Modernizing Canada's Lifetime Performance Index (LPI)

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Two National Selection Indexes
(Prior to April 2025)

Comparison Criteria	Lifetime Performance Index (LPI)	Pro$
Launch date	1991	2015
Update process	Consultation with breeds & A.I. every 3-5 years	Annual cow profit calculations with updated economics
Inclusion of subindexes	Yes, 3 components	No
Published formula	Yes	No
Primary users	Breeders, A.I. & international	Commercial farmers & A.I.
Extension focus	Traits included and their relative weights	Expected response from selection on Pro$

Lifetime Performance Index (LPI)

- First introduced 34 years ago and is highly recognized globally
- Started with only Production and Type components (6 traits)

$$LPI = 40 \ (Production) + 20 \ (Type)$$

where;

$$Production = \frac{2 * FAT}{S.D.} + \frac{9 * PROTEIN}{S.D.}$$

$$Type = \frac{1 * FC}{S.D.} + \frac{5 * MS}{S.D.} + \frac{4 * FL}{S.D.} + \frac{1 * CAP}{S.D.}$$

Evolution of LPI

Legend: ■ Protein ■ Fat ■ Type ■ Longevity ■ Fertility ■ Health

★ Expanded from only production and type in 2001

★ Included female fertility in 2005

★ Increased emphasis over time on health and fertility traits

★ Feed Efficiency was included in 2022 as an add-on trait
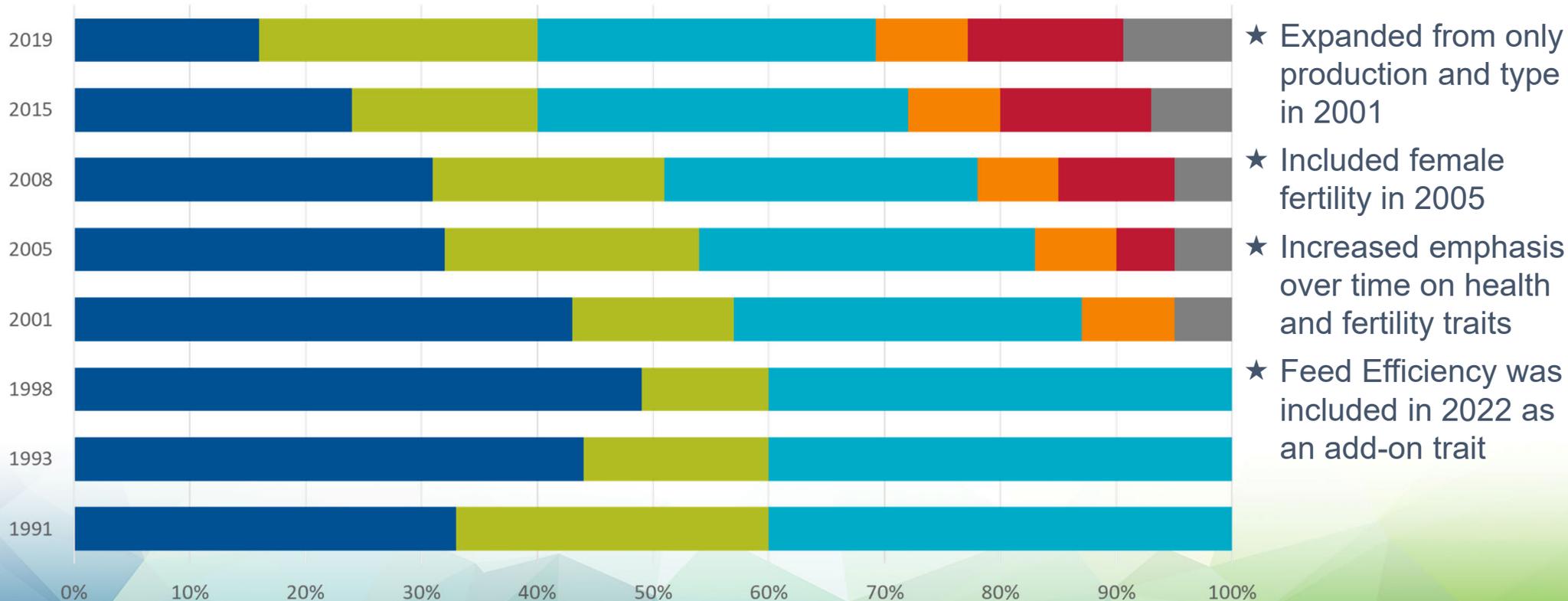
LPI Prior to April 2025 (Holstein)

Production
- **Fat Yield**
- **Protein Yield**
- Fat Deviation*
- Protein Deviation*

*not for Holsteins

LPI

Feed Efficiency

Durability
- **Herd Life**
- **Mammary System**
- **Rump**
- **Feet & Legs**
- **Dairy Strength**
- **Hoof Health**

Health & Fertility
- **Daughter Fertility**
- **Mastitis Resistance**
- Somatic Cell Score
- Udder Depth
- Milking Speed
- Milking Temperament
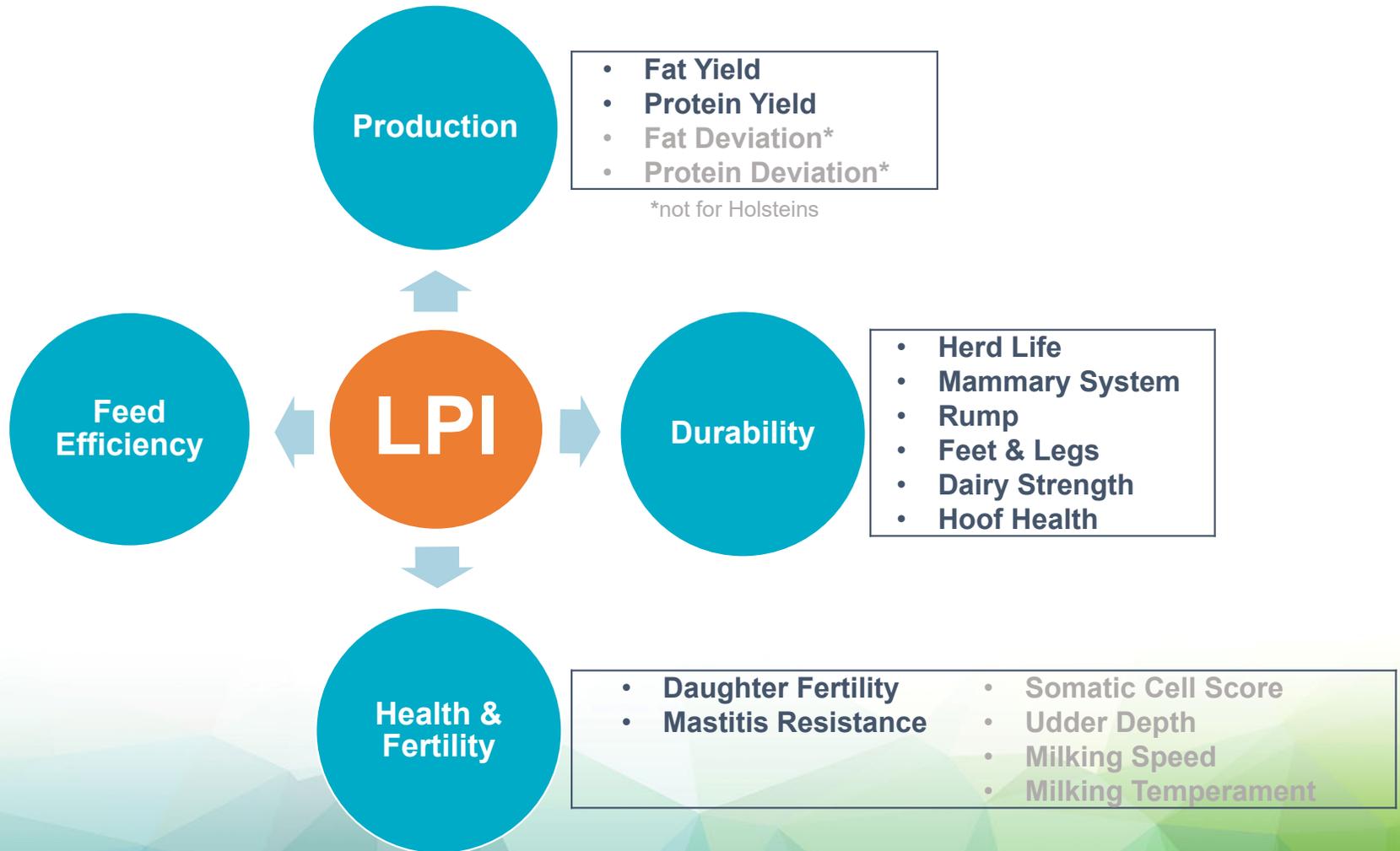
Lifetime Performance Index – Former Communication

$$LPI = \left[\begin{array}{c} \text{Production} \\ \text{Component} \\ \text{x Emphasis} \\ \text{x Factor} \end{array} + \begin{array}{c} \text{Durability} \\ \text{Component} \\ \text{x Emphasis} \\ \text{x Factor} \end{array} + \begin{array}{c} \text{Health \&} \\ \text{Fertility} \\ \text{Component} \\ \text{x Emphasis} \\ \text{x Factor} \end{array} \right] + \text{Constant}$$

Where the relative emphasis placed on each of the three main components in each breed is presented in the following table along with the multiplicative factors for each component.

Breed	LPI Constant	Production		Durability		Health & Fertility	
		Emphasis	Factor	Emphasis	Factor	Emphasis	Factor
Ayrshire	2019	46	.5681	32	.7170	22	.9592
Brown Swiss	966	55	.5458	27	.6835	18	.8328
Canadienne	932	55	.4480	30	.6537	15	.8387
Guernsey	648	50	.5547	35	.7406	15	.6895
Holstein	2255	40	.5420	40	.7971	20	.6869
Jersey	1088	50	.5979	30	.6281	20	.7645
Milking Shorthorn	1076	56	.5419	30	.8335	14	1.0332

Production Component (PROD):

$$PROD = [W_{PY} x (PY\text{-}Avg_{PY})/SD_{PY}] + [W_{PD} x PD/SD_{PD}] + [W_{FY} x (FY\text{-}Avg_{FY})/SD_{FY}] + [W_{FD} x FD/SD_{FD}]$$

Durability Component (DUR):

$$DUR = [W_{HL} x (HL \text{-} 100)/5] + [W_{MS} x MS/5] + [W_{F\&L} x F\&L/5] + [W_{HH} x (HH - 100)/5] +$$

$$[W_{DS} x DS/5] + [W_{RP} x RP/5]$$

Health & Fertility Component (H&F):

$$H\&F = [W_{DF} x (DF\text{-}100)/5] + [W_{MR} x (MR\text{-}100)/5] + [W_{SCS} x (SCS\text{-}100)/5] +$$

$$[W_{UD} x UD/5] + [W_{MSP} x (MSP\text{-}100)/5] + [W_{MT} x (MT\text{-}100)/5]$$

Modernized LPI

Main Goals:

- Expand from 3 components to 6 subindexes
- Include the recently launched traits related to sustainability
- Eliminate the "mathematical" nature of the LPI formula and the related communications
- Create official subindexes to be published on their own as well as combined in LPI
- Indicate the relative emphasis of traits included in each subindex but focus on the expected response for key correlated traits

Modernized LPI

Production

Longevity & Type

Environmental Impact

LPI

Health & Welfare

Milkability

Reproduction

New subindex to facilitate the inclusion of new traits related to sustainability

Recognizes the increased adoption of robot milking systems
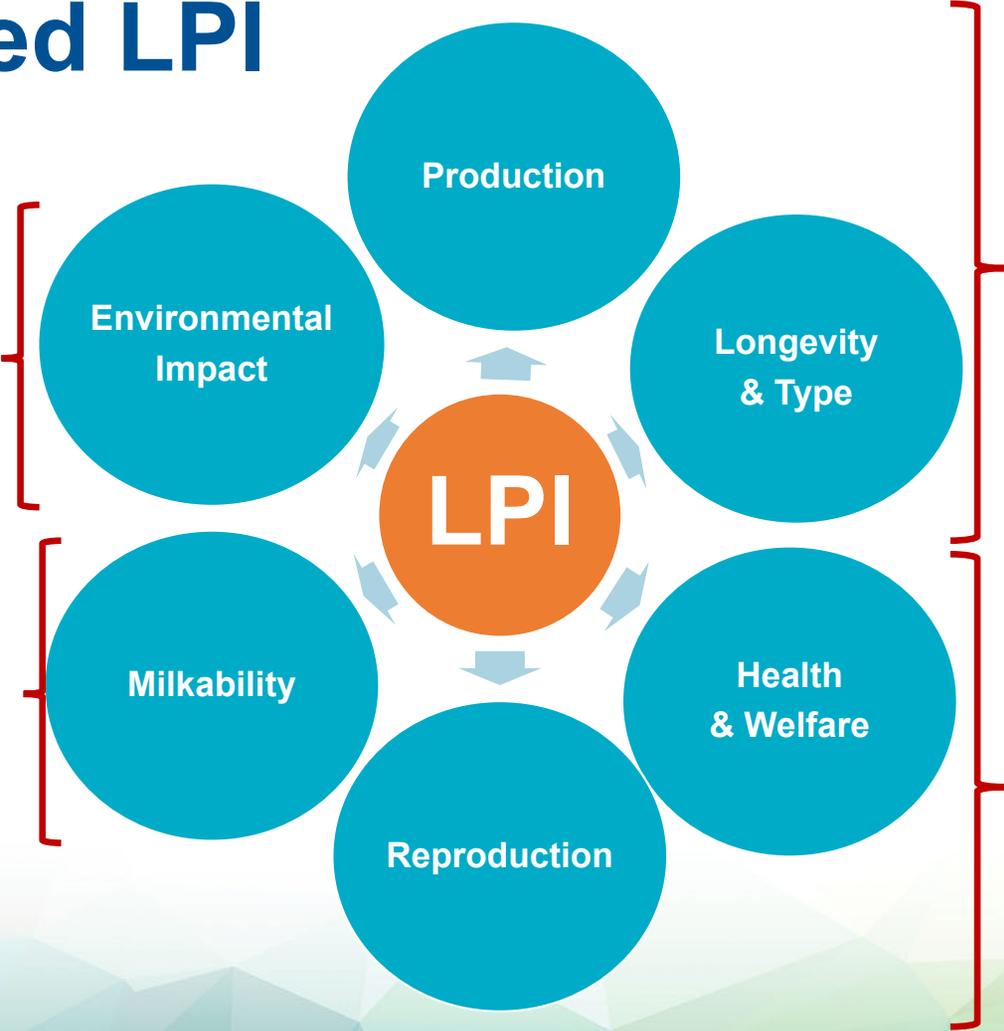
Maintained essentially the same as previous components

Separated Health & Fertility into two subindexes, mainly to handle the growing list of health traits
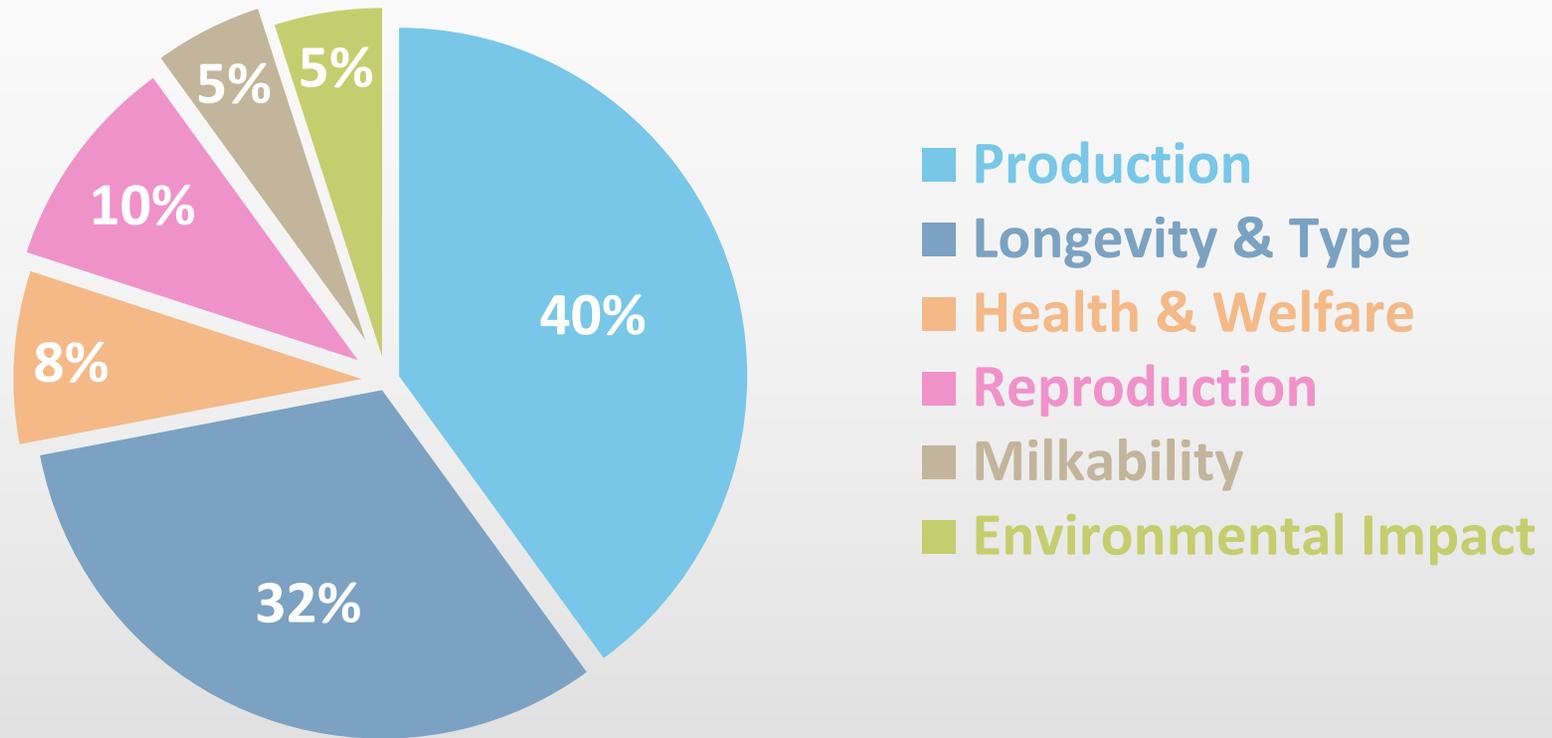
Relative Weights by Breed

Lifetime Performance Index (LPI)	HO	JE	AY	BS	GU	MS	CN
Production (PI)	40	48	46	55	50	52	55
Longevity & Type (LTI)	32	30	30	27	35	30	30
Health & Welfare (HWI)	8	10	4	6	3	8	5
Reproduction (RI)	10	10	9	7	10	5	6
Milkability (MI)	5	2	11	5	2	5	4
Environmental Impact (EI)	5	-	-	-	-	-	-

Modernized LPI - Holstein
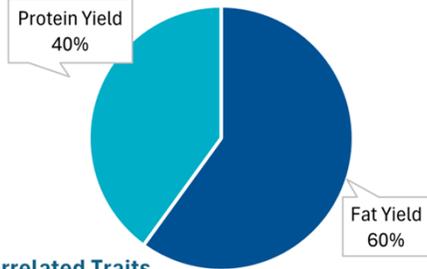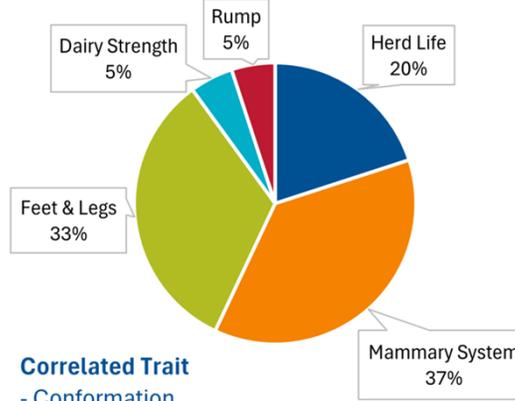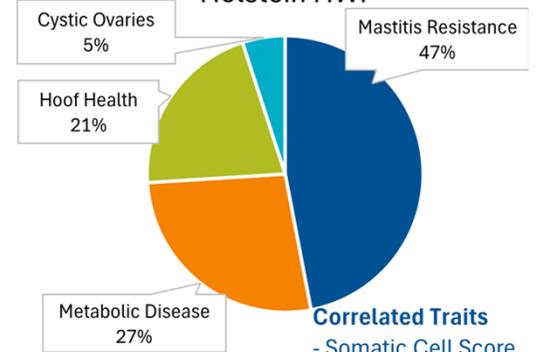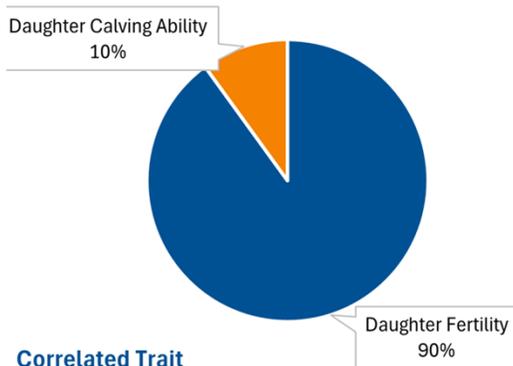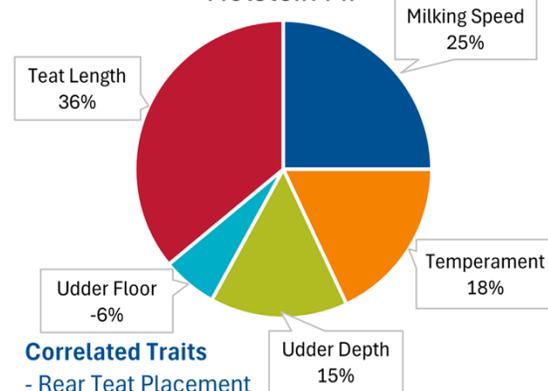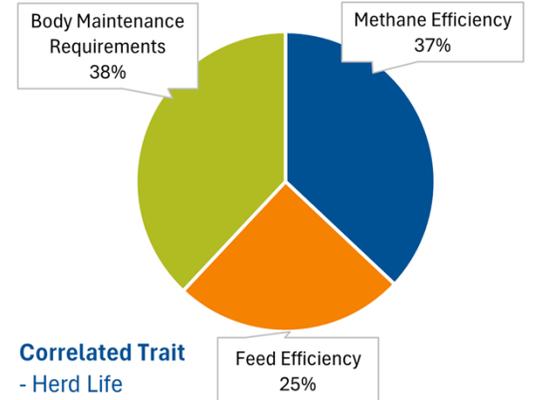
Expected Response from LPI Selection

LPI			%	LPI Corr
	Production	PI	40	0.83
	Longevity & Type	LTI	32	0.69
	Health & Welfare	HWI	8	0.57
	Reproduction	RI	10	0.39
	Milkability	MI	5	0.01
	Environmental Impact	EI	5	0.00

Pie chart: PI 40%, LTI 32%, RI 10%, HWI 8%, MI 5%, EI 5%

		%		5-Yr*
PI	Milk Yield		0.43	534
	Fat Yield	60	0.81	42.1
	Protein Yield	40	0.74	28.0
	Fat Deviation		0.56	0.29
	Protein Deviation		0.54	0.13
	Lactation Persistency		0.10	0.5
LTI	Herd Life	20	0.64	3.4
	Conformation		0.51	3.2
	Mammary System	37	0.47	2.9
	Feet & Legs	33	0.46	2.7
	Dairy Strength	5	0.07	0.5
	Rump	5	0.09	0.6
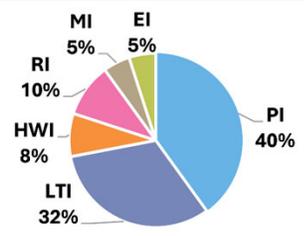
					5-Yr*	
HWI	Mastitis Resistance	47	0.44		2.1	
	Somatic Cell Score		0.46		2.8	
	Metabolic Disease Resistance	27	0.40		2.1	
	Hoof Health	21	0.27		1.4	
	Cystic Ovaries	5	0.20		1.0	
	Metritis		0.37		1.9	
	Retained Placenta		0.19		1.0	
RI	Daughter Fertility	90	0.32		1.6	
	Daughter Calving Ability	10	0.58		2.8	
	Calving Ability	0	0.34		1.9	
MI	Milking Speed	25	0.03		0.1	
	Temperament	18	0.10		0.5	
	Udder Depth	15	0.31		2.0	Shallow
	Udder Floor	-6	-0.01		-0.1	Tilt
	Teat Length	36	-0.19		-1.2	Short
	Rear Teat Placement		0.03		0.2	Close
	Fore Teat Placement		0.15		0.9	Close
EI	Methane Efficiency	37	0.19		0.9	
	Feed Efficiency	25	0.09		0.5	
	Body Maintenance Requirements	38	-0.16		-0.8	

*5-Yr: Expected genetic gain in the next five years expressed in proof units (Production traits in kilograms, type traits in EBV, and other traits in RBV)

Expression Scale for LPI Subindexes

Expression:

- Each subindex is expressed on a standardized scale along with a percentile rank

- Average = 500

- Standard deviation = 100
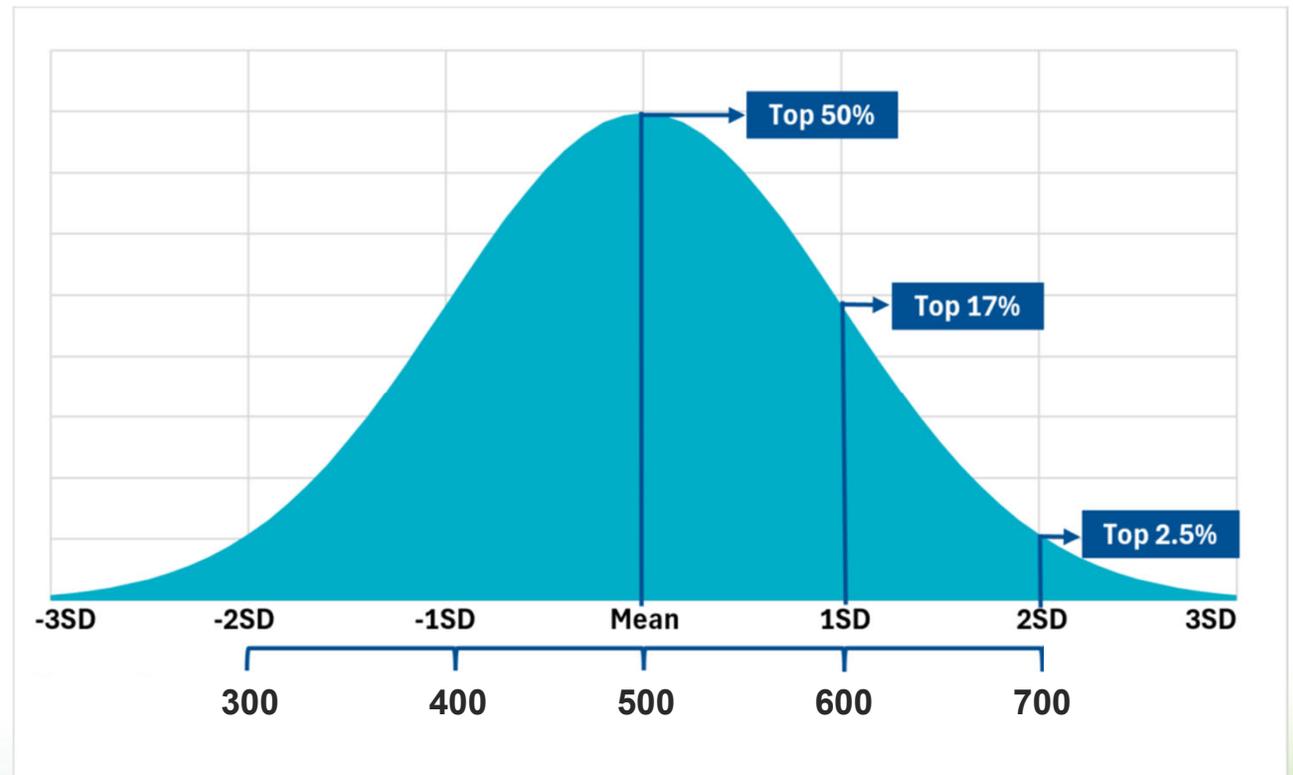
Genetic Evaluation Summary Page

LPI

3850
Rel: 97% %RK: 99

Pro$

$2474

Production GEBV 25*APR

			Kg	%RK	%Dev
Herds	457	Milk	1154	83	
Daughters/Lactations	1509/1827	Fat	98	90	+0.43
Rel	99	Protein	67	92	+0.21

LPI Subindexes ❓

	Rating	%RK	200	300	400	500	600	700	800
Production	706	98							
Longevity & Type	728	99							
Health & Welfare	469	36							
Reproduction	544	65							
Milkability	596	83							
Environmental Impact	549	65							

Conformation GEBV 25*APR

Herds: 384   Daughters: 1081   Rel: 99%

	Rating	%RK	-15	-10	-5	0	5	10	15
Conformation	10	97							

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General Preferences

Primary Breed   Holstein   ∨

Preferred Selection Index | LPI | **Pro$** |

Genetic Evaluations Summary Page

Display descriptive type traits by default? | Yes | **No** |

Display intermediate optimum type traits by scorecard section? | **Yes** | No |

Save

Personalize the relative emphasis on each LPI subindex for the primary breed selected above or add an additional breed

Personalized Lifetime Performance Index (pLPI)

Add another breed | -- | ∨ |

Holstein ⊗

	Offical LPI	pLPI
Production	40%	40
Longevity & Type	32%	32
Health & Welfare	8%	8
Reproduction	10%	10
Milkability	5%	5
Environmental Impact	5%	5
Total		100%

Ayrshire ⊗

	Offical LPI	pLPI
Production	46%	45
Longevity & Type	30%	30
Health & Welfare	4%	5
Reproduction	9%	10
Milkability	11%	10
Total		100%

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Thank You