Big Data, Science and Cow Improvement:

The Power of Information!

Brian Van Doormaal, Canadian Dairy Network (CDN)

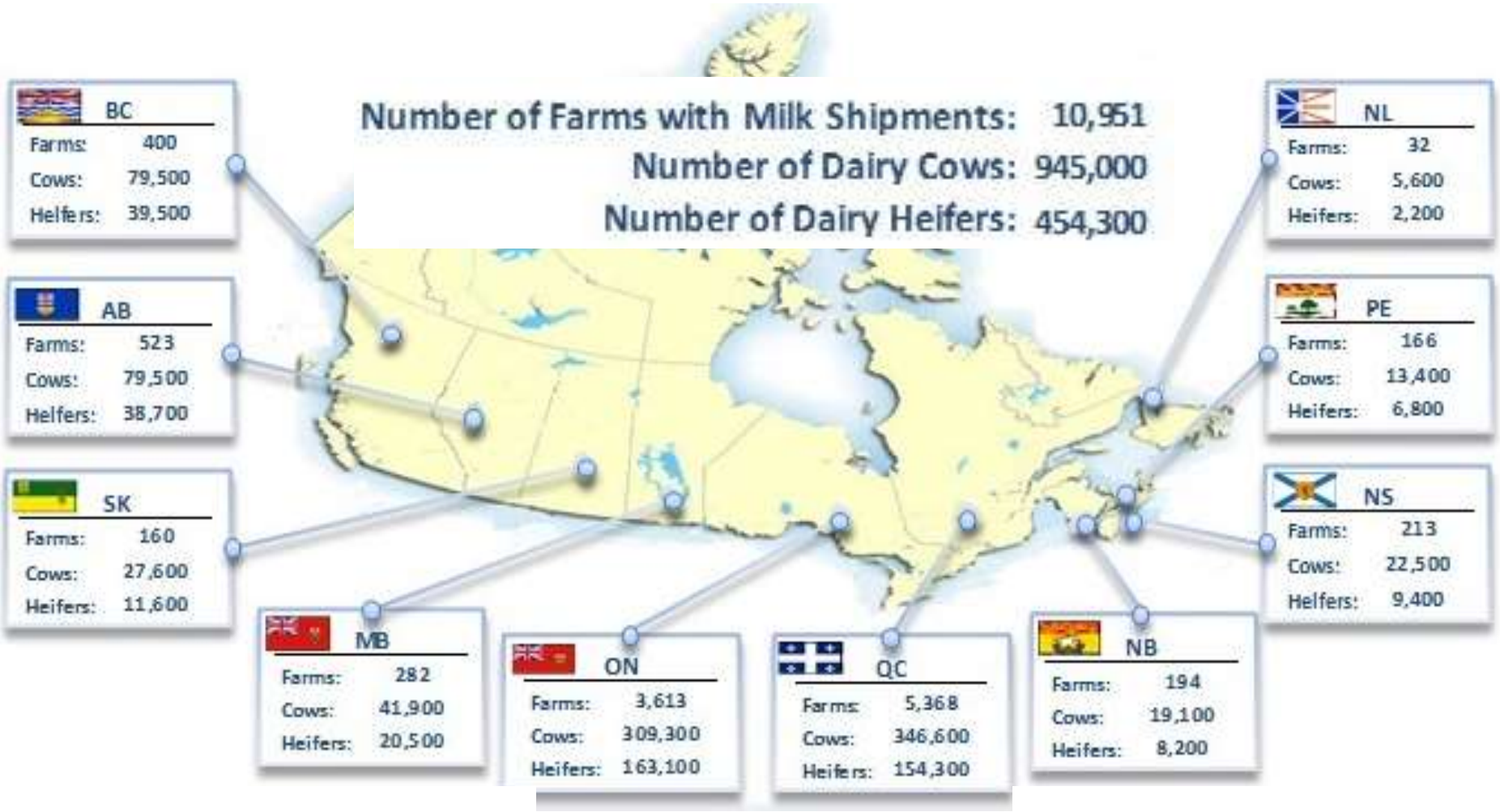
Building a Sustainable Dairy Industry, DFC Symposium

November 7-8, 2017, Ottawa

Our Product

World population expected to approach 10 billion by 2050

Canadian Dairy Population



Source: Canadian Dairy Information Centre, Government of Canada

The Life of a Dairy Farmer

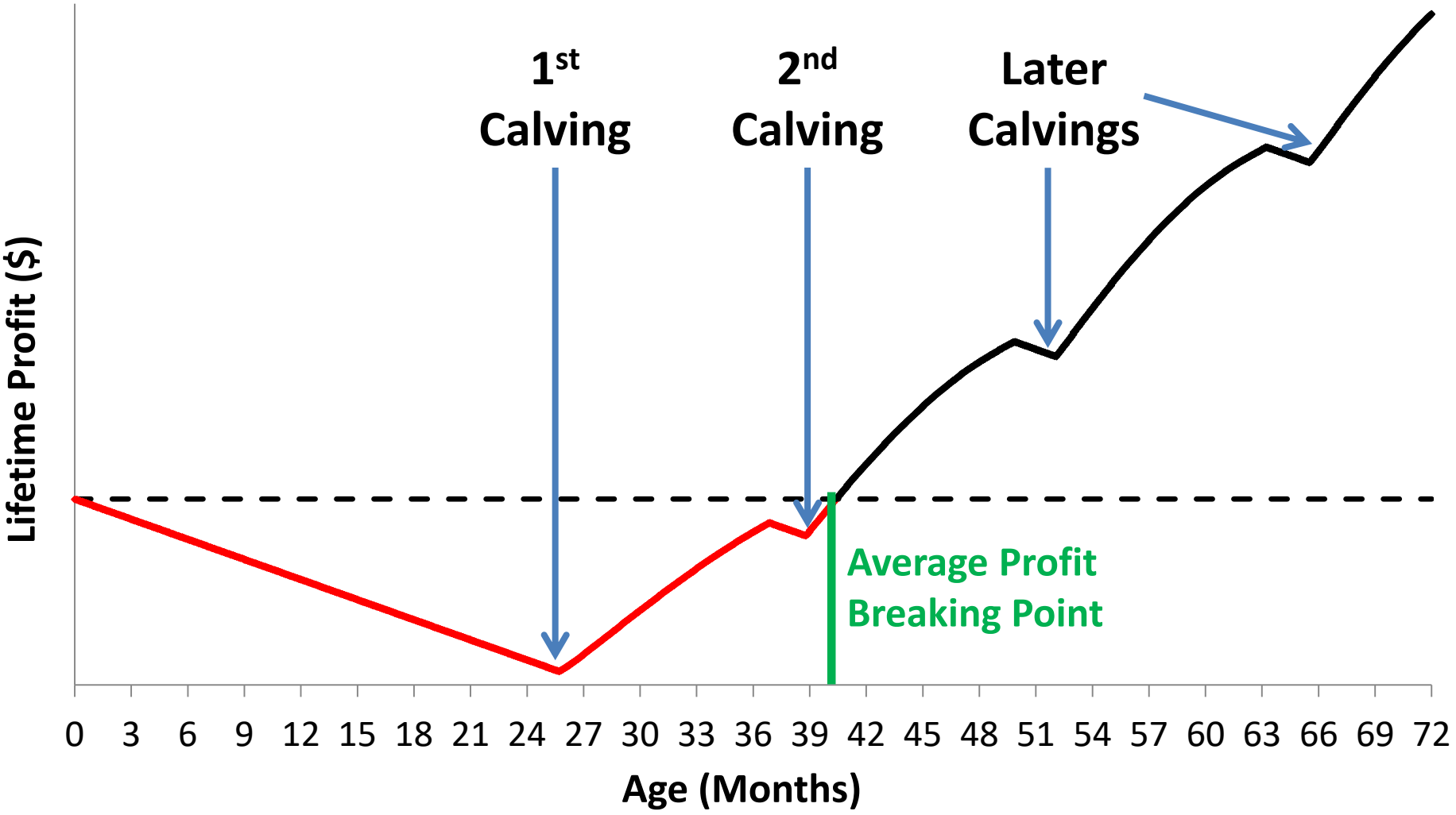
- Dairy farmers MUST milk their herd of cows at least twice every day
- They feed all animals several times daily, provide a sanitary living space and nurture all calves
- They record various events on each animal as they occur daily:
  - Heat detection, breeding, calving, production, etc...
  - Prevention, occurrence and treatment of health events
  - Behavioural characteristics

Dairy Farmers

LOVE

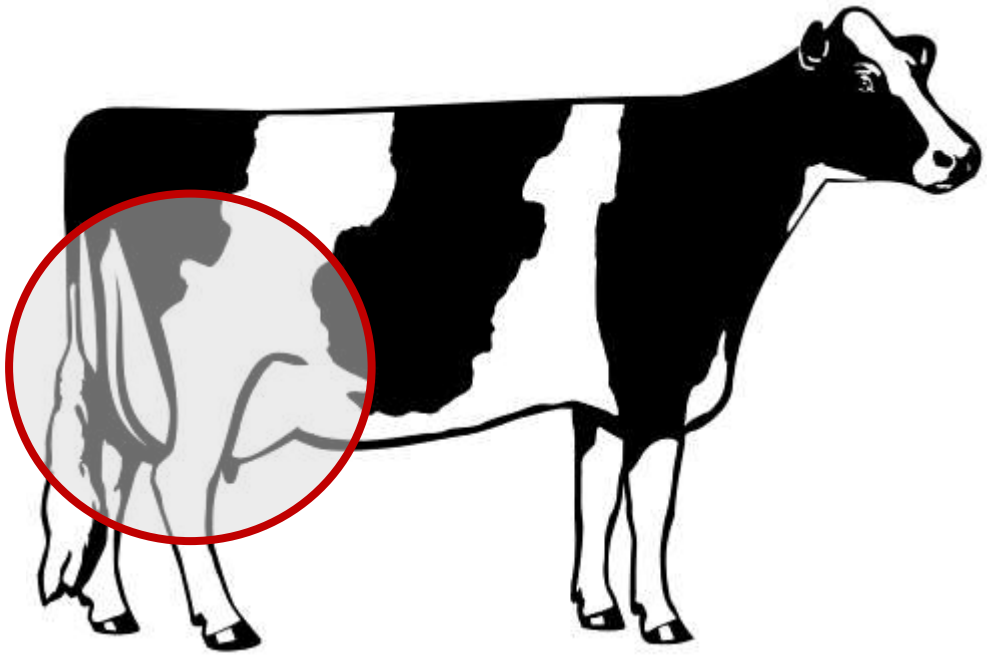
their animals and most know them individually

Typical Lifetime Profit Curve



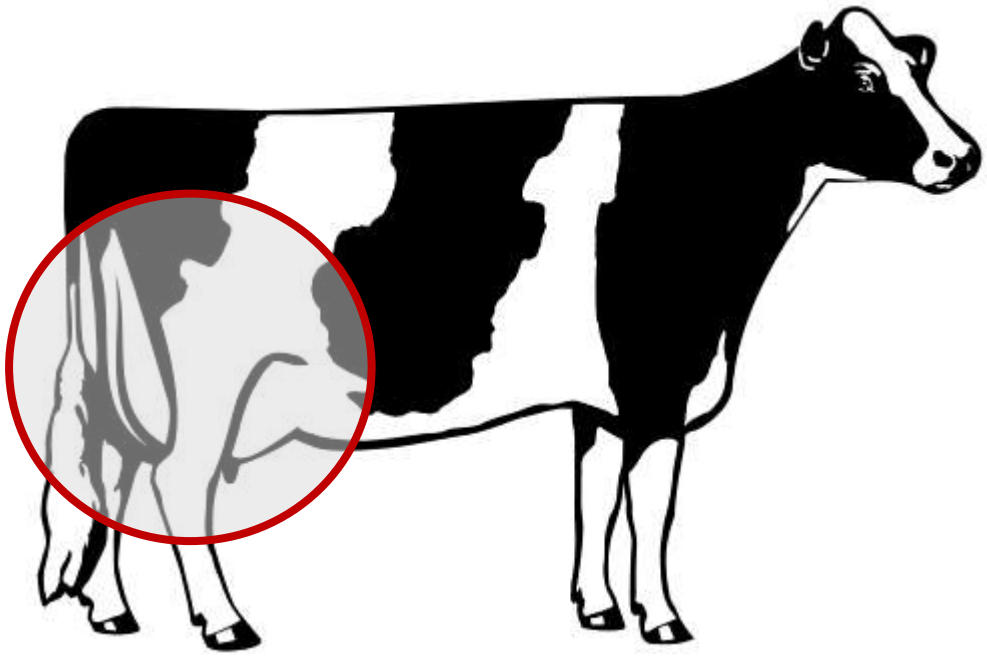
Industry Data Collection

- **Production**
  - Routine farm visits 10-12 times per year to measure milk weight on each cow
  - Also a milk sample for analysis of fat and protein percentages
  - Provides complete lactation records for official publication



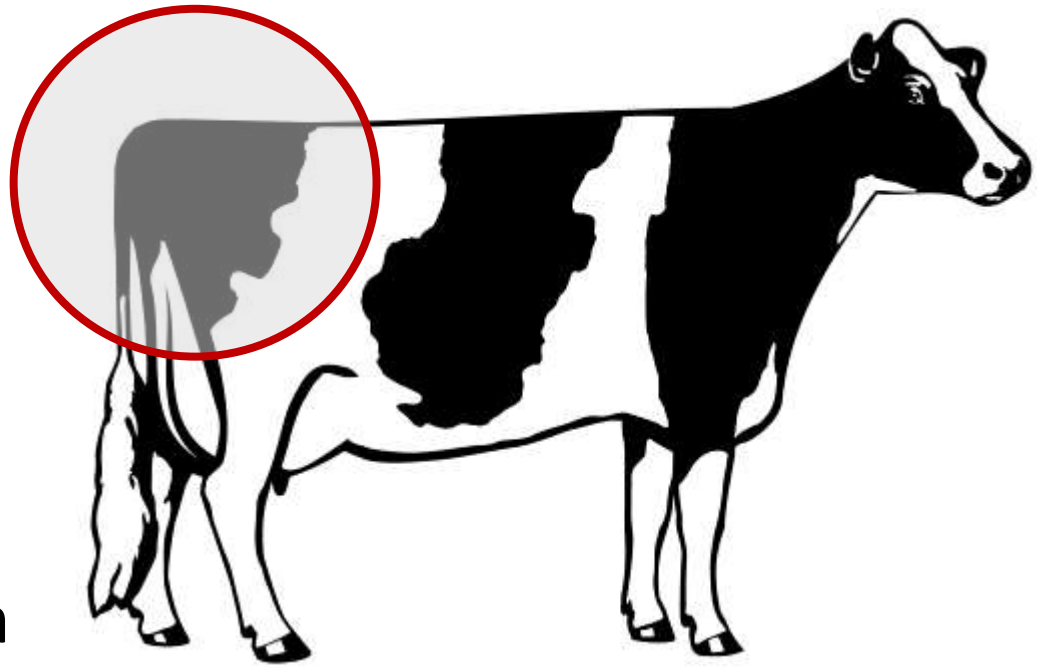
Industry Data Collection

- **Milk Sample Analysis**
  - Milk composition
    - Fat, protein, lactose, fatty acids, etc...
  - Somatic cell count to manage mastitis
  - MUN (indicator of proper energy balance)
  - BHB (indicator for management of ketosis disease)
  - Other tests for herd management



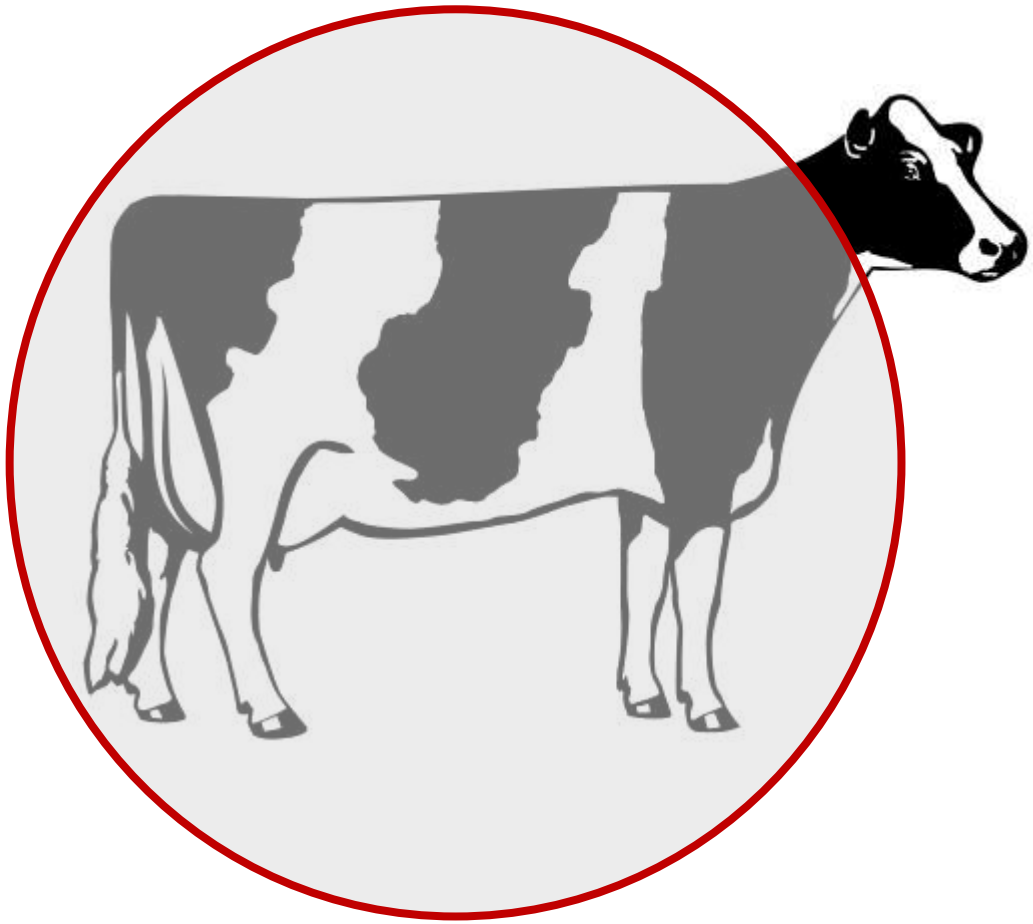
Industry Data Collection

- **Reproduction:**
  - Every breeding
  - Every calving:
    - Calf identification and birth date
    - Calf sex & size
    - Ease of birth
    - Calf survival
  - Identifies sire and dam of calf for pedigree recording



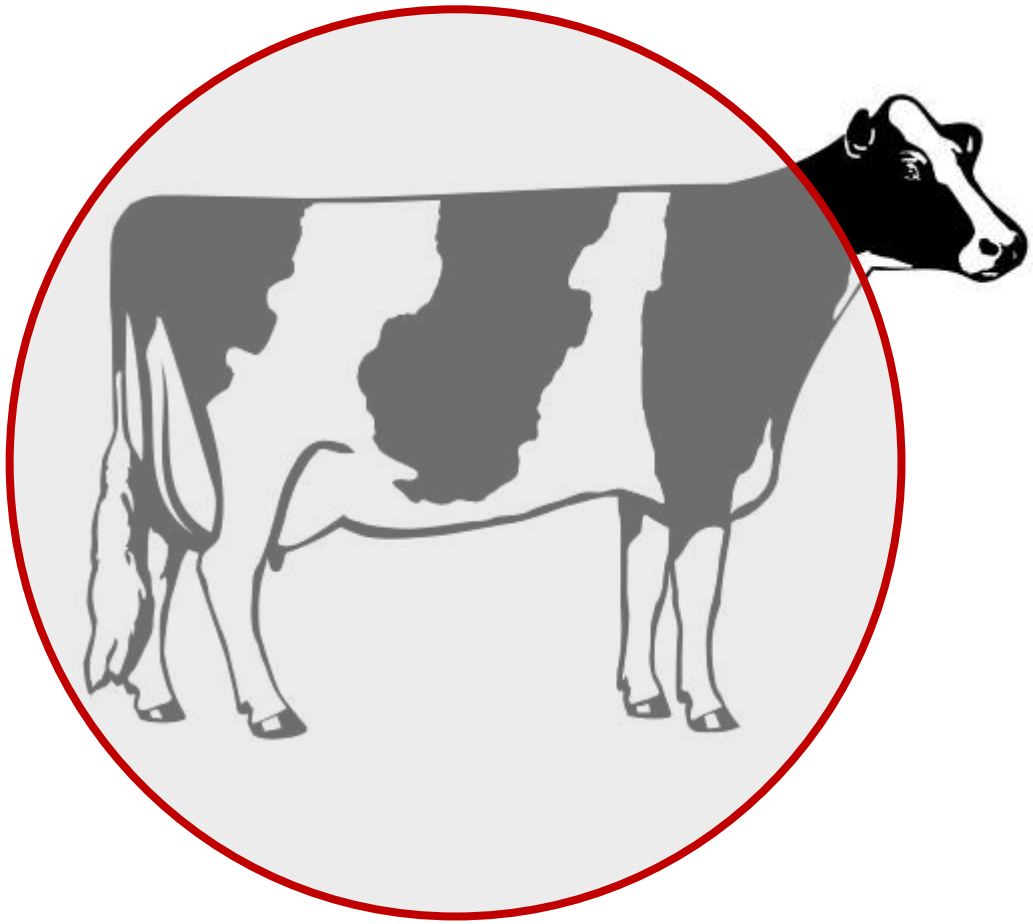
Industry Data Collection

- **Animal Health**
  - ➢ Occurrence of 8 most costly diseases in milking dairy cows
  - ➢ Hoof health lesions that are related to lameness
    - ❑ Genetic evaluations starting December to reduce incidence of Digital Dermatitis

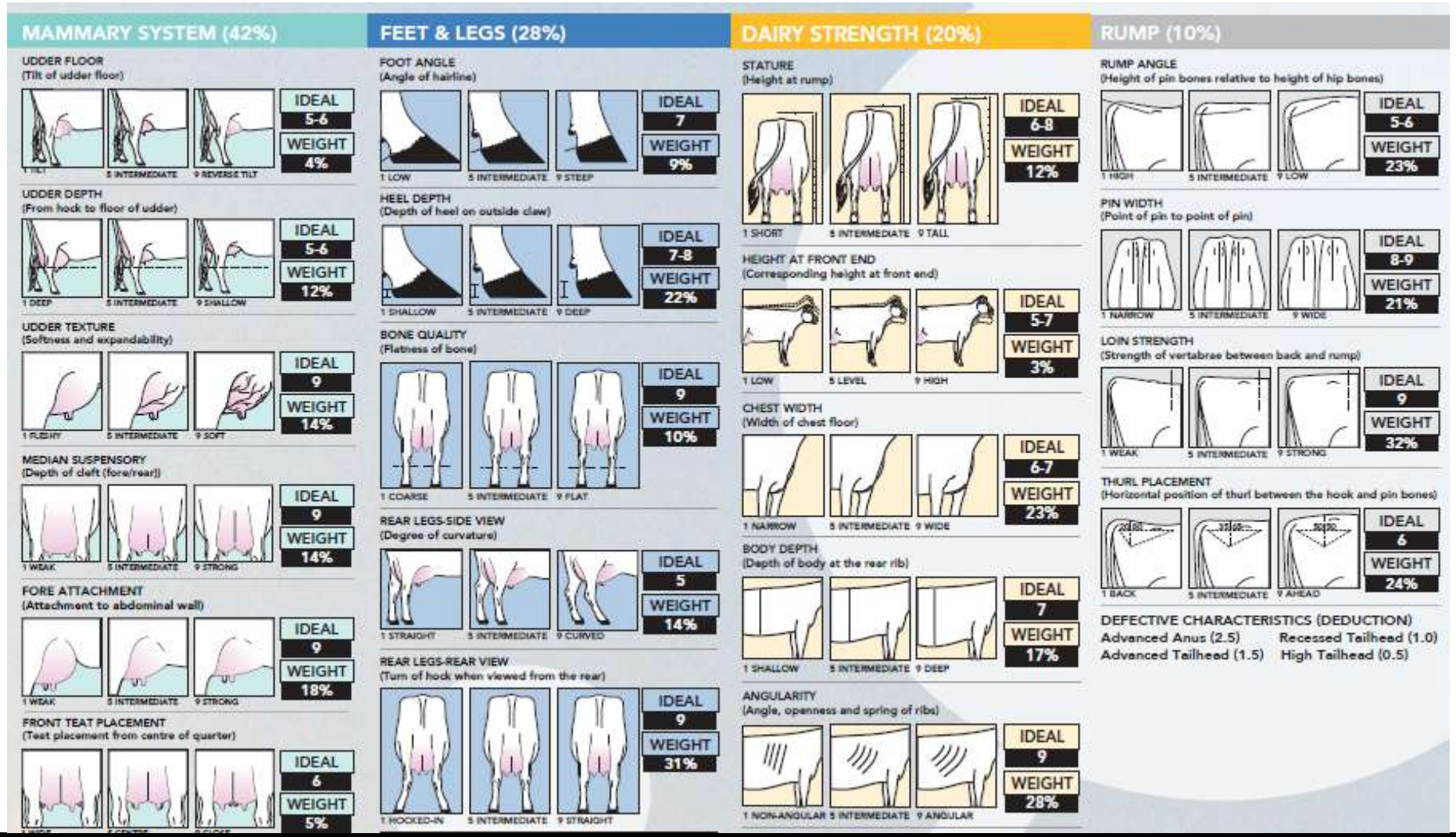


Industry Data Collection

- **Body Characteristics**
  - Overall Conformation
  - Mammary System
  - Feet & Legs
  - Dairy Strength
  - Rump

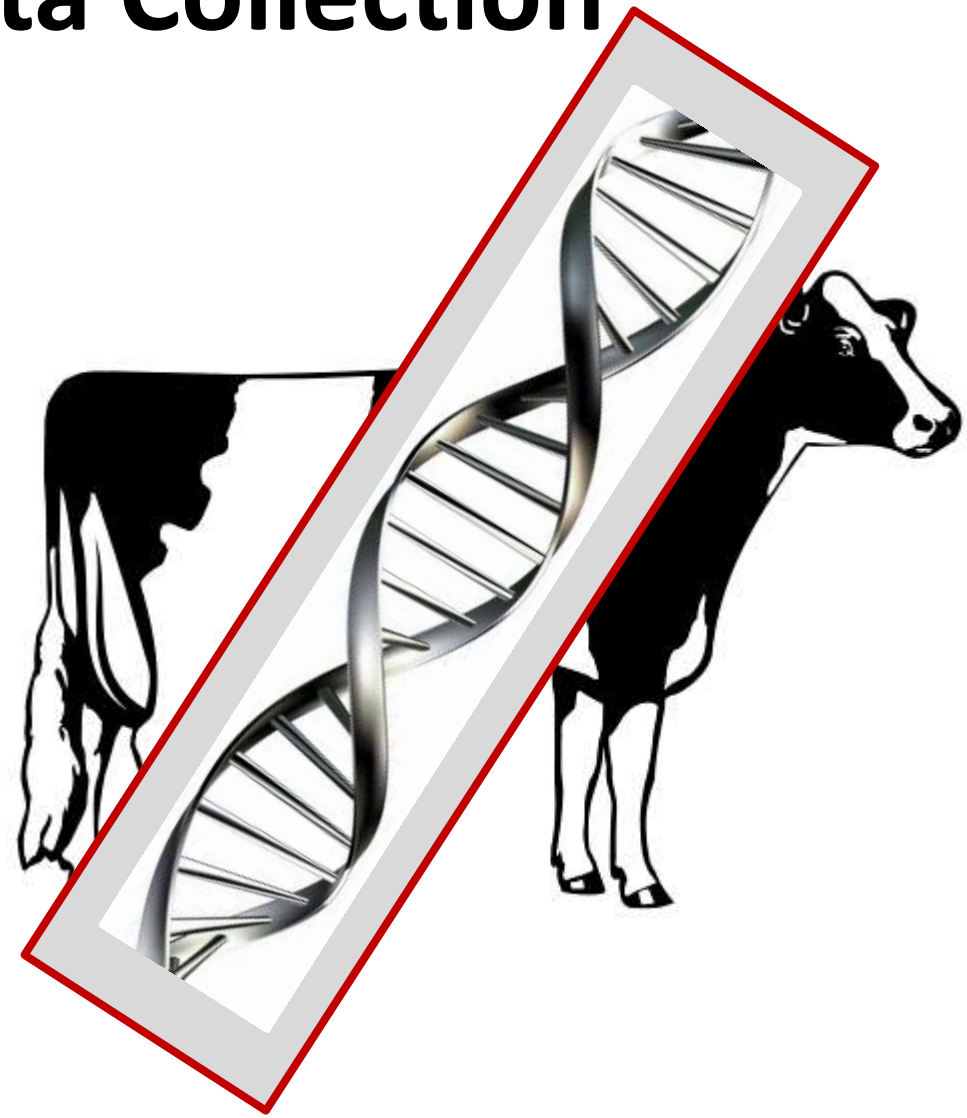


Body Conformation Assessment



Industry Data Collection

- **Animal's DNA**
  - Started in 2009 and interest is growing
  - Primary purpose is more accurate genetic evaluations
  - Result has been a significant increase in the rate of genetic progress

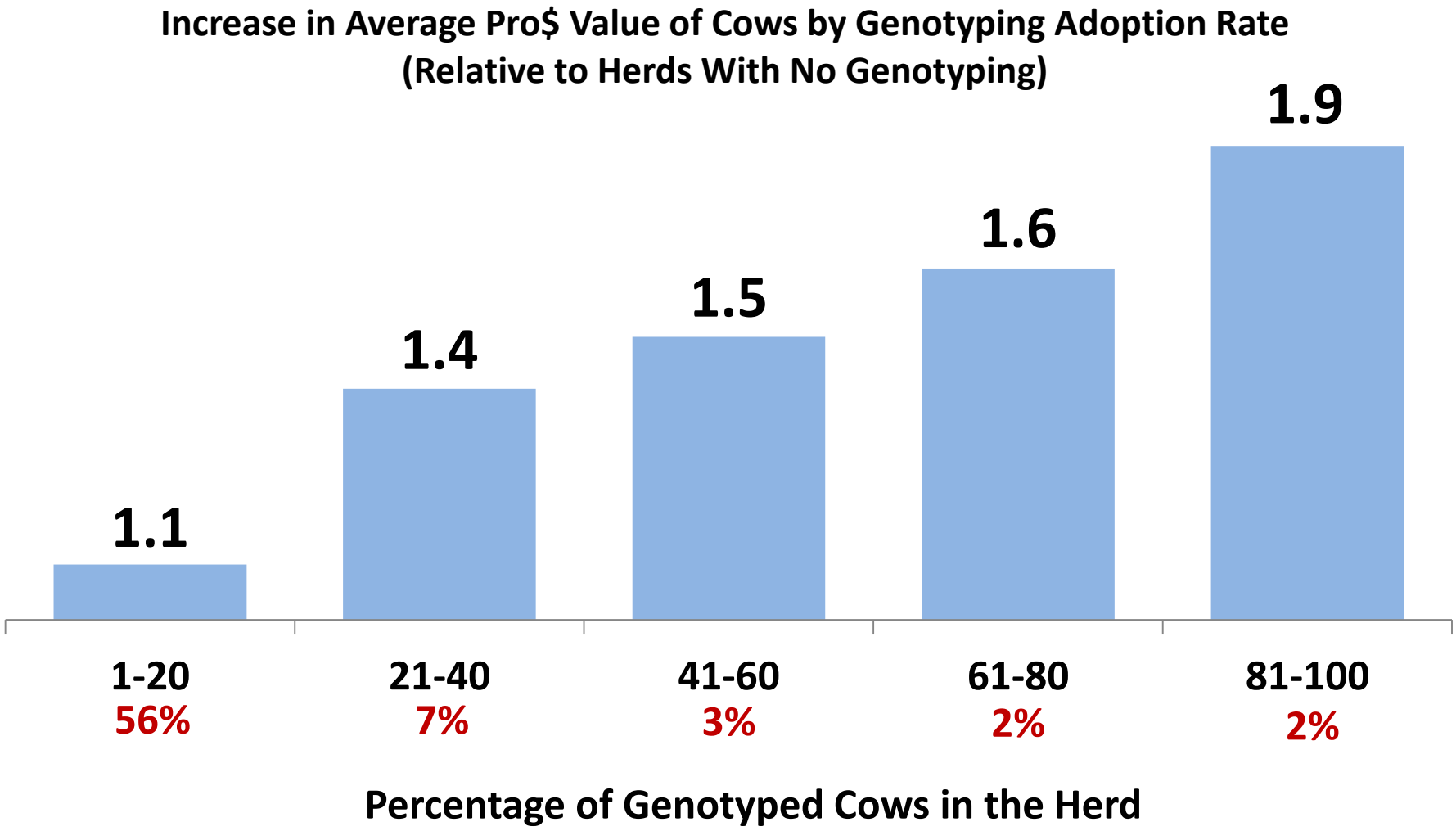


Dairy Cattle Genotypes at CDN

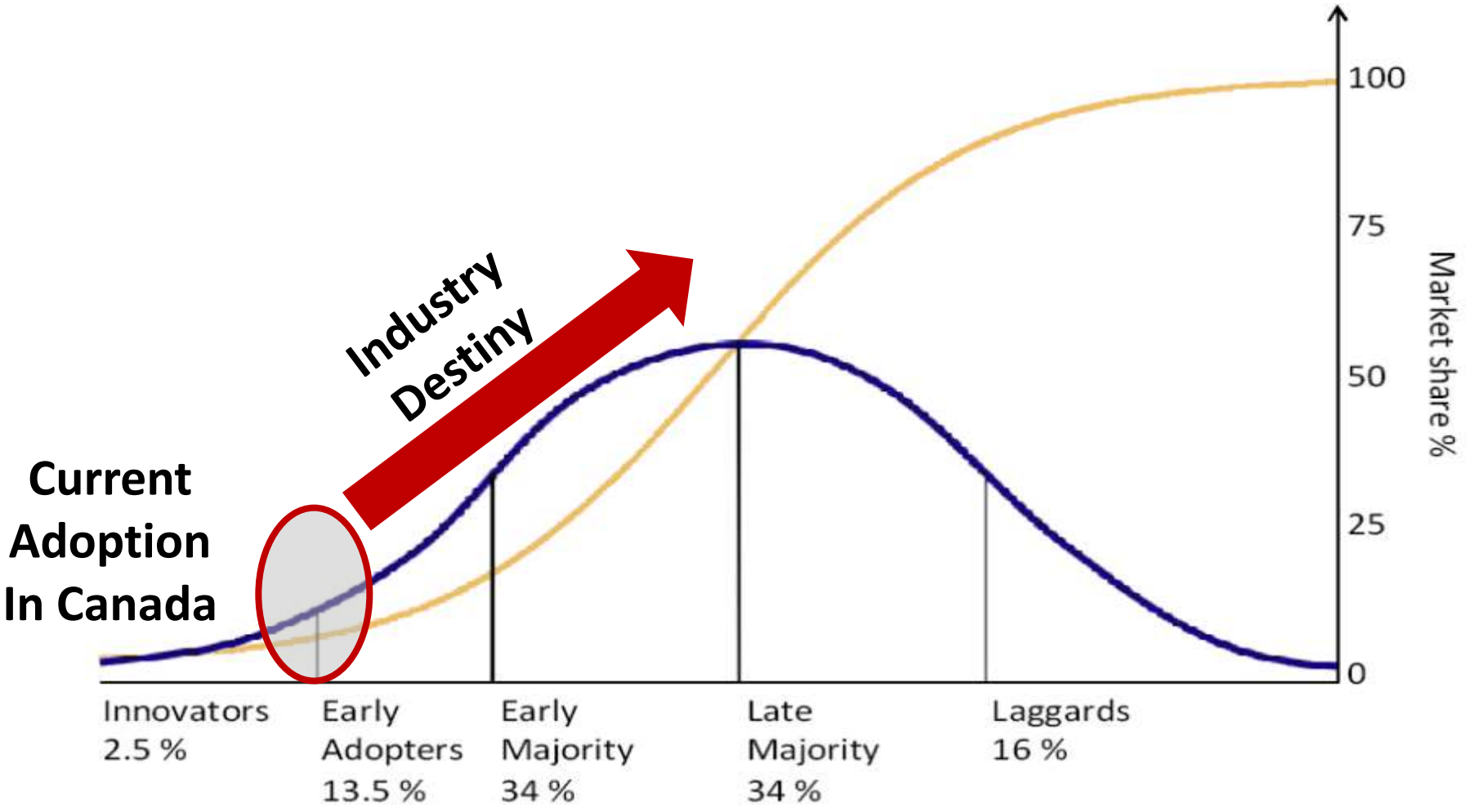
Breed	Genotypes	Percentage
Ayrshire	8,200	0.4%
Brown Swiss	35,600	1.8%
Guernsey	3,700	0.2%
Holstein	1,738,300	86.5%
Jersey	223,200	11.1%
Total	**2,009,000**	**100%**

Over Two Million Total Genotypes!

Herd Genetic Level and Genomics Adoption



Technology Adoption Curve



CDN = The Power of Information

- I've proven my point...
- Dairy farmers (and industry organizations) collect **A LOT** of data pertaining to their animals
- CDN's database is the central data repository for all such data relevant to breed improvement

CDN database currently includes over 1.4 BILLION data records

Data Collection Into Information

- CDN receives data collected by industry partners
- Web site (www.cdn.ca) is a highly used tool for searching information about dairy animals in Canada
  - Over 30,000 unique users each month
- Producers can search animals in their herd or any other animal

CDN Web Site is Global!

English

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Canadian Dairy Research Portal

Welcome

The **AUGUST 2017** genetic evaluations are now available!

With over 31,000 unique users monthly, THANK YOU for making CDN your No. 1 choice for genetic information!

CDN Mobile
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Genetic Evaluation
Data Services

What's New

SEP-2017
Genomic Young Bulls: Accelerating Genetic Progress

AUG-2017
Average Gain in LPI Reliability Due to Genomics

AUG-2017
Inbreeding Update

Calendar

25-OCT-2017
Open Industry Session
Hotel & Suites Le Dauphin, Drummondville, QC PLEASE REGISTER.

26-OCT-2017
Genetic Evaluation Board (GEB) Meeting
Hotel Le Dauphin, Drummondville, QC

11-DEC-2017
CDN Board of Directors Meeting

English

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Search by Registration Number

Breed	Country	Sex	Registration Number	
Holstein	Canada	Male		Submit Query

Search by Name

Breed	Sex	Name	
Jersey	Female	ursula	Submit Query

(•) Name (Full or Start)

Search by Animal Tattoo

Breed	Sex	Letters	Number	Year Letter	
Holstein	Male				Submit Query

English

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Animal Query | Group Query

Quick Search | Advanced Search

Use Quick Search to query top male and Canadian-owned females for each breed. Use the Advanced Search to include all females by including "Non-Canadian" in the Province section.

	Breed	Sex	Country of Registration
Animal Type	Holstein	Male	All Countries

Evaluation Type: EBV | MACE | PA

Genomic Status: All | Genotyped

Active Status: All | Active

Note: This query tool searches many records so please be patient!

Submit Query

English

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STARTMORE RUDOLPH

GenoTest Form | Breed Association

Summary | Genomics | Prod. | Type | Functional | Health | Calving | Progen | Pedigree | Inbreeding

Genetic Evaluation Summary

HOCANM5470579 **STARTMORE RUDOLPH** **RUDOLPH**

0073HO01965 ET BW A1A2 CVF BLF Born 17-JUL-91 2.43%INB 16%R

Sire:	HOCANM383622	MADAWASKA AEROSTAR	25-MAR-85	7.51%	19%
Dam:	HOCANF4324253	STARTMORE RACHELLE ET	30-DEC-85	2.17%	9%
MGS:	HOCANM347993	BUTLERVIEW MATTADOR	28-DEC-76	1.03%	5%

PRODUCTION GEBV 17*AUG

			Kg	%RK	%Dev
Herds	9670				
Daughters	62646	Milk	297	32%	
Lactations	148513	Fat	-12	8%	-0.21
Reliability	99%	Protein	8	20%	-0.02

Pro$ $250

LIFETIME PERFORMANCE INDEX

GLPI	1785	99
PRODUCTION	740	Rel
DURABILITY	497	
HEALTH & FERTILITY	548	

Pedigree Tree

HOCANM5470579

0073HO01965

STARTMORE RUDOLPH Ⓖ
ET BW A1A2 CVF BLF
HH: 1%, 1%, 1%, 1%, 1%
HCD: 1%

RUDOLPH
Born 17-JUL-91 2.43%INB 16%R

MADAWASKA AEROSTAR Ⓖ
HOCANM383622
Born: 25-MAR-85
BW A2A2 CVF BLF
HH: 1%, 1%, 1%, 1%, 1%
HCD: 1%

HANOVERHILL STARBUCK Ⓖ
HOCANM352790
Born: 26-APR-79
BW A1A2 CVF BLF
HH: 1%, 1%, 1%, 1%, 1%
HCD: 1%

ROUND OAK RAG APPLE ELEVATION Ⓖ
HOUSAM1491007
Born: 30-AUG-65
BW CVF BLF

A ANACRES ASTRONAUT IVANHOE
HOCANF2876597
Born: 21-MAR-71
BW

MADAWASKA SHADY
HOCANF3511527
Born: 21-APR-80
BW
HH: 1%, 1%, 1%, 1%, 1%
HCD: 1%

A CLINTON-CAMP MAJESTY Ⓖ
HOCANM333473
Born: 07-OCT-73
BW BLF

MADAWASKA STEPHANIE
HOCANF3152374
Born: 20-JUN-77
BW

STARTMORE RACHELLE ET
HOCANF4324253
Born: 30-DEC-85
ET BW BLF
HH: 1%, 1%, 1%, 1%, 1%
HCD: 1%

BUTLERVIEW MATTADOR Ⓖ
HOCANM347993
Born: 28-DEC-76
BW BLF
HH: 1%, 1%, 1%, 1%, 1%
HCD: 1%

A NORTHCROFT ADMIRAL CITATION
HOCANM311497
Born: 22-NOV-68
BW BLF

BUTLERVIEW PRINCESS MATT
HOUSAF8534982
Born: 02-APR-71
BW

STARTMORE CHANEL ET
HOCANF3602443
Born: 12-MAY-81
ET BW
HH: 1%, 1%, 1%, 1%, 1%
HCD: 1%

S-W-D VALIANT Ⓖ
HOUSAM1650414
Born: 28-JUN-73
BW CVF BLF

A JIM-MAR-D ASTRONAUT GAIL
HOCANF3067682
Born: 29-JAN-72
BW

For many animals, their pedigree includes more than 20 generations...

Totals over a million known ancestors!

English

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STARTMORE RUDOLPH

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Progeny List

STARTMORE RUDOLPH HOCANM5470579 has 88498 progeny
(Up to a maximum of 400 will be displayed)

Go to Group Query* by Parentage to refine the list of progeny
* this will replace your existing Active List

Identification	Name	Birth Year	Act.	GS	LPI Code	LPI	Pro$	Milk	Fat	Prot	%F	%P	SCS	Conf	MS	F&L	DS	RP
HOCANF9049729	OAKPARKE RUDOLPH JANA	1998			EBV	2455	1201	128	47	21	+0.40	+0.16	2.79	2	-1	6	0	5
HOCANF6866793	SILDAJAK SILKE RUDOLPH	1997			EBV	2434	1329	1300	56	45	+0.07	+0.11	3.03	-1	0	-2	-1	0
HOCANF7311536	TOLHURST RUDOLPH SANDI	1999			EBV	2348	983	422	47	24	+0.29	+0.10	2.90	3	3	-4	3	0
HOCANF6921820	MASKITA RUDOLPH LISANNE	1998			EBV	2347	974	626	12	25	-0.09	+0.06	2.77	2	0	4	-2	-4
HOCANF10538520	IRLANDE RUDOLPH SICILE	1998			EBV	2303	1086	1523	43	42	-0.12	-0.07	2.78	-3	-6	0	1	-7
HOCANF6963736	SARTIGAN RUDOLPH ROKLA	1998			EBV	2298	1188	1207	35	25	-0.12	-0.14	2.53	0	-2	-4	3	0
HOCANF8134776	ANBE RUDOLPH CAROL	1999			EBV	2285	1172	867	22	43	-0.09	+0.14	2.71	-2	-4	-1	0	4
HOCANF10527760	LA PRESENTATION RUDORE	1998			EBV	2280	812	80	12	20	+0.09	+0.16	2.86	3	1	0	1	1
HOCANF10591903	GINARY KARGO LAURA	1999			EBV	2234	792	203	45	29	+0.34	+0.20	3.04	0	2	-5	0	-1
HOCANF7466917	MCDONALD JULIA	2004			EBV	2230	898	727	26	28	-0.01	+0.05	2.97	1	0	-1	-1	2
HOCANF101216574	SESSINK RUDOLPH LAURA	2002			EBV	2228	1016	770	48	26	+0.17	+0.03	2.88	-3	-1	-4	-6	4
HOCANF10518465	DELAPLAINE RUDOLPH SISI	1998			EBV	2216	973	1008	12	32	-0.24	0.00	2.72	-2	-3	-1	1	1
HOCANF6855631	LARELEVE RUDOLPH DONNA	1997			EBV	2196	923	962	52	41	+0.15	+0.10	2.87	-6	-1	-8	-3	-11
HOCANF9266936	JEANLU RUDOLPH BLACK ROSE	2001	A		EBV	2196	460	-603	-23	4	0.00	+0.22	2.84	5	7	-4	9	6

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STARTMORE RUDOLPH

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Summary | Genomics | Prod. | Type | Functional | Health | Calving | Progeny | Pedigree | Inbreeding

Genetic Evaluation Summary

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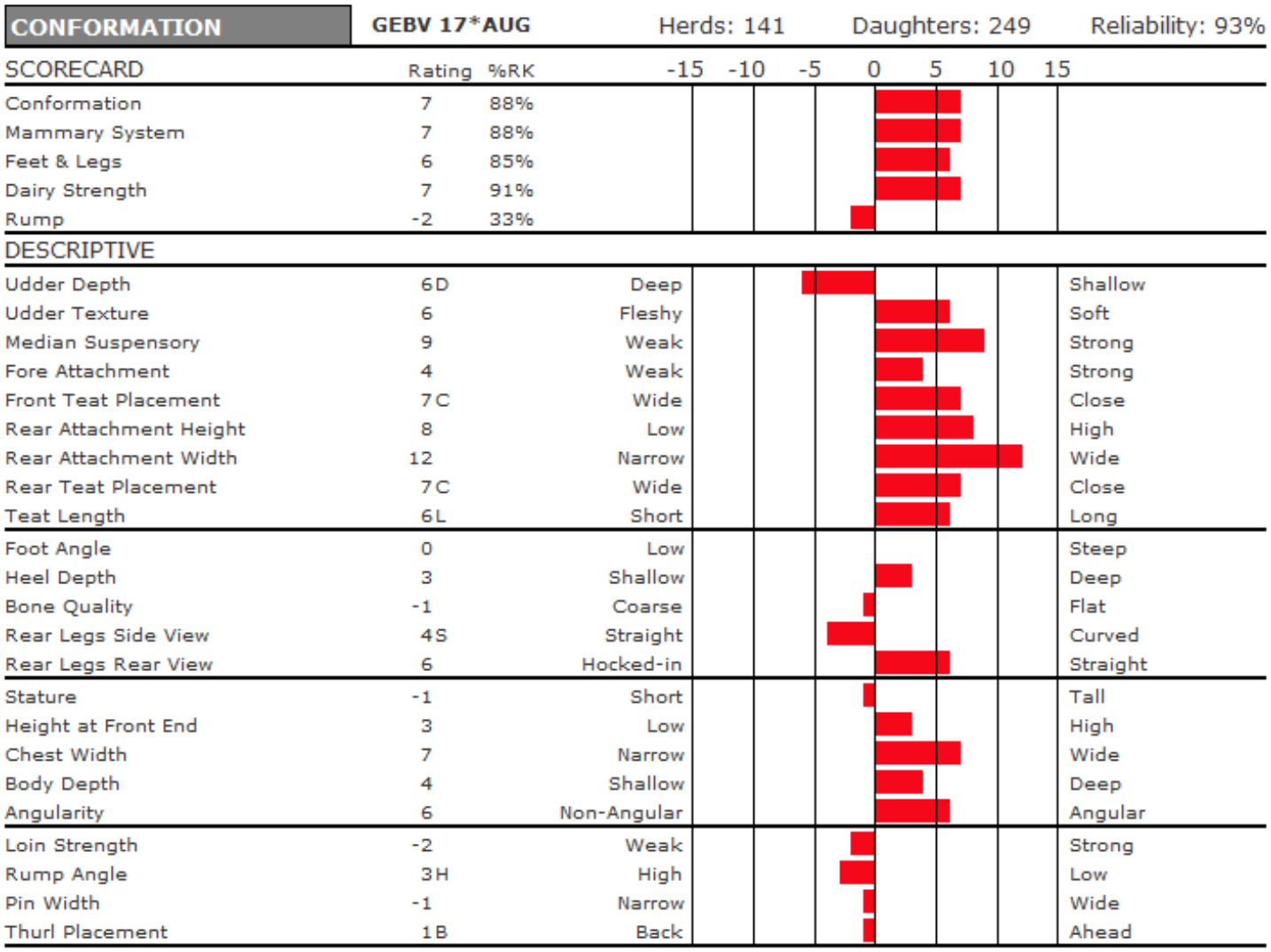
PRODUCTION		GEBV 17*AUG			
Herds	9670		Kg	%RK	%Dev
Daughters	62646	Milk	297	32%	
Lactations	148513	Fat	-12	8%	-0.21
Reliability	99%	Protein	8	20%	-0.02

Pro$
$250

LIFETIME PERFORMANCE INDEX		
GLPI	1785	99
PRODUCTION	740	Rel
DURABILITY	497	
HEALTH & FERTILITY	548	

Body Conformation Traits



CONFORMATION	GEBV 17*AUG		Herds: 141	Daughters: 249	Reliability: 93%
SCORECARD	Rating	%RK	-15 -10 -5 0 5 10 15		
Conformation	7	88%			
Mammary System	7	88%			
Feet & Legs	6	85%			
Dairy Strength	7	91%			
Rump	-2	33%			
DESCRIPTIVE					
Udder Depth	6D		Deep		Shallow
Udder Texture	6		Fleshy		Soft
Median Suspensory	9		Weak		Strong
Fore Attachment	4		Weak		Strong
Front Teat Placement	7C		Wide		Close
Rear Attachment Height	8		Low		High
Rear Attachment Width	12		Narrow		Wide
Rear Teat Placement	7C		Wide		Close
Teat Length	6L		Short		Long
Foot Angle	0		Low		Steep
Heel Depth	3		Shallow		Deep
Bone Quality	-1		Coarse		Flat
Rear Legs Side View	4S		Straight		Curved
Rear Legs Rear View	6		Hocked-in		Straight
Stature	-1		Short		Tall
Height at Front End	3		Low		High
Chest Width	7		Narrow		Wide
Body Depth	4		Shallow		Deep
Angularity	6		Non-Angular		Angular
Loin Strength	-2		Weak		Strong
Rump Angle	3H		High		Low
Pin Width	-1		Narrow		Wide
Thurl Placement	1B		Back		Ahead

Functional Traits

FUNCTIONAL	Rating	Rel		Difference from Breed Average (SD)		Breed Avg.
Herd Life	108G	88%	Short		Long	100
Somatic Cell Score	2.72G	94%	Undesirable		Desirable	3.00
Mastitis Resistance	106G	77%	Susceptible		Resistant	100
Metabolic Disease Resistance	103G	74%	Susceptible		Resistant	100
Lactation Persistency	103G	95%	Poor		High	100
Daughter Fertility	101G	85%	Poor		High	100
Milking Speed	105G	90%	Slow		Fast	100
Milking Temperament	101G	90%	Nervous		Calm	100
Calving Ability	102G	94%	Difficult		Easy	100
Daughter Calving Ability	102G	85%	Difficult		Easy	100
Body Condition Score	105G	94%	Low		High	100
Semen Fertility	59	58%	Low		High	59

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STE ODILE MILKTIME

GenoTest Form | Breed Association

Summary | Genomics | Progeny | Pedigree | Inbreeding

Genetic Evaluation Summary

HOCANM12609045 **STE ODILE MILKTIME** **MILKTIME**

0200HO10904 ET BW A2A2 CVF RDF BYF BLF DPF Born 06-SEP-16 13.16%INB 15%R

Sire:	HO840M3125201993	S-S-I MONTROSS DUKE-ET	24-JUN-14	7.51%	15%
Dam:	HOCANF109659566	STE ODILE SUPERSHOT ELECTRA	12-JUN-15	12.43%	16%
MGS:	HONLDM755898903	COGENT SUPERSHOT	14-MAR-13	9.22%	15%

PRODUCTION GPA 17*AUG

			Kg	%RK	%Dev
Herds					
Daughters		Milk	3362	99%	
Lactations		Fat	111	99%	-0.14
Reliability	75%	Protein	117	99%	+0.04

Pro$	LIFETIME PERFORMANCE INDEX		
$3341	GPA LPI	3437	70
	PRODUCTION	1817	Rel
	DURABILITY	1148	
	HEALTH & FERTILITY	472	

Genomic Evaluation Details

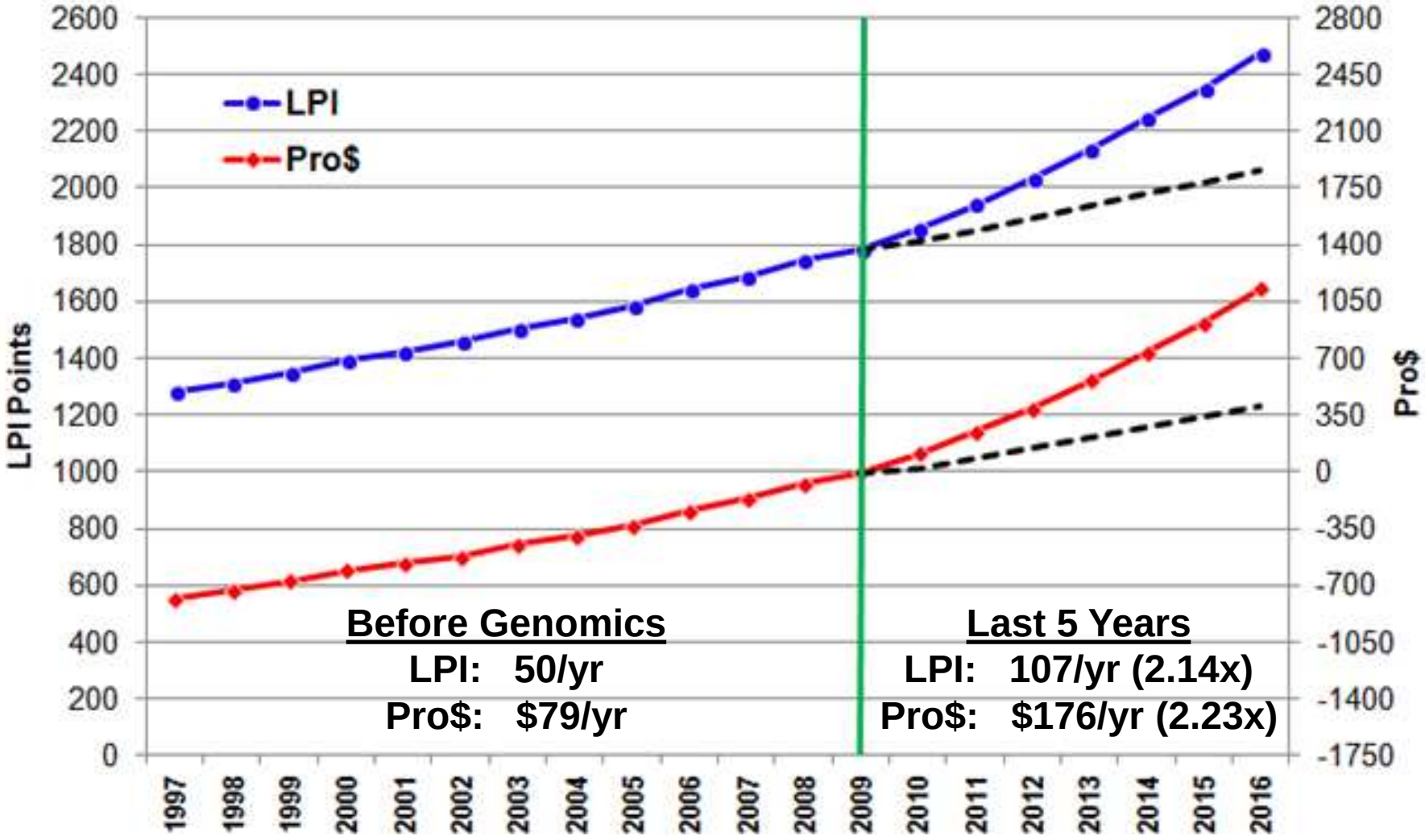
HOCANM12609045 **STE ODILE MILKTIME** **MILKTIME**

0200HO10904 ET BW A2A2 CVF RDF BYF BLF Born 06-SEP-16 13.16%INB 15%R

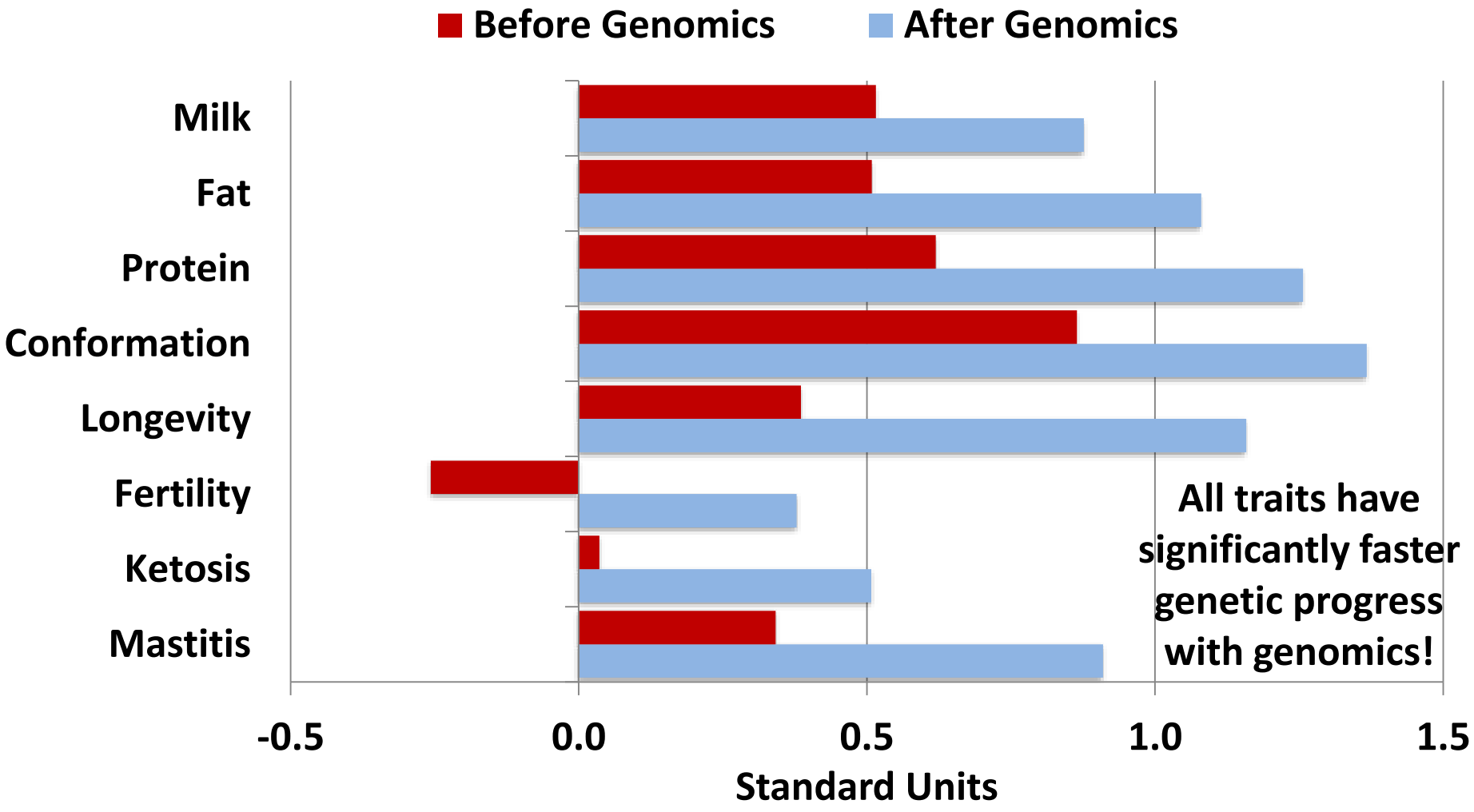
Sire:	HO840M3125201993	S-S-I MONTROSS DUKE-ET	24-JUN-14	7.51%	15%
Dam:	HOCANF109659566	STE ODILE SUPERSHOT ELECTRA	12-JUN-15	12.43%	16%
MGS:	HONLDM755898903	COGENT SUPERSHOT	14-MAR-13	9.22%	15%

Genotype Panel: 150K	Official Genomic Evaluation	Reliability (%)	Reliability Increase with Genomics	Direct Genomic Value (DGV)
LIFETIME PERFORMANCE INDEX **GPA 17*AUG**				
GPA LPI	**3437**	**70**	**+34**	3516
PRODUCTION	1817	75	+36	1896
DURABILITY	1148	71	+34	1148
HEALTH & FERTILITY	472	60	+29	472
Pro$	**$3341**			$3560
PRODUCTION **GPA 17*AUG**				
Milk Yield (kg)	3362	76	+36	3614
Fat Yield (kg)	111	75	+36	120
Protein Yield (kg)	117	75	+36	125
Fat Deviation (%)	-0.14	75	+36	-0.15
Protein Deviation (%)	0.04	75	+36	0.04
CONFORMATION **GPA 17*AUG**				
Conformation	7	72	+35	7
Mammary System	6	73	+35	6
Feet & Legs	6	69	+33	6
Dairy Strength	2	72	+34	2
Rump	6	68	+32	7

Genetic Progress with Genomics



Genomics Impact on Genetic Progress



Annual Net Benefit from Genomics

Period	Average Rate of Progress per Year (Pro $)	Net Annual Economic Value to the Industry[1]
Before genomics (before 2009)	$79	$249 Million/year
With genomics (2009-2014)	$176	$556 Million/year
Expected in 2015-2019	$237	$748 Million/year

[1] Based on 0.9M milking cows; net returns per cow using 2014 Valacta figures for milk income, feed costs, heifer rearing costs and cow survival to 6 years of age; benefits account for the cumulative nature of genetic change and are discounted at 5% per year.

On the Horizon...

- Canadian dairy industry is positioned for three **MAJOR** opportunities within the next few years:
  1. Genetic improvement for additional traits associated with animal health and welfare
  2. Genetic selection for feed efficiency and reduced methane emissions
  3. Collection of DNA in association with national traceability for animal and product traceback

Animal Health & Welfare Traits

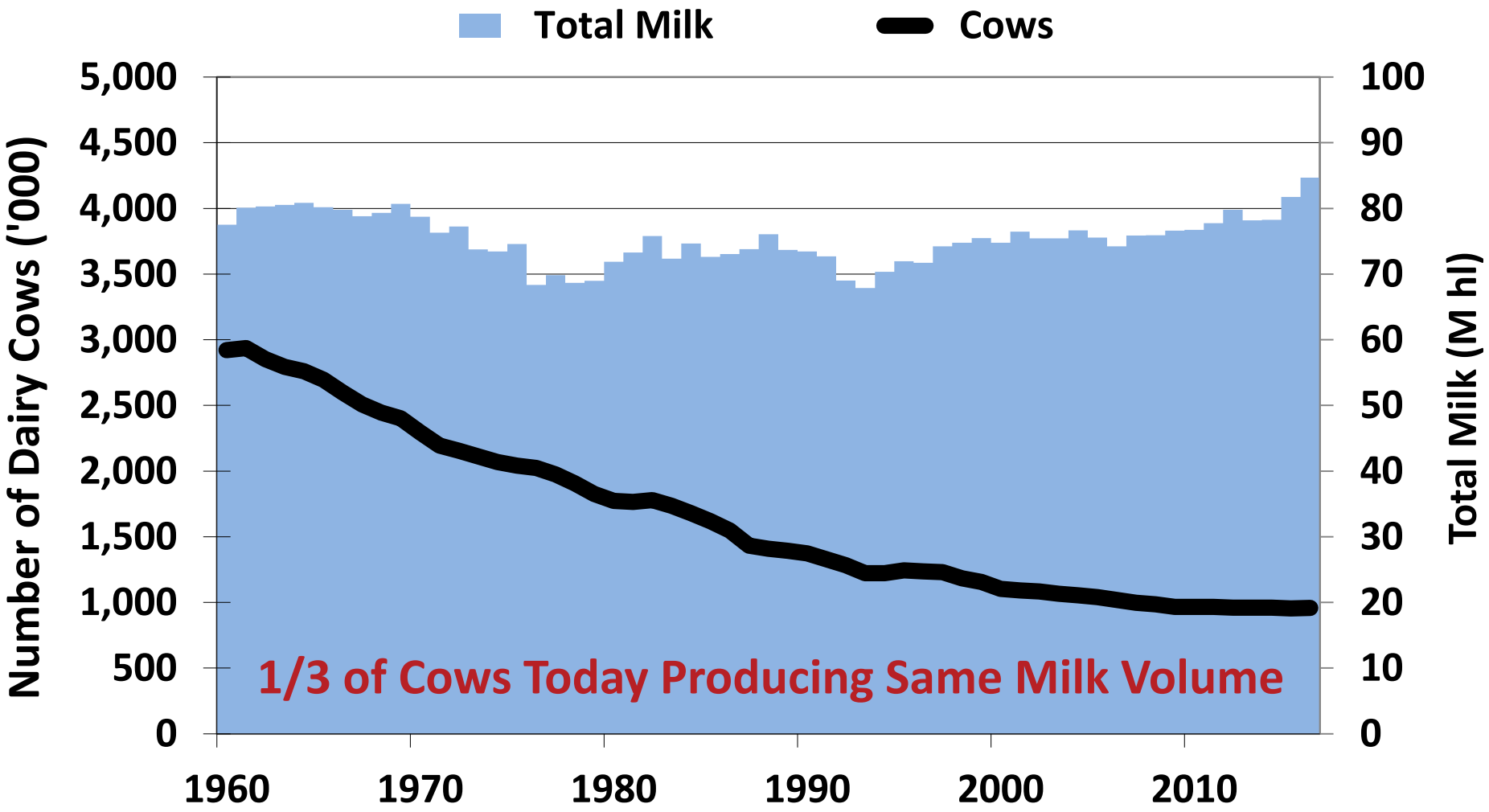
- Producers can currently select for some traits:
  - Resistance to mastitis and metabolic diseases
  - Digital dermatitis (Strawberry foot disease)

- With genomics, CDN will add more traits in coming years:
  - More animal health, disease and welfare traits
  - More traits related to lameness and hoof health

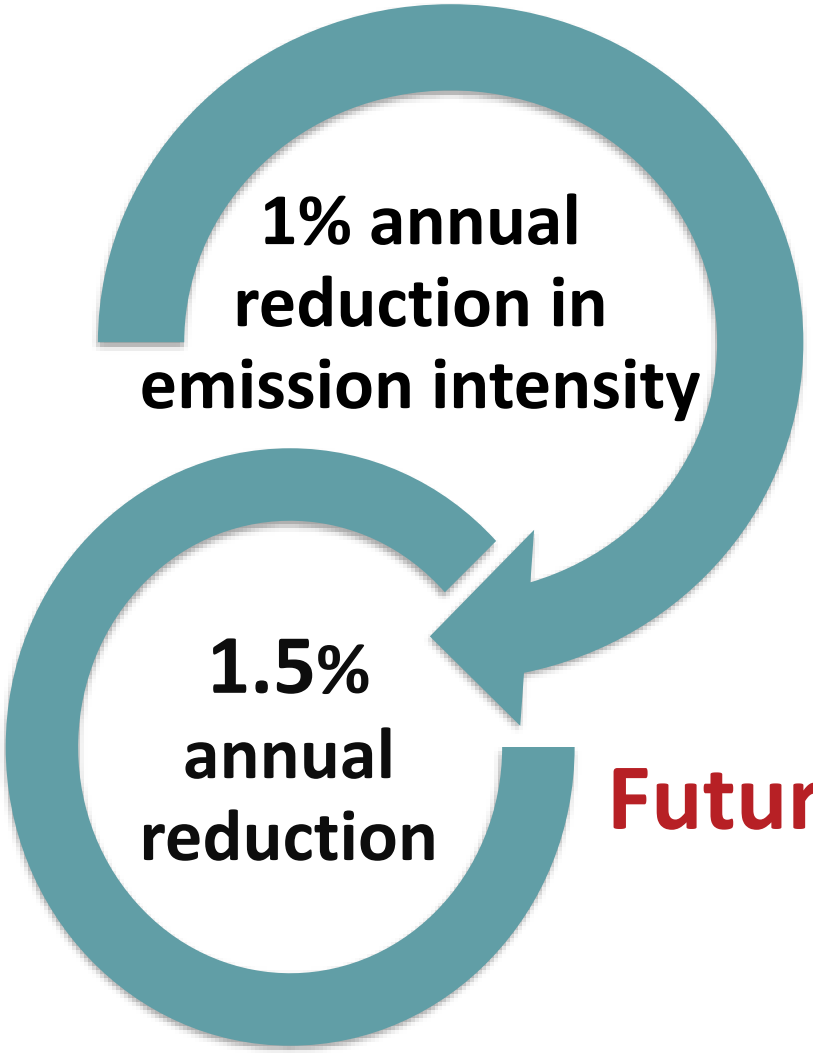
Feed Efficiency & Methane Emissions

- CDN is the industry organization leading a major research project funded by Genome Canada
  - 4-year budget is $10.3M, with $860,000 from CDN and $3.8M from Genome Canada
  - Research leadership from both University of Guelph and University of Alberta (national scope)
  - Involves several other partners, both nationally and internationally, for the collection of daily feed intake and methane emission data as well as DNA for thousands of individual cows
  - Key deliverable is genomic evaluations in near future

Dairy Industry Sustainability



Effect of Selection on “Efficiency”

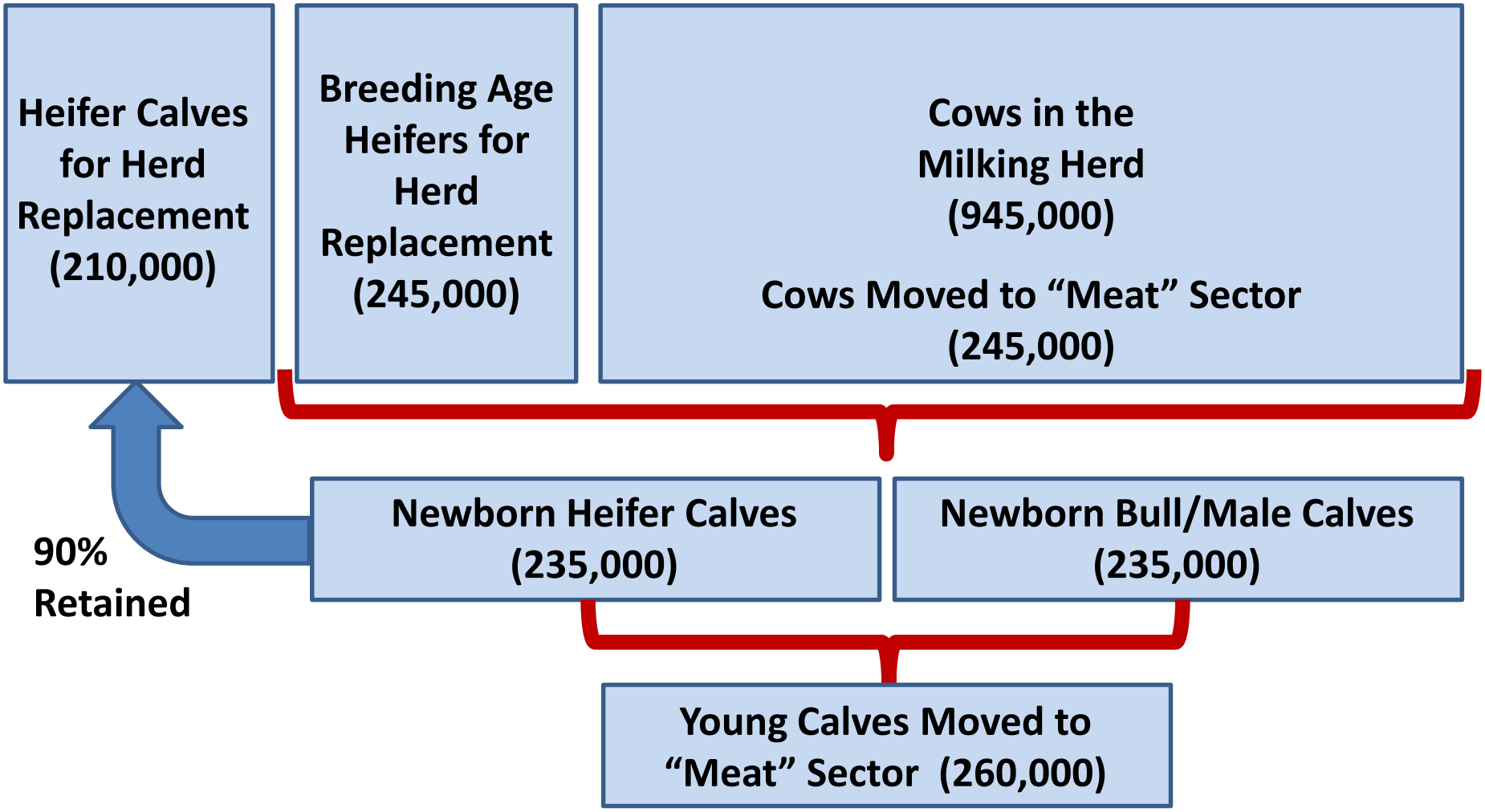


THE Efficient Dairy GENOME PROJECT

National Traceability and Traceback

- Dairy industry is very close to having a complete national traceability system via proAction initiative of Dairy Farmers of Canada
  - All animals uniquely identified at birth
  - All locations where animals may reside have a unique premises identification
  - Producers, transporters and other premise locations mandated to report all animal movements
  - Soon to build national traceability database
- Collection of DNA for newborn calves provides a huge new opportunity and industry benefit

National Dairy Herd Life Cycle



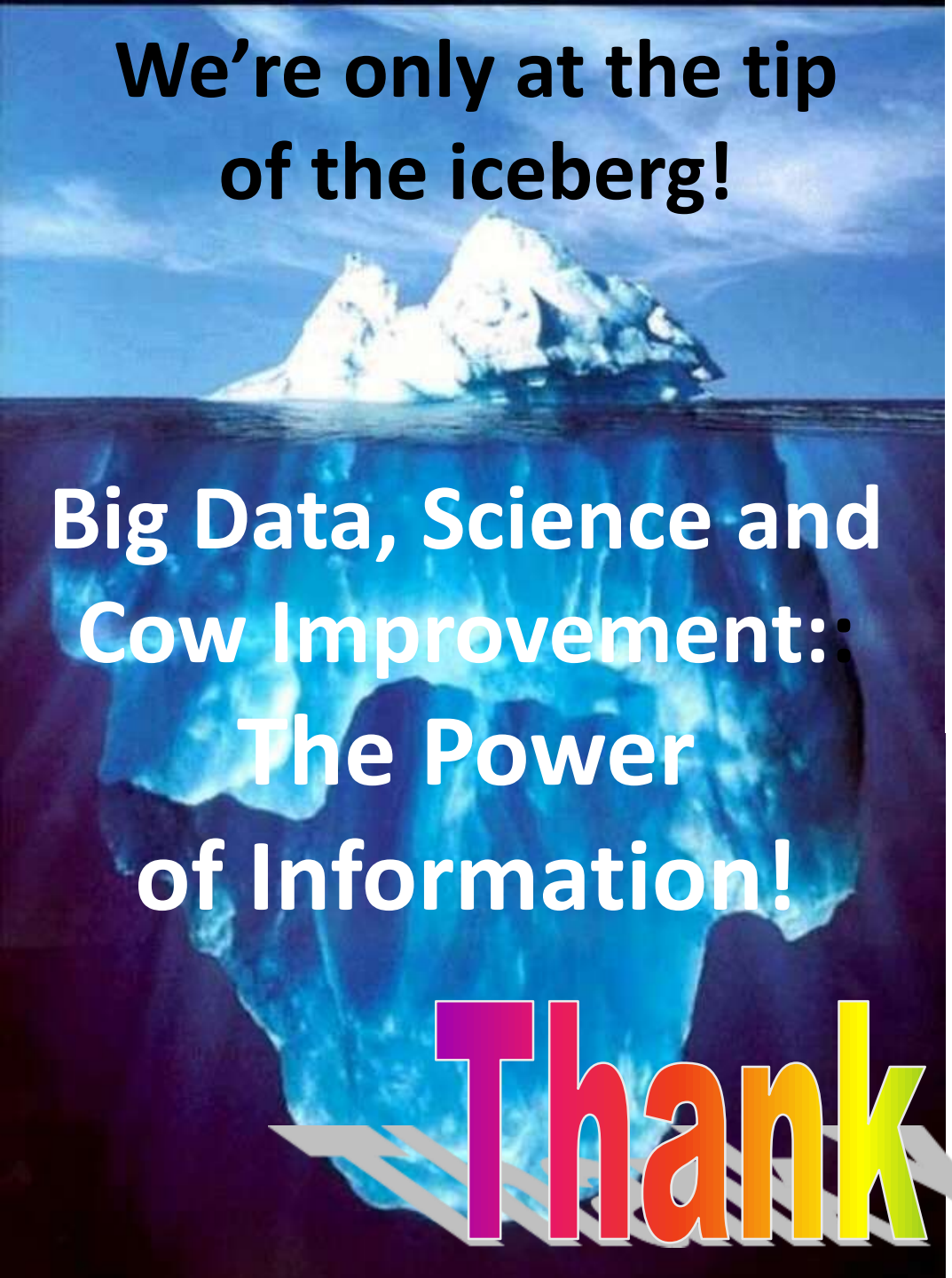
Future Product Traceability

National Traceability allows for "milk" product traceback to farm location

Collection of DNA on all newborn calves allows "meat" product traceback to animal of origin

Summary

- Dairy cattle industry is a major contributor to Canada's economy and growth
- Known as the leading livestock sector for data collection and technology adoption
- Genomics applied for past 8 years has proven its significant value and economic benefits
- Dairy sector is very well positioned for taking advantage of huge opportunities on the horizon



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Canadian Dairy Network

Thank You!