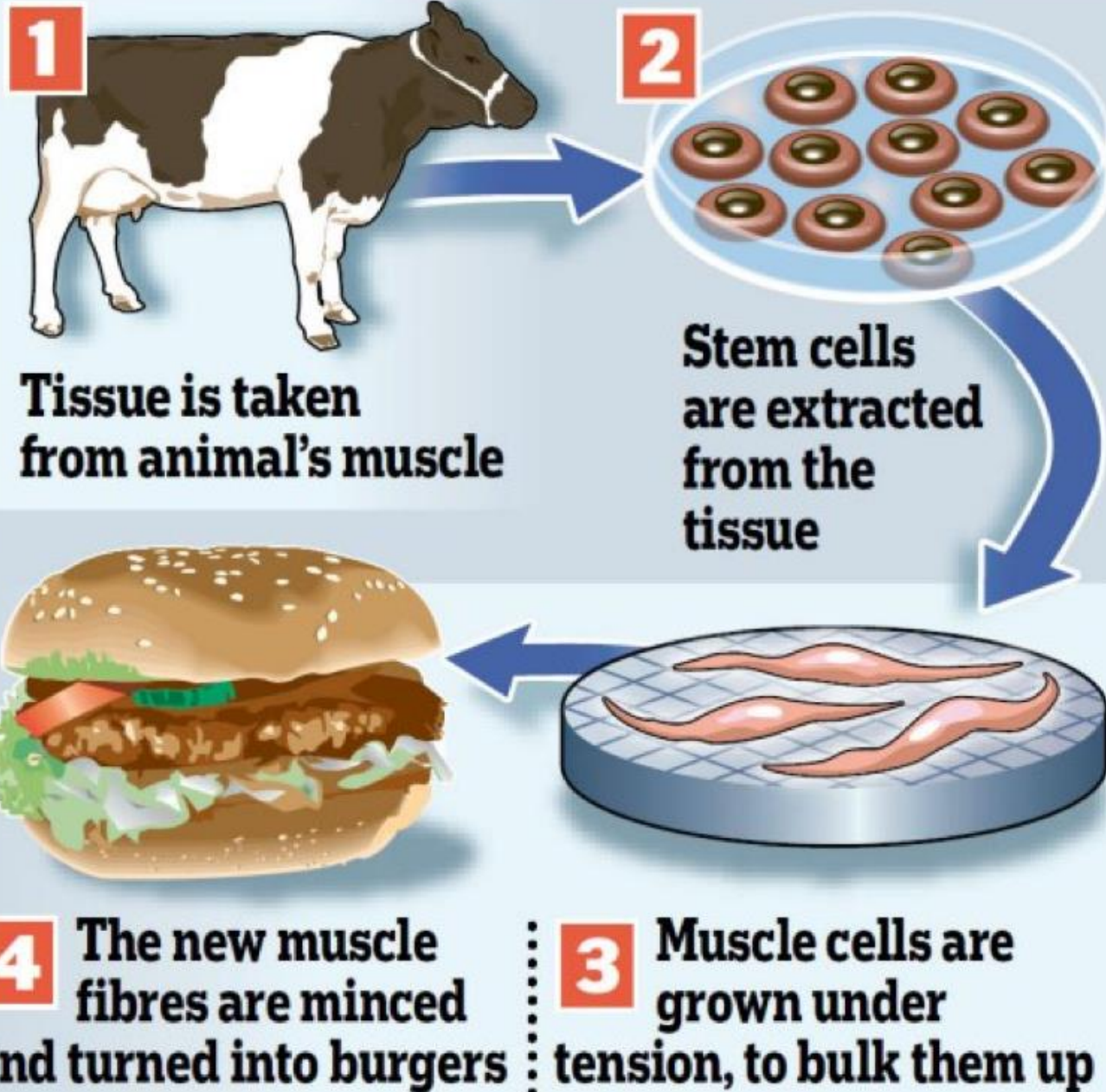
## Scientists Create First 3-D Printed Wagyu Beef

The cultured cut matches the texture and marbling of the famous Japanese meat

CORRYN WETZEL  
09/02/2021

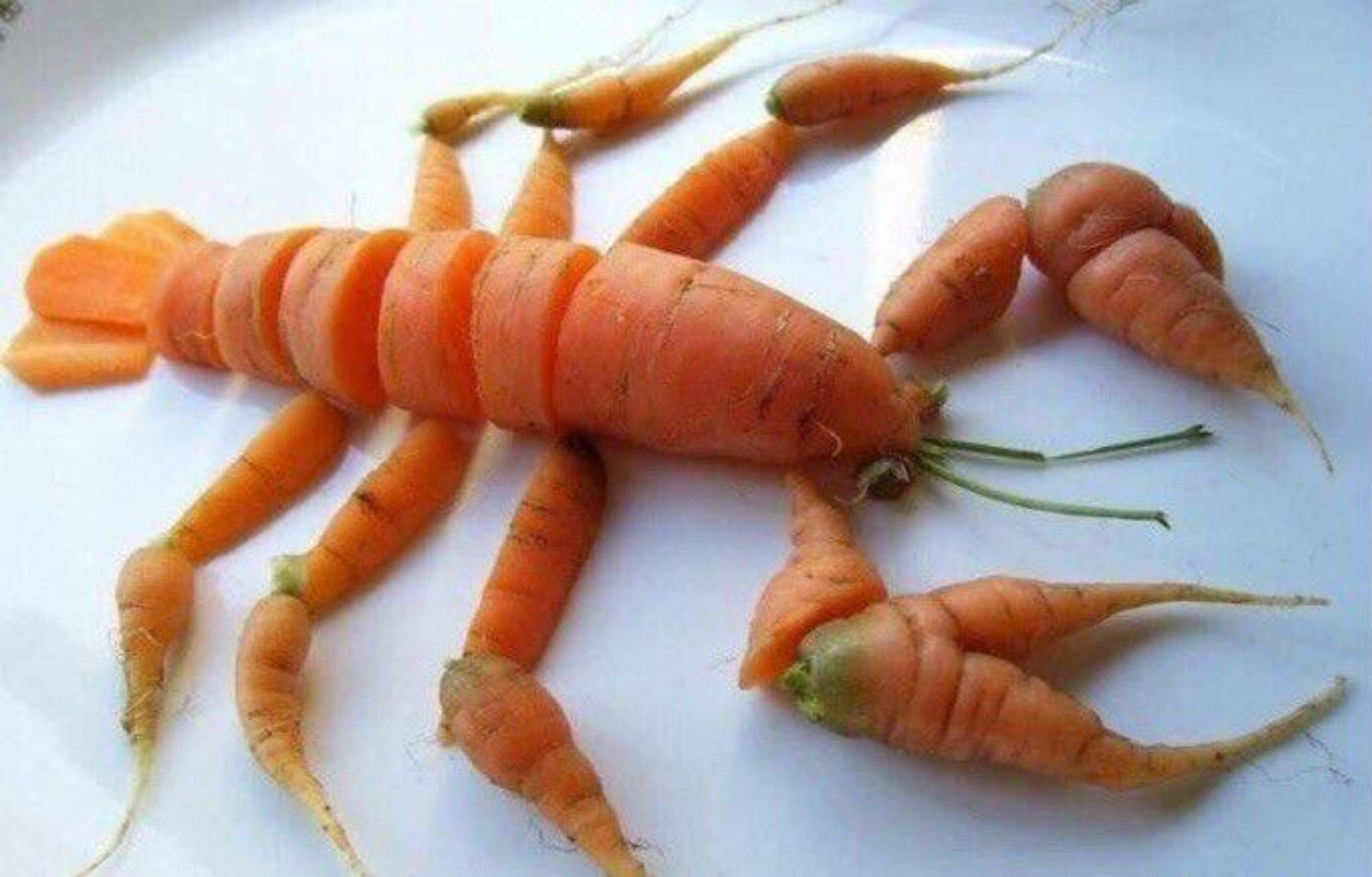


# HOW IT WORKS



## The Message

*“Impossible Foods is addressing the most catastrophic threats facing humanity... A global transition to a plant-based food system will turn back the clock on atmospheric CO2 levels, restore natural ecosystems and reverse meltdown in wildlife biomass. The easiest – if not only – way to make our civilization sustainable is to eliminate **livestock, the most dangerous technology on Earth.**”*



**Not Fake  
Meat**



#1 NATIONAL BESTSELLER

*The*

WITH A NEW  
AFTERWORD BY  
THE AUTHOR

# TIPPING POINT

*How Little Things Can  
Make a Big Difference*

MALCOLM  
GLADWELL

*"A fascinating book that makes you see the world  
in a different way." —FORTUNE*

## The Future 8... Tipping Point?

**Drunk driving = Bad**

**Smoking = Bad**

**Livestock = Bad??**



## Opinion: **It's time for a livestock manifesto**

All species groups need to work together to tackle big issues in a coordinated way

By **Mike McMorris**

Reading Time: 3 minutes

Published: April 8, 2021

**News**



## One More LRIC Initiative:

**“The Livestock sector is important to Ontario’s economy, food security and environment. We commit to working together to grow the sector and to do so in a sustainable manner.”**

**Industry  
Government  
University of Guelph**

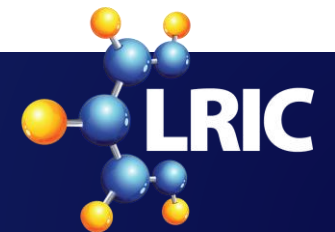




# The Future 9... Bold Leadership



**We need “Piranha Bulls”**



# Future?



**ASF, China recently lost about 65% of its herd**

**7 stories, 12 being built  
1,300 sows each... 15,600**

**When complete, will  
produce 840,000 pigs per  
year**

# The Future



- Fewer farms, fewer but more productive animals
- Plant based protein, yes but concern regarding ultra-processed foods will limit
- World will segment to some extent... some rollback of globalization
- Cellular agriculture will evolve to a marketable product
- Existing niche markets will grow but remain niche
- Marketing systems will evolve
- Our dependence on small number of trade markets will remain... A vulnerability
- Change will be driven by downstream players (e.g. McDonald's shareholders)





- **There will be GE livestock products for sale**
- **Data collection will be much more automated**
- **Some sectors will make good use of that data**
- **Farm practices will be more regulated**
- **Consumers will still say they want, but then largely ignore, information**
- **Farm animals will be generally healthier but susceptible to greater risk**
- **Farm community must build/hold elusive “trust”**



# For More:

**Livestock Innovation monthly newsletter**

**Twitter @LivestockInnov**

**Horizon Series (webinars, On the Fly and White papers)**

**Resources on our website:**

**[www.livestockresearch.ca](http://www.livestockresearch.ca)**

**[mmcmorris@livestockresearch.ca](mailto:mmcmorris@livestockresearch.ca)**





**Thanks for the opportunity!**

**[mmcmorris@livestockresearch.ca](mailto:mmcmorris@livestockresearch.ca)**