Benefits of Gene Ireland and GIBB herds

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G€N€ IR€LAND (GI) Maternal Beef Breeding Program

1 Pedigree Beef Herds

Herd Data Quality Index

2 Maternal Bull Breeder Qualification Process

Commercial Suckler Herds

3 Qualified (GI) Maternal Bull Breeder Herds

Bull Breeder Advice

Bull Breeder Advice

4 Bull Breed Advice

+ Bulls sold as stockbulls

5 G€N€ IR€LAND Stamp

Bull Sale Catalogue

Online Bull Search

Recommended Bull Breeder List

AI STRAWS

500 Inseminations x

Commerical Suckler Cows

Commerical Progeny

On-Farm
Calving
Docility
Fertility
Milk

Tully
Growth
FCE
Carcass
Tenderness

Data   Data   Data

500 Straws in Storage

TOP BULL STRAWS   Semen Retrieved

LIQUID NITROGEN

Top Maternal Bulls Selected

5 Star
5 Star
5 Star

Genetic Evaluations

AI

6

2. Maternal Bull | 3. Qualified Maternal | 4. Bull Breeder Advice | 5. G€N€ IR€LAND STAMP | 6. AI Bull

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Introduction

- Gene Ireland maternal beef breeding program launched in Autumn 2012

- Currently around 300 qualified Gene Ireland maternal beef breeder (GIBB) herds

- Model developed to estimate benefits of GI and GIBB initiatives

- How these benefits may change with genomics and the BDGP

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Introduction

- Initial case study based on Limousin breed (100 GIBB herds)

- Scaled out to "whole of industry" impacts

- Extension to consider benefits from Methane intensity reductions

Benefits Model

- Recursive model with multiple flows of genetic merit

- Sire usage stats estimated from data on both
  - GIBB and non-GIBB pedigree limousin herds
  - Commercial herds

- 25% of replacements from suckler beef x dairy heifers

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Sire types and usage

Bull origin	Bull type	Cow herd GIBB
Foreign	AI	71.1%
	Stockbulls	3.7%
GIBB	Gene Ireland AI	0%
	Homebred stockbulls	2.1%
	Stockbulls	4%
Other pedigree	AI	7.7%
	Homebred stockbulls	N/A
	Stockbulls	11.1%
Non pedigree	Stockbulls	0%

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Sire types and usage

Bull origin	Bull type	GIBB	Cow herd Other pedigree
Foreign	AI	71.1%	50.7%
	Stockbulls	3.7%	1.7%
GIBB	Gene Ireland AI	0%	0%
	Homebred stockbulls	2.1%	N/A
	Stockbulls	4%	1.9%
Other pedigree	AI	7.7%	13.8%
	Homebred stockbulls	N/A	3.5%
	Stockbulls	11.1%	28.2%
Non pedigree	Stockbulls	0%	0%

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Sire types and usage

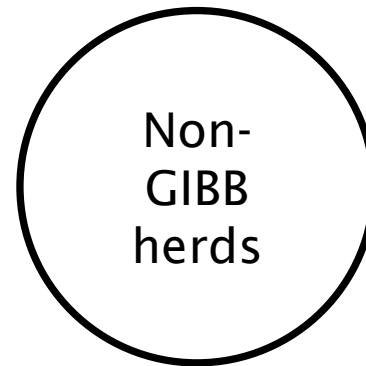| Bull origin	Bull type	Cow herd		
		GIBB	Other pedigree	Commercial
Foreign	AI	71.1%	50.7%	15%
	Stockbulls	3.7%	1.7%	0%
GIBB	Gene Ireland AI	0%	0%	0%
	Homebred stockbulls	2.1%	N/A	N/A
	Stockbulls	4%	1.9%	5%
Other pedigree	AI	7.7%	13.8%	9%
	Homebred stockbulls	N/A	3.5%	N/A
	Stockbulls	11.1%	28.2%	46%
Non pedigree	Stockbulls	0%	0%	25%

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Sire types and usage

Bull origin	Bull type	Cow herd			
		GIBB	Other pedigree	Commercial	Dairy
Foreign	AI	71.1%	50.7%	15%	0%
	Stockbulls	3.7%	1.7%	0%	0%
GIBB	Gene Ireland AI	0%	0%	0%	0%
	Homebred stockbulls	2.1%	N/A	N/A	N/A
	Stockbulls	4%	1.9%	5%	10%
Other pedigree	AI	7.7%	13.8%	9%	10%
	Homebred stockbulls	N/A	3.5%	N/A	N/A
	Stockbulls	11.1%	28.2%	46%	60%
Non pedigree	Stockbulls	0%	0%	25%	20%

Key questions

- Changes in total benefits when:
  - Gene Ireland AI bulls have larger impact

  - Genomics is used

  - Stockbulls from GIBB herds have larger impact

  - AI usage is increased in commercial herds

  - Foreign AI bulls improve

  - A higher proportion of replacements are sourced from dairy crosses

  - Wider pool of Gene Ireland candidates is available

Overview

Commercial dairy
herds
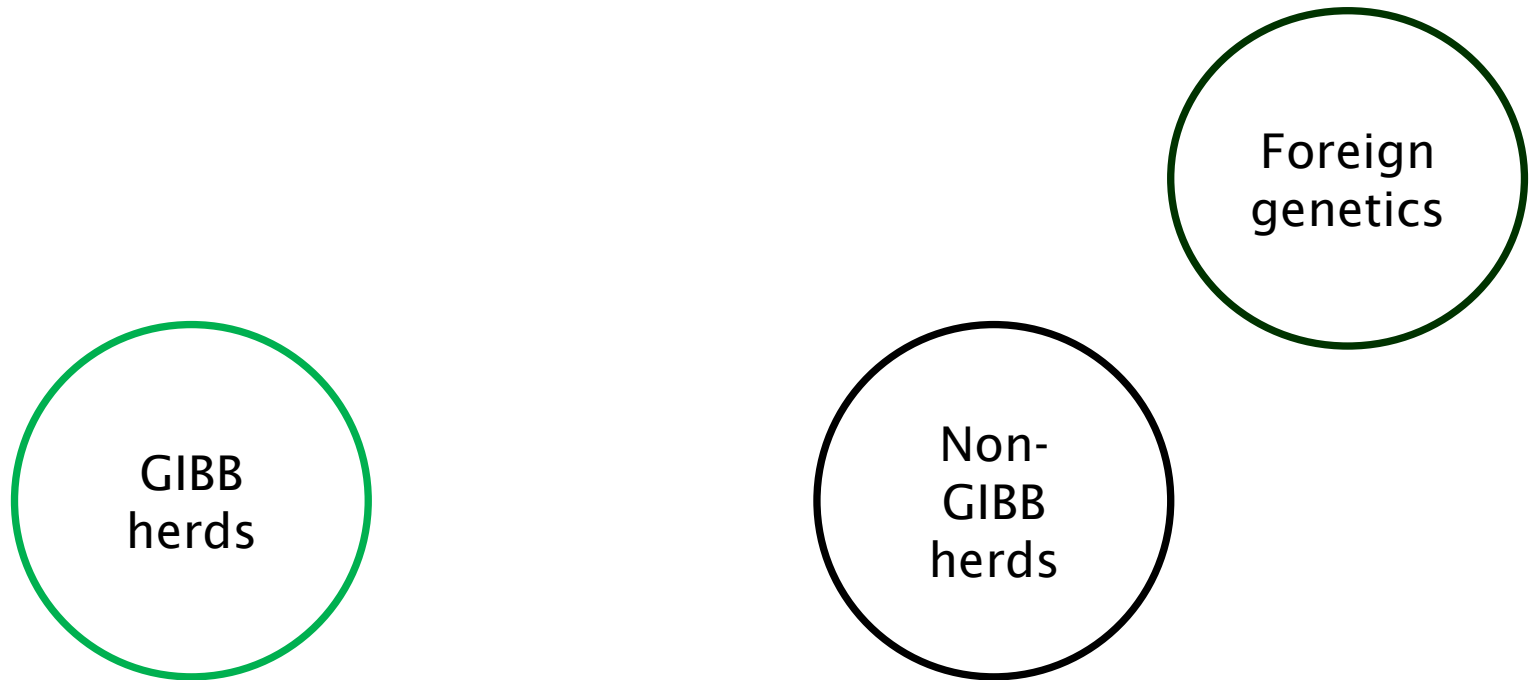(25% of replacements)

Commercial suckler
herds
(75% of replacements)

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Overview

GIBB herds

Non-GIBB herds

Commercial dairy herds
(25% of replacements)

Commercial suckler herds
(75% of replacements)

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Overview

Foreign genetics

GIBB herds

Non-GIBB herds

Commercial dairy herds
(25% of replacements)

Commercial suckler herds
(75% of replacements)

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Overview
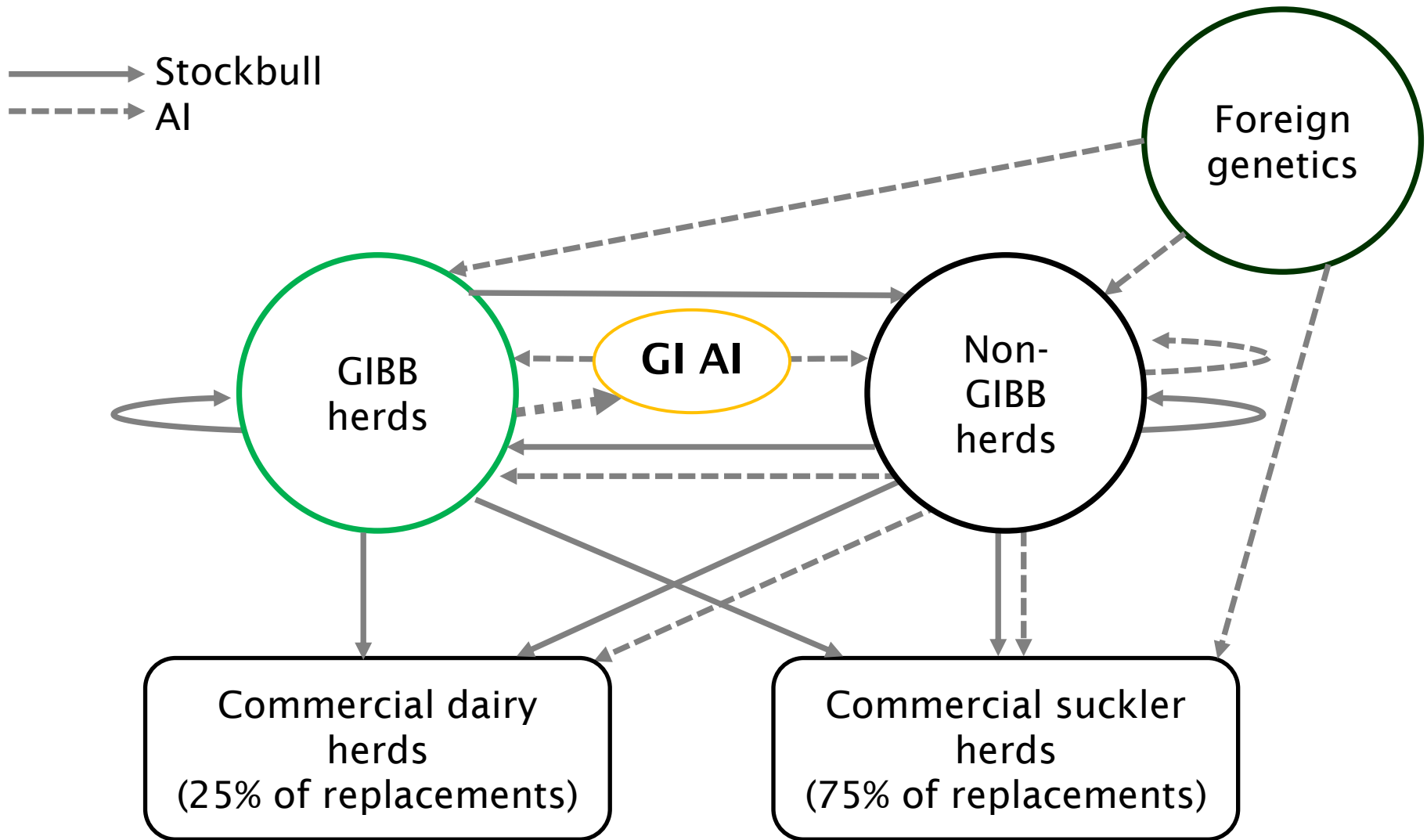
Key Parameters

| Description (Limousin case study)	Parameter
Number of expressions of sire index superiority per year (20% replacements kept x 5 lactations)	400,000
Proportion of expressions of sire index superiority via beef cross dairy	25%

Key Parameters

Description	Parameter
Range in young bull replacement index values	€60
Lift if select the best 50%	€16
Range of young bull index values after progeny recorded	€120
Lift if select the best 50%	€32
Range of Gene Ireland progeny tested candidates	€150
Lift if select the best 20%	€74

Low reliability

High reliability

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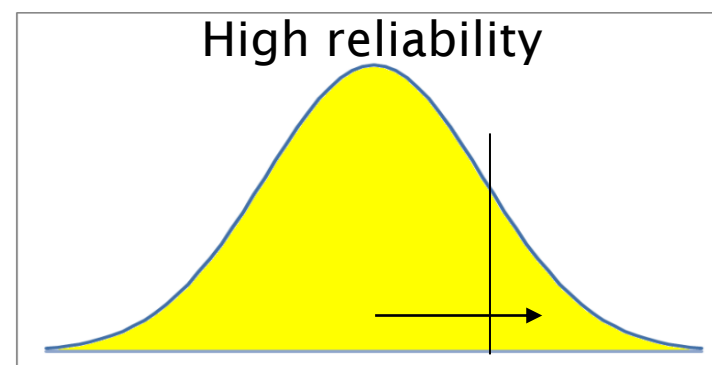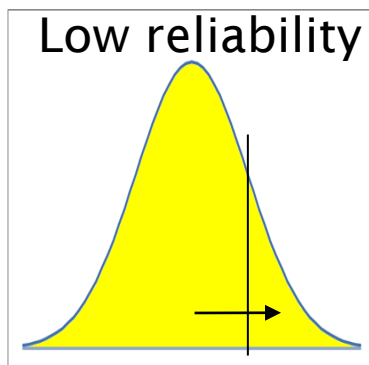
Key Parameters

Description	Parameter
Annual gain in replacement index of foreign bulls used (year on year)	€2
Superiority of a dairy cross relative to a suckler replacement	€15
Immediate lift from BDGP sourcing of improved heifers	€30

BDGP adoption – keeping better replacements

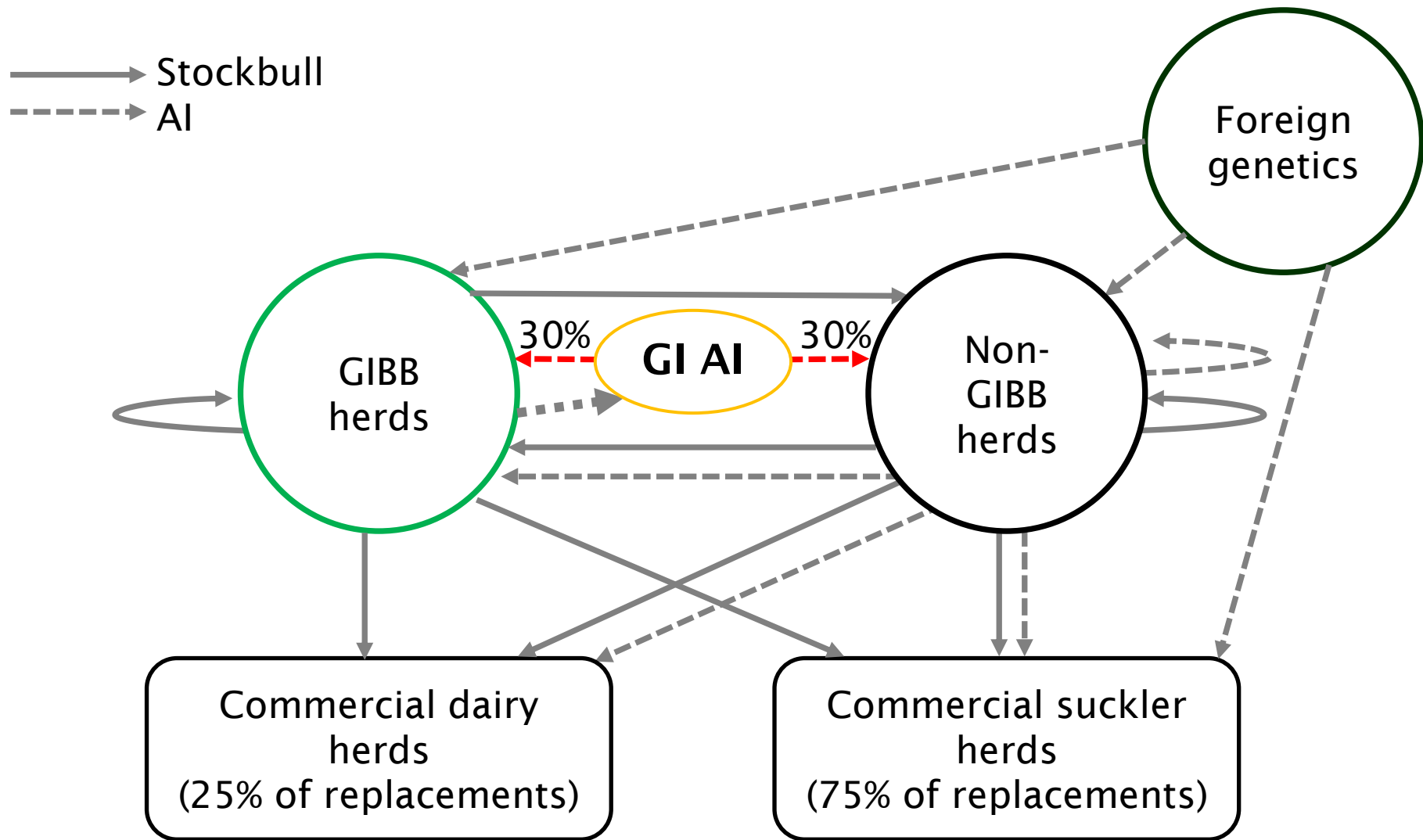| Total benefits (€M)	BDGP Adoption
10 years	32.4
15 years	46.9
20 years	58.2
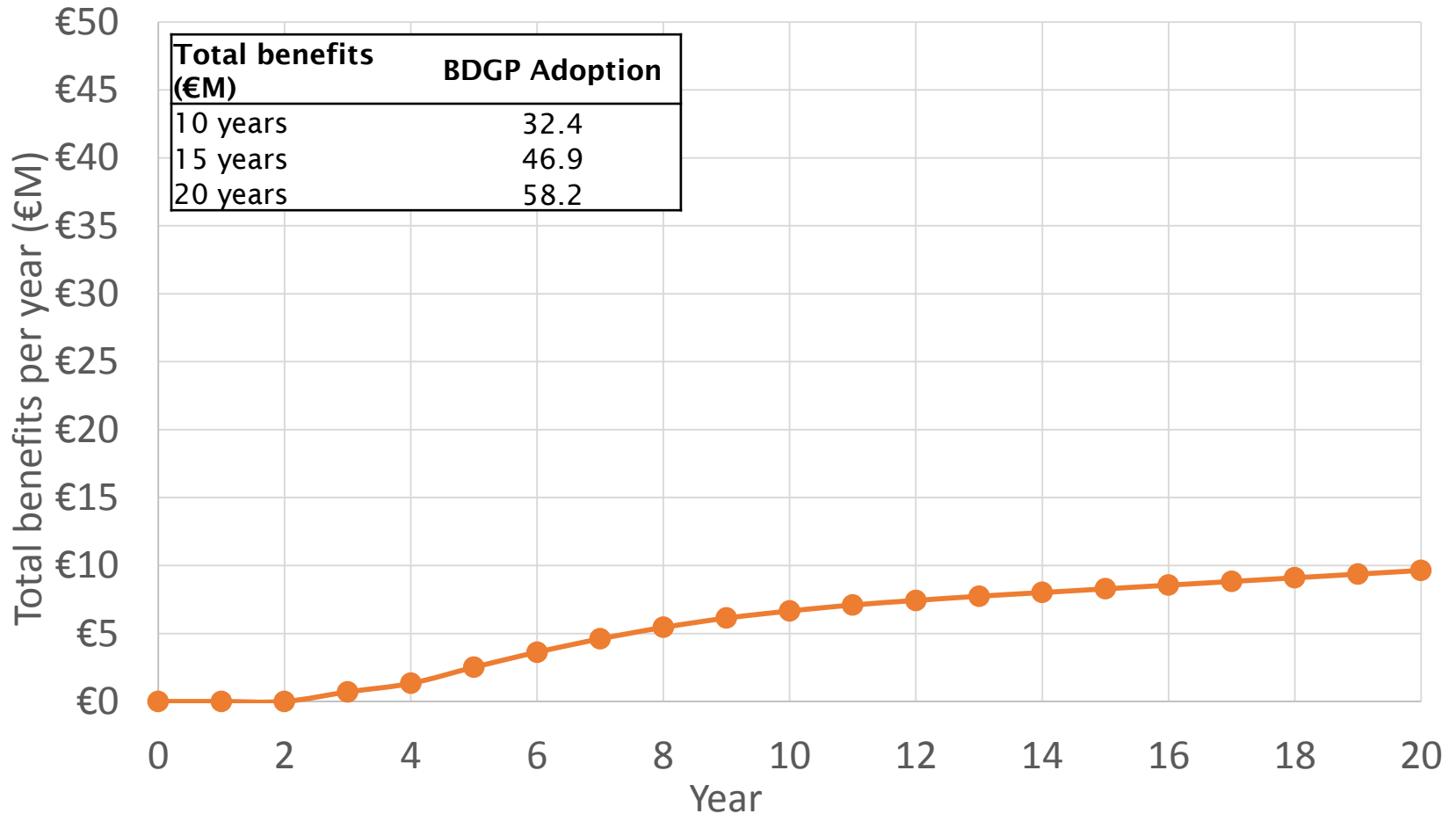
Benefits of BDGP adoption

- Using higher euro star bulls and keeping higher quality replacements has a substantial impact on the total benefits after 10 years, with €32.4M additional total benefits over status quo

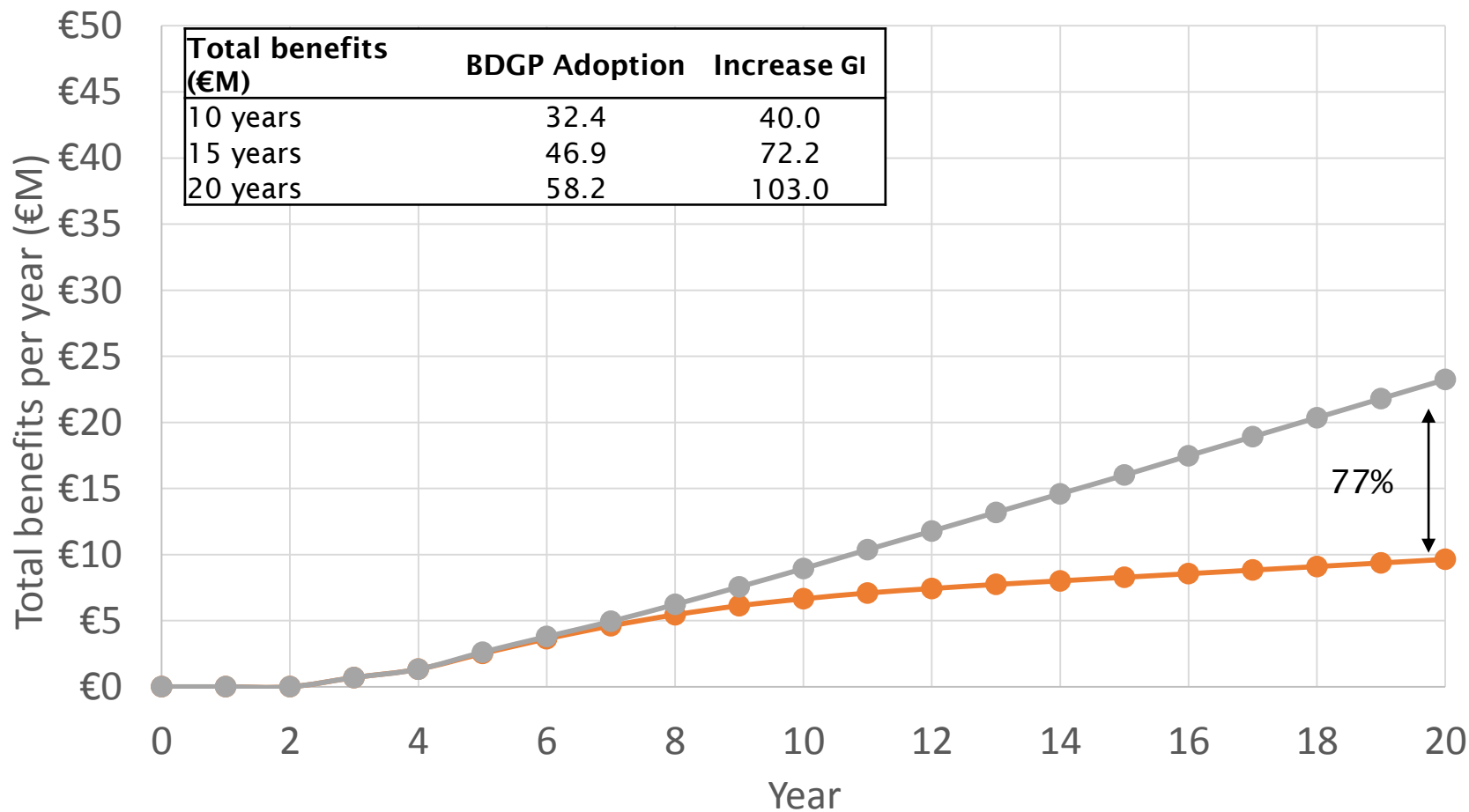- Slower rate of progress without the BDGP

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Increasing Gene Ireland AI usage

- What is the impact of replacing foreign AI usage in pedigree herds with more Gene Ireland AI?
  - Gene Ireland AI use increased to 30% (50%) in all pedigree herds, only GIBB herds

- Impact of using genomics with traditional progeny testing to identify top bulls earlier
  - Gene Ireland AI use increased to 30% in pedigree herds, with main usage at 3 years old instead of 5.

- Impact of a higher proportion (50%) of replacements sourced from dairy herds

- Impact of increasing the Gene Ireland AI usage in commercial herds
  - Non-pedigree stockbull usage displaced by 20% (30%) Gene Ireland AI usage

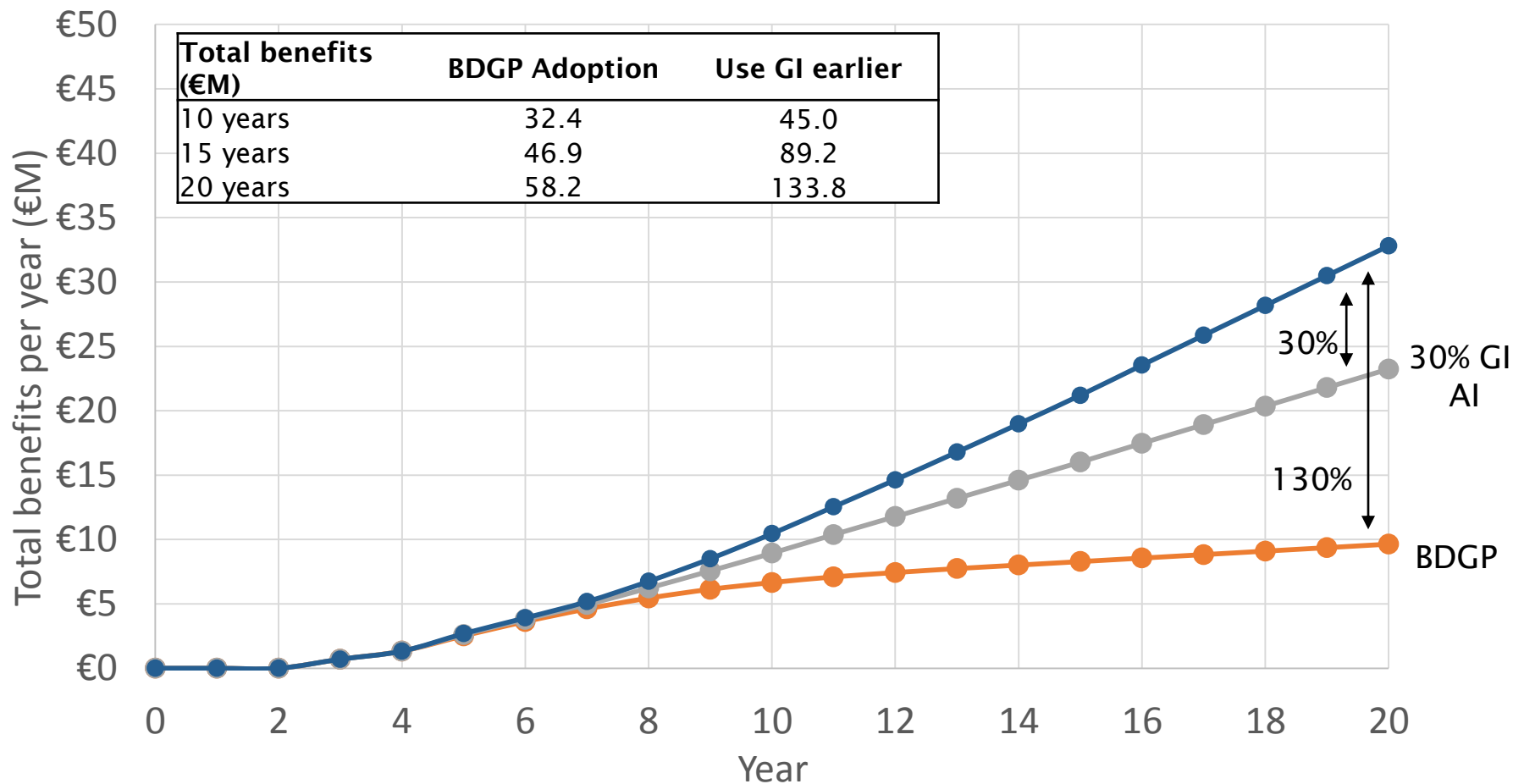ICBF.com

Increasing Gene Ireland AI usage

Stockbull
AI

Foreign genetics

GIBB herds

GI AI

30%   30%

Non-GIBB herds

Commercial dairy herds
(25% of replacements)

Commercial suckler herds
(75% of replacements)

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Increasing Gene Ireland AI usage – 30% usage in pedigree herds

Total benefits (€M)	BDGP Adoption	Increase GI
10 years	32.4	40.0
15 years	46.9	72.2
20 years	58.2	103.0

77%

Early release of GI bulls with genomics

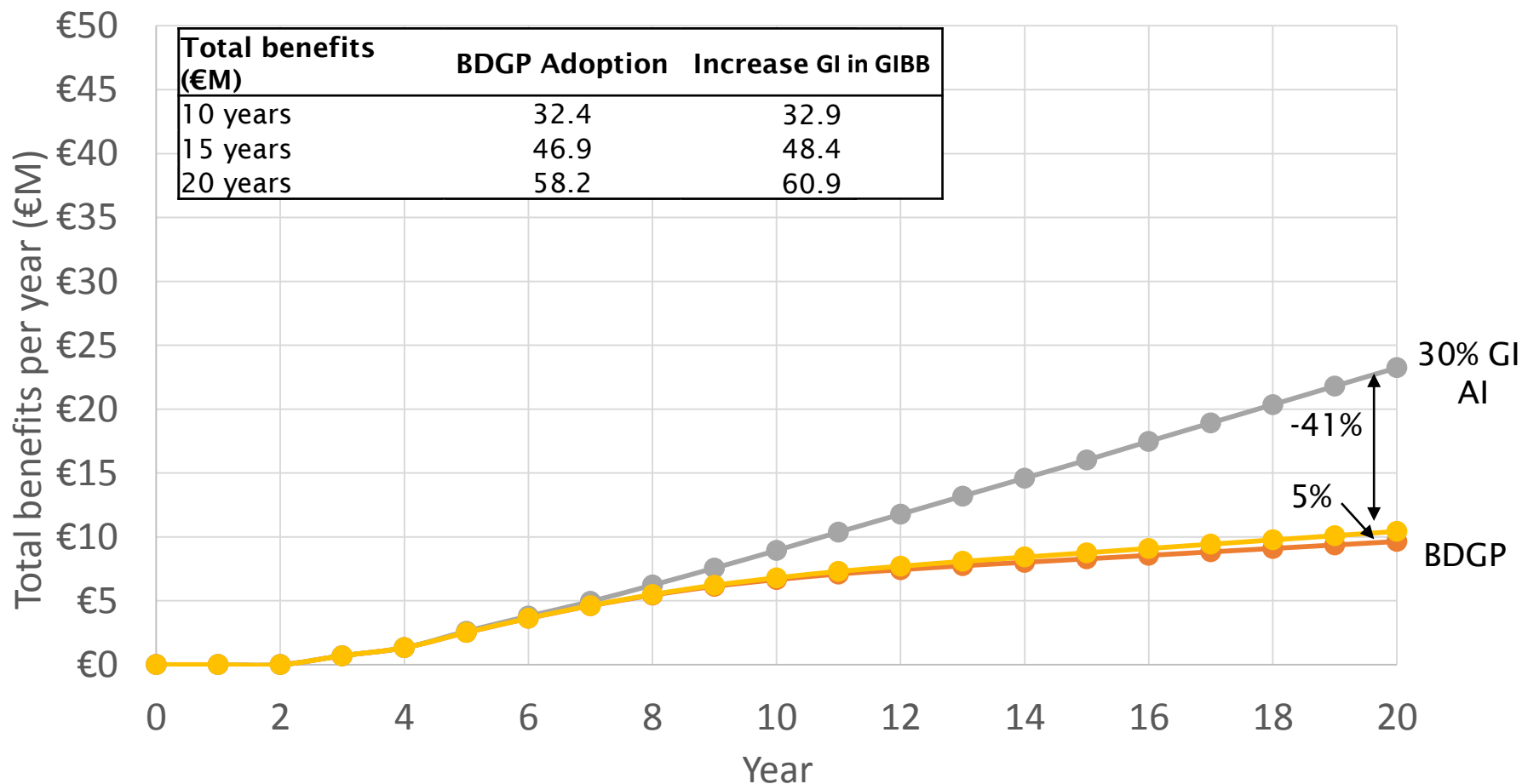| Age of selected GI sire(years)	Progeny proportion	
	Without genomics	With genomics
2	0	0.3
3	0	0.5
4	0	0.2
5	0.3	0
6	0.4	0
7	0.3	0

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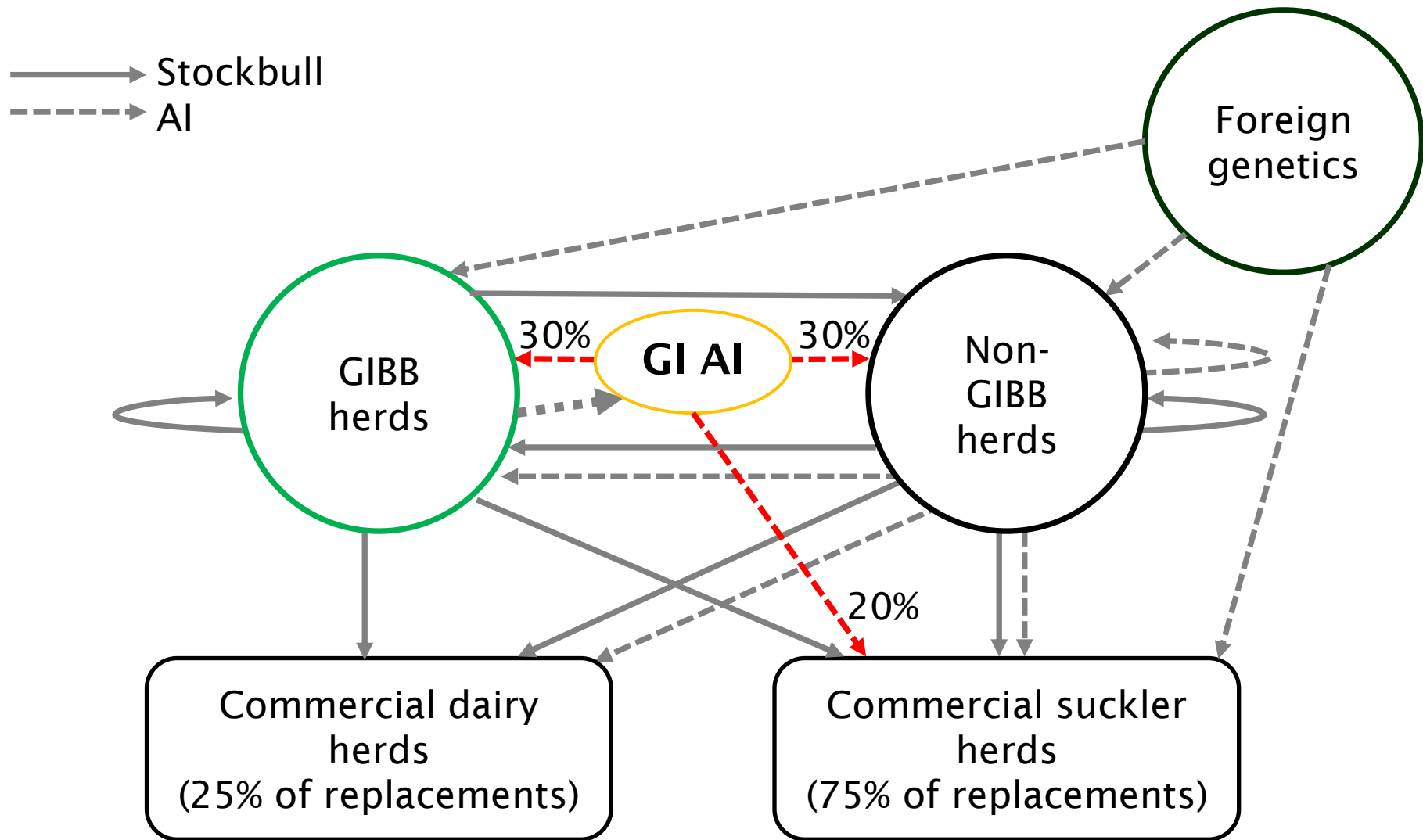# Increasing Gene Ireland AI usage – Gene Ireland bulls used earlier

Total benefits (€M)	BDGP Adoption	Use GI earlier
10 years	32.4	45.0
15 years	46.9	89.2
20 years	58.2	133.8

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Increasing Gene Ireland AI usage

Stockbull

AI

Foreign genetics

GIBB herds

30%

GI AI

Non-GIBB herds

Commercial dairy herds
(25% of replacements)

Commercial suckler herds
(75% of replacements)

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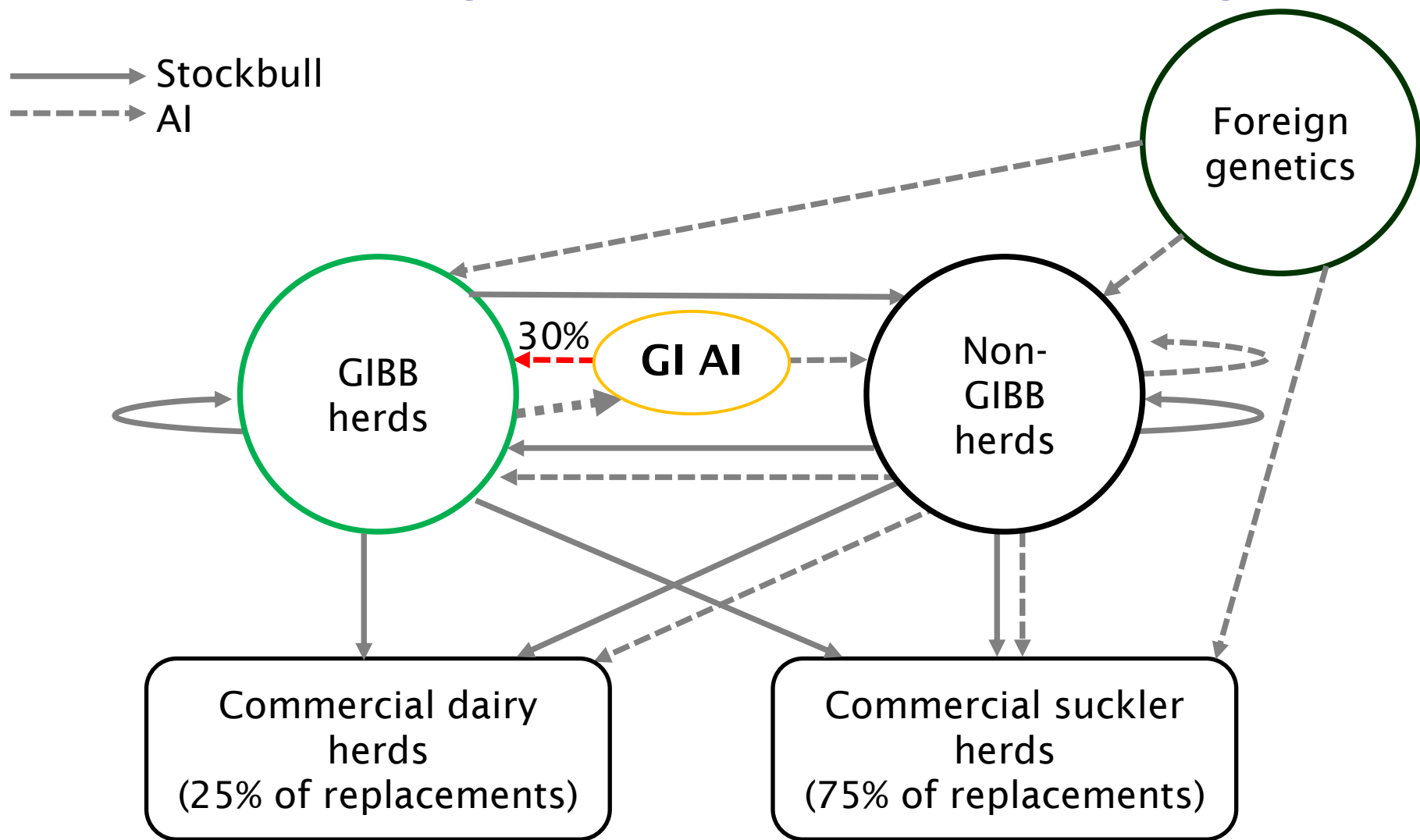
Increasing Gene Ireland AI usage – 30% usage in GIBB herds only

Total benefits (€M)	BDGP Adoption	Increase GI in GIBB
10 years	32.4	32.9
15 years	46.9	48.4
20 years	58.2	60.9

30% GI AI

-41%

5%

BDGP

Total benefits per year (€M)

Year

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Increasing Gene Ireland AI usage

Increasing Gene Ireland AI usage – 30% usage in ped and 20% in commercial

Total benefits (€M)	BDGP Adoption	Increase GI ped and comm
10 years	32.4	65.9
15 years	46.9	108.1
20 years	58.2	145.4
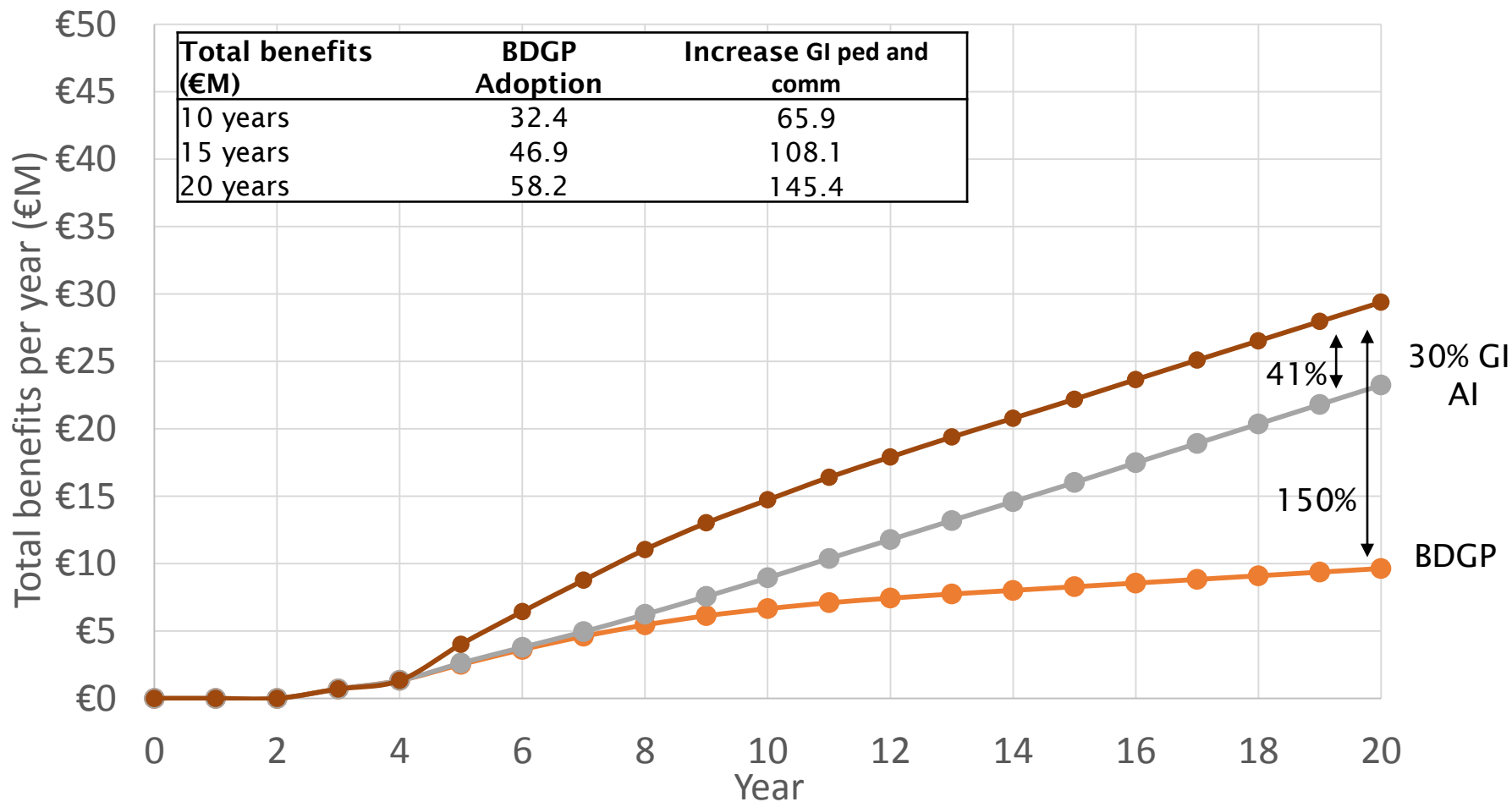
Increasing Gene Ireland AI usage – 30% usage in ped and 30% in commercial

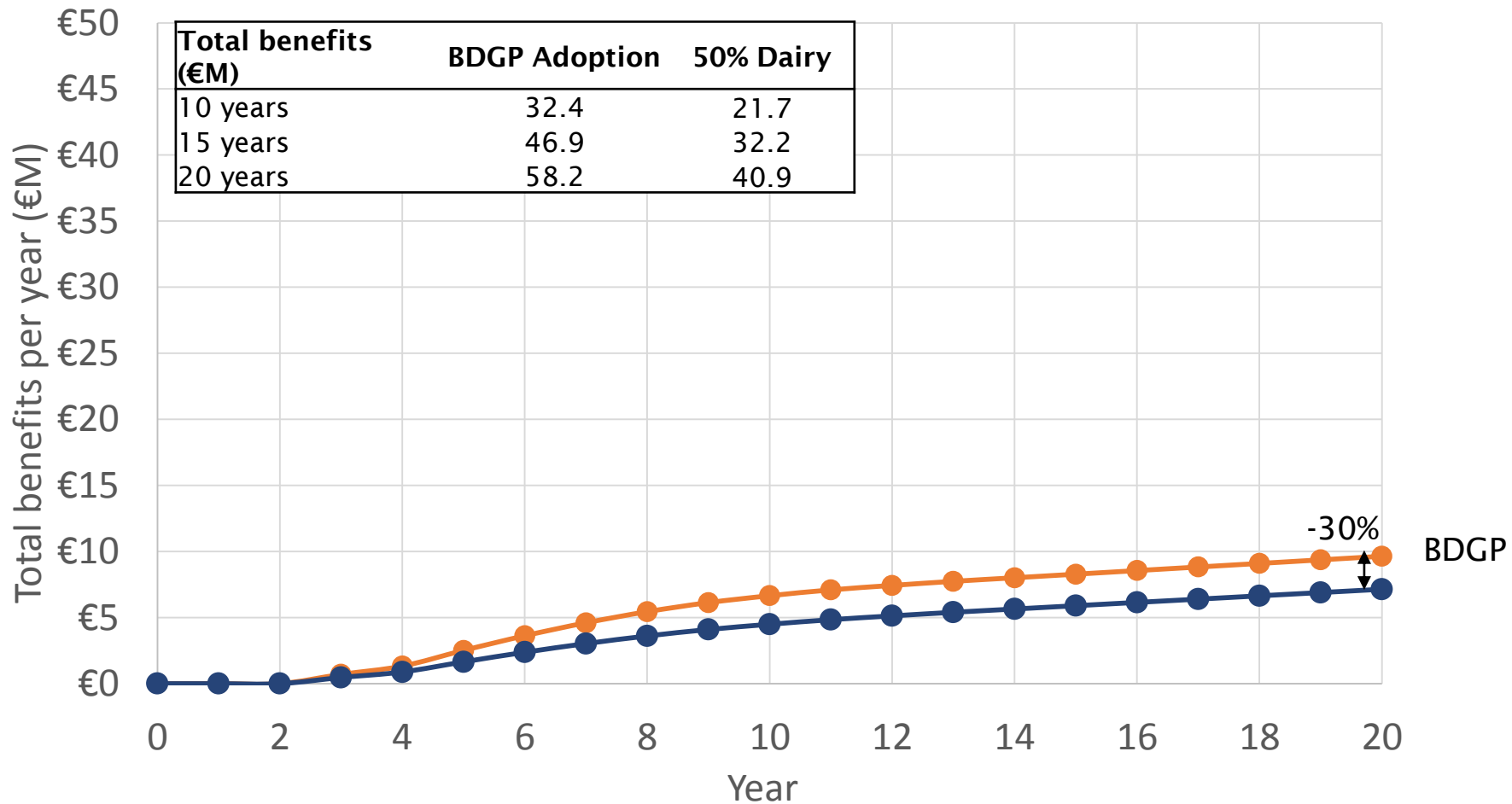| Total benefits (€M)	BDGP Adoption	Increase GI ped and comm
10 years	32.4	77.3
15 years	46.9	123.8
20 years	58.2	163.9
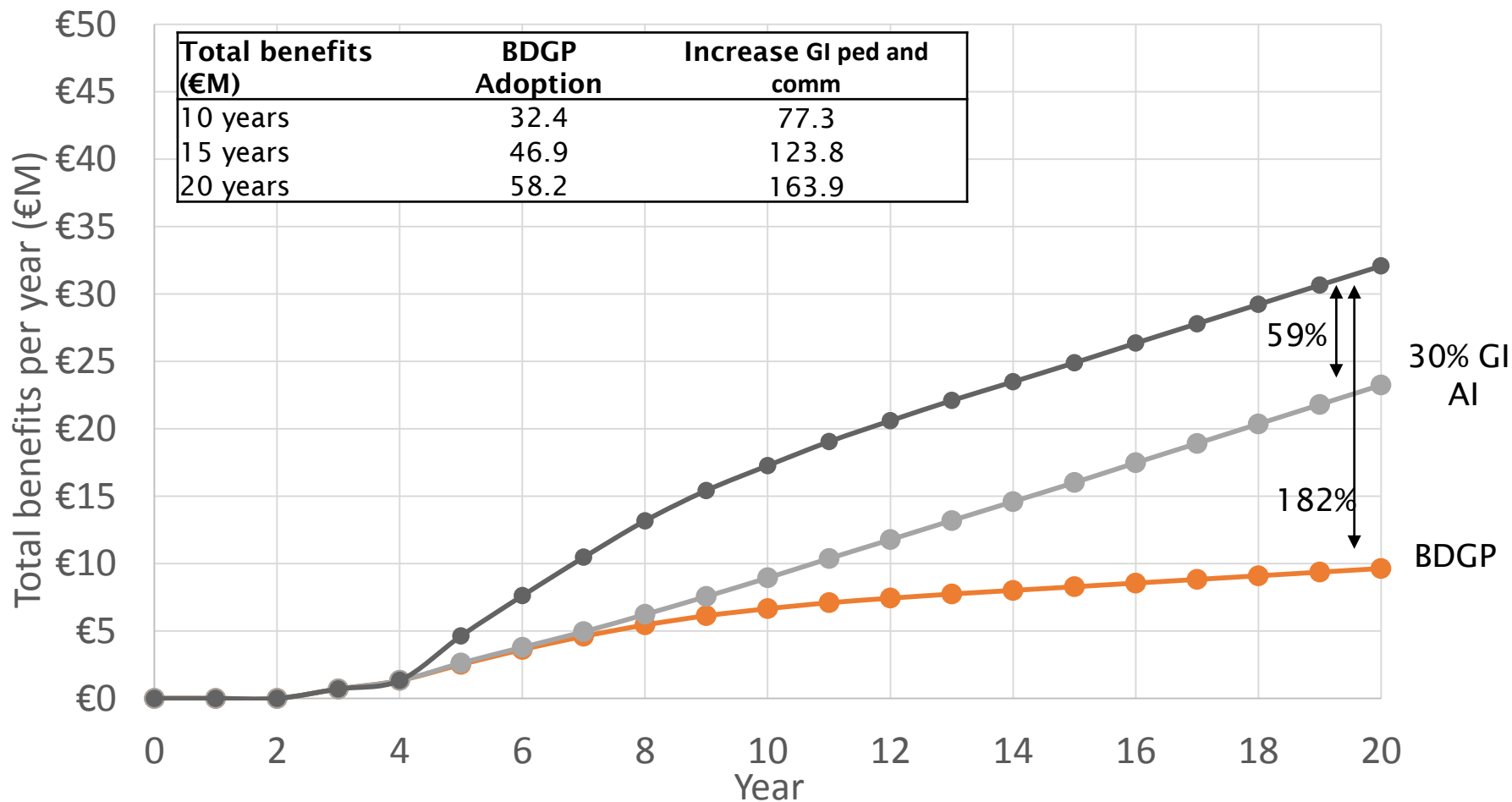
Increasing Gene Ireland AI usage - outcomes

- Using 30% Gene Ireland AI in pedigree herds yields €45M more in benefits after 20 years over BDGP

- Using 30% Gene Ireland AI in GIBB herds only yields €3M more after 20 years at current usage of GIBB stockbulls

- 20% usage of Gene Ireland AI in commercial herds leads to an additional €42M over pedigree herd usage

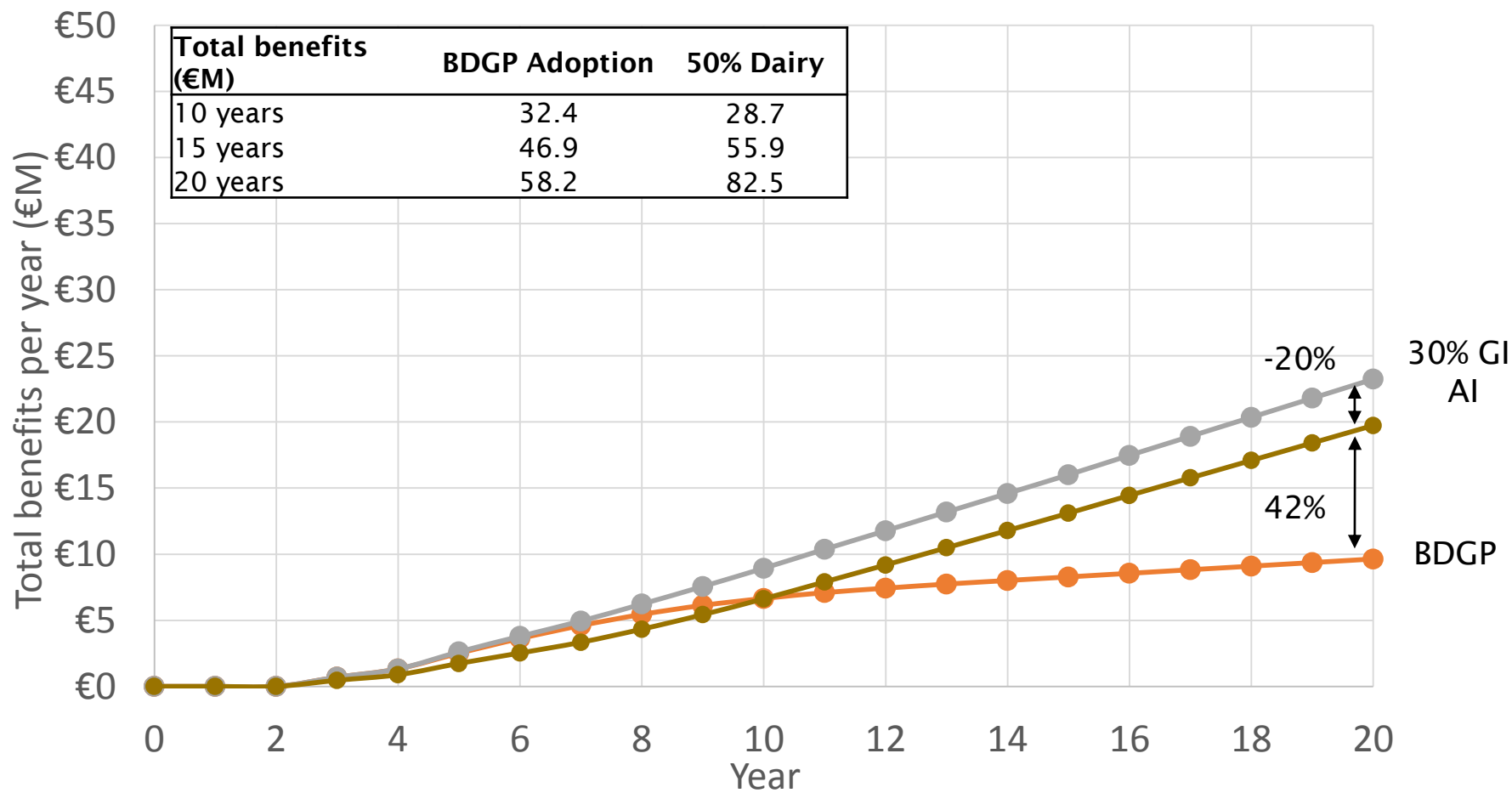- Earlier identification of top bulls adds €31M after 20 years

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Increasing Gene Ireland AI usage
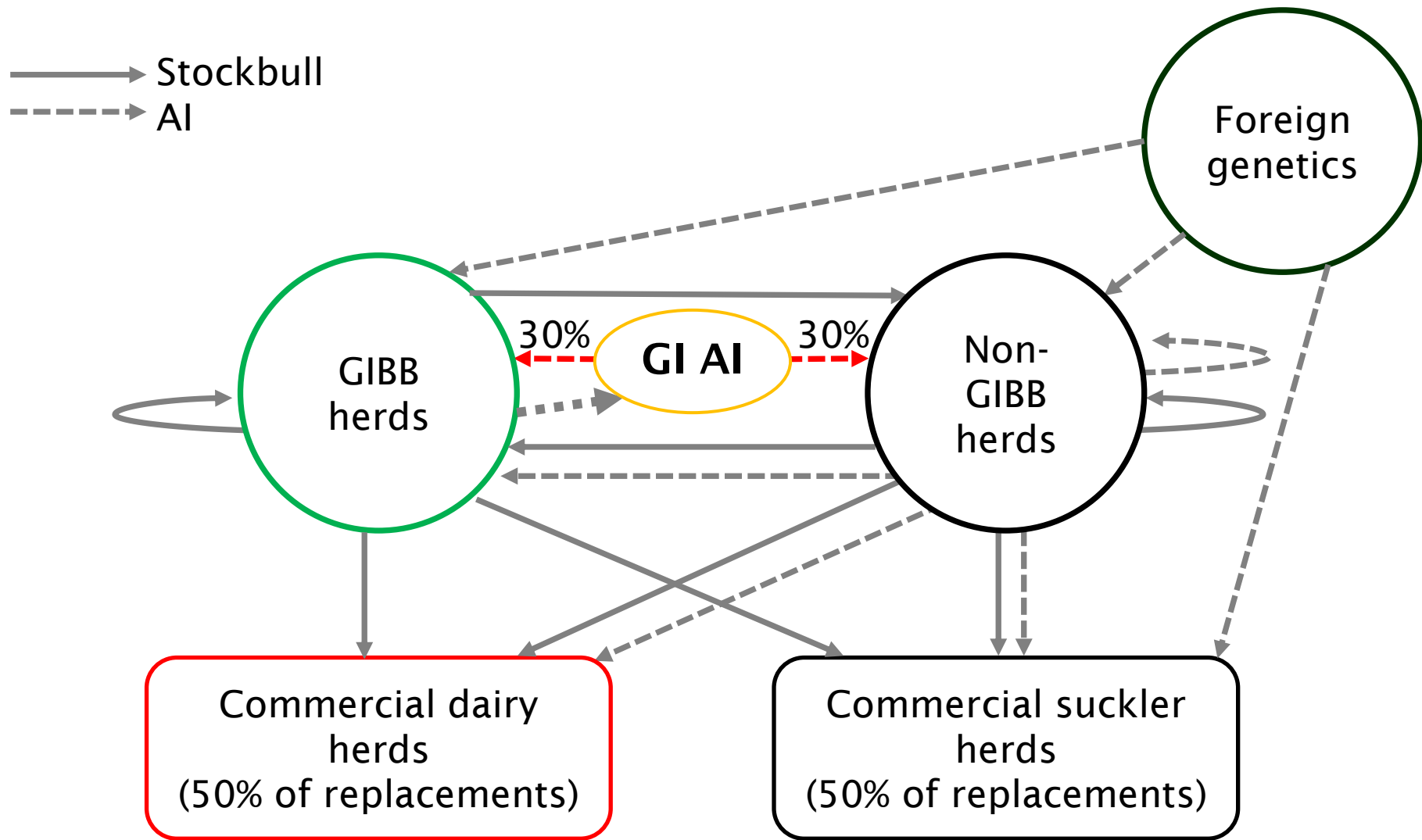
50% of replacements from dairy with BDGP

Total benefits (€M)	BDGP Adoption	50% Dairy
10 years	32.4	21.7
15 years	46.9	32.2
20 years	58.2	40.9

Total benefits per year (€M) vs Year

-30%

BDGP

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Increasing Gene Ireland AI usage – 50% of replacements from dairy

Total benefits (€M)	BDGP Adoption	50% Dairy
10 years	32.4	28.7
15 years	46.9	55.9
20 years	58.2	82.5

Total benefits per year (€M)

Year

-20%

30% GI AI

42%

BDGP

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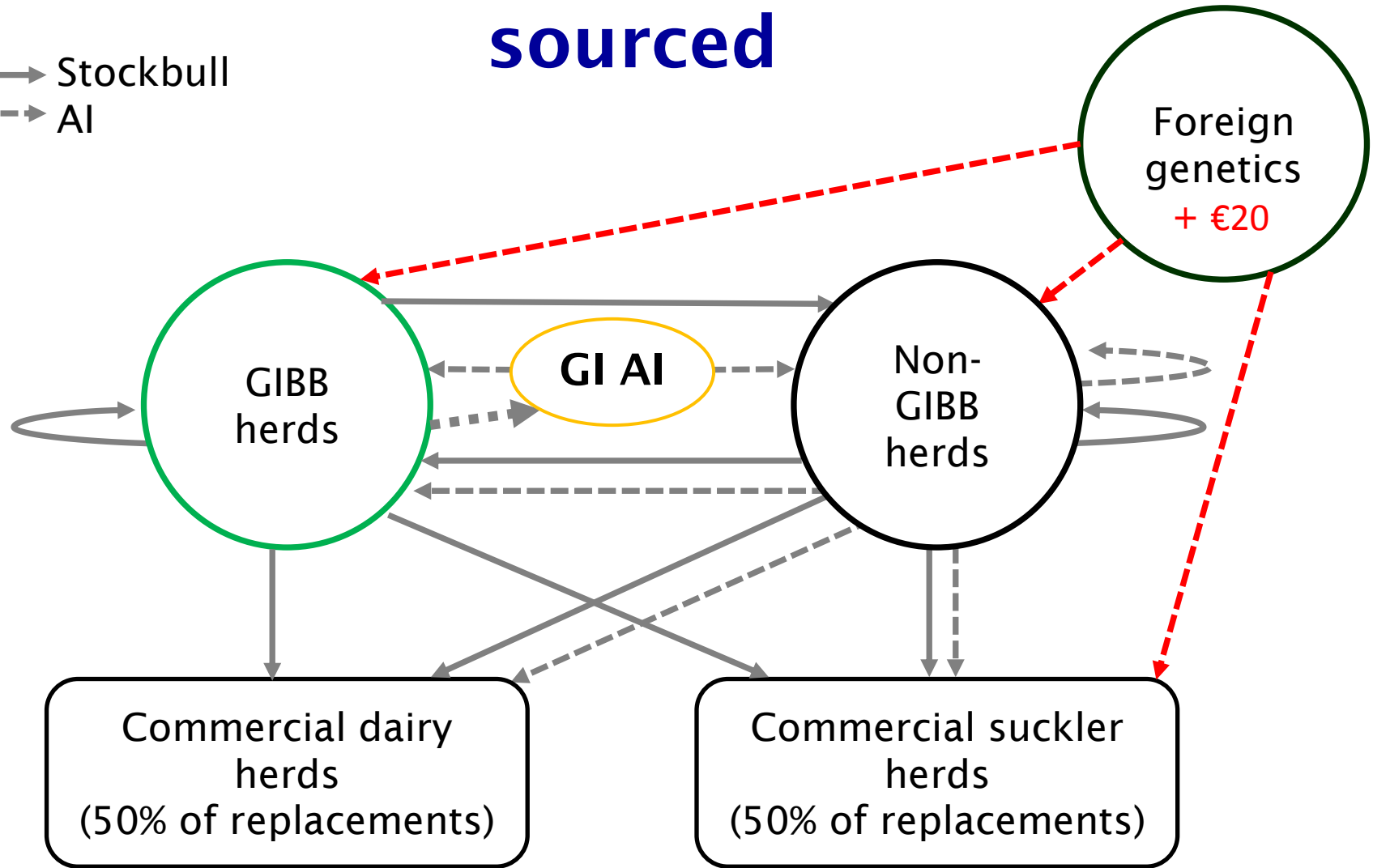
More replacements from dairy

- Sourcing a higher proportion of replacements from dairy herds led to a drop of €11M in total benefits after 10 years compared to status quo with BGDP

- The drop was caused by fewer superior replacements kept in under the BDGP, as 65% adoption would now be 65% of 200k (was 400k)

- With increased usage of GI AI in pedigree herds, sourcing a higher proportion of replacements from dairy still resulted in €20.5M less in total benefits after 20 years

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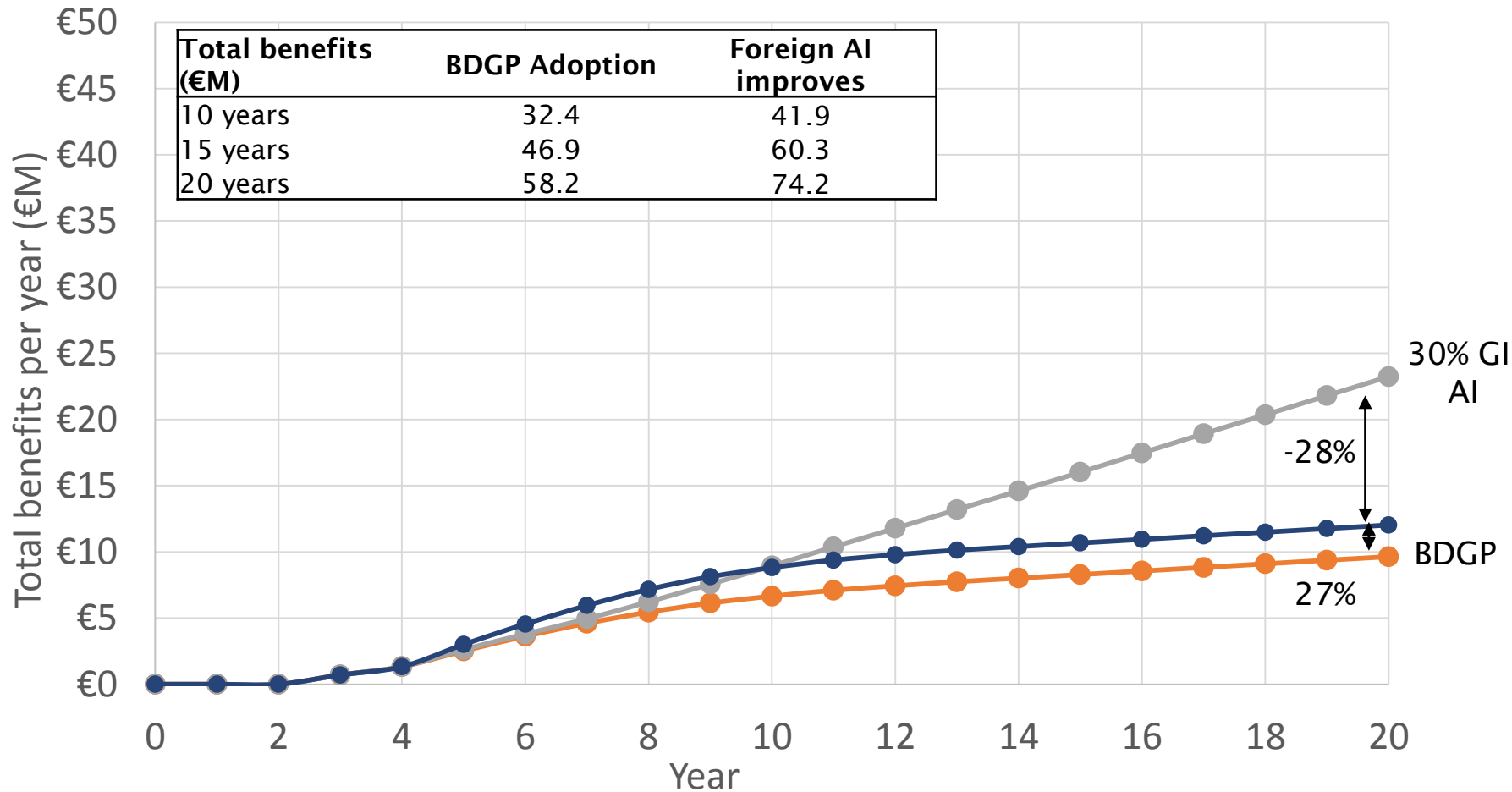# Increased merit of foreign AI bulls sourced

- How will the total benefits change if the Foreign AI sires improve
  - The superiority of the foreign AI sires over Irish sires was set to €20 at year 0
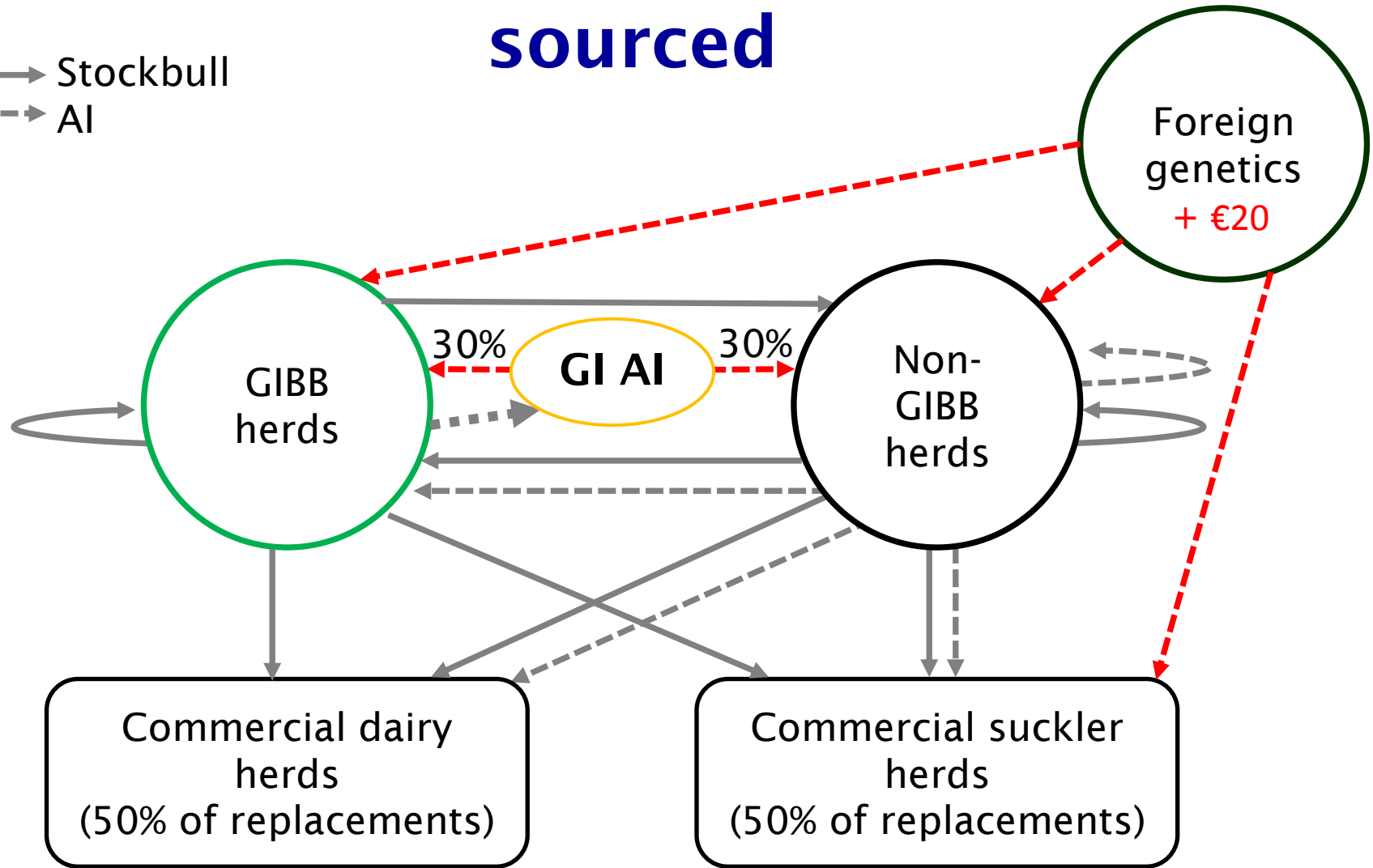
Increased merit of foreign AI bulls sourced

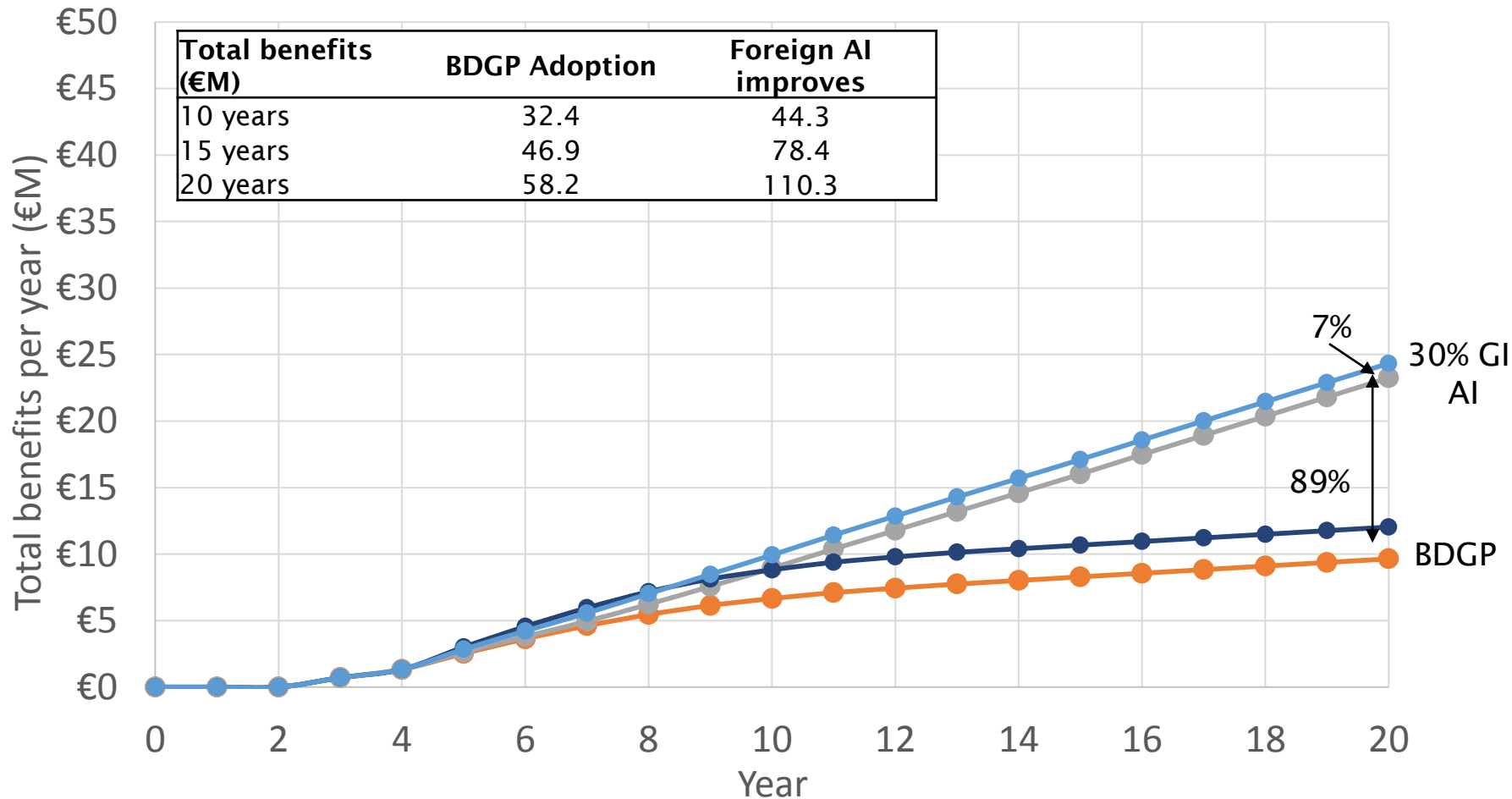| Total benefits (€M)	BDGP Adoption	Foreign AI improves
10 years	32.4	41.9
15 years	46.9	60.3
20 years	58.2	74.2

30% GI AI

-28%

BDGP

27%

Total benefits per year (€M)

Year

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Increased merit of foreign AI bulls sourced

Increased merit of foreign AI bulls sourced – with increased use of GI AI

Total benefits (€M)	BDGP Adoption	Foreign AI improves
10 years	32.4	44.3
15 years	46.9	78.4
20 years	58.2	110.3

7%

30% GI AI

89%

BDGP
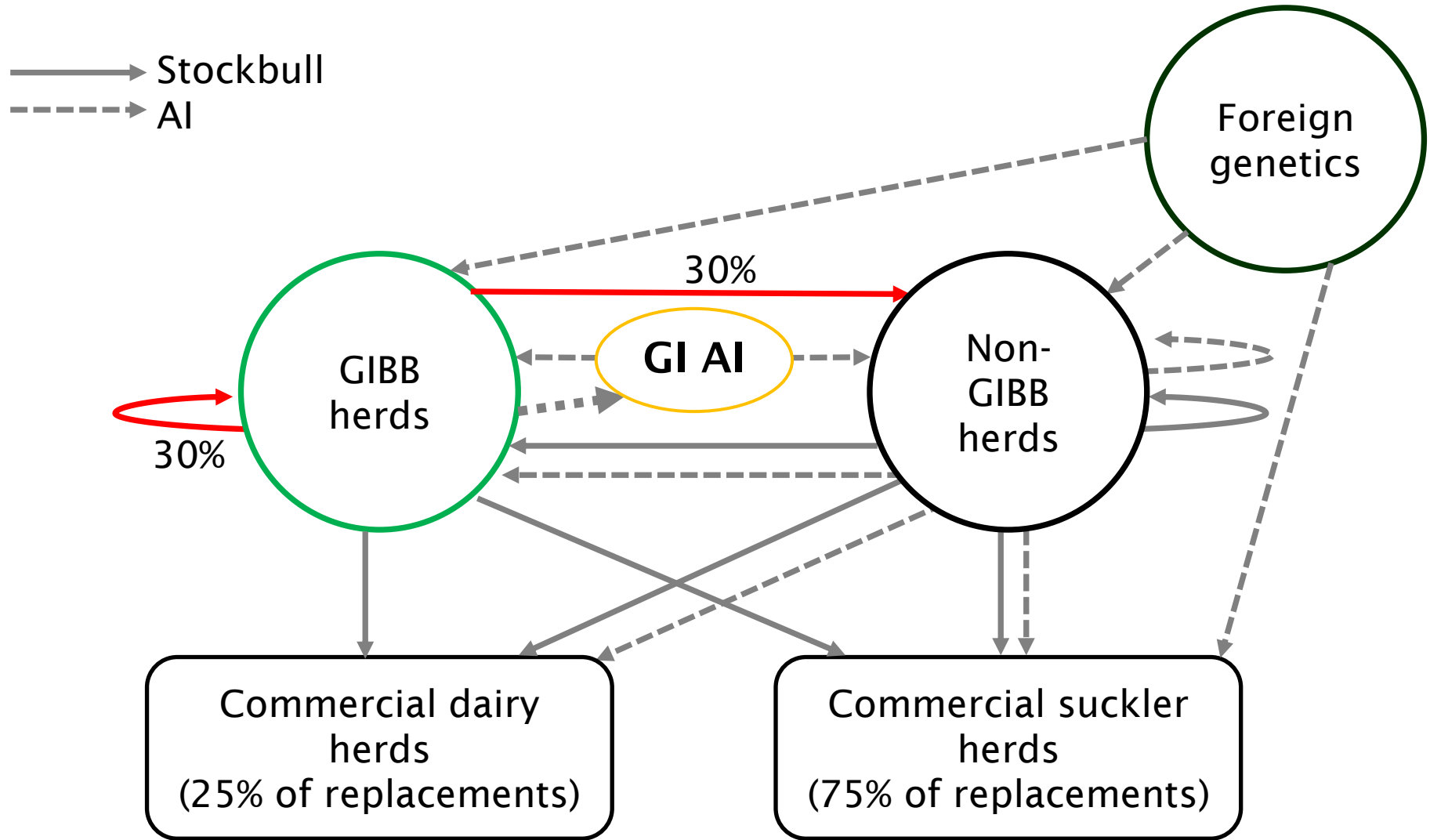
Total benefits per year (€M)

Year

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Increased merit of foreign AI bulls sourced

- Increasing the merit of the foreign AI sires without increasing GI AI usage led to the highest total benefits after 10 years, €9.5M higher than status quo with BDGP

- After 10 years the total benefits per year were parallel to status quo, with the total benefits after 20 years €16M higher than status quo with BGDP

- Increasing merit of foreign AI sires led to a lower increase in benefits with increased GI AI
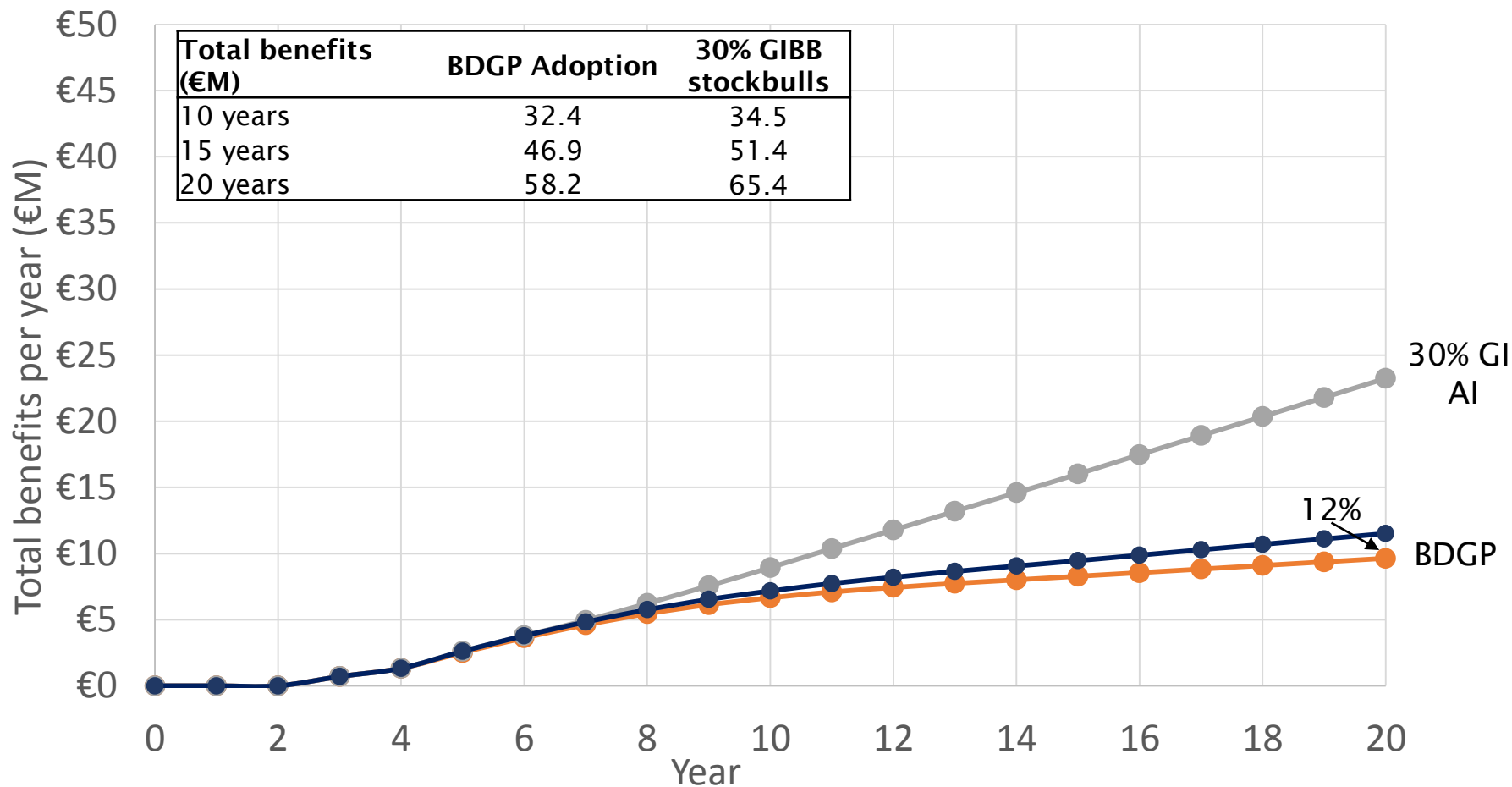 - GI AI displaced foreign AI usage in pedigree herds

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Increasing GIBB stockbull usage

- What is the impact of replacing foreign AI usage in pedigree herds with more GIBB stockbull use?
  - GIBB stockbull use increased to 30%

- What is the effect of using better GIBB stockbulls after genomic selection?
  - GIBB stockbull use increased to 30% with a lift of €20 for top 50% of sires (vs €16)
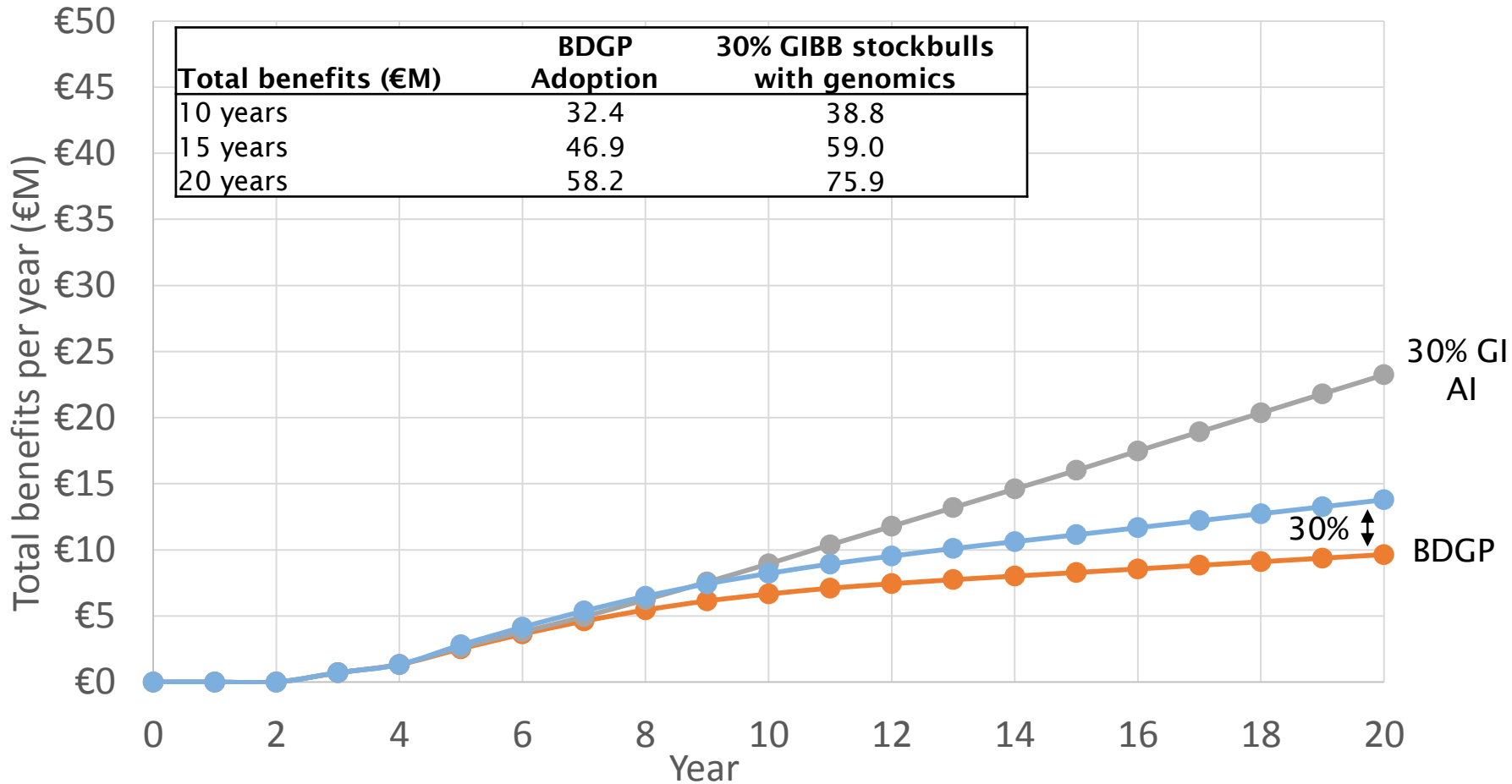
Increasing GIBB stockbull usage

Increasing GIBB stockbull usage – 30% usage in pedigree herds

Total benefits (€M)	BDGP Adoption	30% GIBB stockbulls
10 years	32.4	34.5
15 years	46.9	51.4
20 years	58.2	65.4

Increasing GIBB stockbull usage – Genomics to increase selection differential

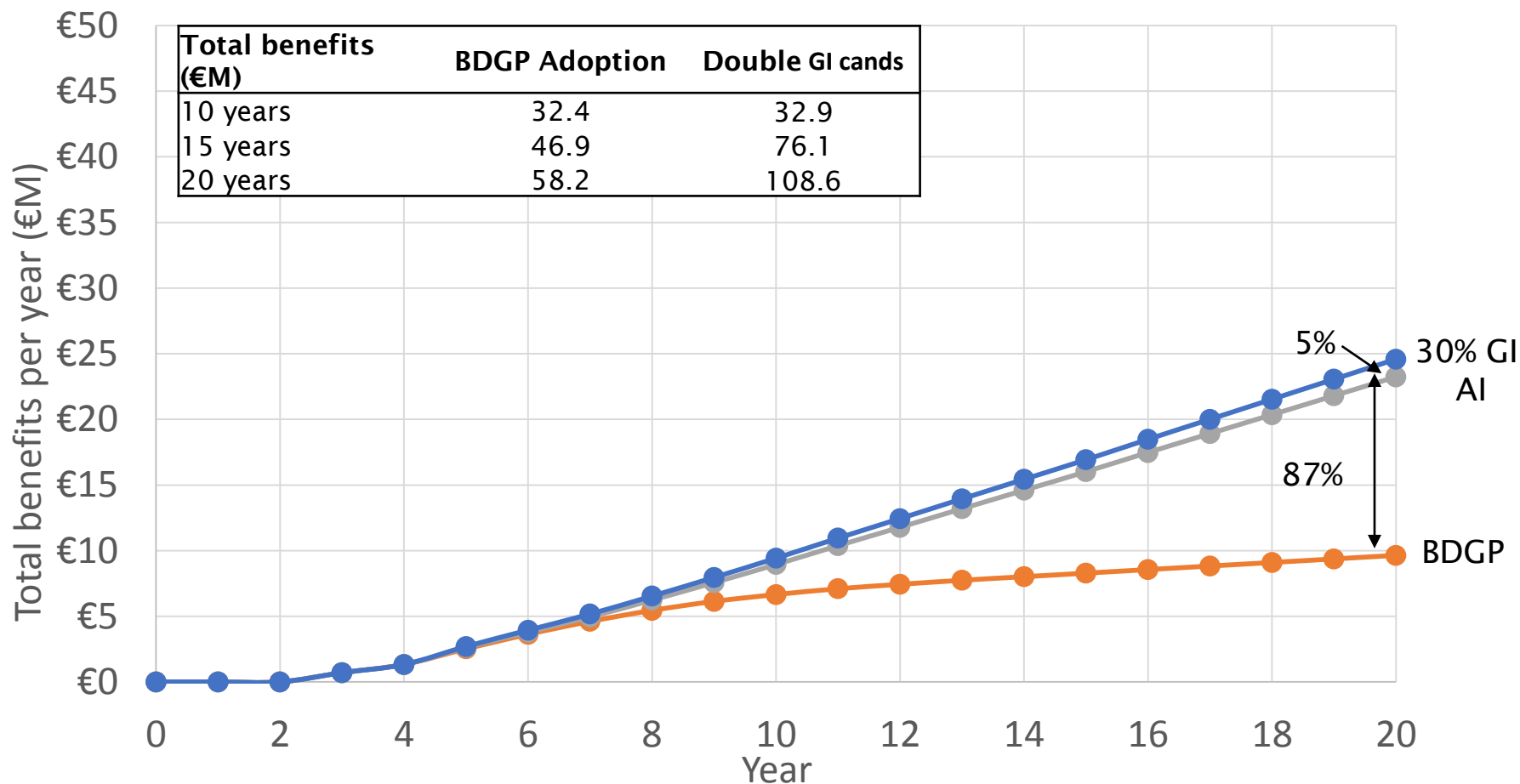| Total benefits (€M)	BDGP Adoption	30% GIBB stockbulls with genomics
10 years	32.4	38.8
15 years	46.9	59.0
20 years	58.2	75.9

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Increasing GIBB stockbull usage

- Extra €2M in total benefits over BDGP after 10 years and extra €7M in total benefits after 20 years from increasing GIBB stockbull usage to 30% in pedigree herds.

- Genomics adds another €10.5M after 20 years for a relatively modest lift (€16 to €20 selection difference)

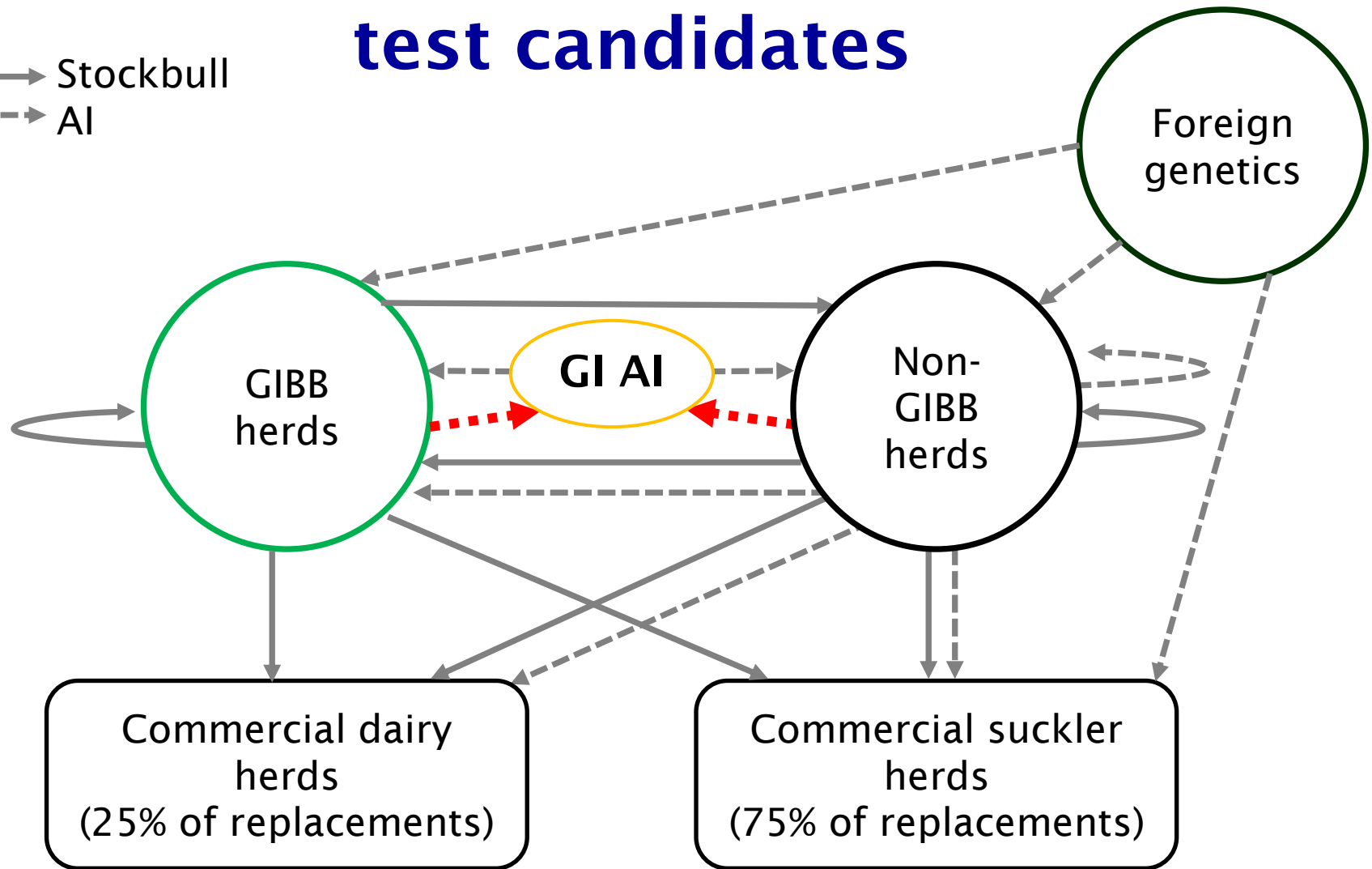ICBF.com

Widening pool of Gene Ireland AI candidates

- Doubling the number of Gene Ireland progeny test candidates from GIBB herds

- Source Gene Ireland Progeny test candidates from all pedigree herds, with lower accuracy (0.15, 0.3)

- Sourcing Gene Ireland Progeny test candidates from 3, 4 and 5 star young bulls from all pedigree herds

- Selecting Gene Ireland Progeny test candidates by genomics with a higher accuracy of 0.65 to 0.75

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Widening Gene Ireland AI candidates– twice as many GI bulls progeny tested
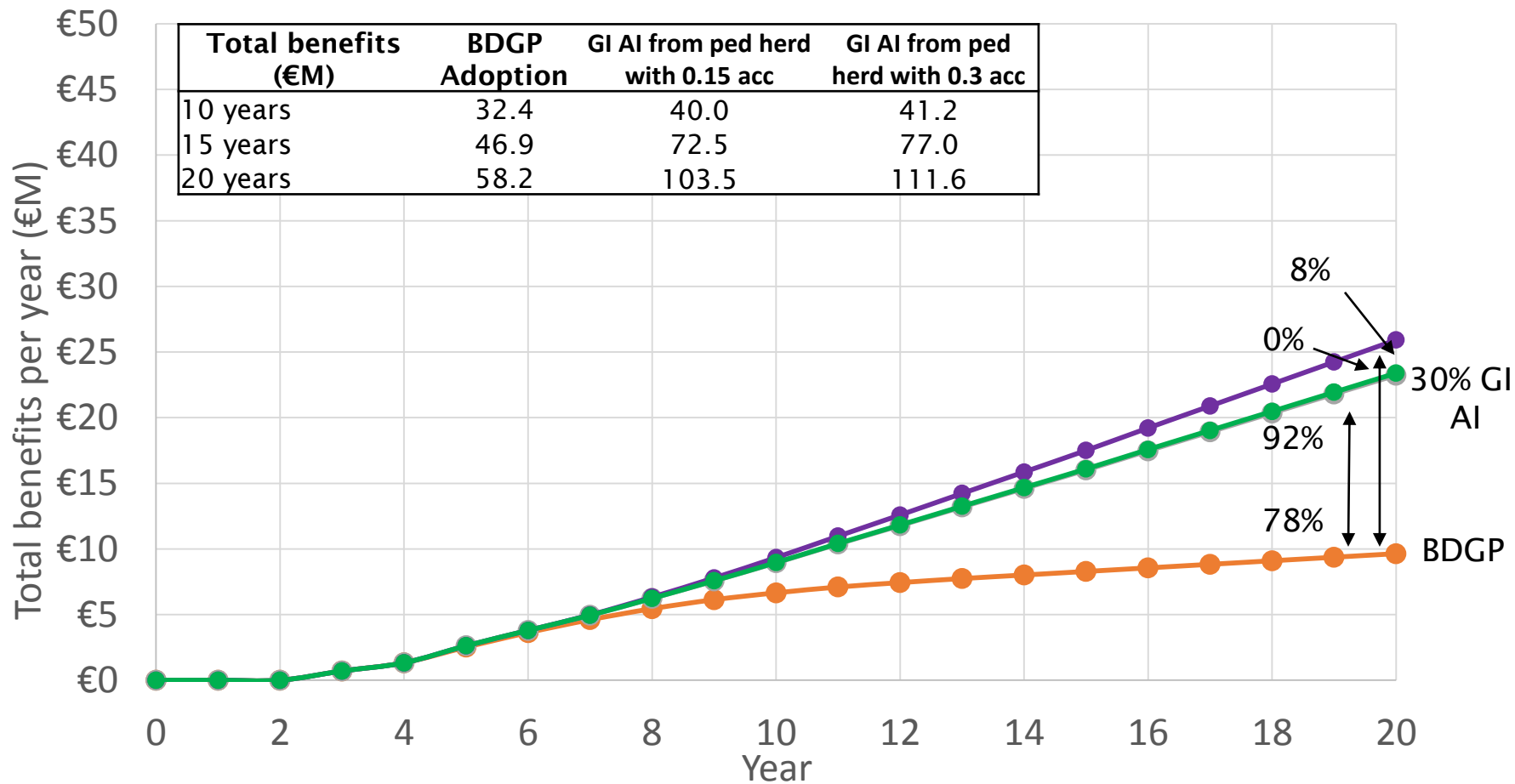
Total benefits (€M)	BDGP Adoption	Double GI cands
10 years	32.4	32.9
15 years	46.9	76.1
20 years	58.2	108.6

Widening pool of Gene Ireland progeny test candidates

Widening Gene Ireland AI candidates – bulls from all pedigree herds

Total benefits (€M)	BDGP Adoption	GI AI from ped herd with 0.15 acc	GI AI from ped herd with 0.3 acc
10 years	32.4	40.0	41.2
15 years	46.9	72.5	77.0
20 years	58.2	103.5	111.6

Widening Gene Ireland AI candidates – 3/4/5 star bulls from all ped herds

Total benefits (€M)	BDGP Adoption	3/4/5 star GI cands
10 years	32.4	41.3
15 years	46.9	77.2
20 years	58.2	112.1

Total benefits per year (€M)

Year

9%

30% GI AI

92%

BDGP
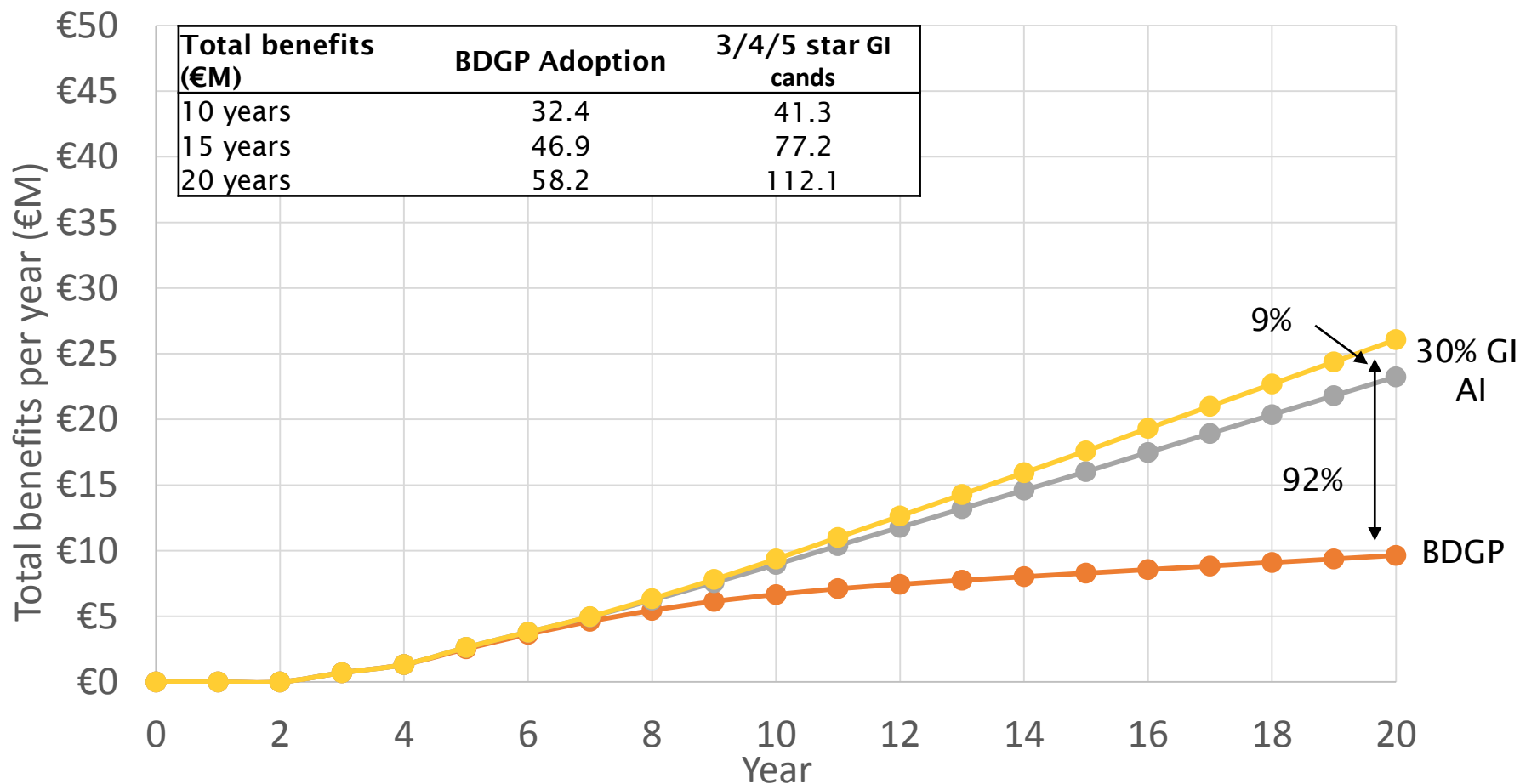
Widening Gene Ireland AI candidates – candidates from genomic selection

Total benefits (€M)	BDGP Adoption	Genomic GI cands acc=0.65	Genomic GI cands acc=0.75
10 years	32.4	43.1	43.3
15 years	46.9	84.2	85.1
20 years	58.2	124.8	126.4
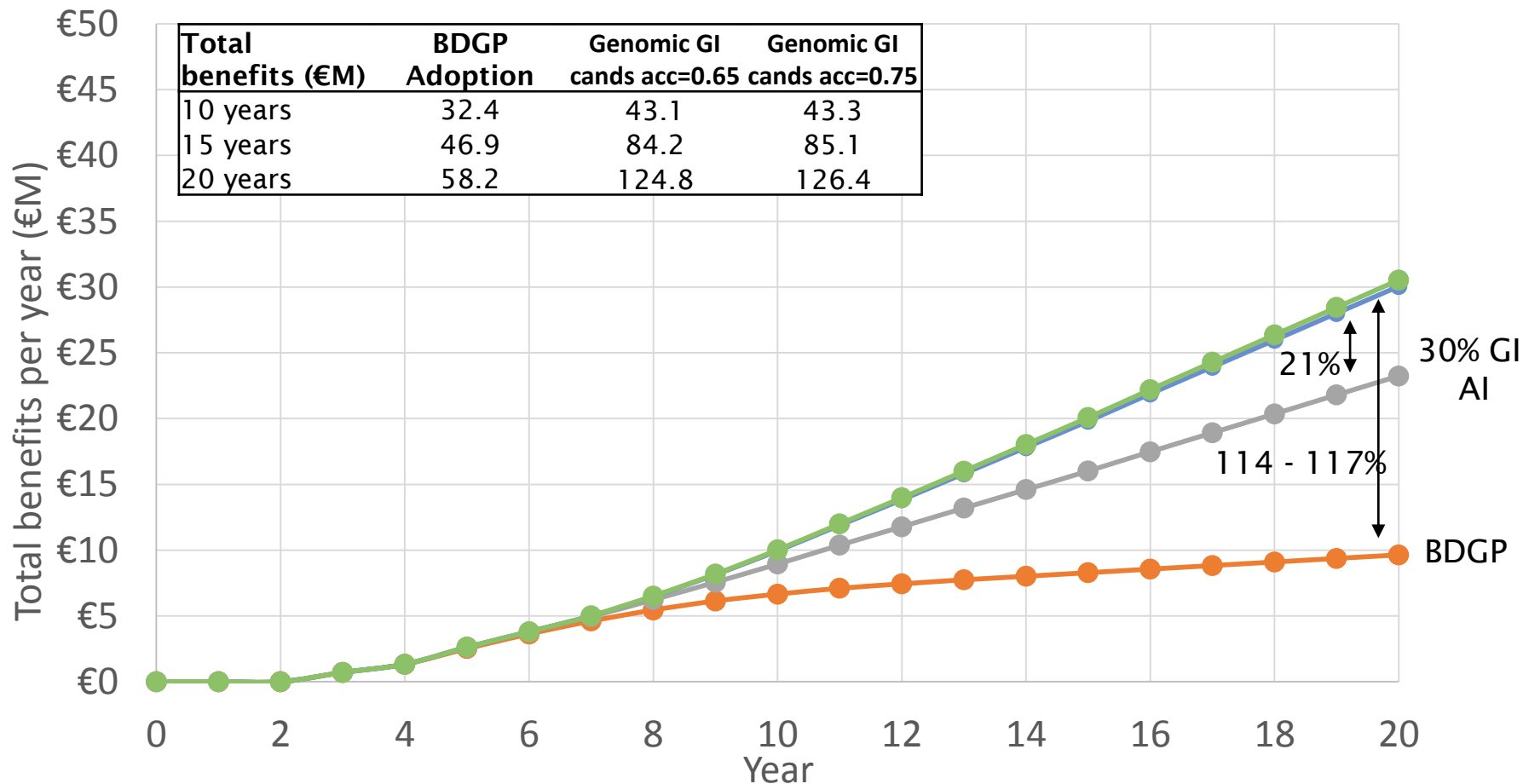
Widening pool of Gene Ireland AI candidates – key outcomes

- "Opening up" GI bull sourcing without genomics has modest impact
  - Sends the wrong message – discourages recording
  - But would it increase adoption of elite GI bulls?

- Genomics is a game changer, as it allows much better bulls to be progeny tested

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Compounding favourable changes
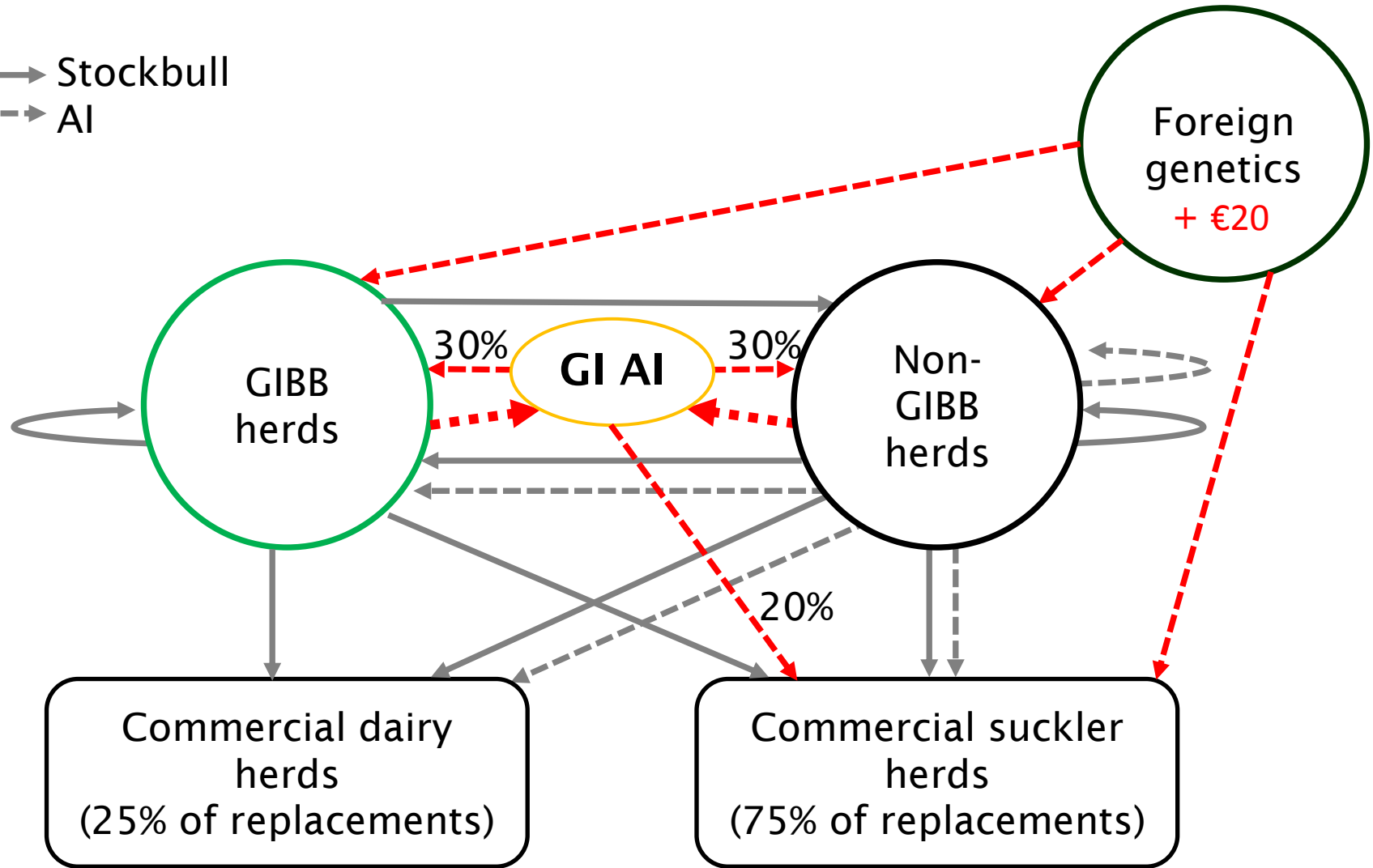
1. Without genomics:
   - Gene Ireland candidates sourced from all pedigree herds
   - 30% usage of Gene Ireland AI in all pedigree herds
   - 20% usage of Gene Ireland in commercial herds
   - Foreign AI superior to GIBB bulls at year 0
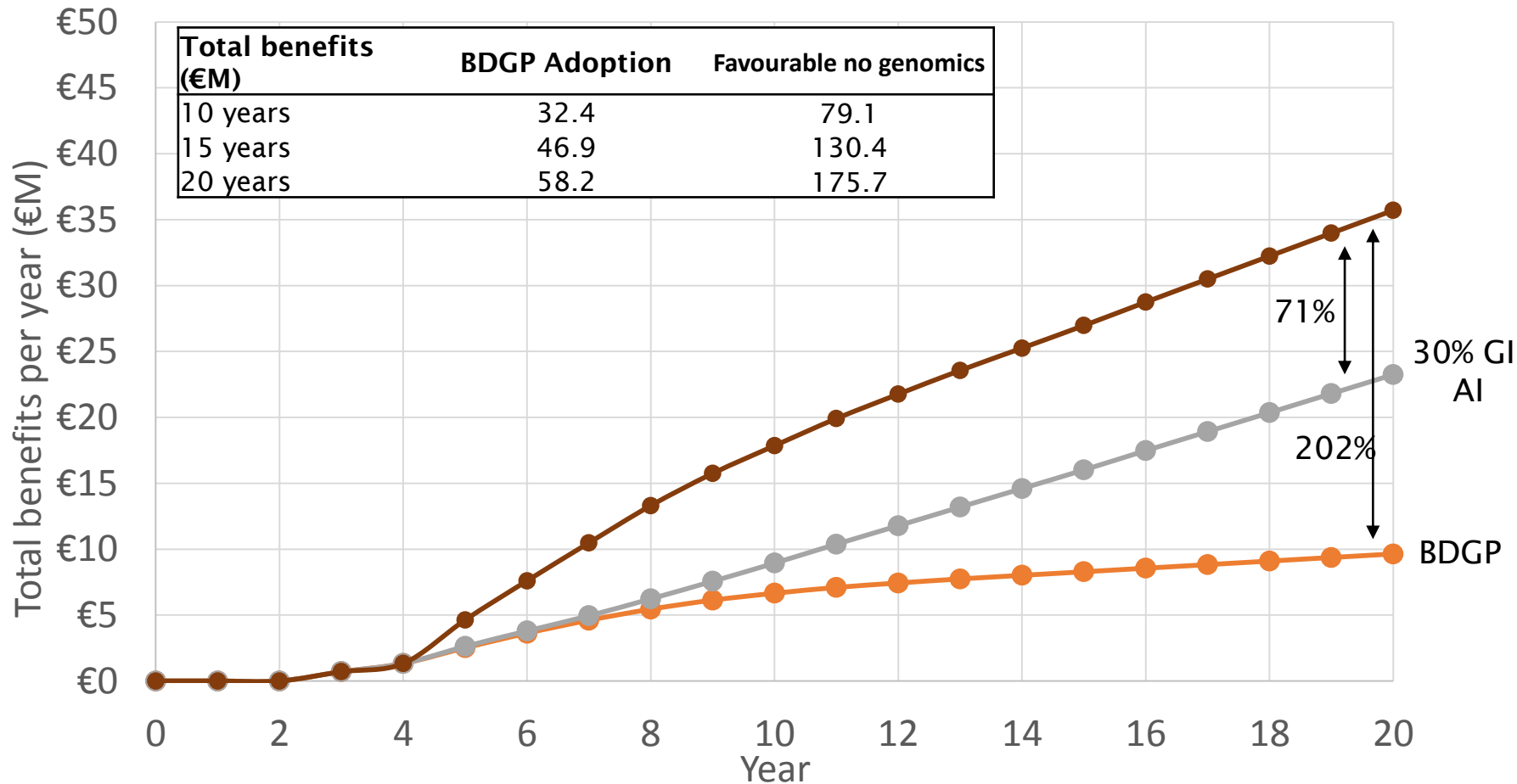2. With genomics:
   - Gene Ireland candidates sourced from all pedigree herds with genomics
   - 30% usage of Gene Ireland AI in all pedigree herds
   - 20% usage of Gene Ireland in commercial herds
   - More accurate selection in GIBB stockbulls from genomics
   - Foreign AI superior to GIBB bulls at year 0
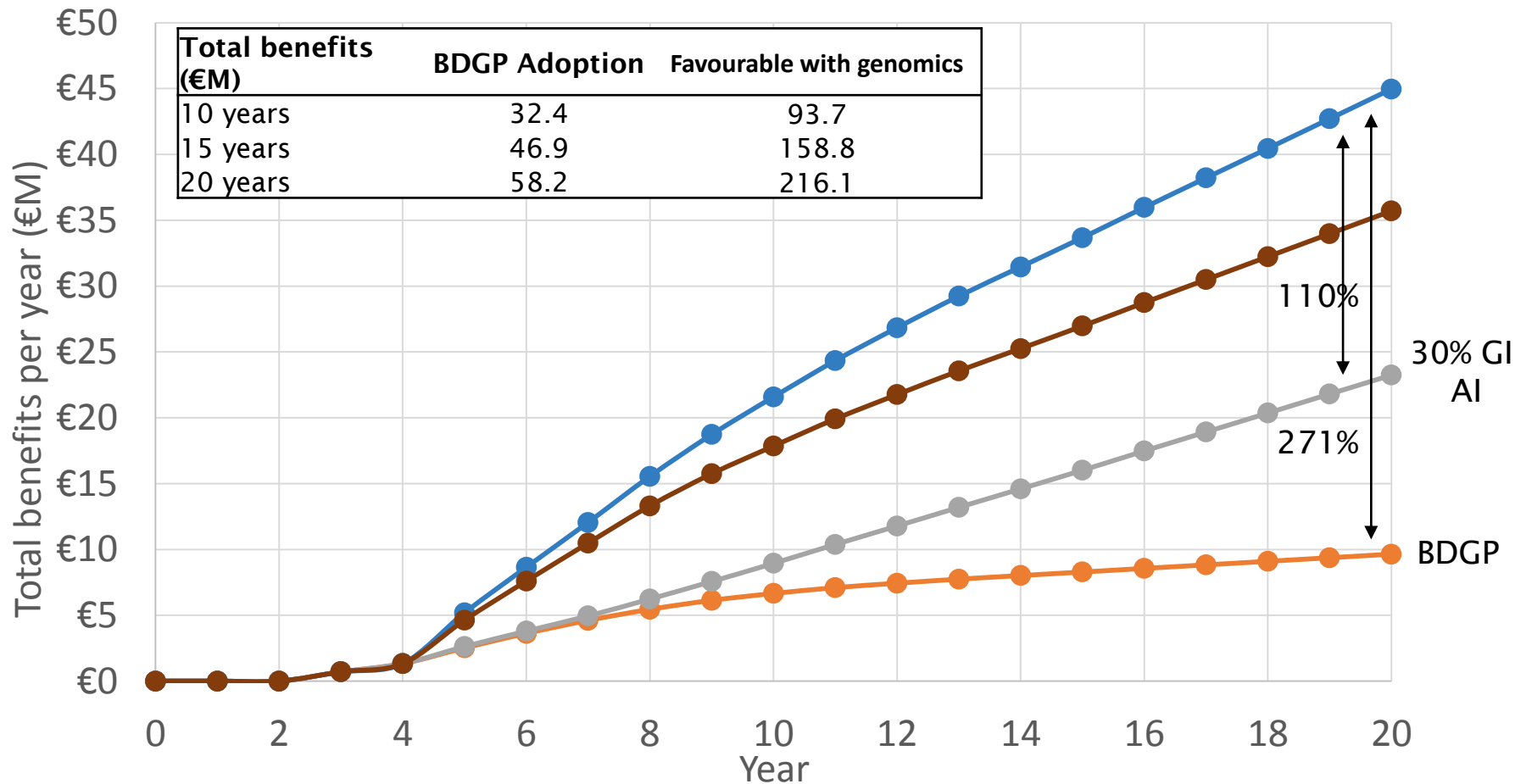
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Compounding favourable changes

Compounding favourable changes – without genomics

Total benefits (€M)	BDGP Adoption	Favourable no genomics
10 years	32.4	79.1
15 years	46.9	130.4
20 years	58.2	175.7

Total benefits per year (€M)

Year

71%

202%

30% GI AI

BDGP

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Compounding favourable changes – with genomics

Total benefits (€M)	BDGP Adoption	Favourable with genomics
10 years	32.4	93.7
15 years	46.9	158.8
20 years	58.2	216.1

Key results - Limousins

- Better replacements through the BGDP leads to €32M more in total benefits in 10 years time

- Increasing usage of Gene Ireland AI to 30% in all pedigree herds produces and extra €44.8M total benefits in 20 years time

- 20% usage of Gene Ireland AI in commercial herds leads to an additional €42M over just pedigree herd usage after 20 years

- Higher merit Foreign AI sires produce good short term results, but wider usage of Gene Ireland AI is a significantly better long term strategy

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# Key results – Limousins (continued)

- Wider usage of stockbulls from GIBB herds leads to extra €2M total benefits over BGDP in 10 years time, and €7M in 20 years time

- Doubling the number of Gene Ireland candidates adds €5.6M after 20 years

- Using genomics to select Gene Ireland progeny test candidates from all pedigree herds adds €22M after 20 years

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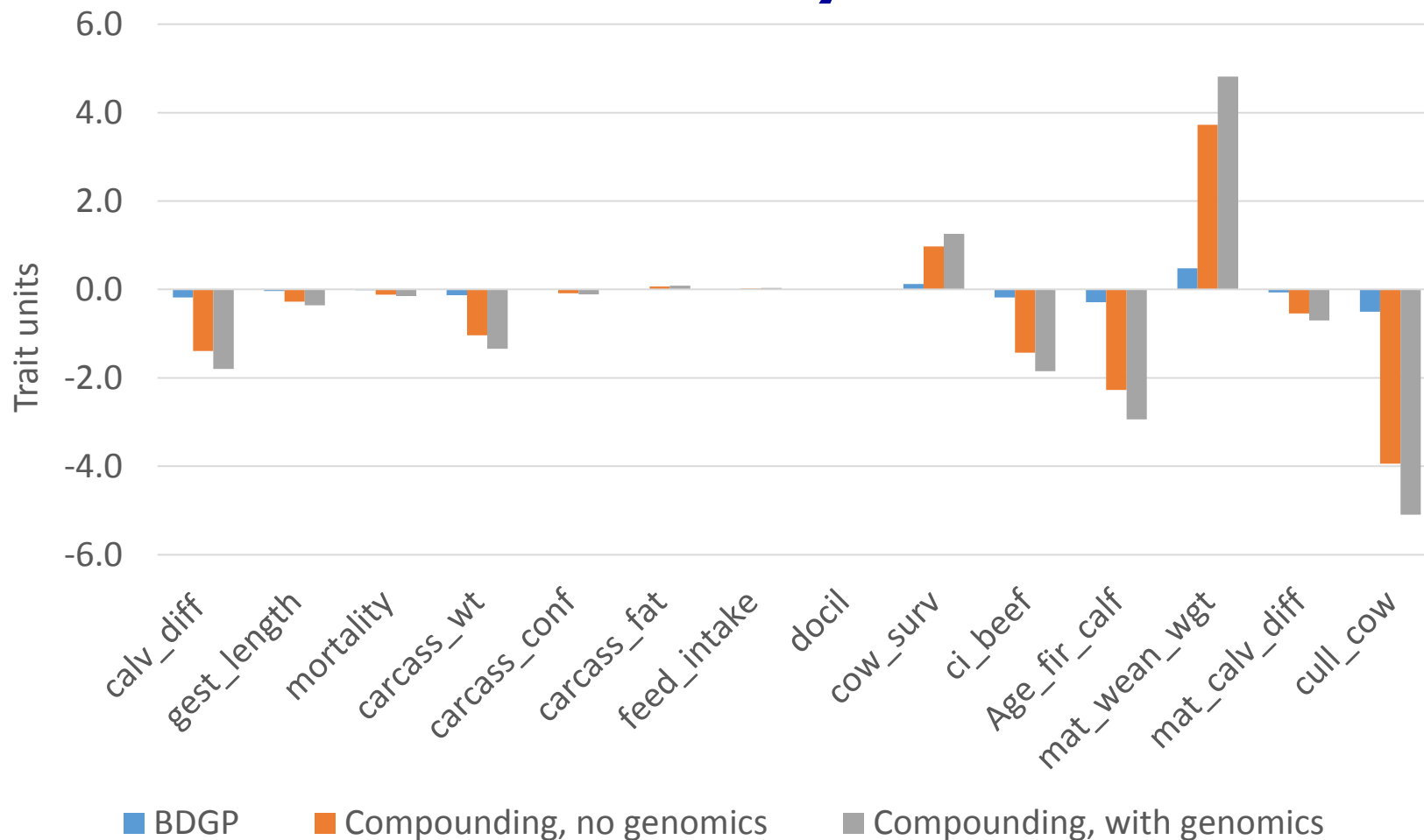# Scaling up to full industry – compounding favourable changes

- Assuming whole industry is 2.2 times the size of the Limousin breed, using the same assumptions on bull usage in different herd types

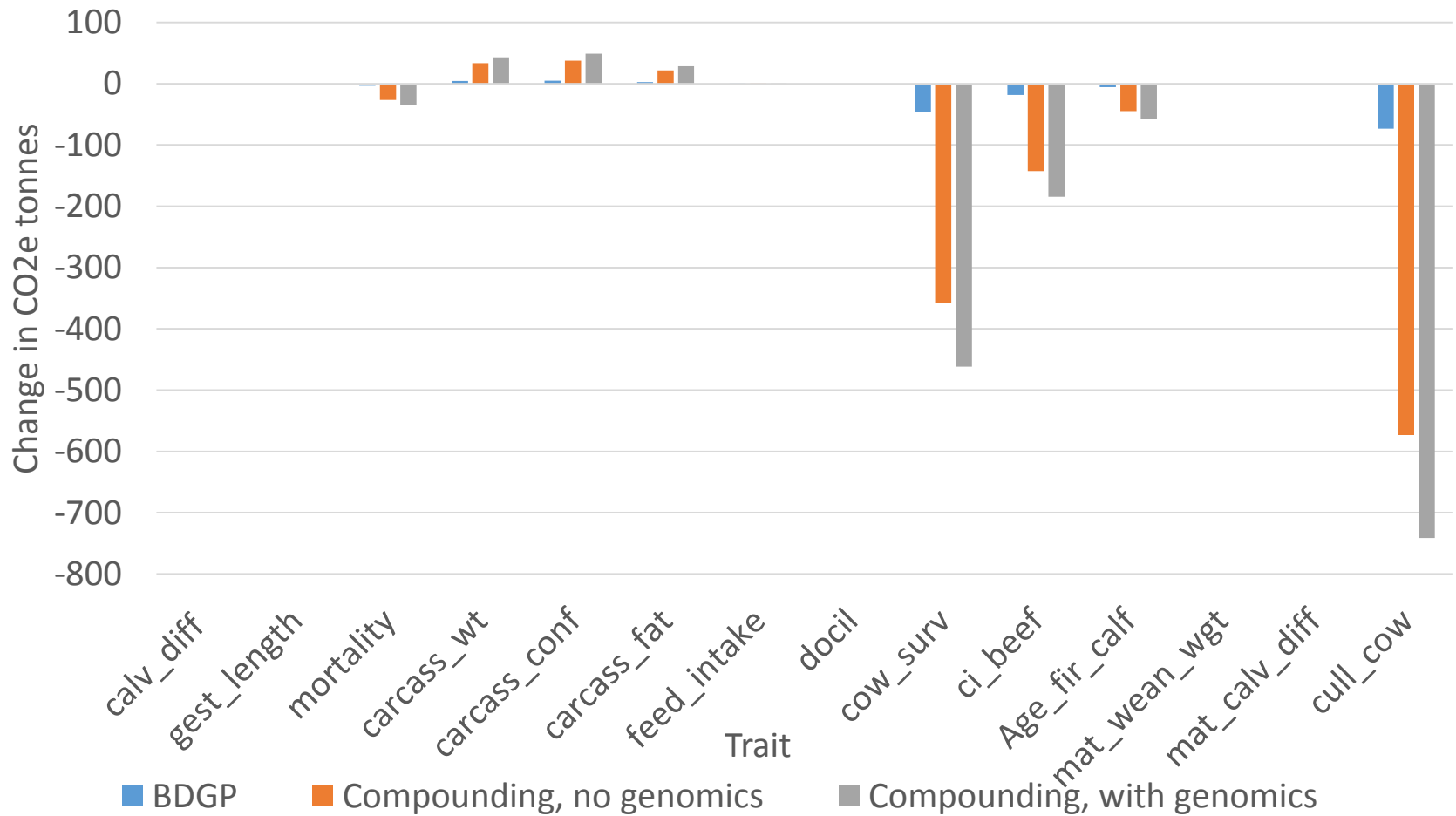| Total benefits (€M)	BDGP adoption	Compounding without genomics	Compounding with genomics
10 years	71.3	173.9	206.2
15 years	103.1	286.9	349.4
20 years	128.1	386.5	475.4
Annualised benefits (€M)			
10 years	10.2	24.8	29.4
15 years	11.3	31.5	38.4
20 years	12.1	36.5	44.9

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Improvement in replacement index
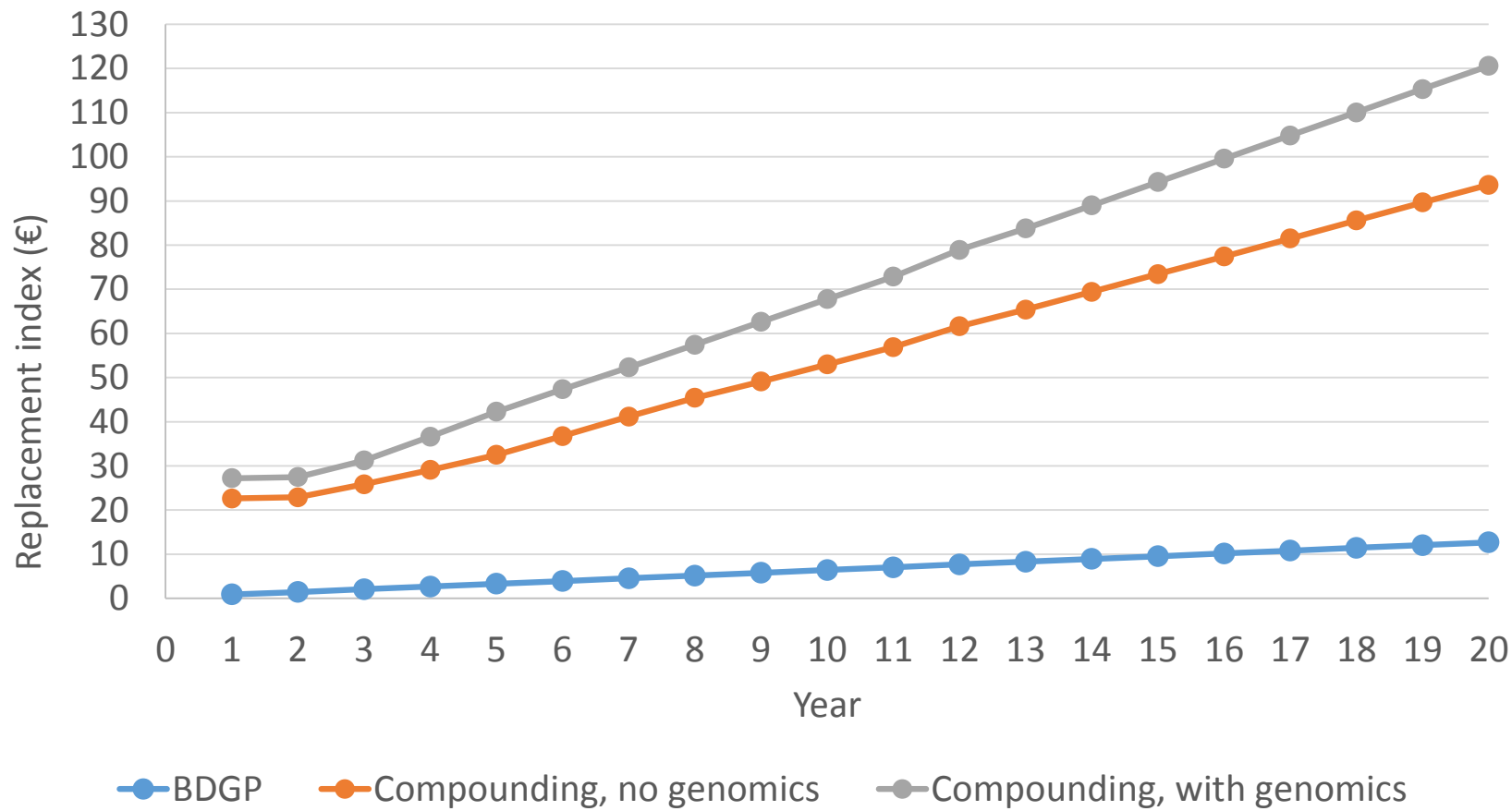
Improvements in component traits – after 10 years

Legend:
- BDGP
- Compounding, no genomics
- Compounding, with genomics

Y-axis: Trait units (6.0, 4.0, 2.0, 0.0, -2.0, -4.0, -6.0)

X-axis categories: calv_diff, gest_length, mortality, carcass_wt, carcass_conf, carcass_fat, feed_intake, docil, cow_surv, ci_beef, Age_fir_calf, mat_wean_wgt, mat_calv_diff, cull_cow

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Changes in GHG emissions by trait – after 10 years

Total changes in GHG emissions – whole industry after 10 years

- Compounding over 10 years, with a reduction of 1,825 CO_2e tonnes for a €1 increase in replacement index

	BDGP	Compounding, no genomics	Compounding, with genomics
Total reduction (CO_2e tonnes)	65,922	653,838	825,260
At €40/CO_2e tonne (€M)	2.6	26.1	33.0
Industry benefit (€M)	71.3	173.9	206.2

Key outcomes/recommendations.

- Increase number of bull breeding herds involved in the G€N€ IR€LAND breeding program.
- Use genomics to help identify high index young bulls to enter the breeding program.
- Maximise the impact of G€N€ IR€LAND
  - Pedigree herds
  - Commercial AI
- Use genomics to identify the best foreign bulls for Ireland
- Clear cost:benefits to industry (5:1), plus additional GHG savings.

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