Genetic parameters for residual energy intake and its relationships with production and other energy efficiency traits in Nordic Red dairy cattle

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Introduction

- Feed cost is a major expense in dairy production
  - Cows' ability to convert feed energy to milk energy important from economical and environmental point of view
- Breeding programmes have focussed on improving production traits
  - Correlated responses in increased feed intake
  - Correlated responses in increased gross energy efficiency
  - Correlated responses in increased mobilisation of body energy reserves and health/fertility problems
- Differences reported in energy efficiency between dairy breeds and individuals
  - Breeding for improved efficiency without corresponding problems in cow health and fertility?

Aim of this study

- Genetic parameters for energy efficiency and its relationships with milk production, energy intake, body weight and body condition
- Specifically: **Nordic Red dairy cattle**

ASMO Uaria ET

Data collection

- Four feeding trials at MTT Agrifood Research Rehtijärvi experimental farm between 1998 and 2008
- 291 animals descending from 72 different sires
- ASMO Nordic Red Dairy Cattle MOET nucleus heifers in their 1st lactation
- Lactation weeks 2 – 30
- Traits:
  - Energy corrected milk yield (ECM)
  - Dry matter intake (DMI)
  - Live weight (LW)
  - Body condition score (BCS)

  - Energy balance (EB)
  - Gross energy efficiency (GE)
  - Residual energy intake (REI)

Statistical analyses

- Random regression models
- Fixed effects:
  - Calving year-month
  - Calving age
- Random regression: *pe* and *a* modelled with 2^{nd} degree Legendre polynomials
- REML using VCE6 (Groeneveld 2008)

Energy efficiency traits

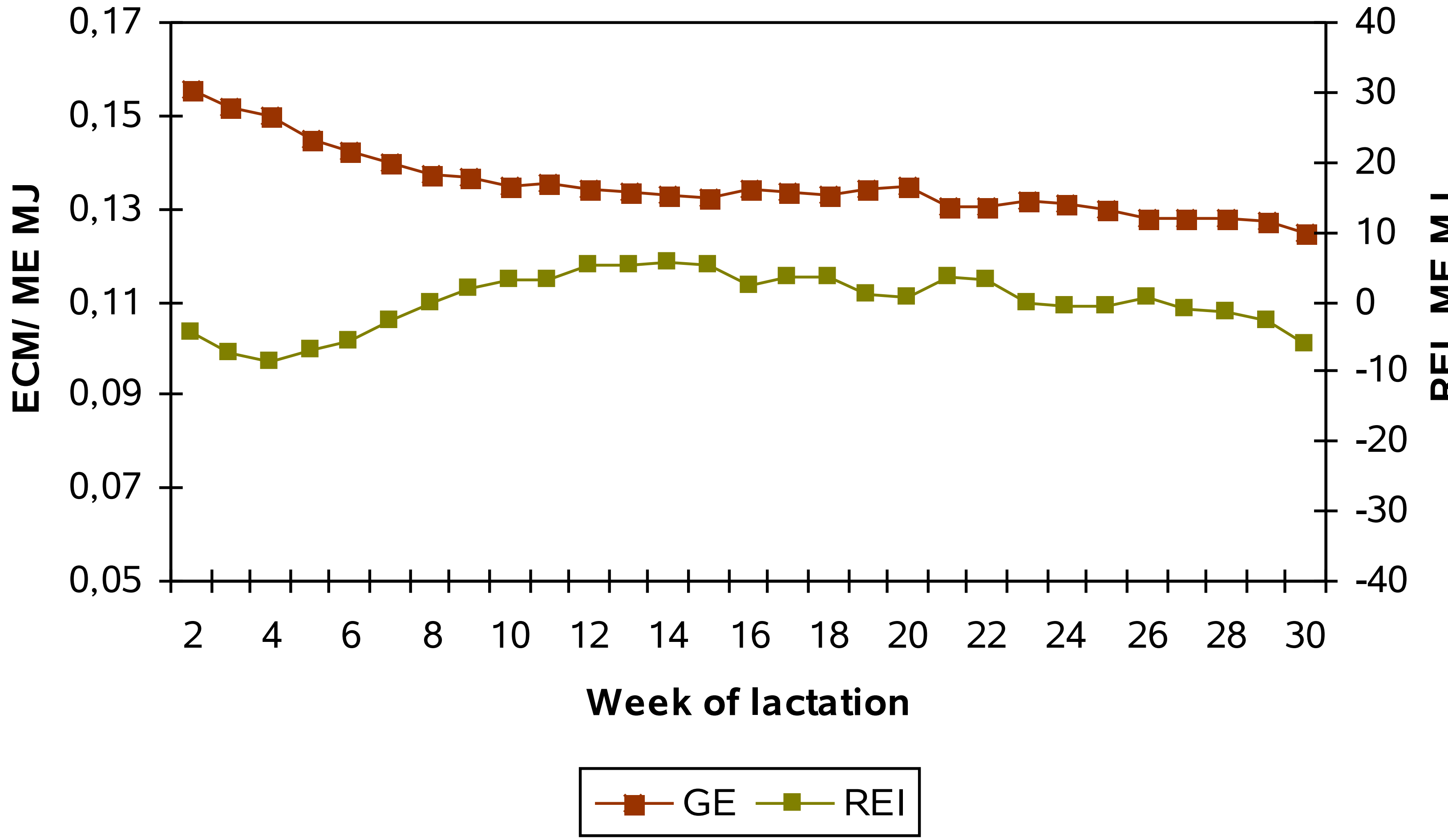
- Energy balance (P + G)
  - Energy intake - (need for maintenance + need for milk)
  - Requirements from official Finnish dairy feed tables
  - MJ ME/d
- Gross energy efficiency (P)
  - Milk energy output/energy intake
  - Calculated from data
  - Kg ECM / MJ ME
- Residual energy intake (P + G)
  - Energy intake - (need for maintenance + milk + BW gain or loss)
  - Requirements estimated from data, REI = cow-wise mean of prediction equation residuals
  - MJ ME/d

Phenotypic correlations

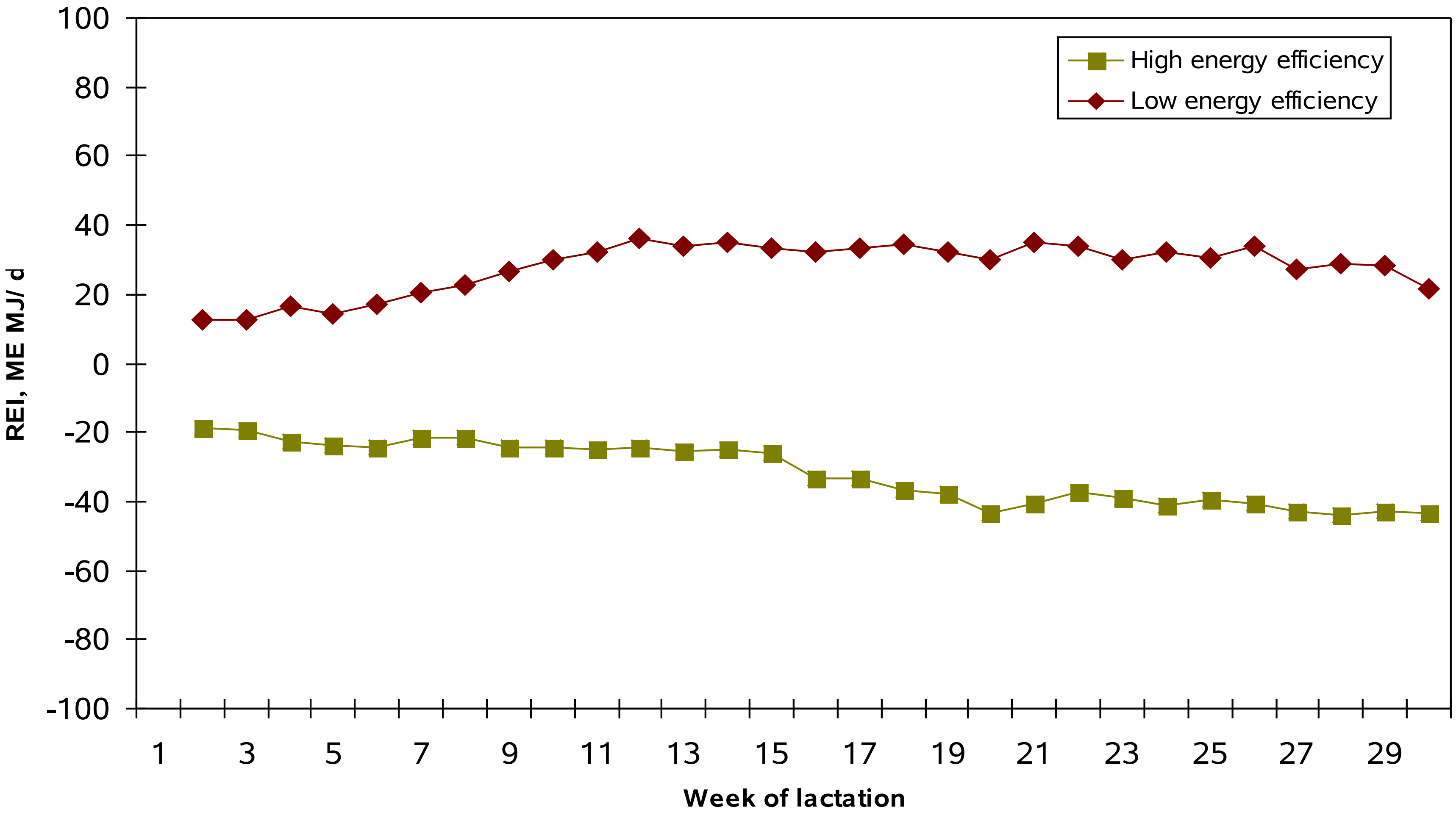
	ECM	DMI	BW	BW change	BCS	BCS change
GE[1]	0,41	-0,70	-0,16	-0,38	-0,14	-0,15
REI[2]	0,0	0,86	0,0	0,0	-0,04	0,03

[1] Higher value higher efficiency
[2] Lower value higher efficiency

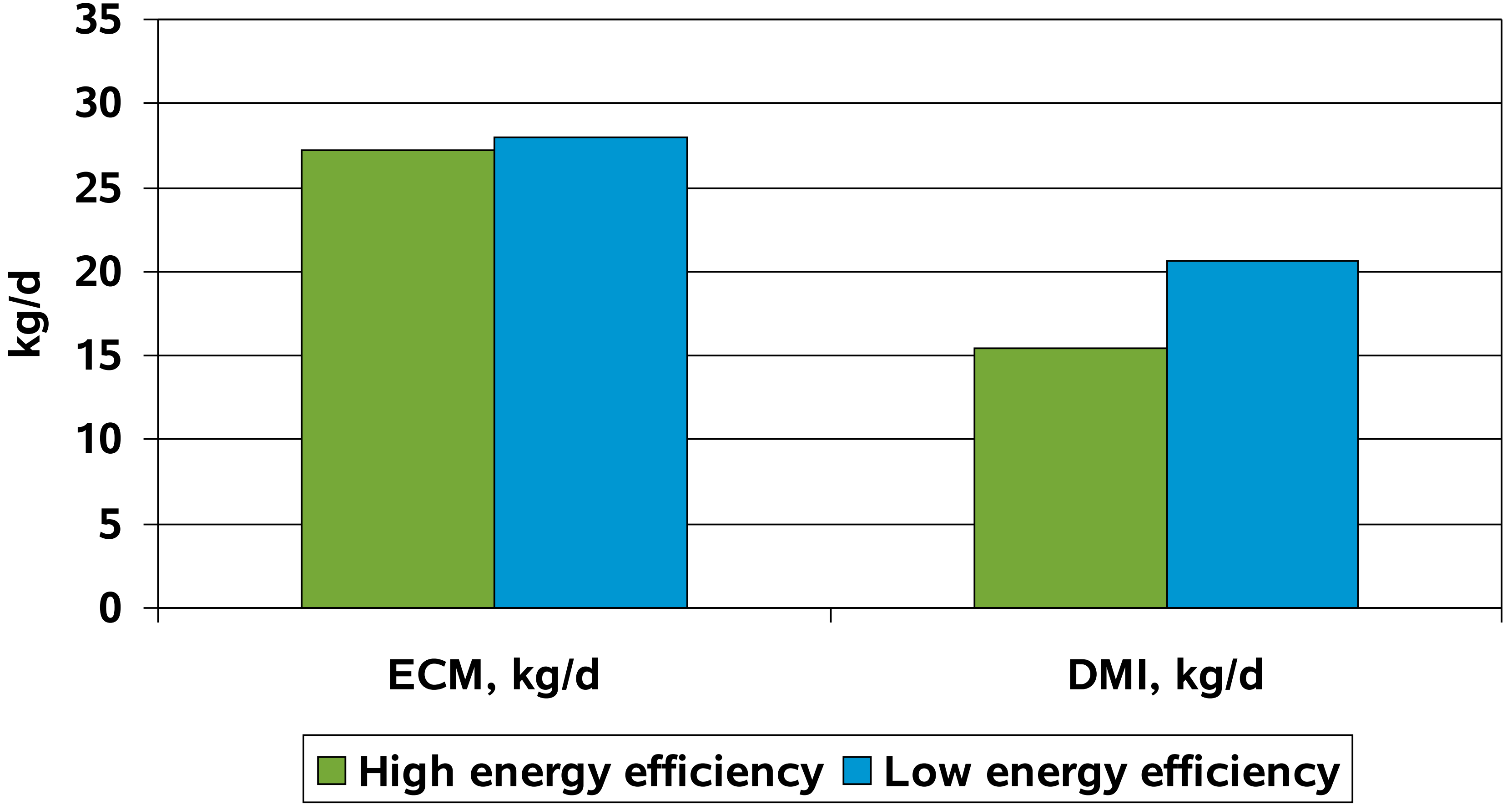
Phenotypic data: average energy efficiency in herd



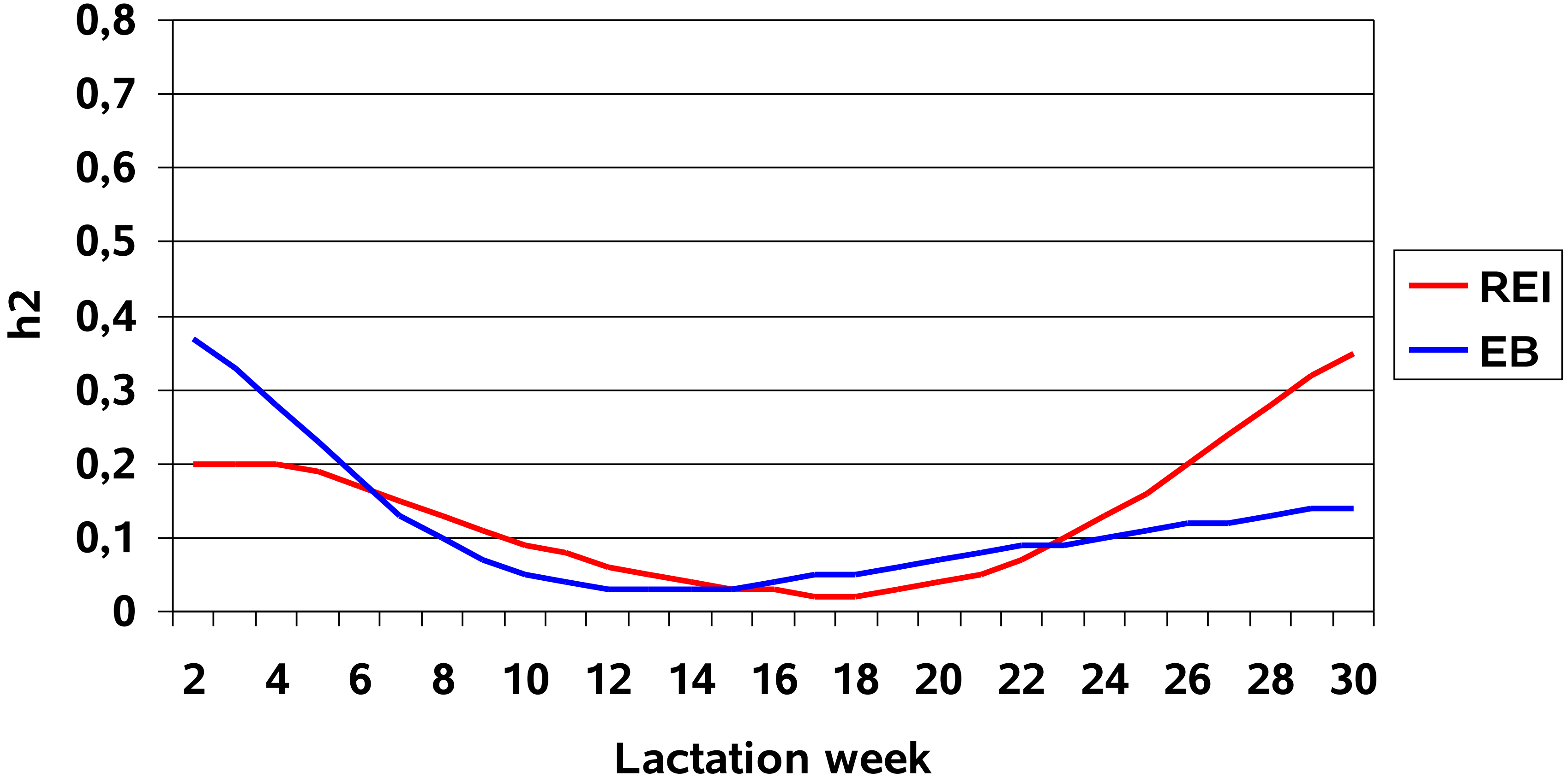
Phenotypic data: energy efficiency of 25% most and least efficient animals



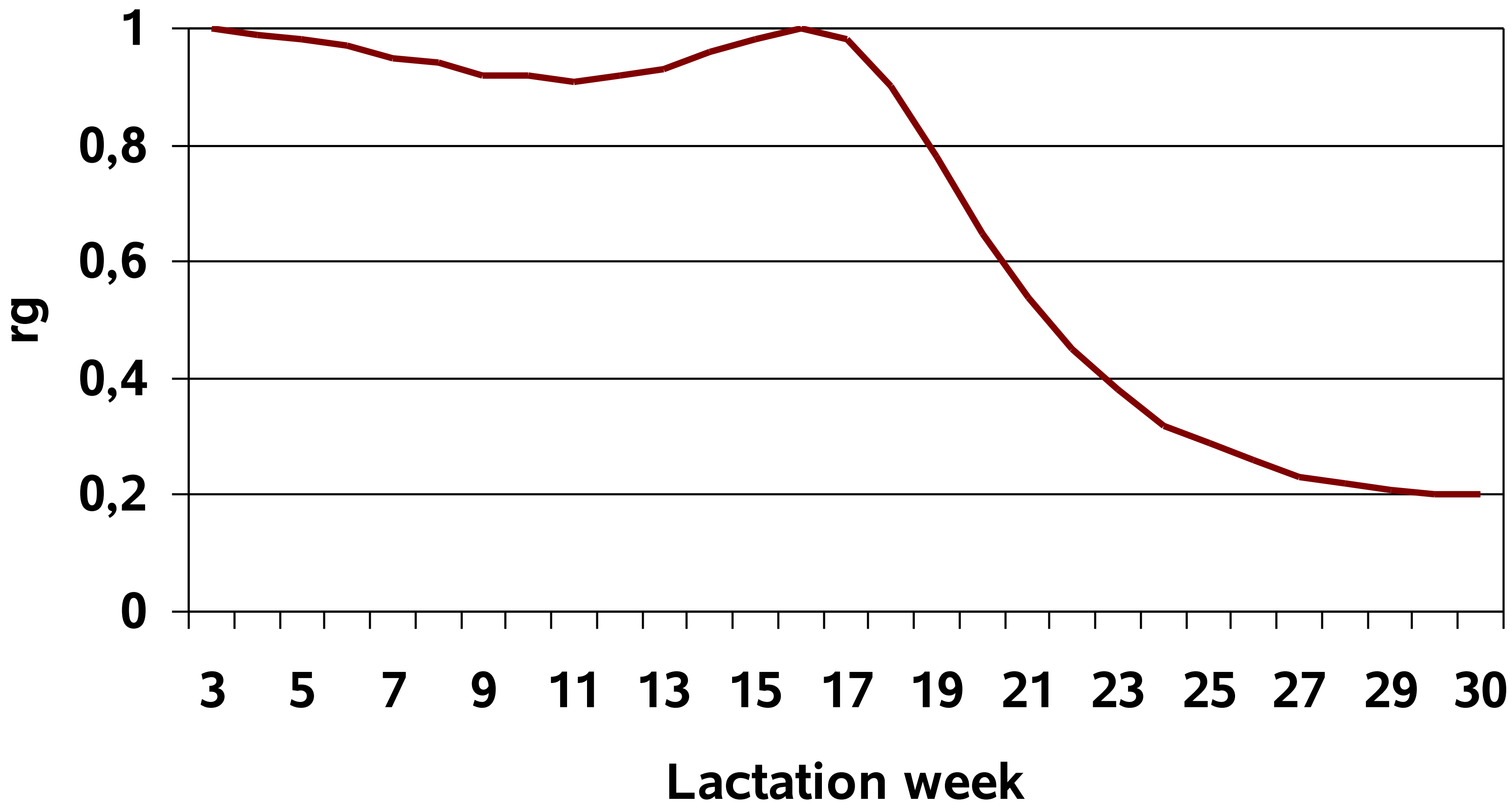
Phenotypic data: ECM and DMI of 25% most and least efficient animals



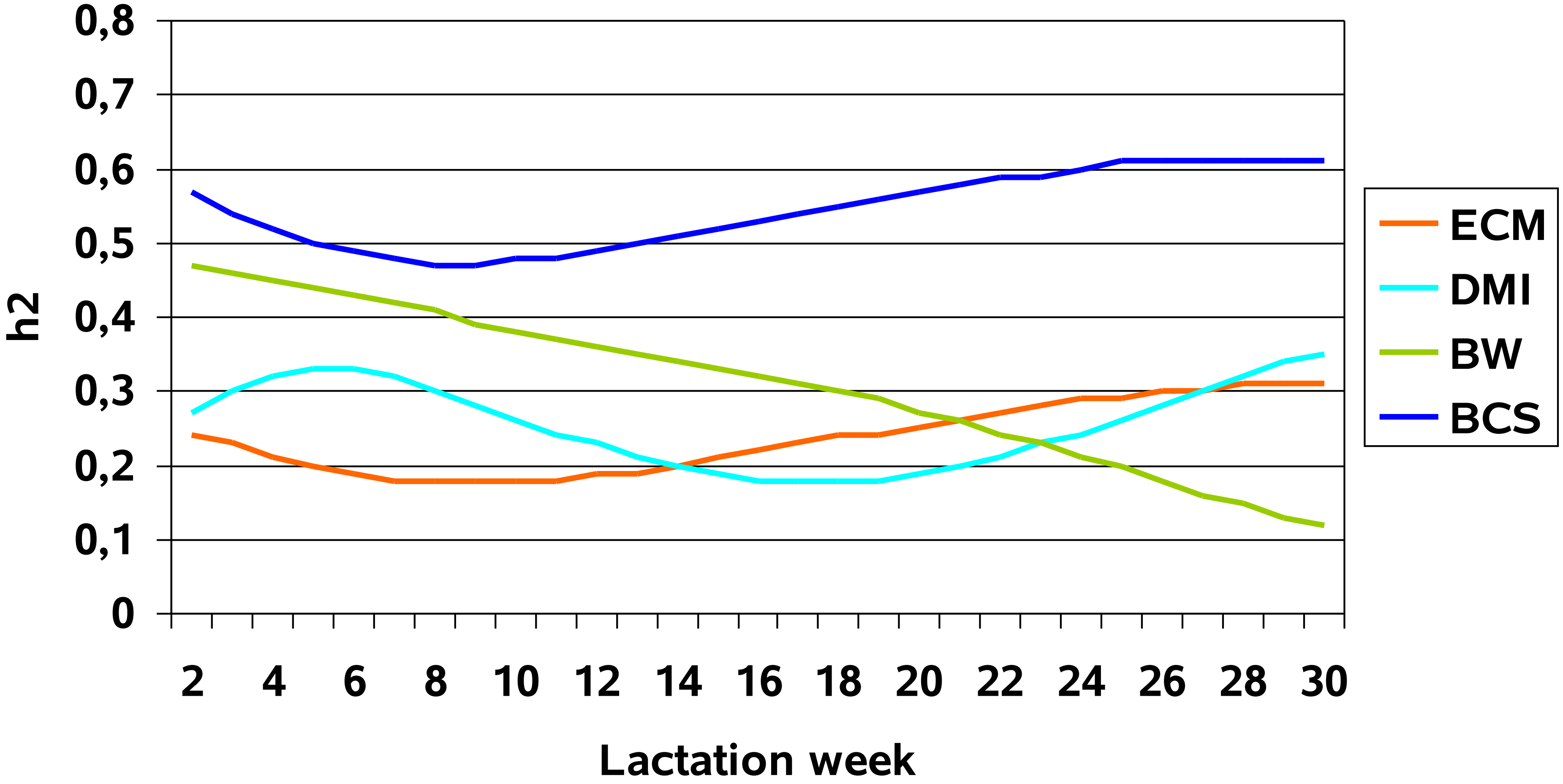
Heritability of energy efficiency



Genetic correlations of REI measured in lw 2 within lactation

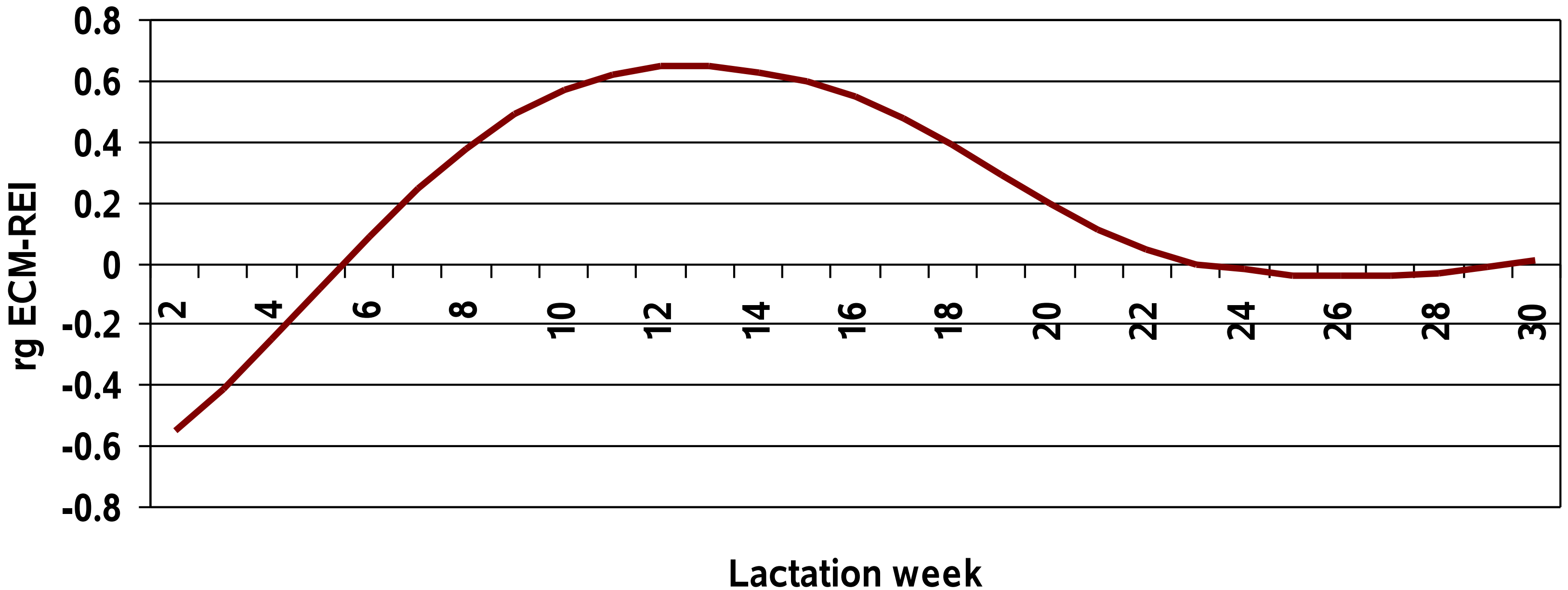


Heritability of production, intake and body weight and condition



Genetic correlations between REI and other traits

- Energy balance and dry matter intake:
  - Genetic correlations with REI **high and positive**
- Body weight and body condition score:
  - Genetic correlations with REI **moderate and positive**
- Energy corrected milk yield:



Conclusions

- Phenotypic (and genetic?) variation exists in REI
- On phenotypic level REI is uncorrelated with ECM, BW and BCS
  - Better trait for selection than GE and EB which are positively correlated with cow size?
- On genetic level REI **is** correlated with BW, BCS, DMI and EB
  - Genetic variation observed in REI is partly due to these other traits?
  - Favouring cows with low REI would lead to smaller cows with smaller intake and more negative EB
- Relationship of REI with milk production changes over lactation
  - When to select?

Thank you for your attention!