Sustainable strategies for dairy cow replacements

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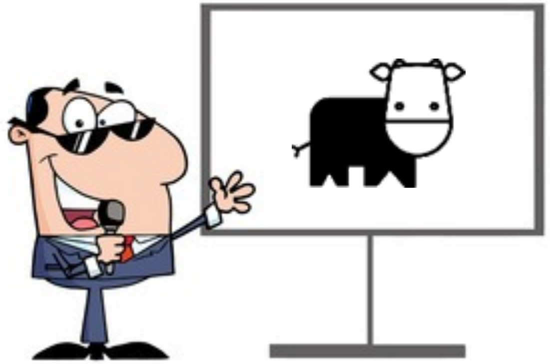
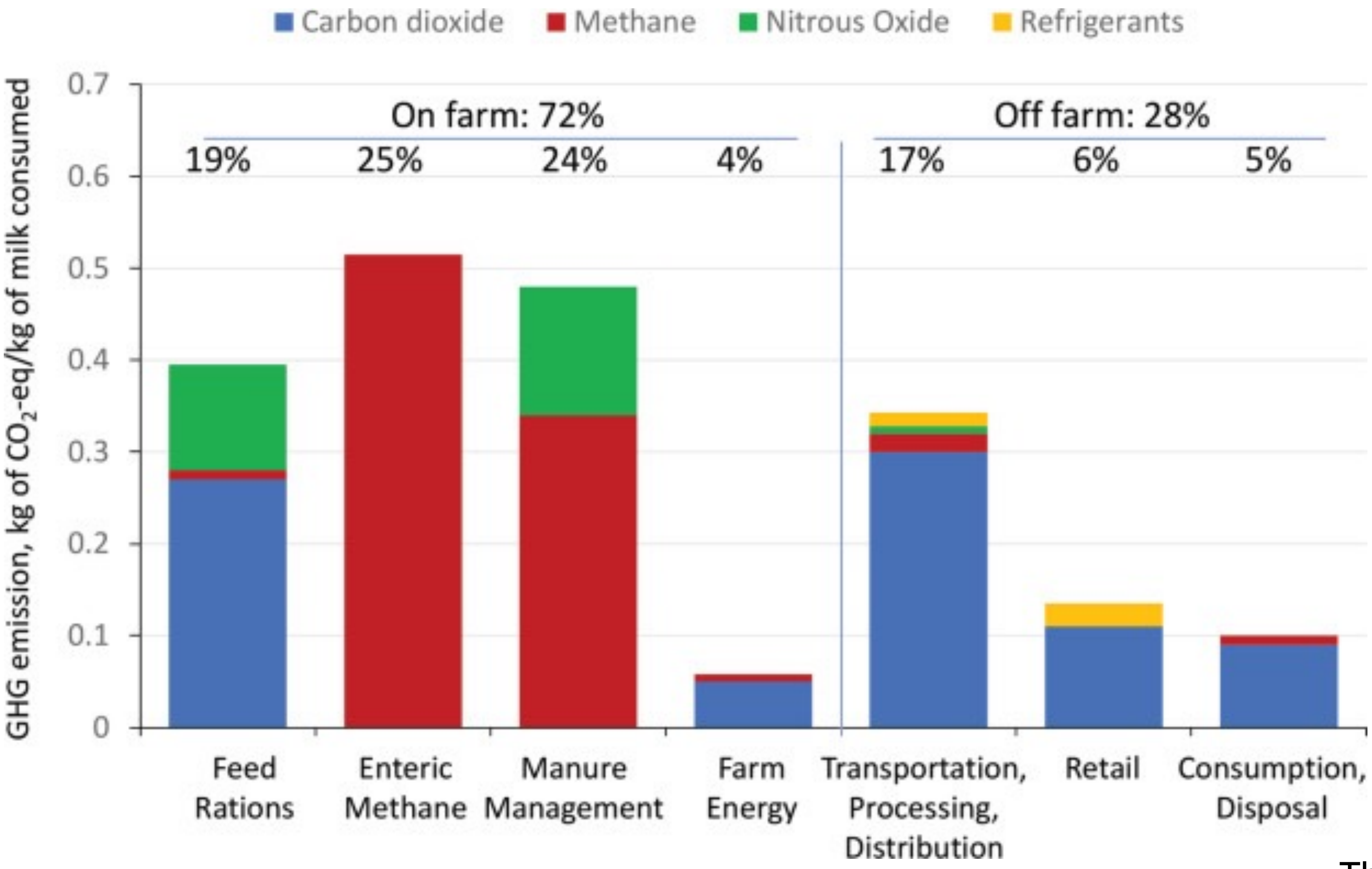
Overview

1. Green house gasses: feed efficiency, reproduction, productive life
2. What affects productive life?
3. Economics of productive lifespan
4. Replacement decision support
5. Summary



Major sources of greenhouse gases (GHG) from production and consumption of milk in the United States

CO_2-eq
per
kg milk



= 100%

Thoma et al., 2013

Role of reproduction and replacement management

J. Dairy Sci. 90:3456–3467
doi:10.3168/jds.2006-675

Prediction of Methane Production from Dairy and Beef Cattle

J. L. Ellis,*[1] E. Kebreab,* N. E. Odongo,* B. W. McBride,* E. K. Okine,† and J. France*
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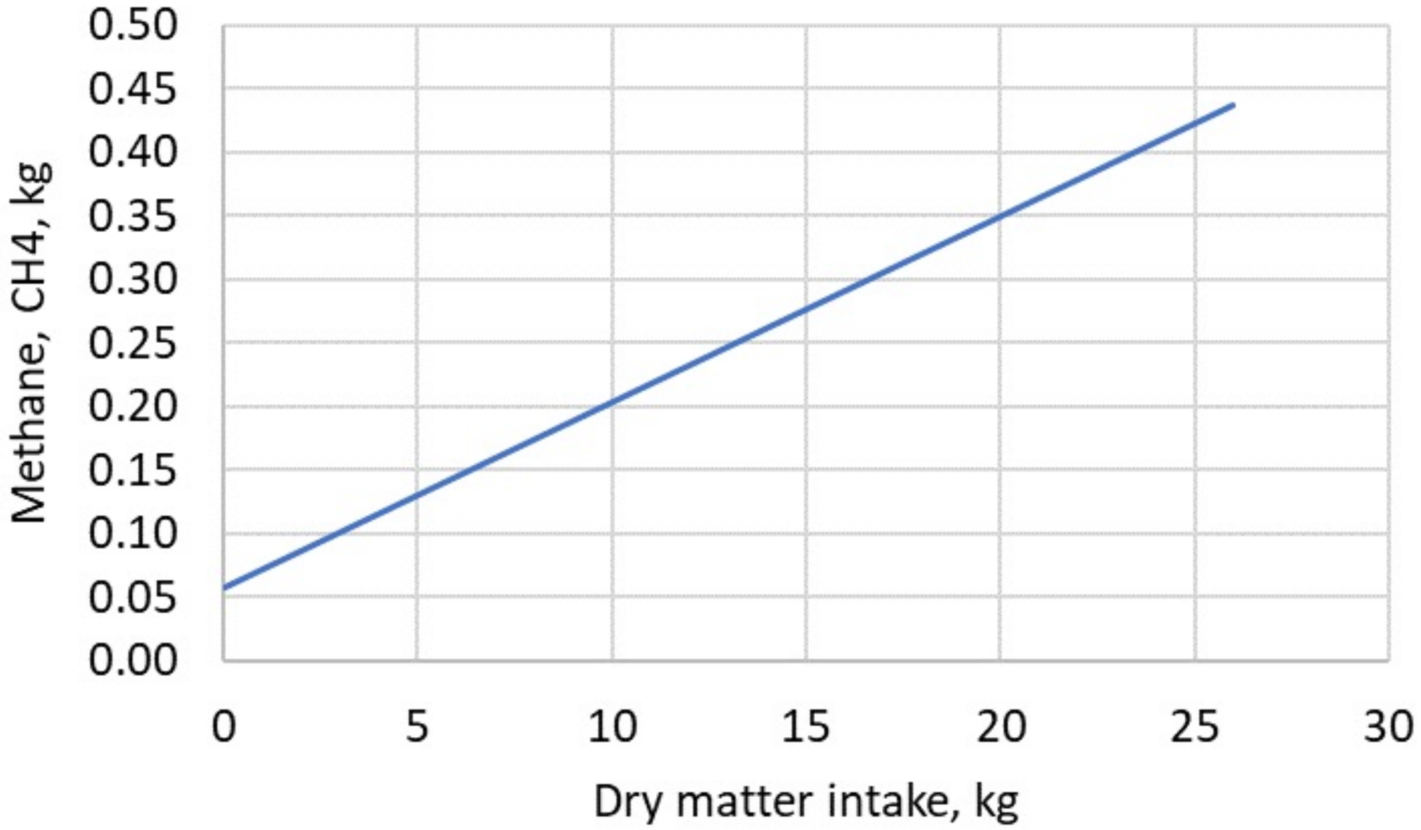
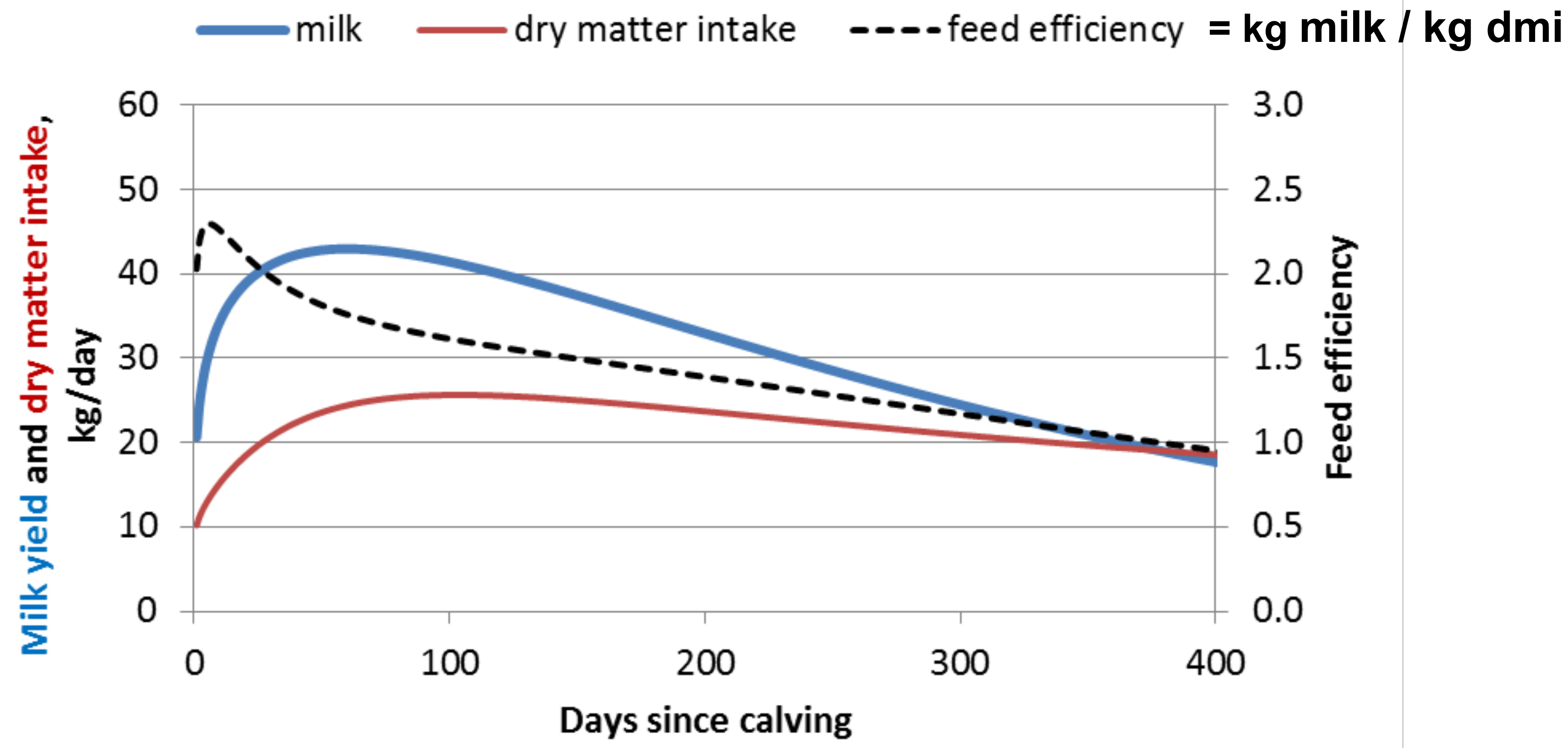
Dry matter intake predicts enteric methane release



Days since calving and feed efficiency



Parity 2+

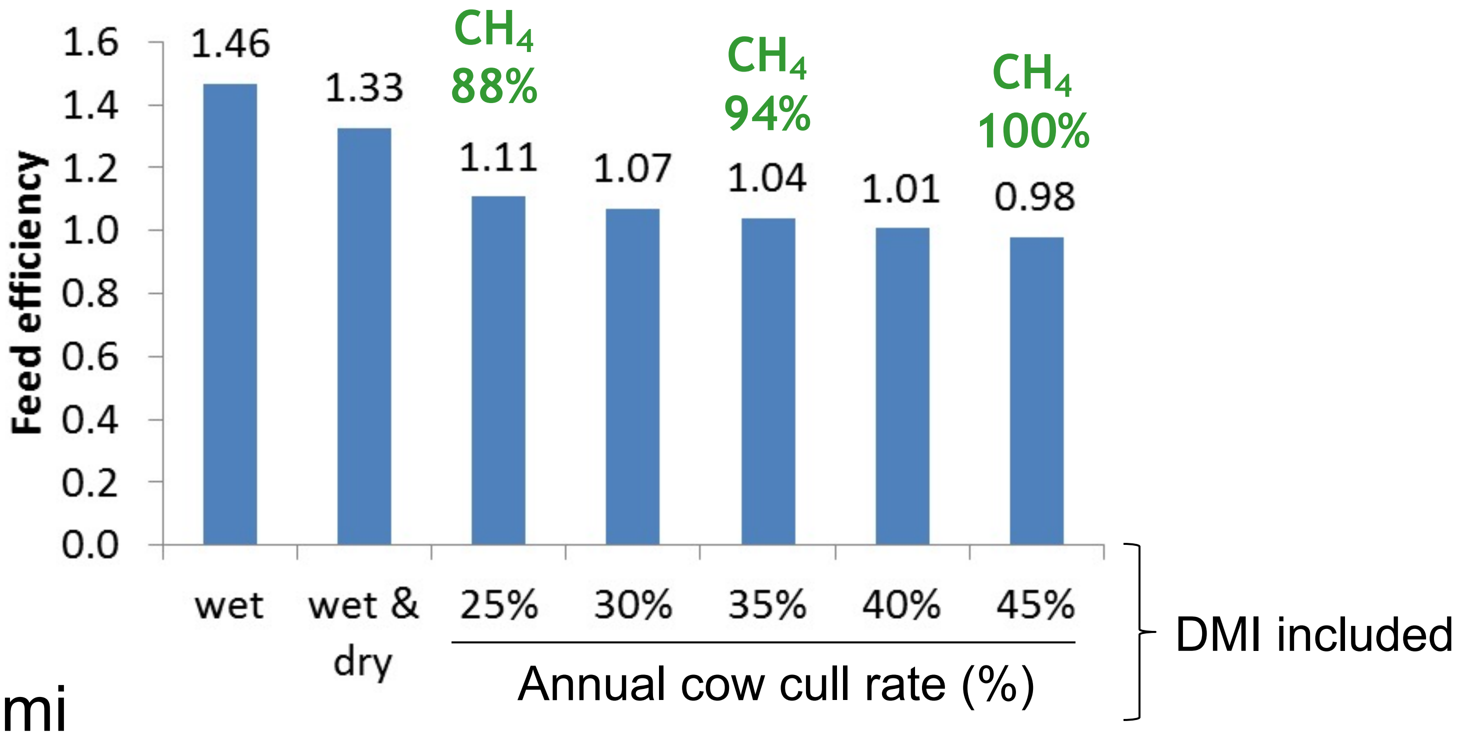
DMI = dry matter intake (= feed without water): production + maintenance

DMI = f(fat-corrected milk, body weight, days since calving)   NRC, 2001

Culling, Feed Efficiency, Methane (CH_4)

Dry matter consumed by replacement heifers varies

	365 days			Annual cull rate (24 months at first calving)				
	Milk	DMI wet	DMI dry	25%	30%	35%	40%	45%
kg	9,432	6,442	668	1,416	1,699	1,982	2,265	2,548

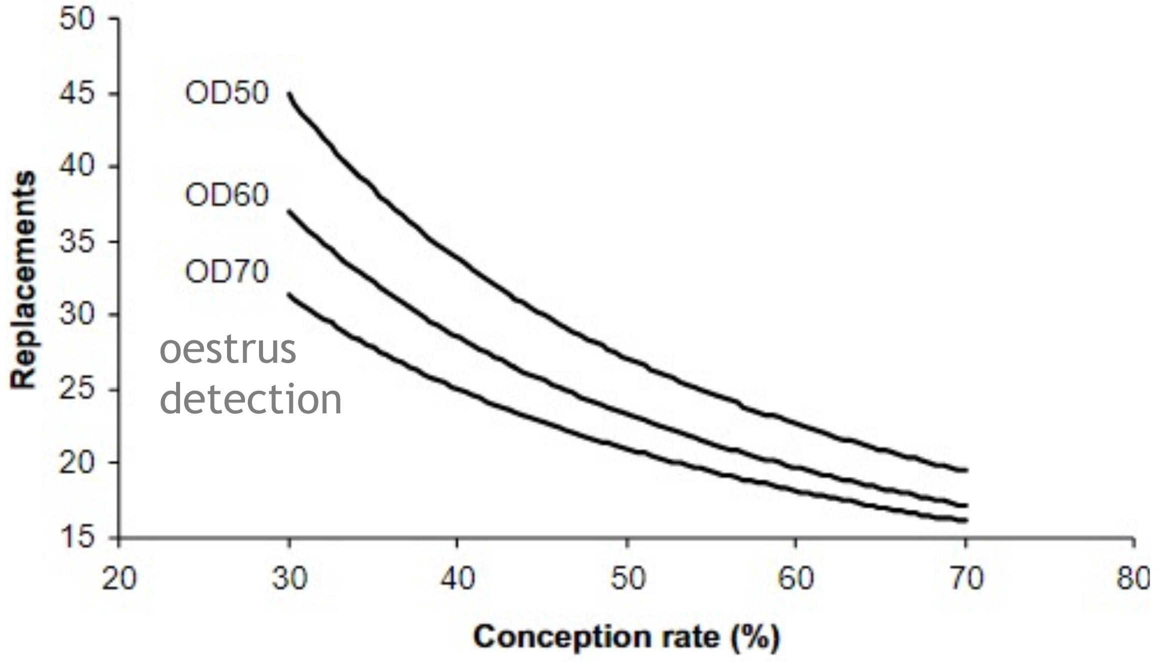


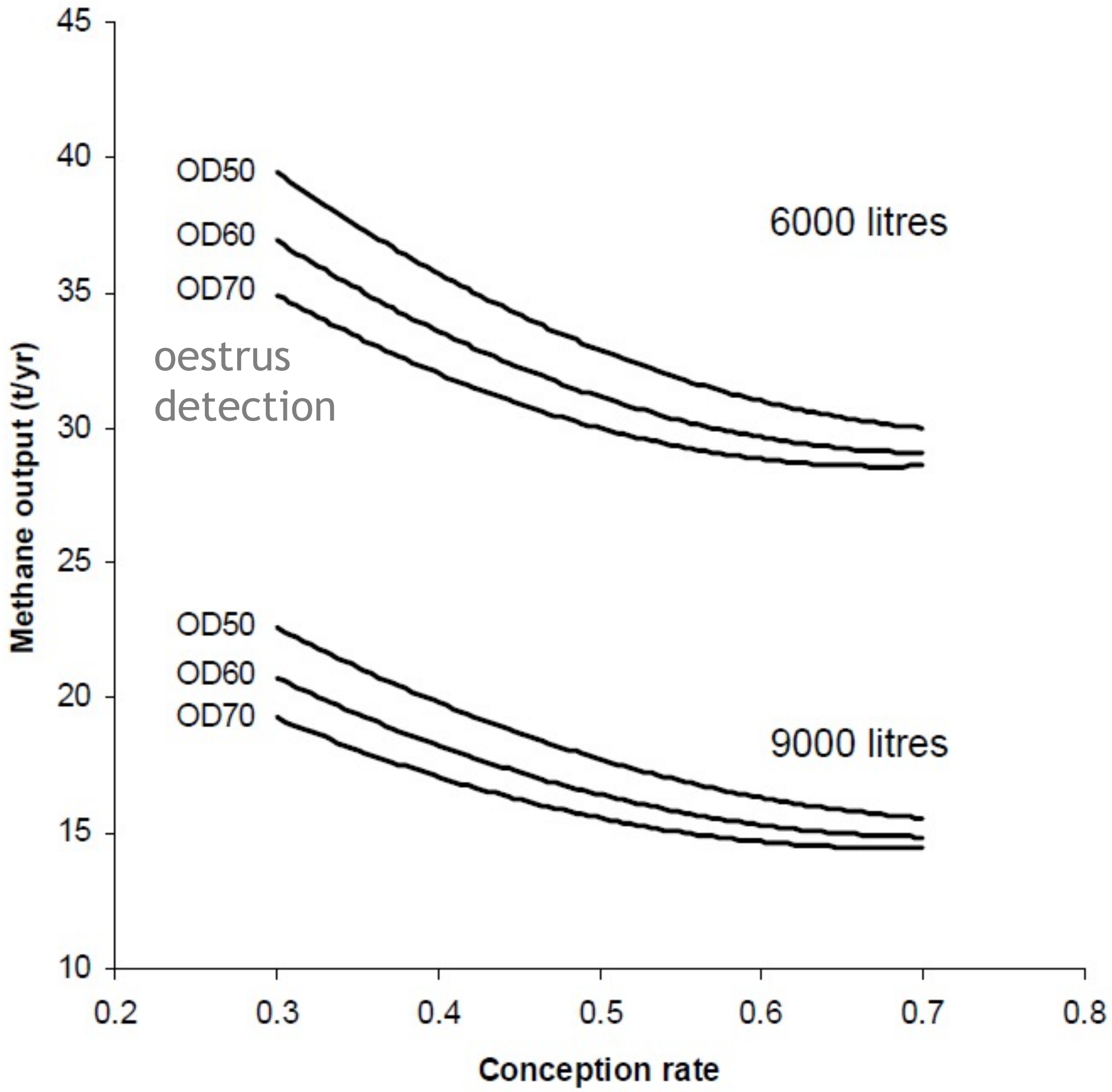
Feed Efficiency = milk/dmi

Fertility and Methane output

Garnsworthy, 2004. An. Feed. Sci. Tech. 112:211-223

- Conception rate ↑ (fertility)
- → Replacements ↓ (heifers/cow)
- → Methane ↓





In practice, little effect of fertility on culling (#heifers)

(Holsteins, ≥100 cows. Pregnancy rate = speed of getting pregnant

Pregnancy Rate	<8%	8 to 12%	12 to 16%	16 to 20%	20 to 24%	24 to 28%	>28%
Number of herds	297	805	1375	1299	765	262	94
Preg. rate-year ave, %	6	10	14	18	22	25	30
Number of cows-all Lact	218	228	299	372	441	503	358
Cows left herd-all Lact, %	40	39	38	37	36	36	36
SCC actual (x1000)	319	277	248	218	194	176	179
Rolling Milk (lbs)	18574	21076	22596	23744	24176	24637	24778

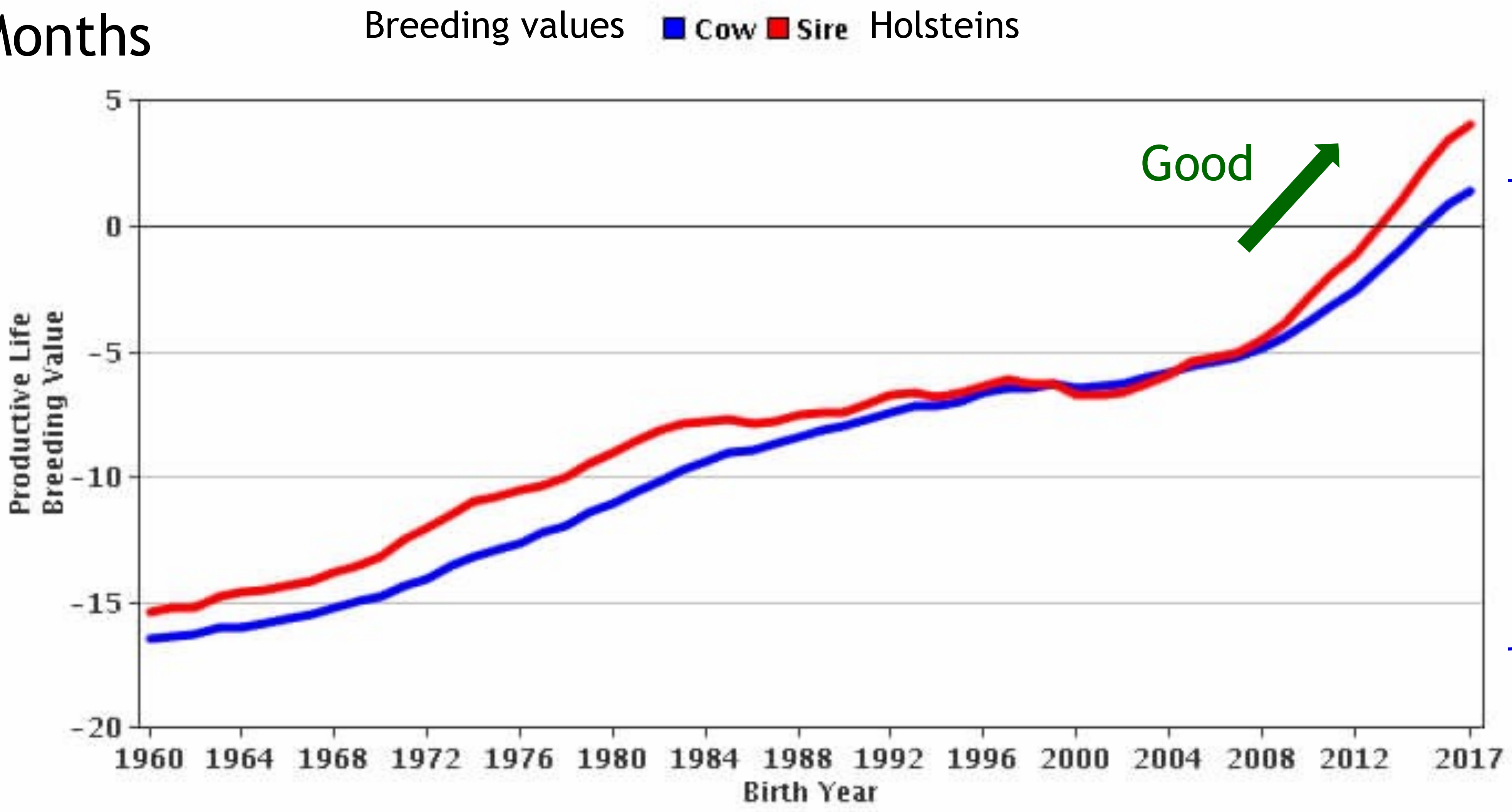
Source: DRMS, DairyMetrics, April 26, 2011

Longer productive life
(lower replacement rate)

Lower climate footprint

Genetically, cows have longer productive lives compared to cows in the past

Months



1960 ➔ 2017
+20 months BV=
+10 months PTA

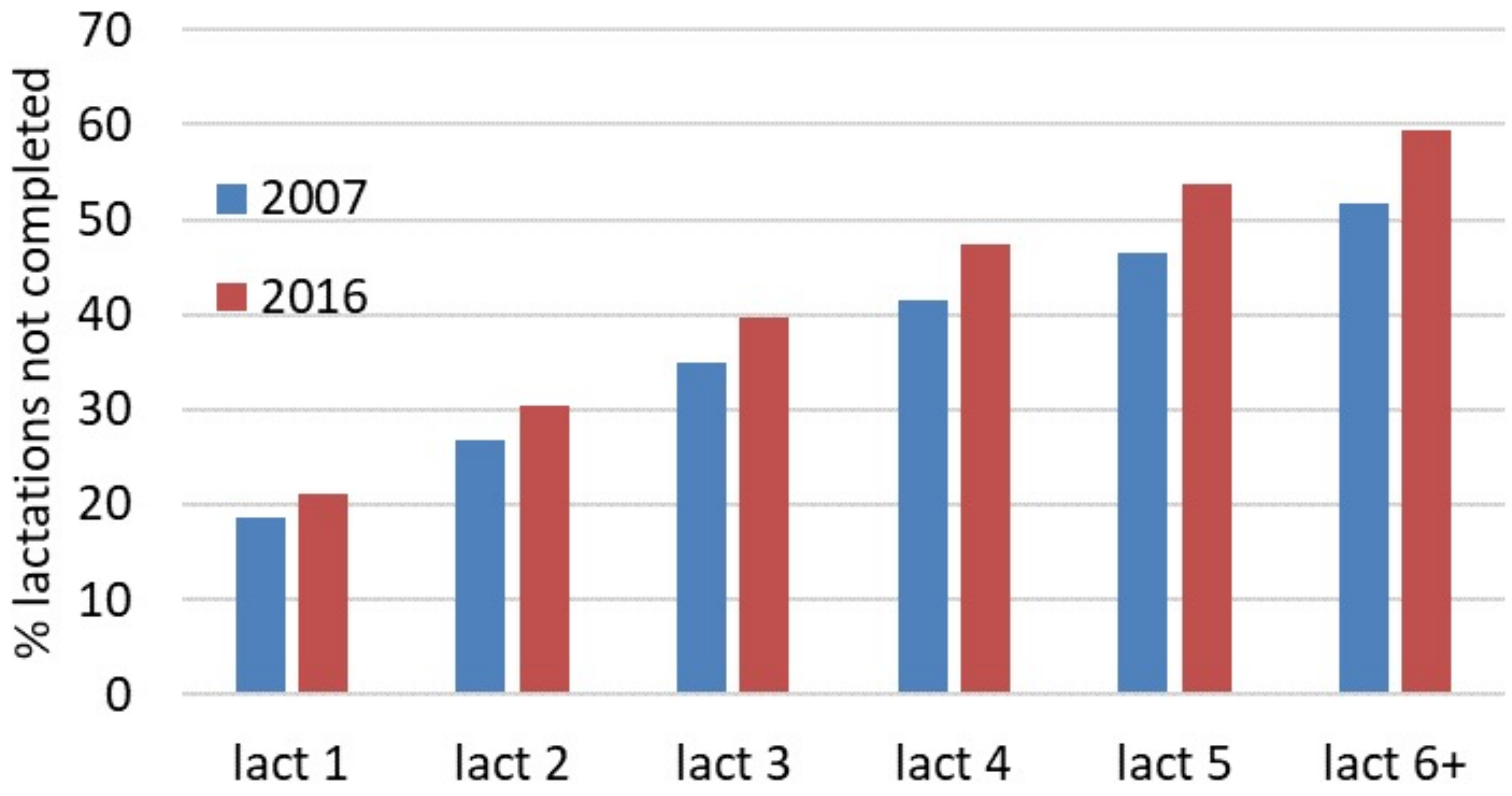
➔ 33% to 21% annual cull rate, but *this genetic gain is not observed in practice*

April 2020 base

https://queries.uscdcb.com/eval/summary/trend.cfm

% cows not reaching next lactation (DHIA)

Actual productive life is decreasing



Source: https://queries.uscdcb.com/publish/dhi/cull.html

Cows that survive

- 4 events per lactation:
  - 1 calving
  - 1 breeding
  - 1 pregnancy diagnosis
  - 1 dry off

- Risk factors for culling: sick, lame, not-pregnant, poor conformation, bad temperament, low milk yield, …

Reviewed in: De Vries and Marcondes (2020). Animal 14(S1):s155-s164

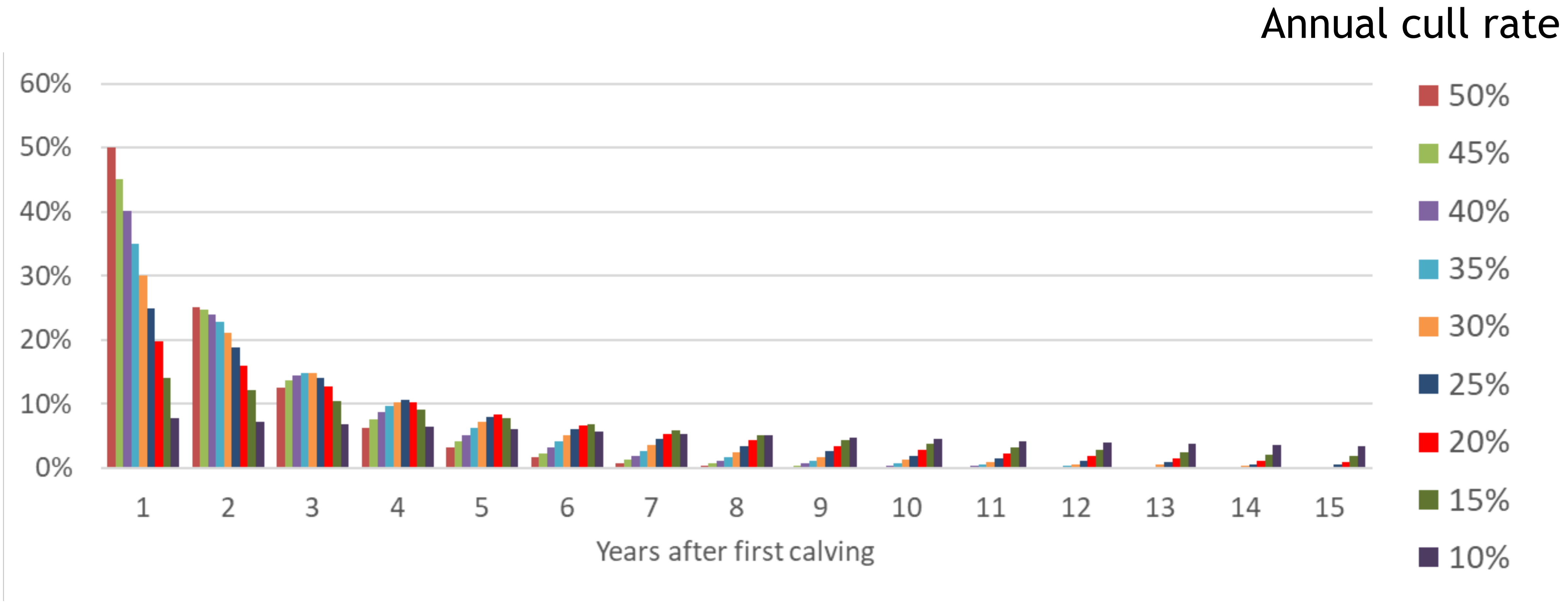
If we could choose, how long should the average cow remain in the herd?

cost of herd structure

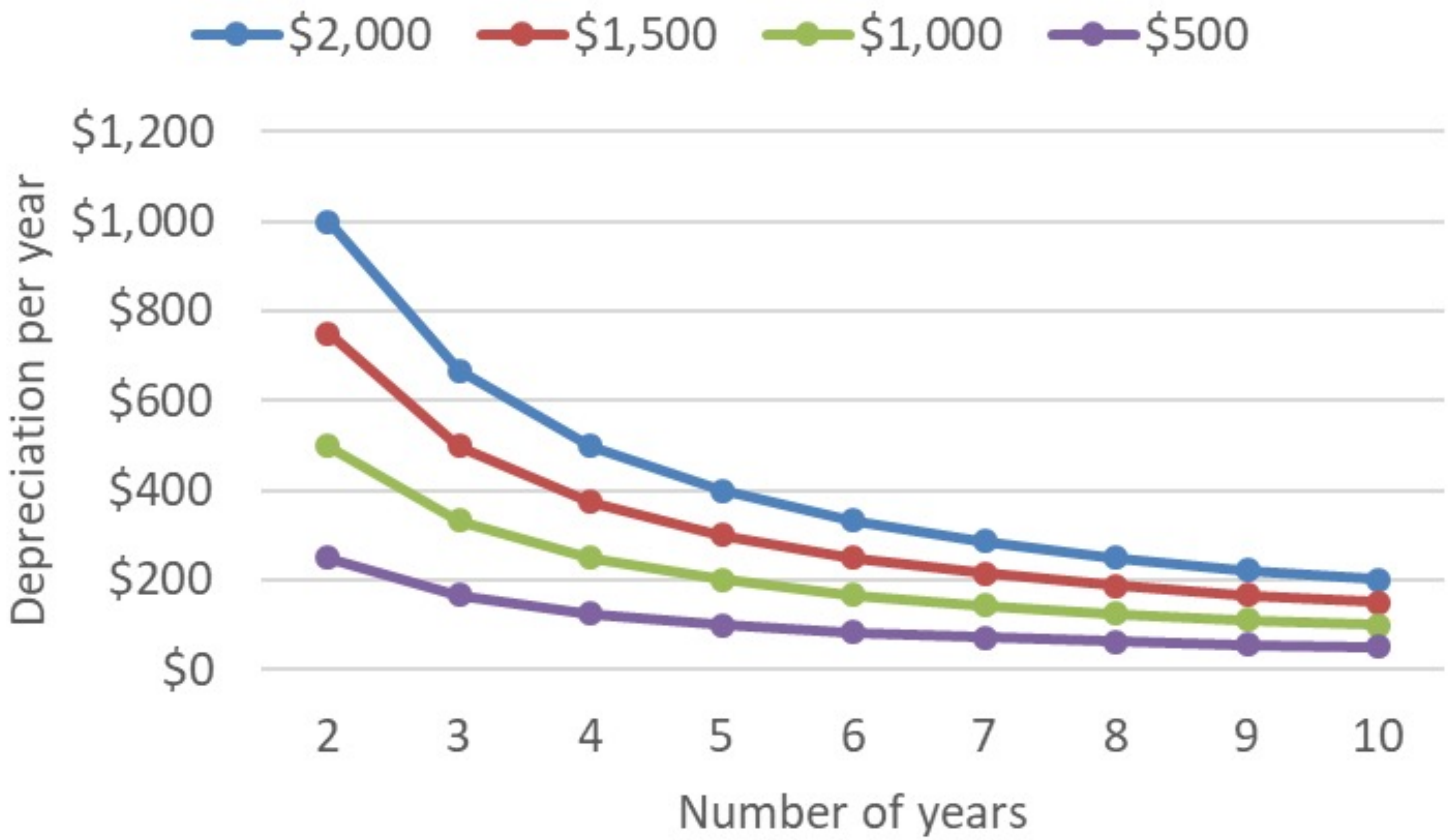
- A simple model
- $/cow/year

De Vries, A. (2020) J. Dairy Sci. 103:3838–3845

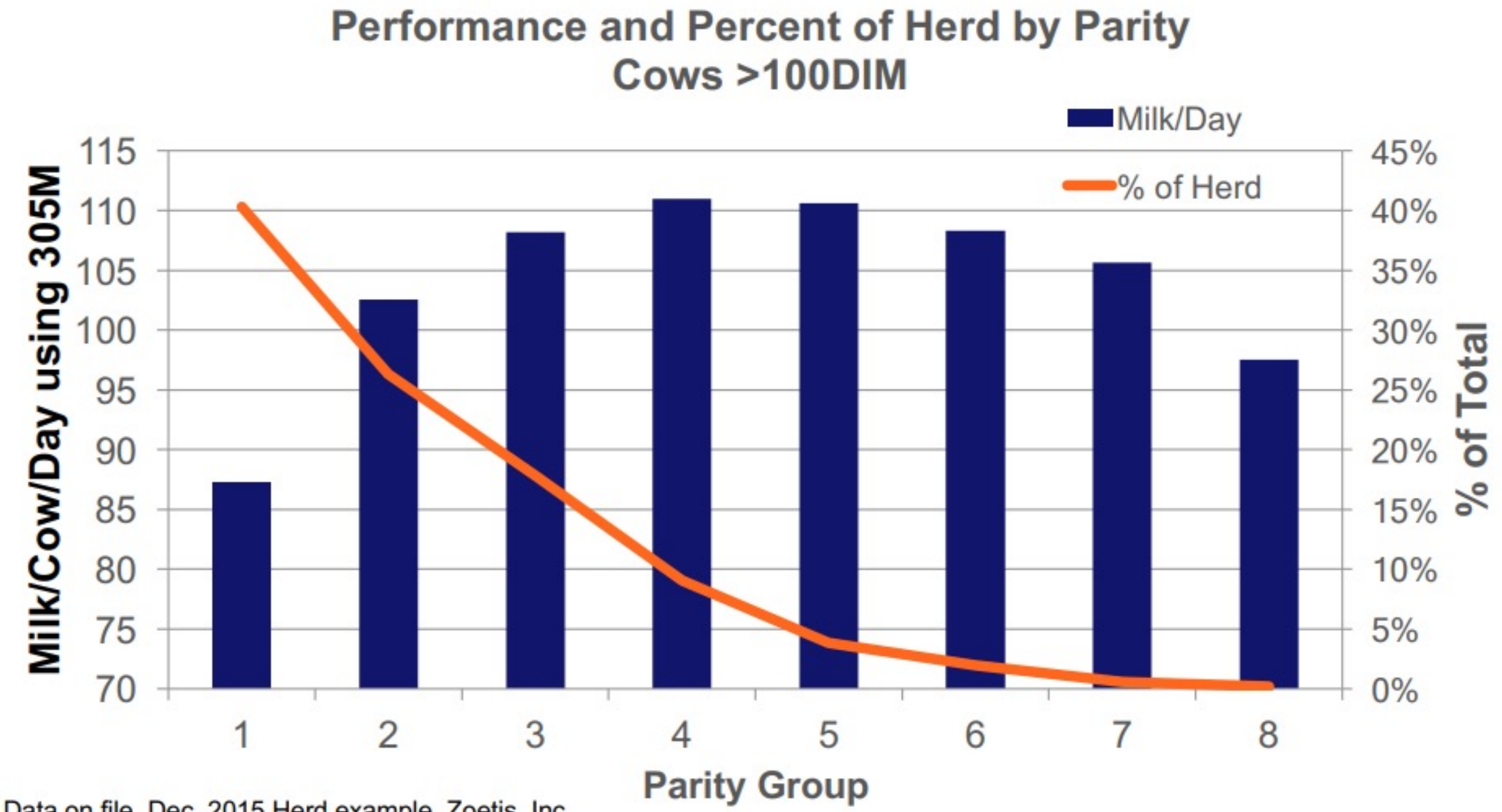
Herd distribution, % cows per parity



Herd replacement cost:
Cow depreciation (loss in value, heifer → cull)



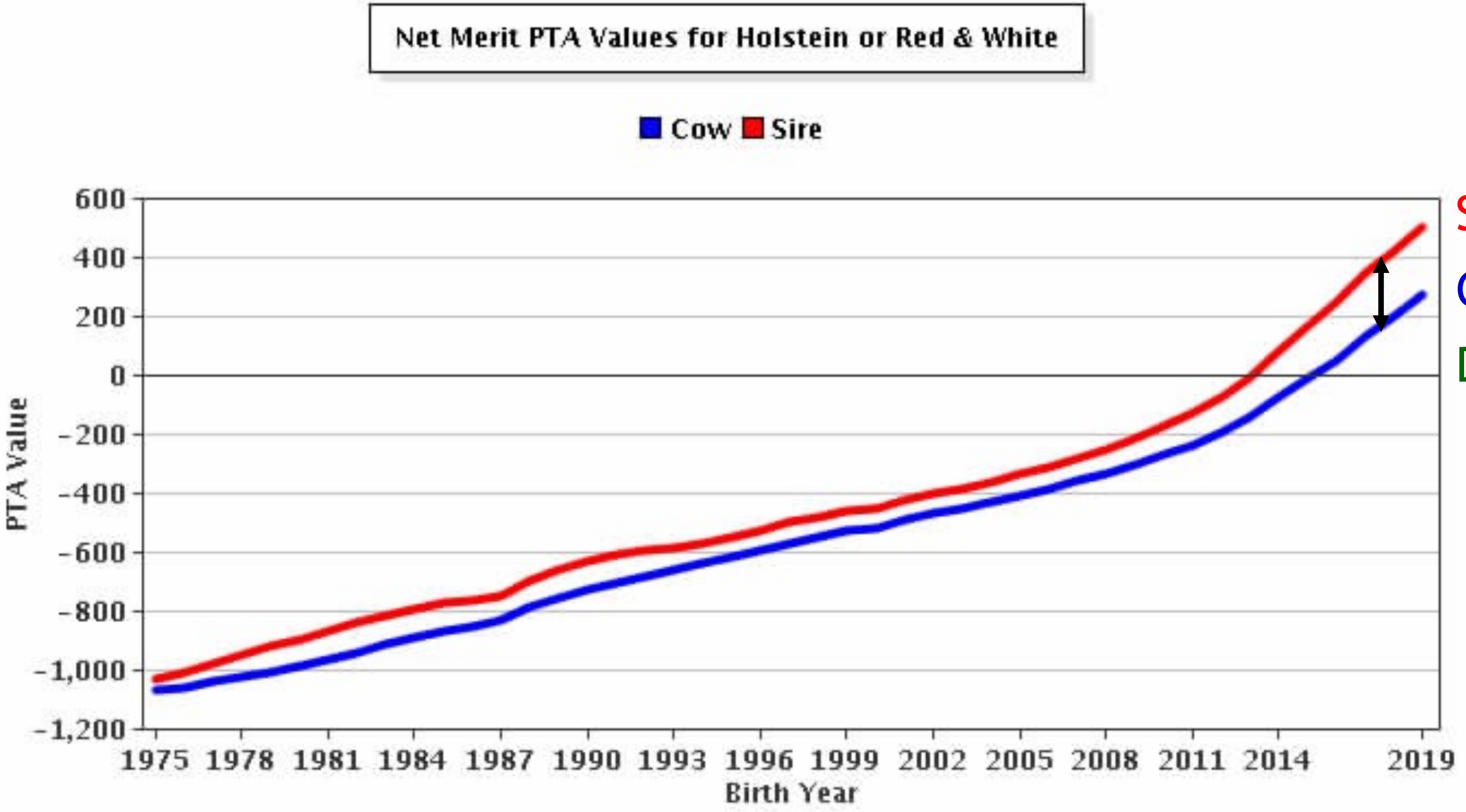
Longevity - driven profit



Data on file, Dec. 2015 Herd example, Zoetis, Inc.

zoetis

Trend in PTA of Lifetime Net Merit dollars = economic selection index from USDA



Sire $504
Cow $276
Dam -$48

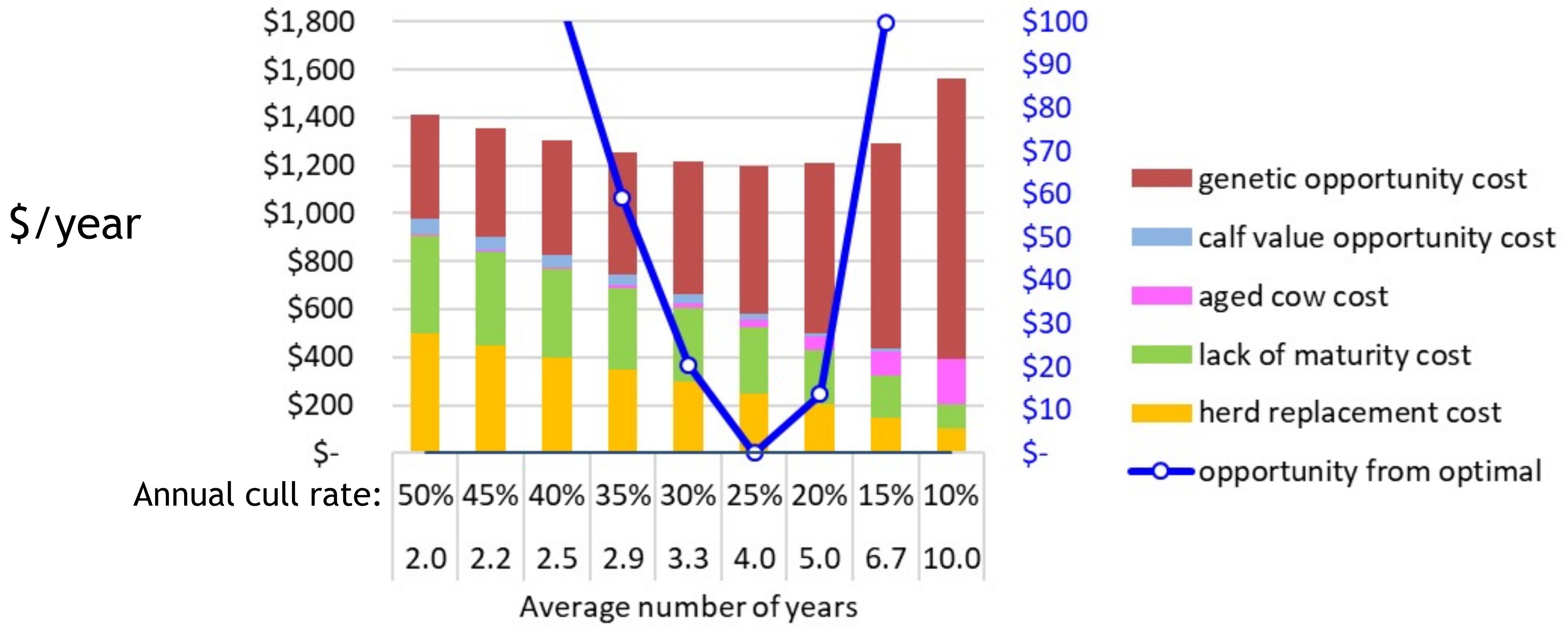
$552 Genetic lag

2x rate of genetic gain compared to before 2010

PTA = predicted transmitting ability
= ½ of estimated breeding value

https://queries.uscdcb.com/eval/summary/trend.cfm

Cost of herd structure: +genetic opportunity cost



Increase sire PTA +$75/year

August 2021 Net Merit $ (US selection index) revision:

More mature cows get more credit

➔ selection for productive life more important

old | new

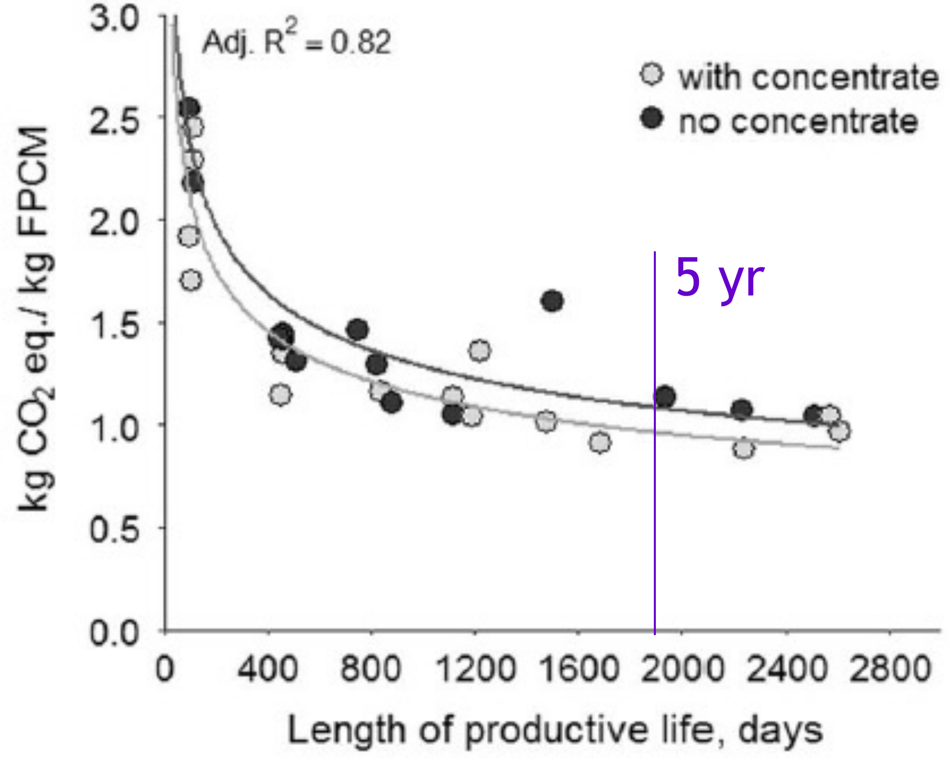
Parity	Herd fraction (%)	Average profit ($)	NM$ trend ($)	Mature yield ($)	Mature weight ($)	Compound interest ($)	Adjusted profit ($)[1]
1	37.1	155	75	−436	89	−77	−50
2	23.3	155	31	0	0	−81	249
3	14.7	155	−14	167	−50	−85	317
4	9.2	155	−58	228	−66	−89	314
5+	15.7	155	−103	228	−74	−93	256

[1]Sum of NM$ trend, mature yield, mature weight, and compound interest plus a constant of $299 so that average profit weighted by fraction of cows in each parity equals $155

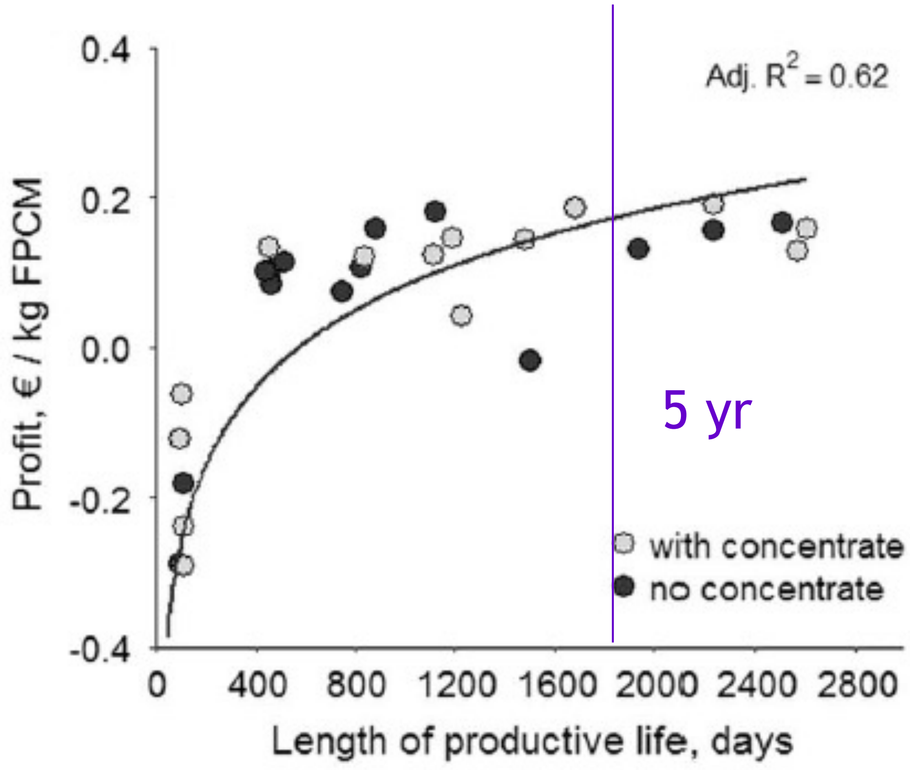
https://www.ars.usda.gov/ARSUserFiles/80420530/Publications/ARR/nmcalc-2021_ARR-NM8.pdf

Productive life: green house gasses, profitability

Green house gas



Profit



Grandl et al. (2019). Animal 13:1 p198

Replacement decision support

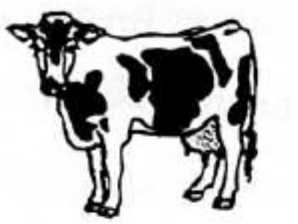
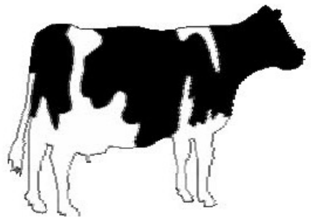
Optimal replacement decisions (theory)

Economics: need to predict future cash flows of incumbent and challenging cow(s)

- Consider **opportunity cost** = cost sacrificed on an average challenging cow by keeping the incumbent cow in the herd *(Van Arendonk, 1991)*

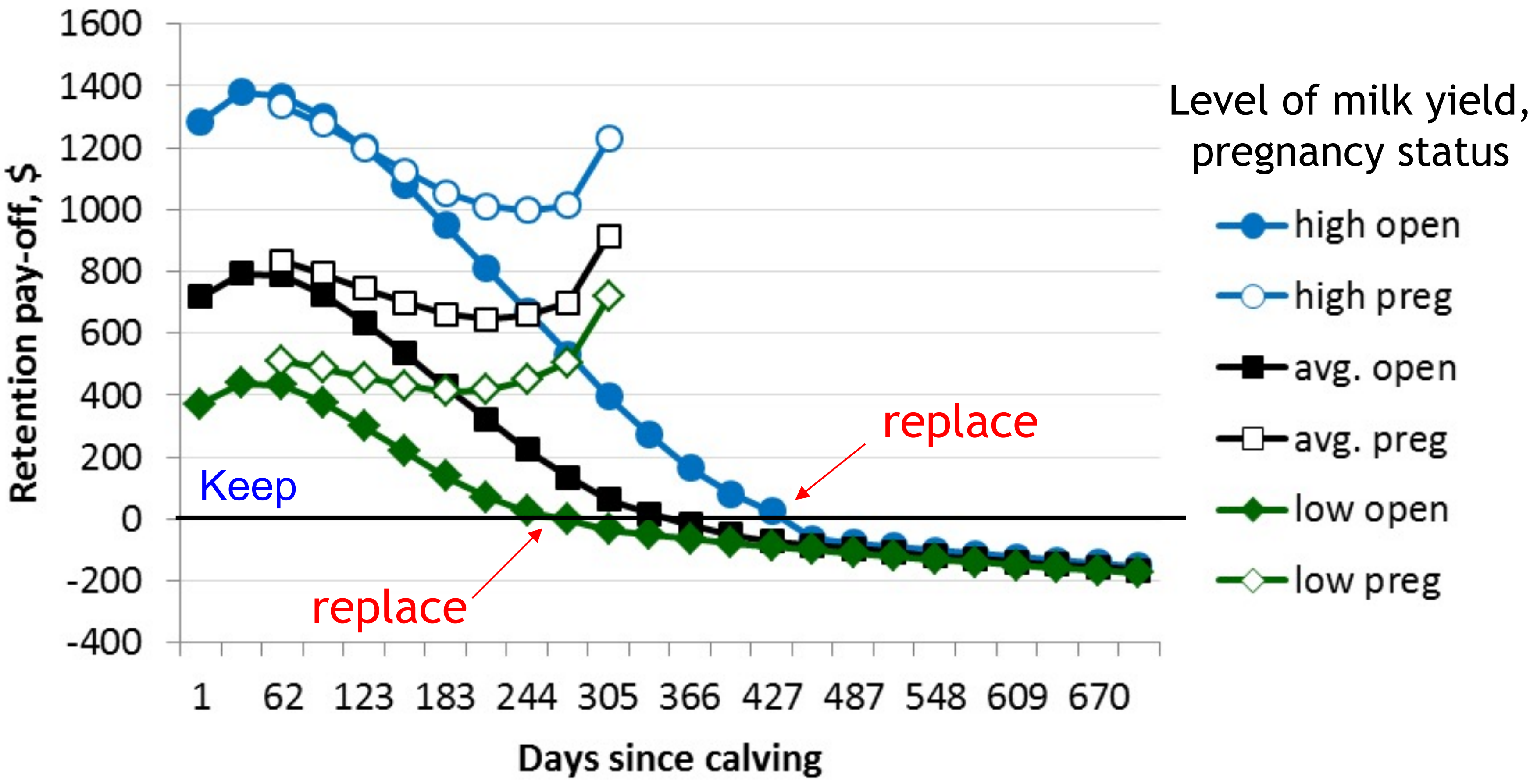
  Sum of future cash flow (incumbent, Keep)
– Sum of future cash flow (challenger, Replace)

= Retention pay-off (RPO) = Future value = Keep value

y = f(x):  **or**  **?**

Value of keeping the cow in the herd

Compared to immediate replacement with a heifer



Higher milk yield and pregnancy protect against culling

Keep Value (≈RPO) and Keep Pct

in Florida herd with 1300 cows

012 - COMBINATION-- LOW COWS & 30 DAY DRY-OFF barn#2

GRP	COW Index	Days In Milk	Prev T.D. Milk	Curr T.D. Milk	KEEP VALUE	KEE PCT	Pre SCC Act	Cur SCC Act	LTD Milk	Proj ME Milk	RAT	No Br	CDE	Bred Heat Date	D Da
7	1437	434	50.0	48.5	-413	3	1131		24799	22473	D		C		
16	72	64		11.6	-382	4									
7	490	398	53.0	52.4	-361	4	325		22484	21350	C		C		
6	2194	350	58.0	44.6	-310	4	141		21872	26304	B		C		
16	77	63		15.5	-229	5									
7	1330	210	44.0	44.6	-243	5	1600		5621	13553	E		C		
7	409	366	48.0	44.6	-133	6	93		24323	24235	B		C		
16	73	64		31.0	-26	7									
16	61	69		36.9	231	11									
7	1859	289	44.0	34.9	298	14	33		15139	19246	E	1	P	08/07	05/
7	2791	242	55.0	36.9	306	14	33		9021	20905	D	2	P	10/08	07/
4	2866	202	69.0	68.0	344	15	3430		8401	26884	A		C		

Summary

1. Greater feed efficiency ➔ lower carbon footprint
2. Mature cows most profitable, efficient
   - Genetics ↑, management ↑
3. Greater productive life good for sustainability and profitability
   - You can have too many heifers (causing high cull rate)
   - Need better decision-making aids: more math, less art

Thank you

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