



Update on Genotyping and Genomic Evaluations in Canada

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SNP Panel Options



- **95** – for parentage verification
- **3K** – initial low density (LD) panel (Sept.'10)
- **6K** – LD panel that replaced the 3K (Oct.'11)
- **10K** – LD+ panel by GeneSeek (Mar.'12)
- **50K** – standard for genomic evaluation
- **HD** – for imputation within breed and across breed genomic evaluation estimation
- **Full sequencing**



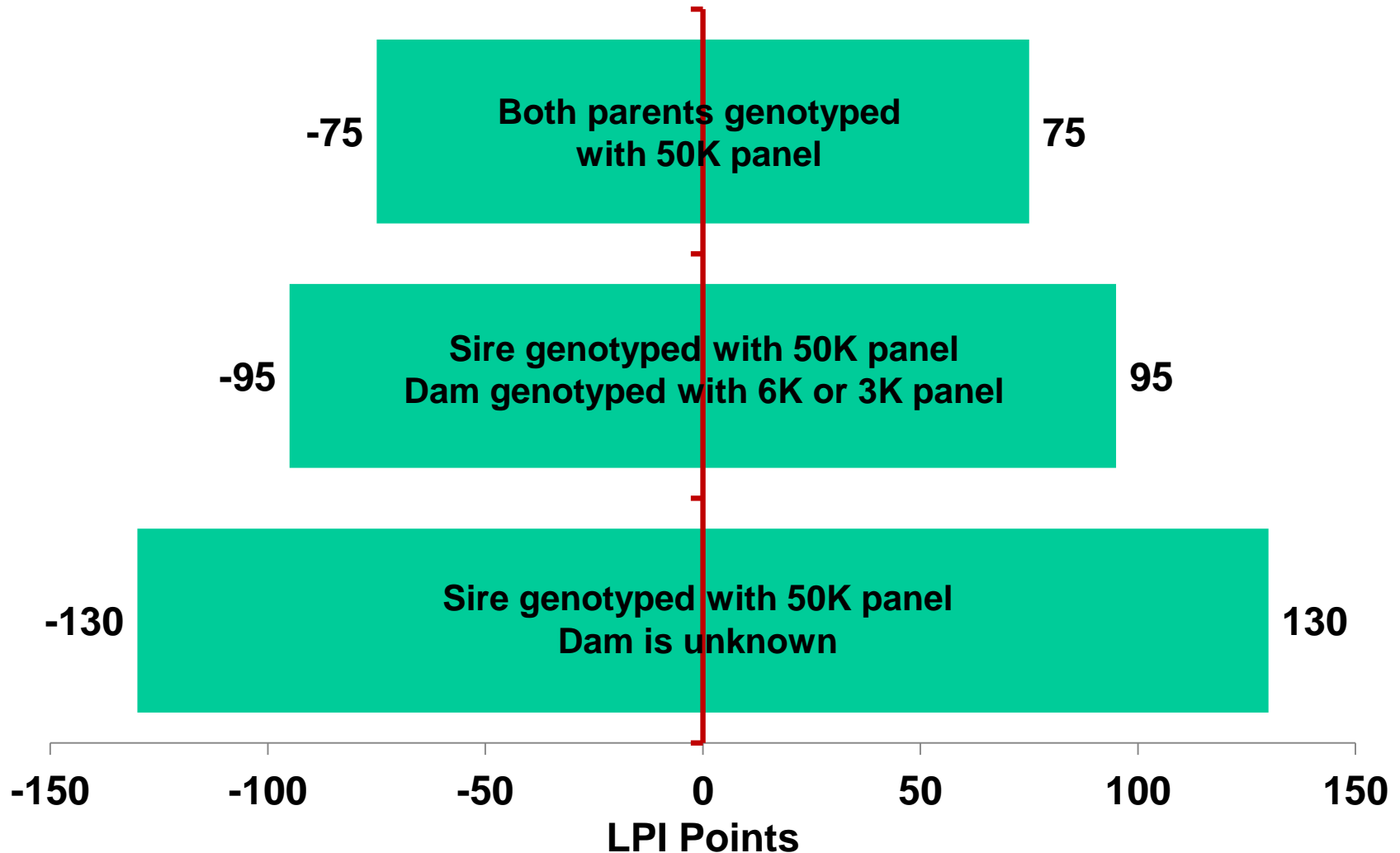
- **Population Based:**
 - Unrelated individuals
 - Sharing small DNA blocks
 - Computationally demanding
- **Family Based:**
 - Genotyped ancestors/progeny
 - More effective for small density panels (with less than 10,000 SNP)
 - Much less demanding computationally

Imputation Error Rates - Methodology at CDN -

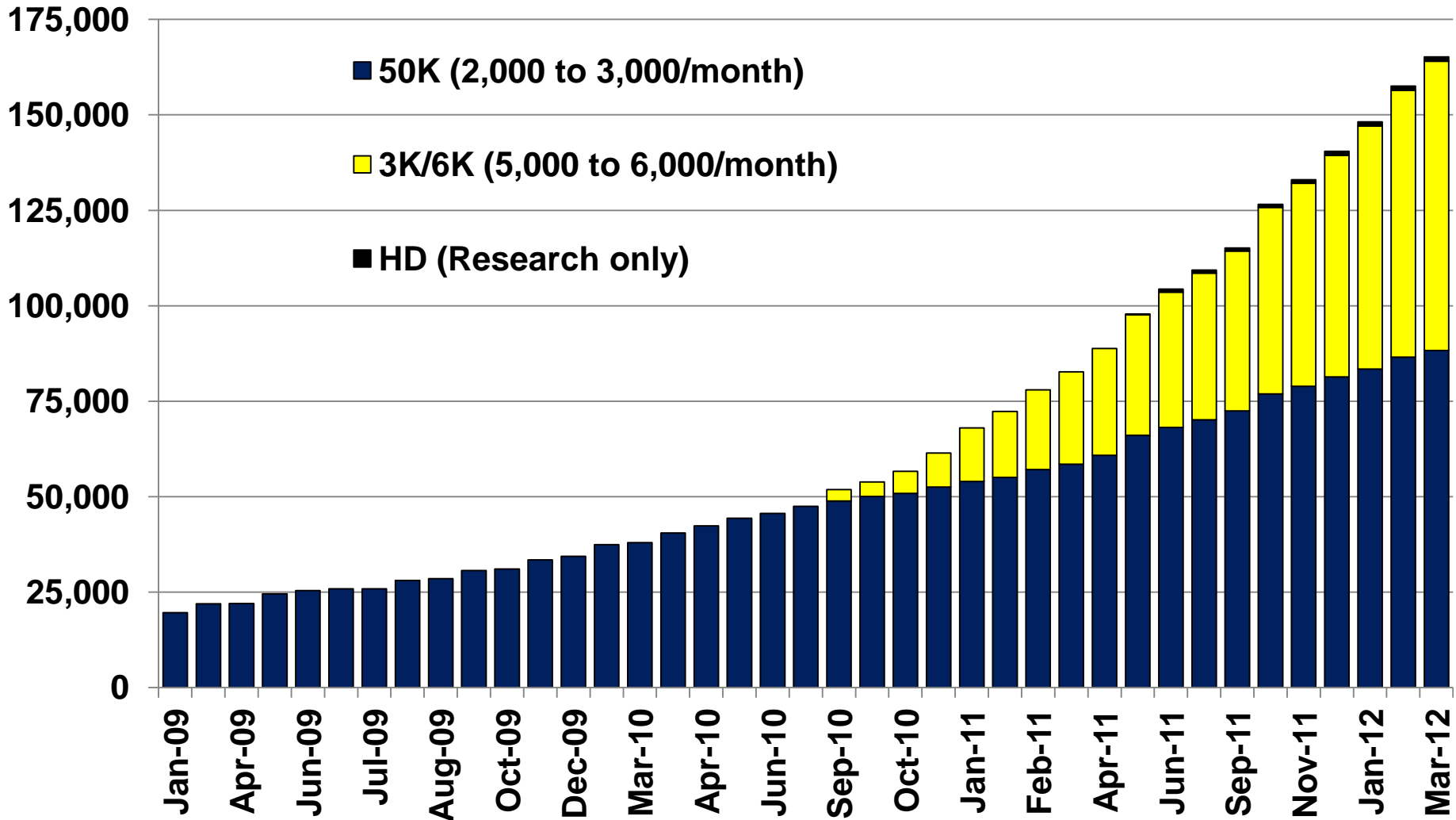


Sire Genotype	Dam Genotype	Average Imputation Error Rate	
		3K Panel	6K Panel
50K	50K	0.9%	0.4%
50K	3K	1.8%	1.1%
50K	6K	1.4%	0.7%
50K	Not Genotyped	2.9%	1.1%
Not Genotyped	Not Genotyped	5.9%	2.3%
Not Genotyped	Not Known	7.7%	5.0%

99% Confidence Range for LPI Using 6K vs 50K



Evolution of Genotypes in NA Database



Genotype Database

- Holstein, April 2012 -



Animal Nation Code	Males				Females				Sub-Total		
	Proven		Young Sires		Cows		Heifers				
	All	%LD	All	%LD	All	%LD	All	%LD	All	%LD	
CAN	3,483	0%	5,574	20%	8,193	58%	12,032	76%	25,864	58%	
USA	12,261	0%	25,330	12%	17,021	41%	49,570	80%	94,185	53%	
OTHER	6,451	0%	9,307	12%	6,355	44%	19,373	73%	37,905	47%	
Sub-Total and %LD					Sub-Total and %LD						
62,406 8.3%					112,544 68.8%						
Grand Total and %LD											
174,950 47.2%											

Genotyped Holstein Young Candidate Bulls



Year of Birth	Number Genotyped
2005*	2,289
2006*	2,493
2007*	3,286
2008	5,170
2009	7,506
2010	12,241
2011	13,936

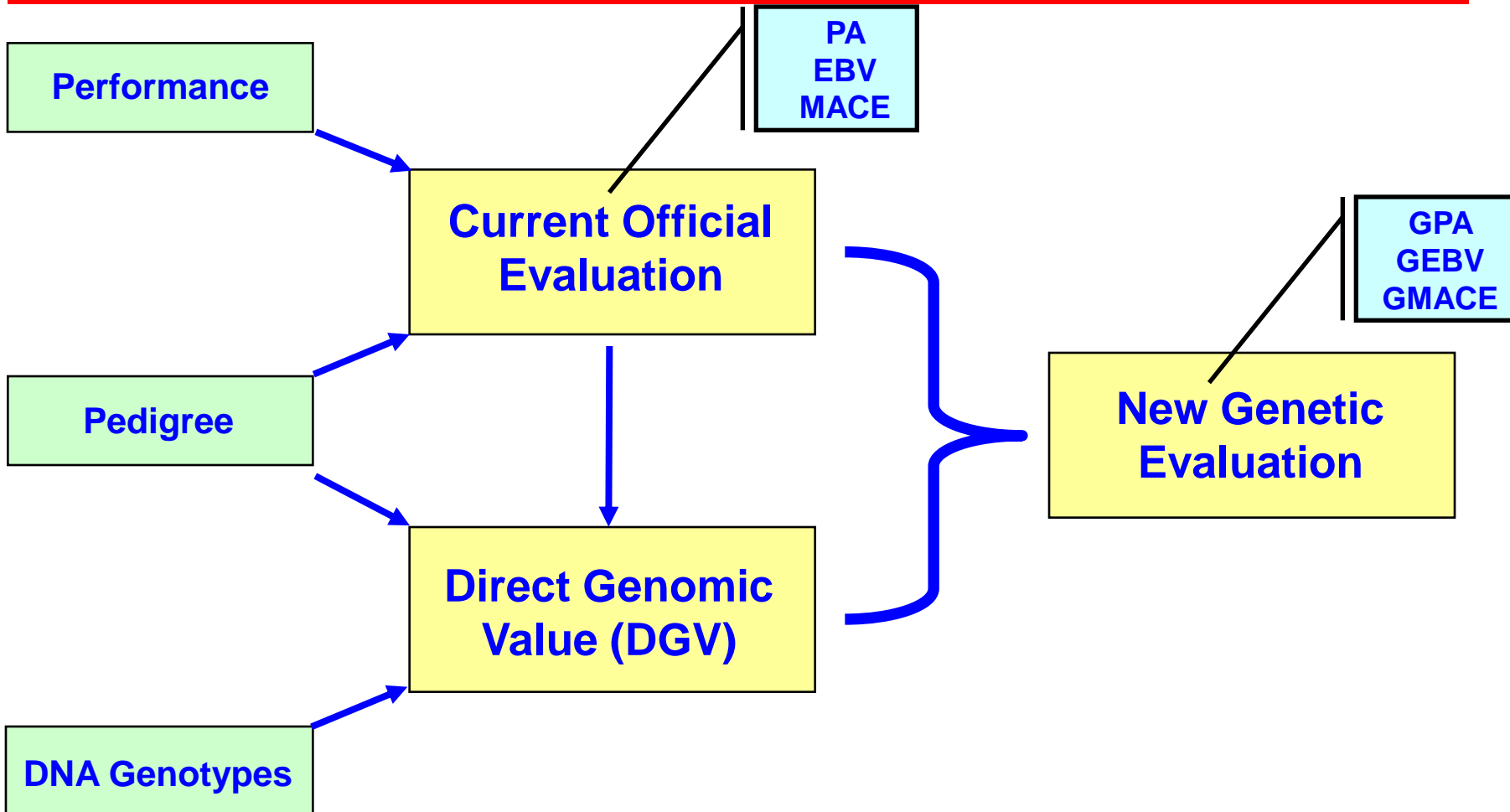
*** includes some bulls that are now progeny proven**

Genomic Evaluation Services in Canada



- **All genotypes sent by labs to USDA for centralized quality assurance processes**
 - USDA sends genotypes and pedigree to CDN monthly
 - USDA and CDN exchange female EBVs monthly
- **CDN computes GEBVs every month for all genotyped animals (63 traits)**
 - Compute all traditional EBVs monthly
 - >16,000 progeny proven sires as “Training” set
 - Release new female GEBVs monthly
 - Provide candidate YS GEBVs to AI monthly

Incorporating DGVs into Genetic Evaluations



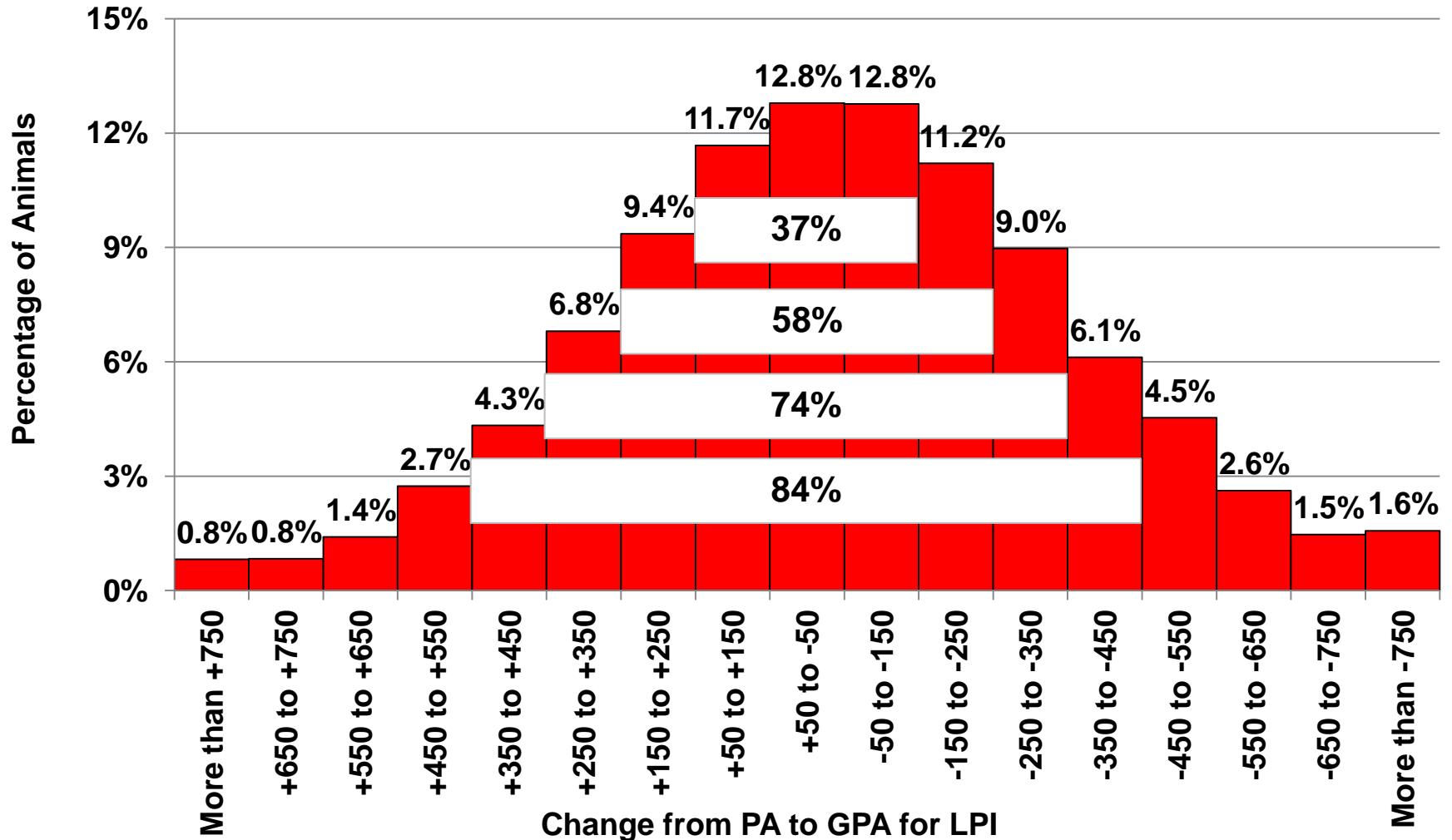
Gain in LPI Reliability

- Holstein, April 2012 -



Sub-Group for Holstein Breed	Average LPI Reliability (%)			
	Traditional	Genomics	Gain	DGV Weight
50K Young Bulls and Heifers (Born 2009-2011)	38	69	31	64%
3K or 6K Heifers (Born 2009-2011)	35	64	29	65%
Younger Cows in 1st or 2nd Lactation (50K)	54	73	19	57%
Foreign Cows with MACE in Canada	42	71	29	63%
1st Crop Proven Sires in Canada	85	90	5	51%
Foreign Sires with MACE in Canada	70	83	13	54%

Distribution of Change from PA to GPA for LPI



Genomic Evaluation Details

www.cdn.ca

Genomic Evaluation Details

HOCANF105753016	COMESTAR LAUTAMIRE PLANET	%INB	%R
Born 28-JUN-09	ET BW	6.77%	13%
Sire: HOUSAM60597003	ENSENADA TABOO PLANET-ET	03-MAR-03	7.21% 12%
Dam: HOCANF104226402	COMESTAR LAUTAMIA BOLTON	02-JUN-07	6.25% 13%
MGS: HOUSAM131823833	SANDY-VALLEY BOLTON-ET	11-SEP-01	6.05% 11%

Genotype Panel:	50K	Official Genomic Evaluation	Reliability (%)	Reliability Increase with Genomics	Direct Genomic Value (DGV)
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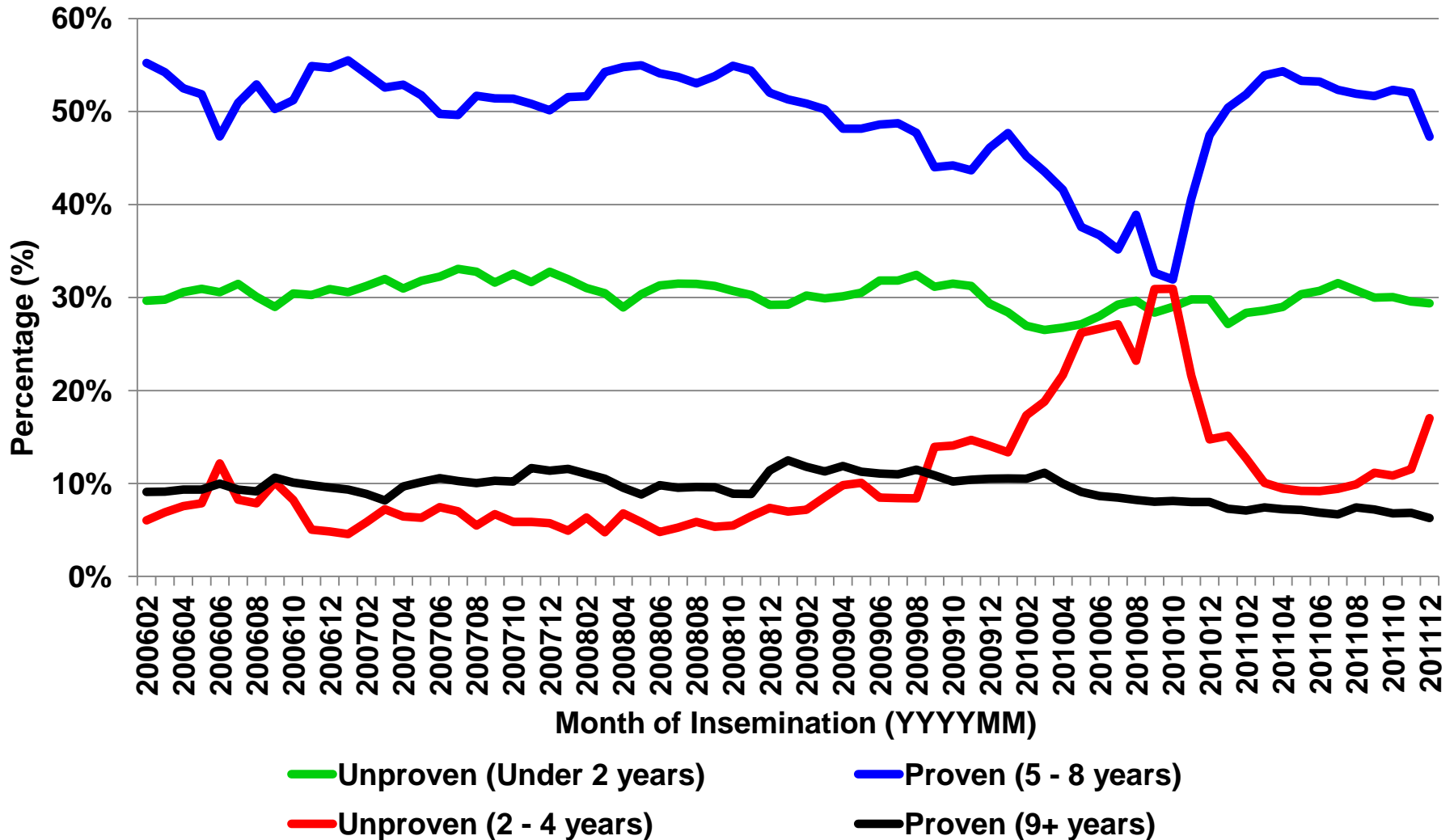
LIFETIME PROFIT INDEX	GEBV 12*APR				
GLPI		3584	70	+22	3124
PRODUCTION		2470	73	+21	1970
DURABILITY		1106	68	+24	1066
HEALTH & FERTILITY		8	60	+24	88

PRODUCTION	GEBV 12*APR				
Milk Yield (kg)		2951	74	+16	2387
Fat Yield (kg)		100	73	+23	77
Protein Yield (kg)		98	73	+20	82
Fat Deviation (%)		-0.05	73	+23	-0.09
Protein Deviation (%)		0.01	73	+20	0.03

CONFORMATION	GEBV 12*APR				
Conformation		12	69	+24	11
Mammary System		12	70	+23	10
Feet & Legs		14	65	+26	15
Dairy Strength		7	70	+23	6
Rump		1	66	+20	-2

FUNCTIONAL	12*APR				
Herd Life	GPA	107	63	+26	108
Somatic Cell Score	GEBV	3.13	71	+36	3.07
Lactation Persistency	GPA	103	61	+21	103
Daughter Fertility	GPA	101	59	+23	103
Milking Speed	GPA	99	58	+19	99
Milking Temperament	GPA	110	57	+19	110
Calving Ability	GPA	104	73	+28	105
Daughter Calving Ability	GPA	107	58	+21	110

Trend in Holstein Sire Usage by Age Category





Launch of

GENO**ID**

Program



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- **New service for producers that wish to:**
 - Catch up on Herdbook registration
 - Start regular Herdbook registration
 - Use genotyping to learn more about the genetic potential of their females
 - Available initially for Holstein producers

 - **Launch date: June 1, 2012**



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- Application form and instructions will be available on Holstein Canada web site www.holstein.ca
 - Each animal requires an application form
 - DNA collected (tail hair, nasal swab or blood)
 - DNA submitted to Holstein Canada with completed application form
 - HC does initial QA, inputs producer information, and sends to lab for genotyping



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- **Results come back to HC and CDN**
 - **CDN conducts parentage discovery (AI sires and dam if genotyped) and provides genomic and genetic evaluations**
 - **HC creates an animal record in Herdbook using pedigree data from discovery process**
 - **Results on a herd basis also available to producers on confidential online account**
 - Genomic evaluations for LPI and 60+ traits
 - Report with animals listed, purity and discovered parents

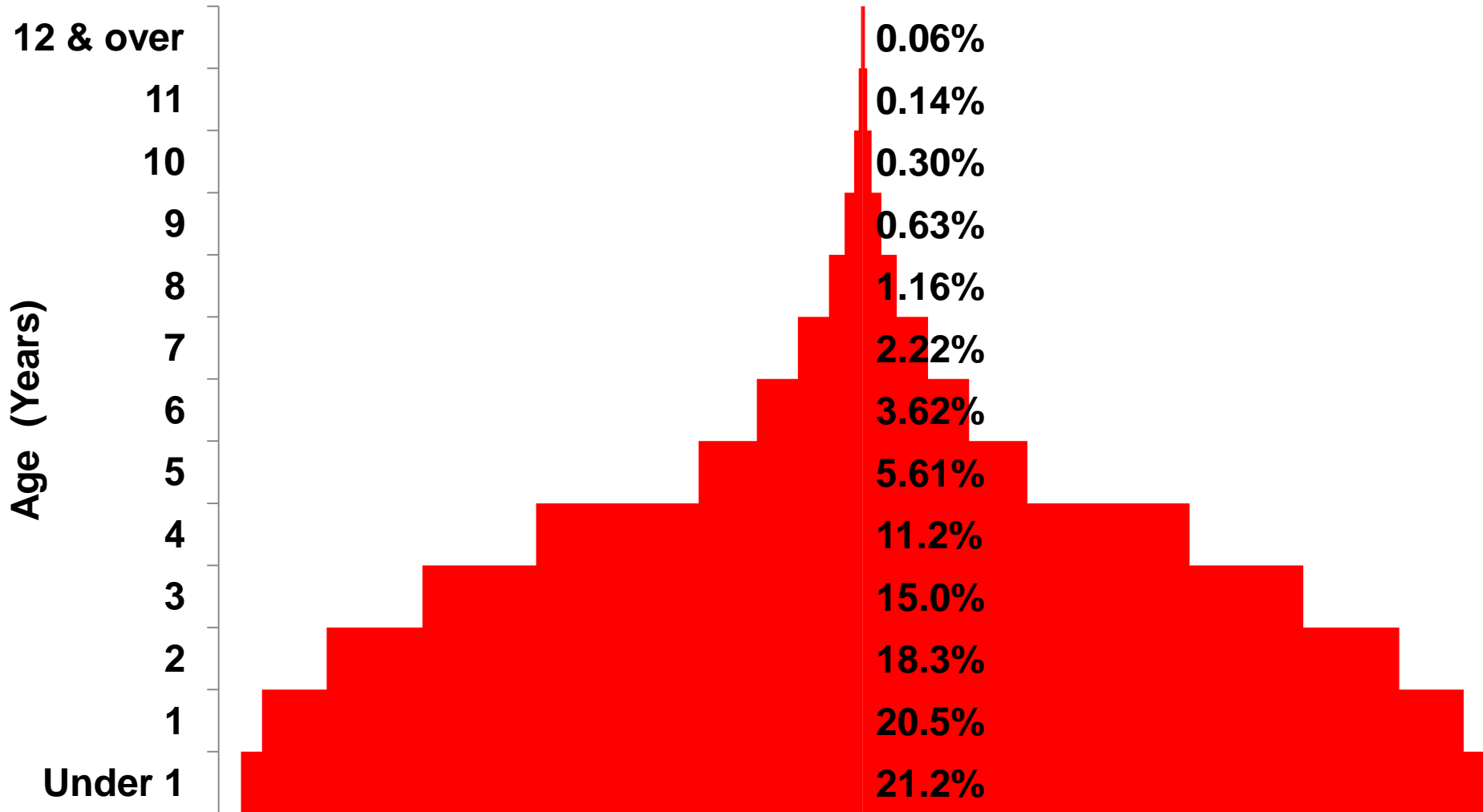


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- **Application form for each animal must include (sample):**
 - Unique lifetime ID number from tag
 - Birth date and Breed
 - Herd management number (also name if desired in the naming of animal)
 - Dam ID if known
 - Birth codes including indication of Multiple Birth/Twin and Embryo Transfer (ET)
 - Animal's coat colour



- **Genotyping is likely under two strategies:**
 - Genotype all heifers under a year of age, or perhaps the youngest cross-section of the herd not yet in the herdbook
 - Genotype the entire herd of heifers and cows
- **Key advantages of this “whole herd” strategy to the herd owner include**
 - Maximum discovery of lineage and level of recordation
 - More accurate estimates of inbreeding for animal and herd
 - Genetic evaluation of all animals for production, conformation and functional traits, which contributes to effective herd management and sire mating

Typical Herd Structure by Age



Typical Lineage Discovery by Whole Herd Genotyping

