Table 1. Estimated economic and greenhouse gas (GHG) emission benefits from adopting new genomic tools in commercial beef cattle assuming 100% adoption and five years post project.

Genomic tools	Benefit, (%/year)	Economic benefits, ($million/year)	%GHG reduction/yr
1. Fertility haplotype test	0.5-1% increase in calf crop	$25.8 - $51.7	1%
2. Fertility haplotype test	0.5-1% decrease in culling	$38.4 –$76.9	1%
3. Female Fertility Indices	4-6% increased calf crop	$24.8 - $37.2	6-10%
4. Female Fertility Indices	10-15% decreased mortality	$4.3 - $6.5	1-2%
5. Female Fertility Indices	10-15% decreased morbidity	$2.5 - $3.8	<1%
6. Female Fertility Indices	1-3% feed saving-feeders	$24.3 - $73.0	1-3%
7. Female Fertility Indices	1-3% feed saving-cows	$23.3 - $70.1	1-3%
8. gEPD RFI, >0.45 acc.	0.5-1% feed saving	$23.9 - $47.8	1%
9. Female fertility indices	10-16% decrease in GHG	$60.8 - $97.3	10-16%
10. Feeding NOP	30-40% reduction in GHGs	-------	30-40%
Total gross benefit/year		$228 - $464	40-56%

Benefits at a national level

1. Base=4.27 million cows [includes bred heifers] x 0.84 calf crop x $1210/calf weaned =$4,340,028,000 gross income. Change would be a 0.5 to 1 percentile increase in calf crop or ((4.27 million x 0.845 x $1210) – Base) = **$25,833,500/yr.**

2. Base=4.27 million cows x 0.16 replacement rate x $1800 to develop replacement=$1,229,760,000 cost. Change would be a 0.5 to 1 percentile decrease in replacement rate or ((4.27 million x 0.155 x $1800) – Base) = **$38,430,000/yr.**

3. Base=4.27 million cows x 0.40 x 0.30 x 0.84 x $1210/calf = $520,803,360. Assumptions include 40% of cows could benefit from an increase in retained heterozygosity, a 30% replacement rate, and a base calf crop of 84%. Difference between a high and low hybrid vigor herd (30% different in retained heterozygosity) is 2-3% improvement in calf crop and 639 kg CO2e/animal slaughtered ($30/t carbon) or ((4.27 million cows x 0.40 x 0.30 x 0.88 x $1210/calf) – Base) = **$24,800,160/yr**.

4. Base=2.47 million feeder cattle x 0.01 x $1750/feeder=$43,225,000 lost due to death loss in feedlots across Canada. Change would be a 10-15% decrease in mortality or ((2.47 million x 0.009 x $1750) – Base) = **$4,322,500/yr.**

5. Base=2.47 million feeder cattle x 0.15 x $70/treatment=$25,935,000 in treatment costs in feedlots across Canada. Change would be a 10-15% decrease in morbidity or ((2.47 million x 0.135 x $70/treatment) – Base) = **$2,593,500/yr.**

6. Base=2.47 million feeders x 9 kg DM/day x 365 days x $0.30/kg DM = $2,434,185,000 in feed cost in feedlots across Canada. Change would be a 1-3% improvement in feed efficiency from increased retained heterozygosity in feeders or ((2.47 million x 8.91 kg DM/day x 365 days x $0.30/kg) – Base) = **$24,341,850/yr.**

7. Base=4.27 million cows x 15 kg DM/day x 365 days x $0.10/kg DM =$2,337,825,000 in feed costs in cows across Canada. Change would be a 1-3% improvement in feed efficiency from increase retained heterozygosity in cows or ((4.27 million x 14.85 kg DM/day x 365 days x $0.10/kg) – Base) = **$23,378,250/yr.**

8. Base = (4.27 million cows x 15 kg DM/day x 365 days x $0.10/kg DM) + (2.47 million feeders x 9 kg DM/day x 365 days x $0.30/kg DM) =$4,772,010,000. Change would be a 0.5-1% improvement in feed efficiency from selection for ((4.27 million cows x 14.925 kg DM/day x 365 days x $0.10/kg DM) + (2.47 million feeders x 8.955 kg DM/day x 365 days x $0.30/kg DM)) – Base) = **$23,860,050/yr.**

9. Canada emits 732,000 kt CO2e; Beef cattle (cattle, non-dairy) are responsible for 2.77% of the total, or 20,276 kt CO2e. Reduced GHG of 16%/yr = 20,276,000 t CO2e x 0.16 x $30/t CO2e = **$97,324,800/yr**

Environment Canada, 2016, at:
http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php

Other assumptions: 550 lb wean calf at $2.20/lb = $1210/weaned calf; $70/calf treated; each 10% increase in genomic retained heterozygosity improves RFI by 0.08 kg DM/d; 375,732t CO2e = $11 million/yr.

Costs at a national level:

Number of heifer calves available=(4.27 million cows and bred heifer x 0.84 calf crop x 0.5 female:male ratio) = 1,793,400

1. Year 1 genotyping

Replacement heifers=(1,793,400 female calves x 0.30 selected for replacements x $50/genotype) = $26,901,000
Bulls = (4.27 million cows and bred heifers/30:1 cow bull ratio) = 142,333 bulls x $90/genotype)=$12,809,970

2. Year 2 genotyping

Replacement heifers=(1,793,400 female calves x 0.30 selected for replacements x $50/genotype) = $26,901,000
Bulls = 142,333 bulls x 0.25 replacement rate x $90/genotype=$3,202,493

3. Year 3 genotyping

Replacement heifers=(1,793,400 female calves x 0.30 selected for replacements x $50/genotype) = $26,901,000

Bulls = 142,333 bulls x 0.25 replacement rate x $90/genotype=$3,202,493
4. Year 4 genotyping
Replacement heifers=(1,793,400 female calves x 0.30 selected for replacements x $50/genotype) = $26,901,000
Bulls = 142,333 bulls x 0.25 replacement rate x $90/genotype=$3,202,493
5. Year 5 genotyping
Replacement heifers=(1,793,400 female calves x 0.30 selected for replacements x $50/genotype) = $26,901,000
Bulls = 142,333 bulls x 0.25 replacement rate x $90/genotype=$3,202,493

Total over 5 years =$160,124,942 or $32.0 million/year; highest costs in first year.
At a 15% adoption rate the cost would be $24.0 million over 5 years; cost ranges from 6.9 to 14.0% of gross benefit (ROI ranges from 7:1 to 14:1). Reducing the cost of genotyping is a key factor to adoption of genomic tools.