

Where are we going with genomics? What about inbreeding?

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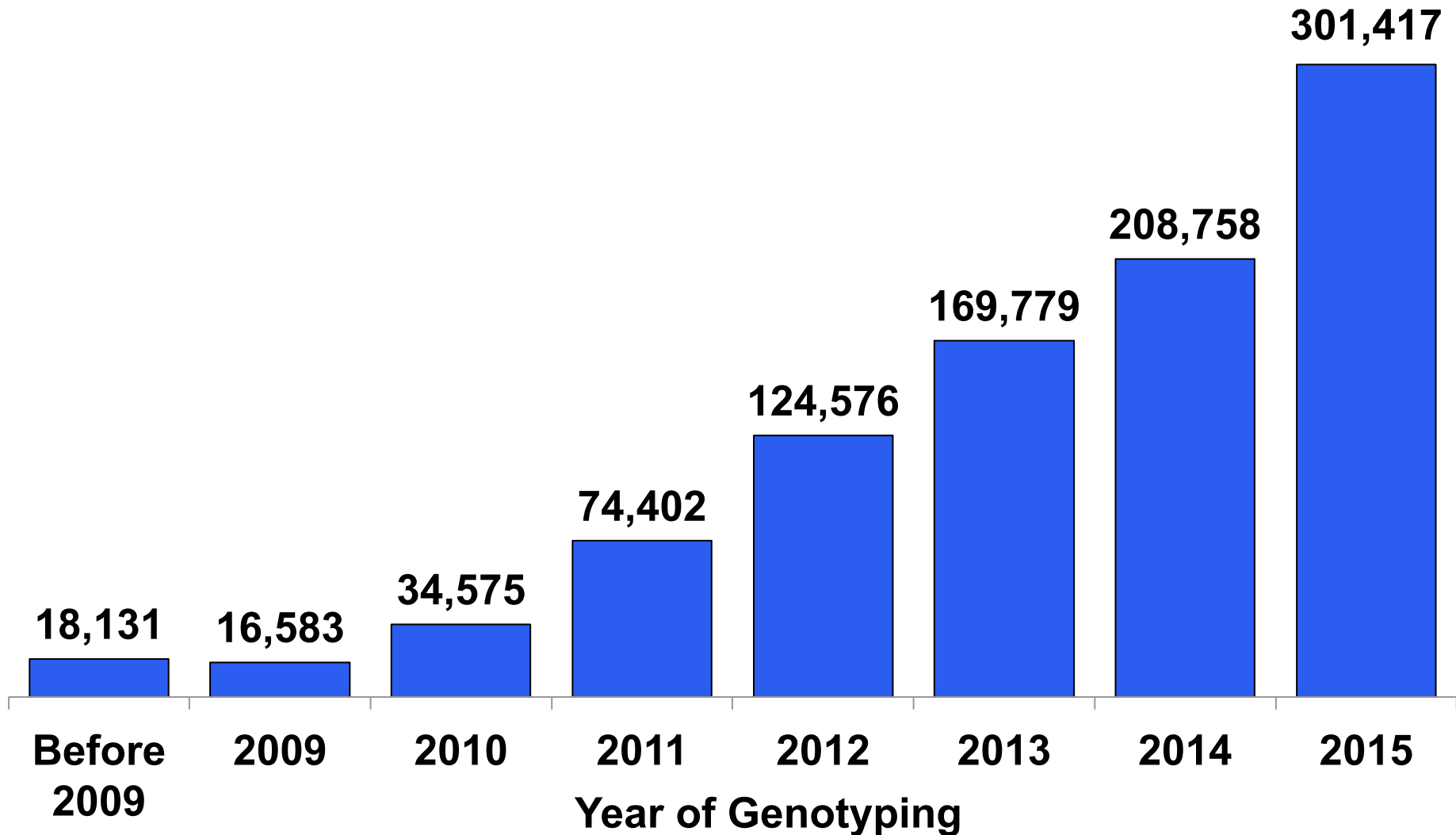
Total Genotypes at CDN

- March 2016 -

Breed	Genotypes	Percentage
Ayrshire	5,732	0.5%
Brown Swiss	21,610	1.8%
Guernsey	2,644	0.2%
Holstein	1,060,214	86.0%
Jersey	143,166	11.6%
Total	1,233,366	100%

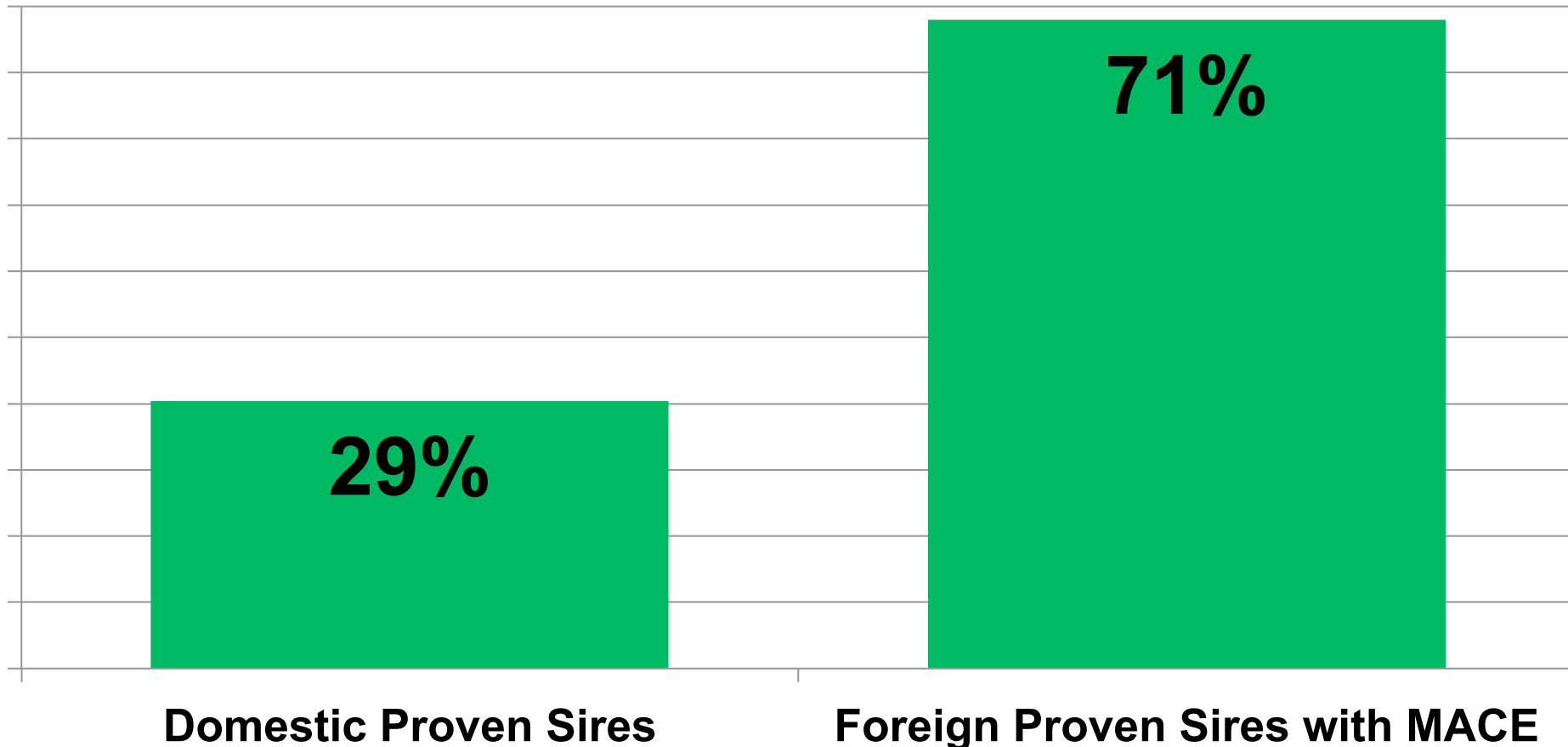
Over 1 Million Holstein Genotypes!

No. Holsteins Genotyped per Year in North America

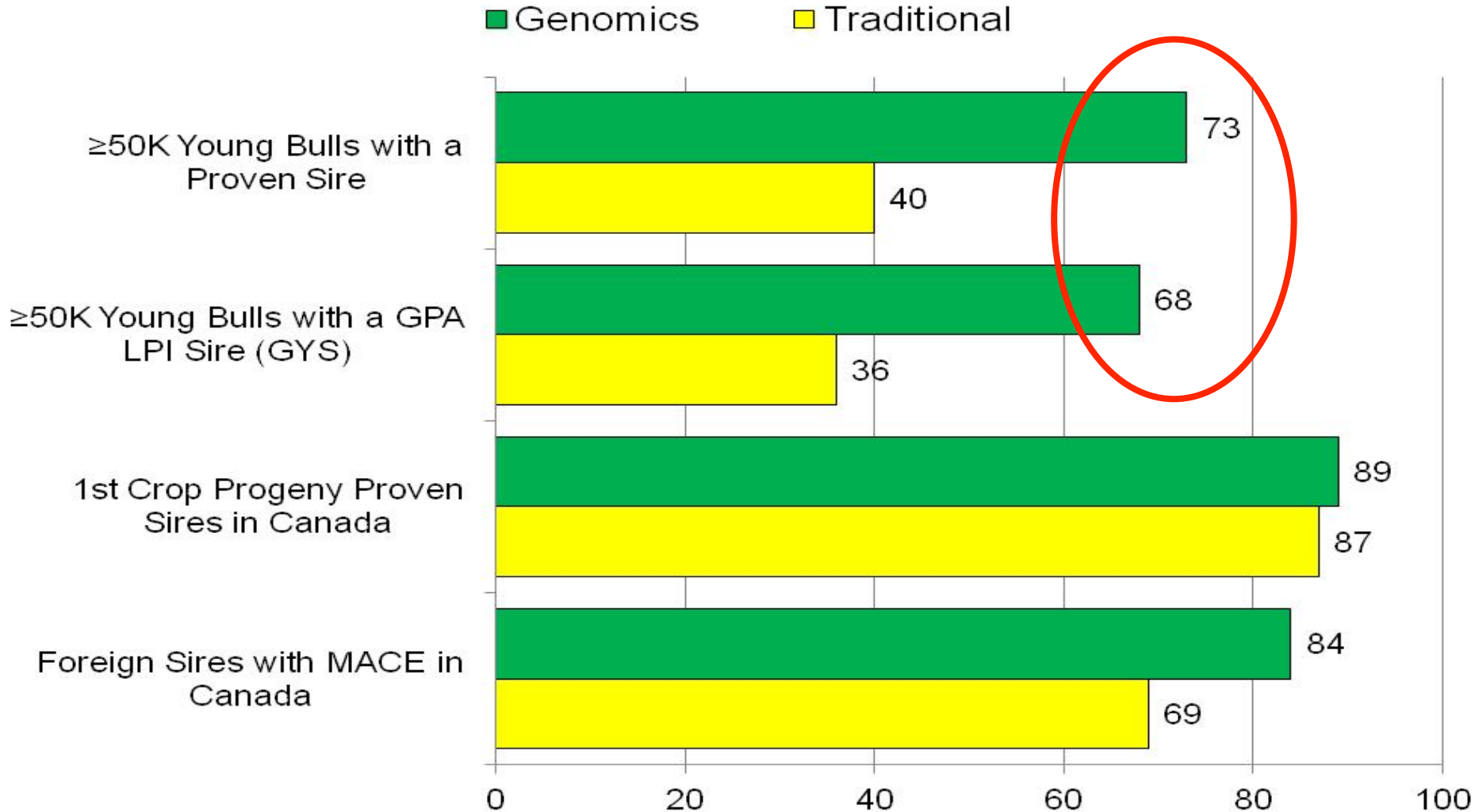


Holstein Reference Sires for Genomics in Canada

≈28,000 Reference Sires

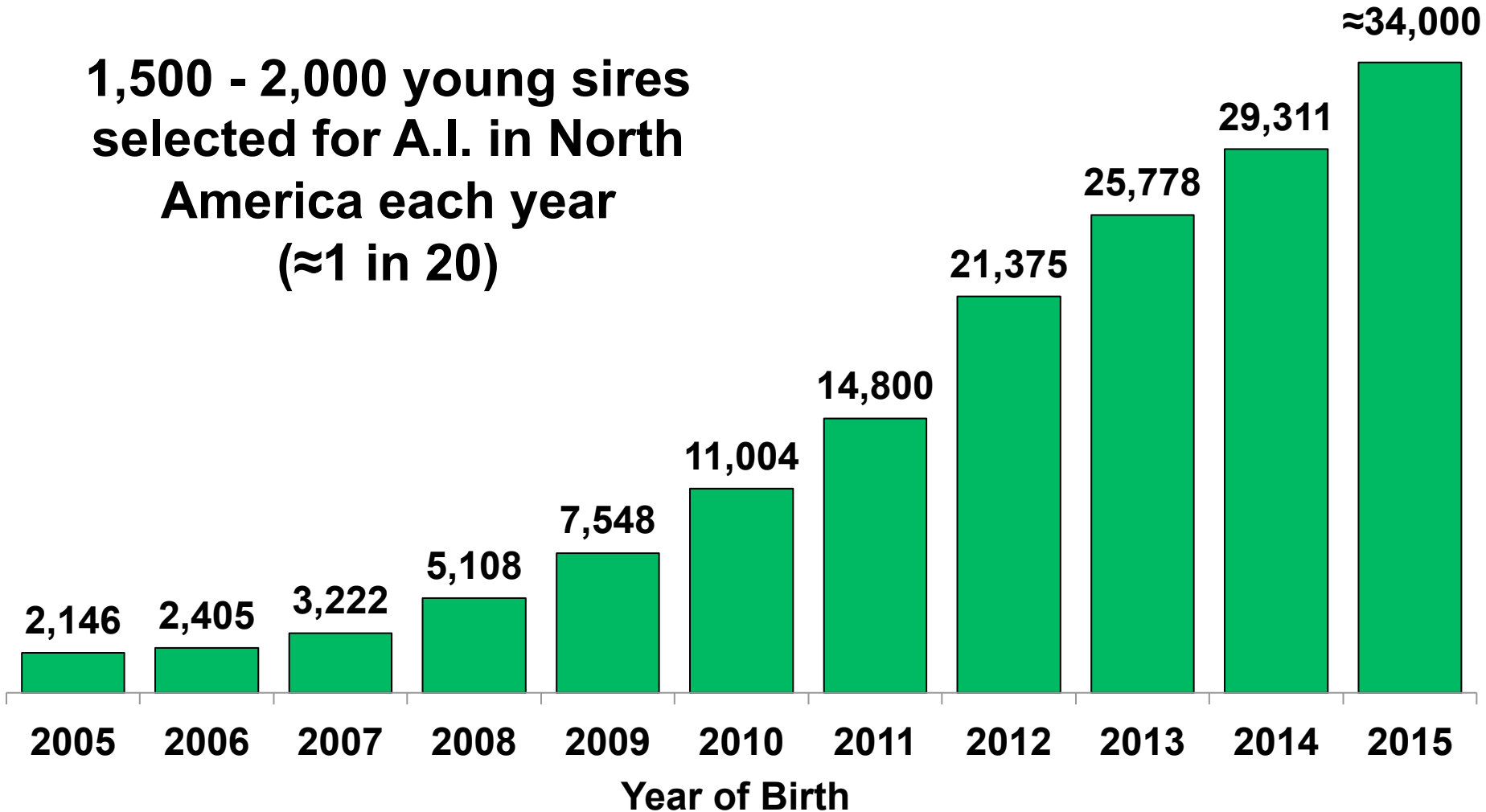


Gain in LPI Reliability with Genomics – HO Bulls

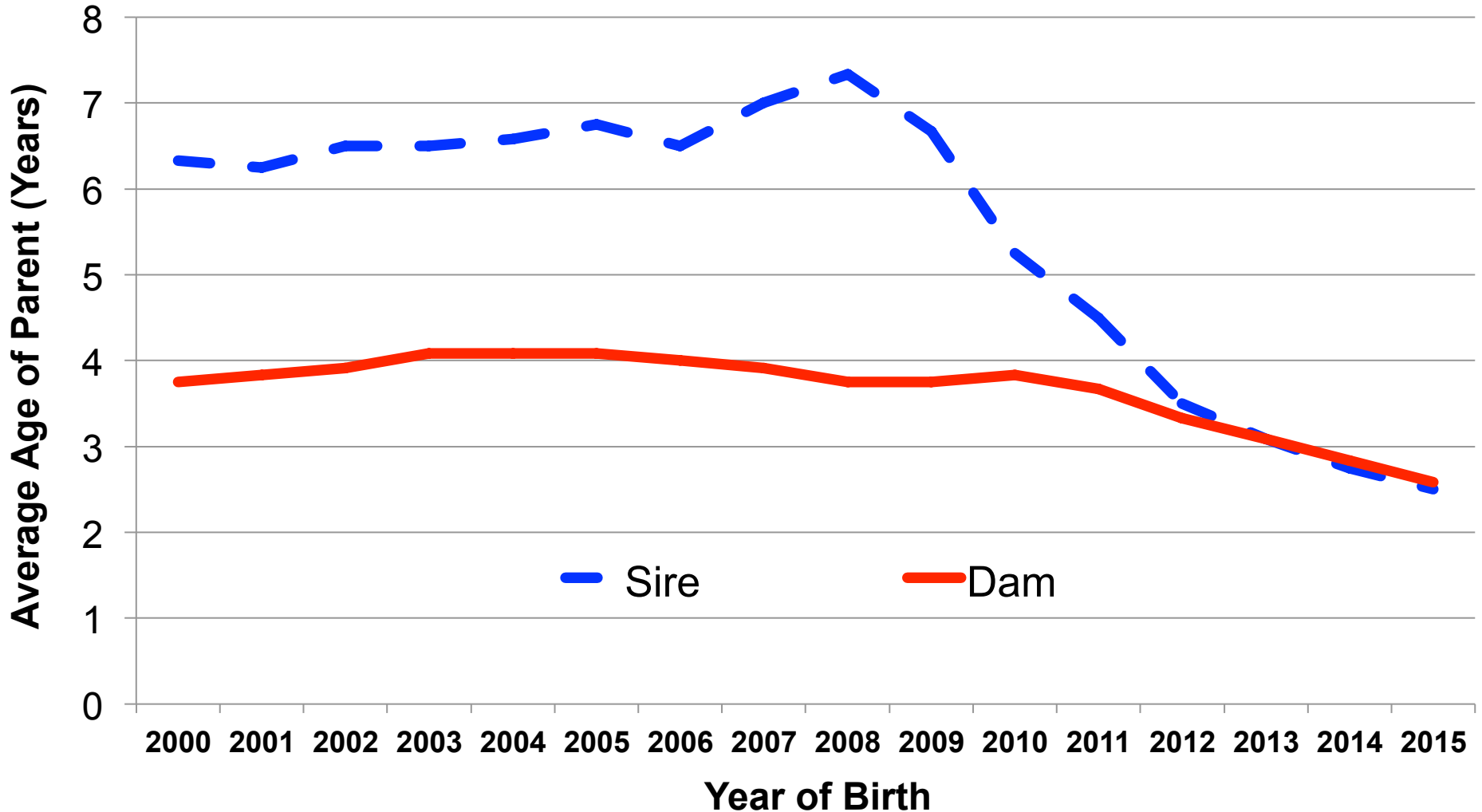


No. Young Bulls Genotyped in North America

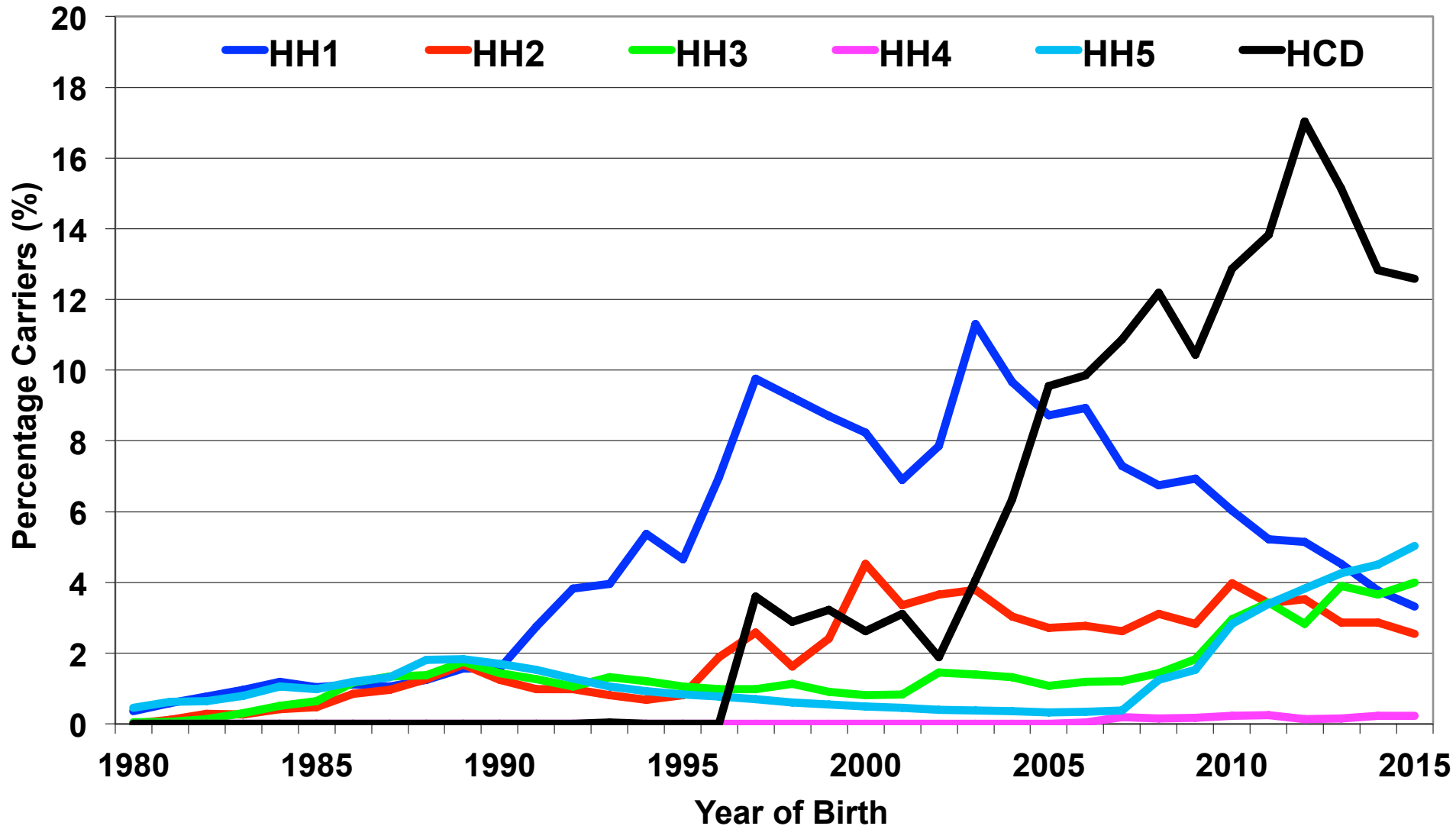
**1,500 - 2,000 young sires
selected for A.I. in North
America each year
(≈ 1 in 20)**



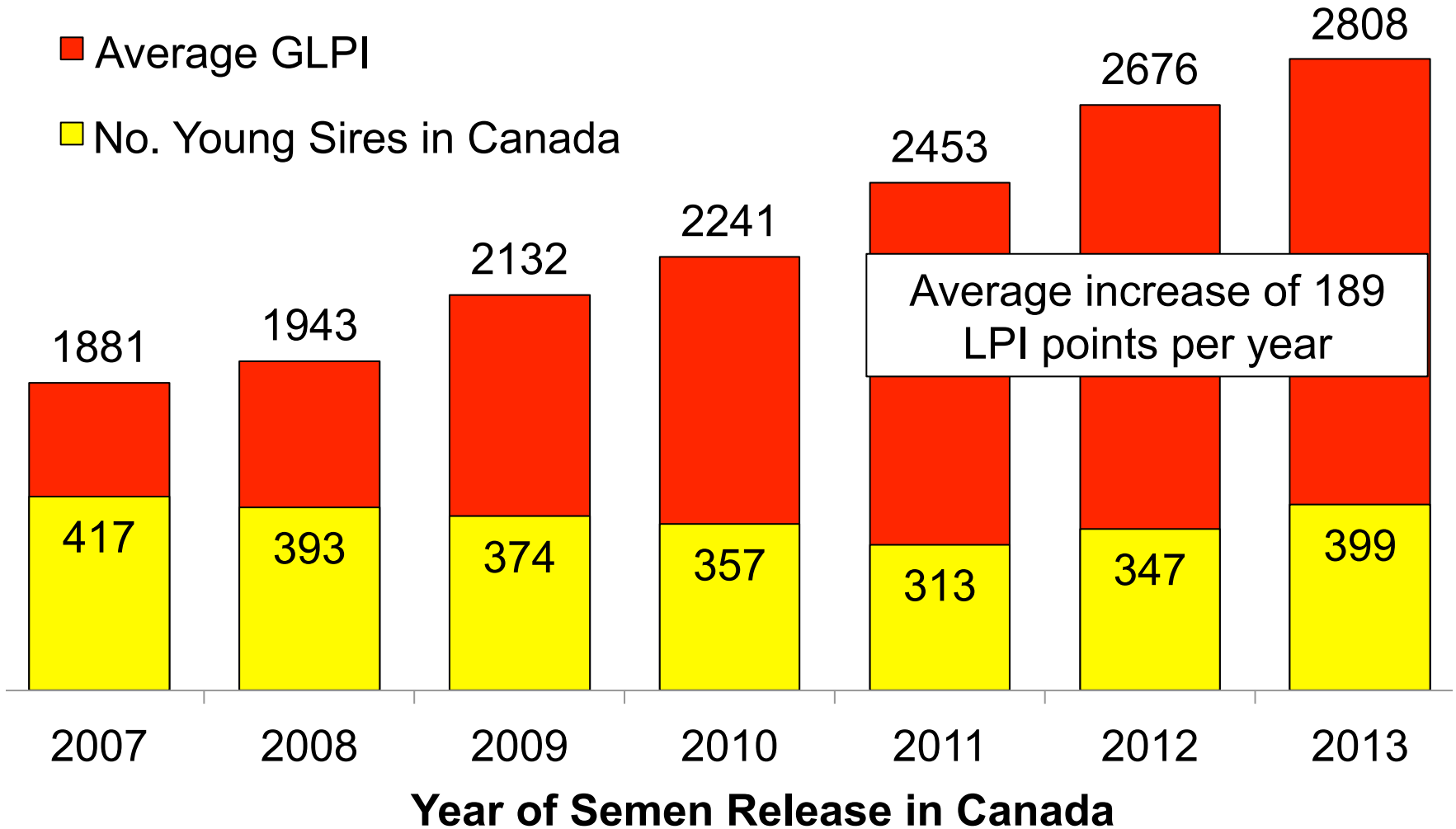
Average Age of Parents of Genotyped Holstein Bulls



Discovery of Holstein Haplotypes - Percent Carriers

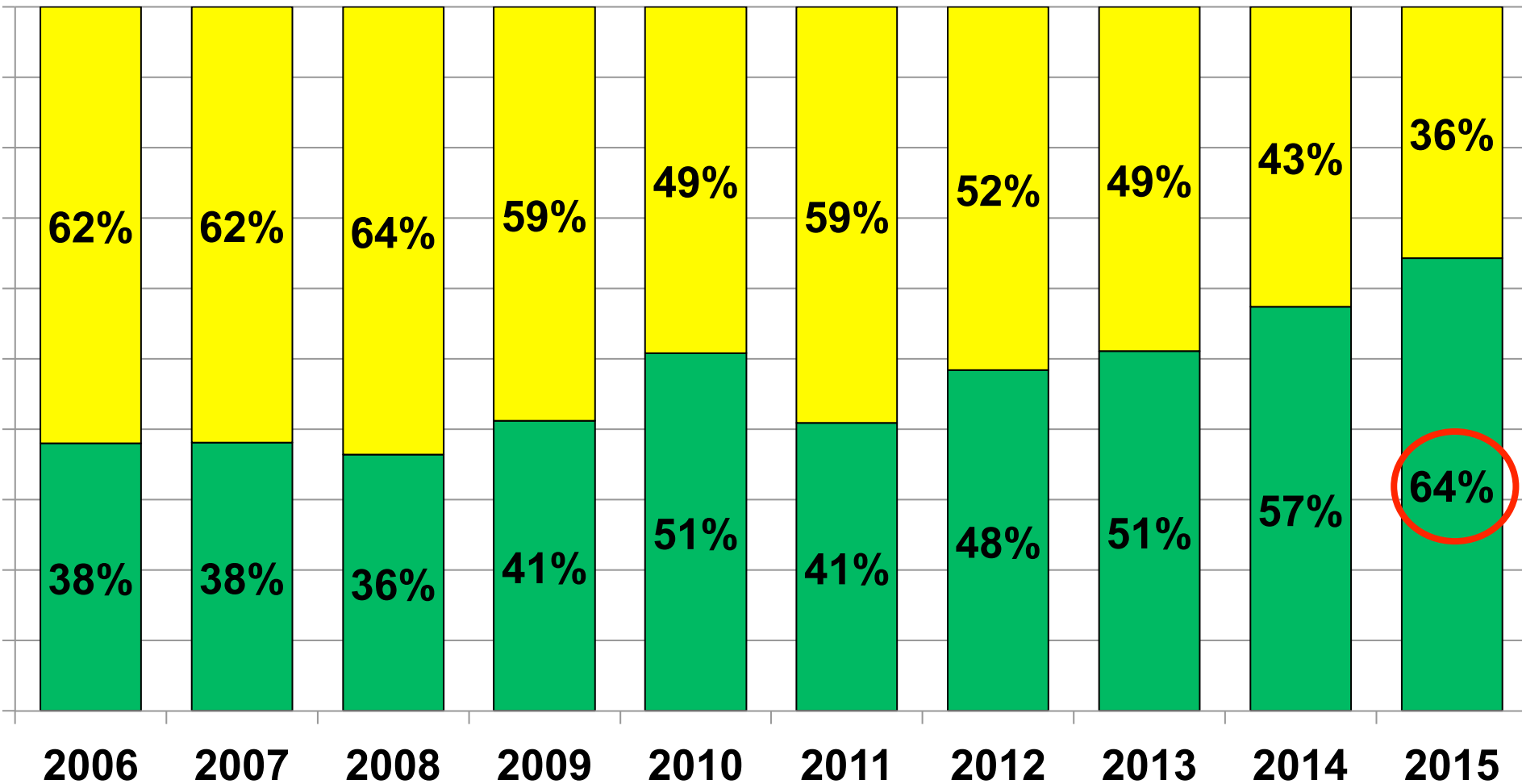


Rapid Progress in Quality of Young Sires Offered

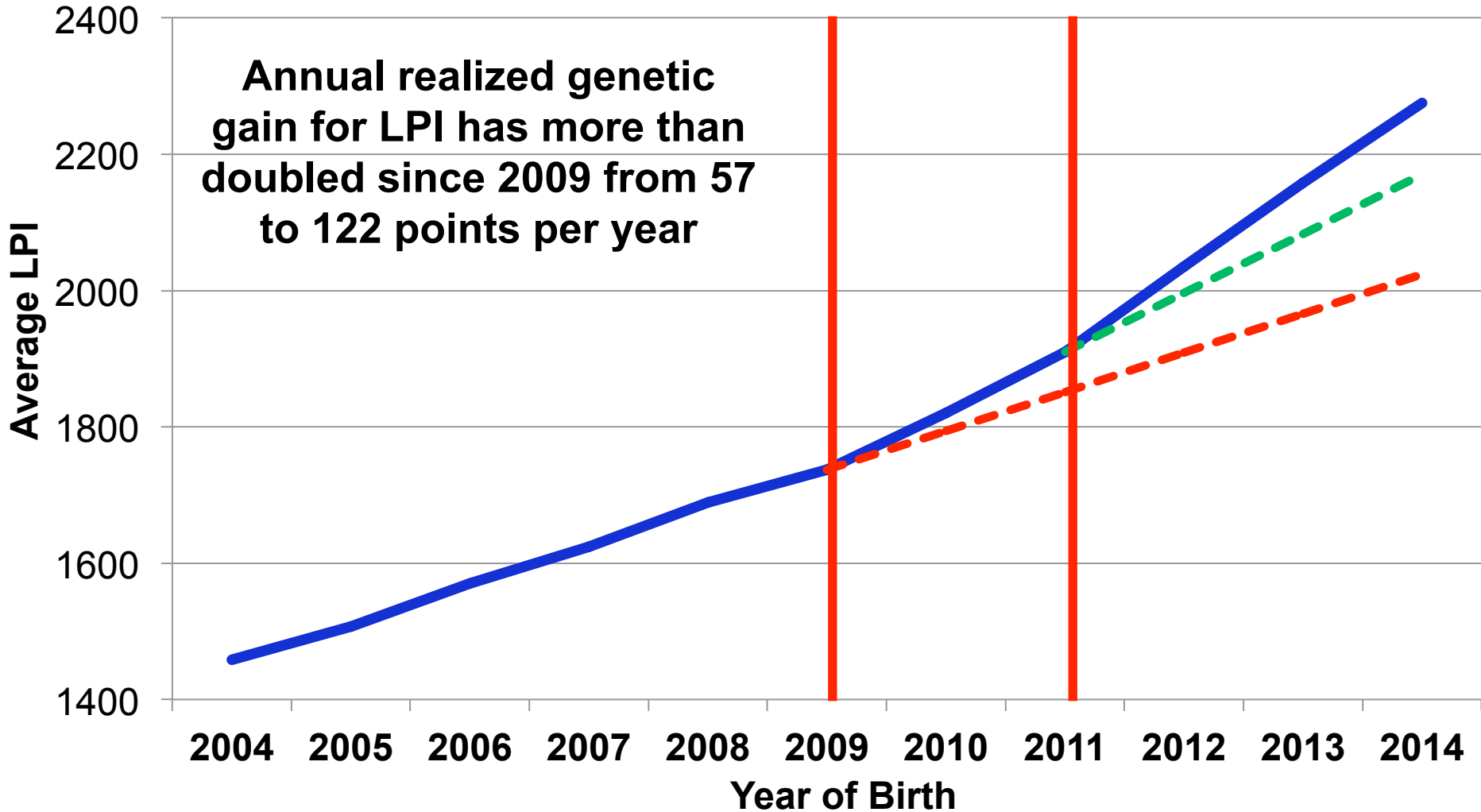


Market Share - Young vs Proven Sires -

■ Unproven Young Bulls ■ Progeny Proven Sires



Impact of Genomic on Genetic Progress - LPI



Impact of Genomics

- **Many GREAT things have resulted from the use of GENOMICS:**
 - Higher accuracy of selection for young animals
 - Shorter generation interval between parents and the next generation of replacements
 - Both for heifers in a herd and for bulls in A.I.
 - **FASTER** rates of genetic progress are a **reality!**
 - Accurate parentage verification and discovery
 - Discovery of existing genetic recessives with the ability to identify carriers to manage matings

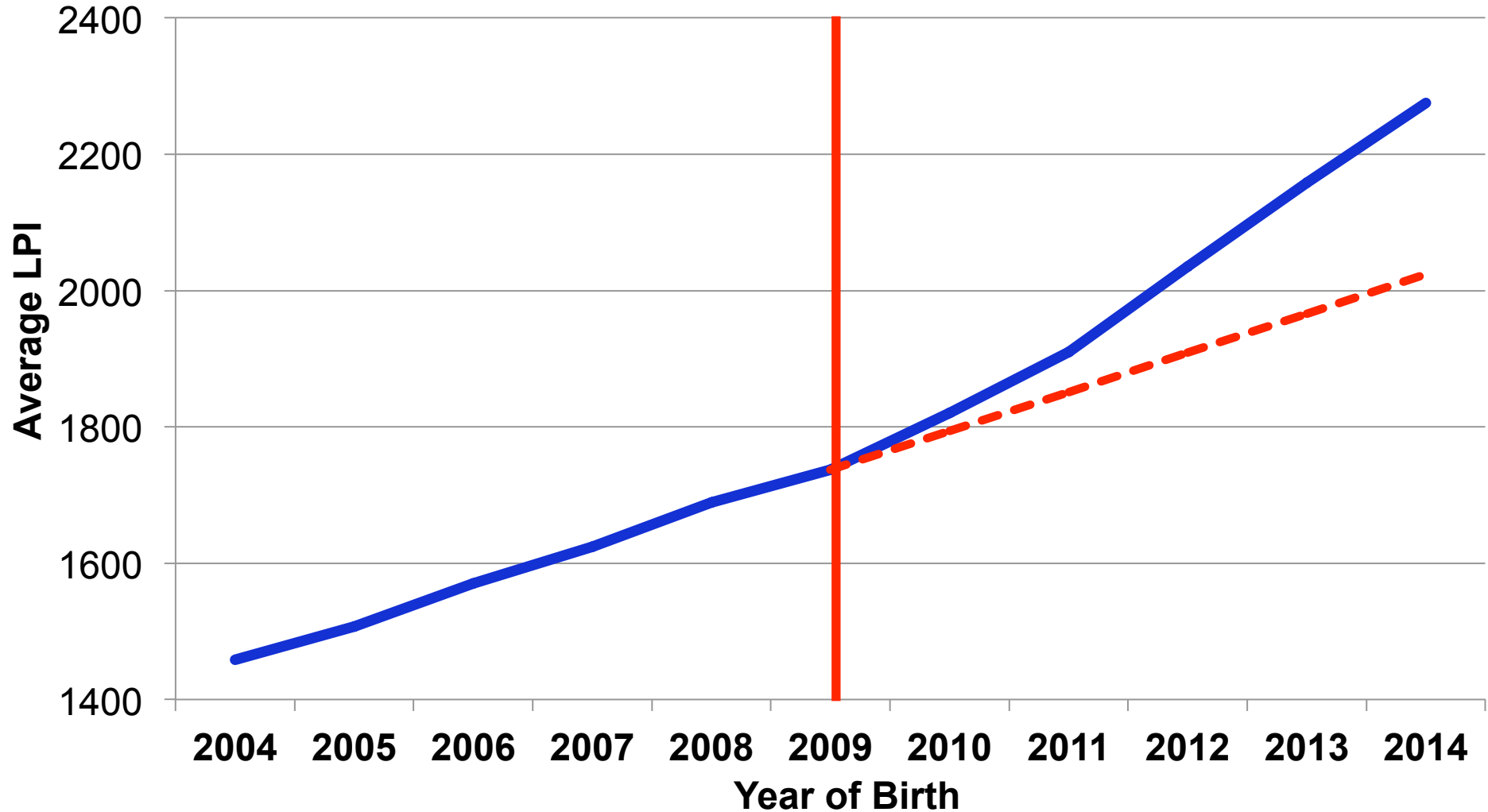
Where is Genomics Going?

- **Arguably, the BIGGEST benefit from genomics is the opportunity to improve new/novel traits of importance**
- **Current examples include:**
 - Animal health and disease resistance
 - Clinical mastitis, metabolic diseases (i.e.: ketosis), etc.
 - Hoof health and lameness
 - Nutraceutical properties of milk (i.e.: fatty acids, cholesterol, etc.) to improve human health
 - Feed efficiency and methane emissions

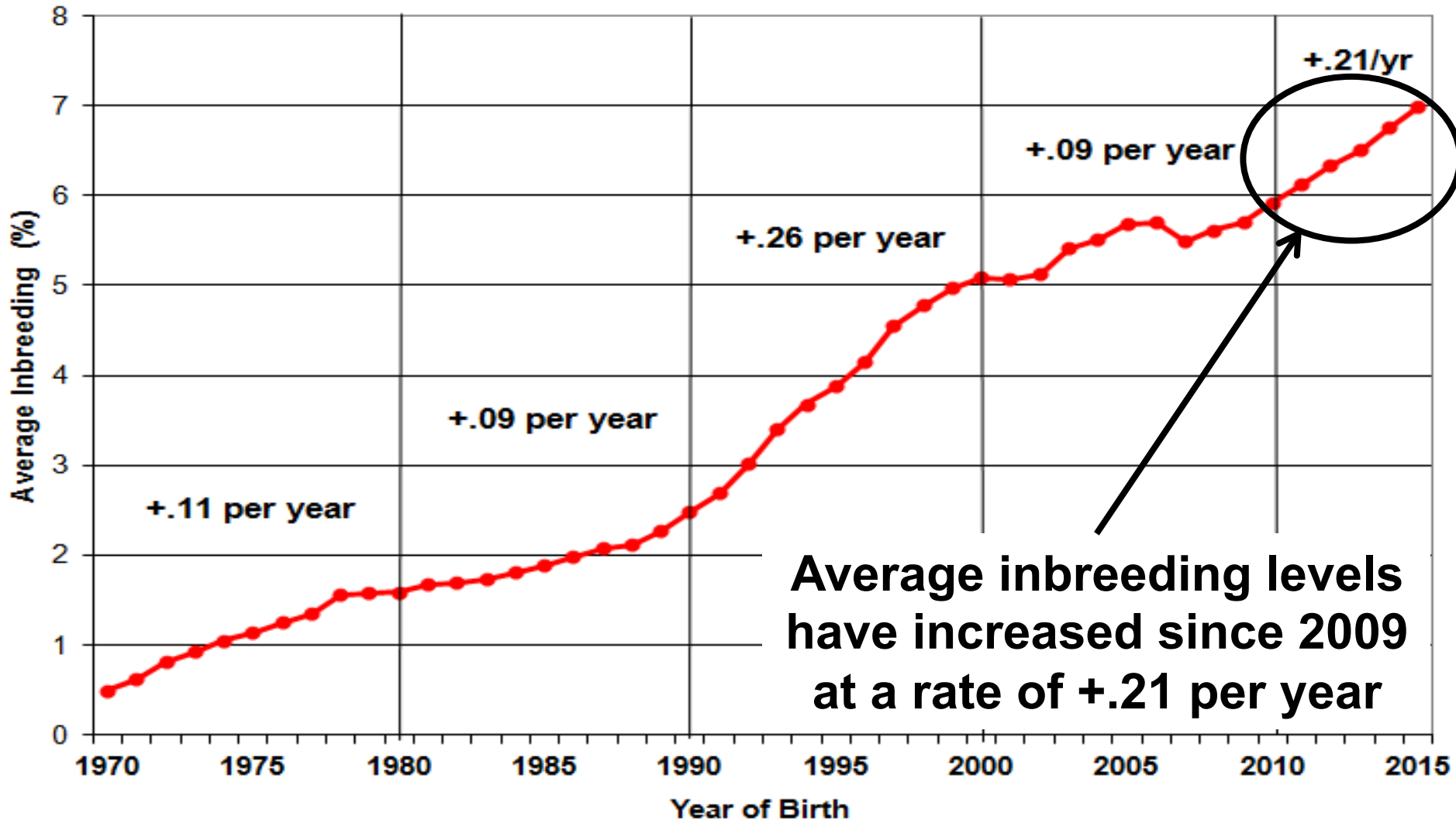
Genomic Selection for Novel Traits

- **Current methods for estimation of genomics are not designed for new/novel traits**
- **Proven sire reference population requires thousands of progeny proven sires following decades of performance recording**
- **“Cow Reference Population” is the solution!**
 - Performance and genotypes collected on the same animals
 - Need tens of thousands for significant accuracy gains
 - With the exception of some “expensive” traits, this approach will likely reduce international collaborations

Impact of Genomic on Genetic Progress - LPI



Balancing Genetic Progress and Inbreeding



Managing Inbreeding

- **The fast paced, competitive RACE for the highest genetics provides little incentive for A.I. companies to search for outcross genomic young bulls**
- **In general, the global Holstein population is highly related with only a few countries as exceptions**
- **Wide scale genotyping is required to identify new cow families and/or outcross young bulls with high genomics**
- **Inbreeding is best managed at the mating level!**

Improved Mating Programs

- **Most computerized mating programs should have the ability to avoid matings that produce progeny that exceed a given level of inbreeding**
 - Based on the genetic relationship of parents from pedigree
- **With genomics, the concept of “genomic inbreeding” has been introduced**
 - Based on the genomic relationship of parents from genotypes
 - For genotyped animals only but pedigree not used
- **Concept of “Chromosome-based mating” has also been suggested**

Conclusions

- **Impact of genomics is HUGE!!!**
 - More accurate genetic selection
 - Moved focus to the youngest animals
 - Increased rates of genetic progress
 - Opportunities to select for new/difficult traits
- **Also creates new challenges...**
 - Faster turnover rate of bulls being marketed
 - Fewer breeders able sell bulls to A.I.
 - Genetic diversity and rates of inbreeding
 - New genetic and genomic evaluation systems

Tip of the iceberg!



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Canadian Dairy Network

Thank You!