Modelling energy partitioning and milk production performance in grass based suckler beef systems

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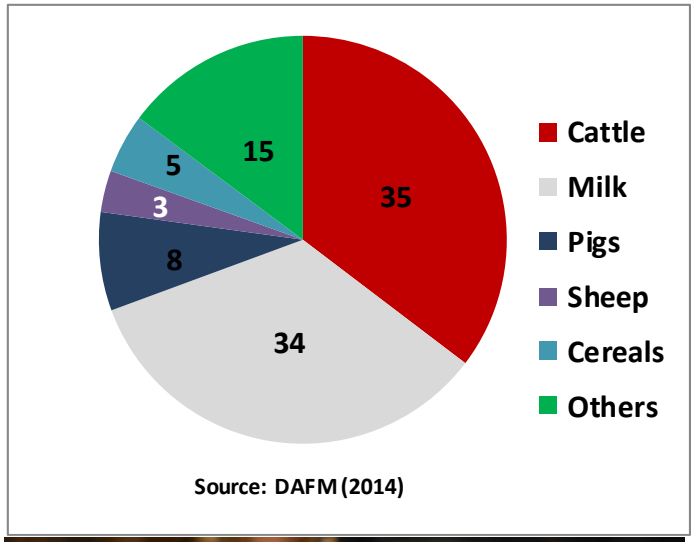
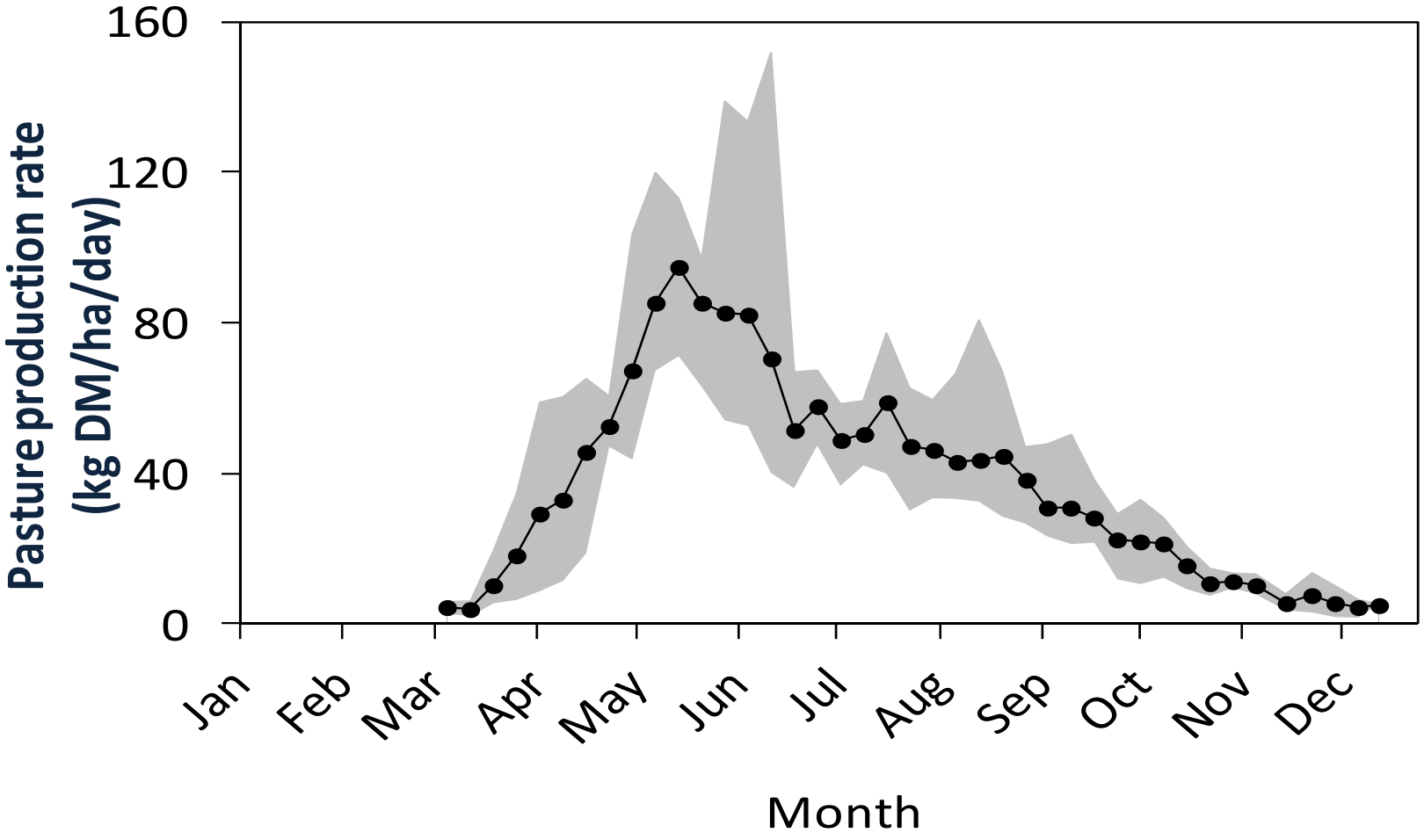
Background

Suckler beef production system in Ireland

- Beef sector accounts for 35% of agricultural output (DAFM, 2014)
- More than 50% of beef output value is from the suckler herd (DAFM, 2016)
- The most competitive advantage - Grass based production system (cost of production is lower)



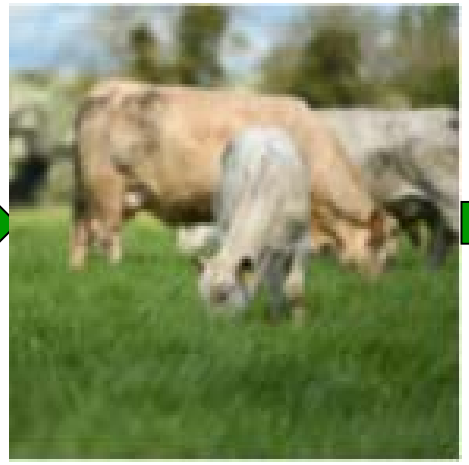
Grass production



Typical production cycle

Cows calve close to start of grazing season

Cows and calves graze together for first season at grass



Weaning of calves - autumn followed by housing

Weaning weight of calves -key output in suckler beef systems

Modelling

Strategies for improvement in key output

- It is necessary to know how the energy intake is transformed to
  - Homeostasis functions e.g. maintenance
  - Homeorhesis function e.g. pregnancy, lactation

↓

Impacts on productive outputs in suckler beef systems

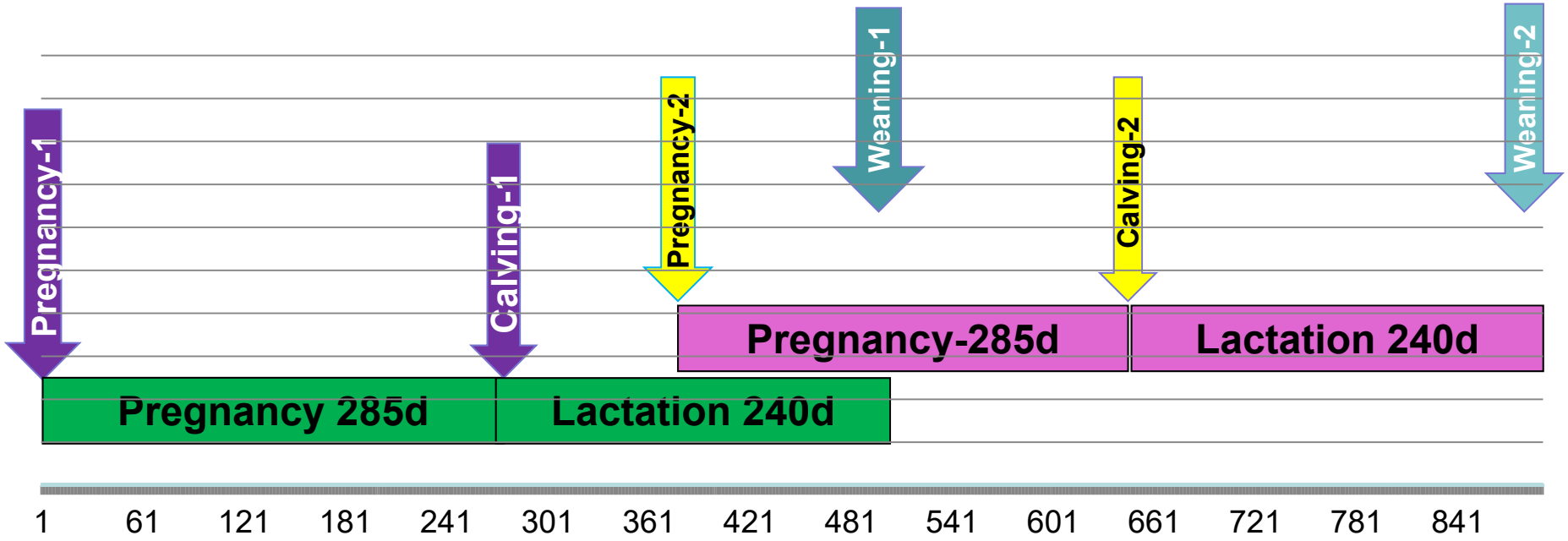
Modelling: -Low cost, no harm, timely and effective
-Models on animal and farm level
-Model on energy partitioning and production performance in grass based systems are lacking.

Objective

To develop a dynamic model of energy partitioning and milk production performance in grass based suckler beef systems.

Materials and methods

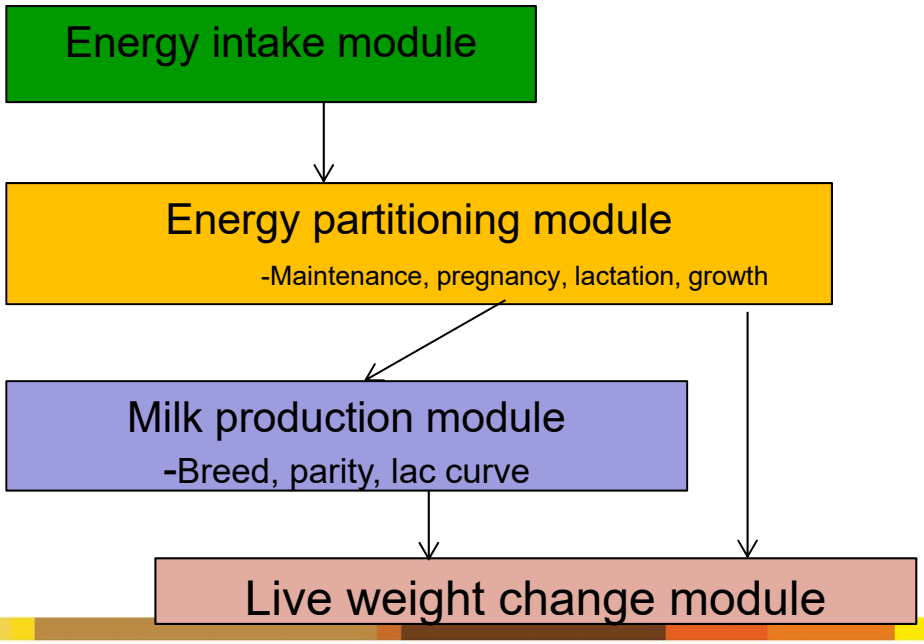
- Data and parameters-Published literature, INRAtion software
- Irish Net Energy System – UFL (I) (1 UFL=7.1 MJ)
- **Software:** A dynamic modeling - Stella (V9.0): day 1 to 890 days



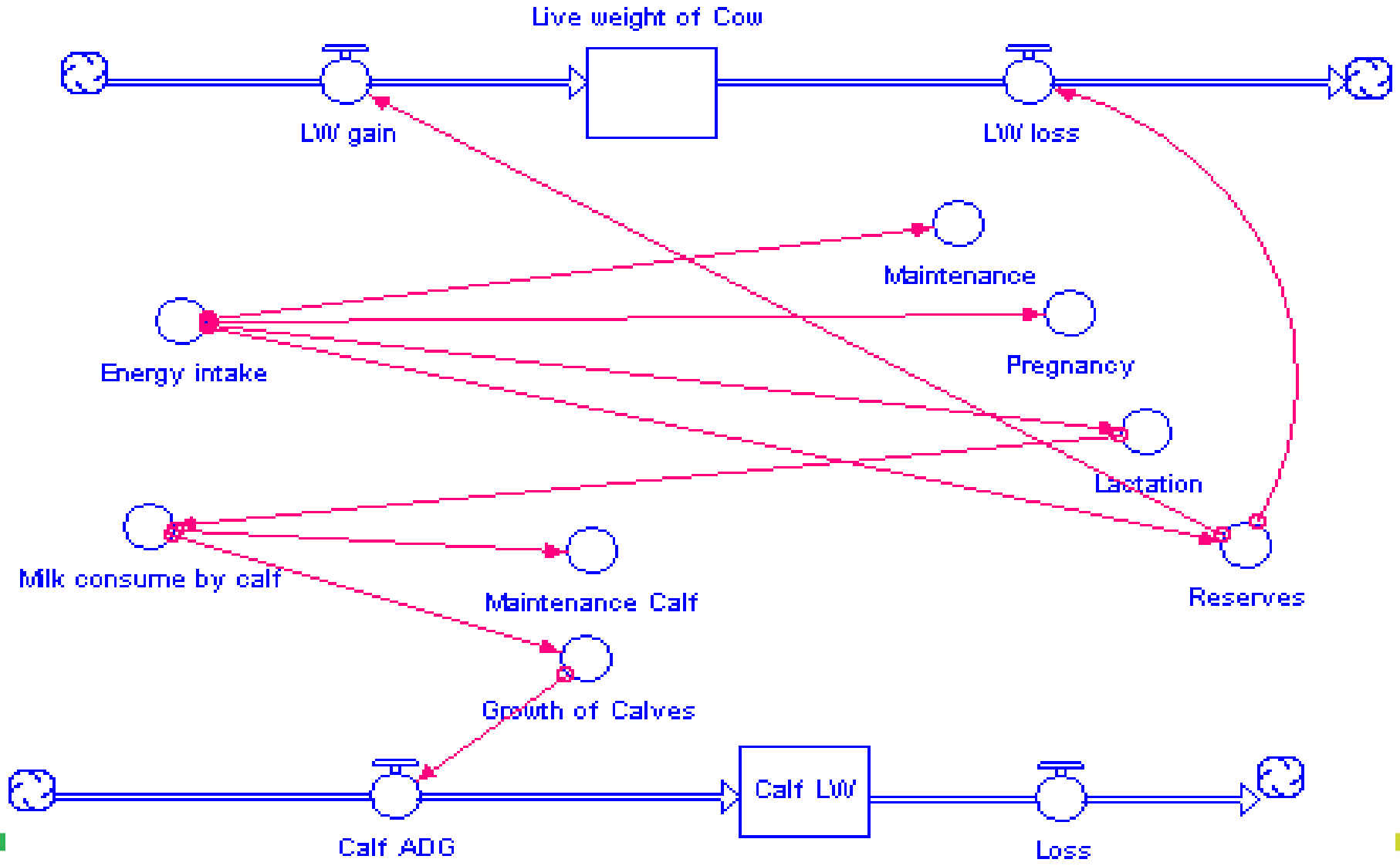
Model description

- Two suckler beef cow genotypes representing alternative suckler cow replacement strategies in Irish suckler herds are used
  - Beef –Late maturing beef cows (B)- sourced from suckler herds
  - Beef x Holstein Friesian (BF)- sourced from dairy herds

Model consists of 4 modules



Stella model



Energy calculation equations

❖Energy intake

- ➢ Grange Suckler Beef System Model (Crosson et al., 2006).

❖ Maintenance requirement (Jarrige, 1989; Jouven et al., 2008)

- ✓ $1.4+0.6 \times LW/100+0.099(2.5- BCS) \times (1+Grazing\ Activity)$ --------Eq 1

❖ Pregnancy requirement (O'Mara , 1996 ; Jouven et al, 2008)

- ✓ Parity 1= $0.0001 \times d^2 - 0.0170 \times d+0.312$ ----------Eq 2
- ✓ Parity 2= $0.0001 \times d^2 - 0.0158 \times d+0.312$ ----------Eq 3

❖ Milk production requirement (INRAtion, Crowley et al., 2001)

- ✓ 1 kg of milk produced = 0.45 UFL ---------- Eq 4
- ✓ Depends on lactation curve of the cows

Energy calculation equations

❖Lactation curve

➢Woods equation (Wood, 1967) fitted to Irish data for Beef and Beef dairy crossbred (McGee et al., 2005). Wood equation is: $y = at^b(e)^{-ct}$ where;

a= initial milk yield, b=increasing rate until peak

c= declining rate after peak and t= days in lactation

➢**Beef parity 1 and 2**

$6.9 \times t^{0.072} \times (e)^{-0.0022 \times t}$ ----------Eq 5

$7.8 \times t^{0.072} \times (e)^{-0.0018 \times t}$ ----------Eq 6

➢**Beef*Dairy parity 1 and 2**

$8.4 \times t^{0.068} \times (e)^{-0.0022 \times t}$ ----------Eq 7

$10.1 \times t^{0.068} \times (e)^{-0.0016 \times t}$ ----------Eq 8

❖ Cow performance (INRAtion, Jouven et al., 2008)

➢LW gain of 1 kg = 4.5 UFL

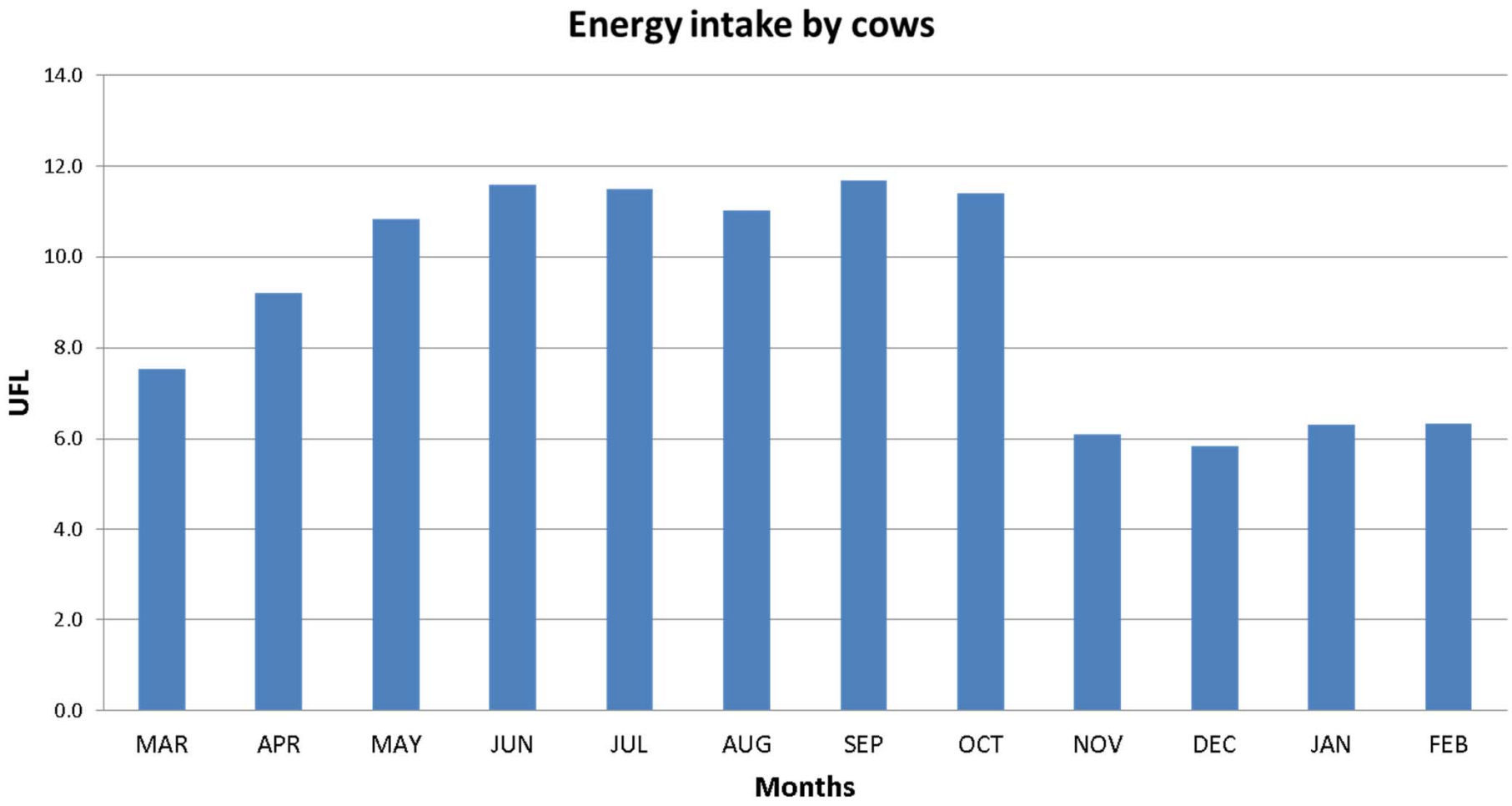
➢LW loss of 1 kg = 3.5 UFL.

➢LW initial = 440 kg (B) - 65% of Mature weight (680 kg)

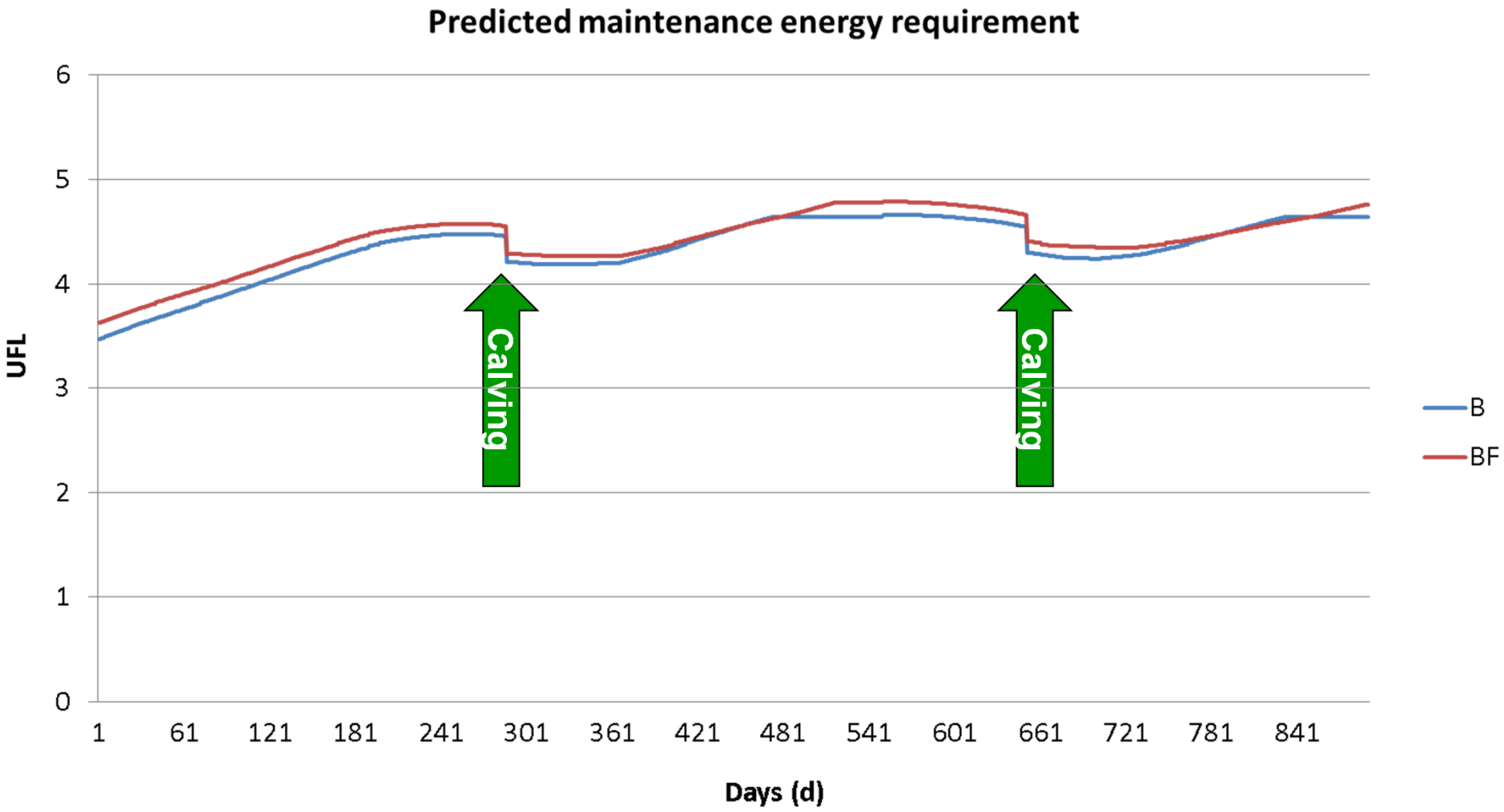
= 410 kg (BF) – 65% of Mature weight (630 kg)

= BCS initial = 2.0

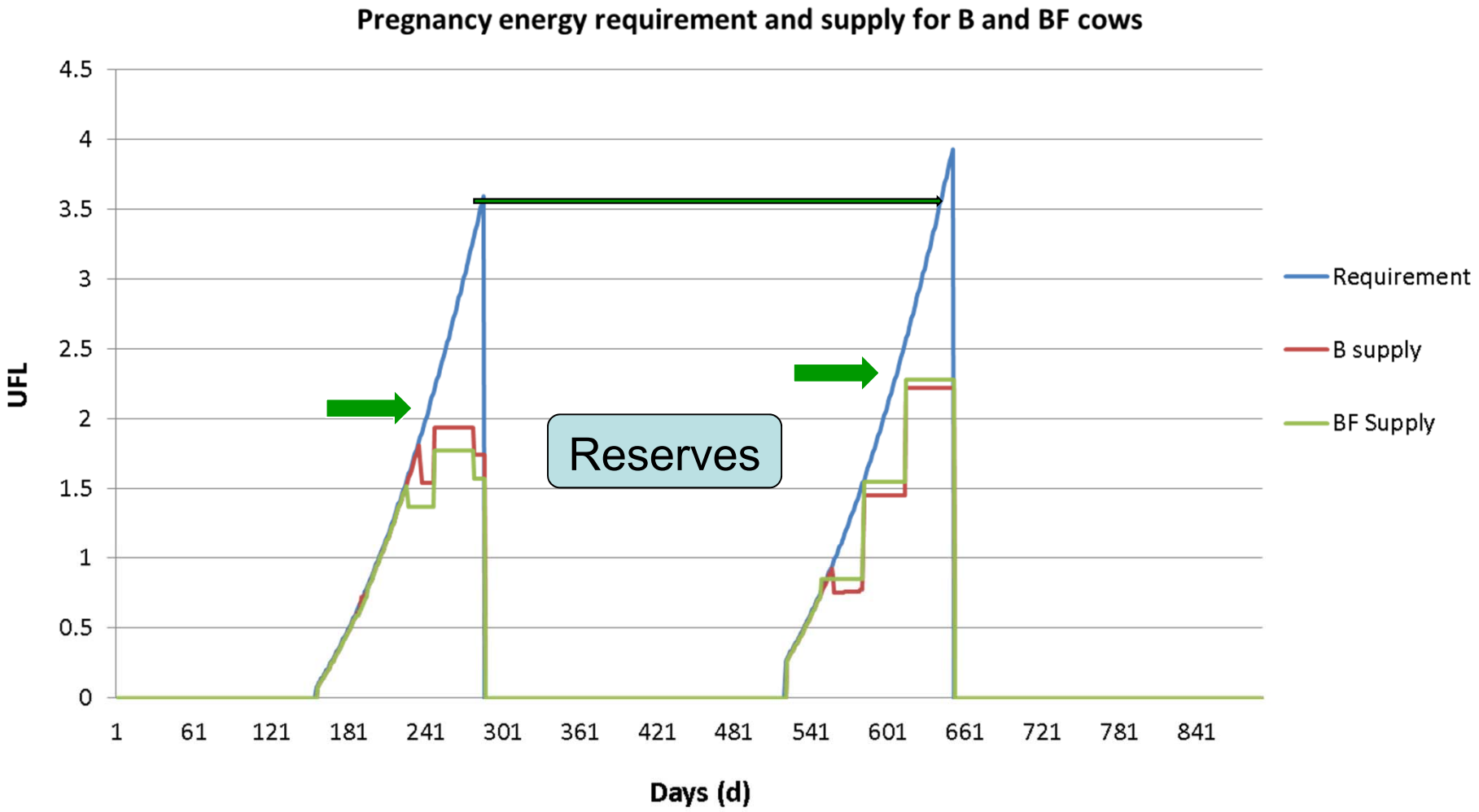
Results


Energy intake by cows
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
UFL
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
Months

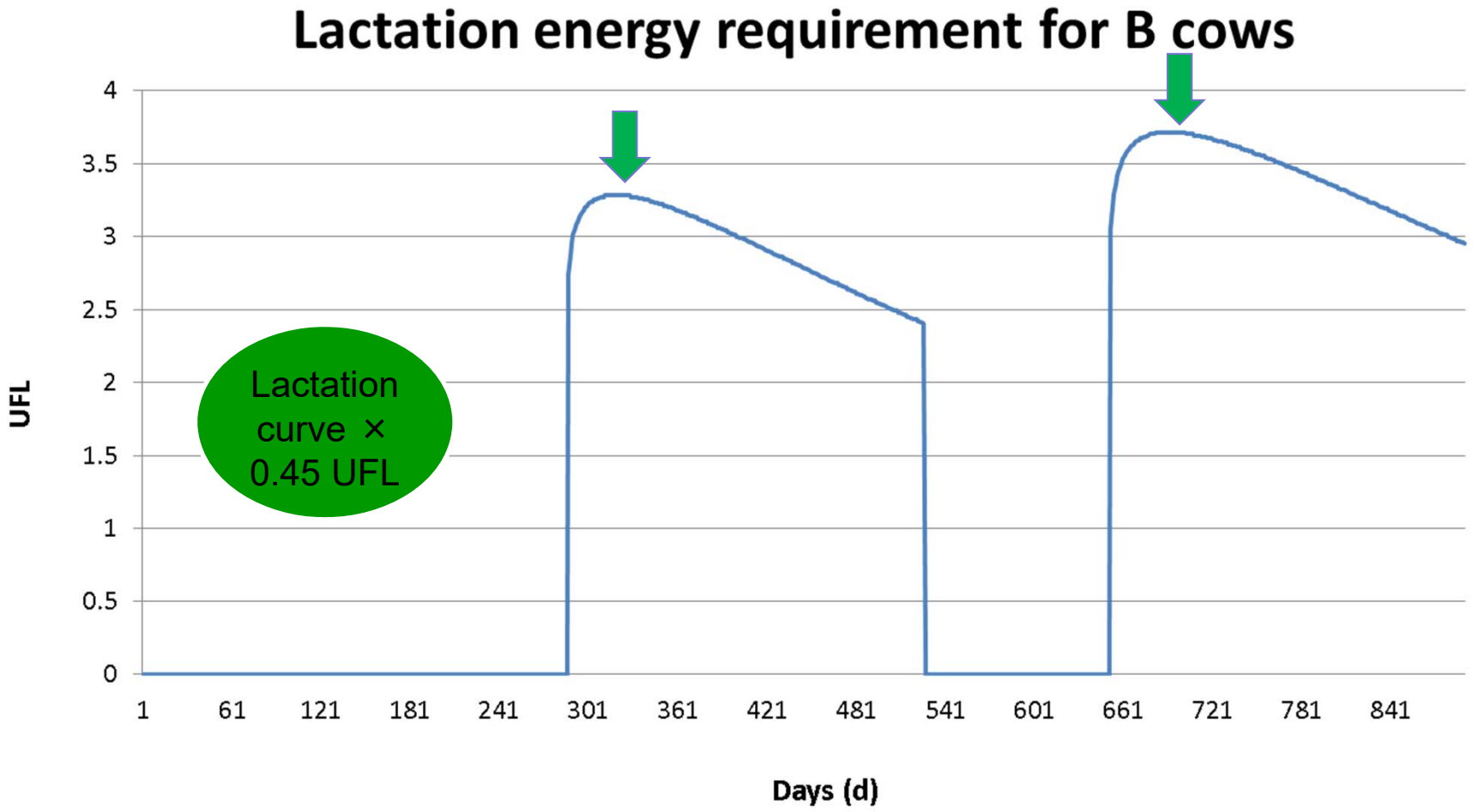
Maintenance requirement



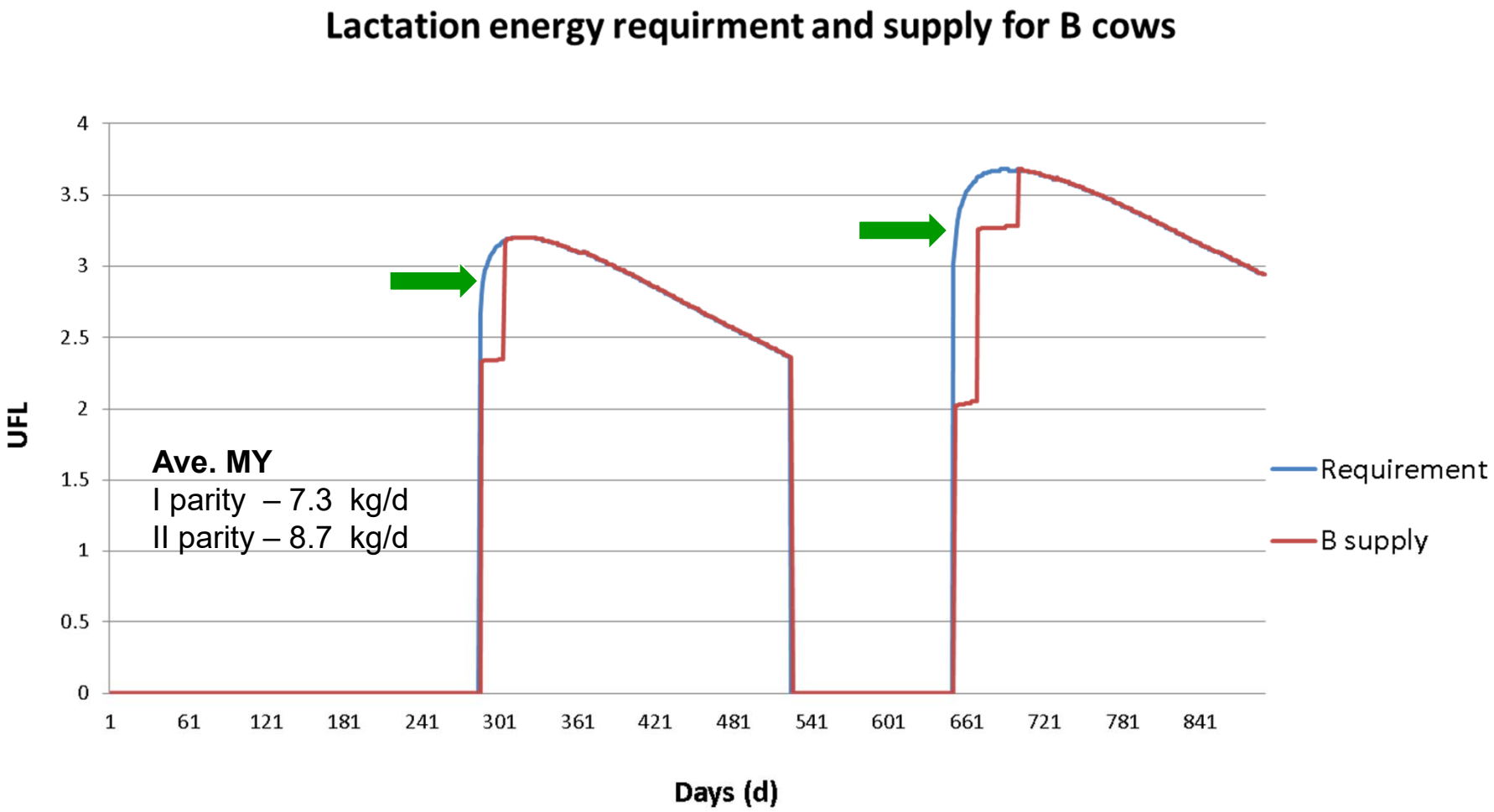
Pregnancy energy calculation



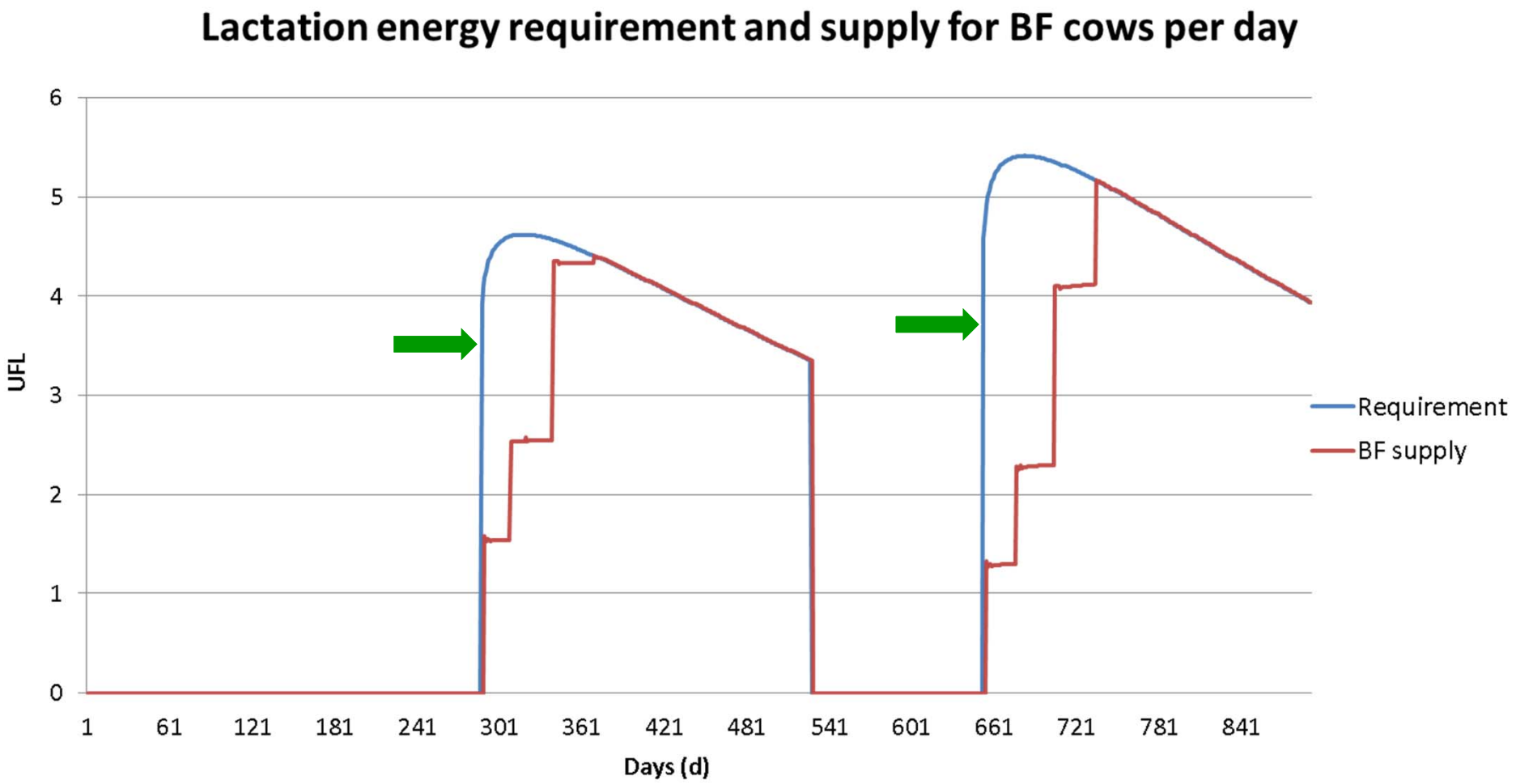
Lactation Energy



Lactation Energy



Lactation Energy



Live weight change of cow

Conclusion

- A dynamic model of energy partitioning and milk production performance has been developed
- Energy intake in suckler beef cows
  - Currently, it is limiting particularly late gestation and post calving (3 months)
- Milk production of cows
  - Ability of cows to mobilize live weight
- Future work will look on validation, expansion to calf model and economic analysis.

Thank You

Questions, Comments and Suggestions