Environmental RTDI Programme 2000–2006

CLIMATE CHANGE – Development of Emission Factors for the Irish Cattle Herd

(2000-LS-5.1.1-M1)

Special Report

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by

UCD School of Agriculture, Food Science and Veterinary Medicine

Author:

F. O'Mara

ENVIRONMENTAL PROTECTION AGENCY

An Ghníomhaireacht um Chaomhnú Comhshaoil
PO Box 3000, Johnstown Castle, Co. Wexford, Ireland

Telephone: +353 53 916 0600 Fax: +353 53 916 0699
E-mail: info@epa.ie Website: www.epa.ie

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DISCLAIMER

CLIMATE CHANGE

The Climate Change Section of the Environmental RTDI Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in this area. The reports in this series are intended as contributions to the necessary debate on climate change and the environment.

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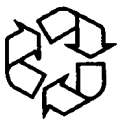

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Details of Project Partner

Frank O'Mara
UCD School of Agriculture, Food Science and Veterinary Medicine
Agriculture and Food Science Centre
Belfield
Dublin 4
Ireland

Tel: +353 1 7167142
Fax: +353 1 7161103
E-mail: frank.omara@ucd.ie

Table of Contents

Executive Summary

The Intergovernmental Panel on Climate Change (IPCC) (1996) suggests that countries with large animal populations should develop specific emission factors for greenhouse gas emissions, and move their inventory from a Tier 1 (using default emission factors) to a Tier 2 (using country-specific emission factors) methodology. Emission factors for methane from enteric fermentation and manure management were developed for the categories of the Irish cattle herd for which data on animal numbers are available from the Central Statistics Office (CSO). The process of deriving these emission factors for each category had the following main steps:

- The country was divided into three regions coinciding with the regions of the Nitrates Directive where it was possible to work out the proportion of animals in each region. This was possible for dairy and beef (suckler) cows, but not for the other categories of animals. In these cases, the country was treated as a single region. For most categories of animals, subcategories were created to give a more accurate assessment of their emissions. Thus 12, 18, 13 and 14 subsystems were modelled for dairy cows, beef cows, non-breeding beef females and non-breeding beef males, respectively.

- The production system in each region was defined in terms of animal performance and characteristics such as size, calving date, and dates of winter housing and spring turnout to grass. In addition the diet of the animals was defined in terms of type and quality of forage fed, and amount and quality of concentrates fed.

- The energy requirements of the animals were defined for each month based on the animals' requirements for maintenance and production, and from this the quantities of feed consumed were calculated.

- From the quantities of feed consumed, daily methane emissions were calculated and summed to give an annual emission. The annual emissions of the subcategories within a category were then combined on a weighted basis to give a single national emission factor for the category.

- From the quantities of feed consumed, daily output of manure organic matter (OM) was calculated while animals were at pasture, and during the 'housing period'. For the latter period, the proportion of manure going into slurry or solid manure type systems was calculated (and account was taken of the proportion produced by out-wintered animals). Methane emissions for manure management were then calculated and the annual emissions of the subcategories within a category were then combined on a weighted basis to give a single national emission factor for the category.

- The process was repeated for 1990, changing any parameters where it was appropriate, and where data existed to allow the change to be made.

The emission factors so derived are summarised in Table 1. There are many differences in comparison to the default factors recommended by the IPCC (1996). These differences reflect the different production systems in Ireland.

It was apparent that the use of the average of June and December livestock numbers from CSO data leads to an anomaly when these specific emission factors are used with non-breeding beef cattle. What is needed is the best estimate of the number of animals that fall into the category each year, and the June data give these estimates before significant numbers of animals are removed from the national herd for slaughter.

The implications for the national inventory of emissions from the cattle herd (both enteric fermentation and manure management) are shown in Fig. 1. The specific Irish Tier 2 values give higher total emissions than the current Tier 1 methodology for both 1990 and 2003, and using June-only numbers for non-breeding cattle gives a further increase. However, the drop in current emissions relative to 1990 is greater using the Tier 2 approach than the current Tier 1 methodology (3,600 t *vs* 10,500 t), and using June numbers further increases the reduction (16,900 t).

It is recommended that:

i. The national inventory for methane from enteric fermentation and manure management is calculated on a Tier 2 basis using these emission factors.

ii. The June cattle numbers (Central Statistics Office) should be used to calculate the Tier 2 inventory for non-breeding cattle.

Table 1. Methane emission factors (kg/head/year) for enteric fermentation and manure management for 2003 and 1990.

	2003		1990	
	Enteric	**Manure**	**Enteric**	**Manure**
Dairy cows	108.8	20.53	101.38	21.57
Beef (suckler) cows	74.2	13.9	74.03	14.02
Male cattle				
<1 year	29.53	8.5	30.46	9.73
1–2 years	60.37	14.25	62.22	16.68
>2 years	34.27	1.48	55.08	4.57
Female cattle				
<1 year	27.86	8.28	27.05	8.79
1–2 years	44.6	9.34	53.54	14.74
>2 years	22.46	0.34	21.65	0.33
Bulls for breeding	81.55	18.95	86.38	23.79
In-calf heifers – dairy	50.16	10.93	51.82	13.4
In-calf heifers – beef	53.58	12.87	55.42	15.61

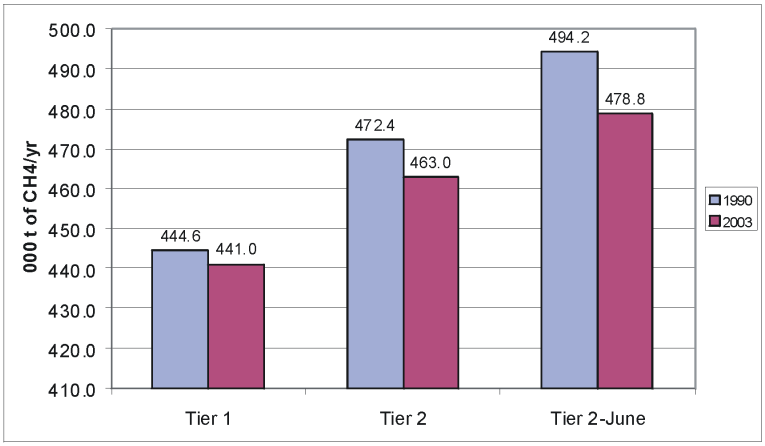

Figure 1. National emissions of methane from enteric fermentation and manure management for 1990 and 2003 using Tier 1 default values, Tier 2 specific Irish emission factors, and using specific Irish emission factors in combination with June animal numbers for non-breeding beef cattle.

1 Introduction

This offprint is part of the Final Report on Project LS-5.1.1 *Methane and Nitrous Oxide Emission Factors*. It reports on emission factors for methane from enteric fermentation and manure management from the Irish cattle herd. These specific Irish emission factors will allow the inventory move from Tier 1 to Tier 2. The Intergovernmental Panel on Climate Change (IPCC) (1996) recommends a Tier 2 approach (i.e. country-specific emission factors) for countries with large cattle populations. Specific emission factors were developed herein, following the same structure as outlined by the IPCC (2001). Separate emission factors were developed for the classes of cattle for which the Central Statistics Office (CSO) publishes annual statistics (Table 1.1).

Table 1.1. Animal categories for which emission factors were developed.

Dairy cows
Beef cows
Cattle <1 year old, male
Cattle <1 year old, female
Cattle 1–2 years old, male
Cattle 1–2 years old, female
Cattle >2 years old, female
Cattle >2 years old, male
Bulls for breeding
In-calf heifers, dairy
In-calf heifers, beef

2 Emission Factors for Dairy Cows

2.1 Materials and Methods

The process had five main steps.

1. Firstly, the country was divided into three regions: 1) south and east, 2) west and midlands, and 3) north west, based on slurry storage requirements of local planning authorities and coinciding with the regions used in the Nitrates Directive. This was an effort to divide the country into regions with different lengths of winter housing and feeding practices. The counties in each region are shown in Table 2.1. The number of cows in each region was obtained from the Cattle Movement and Monitoring System (CMMS) (2003). The total number of cows according to the CMMS (2003) differs slightly from CSO statistics. As the latter are the official statistics, these are used for final inventory calculations, while the CMMS (2003) data are used to determine the proportional breakdown by region. Data on dairy cow populations (from both the CSO and CMMS) are shown in Appendix 1.

2. The production system in each region was defined (data source in parentheses) in terms of calving date (CMMS, 2003), dates of winter housing and spring turnout to grass (expert opinion with reference to slurry storage requirements), milk yield and composition (CSO national statistics for total milk intake and cow numbers, with estimates of on-farm consumption from B. Fingleton, Teagasc, personal communication), concentrate feeding level (Department of Agriculture and Food national statistics on concentrate production and a farm survey conducted in 2003 involving 255 farms with spring-calving dairy cows and 43 farms with autumn-calving cows), forages fed (farm survey), cow live weight, live-weight change and lactation length (Buckley *et al.*, 2003).

3. The daily energy requirement of cows in each region was calculated by month or part thereof based on maintenance requirements, milk yield and composition, requirements for foetal growth, and gain or loss of body weight (l'Institut National de la Recherche Agronomique (INRA), 1989). In this system, net energy requirement is defined in terms of units of feed for lactation (UFL), where 1 UFL is the net energy value of 1 kg of barley at 86% dry matter (DM) and is equal to 7.1 MJ net energy for lactation (NE_l). This international energy system used locally in Ireland was considered more appropriate to the local conditions than the system and equations used by the IPCC (1997 and 2000).

   The important equations were:

   (i) Maintenance NE_l requirements (MJ) = 9.96 +

Table 2.1. Counties assigned to each of the three regions, and number of dairy cows per county in 2003.

Region 1		Region 2		Region 3	
Carlow	10,068	**Clare**	32,018	**Cavan**	33,490
Cork	265,158	**Galway**	29,270	**Donegal**	15,401
Dublin	2,937	**Kerry**	92,845	**Leitrim**	2,613
Kildare	12,559	**Limerick**	94,529	**Monaghan**	34,250
Kilkenny	51,850	**Longford**	7,954		
Laois	26,642	**Louth**	12,806		
Offaly	20,502	**Mayo**	22,281		
Tipperary	109,383	**Meath**	39,458		
Waterford	52,342	**Roscommon**	6,512		
Wexford	47,618	**Sligo**	9,769		
Wicklow	17,388	**Westmeath**	15,218		
Total	**616,447**		**362,660**		**85,754**

Source: CMMS (2003).

(0.6 × LW/100), where LW is live weight (divide by 7.11 to convert to UFL). A 10% activity allowance was added for the housed period, and a 20% allowance added for the grazing period as outlined by INRA (1989).

(ii) NE_l (MJ) required per kg milk = ((0.376 × fat%) + (0.209 × protein%) + 0.948)
(divide by 7.11 to convert to UFL)

(iii) Pregnancy: mean of 12.1 MJ NE_l/day for the last 3 months of pregnancy (divide by 7.11 to convert to UFL)

(iv) Live-weight change: each kg of live weight lost contributed 24.9 MJ NE_l to energy requirements, while each kg of live weight gained required 32 MJ NE_l (divide by 7.11 to convert to UFL).

4. The composition of the diet of cows in each region was described by month or part thereof and daily intake and was calculated by reference to the daily energy requirement. The concentrate allowance was fixed while forage intake varied according to energy requirements. Details of concentrate and forage composition are shown in Appendix 2.

5. Daily methane emissions (MJ/day) were calculated from digestible energy intake using the equation of Yan *et al.* (2000):

$$DEI(0.096 + (0.035 \times S_{DMI}/T_{DMI})) - (2.298 \times (FL - 1))$$

where DEI is digestible energy intake (MJ/day), S_{DMI} and T_{DMI} are silage and total DM intakes (kg/day), respectively, and FL is feeding level (multiples of maintenance energy requirement). However, a constant methane conversion rate of 0.065 of gross energy (GE) intake was applied when the diet was grazed grass plus 3 kg or less of concentrate supplement/day. This was based on a large New Zealand database of grazing animal measurements on similar production systems as in Ireland. (In New Zealand, a methane output of 21.6 g/kg DM for pasture diets is used, which with a grass GE content of 18.45 MJ/kg is equivalent to 6.5% of GE. Harry Clark, AgResearch, New Zealand, personal communication). The daily emissions were summed to give annual emissions for cows in each region, and a weighted national average was then calculated.

2.2 Results

2.2.1 Emission factor for methane from enteric fermentation

In 2003, there were a total of 1.146 million dairy cows in Ireland according to the CSO data (mean of June and December data). National average milk yield was calculated from CSO statistics of monthly milk deliveries, divided by the average number of cows based on June and December figures published by the CSO. This gave an annual milk yield of 4,674 kg for 2003. This was increased by 301 kg to 4,975 kg to account for on-farm consumption (personal communication, B. Fingleton, Teagasc; data based on National Farm Survey). This average was applied irrespective of region or calving date (and was assumed to be the same for spring- and autumn-calving cows). Statistics of milk production are shown in Appendix 1. Annual yield was allocated to each month using lactation curves (L. Shalloo, Teagasc, personal communication) and a 262-day lactation in the case of spring-calving cows (based on data of Buckley *et al.*, 2003) and a standard 305-day lactation for autumn-calving cows. Monthly milk fat and protein contents were also estimated by the lactation curves.

Mean live weight of cows was taken as 538 kg (Buckley *et al.*, 2003). Cows were assumed to lose approximately 30 kg live weight post-calving, and to regain this amount plus an additional 35 kg in late lactation. The extra gain per lactation allowed for growth of animals between lactations.

Mean calving dates of spring-calving dairy cows were 9, 14 and 18 March for Regions 1, 2 and 3, respectively, according to the CMMS (2003). Details are shown in Appendix 1. Calving spread was accommodated by having one-third of cows calving on these dates, one-third calving 4 weeks earlier, and one-third calving 4 weeks later. Thus, nine spring-calving systems were described (3 regions × 3 calving dates).

The mean calving date of autumn-calving cows was 3 October (CMMS, 2003). The CMMS (2003) data did not allow this to be separated by region. Autumn-calving cows were therefore assigned the same calving date in each region. Thus, three autumn-calving systems were described in addition to the nine spring-calving systems.

Turnout dates for both spring- and autumn-calving cows were set at 1 March, 8 March and 22 March in Regions 1,

2 and 3, respectively. For early-calved cows, turnout was initially by day only, for 7 days (considered as part of the grazing period), and then by day and night. Cows that had not calved by the turnout date for their region were assumed to be kept indoors until they calved, and for a further 7 days after calving if calved before 15 March and 3 days if calved after 15 March. For these cows, there was no turnout period by day only. Taking these considerations into account, turnout dates averaged 15 March, 21 March and 29 March for Regions 1, 2 and 3, respectively.

Housing dates were set at 29 November, 22 November and 8 November for Regions 1, 2 and 3, respectively. This gave winter housing periods of 16, 17.8 and 21 weeks for Regions 1, 2 and 3, respectively. Housing and turnout dates were set using expert opinion, but with reference to Co. Council requirements for slurry storage (16, 18 and 22 weeks for Regions 1, 2 and 3, respectively).

Forages fed after housing but before drying off were predominantly grass silage. The other forages likely to make a substantial contribution to the diet were maize silage and whole-crop wheat silage. The numbers of farmers who reported feeding either of these in the Farm Survey are shown in Table 2.2. While feeding these forages could have an impact on methane emissions, their usage on a national level is small, and it was decided to assume that grass silage was the only forage used during the winter.

The DM (and organic matter, OM) digestibility of the grass silage was put at 700 g/kg, which is close to the average of samples tested by Teagasc for 2001–2004 inclusive (691 g/kg; Siobhan Kavanagh, Teagasc, personal communication). The value for dairy cows was put slightly higher than the average as it was felt that dairy farmers were likely to make the highest quality silage. Silage of this digestibility has a gross energy content of 18.8 MJ/kg DM (MAFF, 1992). The GE digestibility coefficient is typically 0.03 (proportionally) lower than the OM digestibility (OMD) coefficient, and was therefore set at 0.67 giving a digestible energy (DE) content of 12.6 MJ/kg DM. The net energy value of the silage was calculated from the DM digestibility (DMD) to be 5.6 MJ NE_l/kg DM (0.785 UFL/kg DM; O'Mara *et al.*, 1997). The ash content of the silage was set at 94 g/kg DM, giving an OM content of 906 g/kg. This was based on MAFF (1992) data for silages with metabolisable energy (ME) values between 10 and 12 MJ/kg DM. Details of silage composition are shown in Appendix 2.

The net energy value of the concentrate was assumed to be 7.6 MJ NE_l /kg DM (1.07 UFL/kg DM). This was based on a mixture of the raw materials typically used in concentrates in Ireland (barley, beet pulp, maize gluten feed, maize distillers grains, rapeseed meal, cottonseed meal, soybean meal, expeller palm kernel meal, molasses and a mineral/vitamin mixture). The OM of this mixture was 942 g/kg with an OMD of 0.782, while the GE and DE were 18.8 and 14.7 MJ/kg DM, respectively. Details of concentrate composition are shown in Appendix 2.

The GE of the grass was set at 18.8 MJ/kg DM. This was based on data from MAFF (1992) and was the average of tabulated vales for fresh grass, all species, with ME 10–12 and ME >12 MJ/kg DM. Ash content on the same basis was 80 g/kg DM. OMD was assumed to be 800, 780 and 740 g/kg for the periods (i) up to end of May, (ii) June–August, and (iii) September onwards, while net energy contents were set at 7.4, 7.3 and 7.0 MJ NE_l/kg DM (1.04, 1.02 and 0.98 UFL/kg DM) for the same periods

Table 2.2. Number and percentage of farms feeding maize silage or whole-crop wheat (WCW) to dairy cows by region in 2003.

	Region 1		Region 2		Region 3	
	No. of farms	% of farms	No. of farms	% of farms	No. of farms	% of farms
After housing						
Maize silage	10	7.4	2	2.2	0	
WCW silage	2	1.5	0		0	
Dry period						
Maize silage	4	3.0	0		0	
WCW silage	1	0.7	0		0	
After calving						
Maize silage	12	8.9	5	5.6	1	3.3
WCW silage	6	4.4	0		0	

(L. Shalloo, Teagasc, personal communication). Details of grass composition are shown in Appendix 2.

The Farm Survey provided data on concentrate feeding levels (Table 2.3). In the questionnaire, farmers were asked to indicate their level of certainty about these concentrate levels on a scale of 1 (excellent) to 4 (poor). Respondents with a level of 4 were excluded, leaving data from 255 farms included. When these quantities of concentrates were inputted into the dairy cow systems and weighted by the number of cows in each system, the mean concentrate intake of dairy cows was lower than the total quantity of dairy concentrate produced in the country. Therefore an adjustment factor of 1.3 was introduced into the dairy cow systems, and all the concentrate intakes shown in Table 2.3 were multiplied by this adjustment factor. This gave a mean concentrate intake of 789 kg/year per cow, which is almost exactly the same as total dairy concentrate production (Appendix 1) divided by the total number of dairy cows (770 kg/head).

Data on calving, turnout and housing dates, and annual intakes of pasture, silage and concentrate are summarised in Table 2.4 for each region. Cumulative annual (2003) methane emissions for each calving group in each region are also shown in Table 2.4. The calculation of the national average emission factor for dairy cows is outlined in Table 2.5. The average emission factor for dairy cows is 108.8 kg CH_4 per year. This varies between 106.0 and 113.4 kg for spring-calving cows, and 106.8 and 109.0 for autumn-calving cows. Detailed tables showing the production, energy requirements, diet and methane emissions on a monthly basis are contained in Appendix 3 for each of the nine spring-calving systems, and the three autumn-calving systems.

2.2.2 *Emission factor for methane from manure management*

The description of systems in terms of feed intake by month (or part thereof), and the description of feedstuffs (Appendix 2) allowed for the calculation of OM intake per day. The OM digestibilities of the dietary ingredients allowed OM excretion per day to be calculated, which was then partitioned between that excreted at pasture and that excreted during the housing period (Table 2.6). Manure OM excreted at pasture averaged 715 kg (580.2–758.6 kg), while manure OM excreted during the housing period averaged 334 kg (259.9–486.1 kg). The detailed calculations for each of the 12 described systems are shown in Appendix 3.

Table 2.3. Concentrate feeding levels of dairy cows (kg/animal/day) by region for farms sampled in the survey of feeding practices in 2003.

	Region 1	Region 2	Region 3
Spring calving			
No. of farms	120	78	17
After calving while indoors	5.33	5.91	6.29
Lactating cows out by day	4.27	4.47	5.5
First 2–4 weeks out by day + night	3.43	3.56	4.52
Remainder of grazing season	1.46	1.76	2.62
Post-housing pre-drying off	1.27	1.4	2.1
Dry period	0.17	0.15	0.47
Autumn calving			
No. of farms	24	16	3[1]
After calving while outdoors	5.46	6.03	
Winter housing period	6.87	7.78	
Lactating cows out by day	5.14	6.31	
First 2–4 weeks out by day + night	3.05	4.31	
Remainder of grazing season	1.43	2.47	
Dry period	0.09[2]	0	

[1]As there were only three farms in this group, data for Region 2 were used.
[2]This was set at 0.

Table 2.4. Summary of dairy system parameters and methane emissions from enteric fermentation by region for 2003.

	Spring-calving cows			Autumn-calving cows
	First third of cows to calve	Second third of cows to calve	Last third of cows to calve	
Region 1				
Calving date	9 Feb	9 March	6 April	3 October
Turnout date by day	1 March	n/a	n/a	1 March
Turnout date by day + night	8 March	16 March	9 April	8 March
Housing date	29 November	29 November	29 November	29 November
Silage intake, kg DM/year	861	1,075	1,263	698
Concentrate intake, kg DM/year	603	570	491	1,378
Pasture intake, kg DM/year	3,173	3,040	2,943	2,724
Total intake, kg DM/year	4,637	4,685	4,696	4,799
Methane emissions, kg/year	106.2	108.7	110.0	106.8
Region 2				
Calving date	14 Feb	14 March	11 April	3 October
Turnout date by day	8 March	n/a	n/a	8 March
Turnout date by day + night	15 March	21 March	14 April	15 March
Housing date	22 November	22 November	22 November	22 November
Silage intake, kg DM/year	1,005	1,157	1,459	709
Concentrate intake, kg DM/year	611	576	477	1,752
Pasture intake, kg DM/year	3,038	2,977	2,796	2,397
Total intake, kg DM/year	4,654	4,710	4,731	4,858
Methane emissions, kg/year	107.3	110.7	111.4	107.6
Region 3				
Calving date	18 Feb	18 March	15 April	3 October
Turnout date by day	22 March	22 March	n/a	22 March
Turnout date by day + night	29 March	29 March	18 April	29 March
Housing date	8 November	8 November	8 November	8 November
Silage intake, kg DM/year	1,264	1,317	1,692	891
Concentrate intake, kg DM/year	656	616	487	1,863
Pasture intake, kg DM/year	2,780	2,825	2,596	2,156
Total intake, kg DM/year	4,700	4,759	4,775	4,910
Methane emissions, kg/year	109.5	111.0	113.4	109.0

Table 2.5. Proportion of dairy cows in each of the 12 systems defined, the CH_4 emission factor for enteric fermentation for each system, and the weighted national average emission factor for dairy cows for 2003.

	Region 1	Region 2	Region 3	National
Proportion of national herd				
Spring-calving cows – early	0.1693	0.0996	0.0236	
Spring-calving cows – mid	0.1693	0.0996	0.0236	
Spring-calving cows – late	0.1693	0.0996	0.0236	
Autumn-calving cows	0.0710	0.0418	0.0099	
Emission factors (kg CH_4/year)				
Spring-calving cows – early	106.2	107.3	109.5	
Spring-calving cows – mid	108.7	110.7	111.0	
Spring-calving cows – late	110.0	111.4	113.4	
Autumn-calving cows	106.8	107.6	109.0	
Weighted average emission factor (kg CH_4/year)				108.81

Table 2.6. Proportion of dairy cows in each of the 12 systems defined, the quantity of OM excreted at pasture or indoors for each system, methane emission factors for manure management, and the weighted national average for dairy cows for these parameters for 2003.

	Region 1	Region 2	Region 3	National
Proportion of national herd				
Spring-calving cows – early	0.1693	0.0996	0.0236	
Spring-calving cows – mid	0.1693	0.0996	0.0236	
Spring-calving cows – late	0.1693	0.0996	0.0236	
Autumn-calving cows	0.0710	0.0418	0.0099	
OM excreted during housing (kg/year)				
Spring-calving cows – early	259.9	301.4	383.0	
Spring-calving cows – mid	310.7	329.4	371.2	
Spring-calving cows – late	354.2	411.0	479.0	
Autumn-calving cows	338.0	386.4	486.1	
Weighted average (kg/year)				334.3
OM excreted during grazing season (kg/year)				
Spring-calving cows – early	758.6	729.7	673.6	
Spring-calving cows – mid	742.6	707.7	643.7	
Spring-calving cows – late	717.9	679.9	632.7	
Autumn-calving cows	700.2	656.7	580.2	
Weighted average (kg/year)				715.4
Manure methane emission factor (kg/cow)				
Spring-calving cows – early	15.9	19.0	24.8	
Spring-calving cows – mid	18.7	20.7	24.0	
Spring-calving cows – late	21.1	25.4	30.7	
Autumn-calving cows	20.2	24.0	31.1	
Weighted average (kg/year)				20.53

Table 2.7. Proportion of manure OM produced by dairy cows during the housing period which goes into different manure management systems.

	Out-wintered	Slurry based	Solid manure
Region 1	1.8	89.6	8.7
Region 2	2.0	94.4	3.6
Region 3	0.0	98.8	1.2

Details of manure management systems for dairy cows were taken from the Farm Survey and are shown in Table 2.7.

The following equation is used to calculate the CH_4 emission from manure management of dairy cows (IPCC,2000):

Total manure OM × 0.24 × 0.67 × ((prop. at pasture × 0.01) + (prop. in slurry type system × 0.39) + (prop. in solid manure system × 0.01)).

Methane emissions from manure management for each calving group in each region are shown in Table 2.6. The average emission factor for dairy cows is 20.5 kg CH_4 per year. This varies between 15.9 and 30.7 kg for spring-calving cows, and 20.2 and 31.1 kg for autumn-calving cows.

2.2.3 Sensitivity analysis

A sensitivity analysis of the key factors determining the methane emission factor was conducted by allowing the

variables to vary above or below the set value. This was carried out for one of the systems, namely the second batch of spring-calving dairy cows in Region 1. Results are shown in Table 2.8. The model is robust to most changes. Changing the methane conversion factor at grass brought about the biggest change in the emission factor (±6 kg). Other factors having a noticeable impact (±2–3 kg) were milk yield, cow live weight, and grass quality. The other factors only had negligible effects. The only factors having noticeable effects on the manure emission factor were silage quality (±2 kg) and to a lesser extent, cow live weight (±0.5 kg).

2.2.4 Calculation of 1990 emissions of dairy cows

Much of the parameters driving the emissions were assumed to be the same in 1990 as in 2003, with some important exceptions. Cow milk yield was adjusted according to data for 1990 and concentrate intake was also adjusted to reflect the amount manufactured in 1990. Silage DMD and OMD were each reduced by 20 g/kg with commensurate reductions in NE and DE values. This was based on data for quality of Irish silages in the years 1990–1992 published by Keating and O'Kiely (1993). Concentrate quality, calving dates, turnout and housing dates, cow size and body-weight changes were all assumed to be the same. The proportion of cows out-wintered and the proportion of manure produced during housing which went into different waste management systems were also assumed to be the same. Finally, the proportion of cows in the three different regions, and the proportion of these which were spring or autumn calving were assumed to be the same as 2003.

Data on calving, turnout, housing dates, and annual intakes of pasture, silage and concentrate are summarised in Table 2.9 for each region. Cumulative annual methane emissions for each calving group in each region are also shown in Table 2.9. The calculation of the 1990 national average emission factor for dairy cows is outlined in Table 2.10. The average emission factor for dairy cows is 101.38 kg CH_4 per year. This varies between 98.7 and 105.9 kg for spring-calving cows, and 99.2 and 101.6 kg for autumn-calving cows.

Manure OM excreted at pasture and methane from manure management in 1990 were calculated as outlined above and are shown in Table 2.11. Manure OM excreted at pasture averaged 653 kg (541–695 kg), while manure OM excreted during the housing period averaged 354 kg (276–510 kg). Methane emissions from manure management for each calving group in each region are shown in Table 2.11. The average emission factor for dairy cows is 21.6 kg CH_4 per year. This varies between 16.7 and 32.5 kg for spring-calving cows, and 19.6 and 30.1 kg for autumn-calving cows.

Table 2.8. Effect of allowing key factors used in determining the emission rates for dairy cows to vary above and below the set value.

Factor	Amount of variation	Emission factor		Amount of variation	Emission factor	
		Enteric	Manure		Enteric	Manure
No change[1]	–	108.65	22.01	–	108.65	22.01
Cow live weight	–5%	106.69	21.53	+5%	110.6	22.48
Amount of concentrates fed	–10%	108.64	22.01	+10%	108.71	21.98
Silage quality	–3%	108.81	24.98	+3%	108.55	19.33
Concentrate quality	–3%	109.87	22.07	+3%	108.24	21.94
Grass quality	–3%	110.66	22.26	+3%	106.76	21.76
Milk yield	–5%	106.31	21.83	+5%	111.0	22.18
Annual live-weight gain	–5 kg	108.19	22.00	+5 kg	109.2	22.02
Length of grazing season	–4 days	107.42	21.98	+4 days	109.89	22.03
Methane conversion factor at grass (*vs* 0.065)	0.06	102.71	22.01	0.07	114.6	22.01

[1]Refers to cows from Region 1, middle third of herd to calve.

Table 2.9. Summary of dairy system parameters and methane emissions from enteric fermentation by region for 1990.

	Spring-calving cows			Autumn-calving cows
	First third of cows to calve	Second third of cows to calve	Last third of cows to calve	
Region 1				
Calving date	9 Feb	9 March	6 April	3 October
Turnout date by day	1 March	n/a	n/a	1 March
Turnout date by day + night	8 March	16 March	9 April	8 March
Housing date	29 November	29 November	29 November	29 November
Silage intake, kg DM/year	884	1,108	1,288	743
Concentrate intake, kg DM/year	464	438	378	1,060
Pasture intake, kg DM/year	2,968	2,831	2,729	2,631
Total intake, kg DM/year	4,317	4,378	4,395	4,434
Methane emissions, kg/year	98.7	101.3	102.6	99.2
Region 2				
Calving date	14 Feb	14 March	11 April	3 October
Turnout date by day	8 March	n/a	n/a	8 March
Turnout date by day + night	15 March	21 March	14 April	15 March
Housing date	22 November	22 November	22 November	22 November
Silage intake, kg DM/year	1,031	1,189	1,480	780
Concentrate intake, kg DM/year	470	443	367	1,348
Pasture intake, kg DM/year	2,839	2,773	2,585	2,348
Total intake, kg DM/year	4,340	4,405	4,432	4,476
Methane emissions, kg/year	99.9	103.2	104.0	100.0
Region 3				
Calving date	18 Feb	18 March	15 April	3 October
Turnout date by day	22 March	22 March	n/a	22 March
Turnout date by day + night	29 March	29 March	18 April	29 March
Housing date	8 November	8 November	8 November	8 November
Silage intake, kg DM/year	1,293	1,344	1,708	981
Concentrate intake, kg DM/year	505	474	375	1,433
Pasture intake, kg DM/year	2,595	2,637	2,400	2,115
Total intake, kg DM/year	4,393	4,455	4,482	4,529
Methane emissions, kg/year	102.2	103.7	105.9	101.6

Table 2.10. Proportion of dairy cows in each of the 12 systems defined, the CH_4 emission factor for enteric fermentation for each system, and the weighted national average emission factor for dairy cows for 1990.

	Region 1	Region 2	Region 3	National
Proportion of national herd				
Spring-calving cows – early	0.1693	0.0996	0.0236	
Spring-calving cows – mid	0.1693	0.0996	0.0236	
Spring-calving cows – late	0.1693	0.0996	0.0236	
Autumn-calving cows	0.0710	0.0418	0.0099	
Emission factors (kg CH_4/year)				
Spring-calving cows – early	98.7	99.9	102.2	
Spring-calving cows – mid	101.3	103.2	103.7	
Spring-calving cows – late	102.6	104.0	105.9	
Autumn-calving cows	99.2	100.0	101.6	
Weighted average emission factor (kg CH_4/year)				101.38

Table 2.11. Proportion of dairy cows in each of the 12 systems defined, the quantity of OM excreted at pasture or indoors for each system, methane emission factors for manure management, and the weighted national average for dairy cows for these parameters for 1990.

	Region 1	Region 2	Region 3	National
Proportion of national herd				
Spring-calving cows – early	0.1693	0.0996	0.0236	
Spring-calving cows – mid	0.1693	0.0996	0.0236	
Spring-calving cows – late	0.1693	0.0996	0.0236	
Autumn-calving cows	0.0710	0.0418	0.0099	
OM excreted during housing (kg/year)				
Spring-calving cows – early	276.1	320.5	404.8	
Spring-calving cows – mid	335.5	356.1	400.0	
Spring-calving cows – late	381.9	440.3	509.8	
Autumn-calving cows	329.5	374.6	471.5	
Weighted average (kg/year)				354.1
OM excreted during grazing season (kg/year)				
Spring-calving cows – early	694.7	666.9	614.0	
Spring-calving cows – mid	676.3	644.1	586.0	
Spring-calving cows – late	652.6	616.3	572.9	
Autumn-calving cows	651.2	609.3	540.6	
Weighted average (kg/year)				653.3
Manure methane emission factor (kg/cow)				
Spring-calving cows – early	16.7	20.1	26.1	
Spring-calving cows – mid	20.0	22.1	25.7	
Spring-calving cows – late	22.6	27.1	32.5	
Autumn-calving cows	19.6	23.2	30.1	
Weighted average (kg/year)				21.57

3 Emission Factors for Beef (Suckler) Cows

3.1 Materials and Methods

The same basic structure as with dairy cows was followed.

1. The country was divided into the same three regions, and the number of beef (suckler) cows in each county is shown in Table 3.1, based on CMMS (2003) data. It was not possible to differentiate calving dates between the three regions, but based on CMMS (2003) data, the mean calving date for spring-calving (i.e. calving between January and June inclusive) suckler cows was 5 April. The mean calving date of autumn-calving (i.e. calving between July and December inclusive) cows was 21 September. The total number of suckler cows according to the CMMS (2003) differs slightly from CSO statistics. As the latter are the official statistics, these are used for final inventory calculations, but the CMMS (2003) data are used to determine the proportional breakdown by region. Data on suckler cow populations (from both the CSO and CMMS) are shown in Appendix 1.

2. The production system in each region was defined (data source in parentheses) in terms of dates of winter housing and spring turnout to grass (expert opinion), milk yield and composition (expert opinion; INRA, 1989; AFRC, 1993), concentrate feeding level (a farm survey conducted in 2003 involving 139 farms with spring-calving suckler cows and 20 farms with autumn-calving suckler cows), forages fed (farm survey) and cow live weight, live-weight change and lactation length (expert opinion).

3. The daily energy requirement of cows in each region was calculated by month or part thereof based on maintenance requirements, milk yield, requirements for foetal growth, and gain or loss of body weight (INRA, 1989). In this system, net energy requirements are defined in terms of UFL. This international energy system used locally in Ireland was considered more appropriate to the local conditions than the system and equations used by the IPCC (1997 and 2000).

The important equations were:

(i) Maintenance UFL requirements = 9.96 + (0.6 × LW/100), where LW is live weight (divide by 7.11 to convert to UFL). A 10% activity allowance was added for housed cows, with a further 10% added for out-wintered cows, while for the dry period, maintenance requirements were reduced by 10% (INRA, 1989).

(ii) UFL required per kg milk = ((0.376 × fat%) + (0.209 × protein%) + 0.948) (divide by 7.11 to convert to UFL). Fat and protein contents of

Table 3.1. Counties assigned to each of the three regions, and number of beef (suckler) cows per county in 2003.

Region 1		Region 2		Region 3	
Carlow	16,223	**Clare**	77,870	**Cavan**	47,207
Cork	83,273	**Galway**	108,302	**Donegal**	45,355
Dublin	3,588	**Kerry**	51,690	**Leitrim**	29,828
Kildare	17,636	**Limerick**	38,085	**Monaghan**	32,070
Kilkenny	36,661	**Longford**	28,461		
Laois	34,008	**Louth**	9,956		
Offaly	31,483	**Mayo**	81,514		
Tipperary	68,121	**Meath**	34,139		
Waterford	26,477	**Roscommon**	55,293		
Wexford	30,284	**Sligo**	33,702		
Wicklow	22,344	**Westmeath**	36,249		
Total	**370,098**		**555,261**		**154,460**

Source: CMMS (2003).

suckler cow milk were assumed to be 3.6 and 3.2%, respectively (INRA, 1989; AFRC, 1993). These values are held constant throughout the year giving a net energy requirement of 2.97 MJ/kg or 0.42 UFL/kg (INRA, 1989).

(iii) Pregnancy: mean of 11.4 MJ/day for the last 4 months of pregnancy (divide by 7.11 to convert to UFL).

(iv) Live-weight change: each kg live weight lost contributed 24.9 MJ (3.5 UFL) to energy requirements, while each kg of live weight gained required 32 MJ (4.5 UFL).

4. The composition of the diet of cows in each region was described by month or part thereof and daily intake was calculated by reference to the daily energy requirement. The concentrate allowance (if fed) was fixed while forage intake varied according to energy requirements.

5. Daily methane emissions were calculated using the equation of Yan *et al.* (2000) as outlined in Section 2.1. However, a constant of 0.065 of gross energy intake was applied when cows were grazing (Section 2.1). The daily emissions were summed to give annual emissions of cows in each region.

6. Emission factors were calculated for empty cows (i.e. cows that did not carry a foetus to produce either a normal or stillborn calf) and for cows producing stillborn calves for each region. This is necessary as these cows are counted as suckler cows in national statistics, but don't lactate and thus have lower energy requirements and feed intake. Cows producing stillborn calves or with an early-death calf differ from empty cows in that they have carried a calf to full term, and thus incur energy requirements for pregnancy, whereas empty cows have no pregnancy requirement.

7. A weighted national average of all suckler cows was then calculated.

3.2 Results

3.2.1 Emission factor for methane from enteric fermentation

In 2003, there were a total of 1.166 million suckler cows in Ireland according to the CSO data. This is slightly more than the figure from the CMMS (2003) data (1.080 million) which relates to number of calves born. Two-thirds of stillborn beef calves are assumed to be suckler calves (approximately one-third of these beef calves will be from dairy cows) which equates to 8,071 calves. The number of empty (cows not bearing a calf) suckler cows is calculated as follows:

CSO cow numbers – (CMMS calves born + CMMS suckler stillborn calves).

For 2003, this is equal to 77,861. Some calves die shortly after birth. While suckler farmers may replace dead calves with fostered dairy calves, there are no data on this. In this exercise, the number of calf deaths up to 3 weeks of age was calculated, and it was assumed that these calves were not replaced, but that their dams were dried off and did not lactate. Two-thirds of beef calves who died before 3 weeks of age are assumed to be suckler calves (approximately one-third of these beef calves will be from dairy cows) which equates to 10,460 calves. The sum of suckler cows with stillborn and early-death calves is thus 8,071 + 10,460 = 18,531.

Average milk yield was assumed to be 1,900 kg/year when lactation length was 8 months (expert opinion). However, milk yield was assumed to be lower for late-calved cows, as lactation lengths were shorter.

Mean live weight of cows was taken as 600 kg at the start of the winter housing period. Cows were assumed to lose 60 kg live weight during the winter housing period in a linear manner, and to gain 84 kg during the following grazing season, again in a linear manner. These data are based on data from the Grange Research Centre suckler herd over 10 years (M. Drennan, Teagasc, personal communication). The higher amount of weight gained during the grazing season is to allow for growth of cows from first lactation onwards.

The mean calving date of spring-calving beef cows was 5 April for all regions according to the CMMS (2003). Calving spread was accommodated by having one-third of cows calving on these dates, one-third calving 5 weeks earlier, and one-third calving 5 weeks later. Thus, nine spring-calving systems were described (3 regions × 3 calving dates). Mean calving date for autumn-calving beef cows was 21 September (CMMS, 2003). Three systems were thus described for autumn-calving cows. An additional two systems per region were described for empty cows and for cows who produced a stillborn calf or whose calf died shortly after birth. Thus, a total of 18 suckler cow systems were described.

Turnout dates were set at 1 April, 5 April and 13 April in Regions 1, 2 and 3, respectively. Housing dates were set at 15 November, 6 November and 31 October for Regions 1, 2 and 3, respectively. This gave winter housing periods of 136, 150 and 164 days for Regions 1, 2 and 3, respectively (although it was somewhat longer for late-calving cows). These housing periods were based on data from the Farm Survey, and expert opinion. Weaning was assumed to occur on 31 October for early-calved cows (i.e. the first third of the herd to calve) in Regions 1 and 2, and at housing for all other cows.

Forages fed after housing were predominantly grass silage. The other forages likely to make a substantial contribution to the diet were hay and straw. The percentages of farmers who reported feeding other forages in the Farm Survey are shown in Table 3.2. While feeding these forages could have an impact on methane emissions, their usage on a national level is small, and it was decided to assume that grass silage was the only forage used during the winter. The DMD of the grass silage was put at 630 g/kg, which is below the national average of 690 g/kg (mean of 2001–2004 Teagasc samples; Siobhan Kavanagh, Teagasc, personal communication). Putting the digestibility of silage fed to suckler cows at a lower level than the national average is based on expert opinion, and also data from Teagasc Monitor Farms showed beef farms to have silage with DMD 35 g/kg lower than dairy Monitor Farms (Siobhan Kavanagh, Teagasc, personal communication). Because of the lower digestibility of the silage compared to that fed to dairy cows, appropriate adjustments were made to the GE (18.4 MJ/kg DM), GE digestibility co-efficient (0.6) and net energy values (4.94 MJ NE_l or 0.695 UFL/kg DM). Autumn-calving suckler cows were assumed to be fed slightly higher quality grass silage (DMD = 660 g/kg, with appropriate adjustments to other values). Details of silage composition are shown in Appendix 2.

Parameters for the concentrate and grass fed were the same as used for dairy cows (Section 2.2).

The Farm Survey provided data on concentrate feeding levels (Table 3.3). In the questionnaire, farmers were asked to indicate their level of certainty about these concentrate levels on a scale of 1 (excellent) to 4 (poor). Respondents with a level of 4 were excluded, leaving data from 114 farms included. Average feeding levels were low. The feeding of concentrates post-turnout was assumed to last for 4 weeks (in the case of late-calved cows, the production systems described have no concentrate feeding post-turnout). The survey shows a low level of concentrate feeding post-housing in autumn for cows whose calves are not weaned before housing.

Table 3.2. Percentage of farms feeding forages other than grass silage to spring-calving suckler cows nationally and by region.

	Nationally	Region 1	Region 2	Region 3
No. of farms	114	34	60	20
After housing				
Maize silage	0.00	0.00	0.00	0.00
Whole-crop wheat	0.00	0.00	0.00	0.00
Hay	9.52	6.23	15.05	0.00
Straw	1.95	5.80	0.00	1.25
Other	0.00	0.00	0.00	0.00
Dry period				
Maize silage	0.49	1.77	0.00	0.00
Whole-crop wheat	0.00	0.00	0.00	0.00
Hay	6.75	6.81	9.20	0.00
Straw	0.99	2.07	0.46	0.87
Other	0.33	0.00	0.00	0.00
After calving				
Maize silage	0.35	1.18	0.00	0.00
Whole-crop wheat	0.00	0.00	0.00	0.00
Hay	3.10	1.32	5.20	0.00
Straw	0.13	0.00	0.25	0.00
Other	0.00	0.00	0.00	0.00

Table 3.3. Concentrate feeding levels (kg/animal/day) by region to spring-calving suckler cows in 2003.

	Region 1	Region 2	Region 3
No. of farms	34	60	20
Cows after calving indoors	1.23	0.8	1.23
Heifers after calving indoors	1.22	0.71	1.2
Lactating cows after turnout	0.73	0.29	0.5
Cows after housing but before weaning	0.38	0.22	0.35
Cows during dry period	0.07	0.24	0.3
Calves at grass prior to weaning	0.48	0.43	0.45

However, as weaning generally occurs at or before housing, this was ignored in the production systems. The survey also shows a low level of concentrate feeding during the dry period, but this is mostly associated with straw-fed cows, and so was ignored in the production systems outlined here. For autumn-calving cows, the survey showed an average concentrate feeding level of 1.83 kg/day during the winter housing period. This was based on 18 farms, and there were insufficient farms to break this down by region.

Data on calving, turnout and housing dates, and annual intakes of pasture, silage and concentrate are summarised in Table 3.4 for each region. Cumulative annual (2003) methane emissions for each calving group in each region are also shown in Table 3.4. The calculation of the national average emission factor for suckler cows is outlined in Table 3.5. The average emission factor for suckler cows is 74.2 kg CH_4 per year. This varies between 72.4 and 79.4 kg for spring-calving cows, and 77.4 and 79.5 for autumn-calving cows. Values were substantially lower for empty cows, and cows with stillborn/early-death calves (51.3–58.7 kg CH_4 per year). Detailed tables showing the production, energy requirements, diet and methane emissions on a monthly basis are given in Appendix 4 for each of the nine spring-calving systems, and the three autumn-calving systems, and for the cows who were empty or who had stillborn calves or calves who died shortly after birth.

3.2.2 Emission factor for methane from manure management

Details of manure management systems for suckler cows were taken from the Farm Survey and are shown in Table 3.6. The description of systems in terms of feed intake by month (or part thereof), and the description of feedstuffs (Appendix 2) allowed for the calculation of OM intake per day. The OM digestibilities of the dietary ingredients allowed OM excretion per day to be calculated, which was then partitioned between that excreted at pasture, and that excreted during the housing period (Table 3.7). Manure OM excreted at pasture averaged 500.7 kg (298–558 kg), while manure OM excreted during the housing period averaged 287.7 kg (192–419 kg). The detailed calculations for each of the 18 described systems are shown in Appendix 4.

The following equation is used to calculate the CH_4 emission from manure management of suckler cows (IPCC, 2000):

Total manure OM × 0.24 × 0.67 × ((prop. at pasture × 0.01) + (prop. in slurry type system × 0.39) + (prop. in solid manure system × 0.011)).

Methane emissions from manure management for each calving group in each region are shown in Table 3.7 based on the Farm Survey. The average emission factor for suckler cows is 13.9 kg CH_4 per year. This varies between 10.3 and 26.2 kg for spring-calving cows, and 12.7 and 26.7 for autumn-calving cows. Values were lower for empty cows, and cows with stillborn/early-death calves (7.9–22.5 kg CH_4 per year).

3.2.3 Sensitivity analysis

A sensitivity analysis of the key factors determining the methane emission factor was conducted by allowing the variables to vary above or below the set value. This was carried out for one of the systems, namely the second batch of spring-calving suckler cows in Region 2. Results are shown in Table 3.8. The model is robust to most changes. Changing the methane conversion factor at grass brought about the biggest change in the enteric emission factor (±3.7 kg). Other factors having a noticeable impact (±1–2 kg) were cow live weight and grass quality. The other factors only had negligible effects. The only factors having noticeable effects on the manure emission factor were silage quality (±2 kg) and, to a lesser extent, cow live weight (±0.5 kg).

Table 3.4. Summary of suckler cow system parameters and methane emissions from enteric fermentation by region for 2003.

	Spring-calving cows			Autumn-calving cows	Empty cows	Cows with stillborn calves
	First third of cows to calve	Second third of cows to calve	Last third of cows to calve			
Region 1						
Calving date	1 March	5 April	10 May	21 Sept	–	5 April
Turnout date by day + night	1 April	1 April	1 April	1 April	1 April	1 April
Housing date	15 Nov	15 Nov	15 Nov	15 Nov	15 Nov	15 Nov
Concentrate intake, kg DM/year	50.4	17.6	0.00	165.3	0.00	0.00
Silage intake, kg DM/year	984	907	824	1,015	639	907
Pasture intake, kg DM/year	2,320	2,328	2,292	2,127	1,496	1,504
Total intake, kg DM/year	3,355	3,252	3,116	3,307	2,136	2,410
Methane emissions, kg/year	77.4	75.3	72.4	77.4	51.3	56.8
Region 2						
Calving date	1 March	5 April	10 May	21 Sept	–	5 April
Turnout date by day + night	5 April	5 April	5 April	5 April	5 April	5 April
Housing date	6 Nov	6 Nov	6 Nov	6 Nov	6 Nov	6 Nov
Concentrate intake, kg DM/year	31.8	7.0	0.00	179.4	0.00	0.00
Silage intake, kg DM/year	1,153	1,028	946	1,172	750	1,028
Pasture intake, kg DM/year	2,223	2,182	2,186	1,995	1,425	1,425
Total intake, kg DM/year	3,408	3,218	3,131	3,347	2,175	2,454
Methane emissions, kg/year	79.0	74.9	73.2	78.8	52.6	58.2
Region 3						
Calving date	1 March	5 April	10 May	21 Sept	–	5 April
Turnout date by day + night	13 April	13 April	13 April	13 April	13 April	13 April
Housing date	31 Oct	31 Oct	31 Oct	31 Oct	31 Oct	31 Oct
Concentrate intake, kg DM/year	58.6	20.5	0.00	188.9	0.00	0.00
Silage intake, kg DM/year	1,251	1,134	1,043	1,300	828	1,107
Pasture intake, kg DM/year	2,104	2,104	2,087	1,871	1,358	1,358
Total intake, kg DM/year	3,414	3,258	3,129	3,359	2,186	2,465
Methane emissions, kg/year	79.4	76.1	73.4	79.5	53.2	58.7

Table 3.5. Proportion of suckler cows in each of the 18 systems defined, the CH_4 emission factor for enteric fermentation for each system, and the weighted national average emission factor for suckler cows for 2003.

	Region 1	Region 2	Region 3	National
Proportion of national herd				
Spring-calving cows – early	0.085	0.128	0.036	
Spring-calving cows – mid	0.085	0.128	0.036	
Spring-calving cows – late	0.085	0.128	0.036	
Autumn-calving cows	0.059	0.088	0.024	
Empty cows	0.023	0.034	0.010	
Cows with stillborn calves	0.005	0.008	0.002	
Emission factors (kg CH_4/year)				
Spring-calving cows – early	77.4	79.0	79.4	
Spring-calving cows – mid	75.3	74.9	76.1	
Spring-calving cows – late	72.4	73.2	73.4	
Autumn-calving cows	77.4	78.8	79.5	
Empty cows	51.3	52.6	53.2	
Cows with stillborn calves	56.8	58.2	58.7	
Weighted average emission factor (kg CH_4/year)				74.2

Table 3.6. Proportion of manure OM produced by suckler cows in 2003 during the housing period which goes into different manure management systems.

	Out-wintered	Slurry based	Solid manure
Region 1	8.2	54.0	37.9
Region 2	23.7	53.4	22.9
Region 3	4.6	94.6	0.9

Table 3.7. Proportion of suckler cows in each of the 18 systems defined, the quantity of OM excreted at pasture or indoors for each system, methane emission factors for manure management, and the weighted national average for suckler cows for these parameters for 2003.

	Region 1	Region 2	Region 3	National
Proportion of national herd				
Spring-calving cows – early	0.085	0.128	0.036	
Spring-calving cows – mid	0.085	0.128	0.036	
Spring-calving cows – late	0.085	0.128	0.036	
Autumn-calving cows	0.059	0.088	0.024	
Empty cows	0.023	0.034	0.010	
Cows with stillborn calves	0.005	0.008	0.002	
OM excreted during housing (kg/year)				
Spring-calving cows – early	309	299	409	
Spring-calving cows – mid	279	263	364	
Spring-calving cows – late	253	242	333	
Autumn-calving cows	318	304	419	
Empty cows	197	192	265	
Cows with stillborn calves	279	263	354	
Weighted average (kg/year)				287.65
OM excreted during grazing season (kg/year)				
Spring-calving cows – early	516	558	462	
Spring-calving cows – mid	516	539	460	
Spring-calving cows – late	505	534	454	
Autumn-calving cows	479	515	415	
Empty cows	333	359	298	
Cows with stillborn calves	342	381	302	
Weighted average (kg/year)				500.73
Manure methane emission factor (kg/cow)				
Spring-calving cows – early	12.4	14.2	26.2	
Spring-calving cows – mid	11.3	12.5	23.4	
Spring-calving cows – late	10.3	11.6	21.5	
Autumn-calving cows	12.7	14.3	26.7	
Empty cows	7.9	9.1	16.9	
Cows with stillborn calves	11.0	12.3	22.5	
Weighted average (kg/year)				13.9

3.2.4 Calculation of 1990 emissions of suckler cows

Many of the parameters driving the emissions were assumed to be the same in 1990 as in 2003, with some important exceptions. The breed composition of the national suckler cow herd has changed since 1990, which will affect cow live weight and milk yield. Drennan and Power (1993) reported that Friesians made up 20% of the suckler cow herd in 1992, but Drennan (1999) reported that this had dropped to 2% in 1998 (Table 3.9), and it can be assumed to be zero in 2003 because of restrictions on claiming suckler cow premiums on Friesian cows in recent years. Data for 1992 were assumed to be representative of 1990. Milk yield of Friesian cows was assumed to be 50% higher than other beef breeds (12 *vs* 8 kg/day over the lactation) which equated to an increase of 0.8 kg/day over the full suckler cow population compared with 2003. The differences in breed profile were estimated to cause the average cow in 1990 to be 30 kg lighter (on average throughout the year) than the average cow in 2003. Silage DMD and OMD were each reduced by 20 g/kg with commensurate reductions in NE and DE values. This was based on data for quality of Irish silages in the years 1990–1992 published by Keating and O'Kiely (1993). Concentrate quality, calving dates, turnout and housing dates, and body-weight changes were all assumed to be the same. The proportion of cows out-wintered was assumed to be 5 percentage units higher in 1990 than in 2003. The proportion of manure produced during housing which went into solid and slurry-based waste management systems was assumed to be the same in

Table 3.8. Effect of allowing key factors used in determining the emission rates for suckler cows to vary above and below the set value.

Factor	Amount of variation	Emission factor		Amount of variation	Emission factor	
		Enteric	Manure		Enteric	Manure
No change[1]	–	74.93	14.82	–	74.93	14.82
Cow live weight	– 5%	72.97	14.28	+ 5%	76.89	15.37
Silage quality	– 3%	75.1	16.82	+ 3%	74.81	13.06
Grass quality	– 3%	76.39	15.0	+ 3%	73.55	14.65
Milk yield	– 5%	74.22	14.81	+ 5%	75.64	14.84
Annual live-weight gain[2]	– 5 kg	74.27	14.65	+ 5 kg	75.56	14.98
Length of grazing season[3]	– 8 days	74.11	15.28	+ 8 days	75.76	14.36
Methane conversion factor at grass (*vs* 0.065)	0.06	71.23	14.82	0.07	78.63	14.82

[1]Refers to cows from Region 2, middle third of herd to calve.

[2]Both winter weight loss and summer weight gain were adjusted to bring about change in this parameter.

[3]Grazing season was lengthened or shortened in the autumn as appropriate, and weaning date was adjusted to be the same as the new housing date.

Table 3.9. Breed composition of the suckler cow herd in 1992 and 1998.

	1992[1]		1998[2]	
	Cows	Heifers	Cows	Heifers
Friesian/Holstein	20	7	2	1
Hereford ×	35	31	31	19
Aberdeen Angus ×	9	9	12	19
Shorthorn	7	2	3	3
Charolais ×	7	15	17	20
Simmental ×	9	13	16	15
Limousin ×	8	15	15	20
Other	5	8	4	4

[1]Drennan and Power (1993).

[2]Drennan (1999).

both years. Finally, the proportion of cows in the three different regions, the proportion of these which were spring or autumn calving, and the proportions which were empty, had stillborn or early-death calves were assumed to be the same as 2003.

Data on calving, turnout and housing dates, and annual intakes of pasture, silage and concentrate are summarised in Table 3.10 for each region. Cumulative annual methane emissions for each calving group in each region are also shown in Table 3.10. The calculation of the 1990 national average emission factor for suckler cows is outlined in Table 3.11. The average emission factor for suckler cows is 74.03 kg CH_4 per year. This varies between 72.1 and 79.5 kg for spring-calving cows, and 77.7 and 79.8 kg for autumn-calving cows. Values were substantially lower for empty cows, and cows with stillborn/early-death calves (49.7–57.1 kg CH_4 per year).

Manure OM excreted at pasture and methane from manure management in 1990 were calculated as outlined above and the results are shown in Table 3.12. Manure OM excreted at pasture averaged 526 kg (306–592 kg), while manure OM excreted during the housing period averaged 290 kg (187–443 kg). Methane emissions from manure management for each calving group in each region are shown in Table 3.12. The average emission factor for suckler cows is 14.02 kg CH_4 per year. This varies between 10.3 and 26.8 kg for spring-calving cows, and 13.4 and 28.3 kg for autumn-calving cows. Values were lower for empty cows and cows with stillborn/early-death calves (7.8–22.6 kg CH_4 per year).

Table 3.10. Summary of suckler cow system parameters and methane emissions from enteric fermentation by region for 1990.

	Spring-calving cows			Autumn-calving cows	Empty cows	Cows with stillborn calves
	First third of cows to calve	Second third of cows to calve	Last third of cows to calve			
Region 1						
Calving date	1 March	5 April	10 May	21 Sept	–	5 April
Turnout date by day + night	1 April	1 April	1 April	1 April	1 April	1 April
Housing date	15 Nov	15 Nov	15 Nov	15 Nov	15 Nov	15 Nov
Concentrate intake, kg DM/year	50.4	17.6	0.00	165.3	0.00	0.00
Silage intake, kg DM/year	1,005	909	823	1,083	632	909
Pasture intake, kg DM/year	2,345	2,356	2,310	2,119	1,455	1,463
Total intake, kg DM/year	3,401	3,284	2,133	3,367	2,087	2,372
Methane emissions, kg/year	77.54	75.18	72.12	77.71	49.69	55.17
Region 2						
Calving date	1 March	5 April	10 May	21 Sept	–	5 April
Turnout date by day + night	5 April	5 April	5 April	5 April	5 April	5 April
Housing date	6 Nov	6 Nov	6 Nov	6 Nov	6 Nov	6 Nov
Concentrate intake, kg DM/year	31.8	7.0	0.00	179.4	0.00	0.00
Silage intake, kg DM/year	1,179	1,032	946	1,248	743	1,032
Pasture intake, kg DM/year	2,249	2,210	2,203	1,985	1,387	1,387
Total intake, kg DM/year	3,460	3,249	3,149	3,412	2,130	2,419
Methane emissions, kg/year	79.10	74.75	72.77	79.16	50.96	56.52
Region 3						
Calving date	1 March	5 April	10 May	21 Sept	–	5 April
Turnout date by day + night	13 April	13 April	13 April	13 April	13 April	13 April
Housing date	31 Oct	31 Oct	31 Oct	31 Oct	31 Oct	31 Oct
Concentrate intake, kg DM/year	58.6	20.5	0.00	188.9	0.00	0.00
Silage intake, kg DM/year	1,282	1,143	1,044	1,385	822	1,111
Pasture intake, kg DM/year	2,131	2,131	2,105	1,859	1,322	1,322
Total intake, kg DM/year	3,471	3,294	3,149	3,432	2,143	2,433
Methane emissions, kg/year	79.47	75.90	72.98	79.83	51.54	57.07

Table 3.11. Proportion of suckler cows in each of the 18 systems defined, the enteric CH_4 emission factor for each system, and the weighted national average emission factor for suckler cows for 1990.

	Region 1	Region 2	Region 3	National
Proportion of national herd				
Spring-calving cows – early	0.085	0.128	0.036	
Spring-calving cows – mid	0.088	0.126	0.036	
Spring-calving cows – late	0.088	0.126	0.036	
Autumn-calving cows	0.059	0.088	0.024	
Empty cows	0.023	0.034	0.010	
Cows with stillborn calves	0.005	0.008	0.002	
Emission factors (kg CH_4/year)				
Spring-calving cows – early	77.5	79.1	79.5	
Spring-calving cows – mid	75.2	74.8	75.9	
Spring-calving cows – late	72.1	72.8	73.0	
Autumn-calving cows	77.7	79.2	79.8	
Empty cows	49.7	51.0	51.5	
Cows with stillborn calves	55.2	56.5	57.1	
Weighted average emission factor (kg CH_4/year)				74.03

Table 3.12. Proportion of suckler cows in each of the 18 systems defined, the quantity of OM excreted at pasture or indoors for each system, methane emission factors for manure management, and the weighted national average for suckler cows for these parameters for 1990.

	Region 1	Region 2	Region 3	National
Proportion of national herd				
Spring-calving cows – early	0.085	0.128	0.036	
Spring-calving cows – mid	0.088	0.126	0.036	
Spring-calving cows – late	0.088	0.126	0.036	
Autumn-calving cows	0.059	0.088	0.024	
Empty cows	0.023	0.034	0.010	
Cows with stillborn calves	0.005	0.008	0.002	
OM excreted during housing (kg/year)				
Spring-calving cows – early	314	301	418	
Spring-calving cows – mid	279	260	367	
Spring-calving cows – late	253	238	334	
Autumn-calving cows	336	317	443	
Empty cows	194	187	263	
Cows with stillborn calves	279	260	355	
Weighted average (kg/year)				290.4
OM excreted during grazing season (kg/year)				
Spring-calving cows – early	542	592	492	
Spring-calving cows – mid	540	568	487	
Spring-calving cows – late	525	559	477	
Autumn-calving cows	500	546	440	
Empty cows	336	367	306	
Cows with stillborn calves	350	396	315	
Weighted average (kg/year)				525.61
Manure methane emission factor (kg/cow)				
Spring-calving cows – early	12.7	14.3	26.8	
Spring-calving cows – mid	11.3	12.5	23.6	
Spring-calving cows – late	10.3	11.5	21.5	
Autumn-calving cows	13.4	14.9	28.3	
Empty cows	7.8	8.9	16.8	
Cows with stillborn calves	11.0	12.2	22.6	
Weighted average (kg/year)				14.02

4 Emission Factors for Non-Breeding Beef Cattle

4.1 Materials and Methods

The process of deriving emission factors for non-breeding beef cattle is somewhat complicated by the fact that cattle move from one category to another up to two times in their life (i.e. from cattle <1 year old to cattle 1–2 years old to cattle >2 years old), unlike dairy or suckler cows who stay in their respective categories once they enter them. Take, for instance, the category cattle <1 year old for the calendar year 2003. Given the predominance of March–April calving in Ireland, cattle under 1 year old in 2003 will include 2002-born cattle for the first few months of 2003, and 2003-born cattle for the last 8–9 months of the year. However, it is only the latter group that are 'caught' by the CSO statistics, which are based on surveys in June and December, because by the time the first survey is taken in June, the 2002-born cattle have moved into the next age category, 1–2 years old. The logical way to generate emission factors is to calculate lifetime emissions, and then partition between the first, second and third years of the animal's life. For spring-born cattle, lifetime emissions were partitioned into CSO categories as follows:

- Emissions between birth and the end of the first winter were assigned to the category cattle <1 year old
- Emissions from the start of the second grazing season to the end of the second winter were assigned to the category cattle 1–2 years old
- Emissions from the start of the third grazing season to slaughter were assigned to the category cattle >2 years old.

Given the dates of the CSO survey, this partitioning is compatible with the birth dates of the Irish cattle herd.

In 2003, 15.7% of calves were born in the autumn (July to December, inclusive). Autumn-born calves were not dealt with separately as it was not deemed necessary and it was felt that it would add unnecessary complications. Consider the case of a calf born in September (Year 1) and slaughtered at age 24 months 2 years later (Year 3). Lifetime energy and DM intake would be similar to a spring-born calf slaughtered at 24 months and the autumn-born calf would still be counted by the CSO as a <1-year-old animal twice (December of Year 1 and June of Year 2) and as a 1- to 2-year-old animal twice (December of Year 2 and June of Year 3). Thus, there should be little or no impact on the national inventory.

The generation of emissions factors followed a number of steps as follows:

1. The cattle herd was divided into a number of categories based on sex, breed and production system (Table 4.1). The proportion of the herd in each category was calculated.

2. Important parameters such as housing dates (expert opinion), turnout dates (expert opinion) and live-weight gains (expert opinion reconciled with actual national carcass weights) during winters and grazing seasons were defined for each system. The most important parameter is live-weight gain as it directly affects the energy requirement and thus feed intake. There is little statistical information on the live-weight gain of the different types of cattle in the Irish cattle herd, but the weight of carcasses of all slaughtered cattle is recorded by the Department of Agriculture and Food. Using data for the average carcass weight of male and female cattle, appropriate live-weight gains were applied to the various life stages of each animal category (expert opinion) such that, when all categories were combined, those data reconciled with the national statistics for carcass weight (±10 kg).

3. Given these data for live weight and live-weight gain, energy requirements of animals were estimated during the winters and grazing seasons of the animals lives using the INRAtion computer program, Version 3.0. This program was devised by the French research organisation INRA, and is based on their net energy system. In Version 3.0, some adaptation for Irish conditions (O'Mara *et al.*, 1997; Crowley, 2001; Crowley *et al.*, 2002) was made to the equations for estimating the energy requirements of growing and finishing animals. Net energy requirements for growing cattle are defined in terms of UFL (1 UFL = 7.11 MJ NE_l) and, for finishing cattle, net energy requirements are defined in terms of

Table 4.1. Beef production systems for male and female beef cattle.

Category	Description
	Beef heifers
1	Early beef breed heifers slaughtered/died off grass at *c.* 18 months old
2	Late-maturing beef breed heifers slaughtered/died at 21–26 months old after indoor feeding during second winter
3	Early-maturing beef breed heifers slaughtered/died at 21–26 months old after indoor feeding during second winter
4	Late-maturing beef breed heifers slaughtered/exported/died off grass at 24+ months old (i.e. third grazing season)
5	Late-maturing beef breed heifers slaughtered at less than 15 months of age
6	Live exports, <6 weeks
7	Live exports, 6 weeks to 12 months
8	Live exports, 12–24 months
9	On-farm deaths of heifers under 3 months
10	On-farm deaths of heifers from 3 to 12 months old
11	Dairy and beef breed in-calf heifers
	Male beef cattle
12	Early beef breed cattle slaughtered/died off grass at *c.* 18 months old
13	Late-maturing beef breed cattle slaughtered/died at 21–26 months old after indoor feeding during second winter
14	Early-maturing beef breed cattle slaughtered/died at 21–26 months old after indoor feeding during second winter
15	Late-maturing beef breed cattle slaughtered/exported/died at 30+ months old after indoor feeding during third winter
16	Late-maturing beef breed cattle slaughtered/exported/died off grass at 24+ months old (i.e. third grazing season)
17	Late-maturing beef breed cattle slaughtered as bulls at less than 15 months of age
18	Live exports, <6 weeks
19	Live exports, 6 weeks to 12 months
20	Live exports, 12–30 months
21	On-farm deaths of cattle under 3 months
22	On-farm deaths of cattle from 3 to 12 months old

UFV (Unité Fourragère Viande – net energy value for meat production including both maintenance and body weight gain, where 1 UFV = 7.61 MJ NE_{mg}).

4. The composition of the diet in each system was described by period (grazing season and winter period) and daily intake was calculated by reference to the daily energy requirement. The concentrate allowance was fixed while forage intake varied according to energy requirements. The Irish modifications to the INRAtion program were predominantly for animals at weanling and finishing stages (i.e. at times that concentrates were likely to be fed). No modifications were made for 'heavy' growing animals (typically animals in their second grazing season or later who were not being finished). For animals in these stages, intakes were adjusted as considered appropriate by expert opinion.

5. Daily methane emissions were calculated using the equation of Yan *et al.* (2000); however, a constant of 0.065 of gross energy intake was applied when the diet was grazed grass plus 3 kg or less of concentrate supplement/day. The daily emissions were summed to give annual emissions per system, and a weighted national average was then calculated.

4.2 Results

4.2.1 Determining the number of animals in each category

4.2.1.1 Beef heifers

According to the CMMS (2003), there were 747,000 live births of females to a beef breed bull in 2003 (plus 5,000 stillbirths). In addition, approximately 270,000 Friesian heifers were born to Friesian cows (Table 4.2) giving total births of females of about 1.02 million. Dairy and suckler cow numbers have been stable for a number of years prior to 2003, so it is safe to assume that similar numbers have been born in recent years. Table 4.3 shows disposal patterns in 2003 for beef heifers. The total is similar to the number of births but there is a difference of some 57,000 animals mainly due to a lower number of Friesian in-calf heifers than Friesian heifer calves born.

Table 4.2. Breakdown of male and female calf crop between suckler and dairy cows and by type of bull for 2003.

Calves born to dairy cows		Calves born to suckler cows	
Total	1,045,934	**Total**	1,098,746
No. born to dairy bull	552,095		
No. born to beef bull	493,839		
% male	0.511	**% male**	0.514
% female	0.489	**% female**	0.486
No. beef males (excl. Friesians)	252,352	**No. beef males**	564,755
No. male dairy (mainly Friesians)	282,121		
No. beef females (excl. Friesians)	241,487	**No. beef females**	533,991
No. Friesian females	269,974		
Total males (suckler and dairy, excl. Friesians)	817,107	**Total females (suckler and dairy, excl. Friesians)**	775,478
% dairy	30.9	**% dairy**	31.1
% suckler	69.1	**% suckler**	68.9

Source: derived from data in CMMS (2003).

Table 4.3. Disposals of beef cattle and number of in-calf beef and dairy heifers in 2003.

Category	Number (000 head)
Beef heifers	
On-farm deaths of females up to 30 months (excluding stillborn)	37
Abattoir slaughter of beef heifers from 0 to 30 months of age	91
Factory slaughter of beef heifers from 0 to 30 months of age	365
Live exports of beef heifers from 0 to 30 months of age	112
Beef breed in-calf heifers	139
Dairy breed in-calf heifers	221
Total	965
Male beef cattle	
On-farm deaths of male beef cattle up to 30+ months (excluding stillborn)	69
Abattoir slaughter of male beef cattle from 0 to 30 months of age	4
Factory slaughter of male beef cattle from 0 to 30+ months of age	770
Factory slaughter of male dairy cattle from 0 to 30+ months of age	224
Live exports of male beef cattle from 0 to 30+ months of age	108
Total	1,175

Source: CMMS (2003) except in-calf heifers (CSO, 2004).

Births (male and female) to non-Friesian bulls totalled 1.59 million in 2003 (CMMS, 2003). Approximately 1.2 million (72.6%) of these were to late-maturing beef breeds (e.g. Charolais, Limousin, Simmental or Belgium Blue bulls). After allowing for entry of 282,000 pure Friesian males into the beef herd each year, the remainder of the beef herd was considered to consist of 72.6% late-maturing beef breeds (e.g. Continental × Friesian cross) and 27.4% early-maturing beef breeds (e.g. Hereford × Friesian cross). For beef heifers, this breaks down to approximately 206,000 early-maturing breeds, and 545,000 late-maturing breeds (with the Friesian heifers being additional). The breakdown of these beef breed heifers between suckler and dairy animals is 0.69:0.31, respectively (details shown in Table 4.4). The allocation of these female cattle to Categories 1 to 11 is shown in Table 4.4 (details in Appendix 5). To avoid complexity, the following assumptions were made:

- All heifers slaughtered off grass at *c.* 18 months of age were early-maturing beef breeds (i.e. Category 1)

Table 4.4. Allocation of female beef cattle to the various categories of animals defined in the study for 2003.

Category	Total	Suckler cow dams		Dairy cow dams		
		Early maturing beef bull	Late maturing beef bull	Early-maturing beef bull	Late-maturing beef bull	Friesian bull
1	89,732	61,915		27,817		
2	151,005		104,193		46,812	
3	74,375	51,319		23,056		
4	115,497		79,693		35,804	
5	35,081		24,206		10,875	
6	23,335				23,335	
7	60,424		41,693		18,731	
8	25,368		17,504		7,864	
9	15,319	5,285	5,285	2,374	2,374	
10	12,403	4,279	4,279	1,922	1,922	
11	408,974		109,196	29,855		269,923
Total	1,011,513	122,798	386,049	85,025	147,718	269,923
Proportion		0.121	0.382	0.084	0.146	0.267
Beef bull progeny		741,590				
Of beef bull progeny:						
Proportion suckler		0.69				
Proportion dairy		0.31				
Proportion early		0.28				
Proportion late		0.72				
Friesian in-calf heifers		269,923				
Beef in-calf heifers		139,051				

of suckler and dairy origin (ratio 0.69:0.31, respectively).

- Heifers slaughtered/died at 21–26 months old after indoor feeding during their second winter (i.e. Categories 2 and 3) were 0.67 late-maturing breeds and 0.33 early-maturing breeds. In both cases, they were of suckler and dairy origin (ratio 0.69:0.31, respectively).
- All heifers slaughtered, exported or died on farm in months May to October, inclusive, that were categorised as being 24–30 months old were late-maturing breeds (Category 4) of suckler and dairy origin (ratio 0.69:0.31, respectively).
- All heifers slaughtered at less than 15 months of age were late-maturing beef breeds (i.e. Category 5) of suckler and dairy origin (ratio 0.69:0.31, respectively).
- All heifers exported live at less than 6 weeks were late-maturing beef breeds of dairy origin (i.e. Category 6).
- All heifers exported live at more than 6 weeks and less than 24 months were late-maturing beef breeds (i.e. Categories 7 and 8) of suckler and dairy origin (ratio 0.69:0.31, respectively).
- On-farm deaths were in the ratio of 0.69:0.31 between suckler and dairy calves, and within these classes, they were broken down 0.5:0.5 between late- and early-maturing breeds (i.e. Categories 9 and 10).
- Beef breed in-calf heifers were apportioned as 30,000 early-maturing breeds and 109,000 late-maturing breeds. Dairy in-calf heifers were assumed to have the same intake and methane emissions as early-maturing beef breed in-calf heifers for their first year before they went in calf.

Of the female calves that were the progeny of beef bulls, the categorisation gave a ratio of 0.72:0.28 between late- and early-maturing breeds (Table 4.4), which is very close to the actual ratio of 0.724:0.276. The categorisation also gave numbers of in-calf heifers equal to those provided by CSO statistics. It should be noted that these in-calf heifers

are treated as a separate class in their second year of life, and are only classified as beef animals for their first year of life.

4.2.1.2 Male beef cattle

According to the CMMS (2003), there were 796,000 live births of males to a beef breed bull and 305,000 births of males to a dairy bull in 2003 (plus 12,000 stillbirths) giving a total of 1.11 million. Dairy and suckler cow numbers have been stable for a number of years prior to 2003, so it is safe to assume that similar numbers have been born in recent years. Table 4.3 shows disposal patterns in 2003 for male beef cattle. The total for disposals is similar to the number of births.

For male beef animals, approximately 282,000 of the disposals in Table 4.3 are dairy breeds, predominantly Friesians, leaving approximately 893,000 cattle of beef breeds. This breaks down to approximately 647,000 late-maturing and 246,000 early-maturing beef breeds (using the ratio of 0.726:0.274 for late- to early-maturing breeds). The breakdown of these between suckler and dairy animals is 0.69:0.31, respectively (details shown in Table 4.5). The allocation of these male cattle to Categories 12 to 22 is shown in Table 4.5 (details in Appendix 6). To avoid complexity, the following assumptions were made:

- All male cattle slaughtered off grass at *c.* 18 months of age were early-maturing beef breeds (i.e. Category 12) of suckler and dairy origin (ratio 0.69:0.31, respectively).
- Male cattle slaughtered/died at 21–26 months old after indoor feeding during their second winter were 0.2 late-maturing breeds and 0.8 early-maturing breeds (i.e. Categories 13 and 14, respectively). Of the early-maturing cattle, 0.4 were pure Friesians, and the remainder of animals in both categories were of suckler and dairy origin (ratio 0.69:0.31, respectively).
- Male cattle slaughtered, exported or died on farm at 30+ months old after indoor feeding during their third winter (i.e. Category 15) were late-maturing breeds of suckler and dairy origin (ratio 0.69:0.31, respectively).
- All male cattle slaughtered, exported or died on farm in months May to October inclusive that were categorised as being 24–30 months old (Category 16) were 0.3 pure Friesians with the remainder being late-maturing breeds of suckler and dairy origin (ratio 0.69:0.31, respectively).
- All male cattle slaughtered at less than 15 months of age were bulls of late-maturing beef breeds (i.e. Category 17) of suckler and dairy origin (ratio 0.69:0.31, respectively).
- All male cattle exported live at less than 6 weeks were pure Friesian (i.e. Category 18).
- All male cattle exported live between 6 weeks and 12 months (i.e. Category 19) were late-maturing beef breeds of suckler and dairy origin (ratio 0.69:0.31, respectively).
- All male cattle exported live between 12 and 30 months (i.e. Category 20) were 0.4 pure Friesians with the remainder being late-maturing beef breeds of suckler and dairy origin (ratio 0.69:0.31, respectively).
- On-farm deaths were in the ratio of 0.69:0.31 between suckler and dairy calves, and within these classes, they were broken down 0.5:0.5 between late- and early-maturing breeds (i.e. Categories 21 and 22).

This categorisation gave 286,000 pure Friesians, close to the number born of 282,000 (Table 4.5). Of these, 233,000 were slaughtered (with the remainder exported or died) which is close to the reported number of 224,000 slaughtered (Table 4.3). Of the male calves that were the progeny of beef bulls, the categorisation gave a ratio of 0.745:0.255 between late- and early-maturing breeds, which again is close to the actual ratio of 0.724:0.276.

4.2.2 Definition of production systems

The mean calving date of dairy cows was 13 March and for beef cows it was 5 April for all regions according to the CMMS (2003). The country was not split into three regions as with dairy and suckler cows, as there was not equivalent information in the CMMS (2003) on numbers per county. Turnout dates for first grazing season for suckler calves was 15 April (10 days old), while for calves of dairy cows, it was set at 15 May, i.e. just over 2 months old. Housing dates for first, second and third winters were 12 November, slightly later than that used for suckler cows in Region 2. Turnout dates for second and third grazing seasons were set at 5 April (as for suckler cows in Region 2), giving a winter housing period of 145 days.

Table 4.5. Allocation of male beef cattle to the various categories of animals defined in the study for 2003.

Category	Total	Suckler		Dairy		
		Early maturing beef bull	Late maturing beef bull	Early-maturing beef bull	Late-maturing beef bull	Friesian bull
12	51,090	35,252		15,838		
13	55,984		38,629		17,355	
14	223,934	92,709		41,652		89,574
15	126,975		87,613		39,362	
16	477,950		230,850		103,715	143,385
17	22,091		15,243		6,848	
18	30,808					30,808
19	19,720		13,607		6,113	
20	56,155		23,248		10,445	22,462
21	29,799	10,281	10,281	4,619	4,619	
22	22,695	7,830	7,830	3,518	3,518	
Total	1,117,201	146,071	427,300	65,626	191,975	286,229
Proportion		0.131	0.382	0.059	0.172	0.256
Beef bull progeny		830,972				
Of beef bull progeny:						
Proportion suckler		0.69				
Proportion dairy		0.31				
Proportion early		0.255				
Proportion late		0.745				
Friesian slaughtered		232,959				
Friesians exported		53,270				

The farm survey provided data on forage fed during the winter (Table 4.6). For cattle in their first winter, grass silage comprised 90% of the forage fed to young bulls and 94% of that fed to steers. For older cattle, the percentages were equally high. Given the almost universal use of grass silage, it was decided to assume that this was the only winter forage fed, to avoid complexity. The DMD of the grass silage used for growing cattle was put at 660 g/kg (i.e. 30 g/kg below the national average), while for finishing cattle, a value of 690 g/kg (i.e. the national average) was used. Other relevant parameters (e.g. net energy and DE values) were adjusted accordingly. The concentrate and grass composition and nutritive value was as used in other dairy and suckler cow production systems. Values for these feedstuffs are shown in Appendix 2.

The farm survey also provided data on concentrate feeding levels (Table 4.7). In the questionnaire, farmers were asked to indicate their level of certainty about these concentrate levels on a scale of 1 (excellent) to 4 (poor). Respondents with a level of 4 were excluded. The survey had very few respondents rearing cattle in young beef production systems. Thus, the data for bulls for beef in Table 4.7 are not considered reliable, and may not all refer to bulls on young beef slaughter systems. Data on concentrate feeding levels for these animals are taken from Fallon *et al.* (2001). When these concentrate levels were applied to the various animal categories, the figure for national beef concentrate usage is 877,000 t (including some 59,000 t fed to suckler cows). This is somewhat lower than national beef compound production in 2003 (949,000, Appendix 1), which in turn is less than beef cattle concentrates fed nationally due to some home mixing of concentrates for beef cattle. It is likely that concentrates fed at grass would make up the difference. It was considered unnecessary to factor this into calculations of emissions of grazing cattle, as a constant proportion of GE intake was applied to grazing animals (0.065), the GE content of both grass and concentrates is assumed to be the same (18.8 MJ/kg DM), and the NE of both feeds is quite similar.

Important parameters of productions systems for beef heifers for Categories 1 to 5 and 11 are outlined in Table 4.8. Category 6 and 9 heifers were assumed not to enter

Table 4.6. Percentage of farms feeding various forages to non-breeding beef cattle nationally in 2003.

	<1 year old						1–2 year old			>2 year old	
	Suckler dam			Dairy dam							
	Steers	Heifers	Bulls	Steers	Heifers	Bulls	Steers	Heifers	Bulls	Steers	Heifers
No. of farms	91	93	8	144	132	11	137	113	6	29	17
Grass silage 1st cut	49.8	49.9	52.9	57.0	50.4	47.2	56.7	54.1	88.3	76.6	93.6
Grass silage 2nd cut	6.8	6.6	25.6	17.2	18.0	18.2	13.6	14.1	0.0	12.2	5.0
Grass silage baled	39.7	41.8	7.2	19.9	24.4	24.5	23.5	25.2	11.7	10.1	1.4
Maize silage	0.6	0.6	0.0	1.0	1.3	4.0	2.0	2.1	0.0	0.0	0.0
Whole-crop wheat	0.0	0.0	0.0	0.3	0.2	4.0	0.0	0.0	0.0	0.5	0.0
Hay	2.9	0.9	14.3	4.2	5.2	0.9	4.0	3.2	0.0	0.5	0.0
Straw	0.2	0.2	0.0	0.2	0.3	0.9	0.0	0.3	0.0	0.0	0.0

Table 4.7. Concentrate feeding levels during housing (kg/animal/day) by age.

	<1 year	*n*[1]	1–2 years	*n*	>2 years	*n*
Steers	1.92	76 + 121	3.2	145	3.78	17
Heifers (beef)	1.89	79 + 104	2.73	117	2.22	15
Heifers (replacements)	1.69	45 + 173	1.71	194		
Beef bulls	1.93	4 + 8	3.9	7		

[1]Number of farms from which data were obtained. For cattle <1 year, number of farms is the sum of those with progeny of suckler (first figure) and dairy cows (second figure).

the CSO statistics of animal numbers, and were ignored. Category 7 heifers (live exports from 6 weeks to 12 months old) were assumed to have the same production system as Category 2 heifers in their first year. Category 8 heifers (live exports, 12–24 months) were assumed to have the same production system as Category 4 heifers in their first 2 years. Category 10 heifers were assumed to have the same production systems as Categories 1 and 2 (weighted average) in their first year.

Table 4.8 shows the average daily gain (ADG) of heifers in each category at various stages of their life. The resulting final slaughter weights should be reconciled with national statistics for carcass weight. This table also shows the killing-out percentage (proportion of final live weight that ends up in the carcass weight) of each category (G. Keane, Teagasc, expert opinion). These killing-out percentages are used to calculate the carcass weight of each category. Combining this with the number of animals in each category allows the weighted average carcass weight to be calculated, and it works out at 278.5 kg. This is within 10 kg of the average carcass weight of 272.5 kg reported by the Department of Agriculture and Food for slaughtered heifers in 2003.

Important parameters of productions systems for male cattle for Categories 12 to 17 are outlined in Table 4.9. Category 18 and 21 male beef cattle were assumed not to enter the CSO statistics of animal numbers, and were ignored. Category 19 male beef cattle (live exports from 6 weeks to 12 months old) were assumed to have the same production system as Category 13 male beef cattle in their first year. Category 20 male beef cattle (live exports, 12–24 months) were assumed to have the same production system as Category 16 male beef cattle in their first 2 years). Category 22 male beef cattle (on-farm deaths from 3 to 12 months) were assumed to have the same production systems as Categories 12 and 13 (weighted average) in their first year.

Table 4.9 shows the average daily gain of male beef cattle in each category at various stages of their life. The resulting final slaughter weights should be reconciled with national statistics for carcass weight. This table also shows the killing-out percentage of each category (G. Keane, Teagasc, expert opinion). These killing-out percentages are used to calculate the carcass weight of each category. Combining this with the number of animals in each category allows the weighted average carcass weight to be calculated, and it works out at 342 kg. This is within 10 kg of the average carcass weight of 341 kg reported by the Department of Agriculture and Food for slaughtered male steers in 2003.

Table 4.8. Parameters of the production systems for female beef cattle in 2003 who are progeny of suckler cows (Suckler), beef bulls crossed on dairy cows (Dairy ×) or Friesian bulls crossed on dairy cows (Dairy).

	Category												
	1		2		3		4		5		11		
	Suckler	Dairy ×	Suckler	Dairy ×	Suckler	Dairy ×	Suckler	Dairy ×	Suckler	Dairy ×	Dairy	Suckler	Dairy ×
Dates (day month)													
Birth	5 Apr	13 Mar	5 Apr	13 Mar	5 Apr	13 Mar	5 Apr	13 Mar	5 Apr	13 Mar	13 Mar	5 Apr	13 Mar
1st turnout	15 Apr	15 May	15 Apr	15 May	15 Apr	15 May	15 Apr	15 May	15 Apr	15 May	15 May	15 Apr	15 May
1st housing	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov
2nd turnout	5 Apr		5 Apr		5 Apr		5 Apr		5 Apr			5 Apr	
2nd housing			12 Nov		12 Nov		12 Nov					12 Nov	
3rd turnout							5 Apr						
Slaughter	16 Aug		3 Feb		3 Feb		26 Jul		26 May			n/a	
Average daily gain (kg/day)													
Calf pre-turnout	1	0.8	1	0.8	1	0.8	1	0.8	1	0.8	0.8	1	0.8
1st grazing	0.995	0.829	0.9	0.718	0.758	0.608	0.758	0.608	0.995	0.829	0.718	0.9	0.718
1st winter	0.625	0.556	0.556	0.556	0.556	0.486	0.556	0.486	0.625	0.625	0.556	0.556	0.556
2nd grazing	0.902	0.902	0.81	0.762	0.667	0.667	0.714	0.619	1.176	0.98			
2nd winter			0.964	0.723	0.843	0.723	0.486	0.486					
3rd grazing							0.91	0.83					
Slaughter weight	480	440	580	520	510	470	630	570	420	380			
Killing-out %	0.5	0.5	0.53	0.53	0.51	0.51	0.535	0.535	0.5	0.5			
Carcass weight	240	220	307	275	260	240	337	305	210	190			
No. of animals	61,915	27,817	104,193	46,812	51,319	23,056	79,693	35,804	24,206	10,875	269,923	109,196	29,855

Table 4.9. Parameters of the production systems for male beef cattle in 2003 who are progeny of suckler cows (Suckler), beef bulls crossed on dairy cows (Dairy ×) or Friesian bulls crossed on dairy cows (Dairy).

	Category													
	12		13		14			15		16			17	
	Suckler	Dairy ×	Suckler	Dairy ×	Suckler	Dairy ×	Dairy	Suckler	Dairy ×	Suckler	Dairy ×	Dairy	Suckler	Dairy
Dates (day month)														
Birth	5 Apr	13 Mar	5 Apr	13 Mar	5 Apr	13 Mar	13 Mar	5 Apr	13 Mar	5 Apr	13 Mar	13 Mar	5 Apr	13 Mar
1st turnout	15 Apr	15 May	15 Apr	15 May	15 Apr	15 May	15 May	15 Apr	15 May	15 Apr	15 May	15 May	15 Apr	15 May
1st housing	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov	12 Nov
2nd turnout	5 Apr		5 Apr		5 Apr			5 Apr		5 Apr			5 Apr	
2nd housing			12 Nov		12 Nov			12 Nov		12 Nov				
3rd turnout								5 Apr		5 Apr				
3rd housing								12 Nov						
Slaughter	20 Jul		20 Feb		20 Feb			5 Jan		12 Aug			29 May	
Average daily gain (kg/day)														
Calf pre-turnout	1.000	0.800	1.000	0.800	1.000	0.800	0.800	1.000	0.800	1.000	0.800	0.800	1.000	0.800
1st grazing	1.232	1.050	1.137	0.829	0.948	0.773	0.773	1.043	0.773	1.137	0.829	0.829	1.280	1.050
1st winter	0.833	0.833	0.556	0.556	0.486	0.486	0.486	0.487	0.417	0.417	0.417	0.417	0.903	0.833
2nd grazing	1.038	1.038	0.857	0.857	0.857	0.810	0.810	0.714	0.714	0.762	0.762	0.762	1.384	1.224
2nd winter			1.000	1.000	0.900	0.900	0.900	0.347	0.347	0.347	0.347	0.347		
3rd grazing								0.800	0.800	0.853	0.853	0.853		
3rd winter								0.800	0.800					
Slaughter weight	550	509	660	600	600	560	560	778	718	688	629	629	535	465
Killing-out %	0.51	0.51	0.54	0.54	0.52	0.52	0.51	0.56	0.56	0.54	0.54	0.52	0.51	0.51
Carcass weight	280	260	356	324	312	291	285	436	402	372	340	327	273	237
No. of animals	35,252	15,838	38,629	17,355	92,709	41,652	89,574	87,613	39,362	230,850	103,715	143,385	15,243	6,848

The fact that for both male and female cattle

(i) the number of animals in each category which would be classified as being from suckler or dairy cows, and from early- or late-maturing beef bulls or Friesian bulls agrees closely with national statistics, and

(ii) that the weighted average for carcass weights agrees well with the national averages

indicates that the manner in which animals were placed into categories and the lifetime growth rates assigned to each category were accurate.

4.2.3 Definition of animal energy requirements, feed intake and methane emissions

For each life stage (winter or grazing season) of each animal category, the average weight, ADG, concentrate allowance, and forage quality were inputted into the computer program INRAtion. This provided data on energy requirements (in UFL for growing cattle and UFV for finishing cattle) and forage intake. It did not give the energy required for maintenance separately from the total energy requirement, and this was calculated by multiplying metabolic weight (i.e. weight to the power of 0.75) by an appropriate coefficient (Appendix 7). Once daily intake was established, methane output was calculated using the equation of Yan *et al.* (2000) for winter periods, and by multiplying GE intake by 0.065 during the grazing season. These data are shown for each life stage of each animal category in Appendices 8 and 9 (female and male data, respectively). As outlined above, this version of INRAtion was not validated with 'heavy' growing cattle, such as those in their second grazing season, and intakes were adjusted in these situations by expert opinion in a few cases.

The description of systems in terms of daily feed intake, and the description of feedstuffs (Appendix 2) allowed for the calculation of OM intake per day. The OM digestibilities of the dietary ingredients allowed OM excretion per day to be calculated, which was then partitioned between that excreted at pasture, and that excreted during the housing period. These data are shown for each life stage of each animal category in Appendices 8 and 9. To calculate methane from manure management, information on the proportions going into different waste management systems was obtained from the Farm Survey (Table 4.10).

Table 4.11 shows the enteric CH_4 output of each animal category of female beef cattle for their first year of life. The total output of CH_4 from enteric fermentation from female beef cattle <1 year old according to Table 4.11 is derived by multiplying the output for each animal by the number of animals in the relevant category and summing the totals. This gives an output of 27,106 t. This was generated by 972,859 heifers (sum of categories in Table 4.11), giving a mean emission of 27.86 kg/animal, which is the methane emission factor from enteric fermentation for female beef cattle <1 year old.

Similarly, Tables 4.12 and 4.13 show the CH_4 output of each animal category of female beef cattle for their second and third years of life, respectively. Emission factors for enteric fermentation for female beef cattle 1–2 years old and >2 years old are 44.60 and 22.46 kg/animal, respectively (derived as above).

On the same basis, the average amount of manure excreted during the summer at pasture and during the winter is calculated to be 104.27 and 189.96 kg/year, respectively, for female cattle <1 year old (Table 4.11). Using these data and the data on waste management systems in Table 4.10, the manure management excretion factor (EF) for methane is calculated as follows:

EF = Total manure OM × 0.24 × 0.67 × ((prop. at pasture × 0.01) + (prop. in slurry-type system × 0.39) + (prop. in solid manure system × 0.01))
= 294.23 × 0.24 × 0.67 × {(((104.27 + (189.96 × 0.059)) / 294.23) × 0.01) + (((189.96 × 0.673) / 294.23) × 0.39) + (((189.96 × 0.268) / 294.23) × 0.01)}
= 47.31 × (0.0039 + 0.169 + 0.0017)
= 8.28 kg/animal.

Table 4.10. Proportion of manure OM produced by beef cattle in 2003 during the housing period which goes into different manure management systems.

	Out-wintered	Slurry based	Solid manure based
Cattle <1 year	5.9	67.3	26.8
Cattle 1–2 years	8.1	72.3	19.6
Cattle >2 years	18.5	43.8	37.7

Table 4.11. Annual output of methane from enteric fermentation, manure OM output and diet intake for each category of female cattle <1 year old in 2003.

	Category														
	1	1	2	2	3	3	4	4	5	5	6	7	7	8	8
Origin	Suck	Dairy	Suck	Dairy	Suck	Dairy	Suck	Dairy	Suck	Dairy	Dairy	Suck	Dairy	Suck	Dairy
Maturity	Early	Early	Late	Late	Early	Early	Late	Late	Late	Late	Late	Late	Late	Late	Late
Breed used in INRAtion	Hr × Fr	Hr × Fr	Ch	Ch × Fr	Hr × Fr	Hr × Fr	Ch	Ch × Fr	Ch	Ch × Fr	Ch × Fr	Ch	Ch × Fr	Ch	Ch × Fr
No. of animals	61,915	27,817	104,193	46,812	51,319	23,056	79,693	35,804	24,206	10,875	23,335	41,693	18,731	17,504	7,864
CH_4, kg/head	31.8	34.2	26.3	29.2	25.4	26.1	24.7	25.8	27.0	32.4	Export	26.3	29.2	24.7	25.8
Manure at grass, kg/head	96.8	139.6	88.0	120.5	79.2	111.5	88.0	110.0	96.8	135.1		88.0	120.5	88.0	110.0
Manure in house, kg/head	229.4	198.7	193.4	188.9	198.3	162.3	175.6	157.9	181.8	172.5		193.4	188.9	175.6	157.9
Silage DMI, kg/head	662	562	490	475	505	389	432	374	374	376		490	475	432	374
Conc. DMI, kg/head	238	238	238	238	238	238	238	238	372	372		238	238	238	238
Grass DMI, kg/head	464	669	422	578	380	535	422	528	464	648		422	578	422	528
Total DMI, kg/head	1,364	1,469	1,149	1,291	1,123	1,161	1,092	1,140	1,210	1,395		1,149	1,291	1,092	1,140
Total CH_4, t[1]	1,971	951	2,737	1,369	1,301	601	1,966	924	654	352		1,095	548	432	203
Total manure at grass, t[1]	5,993	3,882	9,169	5,640	4,064	2,570	7,013	3,939	2,343	1,470		3,669	2,257	1,540	865
Total manure indoors, t[1]	14,205	5,528	20,149	8,845	10,174	3,743	13,997	5,653	4,401	1,876		8,062	3,539	3,074	1,242
Total concs, t[1]	14,722	6,614	24,774	11,131	12,202	5,482	18,949	8,513	8,993	4,040		9,913	4,454	4,162	1,870

[1]Tonnes/year for each category.

Table 4.11. ***Contd.***

	Category												
	9	**9**	**9**	**9**	**9**	**10**	**10**	**10**	**10**	**10**	**11**	**11**	**11**
Origin	Suck	Dairy	Suck	Dairy	Mean	Suck	Dairy	Suck	Dairy		Dairy	Suck	Dairy
Maturity	Early	Early	Late	Late		Early	Early	Late	Late		Early	Late	Early
Breed used in INRAtion	Hr × Fr	Hr × Fr	Ch	Ch × Fr		Hr × Fr	Hr × Fr	Ch	Ch × Fr		FR	Ch	
No. of animals	5,285	2,374	5,285	2,374	15,319	4,279	1,922	4,279	1,922	12,403	269,923	109,196	29,855
CH_4, kg/head	Dead	Dead	Dead	Dead	Dead	See mean	See mean	See mean	See mean	29.9	29.2	26.3	29.2
Manure at grass, kg/head										104.1	120.5	88.0	120.5
Manure in house, kg/head										206.0	188.9	193.4	188.9
Silage DMI, kg/head										558	475	490	475
Conc. DMI, kg/head										238	238	238	238
Grass DMI, kg/head										499	578	422	578
Total DMI, kg/head										1,295	1,291	1,149	1,291
Total CH_4, t[1]										371	7,892	2,868	873
Total manure at grass, t[1]										1,291	32,523	9,609	3,597
Total manure indoors, t[1]										2,554	51,000	21,116	5,641
Total concs, t[1]										2,949	64,180	25,964	7,099

[1]Tonnes/year for each category.

Table 4.12. Annual output of methane from enteric fermentation, manure OM output and diet intake for each category of female cattle 1–2 years old in 2003.

	Category											
	1	1	2	2	3	3	4	4	5	5	8	8
Origin	Suck	Dairy	Suck	Dairy	Suck	Dairy	Suck	Dairy	Suck	Dairy	Suck	Dairy
Maturity	Early	Early	Late	Late	Early	Early	Late	Late	Late	Late	Late	Late
Breed used in INRAtion	Hr × Fr	Hr × Fr	Ch	Ch × Fr	Hr × Fr	Hr × Fr	Ch	Ch × Fr	Ch	Ch × Fr	Ch	Ch × Fr
No. of animals	61,915	27,817	104,193	46,812	51,319	23,056	79,693	35,804	24,206	10,875	17,504	7,864
CH_4, kg/head	21.5	19.9	53.7	50.2	50.1	45.9	60.2	55.7	5.0	4.4	60.2	55.7
Manure at grass, kg/head	203.9	174.2	319.7	307.9	300.0	270.2	276.5	250.7	0.0	0.0	276.5	250.7
Manure in house, kg/head	0.0	0.0	197.1	166.5	175.8	168.8	377.0	354.9	74.6	64.5	377.0	354.9
Silage DMI, kg/head	0	0	540	432	465	440	1,224	1,152	51	51	1,224	1,152
Conc. DMI, kg/head	0	0	250	250	250	250	0	0	329	280	0	0
Grass DMI, kg/head	978	904	1,533	1,476	1,439	1,296	1,326	1,202	0	0	1,326	1,202
Total DMI, kg/head	978	904	2,323	2,158	2,153	1,985	2,550	2,354	380	331	2,550	2,354
Total CH_4, t[1]	1,329	552	5,593	2,348	2,571	1,058	4,794	1,995	122	48	1,053	438
Total manure at grass, t[1]	12,621	4,845	33,309	14,411	15,394	6,230	22,036	8,976	0	0	4,840	1,972
Total manure indoors, t[1]	0	0	20,532	7,793	9,024	3,892	30,047	12,706	1,806	701	6,600	2,791
Total concs, t[1]	0	0	26,031	11,695	12,821	5,760	0	0	7,963	3,043	0	0

[1]Tonnes/year for each category.

Table 4.13. Annual output of methane from enteric fermentation, manure OM output and diet intake for each category of female cattle >2 years old in 2003.

	Category	
	4	4
Origin	Suck	Dairy
Maturity	Late	Late
Breed used in INRAtion	Ch	Ch × Fr
No. of animals	79,693	35,804
CH_4, kg/head	23.8	19.5
Manure at grass, kg/head	226	185
Manure in house, kg/head	0.0	0.0
Silage DMI, kg/head	0	0
Conc. DMI, kg/head	0	0
Grass DMI, kg/head	1,083	889
Total DMI, kg/head	1,083	889
Total CH_4, t[1]	1,895	699
Total manure at grass, t[1]	17,999	6,640
Total manure indoors, t[1]	0	0
Total concs, t[1]	0	0

[1]Tonnes/year for each category.

Similarly, methane emission factors for manure management for female beef cattle 1–2 years old and >2 years old are 9.34 and 0.34 kg/animal, respectively.

Table 4.14 shows the CH_4 output of each animal category of male beef cattle for their first year of life. The total output of CH_4 from enteric fermentation from male beef cattle <1 year old according to Table 4.14 is derived by multiplying the output for each animal by the number of animals in the relevant category and summing the totals. This gives an output of 31,202 t. This was generated by 1,056,594 cattle (sum of categories in Table 4.14), giving a mean emission of 29.53 kg/animal, which is the methane emission factor from enteric fermentation for male beef cattle <1 year old.

Similarly, Tables 4.15 and 4.16 show the CH_4 output of each animal category of male beef cattle for their second and third years of life, respectively. Emission factors for enteric fermentation for male beef cattle 1–2 years old and >2 years old are 60.37 and 34.27 kg/animal, respectively (derived as above).

On the same basis, the average amount of manure excreted during the summer at pasture and during the winter is calculated to be 111.03 and 194.86 kg/year, respectively. Using these data and the data on waste management systems in Table 4.10, the manure management excretion factor for methane is calculated as follows:

EF = Total manure OM × 0.24 × 0.67 × ((prop. at pasture × 0.01) + (prop. in slurry-type system × 0.39) + (prop. in solid manure system × 0.015))
= 305.88 × 0.24 × 0.67 × {(((111.03 + (194.86 × 0.059)) / 305.88) × 0.01) + (((194.86 × 0.673) / 305.88) × 0.39) + (((194.86 × 0.268) / 305.88) × 0.01)}
= 49.19 × (0.004 + 0.167 + 0.0017)
= 8.50 kg/animal.

Similarly, emission factors for manure management for male beef cattle 1–2 years old and >2 years old are 14.25 and 1.48 kg/animal, respectively.

The reason why emission factors for heifers >2 years are less than for heifers of 1–2 years (and the same arises for male cattle) is that the older animals are only kept for part of the third year. Heifers >2 years are assumed to be slaughtered on 26 July. They are only counted as being in their third year since turnout to grass on 5 April, so these emission factors only relate to a 3-month period. In the case of manure emissions, manure OM is deposited on pasture entirely, leading to a very low manure emission factor. This contrasts with females 1–2 years old, where most animals are assumed to be alive for most of the year.

4.2.4 Anomalies with beef emission factors

The use of the average of June and December animal numbers in calculating the inventory can lead to anomalies in the case of beef cattle, especially in older categories. Take for instance male cattle >2 years. Numbers in 2003 are as follows:

June	598,700
December	258,200
Average	428,350

The numbers for June indicate that 598,700 animals are kept by farmers into their third year, and December numbers indicate that over half of these are slaughtered before December. These animals emit, on average, 34.3 kg methane from enteric fermentation. Emissions from this category are best calculated using the June numbers (which best captures the number of animals kept for part of a third year), i.e.

34.3 × 598,700 = 20,535.4 t CH_4.

Table 4.14. Annual output of methane from enteric fermentation, manure OM output and diet intake for each category of male cattle <1 year old in 2003.

	Category														
	12	**12**	**13**	**13**	**14**	**14**	**14**	**15**	**15**	**16**	**16**	**16**	**17**	**17**	**18**
Origin	Suck	Dairy	Suck	Dairy	Suck	Dairy	Dairy	Suck	Dairy	Suck	Dairy	Dairy	Suck	Dairy	Dairy
Maturity	Early	Early	Late	Late	Early	Early	Dairy	Late	Late	Late	Late	Dairy	Late	Late	Dairy
Breed used in INRAtion	Hr × Fr	Hr × Fr	Ch	Ch × Fr	Hr × Fr	Hr × Fr	Friesian	Ch	Ch × Fr	Ch	Ch × Fr	Friesian	Ch	Ch × Fr	Friesian
No. of animals	35,252	15,838	38,629	17,355	92,709	41,652	89,574	87,613	39,362	230,850	103,715	143,385	15,243	6,848	30,808
CH_4, kg/head	37.4	42.0	29.1	31.6	26.7	30.1	30.8	26.7	28.5	27.1	29.7	31.3	33.2	35.8	Export
Manure at grass, kg/head	96.8	168.3	88.0	133.8	79.2	130.6	131.8	88.0	127.6	88.0	135.0	140.3	96.8	168.3	
Manure in house, kg/head	278.2	246.8	224.4	197.8	206.7	184.5	188.9	193.4	162.3	193.4	166.8	180.1	251.5	194.9	
Silage DMI, kg/head	835	734	590	504	533	461	475	490	389	490	403	446	456	455	
Conc. DMI, kg/head	238	238	238	238	238	238	238	238	238	238	238	238	619	372	
Grass DMI, kg/head	464	807	422	642	380	626	632	422	612	422	648	673	464	807	
Total DMI, kg/head	1,537	1,779	1,250	1,383	1,150	1,325	1,345	1,149	1,238	1,149	1,289	1,357	1,540	1,634	
Total CH_4, t[1]	1,319	666	1,124	548	2,473	1,256	2,763	2,343	1,121	6,254	3,077	4,493	507	245	
Total manure at grass, t[1]	3,412	2,665	3,399	2,322	7,343	5,439	11,801	7,710	5,022	20,315	14,007	20,116	1,476	1,152	
Total manure indoors, t[1]	9,806	3,909	8,669	3,433	19,161	7,685	16,924	16,942	6,390	44,641	17,296	25,819	3,833	1,335	
Total concs, t[1]	8,382	3,766	9,185	4,127	22,044	9,904	21,298	20,832	9,359	54,890	24,661	34,093	9,438	2,544	

[1]Tonnes/year for each category.

Table 4.14. ***Contd.***

	Category													
	19	**19**	**20**	**20**	**20**	**21**	**21**	**21**	**21**	**22**	**22**	**22**	**22**	**22**
Origin	Suck	Dairy	Suck	Dairy	Dairy	Suck	Dairy	Suck	Dairy	Suck	Dairy	Suck	Dairy	Mean
Maturity	Late	Late	Late	Late	Dairy	Early	Early	Late	Late	Early	Early	Late	Late	
Breed used in INRAtion	Ch	Ch × Fr	Ch	Ch × Fr	Friesian	Hr × Fr	Hr × Fr	Ch	Ch × Fr	Hr × Fr	Hr × Fr	Ch	Ch × Fr	
No. of animals	13,607	6,113	23,248	10,445	22,462	10,281	4,619	10,281	4,619	7,830	3,518	7,830	3,518	22,695
CH_4, kg/head	29.1	31.6	27.1	29.7	31.3	Dead	Dead	Dead	Dead	See mean	See mean	See mean	See mean	34.4
Manure at grass, kg/head	88.0	133.8	88.0	135.0	140.3									110.6
Manure in house, kg/head	224.4	197.8	193.4	166.8	180.1									242.3
Silage DMI, kg/head	590	504	490	403	446									684
Conc. DMI, kg/head	238	238	238	238	238									238
Grass DMI, kg/head	422	642	422	648	673									530
Total DMI, kg/head	1,250	1,383	1,149	1,289	1,357									1,452
Total CH_4, t[1]	396	193	630	310	704									780
Total manure at grass, t[1]	1,197	818	2,046	1,411	3,151									2,510
Total manure indoors, t[1]	3,054	1,209	4,496	1,742	4,045									5,499
Total concs, t[1]	3,235	1,454	5,528	2,483	5,341									5,396

[1]Tonnes/year for each category.

Table 4.15. Annual output of methane from enteric fermentation, manure OM output and diet intake for each category of male cattle 1–2 years old in 2003.

	Category																
	12	**12**	**13**	**13**	**14**	**14**	**14**	**15**	**15**	**16**	**16**	**16**	**17**	**17**	**20**	**20**	**20**
Origin	Suck	Dairy	Suck	Dairy	Suck	Dairy	Dairy	Suck	Dairy	Suck	Dairy	Dairy	Suck	Dairy	Suck	Dairy	Dairy
Maturity	Early	Early	Late	Late	Early	Early	Dairy	Late	Late	Late	Late	Dairy	Late	Late	Late	Late	Dairy
Breed used in INRAtion	Hr × Fr	Hr × Fr	Ch	Ch × Fr	Hr × Fr	Hr × Fr	Friesian	Ch	Ch × Fr	Ch	Ch × Fr	Friesian	Ch	Ch × Fr	Ch	Ch × Fr	Friesian
No. of animals	35,252	15,838	38,629	17,355	92,709	41,652	89,574	87,613	39,362	230,850	103,715	143,385	15,243	6,848	23,248	10,445	22,462
CH_4, kg/head	20.0	18.2	66.6	63.1	64.4	58.0	59.3	62.9	58.8	68.0	63.0	67.1	5.8	5.7	68.0	63.0	67.1
Manure at grass, kg/head	190.3	159.4	378.5	353.0	360.0	328.4	330.6	312.5	286.7	344.7	313.8	349.8	0.0	0.0	344.7	313.8	349.8
Manure in house, kg/head	0.0	0.0	249.5	243.0	249.5	218.6	228.2	354.9	338.1	377.0	354.9	354.9	84.4	82.6	377.0	354.9	354.9
Silage DMI, kg/head	0	0	630	607	630	520	554	1,152	1,098	1,224	1,152	1,152	43	54	1,224	1,152	1,152
Conc. DMI, kg/head	0	0	402	402	402	402	402	0	0	0	0	0	397	376	0	0	0
Grass DMI, kg/head	913	828	1,815	1,693	1,726	1,575	1,586	1,498	1,375	1,653	1,505	1,677	0	0	1,653	1,505	1,677
Total DMI, kg/head	913	828	2,846	2,701	2,757	2,497	2,541	2,650	2,472	2,877	2,657	2,829	440	430	2,877	2,657	2,829
Total CH_4, t[1]	706	288	2,571	1,094	5,968	2,415	5,315	5,511	2,314	15,703	6,534	9,624	89	39	1,581	658	1,508
Total manure at grass, t[1]	6,709	2,525	14,623	6,126	33,371	13,680	29,616	27,376	11,283	79,579	32,550	50,155	0	0	8,014	3,278	7,857
Total manure indoors, t[1]	0	0	9,637	4,217	23,132	9,104	20,438	31,090	13,310	87,040	36,805	50,882	1,286	565	8,766	3,706	7,971
Total concs, t[1]	0	0	15,514	6,970	37,234	16,728	35,975	0	0	0	0	0	6,052	2,576	0	0	0

[1]Tonnes/year for each category.

Table 4.16. Annual output of methane from enteric fermentation, manure OM output and diet intake for each category of male cattle >2 years old in 2003.

	Category				
	15	**15**	**16**	**16**	**16**
Origin	Suck	Dairy	Suck	Dairy	Dairy
Maturity	Late	Late	Late	Late	Dairy
Breed used in INRAtion	Ch	Ch × Fr	Ch	Ch × Fr	Friesian
No. of animals	87,613	39,362	230,850	103,715	143,385
CH_4, kg/head	67.3	64.3	25.2	24.7	27.3
Manure at grass, kg/head	470.1	442.4	239.1	235.0	259.6
Manure in house, kg/head	169.9	169.3	0.0	0.0	0.0
Silage DMI, kg/head	491	489	0	0	0
Conc. DMI, kg/head	176	176	0	0	0
Grass DMI, kg/head	2,254	2,122	1,146	1,127	1,245
Total DMI, kg/head	2,921	2,786	1,146	1,127	1,245
Total CH_4, t[1]	5,900	2,533	5,811	2,566	3,919
Total manure at grass, t[1]	41,185	17,415	55,189	24,368	37,222
Total manure indoors, t[1]	14,884	6,662	0	0	0
Total concs, t[1]	15,380	6,910	0	0	0

[1]Tonnes/year for each category.

Using the average of June and December animal numbers gives rise to an underestimate (the emission factor has already accounted for the fact that many of these animals only live for about half the year):

$34.3 \times 428{,}350 = 14{,}692.4$ t CH_4.

Thus, in reality, the emissions from this category are about 50% higher than if using the June–December mean figures for animal numbers.

This situation does not arise in dairy or suckler cow numbers, but it does arise to a lesser extent in the category cattle 1–2 years, as some of these animals also do not live for the full year. It is much less of an issue with cattle <1 year, as the vast majority of these live for the full year. On account of the situation with the other two categories, there is a strong case to use the June livestock figures to calculate the national inventory, in particular for non-breeding beef cattle.

4.2.5 Beef cattle emissions in 1990

The CMMS database and statistical report have allowed the detailed categorisation of the Irish cattle herd as outlined above. This information is not available prior to 2002, and thus it is not possible to construct a similar categorisation for 1990. However, some information is known about the differences that may exist between beef cattle systems in 1990 and 2003.

- The number of suckler and dairy cows is known, so that the proportion of beef cattle coming from these origins can be quantified for 1990.
- There is information on the breed of bull (and cow) used on both suckler and dairy cows in 1990 and thus a division for 1990 into early- and late-maturing breeds can be made.
- The number of animals going into a third year is known, and thus the number of animals who are not finished in their second year is known.
- June and December statistics indicate that most cattle >2 years old were kept until at least December of their third year, unlike the situation in 2003, when most were slaughtered before December.
- Silage quality is known to be poorer in 1990 (DMD is 20 g/kg lower on average than 2001–2004).
- Concentrate usage is lower in 1990 than 2003 according to production statistics for beef cattle compound (Appendix 1).

4.2.5.1 Suckler and dairy cows

The numbers of suckler and dairy cows in 1989 and 1990 are shown in Table 4.17. The non-breeding beef animals in 1990 would mainly be the progeny of cows present in 1990 and the previous year. Therefore 2 years are used

Table 4.17. Dairy and suckler cow numbers in 1989 and 1990.

	Dairy	Suckler
1989	1,361,750	656,850
1990	1,340,950	730,350
Average	1,351,350	693,600
Proportion	0.6608	0.3392

Source: CSO.

to determine the proportion of dairy and suckler cows. Given that 48% of dairy cows were mated to a Friesian bull (Drennan and Power, 1993), the remainder of the calf crop in 1990 was split almost exactly between suckler and dairy dams.

4.2.5.2 Breed type

Table 3.9 shows the breed composition of cows in 1992 *vs* 1998. There has been a trend towards continental breeds (mainly at the expense of Friesians), which would tend to make the calves more late maturing. Table 4.18 shows the breeds of sires used on dairy and suckler cows in 1992 and 1998. Charolais, Simmental and Limousin are considered late-maturing breeds. In 1992, bulls of these breeds were used on 45.6% of all cows according to the data in Table 4.18. This had risen to 50.1% in 1998. These figures might be slight underestimates, as there are likely to be some late-maturing breeds in the 'Other' category. The proportion of late-maturing breeds in 1992 is applied to 1990, and the figure is increased to 48% to take account of the 'Other' category. When calves born to a Friesian bull are excluded (Table 4.19), the numbers of beef calves considered late- and early-maturing are in the ratio 0.7:0.3. This is not much different to the data used for 2003 (0.724:0.276).

4.2.5.3 Apportioning animals to categories for 1990

In order to apportion animals to the categories used above, the following rules were applied to the animal numbers in 1990:

1. Proportions of animals stillborn, and who died at less than 3 months old, 3–12 months old, 1–2 years old and >2 years old were established from 2003 data (CMMS, 2003) and the same proportions were applied to the cattle population in 1990.

2. Live exports were accounted for as follows: 40,000 Friesian males, 14,000 Friesian females, 20,000 each for late-maturing beef breed males and females, 20,000 each for early-maturing beef breed males and females.

3. Of the remaining Friesian males, 25% were assigned to Category 14 (slaughtered during the second winter) and 75% were assigned to Category 16 (slaughtered during the third grazing season). All the remaining Friesian females were assigned to Category 11 (replacement heifers).

4. All the remaining early-maturing males were assigned to Category 14. Of the heifers, 40,000 were assigned to Category 11, with the remainder being split between Category 1 (slaughtered off grass during the second grazing season) and Category 3 (slaughtered during second winter).

5. All the remaining late-maturing males were assigned to Category 15 (slaughtered during the third winter). Of the heifers, 40,000 were assigned to Category 11, with the remainder being split between Category 2 (slaughtered during the second winter) and Category 3 (slaughtered during the third grazing season).

Table 4.18. Breed of sire (%) used on dairy and suckler cows in 1992 and 1998.

	Dairy	Suckler
1992[1]		
No. of cows	1,351,350	693,600
Friesian/Holstein	48	2
Hereford	16	11
Aberdeen Angus	2	2
Shorthorn	1	2
Charolais	9	42
Simmental	11	16
Limousin	9	20
Other	4	5
1998[2]		
No. of cows	1,216,300	1,222,050
Friesian/Holstein	47	1
Hereford	18	9
Aberdeen Angus	8	6
Shorthorn	–	1
Charolais	7	46
Simmental	6	16
Limousin	8	17
Other	6	6

[1]Drennan and Power (1993).
[2]Drennan (1999).

Table 4.19. Estimation of classification of 1990 beef herd by origin (suckler or dairy dam) and maturity type.

	Dairy		Suckler		Total	
	n	Proportion	*n*	Proportion	*n*	Proportion
Cow no. (mean of 1989 and 1990)	1,351,350		693,600		2,044,950	
Calving %[1]	91.3		94.3			
No. of calves	1,233,783		654,065		1,887,847	
Friesian bull usage %[2]	48					
No. of Friesian calves	592,216					
% male[3]	51.1		51.4			
% female[3]	48.9		48.6			
No. of Friesian males	302,622	0.25		0.00	302,622	0.16
No. of Friesian females	289,593	0.23		0.00	289,593	0.15
No. of beef late-maturing males	195,443	0.16	268,951	0.41	464,395	0.25
No. of beef late-maturing females	187,029	0.15	254,300	0.39	441,329	0.23
No. of beef early-maturing males	132,397	0.11	67,238	0.10	199,635	0.11
No. of beef early-maturing females	126,697	0.10	63,575	0.10	190,272	0.10
Total	1,233,783		654,065		1,887,847	

[1]Based on 2003 calves born (according to the CMMS, 2003) divided by no. of cows in 2003 according to the CSO.
[2]Drennan and Power (1993).
[3]Based on the CMMS (2003).

This gave a breakdown between categories as outlined in Table 4.20.

Thus the national herd was apportioned in the categories as outlined for 2003 above. Using the same procedures as outlined above, carcass weight for steers was calculated to be 364.2 kg. This heavier carcass weight in comparison to 2003 is in line with expectations (actual national steer carcass weight was 357 kg). For females, the carcass weight in 1990 was calculated to be 296.3 kg (actual national heifer carcass weight was 292 kg).

Concentrate usage

When the concentrate feeding levels used in 2003 are applied to these animal categories in 1990, national beef concentrate usage is approximately 738,000 t. This is far in excess of the amount of beef cattle compound produced in 1990 (340,000 t). Even allowing for some beef concentrate being mixed on farm, it is obvious that concentrate feeding levels were lower in 1990 than in 2003. An assumption was made that the 1990 concentrate feeding level was 0.67 of that in 1990.

Silage quality

Silage digestibility and related parameters were adjusted as described above for dairy and suckler cows.

4.2.5.4 Methane emission factors for 1990

The weighted averages for emission factors were calculated (as outlined for 2003). For enteric fermentation,

Table 4.20. Proportion of non-breeding beef cattle in different categories in 1990.

Females		Males	
Stillborn:	0.94	**Stillborn:**	0.94
Category 1	3.26	**Category 14**	23.87
Category 2	9.71	**Category 15**	43.43
Category 3	9.79	**Category 16**	19.13
Category 4	29.14	**Category 18**	2.07
Category 6	2.61	**Category 20**	6.21
Category 8	3.26	**Category 21**	2.47
Category 9	2.47	**Category 22**	1.88
Category 10	1.88		
Category 11	36.94		

they were 27.05, 53.54 and 21.65 kg/animal for female animals <1 year old, 1–2 years old and >2 years old, respectively. For manure management, they were 8.79, 14.74 and 0.33 kg/animal for animals <1 year old, 1–2 years old and >2 years old, respectively.

For enteric fermentation, the weighted averages were 30.46, 62.22 and 55.08 kg/animal for male animals <1 year old, 1–2 years old and >2 years old, respectively. For manure management, they were 9.73, 16.68 and 4.57 kg/animal for animals <1 year old, 1–2 years old and >2 years old, respectively.

5 Bulls for Breeding and In-Calf Heifers

Bulls for breeding and in-calf heifers are small categories in the Irish cattle herd, accounting for a combined 6% of the national cattle herd. Separate production systems are not defined for these categories, as with non-breeding beef cattle, because of lack of published data on their feed intake, and the small number of animals involved.

Bulls for breeding are mostly of continental breeds, and their emission factors are based on those for Category 13 cattle of suckler origin in their second year. The value of 66.5 kg/year for animals in this category in 2003 is determined by an applicable period of 310 days in their second year, which is adjusted to 81.55 kg/year using the full period of 365 days for breeding bulls. Similarly, the emission factor for 1990 is 86.38 kg/year and corresponding adjustments for manure management give emission factors of 18.95 and 23.79 kg/year in 2003 and 1990, respectively. (Note: it was assumed that 25% of manure during the housing period was in solid manure systems.)

In-calf heifers were assigned the same emission factors as Category 2 heifers in their second year. In-calf heifers only need emissions associated with the period March–December of their second year to be counted, as they are subsequently counted as dairy or suckler cows in the CSO census. Category 2 heifers are assumed to be slaughtered on 3 February. Adjustment to account for the slightly longer period was not made in respect of in-calf heifers, as they are carrying a calf in addition to normal growth. Their emission factors (kg/head/year) are as follows:

Dairy, 1990:	enteric – 51.82	manure – 13.40
Dairy, 2003:	enteric – 50.16	manure – 10.93
Suckler, 1990:	enteric – 55.42	manure – 15.61
Suckler, 2003:	enteric – 53.58	manure – 12.87.

6 Summary and Recommendations

The new emission factors are summarised in Table 6.1. There are many differences in comparison to the default factors recommended by the IPCC (1996) in the absence of specific country values. These differences reflect the different production systems in Ireland.

The implications for the national inventory of emissions from the cattle herd (both enteric fermentation and manure management) are shown in Fig. 6.1. The specific Irish Tier 2 values give higher total emissions for both 1990 and 2003, and using June-only numbers for non-breeding cattle gives a further increase. However, the drop in current emissions relative to 1990 is greater using the Tier 2 approach (3,600 t *vs* 10,500 t), and using June numbers increases the reduction to 16,900 t.

It is recommended that:

1. The national inventory for methane from enteric fermentation and manure management is calculated on a Tier 2 basis using these emission factors, and

2. June cattle numbers (CSO) should be used to calculate the Tier 2 inventory for non-breeding cattle.

Table 6.1. Methane emission factors for enteric fermentation and manure management for 2003 and 1990.

	2003		1990	
	Enteric	**Manure**	**Enteric**	**Manure**
Dairy cows	108.8	20.53	101.38	21.57
Beef (suckler) cows	74.2	13.9	74.03	14.02
Male cattle				
<1 year	29.53	8.5	30.46	9.73
1–2 years	60.37	14.25	62.22	16.68
>2 years[1]	34.27	1.48	55.08	4.57
Female cattle				
<1 year	27.86	8.28	27.05	8.79
1–2 years	44.6	9.34	53.54	14.74
>2 years[1]	22.46	0.34	21.65	0.33
Bulls for breeding	81.55	18.95	86.38	23.79
In-calf heifers – dairy	50.16	10.93	51.82	13.4
In-calf heifers – beef	53.58	12.87	55.42	15.61

[1]The emission factors for cattle >2 years are less than for cattle of 1–2 years because they are only kept for part of the third year, particularly in 2003.

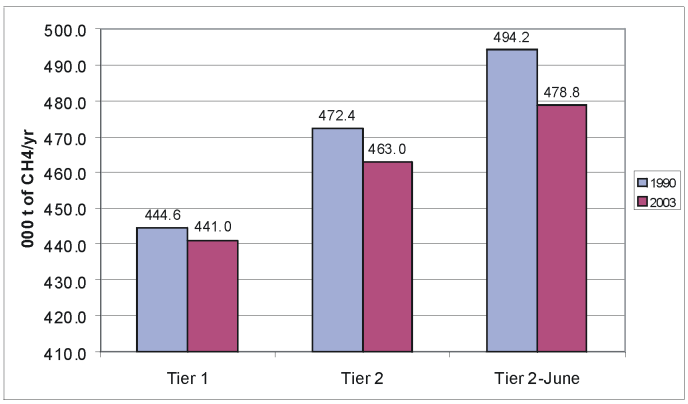

Figure 6.1. National emissions of methane from enteric fermentation and manure management for 1990 and 2003 using Tier 1 default values, specific Irish emission factors, and using specific Irish emission factors in combination with June animal numbers for non-breeding beef cattle.

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Appendix 1 Statistics on Cattle Population, Milk Production and Concentrate Manufacture

Table A1.1. Irish dairy cow numbers (CSO data for June, December and average), total milk deliveries and milk retained on farm, and average milk yield per cow.

	CSO dairy cow numbers ('000)			Total milk deliveries	Deliveries/cow	Milk used on farm	Yield/cow	Yield/cow
	June	Dec	Average	L × 10^6	L	L	L	kg[1]
1989	1,382	1,342	1,362	5,097	3,743	255	3,998	4,117
1990	1,360	1,322	1,341	5,117	3,816	255	4,071	4,192
1991	1,331	1,288	1,309	5,061	3,865	258	4,123	4,246
1992	1,278	1,246	1,262	5,105	4,045	262	4,307	4,435
1993	1,264	1,248	1,256	5,052	4,022	257	4,280	4,407
1994	1,261	1,233	1,247	5,120	4,106	261	4,367	4,497
1995	1,256	1,221	1,239	5,136	4,147	273	4,419	4,551
1996	1,266	1,216	1,241	5,144	4,145	309	4,455	4,587
1997	1,252	1,201	1,227	5,105	4,162	313	4,475	4,608
1998	1,234	1,199	1,216	4,944	4,065	318	4,383	4,513
1999	1,201	1,174	1,187	4,973	4,189	281	4,470	4,603
2000	1,178	1,153	1,165	5,011	4,301	286	4,587	4,723
2001	1,183	1,148	1,165	5,184	4,449	287	4,736	4,876
2002	1,164	1,129	1,146	5,039	4,396	314	4,710	4,850
2003	1,156	1,136	1,146	5,200	4,539	292	4,831	4,974

Source: all data from CSO except milk used on farms (Billy Fingleton, personal communication).
L, litres.
[1]Litres / 0.971164.

Table A1.2. Annual fat and protein content of milk intake by creameries and pasteurisers (domestic).

	Fat content (%)	Protein content (%)
1992	3.56	3.21
1993	3.55	3.2
1994	3.57	3.2
1995	3.58	3.24
1996	3.59	3.21
1997	3.61	3.21
1998	3.67	3.24
1999	3.7	3.25
2000	3.7	3.27
2001	3.74	3.28
2002	3.73	3.27
2003	3.73	3.3
2004	3.75	3.3

Source: CSO.

Table A1.3. No. of dairy calves (i.e. dairy breed dam) born by county and mean calving date (MCD) for spring-calving cows in 2003.

	No. of calves	MCD
Carlow	10,068	12 Mar
Cavan	33,490	18 Mar
Clare	32,018	17 Mar
Cork	265,158	9 Mar
Donegal	15,401	17 Mar
Dublin	2,937	14 Mar
Galway	29,270	17 Mar
Kerry	92,845	12 Mar
Kildare	12,559	14 Mar
Kilkenny	51,850	8 Mar
Laois	26,642	12 Mar
Leitrim	2,613	23 Mar
Limerick	94,529	14 Mar
Longford	7,954	19 Mar
Louth	12,806	14 Mar
Mayo	22,281	21 Mar
Meath	39,458	16 Mar
Monaghan	34,250	17 Mar
Offaly	20,502	14 Mar
Roscommon	6,512	20 Mar
Sligo	9,769	19 Mar
Tipperary	109,383	11 Mar
Waterford	52,342	8 Mar
Westmeath	15,218	18 Mar
Wexford	47,618	8 Mar
Wicklow	17,388	14 Mar
Ireland	**1,064,861**	**13 Mar**

Source: CMMS (2003).

Table A1.4. Production of compound feedstuffs (tonnes).

	Calf	Dairy	Beef	Bull	Other	Total	Exports
1989	168,767	903,602	342,542	9,134		1,424,045	
1990	159,041	801,149	340,063	18,916		1,319,169	
1991	163,996	775,462	416,185	13,132	4,373	1,376,148	11,190
1992							
1993							
1994							
1995	181,837	936,811	804,405	28,105	3,375	1,954,534	32,117
1996	177,860	810,991	694,762	19,426	11,189	1,714,228	27,349
1997	147,009	656,607	606,731	15,800	26,208	1,452,356	21,529
1998	155,223	821,026	796,673	19,011	32,098	1,824,030	23,376
1999							
2000	150,283	823,403	901,559	29,062	21,450	1,929,514	39,823
2001	170,708	884,946	854,051	34,501	18,650	1,962,856	33,969
2002							
2003	169,699	887,352	949,153	68,556	26,092	2,100,853	51,428

Source: Department of Agriculture and Food.

Table A1.5. Irish suckler (beef) cow numbers (CSO data for June, December and average).

	December	June	Average
1989	659	655	657
1990	729	731	730
1991	784	817	801
1992	917	889	903
1993	937	980	958
1994	969	1,011	990
1995	1,005	1,039	1,022
1996	1,083	1,113	1,098
1997	1,164	1,202	1,183
1998	1,196	1,248	1,222
1999	1,167	1,217	1,192
2000	1,155	1,187	1,171
2001	1,160	1,197	1,178
2002	1,151	1,154	1,153
2003	1,144	1,187	1,166

Source: all data from CSO.

Table A1.6. No. of beef calves (i.e. beef breed dam) born by county in 2003.

	No. of calves
Carlow	16,223
Cavan	47,207
Clare	77,870
Cork	83,273
Donegal	45,355
Dublin	3,588
Galway	108,302
Kerry	51,690
Kildare	17,636
Kilkenny	36,661
Laois	34,008
Leitrim	29,828
Limerick	38,085
Longford	28,461
Louth	9,956
Mayo	81,514
Meath	34,139
Monaghan	32,070
Offaly	31,483
Roscommon	55,293
Sligo	33,702
Tipperary	68,121
Waterford	26,477
Westmeath	36,249
Wexford	30,284
Wicklow	22,344
Ireland	1,079,819

Source: CMMS (2003).

Table A1.7. Number of calves born by month and breed of dam in 2003, and derivation of number of spring- and autumn-calving beef (suckler) cows, and mean calving date (MCD) for each.

	Ch[1]	Si[1]	Lm[1]	BA[1]	BB[1]	SA[1]	SH[1]	AA[1]	HE[1]	MO[1]	RB[1]	MY[1]	A: Total	% calving by month	B: Days since year start (month median)	A × B
Jan	12,638	11,204	12,509	273	2,839	260	1,929	6,858	10,956	966	225	423	61,080	5.6	16	977,280
Feb	21,339	20,310	21,226	415	4,839	375	3,944	12,755	21,021	3,111	548	1,163	111,046	10.1	45	4,997,070
Mar	48,249	39,187	46,824	772	10,058	917	9,154	30,726	45,448	3,630	593	1,084	236,642	21.6	75	17,748,150
Apr	54,766	38,044	50,967	1,009	10,334	806	9,943	32,005	45,144	2,535	251	710	246,514	22.5	105	25,883,970
May	35,176	22,587	31,652	593	6,587	555	5,921	19,708	27,287	1,315	147	317	151,845	13.8	136	20,650,920
Jun	20,859	12,432	17,349	336	3,890	296	3,386	10,936	15,445	579	72	174	85,754	7.8	166	14,235,164
Jul	12,545	7,296	10,408	234	2,320	159	1,853	6,356	9,467	297	25	65	51,025	4.6	196	10,000,900
Aug	8,367	5,234	7,672	160	1,641	129	1,278	4,094	6,535	200	26	57	35,393	3.2	227	8,034,211
Sep	6,823	4,779	6,864	192	1,437	120	873	3,224	4,939	412	70	126	29,859	2.7	258	7,703,622
Oct	6,260	4,777	6,989	189	1,420	121	800	2,838	4,319	450	66	102	28,331	2.6	288	8,159,328
Nov	6,058	4,462	6,435	180	1,428	132	661	2,656	4,070	342	100	89	26,613	2.4	319	8,489,547
Dec	7,537	5,822	8,294	185	1,768	142	947	3,290	4,947	375	81	81	33,469	3.0	349	11,680,681
Total	240,617	176,134	227,189	4,538	48,561	4,012	40,689	135,446	199,578	14,212	2,204	4,391	1,097,571	100		

			Calving days
No. spring	892,881	**Spring**	
No. autumn	204,690	**Total Jan–June**	84,492,554
% spring	81.35	**Average Jan–June**	94.6
% autumn	18.65	**MCD**	05 Apr
		Autumn	
		Total Jul–Dec	54,068,289
		Average Jul–Dec	264.1
		MCD	21 Sep

Source: CMMS (2003). Other data calculated in this project.

[1]Ch, Charolais; Si, Simmental; Lm, Limousin; BA, Blonde D'Aquitaine; BB, Belgian Blue; SA, Salers; SH, Shorthorn; AA, Aberdeen Angus; HE, Hereford; MO, Montbelliarde; RB, Rotbunte; MY, Meuse Rhine Yssel.

Appendix 2 Composition of Concentrate and Forage Used in Dairy Cow, Suckler Cow and Beef Cattle Production Systems

Table A2.1. Assumed composition of silage, concentrate and grass used in modelling of dairy cow production systems.

	2003	1990
Silage NE_l, MJ/kg DM	5.6	5.4
Silage, UFL/kg DM	0.79	0.76
Silage GE, MJ/kg DM	18.8	18.8
Silage DE, MJ/kg DM	12.6	12.2
Silage OMD, kg/kg	0.7	0.68
Silage OM, kg/kg DM	0.91	0.91
Silage DOMD, kg/kg	0.63	0.62
Concentrate NE_l, MJ/kg DM	7.6	
Concentrate UFL/kg DM	1.07	
Concentrate GE, MJ/kg DM	18.8	
Concentrate DE, MJ/kg DM	14.7	
Concentrate DOMD, kg/kg	0.74	
Concentrate OM, kg/kg DM	0.94	
Concentrate OMD, kg/kg	0.78	
Grass GE, MJ/kg DM	18.8	
Grass NE_l, MJ/kg DM (up to May)	7.4	
Grass NE_l, MJ/kg DM (Jun–Aug)	7.3	
Grass NE_l, MJ/kg DM (Sept on)	7.0	
Grass UFL/kg DM (up to May)	1.04	
Grass UFL/kg DM (Jun–Aug)	1.02	
Grass UFL/kg DM (Sept on)	0.98	
Grass DE, MJ/kg DM (up to May)	15.1	
Grass DE, MJ/kg DM (Jun–Aug)	14.7	
Grass DE, MJ/kg DM (Sept on)	14.1	
Grass OM, kg/kg DM	0.92	
Grass OMD, kg/kg (up to May)	0.80	
Grass OMD, kg/kg (Jun–Aug)	0.78	
Grass OMD, kg/kg (Sept on)	0.74	
Grass DOMD, kg/kg (up to May)	0.74	
Grass DOMD, kg/kg (Jun–Aug)	0.72	
Grass DOMD, kg/kg (Sept on)	0.68	

NE_l, net energy for lactation.
UFL, unit of feed for lactation (net energy of 1 kg of air-dry barley).
GE, gross energy.
DE, digestible energy.
ME, metabolisable energy.
OMD, organic matter digestibility (assumed equal to dry matter digestibility).
OM, organic matter.
DOMD, digestible organic matter in the dry matter.

Table A2.2. Average dry matter digestibility (DMD) (g/kg) of grass silages tested by Teagasc from 2001 to 2004.

	Average DMD (g/kg)
2001	69.95
2002	67.3
2003	68.0
2004	71.1
Mean	69.95

Source: Siobhan Kavanagh, Teagasc, personal communication.

Table A2.3. Assumed composition of silage, concentrate and grass used in modelling of suckler cow production systems.

	2003		1990	
	Spring calvers	**Autumn calvers**	**Spring calvers**	**Autumn calvers**
Silage NE_l, MJ/kg DM	4.9	5.2	4.8	5.0
Silage, UFL/kg DM	0.70	0.73	0.67	0.71
Silage GE, MJ/kg DM	18.4	18.4	18.4	18.4
Silage DE, MJ/kg DM	11.0	11.6	10.7	11.2
Silage OM digestibility, kg/kg	0.63	0.66	0.61	0.64
Silage OM, kg/kg	0.91	0.91	0.91	0.91
Silage DOMD, kg/kg	0.57	0.60	0.55	0.58
Concentrate NE_l, MJ/kg DM	7.6			
Concentrate UFL/kg DM	1.07			
Concentrate GE, MJ/kg DM	18.8			
Concentrate DE, MJ/kg DM	14.7			
Concentrate DOMD, kg/kg	0.74			
Concentrate OM, kg/kg	0.94			
Concentrate OMD, kg/kg	0.78			
Grass GE, MJ/kg DM	18.8			
Grass NE_l, MJ/kg DM (up to May)	7.4			
Grass NE_l, MJ/kg DM (Jun–Aug)	7.3			
Grass NE_l, MJ/kg DM (Sept on)	7.0			
Grass UFL/kg DM (up to May)	1.04			
Grass UFL/kg DM (Jun–Aug)	1.02			
Grass UFL/kg DM (Sept on)	0.98			
Grass DE, MJ/kg DM (up to May)	14.5			
Grass DE, MJ/kg DM (Jun–Aug)	14.2			
Grass DE, MJ/kg DM (Sept on)	13.6			
Grass OM kg/kg	0.92			
Grass OMD, kg/kg (up to May)	0.80			
Grass OMD, kg/kg (Jun–Aug)	0.78			
Grass OMD, kg/kg (Sept on)	0.74			
Grass DOMD, kg/kg (up to May)	0.74			
Grass DOMD, kg/kg (Jun–Aug)	0.72			
Grass DOMD, kg/kg (Sept on)	0.68			

For abbreviations, see footnote to Table A2.1.

Table A2.4. Assumed composition of silage, concentrate and grass used in modelling of other beef production systems.

	2003		1990	
	Growing	Finishing	Growing	Finishing
Silage NE_l, MJ/kg DM	5.2	5.5	5.0	5.3
Silage, UFL/kg DM	0.73	0.77	0.71	0.75
Silage NE_{mg}, MJ/kg DM	5.2	5.5	5.0	5.3
Silage UFV/kg DM	0.68	0.727	0.65	0.698
Silage GE, MJ/kg DM	18.4	18.8	18.4	18.8
Silage DE, MJ/kg DM	11.6	12.4	11.2	11.8
Silage OM digestibility, kg/kg	0.66	0.69	0.64	0.67
Silage OM%	0.91	0.91	0.91	0.91
Silage DOMD, kg/kg	0.60	0.63	0.58	0.61
Concentrate NE_l, MJ/kg DM	7.6			
Concentrate UFL/kg DM	1.07			
Concentrate NE_{mg}, MJ/kg DM	7.8			
Concentrate UFV/kg DM	1.03			
Concentrate GE, MJ/kg DM	18.4			
Concentrate DE, MJ/kg DM	14.5			
Concentrate DOMD, kg/kg	0.75			
Concentrate OM%	0.93			
Concentrate OMD, kg/kg	0.79			
Grass GE, MJ/kg DM	18.8			
Grass NE_l, MJ/kg DM (up to May)	7.4			
Grass NE_l, MJ/kg DM (Jun–Aug)	7.3			
Grass NE_l, MJ/kg DM (Sept on)	7.0			
Grass UFL/kg DM (up to May)	1.04			
Grass UFL/kg DM (Jun–Aug)	1.02			
Grass UFL/kg DM (Sept on)	0.98			
Grass NE_{mg}, MJ/kg DM (up to May)	7.8			
Grass NE_{mg}, MJ/kg DM (Jun–Aug)	7.5			
Grass NE_{mg}, MJ/kg DM (Sept on)	7.2			
Grass UFV/kg DM (up to May)	1.02			
Grass UFV/kg DM (Jun–Aug)	0.98			
Grass UFV/kg DM (Sept on)	0.94			
Grass DE, MJ/kg DM (up to May)	14.5			
Grass DE, MJ/kg DM (Jun–Aug)	14.2			
Grass DE, MJ/kg DM (Sept on)	13.6			
Grass OM, kg/kg	0.92			
Grass OMD, kg/kg (up to May)	0.80			
Grass OMD, kg/kg (Jun–Aug)	0.78			
Grass OMD, kg/kg (Sept on)	0.74			
Grass DOMD, kg/kg (up to May)	0.74			
Grass DOMD, kg/kg (Jun–Aug)	0.72			
Grass DOMD, kg/kg (Sept on)	0.68			

For abbreviations, see footnote to Table A2.1.

Appendix 3 Production, Energy Requirements, Diet and Methane Emissions on a Monthly Basis for the 12 Dairy Production Systems Defined for 2003

2003, Region 1: Dairy cows (first third of herd to calve).

	Jan	Feb	Feb	March	March	April	April	May	June	July	Aug	Sept	Oct	Oct	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Calved pre-turnout	Out by day	Day and night, first 4 weeks	Day and night, first 4 weeks	Rest of April							Dry	Out	Housed	
Days in month or period	31	9	19	7	24	4	26	31	30	31	31	30	29	2	29	1	31
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	37.8	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2
Daily milk yield, kg/day	0.0	0.0	16.9	22.5	22.5	23.8	23.8	22.9	20.9	19.1	16.8	14.9	12.3	0.0	0.0	0.0	0.0
Milk fat %	0	0	3.93	3.66	3.66	3.47	3.47	3.43	3.49	3.59	3.73	3.92	4.02	0	0	0	0
Milk protein %	0	0	3.1	3.11	3.11	3.16	3.16	3.25	3.29	3.32	3.41	3.56	3.61	0	0	0	0
Monthly milk yield, kg	0	0	321	158	540	95	619	709	628	591	521	446	357	0	0	0	0
Milk energy output, MJ NE_l/day	0.0	0.0	51.9	66.9	66.9	69.3	69.3	66.7	61.7	57.0	51.4	47.0	39.5	0.0	0.0	0.0	0.0
Pregnancy requirement, MJ NE_l/day	12.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	8.3	8.3	12.1
Body weight change, kg/day	0.2	0	–0.5	–0.5	–0.5	–0.25	–0.25	0	0	0.2	0.3	0.3	0.4	0.6	0.6	0.2	0.2
Monthly body weight change, kg	6.2	0	–9.5	–3.5	–12	–1	–6.5	0	0	6.2	9.3	9	11.6	1.2	17.4	0.2	6.2
Energy of body weight change, MJ NE_l/day	6.4	0.0	–12.4	–12.4	–12.4	–6.2	–6.2	0.0	0.0	6.4	9.6	9.6	12.8	19.2	19.2	6.4	6.4
Approximate proportion of concentrate (PC)	0.00	0.00	0.45	0.34	0.29	0.27	0.12	0.11	0.12	0.12	0.12	0.12	0.13	0.00	0.00	0.00	0.00
Energy req., MJ NE_l/day before adj. for PC	54.7	48.3	75.6	92.3	94.0	102.6	102.6	106.2	101.2	102.9	100.5	96.1	91.8	67.0	67.0	50.9	54.7
Adjustment for PC, MJ NE_l/day			9.6	5.9	4.7	4.4	1.9	2.0	1.8	1.8	1.8	1.6	1.5				
Energy req., MJ NE_l/day after adj. for PC	54.7	48.3	85.2	98.2	98.7	107.0	104.4	108.1	103.0	104.7	102.3	97.7	93.3	67.0	67.0	50.9	54.7
Concentrate level, kg/day	0	0	5.3	4.3	3.4	3.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0	0	0	0
Adjusted concentrate level, kg DM/day	0.0	0.0	6.0	4.8	3.8	3.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0	0.0	0.0
Total concentrate usage, kg/month	0	0	113	33	92	15	44	52	50	52	52	50	49	0	0	0	0
Grass intake, kg/month	0	0	0	35	226	42	322	400	373	393	383	366	335	19	279	0	0
Silage intake, kg/month	304	78	136	31	0	0	0	0	0	0	0	0	0	0	0	9	304
Estimated grass input	none	none	none	day	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none	
Estimated grass intake, kg/day	0.0	0.0	0.0	5.0	9.4	10.5	12.4	12.9	12.4	12.7	12.3	12.2	11.6	9.6	9.6	0.0	0.0
Estimated silage intake, kg/day	9.8	8.7	7.1	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.1	9.8
Estimated total intake, kg/day	9.8	8.7	13.1	14.2	13.2	14.4	14.1	14.6	14.1	14.4	14.0	13.9	13.2	9.6	9.6	9.1	9.8
Intake/month, kg	304	78	249	100	318	57	366	452	424	445	435	416	384	19	279	9	304
Gross energy intake, MJ/day	184	163	246	268	249	270	265	274	265	270	264	261	249	181	181	171	184
DE intake, MJ/day	123	109	178	202	198	215	211	219	208	212	207	197	188	136	136	115	123
Feeding level	1.5	1.3	2.4	2.6	2.5	2.7	2.6	2.7	2.6	2.7	2.6	2.5	2.4	1.7	1.7	1.4	1.5
Methane output (Yan *et al*., 2000), MJ/day	15.0	13.5	17.3													14.1	15.0
Methane output (0.065 of GEI), MJ/day				17.4	16.2	17.5	17.2	17.8	17.3	17.5	17.1	16.9	16.2	11.7	11.7		
Methane, kg/day	0.27	0.24	0.31	0.31	0.29	0.32	0.31	0.32	0.31	0.32	0.31	0.30	0.29	0.21	0.21	0.25	0.27
Methane/animal/month, kg	8.4	2.2	5.9	2.2	7.0	1.3	8.0	9.9	9.3	9.8	9.5	9.1	8.4	0.4	6.1	0.3	8.4
Methane, proportion of GEI	0.081	0.083	0.070	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.082	0.081
Estimated total OM intake, kg/day	8.9	7.8	12.1	13.1	12.3	13.3	13.0	13.4	13.0	13.2	12.9	12.8	12.2	8.8	8.8	8.3	8.9
Total diet DOMD, kg/day	6.2	5.5	8.9	10.0	9.7	10.6	10.4	10.7	10.2	10.3	10.1	9.5	9.1	6.5	6.5	5.8	6.2
OM excreted, kg/day	2.7	2.4	3.2	3.1	2.5	2.7	2.6	2.7	2.9	2.9	2.8	3.3	3.1	2.3	2.3	2.5	2.7
OM excreted, kg/month	83	21	60	22	60	11	68	84	86	90	88	98	90	5	67	2	83
OM excreted at pasture, kg/month				11	60	11	68	84	86	90	88	98	90	5	67		
OM excreted during housing, kg/month	83	21	60	11												2	83

2003, Region 1: Dairy cows (second third of herd to calve).

	Jan	Feb	March	March	March	April	April	May	June	July	Aug	Sept	Oct	Nov	Nov	Nov	Dec
Cow status/notes			Dry, up to calving	Calved pre-turnout	Day and night, first 4 weeks	Day and night, first 4 weeks	Rest of April								Dry and Out	Housed	
Days in month or period	31	28	9	7	15	13	17	31	30	31	31	30	31	26	3	1	31
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	36.2	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2
Daily milk yield, kg/day	0.0	0.0	0.0	19.6	19.6	23.4	23.4	23.5	21.8	19.6	17.8	15.7	13.6	11.0	0.0	0.0	0.0
Milk fat %	0	0	0	3.81	3.81	3.58	3.58	3.41	3.42	3.52	3.64	3.84	3.89	4.2	0	0	0
Milk protein %	0	0	0	3.24	3.24	3.21	3.21	3.2	3.23	3.26	3.33	3.49	3.5	3.67	0	0	0
Monthly milk yield, kg	0.00	0	0	294	255	304	398	728	655	609	552	470	423	286	0	0	0
Milk energy output, MJ NE_l/day	0.0	0.0	0.0	59.9	59.9	69.3	69.3	68.0	63.5	58.0	53.6	48.8	42.9	36.2	0.0	0.0	0.0
Pregnancy requirement, MJ NE_l/day	12.1	12.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0
Body weight change, kg/day	0.2	0.2	0	–0.5	–0.5	–0.25	–0.25	–0.25	0		0.3	0.35	0.35	0.4	0.6	0.2	0.2
Monthly body weight change, kg	6.2	5.6	0	–3.5	–7.5	–3.25	–4.25	–7.75	0	0	9.3	10.5	10.85	10.4	1.8	0.2	6.2
Energy of body weight change, MJ NE_l/day	6.4	6.4	0.0	–12.4	–12.4	–6.2	–6.2	–6.2	0.0	0.0	9.6	11.2	11.2	12.8	19.2	6.4	6.4
Approximate proportion of concentrate (PC)			0.00	0.42	0.31	0.27	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.00	0.00	0.00
Energy req., MJ NE_l/day before adj. for PC	54.7	54.7	48.3	83.7	87.0	102.6	102.6	101.3	103.0	97.5	102.7	99.5	93.6	88.5	58.7	42.6	51.6
Adjustment for PC, MJ NE_l/day	0.0	0.0	0.0	8.3	5.0	4.4	1.9	1.8	1.8	1.7	1.8	1.7	1.6	1.5	0.0	0.0	0.0
Energy req., MJ NE_l/day after adj. for PC	54.7	54.7	48.3	92.0	92.0	107.0	104.4	103.1	104.8	99.2	104.6	101.2	95.1	90.0	58.7	42.6	51.6
Concentrate level, kg/day	0.0	0.0	0.0	5.3	3.4	3.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	0.0
Adjusted concentrate level, kg DM/day	0.0	0.0	0.0	6.0	3.8	3.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0	0.0
Total concentrate usage, kg/month	0	0	0	89	50	50	29	52	50	52	52	50	52	44	0	0	0
Grass intake, kg/month	0	0	0	0	110	137	211	379	381	369	392	381	366	288	25	0	0
Silage intake, kg/month	304	274	78	125	0	0	0	0	0	0	0	0	0	0	0	8	286
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	8.5	10.5	12.4	12.2	12.7	11.9	12.7	12.7	11.8	11.1	8.4	0.0	0.0
Estimated silage intake, kg/day	9.8	9.8	8.7	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	9.2
Estimated total intake, kg/day	9.8	9.8	8.7	14.3	12.3	14.4	14.1	13.9	14.4	13.6	14.3	14.4	13.5	12.8	8.4	7.6	9.2
Intake/month, kg	304	274	78	215	160	187	239	431	431	421	444	431	418	332	25	8	286
Gross energy intake, MJ/day	184	184	163	269	232	270	265	261	270	256	269	270	254	240	158	143	174
DE intake, MJ/day	123	123	109	193	184	215	211	208	212	200	211	204	192	181	119	96	116
Feeding level	1.5	1.5	1.3	2.5	2.3	2.7	2.6	2.6	2.7	2.5	2.6	2.6	2.4	2.3	1.5	1.2	1.4
Methane output (Yan *et al*., 2000), MJ/day	15.0	15.0	13.5	18.9												12.2	14.3
Methane output (0.065 of GEI), MJ/day					15.1	17.5	17.2	17.0	17.6	16.6	17.5	17.6	16.5	15.6	10.3		
Methane, kg/day	0.27	0.27	0.24	0.34	0.27	0.32	0.31	0.31	0.32	0.30	0.31	0.32	0.30	0.28	0.18	0.22	0.26
Methane/animal/month, kg	8.4	7.5	2.2	5.1	3.5	4.1	5.3	9.5	9.5	9.3	9.8	9.5	9.2	7.3	0.6	0.2	7.9
Methane, proportion of GEI	0.081	0.081	0.083	0.070	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.085	0.082
Estimated total OM intake, kg/day	8.9	8.9	7.8	13.2	11.4	13.3	13.0	12.8	13.3	12.5	13.2	13.3	12.5	11.8	7.7	6.9	8.4
Total diet DOMD, kg/day	6.2	6.2	5.5	9.7	9.1	10.6	10.4	10.2	10.3	9.8	10.3	9.9	9.3	8.8	5.7	4.8	5.9
OM excreted, kg/day	2.7	2.7	2.4	3.5	2.4	2.7	2.6	2.6	2.9	2.8	2.9	3.4	3.2	3.0	2.0	2.1	2.5
OM excreted, kg/month	83	75	21	53	35	35	45	80	87	85	90	101	98	78	6	2	78
OM excreted at pasture, kg/month					35	35	45	80	87	85	90	101	98	78	6		
OM excreted during housing, kg/month	83	75	21	53												2	78

2003, Region 1: Dairy cows (last third of herd to calve).

	Jan	Feb	March	April	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec	Dec
Cow status/notes		Dry	Dry	Dry up to calving	Calved pre-turnout	Day and night, first 4 weeks	Day and night, first 4 weeks	Rest of May						Out	Housed	Housed	Dry
Days in month or period	31	28	31	6	3	21	7	24	30	31	31	30	31	29	1	24	7
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	36.2	36.2	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2	36.2
Daily milk yield, kg/day	0.0	0.0	0.0	0.0	20.2	20.2	25.0	25.0	24.1	22.1	19.7	17.7	15.4	13.5	13.5	11.6	0.0
Milk fat %	0	0	0	0	3.66	3.66	3.52	3.52	3.41	3.45	3.56	3.72	3.92	4.01	4.01	4.09	0
Milk protein %	0	0	0	0	3.36	3.36	3.26	3.26	3.18	3.09	3.28	3.42	3.44	3.54	3.54	3.53	0
Monthly milk yield, kg	0	0	0	0	61	424	175	600	722	685	611	531	478	390	13	280	0
Milk energy output, MJ NE_l/day	0.0	0.0	0.0	0.0	61.0	61.0	73.8	73.8	69.7	63.9	58.5	54.2	48.4	43.0	43.0	37.5	0.0
Pregnancy requirement, MJ NE_l/day	9.7	12.1	12.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Body weight change, kg/day	0.2	0	0	0	–0.5	–0.5	–0.25	–0.25	–0.25	0	0.3	0.4	0.45	0.4	0.4	0.3	0.2
Monthly body weight change, kg	6.2	0	0	0	–1.5	–10.5	–1.75	–6	–7.5	0	9.3	12	13.95	11.6	0.4	7.2	1.4
Energy of body weight change, MJ NE_l/day	6.4	0.0	0.0	0.0	–12.4	–12.4	–6.2	–6.2	–6.2	0.0	9.6	12.8	14.4	12.8	12.8	9.6	6.4
Approximate proportion of concentrate (PC)			0.00	0.00	0.41	0.31	0.11	0.11	0.12	0.12	0.11	0.11	0.11	0.12	0.10	0.10	0.00
Energy req., MJ NE_l/day before adj. for PC	52	48	48	48	85	88	107	107	103	103	108	106	102	95	92	83	43
Adjustment for PC, MJ NE_l/day	0.00	0.00	0.00	0.00	8.15	4.90	1.99	1.99	1.84	1.85	1.99	1.91	1.78	1.60	1.23	0.96	0.00
Energy req., MJ NE_l/day after adj. for PC	52	48	48	48	93	93	109	109	105	105	110	108	104	97	93	84	43
Concentrate level, kg/day	0.0	0.0	0.0	0.0	5.3	3.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.3	1.3	0.0
Adjusted concentrate level, kg DM/day	0.0	0.0	0.0	0.0	6.0	3.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.4	1.4	0.0
Total concentrate usage, kg/month	0	0	0	0	18	81	12	40	50	52	52	50	52	49	1	34	0
Grass intake, kg/month	0	0	0	0	0	181	91	313	381	395	414	412	406	350	0	0	0
Silage intake, kg/month	291	242	268	52	26	0	0	0	0	0	0	0	0	0	15	316	53
Estimated grass input	none	none	none	day	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none	
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	0.0	8.6	13.0	13.0	12.7	12.7	13.4	13.7	13.1	12.1	0.0	0.0	0.0
Estimated silage intake, kg/day	9.4	8.7	8.7	8.7	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	13.2	7.6
Estimated total intake, kg/day	9.4	8.7	8.7	8.7	14.5	12.5	14.7	14.7	14.4	14.4	15.0	15.4	14.8	13.7	16.2	14.6	7.6
Intake/month, kg	291	242	268	52	43	262	103	353	431	447	466	462	458	399	16	350	53
Gross energy intake, MJ/day	176	163	163	163	272	234	276	276	270	271	283	289	278	258	304	274	143
DE intake, MJ/day	118	109	109	109	195	186	221	221	212	213	221	219	210	195	207	187	96
Feeding level	1.4	1.3	1.3	1.3	2.6	2.4	2.8	2.8	2.7	2.7	2.8	2.7	2.6	2.5	2.6	2.3	1.2
Methane output (Yan *et al*., 2000), MJ/day	14.4	13.5	13.5	13.5	19.1										22.8	20.8	12.2
Methane output (0.065 of GEI), MJ/day						15.2	18.0	18.0	17.6	17.6	18.4	18.8	18.1	16.8			
Methane, kg/day	0.26	0.24	0.24	0.24	0.34	0.27	0.32	0.32	0.32	0.32	0.33	0.34	0.32	0.30	0.41	0.37	0.22
Methane/animal/month, kg	8.0	6.8	7.5	1.5	1.0	5.7	2.3	7.7	9.5	9.8	10.2	10.1	10.1	8.8	0.4	9.0	1.5
Methane, proportion of GEI	0.082	0.083	0.083	0.083	0.070	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.075	0.076	0.085
Estimated total OM intake, kg/day	8.5	7.8	7.8	7.8	13.3	11.6	13.6	13.6	13.3	13.3	13.9	14.2	13.6	12.7	14.7	13.3	6.9
Total diet DOMD, kg/day	5.9	5.5	5.5	5.5	9.8	9.2	10.8	10.8	10.3	10.4	10.8	10.6	10.2	9.5	10.4	9.4	4.8
OM excreted, kg/day	2.5	2.4	2.4	2.4	3.5	2.4	2.7	2.7	2.9	2.9	3.0	3.6	3.5	3.2	4.3	3.9	2.1
OM excreted, kg/month	79	66	73	14	11	50	19	66	87	91	94	109	108	94	4	93	15
OM excreted at pasture, kg/month						50	19	66	87	91	94	109	108	94			
OM excreted during housing, kg/month	79	66	73	14	11										4	93	15

2003, Region 1: Dairy cows (autumn-calving cows).

	Jan	Feb	March	March	April	April	May	June	July	Aug	Aug	Sept	Oct	Oct	Nov	Nov	Dec
Cow status/notes			Out by day	Day and night, first 4 weeks	Day and night, first 4 weeks					Milk	Dry	Dry	Dry	Calved	Out	Housed	Housed
Days in month or period	31	28	7	24	4	26	31	30	31	4	27	30	3	28	29	1	31
Maintenance requirement, MJ NE_l/day	36.2	36.2	37.8	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2
Daily milk yield, kg/day	18.0	17.3	17.1	17.1	16.8	16.8	15.8	13.7	11.7	10.7	0.0	0.0	0.0	15.8	18.8	18.8	18.8
Milk fat %	3.68	3.72	3.75	3.75	3.71	3.71	3.69	3.79	3.95	4.06	0	0	0	4.13	3.87	3.87	3.68
Milk protein %	3.12	3.18	3.26	3.26	3.39	3.39	3.46	3.53	3.63	3.72	0	0	0	3.34	3.19	3.19	3.09
Monthly milk yield, kg	559	485	119	410	67	437	490	412	363	43	0	0	0	443	545	19	583
Milk energy output, MJ NE_l/day	53.7	52.2	51.9	51.9	51.3	51.3	48.3	42.7	37.3	34.9	0.0	0.0	0.0	50.5	57.6	57.6	56.0
Pregnancy requirement, MJ NE_l/day									1.48	1.70	1.70	1.70	1.70				
Body weight change, kg/day	0	0	0	0.25	0.25	0.25	0.5	0.5	0.5	0.5	0.5	0.15	0	–0.6	–0.6	–0.3	–0.3
Monthly body weight change, kg	0	0	0	6	1	6.5	15.5	15	15.5	2	13.5	4.5	0	–16.8	–17.4	–0.3	–9.3
Energy of body weight change, MJ NE_l/day	0.0	0.0	0.0	8.0	8.0	8.0	16.0	16.0	16.0	16.0	16.0	4.8	0.0	–14.9	–14.9	–7.5	–7.5
Approximate proportion of concentrate (PC)	0.50	0.51	0.41	0.25	0.25	0.12	0.11	0.12	0.11	0.11	0.00	0.00	0.00	0.51	0.48	0.52	0.52
Energy req., MJ NE_l/day before adj. for PC	90	88	90	99	99	99	104	98	103	103	68	56	52	75	82	86	85
Adjustment for PC, MJ NE_l/day	11.8	12.1	8.4	3.8	3.8	1.7	1.8	1.7	1.8	1.8	0.0	0.0	0.0	12.0	10.7	12.5	12.8
Energy req., MJ NE_l/day after adj. for PC	102	100	98	103	103	100	106	100	105	104	68	56	52	87	93	99	98
Concentrate level, kg/day	6.9	6.9	5.1	3.1	3.1	1.4	1.4	1.4	1.4	1.4	0.0	0.0	0.0	5.5	5.5	6.9	6.9
Adjusted concentrate level, kg DM/day	7.7	7.7	5.7	3.4	3.4	1.6	1.6	1.6	1.6	1.6	0.0	0.0	0.0	6.1	6.1	7.7	7.7
Total concentrate usage, kg/month	238	215	40	82	14	42	50	48	50	6	0	0	0	171	177	8	238
Grass intake, kg/month	0	0	35	251	41	311	392	363	397	51	262	243	22	163	193	0	0
Silage intake, kg/month	241	211	22	0	0	0	0	0	0	0	0	0	0	0	0	7	217
Estimated grass input	none	none	day	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	5.0	10.4	10.4	11.9	12.6	12.1	12.8	12.7	9.7	8.1	7.4	5.8	6.7	0.0	0.0
Estimated silage intake, kg/day	7.8	7.5	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	7.0
Estimated total intake, kg/day	15.4	15.2	13.9	13.8	13.8	13.5	14.2	13.7	14.4	14.3	9.7	8.1	7.4	11.9	12.8	14.9	14.7
Intake/month, kg	478.7	426.0	97.1	332.4	55.1	352.1	441.5	410.5	447.0	57.2	261.8	242.7	22.2	334.3	370.3	14.9	455.2
Gross energy intake, MJ/day	290.3	286.0	260.7	260.4	259.0	254.6	267.7	257.2	271.1	268.9	182.3	152.1	139.2	224.5	240.1	280.7	276.1
DE intake, MJ/day	210.7	207.8	199.0	207.1	206.1	203.2	213.6	201.6	212.4	210.7	137.1	114.4	104.6	172.2	184.0	204.2	201.1
Feeding level	2.8	2.8	2.6	2.6	2.6	2.5	2.7	2.5	2.7	2.6	1.7	1.4	1.3	2.2	2.4	2.7	2.7
Methane output (Yan *et al*., 2000), MJ/day	19.8	19.5														19.1	18.8
Methane output (0.065 of GEI), MJ/day			16.9	16.9	16.8	16.6	17.4	16.7	17.6	17.5	11.9	9.9	9.0	14.6	15.6		
Methane, kg/day	0.36	0.35	0.30	0.30	0.30	0.30	0.31	0.30	0.32	0.31	0.21	0.18	0.16	0.26	0.28	0.34	0.34
Methane/animal/month, kg	11.0	9.8	2.1	7.3	1.2	7.7	9.7	9.0	9.8	1.3	5.7	5.3	0.5	7.3	8.1	0.3	10.5
Methane, proportion of GEI	0.068	0.068	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.068	0.068
Estimated total OM intake, kg/day	14.3	14.1	12.8	12.8	12.8	12.5	13.1	12.6	13.3	13.2	8.9	7.4	6.8	11.1	11.9	13.8	13.6
Total diet DOMD, kg/day	10.6	10.4	9.9	10.2	10.1	10.0	10.5	9.8	10.4	10.3	6.6	5.5	5.0	8.5	9.0	10.3	10.1
OM excreted, kg/day	3.7	3.6	3.0	2.6	2.6	2.5	2.7	2.8	2.9	2.9	2.3	1.9	1.8	2.7	2.9	3.6	3.5
OM excreted, kg/month	114	102	21	63	10	66	82	83	91	12	63	58	5	74	83	4	108
OM excreted at pasture, kg/month			10	63	10	66	82	83	91	12	63	58	5	74	83		
OM excreted during housing, kg/month	114	102	10													4	108

2003, Region 2: Dairy cows (first third of herd to calve).

	Jan	Feb	Feb	March	March	March	April	April	May	June	July	Aug	Sept	Oct	Nov	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Calved pre-turnout	Calved pre-turnout	Out by day	Day and night, first 4 weeks	Day and night, first 4 weeks	Rest of April							Out	Out + dry	Housed	
Days in month or period	31	14	14	7	7	17	11	19	31	30	31	31	30	31	3	19	8	31
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	36.2	37.8	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2
Daily milk yield, kg/day	0.0	0.0	16.9	22.6	22.6	22.6	23.9	23.9	23.0	21.0	19.1	16.9	14.9	12.3	10.2	0.0	0.0	0.0
Milk fat %	0	0	3.93	3.66	3.66	3.66	3.47	3.47	3.43	3.49	3.59	3.73	3.92	4.02	4.35	0	0	0
Milk protein %	0	0	3.1	3.11	3.11	3.11	3.16	3.16	3.25	3.29	3.32	3.41	3.56	3.61	3.83	0	0	0
Monthly milk yield, kg	0	0	237	158	158	384	263	454	711	631	593	523	447	383	31	0	0	0
Milk energy output, MJ NE_l/day	0.0	0.0	52.0	67.2	67.2	67.2	69.6	69.6	66.9	61.9	57.2	51.6	47.2	39.7	34.6	0.0	0.0	0.0
Pregnancy requirement, MJ NE_l/day	12.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	12.1	12.1
Body weight change, kg/day	0.2	0	–0.5	–0.5	–0.5	–0.5	–0.25	–0.25	0	0	0.2	0.3	0.3	0.4	0.4	0.7	0.2	0.2
Monthly body weight change, kg	6.2	0	–7	–3.5	–3.5	–8.5	–2.75	–4.75	0	0	6.2	9.3	9	12.4	1.2	13.3	1.6	6.2
Energy of body weight change, MJ NE_l/day	6.4	0.0	–12.4	–12.4	–12.4	–12.4	–6.2	–6.2	0.0	0.0	6.4	9.6	9.6	12.8	12.8	22.4	6.4	6.4
Approximate proportion of concentrate (PC)	0.00	0.00	0.45	0.39	0.33	0.29	0.27	0.12	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.00	0.00	0.00
Energy req., MJ NE_l/day before adj. for PC	55	48	76	91	93	94	103	103	106	101	103	101	96	92	87	66	55	55
Adjustment for PC, MJ NE_l/day	0.0	0.0	9.5	7.4	5.8	4.6	4.4	1.9	2.0	1.8	1.8	1.8	1.6	1.5	1.5	0.0	0.0	0.0
Energy req., MJ NE_l/day after adj. for PC	55	48	85	98	98	99	107	105	108	103	105	103	98	93	88	66	55	55
Concentrate level, kg/day	0.0	0.0	5.3	5.3	4.3	3.4	3.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	0.0
Adjusted concentrate level, kg DM/day	0.0	0.0	6.0	6.0	4.8	3.8	3.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0	0.0
Total concentrate usage, kg/month	0	0	83	42	33	65	42	32	52	50	52	52	50	52	5	0	0	0
Grass intake, kg/month	0	0	0	0	35	160	116	236	401	374	394	384	367	359	33	179	0	0
Silage intake, kg/month	304	121	100	67	32	0	0	0	0	0	0	0	0	0	0	0	78	304
Estimated grass input	none	none	none	none	day	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	5.0	9.4	10.6	12.4	12.9	12.5	12.7	12.4	12.2	11.6	10.9	9.4	0.0	0.0
Estimated silage intake, kg/day	9.8	8.7	7.2	9.5	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8	9.8
Estimated total intake, kg/day	9.8	8.7	13.1	15.5	14.3	13.3	14.4	14.1	14.6	14.2	14.4	14.1	13.9	13.3	12.5	9.4	9.8	9.8
Intake/month, kg	304	121	184	108	100	225	158	268	453	425	446	436	417	411	38	179	78	304
Gross energy intake, MJ/day	184	163	247	291	268	249	271	265	275	266	270	264	261	249	236	177	184	184
DE intake, MJ/day	123	109	178	207	202	198	215	212	219	209	212	207	197	188	178	133	123	123
Feeding level	1.5	1.3	2.4	2.7	2.6	2.5	2.7	2.7	2.7	2.6	2.7	2.6	2.5	2.4	2.2	1.7	1.5	1.5
Methane output (Yan *et al*., 2000), MJ/day	15.0	13.5	17.4	20.4													15.0	15.0
Methane output (0.065 of GEI), MJ/day					17.4	16.2	17.6	17.2	17.9	17.3	17.6	17.2	17.0	16.2	15.3	11.5		
Methane, kg/day	0.27	0.24	0.31	0.37	0.31	0.29	0.32	0.31	0.32	0.31	0.32	0.31	0.31	0.29	0.28	0.21	0.27	0.27
Methane/animal/month, kg	8.4	3.4	4.4	2.6	2.2	4.9	3.5	5.9	9.9	9.3	9.8	9.6	9.2	9.0	0.8	3.9	2.2	8.4
Methane, proportion of GEI	0.081	0.083	0.070	0.070	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.081	0.081
Estimated total OM intake, kg/day	8.9	7.8	12.1	14.2	13.2	12.3	13.3	13.0	13.5	13.1	13.3	13.0	12.8	12.2	11.6	8.7	8.9	8.9
Total diet DOMD, kg/day	6.2	5.5	8.9	10.4	10.0	9.8	10.6	10.4	10.8	10.2	10.4	10.1	9.6	9.1	8.6	6.4	6.2	6.2
OM excreted, kg/day	2.7	2.4	3.2	3.8	3.1	2.5	2.7	2.6	2.7	2.9	2.9	2.9	3.3	3.1	2.9	2.3	2.7	2.7
OM excreted, kg/month	83	33	44	27	22	43	30	50	84	86	90	88	98	97	9	43	21	83
OM excreted at pasture, kg/month					11	43	30	50	84	86	90	88	98	97	9	43		
OM excreted during housing, kg/month	83	33	44	27	11												21	83

2003, Region 2: Dairy cows (second third of herd to calve).

	Jan	Feb	March	March	March	April	April	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec	Dec
Cow status/notes			Dry, up to calving	Calved pre-turnout	Day and night, first 4 weeks	Day and night, first 4 weeks	Rest of April								Housed	Housed	Dry
Days in month or period	31	28	14	7	10	18	12	31	30	31	31	30	31	22	8	1	30
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	36.2	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2	36.2
Daily milk yield, kg/day	0.0	0.0	0.0	19.4	19.4	23.1	23.1	23.2	21.6	19.4	17.6	15.5	13.5	10.9	10.9	9.2	0.0
Milk fat %	0	0	0	3.81	3.81	3.58	3.58	3.41	3.42	3.52	3.64	3.84	3.89	4.2	4.2	4.42	0
Milk protein %	0	0	0	3.24	3.24	3.21	3.21	3.2	3.23	3.26	3.33	3.49	3.5	3.67	3.67	3.77	0
Monthly milk yield, kg	0	0	0	194	349	416	277	719	648	602	546	464	418	239	87	9	0
Milk energy output, MJ NE_l/day	0	0	0	59	59	69	69	67	63	57	53	48	42	36	36	31	0
Pregnancy requirement, MJ NE_l/day	12.1	12.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8
Body weight change, kg/day	0.2	0.2	0	–0.5	–0.5	–0.25	–0.25	–0.25	0		0.35	0.35	0.35	0.3	0.2	0.2	0.2
Monthly body weight change, kg	6.2	5.6	0	–3.5	–5	–4.5	–3	–7.75	0	0	10.85	10.5	10.85	6.6	1.6	0.2	6
Energy of body weight change, MJ NE_l/day	6.4	6.4	0.0	–12.4	–12.4	–6.2	–6.2	–6.2	0.0	0.0	11.2	11.2	11.2	9.6	6.4	6.4	6.4
Approximate proportion of concentrate (PC)			0.00	0.42	0.31	0.27	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.14	0.10	0.11	0.00
Energy req., MJ NE_l/day before adj. for PC	54.7	54.7	48.3	83.0	86.3	101.8	101.8	100.5	102.3	96.8	103.7	99.0	93.1	84.9	78.4	73.9	49.4
Adjustment for PC, MJ NE_l/day	0.00	0.00	0.00	8.41	5.05	4.43	1.83	1.79	1.82	1.68	1.86	1.69	1.56	1.43	0.88	0.82	0.00
Energy req., MJ NE_l/day after adj. for PC	54.7	54.7	48.3	91.4	91.3	106.2	103.6	102.3	104.1	98.5	105.6	100.6	94.6	86.3	79.3	74.7	49.4
Concentrate level, kg/day	0.0	0.0	0.0	5.3	3.4	3.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.3	1.3	0.0
Adjusted concentrate level, kg DM/day	0.0	0.0	0.0	6.0	3.8	3.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.4	1.4	0.0
Total concentrate usage, kg/month	0	0	0	60	69	69	20	52	50	52	52	50	52	37	11	1	0
Grass intake, kg/month	0	0	0	0	151	188	147	375	378	366	397	378	364	232	0	0	0
Silage intake, kg/month	304	274	121	83	0	0	0	0	0	0	0	0	0	0	98	11	266
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none	
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	8.4	10.4	12.3	12.1	12.6	11.8	12.8	12.6	11.7	10.6	0.0	0.0	0.0
Estimated silage intake, kg/day	9.8	9.8	8.7	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	11.5	8.9
Estimated total intake, kg/day	9.8	9.8	8.7	14.2	12.2	14.3	14.0	13.8	14.3	13.5	14.5	14.3	13.4	12.2	13.7	12.9	8.9
Intake/month, kg	304	274	121	142	220	257	168	427	428	418	449	429	416	269	110	13	266
Gross energy intake, MJ/day	184	184	163	267	230	268	263	259	268	254	272	269	252	230	257	242	167
DE intake, MJ/day	123	123	109	192	183	213	209	207	210	199	213	203	191	174	175	165	112
Feeding level	1.5	1.5	1.3	2.5	2.3	2.7	2.6	2.6	2.6	2.5	2.7	2.5	2.4	2.2	2.2	2.1	1.4
Methane output (Yan *et al*., 2000), MJ/day	15.0	15.0	13.5	18.8											19.6	18.5	13.8
Methane output (0.065 of GEI), MJ/day					15.0	17.4	17.1	16.8	17.4	16.5	17.7	17.5	16.4	15.0			
Methane, kg/day	0.27	0.27	0.24	0.34	0.27	0.32	0.31	0.31	0.32	0.30	0.32	0.32	0.30	0.27	0.35	0.33	0.25
Methane/animal/month, kg	8.4	7.5	3.4	3.4	4.9	5.7	3.7	9.5	9.5	9.3	10.0	9.5	9.2	6.0	2.8	0.3	7.5
Methane, proportion of GEI	0.081	0.081	0.083	0.070	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.000	0.077	0.083
Estimated total OM intake, kg/day	8.9	8.9	7.8	13.1	11.3	13.2	12.9	12.7	13.2	12.5	13.4	13.2	12.4	11.3	12.5	11.7	8.0
Total diet DOMD, kg/day	6.2	6.2	5.5	9.6	9.0	10.5	10.3	10.1	10.3	9.7	10.4	9.8	9.2	8.4	8.8	8.3	5.6
OM excreted, kg/day	2.7	2.7	2.4	3.5	2.3	2.7	2.6	2.6	2.9	2.7	2.9	3.4	3.2	2.9	3.6	3.4	2.4
OM excreted, kg/month	83	75	33	35	23	49	31	80	87	85	91	101	98	63	29	3	72
OM excreted at pasture, kg/month					23	49	31	80	87	85	91	101	98	63			
OM excreted during housing, kg/month	83	75	33	35											29	3	72

2003, Region 2: Dairy cows (last third of herd to calve).

	Jan	Feb	March	April	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec	Dec
Cow status/notes		Dry	Dry	Dry up to calving	Calved pre-turnout	Day and night, first 4 weeks	Day and night, first 4 weeks	Rest of May						Out	Housed	Housed	Dry
Days in month or period	31	28	31	11	3	16	12	19	30	31	31	30	31	22	8	29	2
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	36.2	36.2	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2	36.2
Daily milk yield, kg/day	0.0	0.0	0.0	0.0	20.4	20.4	25.2	25.2	24.3	22.3	19.9	17.9	15.6	13.6	13.6	11.8	0.0
Milk fat %	0	0	0	0	3.66	3.66	3.52	3.52	3.41	3.45	3.56	3.72	3.92	4.01	4.01	4.09	0
Milk protein %	0	0	0	0	3.36	3.36	3.26	3.26	3.18	3.09	3.28	3.42	3.44	3.54	3.54	3.53	0
Monthly milk yield, kg	0	0	0	0	61	326	303	480	729	691	616	536	482	299	109	341	0
Milk energy output, MJ NE_l/day	0.0	0.0	0.0	0.0	61.6	61.6	74.5	74.5	70.3	64.5	59.1	54.7	48.9	43.4	43.4	37.9	0.0
Pregnancy requirement, MJ NE_l/day	7.8	12.1	12.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Body weight change, kg/day	0.2	0.2	0	0	–0.5	–0.5	–0.25	–0.25	–0.25	0	0	0.4	0.45	0.45	0.35	0.3	0.2
Monthly body weight change, kg	6.2	5.6	0	0	–1.5	–8	–3	–4.75	–7.5	0	0	12	13.95	9.9	2.8	8.7	0.4
Energy of body weight change, MJ NE_l/day	6.4	6.4	0.0	0.0	–12.4	–12.4	–6.2	–6.2	–6.2	0.0	0.0	12.8	14.4	14.4	11.2	9.6	6.4
Approximate proportion of concentrate (PC)			0.00	0.00	0.41	0.31	0.11	0.11	0.12	0.12	0.12	0.11	0.11	0.12	0.09	0.10	0.00
Energy req., MJ NE_l/day before adj. for PC	50	55	48	48	85	89	108	108	104	104	99	107	103	97	91	84	43
Adjustment for PC, MJ NE_l/day	0.0	0.0	0.0	0.0	8.1	4.9	2.0	2.0	1.9	1.9	1.7	1.9	1.8	1.7	1.1	1.0	0.0
Energy req., MJ NE_l/day after adj. for PC	50	55	48	48	93	94	110	110	105	106	100	109	105	99	92	85	43
Concentrate level, kg/day	0.0	0.0	0.0	0.0	5.3	3.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.3	1.3	0.0
Adjusted concentrate level, kg DM/day	0.0	0.0	0.0	0.0	6.0	3.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.4	1.4	0.0
Total concentrate usage, kg/month	0	0	0	0	18	61	20	32	50	52	52	50	52	37	11	41	0
Grass intake, kg/month	0	0	0	0	0	139	157	249	383	398	374	414	408	272	0	0	0
Silage intake, kg/month	280	274	268	95	26	0	0	0	0	0	0	0	0	0	116	384	15
Estimated grass input	none	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none	
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	0.0	8.7	13.1	13.1	12.8	12.8	12.1	13.8	13.2	12.4	0.0	0.0	0.0
Estimated silage intake, kg/day	9.0	9.8	8.7	8.7	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.5	13.2	7.6
Estimated total intake, kg/day	9.0	9.8	8.7	8.7	14.6	12.5	14.8	14.8	14.5	14.5	13.7	15.5	14.8	14.0	15.9	14.7	7.6
Intake/month, kg	280	274	268	95	44	201	178	281	434	450	426	464	460	309	128	425	15
Gross energy intake, MJ/day	170	184	163	163	274	236	278	278	272	273	258	291	279	264	300	275	143
DE intake, MJ/day	114	123	109	109	196	187	222	222	213	214	203	220	211	199	204	188	96
Feeding level	1.4	1.5	1.3	1.3	2.6	2.4	2.8	2.8	2.7	2.7	2.5	2.8	2.6	2.5	2.5	2.3	1.2
Methane output (Yan *et al*., 2000), MJ/day	14.0	15.0	13.5	13.5	19.3										22.5	20.9	12.2
Methane output (0.065 of GEI), MJ/day						15.3	18.1	18.1	17.7	17.7	16.8	18.9	18.1	17.2			
Methane, kg/day	0.25	0.27	0.24	0.24	0.35	0.28	0.32	0.32	0.32	0.32	0.30	0.34	0.33	0.31	0.40	0.37	0.22
Methane/animal/month, kg	7.8	7.5	7.5	2.7	1.0	4.4	3.9	6.2	9.5	9.9	9.4	10.2	10.1	6.8	3.2	10.9	0.4
Methane, proportion of GEI	0.082	0.081	0.083	0.083	0.070	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.075	0.076	0.085
Estimated total OM intake, kg/day	8.18	8.88	7.84	7.84	13.42	11.63	13.65	13.65	13.34	13.38	12.68	14.27	13.70	12.95	14.50	13.32	6.91
Total diet DOMD, kg/day	5.73	6.21	5.49	5.49	9.85	9.23	10.89	10.89	10.40	10.44	9.89	10.63	10.20	9.65	10.26	9.44	4.84
OM excreted, kg/day	2.45	2.66	2.35	2.35	3.57	2.39	2.76	2.76	2.93	2.94	2.79	3.65	3.50	3.30	4.24	3.89	2.07
OM excreted, kg/month	76	75	73	26	11	38	33	52	88	91	86	109	108	73	34	113	4
OM excreted at pasture, kg/month						38	33	52	88	91	86	109	108	73			
OM excreted during housing, kg/month	76	75	73	26	11										34	113	4

2003, Region 2: Dairy cows (autumn-calving cows).

	Jan	Feb	March	March	March	April	April	May	June	July	Aug	Aug	Sept	Oct	Oct	Nov	Nov	Dec
Cow status/notes				Out by day	Day and night, first 4 weeks	Day and night, first 4 weeks	Rest of April				Milk	Dry	Dry	Dry	Calved	Out	Housed	Housed
Days in month or period	31	28	7	7	17	11	19	31	30	31	4	27	30	3	28	22	8	31
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	37.8	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2
Daily milk yield, kg/day	18.0	17.3	17.1	17.1	17.1	16.8	16.8	15.8	13.7	11.7	10.7	0.0	0.0	0.0	15.8	18.8	18.8	18.8
Milk fat %	3.68	3.72	3.75	3.75	3.75	3.71	3.71	3.69	3.79	3.95	4.06	0	0	0	4.13	3.87	3.87	3.68
Milk protein %	3.12	3.18	3.26	3.26	3.26	3.39	3.39	3.46	3.53	3.63	3.72	0	0	0	3.34	3.19	3.19	3.09
Monthly milk yield, kg	559	485	119	119	290	185	320	490	412	363	43	0	0	0	443	413	150	583
Milk energy output, MJ NE_l/day	53.7	52.2	51.9	51.9	51.9	51.3	51.3	48.3	42.7	37.3	34.9	0.0	0.0	0.0	50.5	57.6	57.6	56.0
Pregnancy requirement, MJ NE_l/day										10.5	12.1	12.1	12.1	12.1				
Body weight change, kg/day	0	0	0	0.2	0.2	0.2	0.25	0.5	0.5	0.5	0.5	0.5	0.1	0	–0.6	–0.6	–0.3	–0.3
Monthly body weight change, kg	0	0	0	1.4	3.4	2.2	4.75	15.5	15	15.5	2	13.5	3	0	–16.8	–13.2	–2.4	–9.3
Energy of body weight change, MJ NE_l/day	0.0	0.0	0.0	6.4	6.4	6.4	8.0	16.0	16.0	16.0	16.0	16.0	3.2	0.0	–14.9	–14.9	–7.5	–7.5
Approximate proportion of concentrate (PC)	0.56	0.56	0.57	0.47	0.35	0.35	0.20	0.19	0.20	0.19	0.19	0.00	0.00	0.00	0.55	0.52	0.58	0.58
Energy req., MJ NE_l/day before adj. for PC	90	88	88	96	98	97	99	104	98	103	103	68	55	52	75	82	86	85
Adjustment for PC, MJ NE_l/day	14.7	15.0	15.2	10.9	6.4	6.4	2.9	2.9	2.8	2.9	2.9	0.0	0.0	0.0	14.0	12.5	15.5	15.8
Energy req., MJ NE_l/day after adj. for PC	105	103	103	107	104	104	102	107	101	106	105	68	55	52	89	95	102	101
Concentrate level, kg/day	7.8	7.8	7.8	6.3	4.3	4.3	2.5	2.5	2.5	2.5	2.5	0.0	0.0	0.0	6.0	6.0	7.8	7.8
Adjusted concentrate level, kg DM/day	8.7	8.7	8.7	7.1	4.8	4.8	2.8	2.8	2.8	2.8	2.8	0.0	0.0	0.0	6.7	6.7	8.7	8.7
Total concentrate usage, kg/month	270	244	61	49	82	53	52	86	83	86	11	0	0	0	189	148	70	270
Grass intake, kg/month	0	0	0	35	155	100	207	359	331	364	47	252	236	22	152	137	0	0
Silage intake, kg/month	214	186	46	20		0	0	0	0	0	0	0	0	0	0	0	51	191
Estimated grass input	none	none	none	day	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	5.0	9.1	9.1	10.9	11.6	11.0	11.7	11.6	9.3	7.9	7.4	5.4	6.2	0.0	0.0
Estimated silage intake, kg/day	6.9	6.7	6.6	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	6.2
Estimated total intake, kg/day	15.6	15.4	15.3	15.0	13.9	13.9	13.7	14.4	13.8	14.5	14.4	9.3	7.9	7.4	12.2	13.0	15.1	14.9
Intake/month, kg	483	430	107	105	237	153	260	445	414	450	58	252	236	22	341	286	121	461
Gross energy intake, MJ/day	293	289	288	282	262	261	257	270	259	273	271	175	148	139	229	244	284	279
DE intake, MJ/day	215	212	211	216	208	207	205	215	203	214	212	137	111	105	176	187	208	205
Feeding level	2.9	2.9	2.9	2.8		2.6	2.6	2.7	2.6	2.7	2.7	1.7	1.4	1.3	2.3	2.4	2.8	2.8
Methane output (Yan *et al*., 2000), MJ/day	19.6	19.3	19.2														18.9	18.6
Methane output (0.065 of GEI), MJ/day				18.3	17.0	16.9	16.7	17.5	16.9	17.7	17.6	11.4	9.6	9.0	14.9	15.9		
Methane, kg/day	0.35	0.35	0.35	0.33	0.31	0.30	0.30	0.32	0.30	0.32	0.32	0.20	0.17	0.16	0.27	0.28	0.34	0.33
Methane/animal/month, kg	10.9	9.7	2.4	2.3	5.2	3.4	5.7	9.8	9.1	9.9	1.3	5.5	5.2	0.5	7.5	6.3	2.7	10.4
Methane, proportion of GEI	0.067	0.067	0.067	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.067	0.067
Estimated total OM intake, kg/day	14.4	14.2	14.2	13.9	12.9	12.9	12.6	13.3	12.7	13.4	13.3	8.6	7.2	6.8	11.3	12.1	14.0	13.8
Total diet DOMD, kg/day	10.8	10.6	10.6	10.7	10.3	10.2	10.1	10.6	9.9	10.5	10.4	6.7	5.4	5.0	8.7	9.2	10.5	10.3
OM excreted, kg/day	3.7	3.6	3.6	3.2	2.7	2.7	2.6	2.7	2.8	2.9	2.9	1.9	1.9	1.8	2.7	2.9	3.5	3.5
OM excreted, kg/month	114	101	25	22	45	29	49	84	84	91	12	51	56	5	75	63	28	107
OM excreted at pasture, kg/month				11	45	29	49	84	84	91	12	51	56	5	75	63		
OM excreted during housing, kg/month	114	101	25	11													28	107

2003, Region 3: Dairy cows (first third of herd to calve).

	Jan	Feb	Feb	March	March	March	April	April	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Calved pre-turnout	Calved pre-turnout	Out by day	Day and night, first 4 weeks	Day and night, first 4 weeks	Rest of April							Out	Housed + dry	
Days in month or period	31	18	10	21	7	3	25	5	31	30	31	31	30	31	8	22	31
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	36.2	37.8	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2
Daily milk yield, kg/day	0.0	0.0	17.0	22.7	22.7	22.7	24.0	24.0	23.0	21.1	19.2	16.9	15.0	12.4	10.3	0.0	0.0
Milk fat %	0	0	3.93	3.66	3.66	3.66	3.47	3.47	3.43	3.49	3.59	3.73	3.92	4.02	4.35	0	0
Milk protein %	0	0	3.1	3.11	3.11	3.11	3.16	3.16	3.25	3.29	3.32	3.41	3.56	3.61	3.83	0	0
Monthly milk yield, kg	0	0	170	476	159	68	600	120	714	633	595	525	449	384	82	0	0
Milk energy output, MJ NE_l/day	0.0	0.0	52.2	67.4	67.4	67.4	69.8	69.8	67.2	62.2	57.4	51.8	47.4	39.8	34.8	0.0	0.0
Pregnancy requirement, MJ NE_l/day	12.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	12.1
Body weight change, kg/day	0.2	0	–0.5	–0.5	–0.25	–0.25	–0.25	0	0	0	0.3	0.3	0.3	0.4	0.35	0.2	0.2
Monthly body weight change, kg	6.2	0	–5	–10.5	–1.75	–0.75	–6.25	0	0	0	9.3	9.3	9	12.4	2.8	4.4	6.2
Energy of body weight change, MJ NE_l/day	6.4	0.0	–12.4	–12.4	–6.2	–6.2	–6.2	0.0	0.0	0.0	9.6	9.6	9.6	12.8	11.2	6.4	6.4
Approximate proportion of concentrate (PC)	0.00	0.00	0.45	0.38	0.31	0.27	0.27	0.11	0.11	0.12	0.11	0.12	0.12	0.13	0.14	0.00	0.00
Energy req., MJ NE_l/day before adj. for PC	54.7	48.3	76.0	91.2	99.1	100.7	103.1	109.3	106.7	101.7	106.5	100.9	96.5	92.1	85.5	48.1	54.7
Adjustment for PC, MJ NE_l/day	0.00	0.00	9.53	7.41	5.41	4.45	4.41	2.06	1.98	1.80	1.95	1.78	1.63	1.53	1.43	0.00	0.00
Energy req., MJ NE_l/day after adj. for PC	54.7	48.3	85.5	98.6	104.5	105.2	107.5	111.4	108.6	103.5	108.4	102.7	98.1	93.6	86.9	48.1	54.7
Concentrate level, kg/day	0.0	0.0	5.3	5.3	4.3	3.4	3.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0
Adjusted concentrate level, kg DM/day	0.0	0.0	6.0	6.0	4.8	3.8	3.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	0.0	0.0
Total concentrate usage, kg/month	0	0	60	125	33	12	96	8	52	50	52	52	50	52	13	0	0
Grass intake, kg/month	0	0	0	0	35	31	265	67	402	375	409	384	367	360	85	0	0
Silage intake, kg/month	304	156	72	200	39	0	0	0	0	0	0	0	0	0	0	190	304
Estimated grass input	none	none	none	none	day	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	5.0	10.3	10.6	13.3	13.0	12.5	13.2	12.4	12.2	11.6	10.6	0.0	0.0
Estimated silage intake, kg/day	9.8	8.7	7.2	9.5	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.6	9.8
Estimated total intake, kg/day	9.8	8.7	13.2	15.5	15.4	14.1	14.4	15.0	14.6	14.2	14.9	14.1	13.9	13.3	12.3	8.6	9.8
Intake/month, kg	304	156	132	326	108	42	361	75	454	426	461	436	418	412	99	190	304
Gross energy intake, MJ/day	184	163	247	291	289	265	271	282	275	267	280	265	262	250	232	162	184
DE intake, MJ/day	123	109	178	208	216	211	216	225	220	209	219	207	198	189	175	109	123
Feeding level	1.5	1.3	2.4	2.7	2.8	2.7	2.7	2.8	2.8	2.6	2.7	2.6	2.5	2.4	2.2	1.3	1.5
Methane output (Yan *et al*., 2000), MJ/day	15.0	13.5	17.4	20.5												13.5	15.0
Methane output (0.065 of GEI), MJ/day					18.8	17.2	17.6	18.3	17.9	17.3	18.2	17.2	17.0	16.2	15.1		
Methane, kg/day	0.27	0.24	0.31	0.37	0.34	0.31	0.32	0.33	0.32	0.31	0.33	0.31	0.31	0.29	0.27	0.24	0.27
Methane/animal/month, kg	8.4	4.4	3.1	7.7	2.4	0.9	7.9	1.6	10.0	9.3	10.1	9.6	9.2	9.0	2.2	5.3	8.4
Methane, proportion of GEI	0.081	0.083	0.070	0.070	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.083	0.081
Estimated total OM intake, kg/day	8.9	7.8	12.1	14.3	14.2	13.1	13.4	13.9	13.5	13.1	13.7	13.0	12.8	12.3	11.4	7.8	8.9
Total diet DOMD, kg/day	6.2	5.5	9.0	10.4	10.7	10.4	10.6	11.1	10.8	10.2	10.7	10.1	9.6	9.1	8.5	5.5	6.2
OM excreted, kg/day	2.7	2.4	3.2	3.8	3.4	2.7	2.7	2.8	2.7	2.9	3.0	2.9	3.3	3.1	2.9	2.3	2.7
OM excreted, kg/month	83	42	32	80	24	8	68	14	85	86	93	89	98	97	23	52	83
OM excreted at pasture, kg/month					12	8	68	14	85	86	93	89	98	97	23		
OM excreted during housing, kg/month	83	42	32	80	12											52	83

2003, Region 3: Dairy cows (second third of herd to calve).

	Jan	Feb	March	March	March	March	April	April	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec	Dec
Cow status/notes			Dry, up to calving	Calved pre-turnout	Out by day	Day and night, first 4 weeks	Day and night, first 4 weeks	Rest of April								Housed	Housed	Dry
Days in month or period	31	28	18	3	7	3	25	5	31	30	31	31	30	31	8	22	5	26
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	36.2	37.8	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2	36.2
Daily milk yield, kg/day	0.0	0.0	0.0	18.8	18.8	18.8	22.4	22.4	22.4	20.9	18.8	17.0	15.0	13.1	10.5	10.5	8.9	0.0
Milk fat %	0	0	0	3.81	3.81	3.81	3.58	3.58	3.41	3.42	3.52	3.64	3.84	3.89	4.2	4.2	4.42	0
Milk protein %	0	0	0	3.24	3.24	3.24	3.21	3.21	3.2	3.23	3.26	3.33	3.49	3.5	3.67	3.67	3.77	0
Monthly milk yield, kg	0	0	0	131	56	469	559	112	696	627	582	528	449	405	84	232	45	0
Milk energy output, MJ NE_l/day	0.0	0.0	0.0	57.3	57.3	57.3	66.3	66.3	65.0	60.7	55.4	51.3	46.7	41.0	34.7	34.7	30.3	0.0
Pregnancy requirement, MJ NE_l/day	12.1	12.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5
Body weight change, kg/day	0.2	0.2	0	–0.5	–0.5	–0.5	–0.25	–0.25	–0.25	0		0.325	0.35	0.35	0.35	0.2	0.2	0.2
Monthly body weight change, kg	6.2	5.6	0	–1.5	–3.5	–1.5	–6.25	–1.25	–7.75	0	0	10.08	10.5	10.85	2.8	4.4	1	5.2
Energy of body weight change, MJ NE_l/day	6.4	6.4	0.0	–12.4	–12.4	–12.4	–6.2	–6.2	–6.2	0.0	0.0	10.4	11.2	11.2	11.2	6.4	6.4	6.4
Approximate proportion of concentrate (PC)				0.43	0.38	0.32	0.27	0.12	0.12	0.12	0.13	0.12	0.12	0.13	0.14	0.11	0.11	0.00
Energy req., MJ NE_l/day before adj. for PC	55	55	48	81	83	84	100	100	98	100	95	101	97	92	85	77	73	49
Adjustment for PC, MJ NE_l/day	0.0	0.0	0.0	8.7	6.8	5.1	4.5	1.8	1.7	1.8	1.6	1.8	1.6	1.5	1.4	0.9	0.8	0.0
Energy req., MJ NE_l/day after adj. for PC	55	55	48	90	90	90	104	101	100	102	97	103	99	93	87	78	74	49
Concentrate level, kg/day	0.0	0.0	0.0	5.3	4.3	3.4	3.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.3	1.3	0.0
Adjusted concentrate level, kg DM/day	0.0	0.0	0.0	6.0	4.8	3.8	3.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.4	1.4	0.0
Total concentrate usage, kg/month	0	0	0	42	14	96	96	8	52	50	52	52	50	52	13	31	7	0
Grass intake, kg/month	0	0	0	0	15	204	253	60	366	369	358	386	371	358	85	0	0	0
Silage intake, kg/month	304	274	156	24	9	0	0	0	0	0	0	0	0	0	0	265	56	229
Estimated grass input	none	none	none	none		all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none	
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	5.0	8.2	10.1	12.0	11.8	12.3	11.6	12.4	12.4	11.5	10.6	0.0	0.0	0.0
Estimated silage intake, kg/day	9.8	9.8	8.7	8.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.1	11.3	8.8
Estimated total intake, kg/day	9.8	9.8	8.7	13.9	12.7	12.0	14.0	13.7	13.5	14.0	13.2	14.1	14.1	13.2	12.3	13.5	12.7	8.8
Intake/month, kg	304	274	156	42	38	300	349	68	418	419	410	438	422	410	98	297	63	229
Gross energy intake, MJ/day	184	184	163	262	239	225	262	257	253	263	249	265	264	249	231	253	239	165
DE intake, MJ/day	123	123	109	188	182	179	209	205	202	206	195	208	200	188	175	173	163	111
Feeding level	1.5	1.5	1.3	2.5	2.4	2.3	2.6	2.6	2.5	2.6	2.4	2.6	2.5	2.4	2.2	2.2	2.0	1.4
Methane output (Yan *et al*., 2000), MJ/day	15.0	15.0	13.5	18.4												19.3	18.3	13.7
Methane output (0.065 of GEI), MJ/day					15.5	14.7	17.1	16.7	16.5	17.1	16.2	17.3	17.2	16.2	15.0			
Methane, kg/day	0.27	0.27	0.24	0.33	0.28	0.26	0.31	0.30	0.30	0.31	0.29	0.31	0.31	0.29	0.27	0.35	0.33	0.25
Methane/animal/month, kg	8.4	7.5	4.4	1.0	0.8	6.6	7.7	1.5	9.2	9.2	9.0	9.6	9.3	9.0	2.2	7.6	1.6	6.5
Methane, proportion of GEI	0.081	0.081	0.083	0.070	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.076	0.077	0.083
Estimated total OM intake, kg/day	8.88	8.88	7.84	12.83	11.74	11.12	12.93	12.60	12.44	12.90	12.21	13.02	12.97	12.20	11.35	12.27	11.55	7.97
Total diet DOMD, kg/day	6.21	6.21	5.49	9.44	9.04	8.83	10.27	10.05	9.92	10.06	9.53	10.16	9.66	9.10	8.47	8.69	8.19	5.58
OM excreted, kg/day	2.66	2.66	2.35	3.39	2.70	2.29	2.65	2.55	2.52	2.84	2.68	2.86	3.31	3.11	2.89	3.57	3.35	2.39
OM excreted, kg/month	83	75	42	10	8	7	66	13	78	85	83	89	99	96	23	79	17	62
OM excreted at pasture, kg/month					4	7	66	13	78	85	83	89	99	96	23			
OM excreted during housing, kg/month	83	75	42	10	4											79	17	62

2003, Region 3: Dairy cows (last third of herd to calve).

	Jan	Feb	March	April	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes		Dry	Dry	Dry up to calving	Calved pre-turnout	Day and night, first 4 weeks	Day and night, first 4 weeks	Rest of May						Out	Housed	Housed
Days in month or period	31	28	31	15	3	12	12	19	30	31	31	30	31	8	22	31
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	36.2	36.2	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2
Daily milk yield, kg/day	0.0	0.0	0.0	0.0	20.6	20.6	25.5	25.5	24.6	22.6	20.1	18.1	15.7	13.7	13.7	11.9
Milk fat %	0	0	0	0	3.66	3.66	3.52	3.52	3.41	3.45	3.56	3.72	3.92	4.01	4.01	4.09
Milk protein %	0	0	0	0	3.36	3.36	3.26	3.26	3.18	3.09	3.28	3.42	3.44	3.54	3.54	3.53
Monthly milk yield, kg	0	0	0	0	62	247	306	485	737	699	623	542	488	110	302	369
Milk energy output, MJ NE_l/day	0.0	0.0	0.0	0.0	62.3	62.3	75.3	75.3	71.1	65.2	59.7	55.3	49.4	43.9	43.9	38.3
Pregnancy requirement, MJ NE_l/day	6.2	12.1	12.1	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Body weight change, kg/day	0.3	0.3	0.3	0	–0.5	–0.5	–0.5	–0.25	–0.25	0	0	0.5	0.5	0.45	0	0
Monthly body weight change, kg	9.3	8.4	9.3	0	–1.5	–6	–6	–4.75	–7.5	0	0	15	15.5	3.6	0	0
Energy of body weight change, MJ NE_l/day	9.6	9.6	9.6	0.0	–12.4	–12.4	–12.4	–6.2	–6.2	0.0	0.0	16.0	16.0	14.4	0.0	0.0
Approximate proportion of concentrate (PC)				0.00	0.41	0.30	0.27	0.11	0.12	0.11	0.12	0.10	0.11	0.12	0.10	0.11
Energy req., MJ NE_l/day before adj. for PC	52	58	58	48	86	89	102	109	104	105	99	111	105	98	80	75
Adjustment for PC, MJ NE_l/day	0.0	0.0	0.0	0.0	8.0	4.9	4.4	2.0	1.9	1.9	1.7	2.1	1.9	1.7	0.9	0.8
Energy req., MJ NE_l/day after adj. for PC	52	58	58	48	94	94	107	111	106	107	101	113	107	99	81	75
Concentrate level, kg/day	0.0	0.0	0.0	0.0	5.3	3.4	3.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.3	1.3
Adjusted concentrate level, kg DM/day	0.0	0.0	0.0	0.0	6.0	3.8	3.8	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.4	1.4
Total concentrate usage, kg/month	0	0	0	0	18	46	46	32	50	52	52	50	52	13	31	44
Grass intake, kg/month	0	0	0	0	0	106	126	252	387	401	377	431	418	99	0	0
Silage intake, kg/month	289	290	321	130	26	0	0	0	0	0	0	0	0	0	277	358
Estimated grass input	none	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	0.0	8.8	10.5	13.2	12.9	12.9	12.2	14.4	13.5	12.4	0.0	0.0
Estimated silage intake, kg/day	9.3	10.4	10.4	8.7	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6	11.6
Estimated total intake, kg/day	9.3	10.4	10.4	8.7	14.7	12.6	14.3	14.9	14.6	14.6	13.8	16.0	15.2	14.1	14.0	13.0
Intake/month, kg	289	290	321	130	44	152	172	283	437	453	429	481	470	113	308	402
Gross energy intake, MJ/day	175	195	195	163	276	237	270	280	274	275	260	302	285	265	263	244
DE intake, MJ/day	117	131	131	109	198	189	214	224	215	215	204	228	215	200	179	167
Feeding level	1.4	1.6	1.6	1.3	2.6	2.4	2.7	2.8	2.7	2.7	2.6	2.9	2.7	2.5	2.2	2.1
Methane output (Yan *et al*., 2000), MJ/day	14.4	15.7	15.7	13.5	19.4										20.0	18.7
Methane output (0.065 of GEI), MJ/day						15.4	17.5	18.2	17.8	17.9	16.9	19.6	18.5	17.2		
Methane, kg/day	0.26	0.28	0.28	0.24	0.35	0.28	0.31	0.33	0.32	0.32	0.30	0.35	0.33	0.31	0.36	0.34
Methane/animal/month, kg	8.0	7.9	8.8	3.6	1.0	3.3	3.8	6.2	9.6	9.9	9.4	10.6	10.3	2.5	7.9	10.4
Methane, proportion of GEI	0.082	0.081	0.081	0.083	0.070	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.076	0.077
Estimated total OM intake, kg/day	8.45	9.40	9.40	7.84	13.52	11.71	13.27	13.76	13.44	13.48	12.77	14.79	13.99	13.02	12.73	11.81
Total diet DOMD, kg/day	5.91	6.58	6.58	5.49	9.92	9.30	10.55	10.98	10.49	10.52	9.96	11.01	10.42	9.70	9.02	8.38
OM excreted, kg/day	2.53	2.82	2.82	2.35	3.60	2.41	2.72	2.78	2.95	2.96	2.81	3.78	3.57	3.32	3.71	3.44
OM excreted, kg/month	79	79	87	35	11	29	33	53	89	92	87	113	111	27	82	106
OM excreted at pasture, kg/month						29	33	53	89	92	87	113	111	27		
OM excreted during housing, kg/month	79	79	87	35	11										82	106

2003, Region 3: Dairy cows (autumn-calving cows).

	Jan	Feb	March	March	March	April	April	May	June	July	August	Aug	Sept	Oct	Oct	Nov	Nov	Dec
Cow status/notes				Out by day	Day and night, first 4 weeks	Day and night, first 4 weeks					Milk	Dry	Dry	Dry	Calved	Out	Housed	Housed
Days in month or period	31	28	21	7	3	25	5	31	30	31	4	27	30	3	28	8	22	31
Maintenance requirement, MJ NE_l/day	36.2	36.2	36.2	37.8	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	36.2	36.2
Daily milk yield, kg/day	18.0	17.3	17.1	17.1	17.1	16.8	16.8	15.8	13.7	11.7	10.7	0.0	0.0	0.0	15.8	18.8	18.8	18.8
Milk fat %	3.68	3.72	3.75	3.75	3.75	3.71	3.71	3.69	3.79	3.95	4.06	0	0	0	4.13	3.87	3.87	3.68
Milk protein %	3.12	3.18	3.26	3.26	3.26	3.39	3.39	3.46	3.53	3.63	3.72	0	0	0	3.34	3.19	3.19	3.09
Monthly milk yield, kg	559	485	358	119	51	421	84	490	412	363	43	0	0	0	443	150	413	583
Milk energy output, MJ NE_l/day	53.7	52.2	51.9	51.9	51.9	51.3	51.3	48.3	42.7	37.3	34.9	0.0	0.0	0.0	50.5	57.6	57.6	56.0
Pregnancy requirement, MJ NE_l/day										10.5	12.1	12.1	12.1	12.1				
Body weight change, kg/day	0	0	0	0.2	0.2	0.2	0.25	0.5	0.5	0.5	0.5	0.5	0.1	0	–0.6	–0.6	–0.3	–0.3
Monthly body weight change, kg	0	0	0	1.4	0.6	5	1.25	15.5	15	15.5	2	13.5	3	0	–16.8	–4.8	–6.6	–9.3
Energy of body weight change, MJ NE_l/day	0.0	0.0	0.0	6.4	6.4	6.4	8.0	16.0	16.0	16.0	16.0	16.0	3.2	0.0	–14.9	–14.9	–7.5	–7.5
Approximate proportion of concentrate (PC)	0.56	0.56	0.57	0.47	0.35	0.35	0.20	0.19	0.20	0.19	0.19	0.00	0.00	0.00	0.55	0.52	0.58	0.58
Energy req., MJ NE_l/day before adj. for PC	90	88	88	96	98	97	99	104	98	103	103	68	55	52	75	82	86	85
Adjustment for PC, MJ NE_l/day	14.7	15.0	15.2	10.9	6.4	6.4	2.9	2.9	2.8	2.9	2.9	0.0	0.0	0.0	14.0	12.5	15.5	15.8
Energy req., MJ NE_l/day after adj. for PC	105	103	103	107	104	104	102	107	101	106	105	68	55	52	89	95	102	101
Concentrate level, kg/day	7.8	7.8	7.8	6.3	4.3	4.3	2.5	2.5	2.5	2.5	2.5	0.0	0.0	0.0	6.0	6.0	7.8	7.8
Adjusted concentrate level, kg DM/day	8.7	8.7	8.7	7.1	4.8	4.8	2.8	2.8	2.8	2.8	2.8	0.0	0.0	0.0	6.7	6.7	8.7	8.7
Total concentrate usage, kg/month	270	244	183	49	14	120	14	86	83	86	11	0	0	0	189	54	191	270
Grass intake, kg/month	0	0	0	35	27	226	55	359	331	364	47	252	236	22	152	50	0	0
Silage intake, kg/month	214	186	139	20		0	0	0	0	0	0	0	0	0	0	0	141	191
Estimated grass input	none	none	none	day	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	5.0	9.1	9.1	10.9	11.6	11.0	11.7	11.6	9.3	7.9	7.4	5.4	6.2	0.0	0.0
Estimated silage intake, kg/day	6.9	6.7	6.6	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	6.2
Estimated total intake, kg/day	15.6	15.4	15.3	15.0	13.9	13.9	13.7	14.4	13.8	14.5	14.4	9.3	7.9	7.4	12.2	13.0	15.1	14.9
Intake/month, kg	483	430	322	105	42	347	68	445	414	450	58	252	236	22	341	104	332	461
Gross energy intake, MJ/day	293	289	288	282	262	261	257	270	259	273	271	175	148	139	229	244	284	279
DE intake, MJ/day	215	212	211	216	208	207	205	215	203	214	212	137	111	105	176	187	208	205
Feeding level	2.9	2.9	2.9	2.8		2.6	2.6	2.7	2.6	2.7	2.7	1.7	1.4	1.3	2.3	2.4	2.8	2.8
Methane output (Yan *et al*., 2000), MJ/day	19.6	19.3	19.2														18.9	18.6
Methane output (0.065 of GEI), MJ/day				18.3	17.0	16.9	16.7	17.5	16.9	17.7	17.6	11.4	9.6	9.0	14.9	15.9		
Methane, kg/day	0.35	0.35	0.35	0.33	0.31	0.30	0.30	0.32	0.30	0.32	0.32	0.20	0.17	0.16	0.27	0.28	0.34	0.33
Methane/animal/month, kg	10.9	9.7	7.3	2.3	0.9	7.6	1.5	9.8	9.1	9.9	1.3	5.5	5.2	0.5	7.5	2.3	7.5	10.4
Methane, proportion of GEI	0.067	0.067	0.067	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.067	0.067
Estimated total OM intake, kg/day	14.4	14.2	14.2	13.9	12.9	12.9	12.6	13.3	12.7	13.4	13.3	8.6	7.2	6.8	11.3	12.1	14.0	13.8
Total diet DOMD, kg/day	10.8	10.6	10.6	10.7	10.3	10.2	10.1	10.6	9.9	10.5	10.4	6.7	5.4	5.0	8.7	9.2	10.5	10.3
OM excreted, kg/day	3.7	3.6	3.6	3.2	2.7	2.7	2.6	2.7	2.8	2.9	2.9	1.9	1.9	1.8	2.7	2.9	3.5	3.5
OM excreted, kg/month	114	101	76	22	8	66	13	84	84	91	12	51	56	5	75	23	78	107
OM excreted at pasture, kg/month				11	8	66	13	84	84	91	12	51	56	5	75	23		
OM excreted during housing, kg/month	114	101	76	11													78	107

Appendix 4 Production, Energy Requirements, Diet and Methane Emissions on a Monthly Basis for the 18 Suckler Cow Production Systems Defined for 2003

2003, Region 1: Suckler cows (first third of herd to calve).

	Jan	Feb	March	April	April	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Calved pre-turnout	First 4 weeks out	Rest of April							Out, weaned	Housed	Dry
Days in month or period	31	28	31	28	2	31	30	31	31	30	31	15	15	31
Cow weight at start of period, kg	580	566	554	540	550	551	563	574	585	596	607	619	600	593
Cow weight at end of period, kg	566	554	540	550	551	563	574	585	596	607	619	624	593	580
Cow weight average over period, kg	573	560	547	545	551	557	568	579	591	602	613	621	597	587
Milk production, kg/day	0	0	7	10	10	10	9	8	7	6	6	0	0	0
Milk yield/month, kg	0	0	217	280	20	310	270	248	217	180	186	0	0	0
Energy milk, MJ NE_l/day	0.0	0.0	20.8	29.7	29.7	29.7	26.7	23.8	20.8	17.8	17.8	0.0	0.0	0.0
Energy for pregnancy, MJ NE_l/day	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	11.4	11.4
Energy for maintenance, MJ NE_l/day	34.3	33.8	36.9	37.4	37.6	37.9	38.5	39.0	39.5	40.1	40.6	36.9	35.3	34.9
Body-weight change, kg/day	–0.44	–0.44	–0.44	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	–0.44	–0.44
Energy body-weight change, MJ NE_l/day	–10.9	–10.9	–10.9	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	–10.9	–10.9
Body-weight change/period, kg	–13.6	–12.3	–13.6	10.3	0.7	11.4	11.0	11.4	11.4	11.0	11.4	5.5	–6.6	–13.6
Energy requirement, MJ NE_l/day	34.7	34.2	46.7	78.8	79.1	79.4	76.9	74.5	72.1	69.6	70.2	60.0	35.7	35.3
Concentrates fed, kg/day	0.0	0.0	1.2	0.7									0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	1.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0	0	0	10.01	10.69	10.73	10.61	10.27	9.94	9.99	10.07	8.62		
Estimated silage intake, kg/day	7.0	6.9	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2	7.1
Total DMI, kg/day	7.0	6.9	8.9	10.6	10.7	10.7	10.6	10.3	9.9	10.0	10.1	8.6	7.2	7.1
Concentrate intake, kg DM/period	0.0	0.0	32.8	17.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Silage intake, kg/period	218	194	243	0	0	0	0	0	0	0	0	0	108	222
Pasture intake, kg/period	0	0	0	280	21	333	318	318	308	300	312	129	0	0
Gross energy intake, MJ/day	129	127	164	200	201	202	199	193	187	188	189	162	133	131
Feeding level	1.0	1.0	1.3										1.0	1.0
DEI, MJ/day	78	76	102										80	79
Methane output (Yan *et al*., 2000), MJ/day	10.1	10.0	12.3										10.4	10.3
Methane output (0.065 of GEI), MJ/day				13.0	13.1	13.1	13.0	12.6	12.1	12.2	12.3	10.5		
Methane, kg/day	0.18	0.18	0.22	0.23	0.23	0.24	0.23	0.23	0.22	0.22	0.22	0.19	0.19	0.19
Methane/animal/month, kg	5.6	5.0	6.9	6.5	0.5	7.3	7.0	7.0	6.8	6.6	6.9	2.8	2.8	5.7
Methane, proportion of GEI	0.078	0.078	0.075	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.078	0.078
Estimated total OM intake, kg/day	6.4	6.3	8.1	9.8	9.8	9.9	9.8	9.5	9.1	9.2	9.3	7.9	6.6	6.5
Total diet DOMD, kg/day	4.0	3.9	5.2	7.8	7.9	7.9	7.6	7.4	7.1	6.8	6.9	5.9	4.1	4.1
OM excreted, kg/day	2.4	2.3	2.8	2.0	2.0	2.0	2.1	2.1	2.0	2.4	2.4	2.1		2.4
OM excreted, kg/month	73.0	64.9	88.1	55.2	3.9	61.2	64.4	64.4	62.4	71.7	74.7	30.9	36.4	74.3
OM excreted at pasture, kg/month				55.2	3.9	61.2	64.4	64.4	62.4	71.7	74.7	30.9		
OM excreted during housing, kg/month	73.0	64.9	88.1										36.4	74.3

2003, Region 1: Suckler cows (second third of herd to calve).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Dry, up to calving	Out, dry, up to calving	Rest of April	Rest of first 4 weeks	Rest of May						Out, with calf	Housed	Dry
Days in month or period	31	28	31	5	25	3	28	30	31	31	30	31	15	15	31
Cow weight at start of period, kg	580	566	554	540	542	551	552	563	574	585	596	607	619	600	593
Cow weight at end of period, kg	566	554	540	542	551	552	563	574	585	596	607	619	624	593	580
Cow weight average over period, kg	573	560	547	541	547	552	557	568	579	591	602	613	621	597	587
Milk production, kg/day	0	0	0	0	10	10	10	9	8	7	6	6	6	0	0
Milk yield/month, kg	0	0	0	0	250	30	280	270	248	217	180	186	90	0	0
Energy milk, MJ NE_l/day	0.0	0.0	0.0	0.0	29.7	29.7	29.7	26.7	23.8	20.8	17.8	17.8	17.8	0.0	0.0
Energy for pregnancy, MJ NE_l/day	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
Energy for maintenance, MJ NE_l/day	34.3	33.8	33.2	33.4	37.4	37.7	37.9	38.5	39.0	39.5	40.1	40.6	41.0	35.3	34.9
Body-weight change, kg/day	–0.44	–0.44	–0.44	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	–0.44	–0.44
Energy body-weight change, MJ NE_l/day	–10.9	–10.9	–10.9	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	–10.9	–10.9
Body-weight change/period, kg	–13.6	–12.3	–13.6	1.8	9.2	1.1	10.3	11.0	11.4	11.4	11.0	11.4	5.5	–6.6	–13.6
Energy requirement, MJ NE_l/day	34.7	34.2	33.6	56.6	78.9	79.1	79.4	76.9	74.5	72.1	69.6	70.2	70.6	24.4	33.5
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	0.7	0.7								0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	7.7	10.0	10.1	10.7	10.6	10.3	9.9	10.0	10.1	10.1		
Estimated silage intake, kg/day	7.0	6.9	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	6.8
Total DMI, kg/day	7.0	6.9	6.8	7.7	10.6	10.7	10.7	10.6	10.3	9.9	10.0	10.1	10.1	4.9	6.8
Concentrate intake, kg DM/period	0.0	0.0	0.0	0.0	15.7	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Silage intake, kg/period	217.9	193.7	211.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.0	210.0
Pasture intake, kg/period	0.0	0.0	0.0	38.3	250.5	30.2	300.6	318.2	318.4	308.1	299.8	312.2	151.9	0.0	0.0
Gross energy intake, MJ/day	129	127	125	144	200	201	202	199	193	187	188	189	190	91	125
Feeding level	1.0	1.0	1.0											0.7	1.0
DEI, MJ/day	77.6	76.4	75.1											54.4	74.8
Methane output (Yan *et al.*, 2000), MJ/day	10.1	10.0	9.8											7.8	9.9
Methane output (0.065 of GEI), MJ/day				9.3	13.0	13.1	13.1	13.0	12.6	12.1	12.2	12.3	12.4		
Methane, kg/day	0.18	0.18	0.18	0.17	0.23	0.23	0.24	0.23	0.23	0.22	0.22	0.22	0.22	0.14	0.18
Methane/animal/month, kg	5.6	5.0	5.5	0.8	5.8	0.7	6.6	7.0	7.0	6.8	6.6	6.9	3.3	2.1	5.5
Methane, proportion of GEI	0.078	0.078	0.078	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.086	0.079
Estimated total OM intake, kg/day	6.4	6.3	6.2	7.0	9.8	9.8	9.9	9.8	9.5	9.1	9.2	9.3	9.3	4.5	6.1
Total diet DOMD, kg/day	4.0	3.9	3.9	5.6	7.8	7.9	7.9	7.6	7.4	7.1	6.8	6.9	6.9	2.8	3.9
OM excreted, kg/day	2.4	2.3	2.3	1.4	2.0	2.0	2.0	2.1	2.1	2.0	2.4	2.4	2.4	1.7	2.3
OM excreted, kg/month	73	65	71	7	49	6	55	64	64	62	72	75	36	25	70
OM excreted at pasture, kg/month				7	49	6	55	64	64	62	72	75	36		
OM excreted during housing, kg/month	73	65	71											25	70

2003, Region 1: Suckler cows (last third of herd to calve).

	Jan	Feb	March	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes	Dry, up to calving	Dry, up to calving	Dry, up to calving	Out, dry, up to calving	Dry, up to calving	Rest of May						Out, with calf	Housed	Dry
Days in month or period	31	28	31	30	10	21	30	31	31	30	31	15	15	31
Cow weight at start of period, kg	580	566	554	540	551	555	563	574	585	596	607	619	600	593
Cow weight at end of period, kg	566	554	540	551	555	563	574	585	596	607	619	624	593	580
Cow weight average over period, kg	573	560	547	546	553	559	568	579	591	602	613	621	597	587
Milk production, kg/day	0	0	0	0	0	10	10	9	8	7	6	6	0	0
Milk yield/month, kg	0	0	0	0	0	210	300	279	248	210	186	90	0	0
Energy milk, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	29.7	29.7	26.7	23.8	20.8	17.8	17.8	0.0	0.0
Energy for pregnancy, MJ NE_l/day	7.7	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy for maintenance, MJ NE_l/day	34.3	33.8	33.2	33.6	34.0	38.0	38.5	39.0	39.5	40.1	40.6	41.0	35.3	34.9
Body-weight change, kg/day	–0.44	–0.44	–0.44	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	–0.44	–0.44
Energy body-weight change, MJ NE_l/day	–10.9	–10.9	–10.9	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	–10.9	–10.9
Body-weight change/period, kg	–13.6	–12.3	–13.6	11.0	3.7	7.7	11.0	11.4	11.4	11.0	11.4	5.5	–6.6	–13.6
Energy requirement, MJ NE_l/day	31.1	34.2	33.6	56.8	57.1	79.4	79.9	77.5	75.0	72.6	70.2	70.6	24.4	23.9
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	0.0								0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	7.7	7.7	10.7	11.0	10.7	10.3	10.4	10.1	10.1		
Estimated silage intake, kg/day	6.3	6.9	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	4.8
Total DMI, kg/day	6.3	6.9	6.8	7.7	7.7	10.7	11.0	10.7	10.3	10.4	10.1	10.1	4.9	4.8
Concentrate intake, kg DM/period	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	195	194	211	0	0	0	0	0	0	0	0	0	74	150
Pasture intake, kg/period	0	0	0	230	77	226	330	331	321	313	312	152	0	0
Gross energy intake, MJ/day	116	127	125	144	145	202	207	201	195	196	189	190	91	89
Feeding level	0.9	1.0	1.0										0.7	0.7
DEI, MJ/day	69	76	75										54	53
Methane output (Yan *et al.*, 2000), MJ/day	9.3	10.0	9.8										7.8	7.7
Methane output (0.065 of GEI), MJ/day				9.4	9.4	13.1	13.5	13.1	12.6	12.7	12.3	12.4		
Methane, kg/day	0.17	0.18	0.18	0.17	0.17	0.24	0.24	0.23	0.23	0.23	0.22	0.22	0.14	0.14
Methane/animal/month, kg	5.2	5.0	5.5	5.1	1.7	5.0	7.3	7.3	7.0	6.9	6.9	3.3	2.1	4.3
Methane, proportion of GEI	0.080	0.078	0.078	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.086	0.087
Estimated total OM intake, kg/day	5.7	6.3	6.2	7.1	7.1	9.9	10.1	9.8	9.5	9.6	9.3	9.3	4.5	4.4
Total diet DOMD, kg/day	3.6	3.9	3.9	5.7	5.7	7.9	7.9	7.7	7.4	7.1	6.9	6.9	2.8	2.8
OM excreted, kg/day	2.1	2.3	2.3	1.4	1.4	2.0	2.2	2.2	2.1	2.5	2.4	2.4	1.7	1.6
OM excreted, kg/month	65.3	64.9	70.7	42.4	14.2	41.5	66.9	67.0	64.9	74.8	74.7	36.3	24.8	50.3
OM excreted at pasture, kg/month				42.4	14.2	41.5	66.9	67.0	64.9	74.8	74.7	36.3		
OM excreted during housing, kg/month	65.3	64.9	70.7										24.8	50.3

2003, Region 1: Suckler cows (autumn-calving cows).

	Jan	Feb	March	April	May	May	June	July	Aug	Sept	Sept	Oct	Nov	Nov	Dec
Cow status/notes				Out to grass		Dry	Dry	Dry	Dry	Dry	Calved		Out	Housed	
Days in month or period	31	28	31	30	21	10	30	31	31	21	9	31	15	15	31
Cow weight at start of period, kg	580	566	554	540	551	559	563	574	585	596	604	607	619	600	593
Cow weight at end of period, kg	566	554	540	551	559	563	574	585	596	604	607	619	624	593	580
Cow weight average over period, kg	573	560	547	546	555	561	568	579	591	600	606	613	621	597	587
Milk production, kg/day	7	7	7	7	7	0	0	0	0	0	10	10	10	8	7
Milk yield/month, kg	217	196	217	210	147	0	0	0	0	0	90	310	150	120	217
Energy milk, MJ NE_l/day	20.8	20.8	20.8	20.8	20.8	0.0	0.0	0.0	0.0	0.0	29.7	29.7	29.7	23.8	20.8
Energy for pregnancy, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	11.4	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0
Energy for maintenance, MJ NE_l/day	38.1	37.5	36.9	37.4	37.8	34.3	34.6	35.1	35.6	36.0	40.3	40.6	41.0	39.2	38.8
Body-weight change, kg/day	–0.44	–0.44	–0.44	0.367	0.367	0.39	0.367	0.367	0.367	0.367	0.367	0.367	0.367	–0.44	–0.44
Energy body-weight change, MJ NE_l/day	–10.9	–10.9	–10.9	11.7	11.7	12.5	11.7	11.7	11.7	11.7	11.7	11.7	11.7	–10.9	–10.9
Body-weight change/period, kg	–13.6	–12.3	–13.6	11.0	7.7	3.9	11.0	11.4	11.4	7.7	3.3	11.4	5.5	–6.6	–13.6
Energy requirement, MJ NE_l/day	48.0	47.3	46.7	69.9	70.4	58.2	57.7	58.2	58.7	59.1	81.7	82.1	82.5	52.0	48.6
Concentrates fed, kg/day	1.8	1.8	0.0	0.0	0.0									1.8	1.8
Concentrate DM fed, kg DM/day	1.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.6
Estimated grass input	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	9.5	9.5	7.9	8.0	8.0	8.1	8.5	11.7	11.8	11.8		
Estimated silage intake, kg/day	6.9	6.8	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	7.0
Total DMI, kg/day	8.5	8.4	9.0	9.5	9.5	7.9	8.0	8.0	8.1	8.5	11.7	11.8	11.8	9.3	8.6
Concentrate intake, kg DM/period	49	44	0	0	0	0	0	0	0	0	0	0	0	24	49
Silage intake, kg/period	214	190	278	0	0	0	0	0	0	0	0	0	0	115	218
Pasture intake, kg/period	0	0	0	284	200	79	239	249	251	178	106	365	178	0	0
Gross energy intake, MJ/day	157	154	165	178	179	148	150	151	152	160	220	221	222	171	159
Feeding level	1.3	1.3	1.3											1.3	1.3
DEI, MJ/day	103	102	104											112	105
Methane output (Yan *et al.*, 2000), MJ/day	12.3	12.1	13.0											13.3	12.4
Methane output (0.065 of GEI), MJ/day				11.6	11.6	9.6	9.7	9.8	9.9	10.4	14.3	14.4	14.5		
Methane, kg/day	0.22	0.22	0.23	0.21	0.21	0.17	0.17	0.18	0.18	0.19	0.26	0.26	0.26	0.24	0.22
Methane/animal/month, kg	6.8	6.1	7.2	6.2	4.4	1.7	5.2	5.5	5.5	3.9	2.3	8.0	3.9	3.6	6.9
Methane, proportion of GEI	0.078	0.078	0.079	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.078	0.078
Estimated total OM intake, kg/day	7.7	7.6	8.1	8.7	8.8	7.2	7.3	7.4	7.4	7.8	10.8	10.8	10.9	8.4	7.8
Total diet DOMD, kg/day	5.3	5.2	5.4	7.0	7.0	5.8	5.7	5.8	5.8	5.8	8.0	8.0	8.1	5.8	5.4
OM excreted, kg/day	2.5	2.4	2.8	1.7	1.8	1.4	1.6	1.6	1.6	2.0	2.8	2.8	2.8	2.7	2.5
OM excreted, kg/month	76	68	86	52	37	14	48	50	51	43	25	87	42	40	77
OM excreted at pasture, kg/month				52	37	14	48	50	51	43	25	87	42		
OM excreted during housing, kg/month	76	68	86											40	77

2003, Region 1: Suckler cows (spring cows, empty).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Dry, up to calving	Out, dry, up to calving	Rest of April	Rest of first 4 weeks	Rest of May						Out	Housed	Dry
Days in month or period	31	28	31	5	25	3	28	30	31	31	30	31	15	15	31
Cow weight at start of period, kg	580	566	554	540	542	551	552	563	574	585	596	607	619	600	593
Cow weight at end of period, kg	566	554	540	542	551	552	563	574	585	596	607	619	624	593	580
Cow weight average over period, kg	573	560	547	541	547	552	557	568	579	591	602	613	621	597	587
Milk production, kg/day	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Milk yield/month, kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Energy milk, MJ NE_l/day	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Energy for pregnancy, MJ NE_l/day															
Energy for maintenance, MJ NE_l/day	34.3	33.8	33.2	33.4	33.7	33.9	34.2	34.6	35.1	35.6	36.1	36.6	36.9	35.3	34.9
Body-weight change, kg/day	–0.44	–0.44	–0.44	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	–0.44	–0.44
Energy body-weight change, MJ NE_l/day	–10.9	–10.9	–10.9	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	–10.9	–10.9
Body-weight change/period, kg	–13.6	–12.3	–13.6	1.8	9.2	1.1	10.3	11.0	11.4	11.4	11.0	11.4	5.5	–6.6	–13.6
Energy requirement, MJ NE_l/day	23.4	22.8	22.3	45.2	45.4	45.7	45.9	46.4	46.8	47.3	47.8	48.3	48.7	24.4	23.9
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	0.0	0.0								0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	6.1	6.1	6.2	6.2	6.4	6.5	6.5	6.9	6.9	7.0		
Estimated silage intake, kg/day	4.7	4.6	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	4.8
Total DMI, kg/day	4.7	4.6	4.5	6.1	6.1	6.2	6.2	6.4	6.5	6.5	6.9	6.9	7.0	4.9	4.8
Concentrate intake, kg DM/period	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	147	129	140	0	0	0	0	0	0	0	0	0	0	74	150
Pasture intake, kg/period	0	0	0	31	154	19	174	192	200	202	206	215	105	0	0
Gross energy intake, MJ/day	87	85	83	115	116	116	117	120	121	123	129	130	131	91	89
Feeding level	0.7	0.7	0.7											0.7	0.7
DEI, MJ/day	52	51	50											54	53
Methane output (Yan *et al.*, 2000), MJ/day	7.6	7.4	7.3											7.8	7.7
Methane output (0.065 of GEI), MJ/day				7.5	7.5	7.5	7.6	7.8	7.9	8.0	8.4	8.5	8.5		
Methane, kg/day	0.14	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.14	0.14
Methane/animal/month, kg	4.2	3.7	4.0	0.7	3.4	0.4	3.8	4.2	4.4	4.4	4.5	4.7	2.3	2.1	4.3
Methane, proportion of GEI	0.087	0.087	0.088	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.086	0.087
Estimated total OM intake, kg/day	4.3	4.2	4.1	5.6	5.7	5.7	5.7	5.9	5.9	6.0	6.3	6.4	6.4	4.5	4.4
Total diet DOMD, kg/day	2.7	2.6	2.6	4.5	4.5	4.5	4.6	4.6	4.6	4.7	4.7	4.7	4.8	2.8	2.8
OM excreted, kg/day	1.6	1.5	1.5	1.1	1.1	1.1	1.1	1.3	1.3	1.3	1.6	1.7	1.7	1.7	1.6
OM excreted, kg/month	49	43	47	6	28	3	32	39	41	41	49	51	25	25	50
OM excreted at pasture, kg/month				6	28	3	32	39	41	41	49	51	25		
OM excreted during housing, kg/month	49	43	47											25	50

2003, Region 1: Suckler cows (spring cow, stillborn and early calf deaths).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Dry, up to calving	Out, dry, up to calving	Rest of April	Rest of first 4 weeks	Rest of May						Out, with calf	Housed	Dry
Days in month or period	31	28	31	5	25	3	28	30	31	31	30	31	15	15	31
Cow weight at start of period, kg	580	566	554	540	542	551	552	563	574	585	596	607	619	600	593
Cow weight at end of period, kg	566	554	540	542	551	552	563	574	585	596	607	619	624	593	580
Cow weight average over period, kg	573	560	547	541	547	552	557	568	579	591	602	613	621	597	587
Milk production, kg/day	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Milk yield/month, kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Energy milk, MJ NE_l/day	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Energy for pregnancy, MJ NE_l/day	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
Energy for maintenance, MJ NE_l/day	34.3	33.8	33.2	33.4	33.7	33.9	34.2	34.6	35.1	35.6	36.1	36.6	36.9	35.3	34.9
Body-weight change, kg/day	–0.44	–0.44	–0.44	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	0.367	–0.44	–0.44
Energy body-weight change, MJ NE_l/day	–10.9	–10.9	–10.9	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	–10.9	–10.9
Body-weight change/period, kg	–13.6	–12.3	–13.6	1.8	9.2	1.1	10.3	11.0	11.4	11.4	11.0	11.4	5.5	–6.6	–13.6
Energy requirement, MJ NE_l/day	34.7	34.2	33.6	56.6	45.4	45.7	45.9	46.4	46.8	47.3	47.8	48.3	48.7	24.4	33.5
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	0.0	0.0								0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	7.7	6.1	6.2	6.2	6.4	6.5	6.5	6.9	6.9	7.0		
Estimated silage intake, kg/day	7.0	6.9	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	6.8
Total DMI, kg/day	7.0	6.9	6.8	7.7	6.1	6.2	6.2	6.4	6.5	6.5	6.9	6.9	7.0	4.9	6.8
Concentrate intake, kg DM/period	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	218	194	211	0	0	0	0	0	0	0	0	0	0	74	210
Pasture intake, kg/period	0	0	0	38	154	19	174	192	200	202	206	215	105	0	0
Gross energy intake, MJ/day	129	127	125	144	116	116	117	120	121	123	129	130	131	91	125
Feeding level	1.0	1.0	1.0											0.7	1.0
DEI, MJ/day	78	76	75											54	75
Methane output (Yan *et al.*, 2000), MJ/day	10.1	10.0	9.8											7.8	9.9
Methane output (0.065 of GEI), MJ/day				9.3	7.5	7.5	7.6	7.8	7.9	8.0	8.4	8.5	8.5		
Methane, kg/day	0.18	0.18	0.18	0.17	0.13	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.14	0.18
Methane/animal/month, kg	5.6	5.0	5.5	0.8	3.4	0.4	3.8	4.2	4.4	4.4	4.5	4.7	2.3	2.1	5.5
Methane, proportion of GEI	0.078	0.078	0.078	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.086	0.079
Estimated total OM intake, kg/day	6.4	6.3	6.2	7.0	5.7	5.7	5.7	5.9	5.9	6.0	6.3	6.4	6.4	4.5	6.1
Total diet DOMD, kg/day	4.0	3.9	3.9	5.6	4.5	4.5	4.6	4.6	4.6	4.7	4.7	4.7	4.8	2.8	3.9
OM excreted, kg/day	2.4	2.3	2.3	1.4	1.1	1.1	1.1	1.3	1.3	1.3	1.6	1.7	1.7	1.7	2.3
OM excreted, kg/month	73	65	71	7	28	3	32	39	41	41	49	51	25	25	70
OM excreted at pasture, kg/month				7	28	3	32	39	41	41	49	51	25		
OM excreted during housing, kg/month	73	65	71											25	70

2003, Region 2: Suckler cows (first third of herd to calve).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Calved pre-turnout	Calved pre-turnout	Rest of April	Rest of first 4 weeks	Rest of May						Out, weaned	Housed	Dry
Days in month or period	31	28	31	5	25	3	28	30	31	31	30	31	6	24	31
Cow weight at start of period, kg	578	566	554	542	540	550	551	562	574	586	598	609	622	600	590
Cow weight at end of period, kg	566	554	542	540	550	551	562	574	586	598	609	622	624	590	578
Cow weight average over period, kg	572	560	548	541	545	550	556	568	580	592	604	615	623	595	584
Milk production, kg/day	0	0	7	7	10	10	10	9	8	7	6	6	0	0	0
Milk yield/month, kg	0	0	217	35	250	30	280	270	248	217	180	186	0	0	0
Energy milk, MJ NE_l/day	0.0	0.0	20.8	20.8	29.7	29.7	29.7	26.7	23.8	20.8	17.8	17.8	0.0	0.0	0.0
Energy for pregnancy, MJ NE_l/day	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	11.4	11.4
Energy for maintenance, MJ NE_l/day	34.7	34.2	37.5	37.1	37.3	37.6	37.9	38.4	39.0	39.6	40.2	40.7	37.0	35.7	35.3
Body-weight change, kg/day	–0.4	–0.4	–0.4	–0.4	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	–0.4	–0.4
Energy body-weight change, MJ NE_l/day	–10.0	–10.0	–10.0	–10.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	–10.0	–10.0
Body-weight change/period, kg	–12.4	–11.2	–12.4	–2.0	9.8	1.2	10.9	11.7	12.1	12.1	11.7	12.1	2.3	–9.6	–12.4
Energy requirement, MJ NE_l/day	36.2	35.6	48.3	47.9	79.5	79.8	80.1	77.6	75.2	72.9	70.5	71.0	60.8	37.2	36.7
Concentrates fed, kg/day	0.0	0.0	0.8	0.8	0.3	0.3								0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.7	0.7	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	10.5	10.5	10.8	10.7	10.4	10.0	10.1	10.2	8.7		
Estimated silage intake, kg/day	7.3	7.2	8.7	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.4
Total DMI, kg/day	7.3	7.2	9.4	9.3	10.7	10.8	10.8	10.7	10.4	10.0	10.1	10.2	8.7	7.5	7.4
Concentrate intake, kg DM/period	0	0	21	3	6	1	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	227	202	270	43	0	0	0	0	0	0	0	0	0	181	230
Pasture intake, kg/period	0	0	0	0	262	32	303	321	322	311	303	316	52	0	0
Gross energy intake, MJ/day	135	133	173	172	202	203	204	201	195	189	190	192	164	138	137
Feeding level	1.0	1.0	1.3	1.3										1.0	1.0
DEI, MJ/day	81	80	106	106										83	82
Methane output (Yan *et al*., 2000), MJ/day	10.5	10.3	13.0	12.9										10.8	10.6
Methane output (0.065 of GEI), MJ/day					13.1	13.2	13.2	13.1	12.7	12.3	12.4	12.5	10.7		
Methane, kg/day	0.19	0.19	0.23	0.23	0.24	0.24	0.24	0.24	0.23	0.22	0.22	0.22	0.19	0.19	0.19
Methane/animal/month, kg	5.8	5.2	7.2	1.2	5.9	0.7	6.7	7.1	7.1	6.8	6.7	6.9	1.2	4.7	5.9
Methane, proportion of GEI	0.078	0.078	0.075	0.075	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.078	0.078
Estimated total OM intake, kg/day	6.6	6.5	8.5	8.5	9.9	9.9	10.0	9.8	9.5	9.2	9.3	9.4	8.0	6.8	6.7
Total diet DOMD, kg/day	4.2	4.1	5.5	5.4	7.9	7.9	8.0	7.7	7.4	7.2	6.9	6.9	5.9	4.3	4.2
OM excreted, kg/day	2.5	2.4	3.1	3.0	2.0	2.0	2.0	2.2	2.1	2.0	2.4	2.4	2.1	2.5	2.5
OM excreted, kg/month	76	68	95	15	50	6	56	65	65	63	73	76	13	61	77
OM excreted at pasture, kg/month					50	6	56	65	65	63	73	76	13		
OM excreted during housing, kg/month	76	68	95	15										61	77

2003, Region 2: Suckler cows (second third of herd to calve).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Dry, up to calving	Dry, up to calving	Rest of April	Rest of first 4 weeks	Rest of May						Out, with calf	Housed	Dry
Days in month or period	31	28	31	5	25	3	28	30	31	31	30	31	6	24	31
Cow weight at start of period, kg	578	566	554	542	540	550	551	562	574	586	598	609	622	600	590
Cow weight at end of period, kg	566	554	542	540	550	551	562	574	586	598	609	622	624	590	578
Cow weight average over period, kg	572	560	548	541	545	550	556	568	580	592	604	615	623	595	584
Milk production, kg/day	0	0	0	0	10	9	9	8	7	6	6	6	6	0	0
Milk yield/month, kg	0	0	0	0	250	27	252	240	217	186	180	186	36	0	0
Energy milk, MJ NE_l/day	0.0	0.0	0.0	0.0	29.7	26.7	26.7	23.8	20.8	17.8	17.8	17.8	17.8	0.0	0.0
Energy for pregnancy, MJ NE_l/day	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
Energy for maintenance, MJ NE_l/day	34.7	34.2	33.7	33.4	37.3	37.6	37.9	38.4	39.0	39.6	40.2	40.7	41.1	35.7	35.3
Body-weight change, kg/day	–0.4	–0.4	–0.4	–0.4	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	–0.4	–0.4
Energy body-weight change, MJ NE_l/day	–10.0	–10.0	–10.0	–10.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	–10.0	–10.0
Body-weight change/period, kg	–12.4	–11.2	–12.4	–2.0	9.8	1.2	10.9	11.7	12.1	12.1	11.7	12.1	2.3	–9.6	–12.4
Energy requirement, MJ NE_l/day	36.2	35.6	35.1	34.8	79.5	76.8	77.1	74.7	72.3	69.9	70.5	71.0	71.4	25.8	34.9
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	0.3	0.3								0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	10.5	10.1	10.4	10.3	10.0	9.6	10.1	10.2	10.2		
Estimated silage intake, kg/day	7.3	7.2	7.1	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	7.1
Total DMI, kg/day	7.3	7.2	7.1	7.0	10.7	10.4	10.4	10.3	10.0	9.6	10.1	10.2	10.2	5.2	7.1
Concentrate intake, kg DM/period	0	0	0	0	6	1	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	227	202	220	35	0	0	0	0	0	0	0	0	0	125	219
Pasture intake, kg/period	0	0	0	0	262	30	292	309	309	299	303	316	61	0	0
Gross energy intake, MJ/day	135	133	131	130	202	195	196	194	187	181	190	192	193	96	130
Feeding level	1.0	1.0	1.0	1.0										0.7	1.0
DEI, MJ/day	81	80	79	78										58	78
Methane output (Yan *et al.*, 2000), MJ/day	10.5	10.3	10.2	10.1										8.2	10.2
Methane output (0.065 of GEI), MJ/day					13.1	12.7	12.7	12.6	12.2	11.8	12.4	12.5	12.5		
Methane, kg/day	0.19	0.19	0.18	0.18	0.24	0.23	0.23	0.23	0.22	0.21	0.22	0.22	0.22	0.15	0.18
Methane/animal/month, kg	5.8	5.2	5.7	0.9	5.9	0.7	6.4	6.8	6.8	6.6	6.7	6.9	1.3	3.5	5.7
Methane, proportion of GEI	0.078	0.078	0.078	0.078	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.085	0.079
Estimated total OM intake, kg/day	6.6	6.5	6.4	6.4	9.9	9.6	9.6	9.5	9.2	8.9	9.3	9.4	9.4	4.7	6.4
Total diet DOMD, kg/day	4.2	4.1	4.1	4.0	7.9	7.6	7.7	7.4	7.2	6.9	6.9	6.9	7.0	3.0	4.0
OM excreted, kg/day	2.5	2.4	2.4	2.4	2.0	1.9	1.9	2.1	2.0	2.0	2.4	2.4	2.5	1.7	2.4
OM excreted, kg/month	76	68	74	12	50	6	54	63	63	60	73	76	15	42	73
OM excreted at pasture, kg/month					50	6	54	63	63	60	73	76	15		
OM excreted during housing, kg/month	76	68	74	12										42	73

2003, Region 2: Suckler cows (last third of herd to calve).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes	Dry, up to calving	Dry, up to calving	Dry, up to calving	Dry, up to calving	Dry, up to calving	Dry, up to calving	Rest of May						Out, with calf	Housed	Dry
Days in month or period	31	28	31	5	25	10	21	30	31	31	30	31	6	24	31
Cow weight at start of period, kg	578	566	554	542	540	550	554	562	574	586	598	609	622	600	590
Cow weight at end of period, kg	566	554	542	540	550	554	562	574	586	598	609	622	624	590	578
Cow weight average over period, kg	572	560	548	541	545	552	558	568	580	592	604	615	623	595	584
Milk production, kg/day	0	0	0	0	0	0	10	10	9	8	7	6	6	0	0
Milk yield/month, kg	0	0	0	0	0	0	210	300	279	248	210	186	36	0	0
Energy milk, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	0.0	29.7	29.7	26.7	23.8	20.8	17.8	17.8	0.0	0.0
Energy for pregnancy, MJ NE_l/day	7.7	11.4	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy for maintenance, MJ NE_l/day	34.7	34.2	33.7	33.4	33.6	33.9	38.0	38.4	39.0	39.6	40.2	40.7	41.1	35.7	35.3
Body-weight change, kg/day	–0.4	–0.4	–0.4	–0.4	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	–0.4	–0.4
Energy body-weight change, MJ NE_l/day	–10.0	–10.0	–10.0	–10.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	–10.0	–10.0
Body-weight change/period, kg	–12.4	–11.2	–12.4	–2.0	9.8	3.9	8.2	11.7	12.1	12.1	11.7	12.1	2.3	–9.6	–12.4
Energy requirement, MJ NE_l/day	32.5	35.6	35.1	34.8	57.5	57.8	80.1	80.6	78.2	75.8	73.4	71.0	71.4	25.8	25.3
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	0.0	0.0								0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	7.8	7.8	10.8	11.1	10.8	10.5	10.5	10.2	10.2		
Estimated silage intake, kg/day	6.6	7.2	7.1	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.1
Total DMI, kg/day	6.6	7.2	7.1	7.0	7.8	7.8	10.8	11.1	10.8	10.5	10.5	10.2	10.2	5.2	5.1
Concentrate intake, kg DM/period	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	204	202	220	35	0	0	0	0	0	0	0	0	0	125	159
Pasture intake, kg/period	0	0	0	0	194	78	228	333	334	324	316	316	61	0	0
Gross energy intake, MJ/day	121	133	131	130	146	147	204	209	203	197	198	192	193	96	94
Feeding level	0.9	1.0	1.0	1.0										0.7	0.7
DEI, MJ/day	73	80	79	78										58	57
Methane output (Yan *et al.*, 2000), MJ/day	9.7	10.3	10.2	10.1										8.2	8.1
Methane output (0.065 of GEI), MJ/day					9.5	9.5	13.2	13.6	13.2	12.8	12.9	12.5	12.5		
Methane, kg/day	0.17	0.19	0.18	0.18	0.17	0.17	0.24	0.24	0.24	0.23	0.23	0.22	0.22	0.15	0.14
Methane/animal/month, kg	5.4	5.2	5.7	0.9	4.3	1.7	5.0	7.3	7.3	7.1	6.9	6.9	1.3	3.5	4.5
Methane, proportion of GEI	0.080	0.078	0.078	0.078	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.085	0.085
Estimated total OM intake, kg/day	6.0	6.5	6.4	6.4	7.2	7.2	10.0	10.2	9.9	9.6	9.7	9.4	9.4	4.7	4.6
Total diet DOMD, kg/day	3.8	4.1	4.1	4.0	5.7	5.7	8.0	8.0	7.7	7.5	7.2	6.9	7.0	3.0	2.9
OM excreted, kg/day	2.2	2.4	2.4	2.4	1.4	1.4	2.0	2.2	2.2	2.1	2.5	2.4	2.5	1.7	1.7
OM excreted, kg/month	68	68	74	12	36	14	42	67	68	66	76	76	15	42	53
OM excreted at pasture, kg/month					36	14	42	67	68	66	76	76	15		
OM excreted during housing, kg/month	68	68	74	12										42	53

2003, Region 2: Suckler cows (autumn-calving cows).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Sept	Oct	Nov	Nov	Dec
Cow status/notes					Out to grass		Dry	Dry	Dry	Dry	Dry	Calved		Out	Housed	
Days in month or period	31	28	31	5	25	21	10	30	31	31	21	9	31	6	24	31
Cow weight at start of period, kg	578	566	554	542	540	550	558	562	574	586	598	606	609	622	600	590
Cow weight at end of period, kg	566	554	542	540	550	558	562	574	586	598	606	609	622	624	590	578
Cow weight average over period, kg	572	560	548	541	545	554	560	568	580	592	602	608	615	623	595	584
Milk production, kg/day	7	7	7	7	7	7	0	0	0	0	0	10	10	10	8	7
Milk yield/month, kg	217	196	217	35	175	147	0	0	0	0	0	90	310	60	192	217
Energy milk, MJ NE_l/day	20.8	20.8	20.8	20.8	20.8	20.8	0.0	0.0	0.0	0.0	0.0	29.7	29.7	29.7	23.8	20.8
Energy for pregnancy, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	0.0	11.4	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0
Energy for maintenance, MJ NE_l/day	38.6	38.0	37.5	37.1	37.3	37.8	34.3	34.6	35.1	35.6	36.1	40.4	40.7	41.1	39.7	39.2
Body-weight change, kg/day	–0.4	–0.4	–0.4	–0.4	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	–0.4	–0.4
Energy body-weight change, MJ NE_l/day	–10.0	–10.0	–10.0	–10.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	–10.0	–9.95
Body-weight change/period, kg	–12.4	–11.2	–12.4	–2.0	9.8	8.2	3.9	11.7	12.1	12.1	8.2	3.5	12.1	2.3	–9.6	–12.4
Energy requirement, MJ NE_l/day	49.4	48.9	48.3	47.9	70.6	71.0	58.1	58.5	59.0	59.5	59.9	82.5	82.9	83.3	53.5	50.0
Concentrates fed, kg/day	1.8	1.8	0.0	0.0	0.0	0.0									1.8	1.8
Concentrate DM fed, kg DM/day	1.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.6
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	9.5	9.6	7.9	8.1	8.1	8.2	8.6	11.8	11.9	11.9		
Estimated silage intake, kg/day	7.2	7.1	9.3	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	7.3
Total DMI, kg/day	8.8	8.7	9.3	9.2	9.5	9.6	7.9	8.1	8.1	8.2	8.6	11.8	11.9	11.9	9.5	8.9
Concentrate intake, kg DM/period	49	44	0	0	0	0	0	0	0	0	0	0	0	0	38	49
Silage intake, kg/period	223	198	287	46	0	0	0	0	0	0	0	0	0	0	191	226
Pasture intake, kg/period	0	0	0	0	239	202	79	242	252	254	181	107	369	72	0	0
Gross energy intake, MJ/day	162	160	171	169	180	181	148	152	153	154	162	223	224	225	176	164
Feeding level	1.3	1.3	1.3	1.3											1.3	1.3
DEI, MJ/day	106	105	107	107											116	108
Methane output (Yan *et al.*, 2000), MJ/day	12.6	12.5	13.4	13.3											13.7	12.8
Methane output (0.065 of GEI), MJ/day					11.7	11.7	9.6	9.8	9.9	10.0	10.5	14.5	14.5	14.6		
Methane, kg/day	0.23	0.22	0.24	0.24	0.21	0.21	0.17	0.18	0.18	0.18	0.19	0.26	0.26	0.26	0.25	0.23
Methane/animal/month, kg	7.0	6.3	7.5	1.2	5.2	4.4	1.7	5.3	5.5	5.6	4.0	2.3	8.1	1.6	5.9	7.1
Methane, proportion of GEI	0.078	0.078	0.079	0.079	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.078	0.078
Estimated total OM intake, kg/day	8.0	7.9	8.4	8.3	8.8	8.8	7.2	7.4	7.5	7.5	7.9	10.9	10.9	11.0	8.7	8.1
Total diet DOMD, kg/day	5.5	5.4	5.5	5.5	7.0	7.1	5.8	5.8	5.8	5.9	5.9	8.1	8.1	8.1	5.9	5.5
OM excreted, kg/day	2.5	2.5	2.9	2.8	1.8	1.8	1.4	1.6	1.6	1.7	2.1	2.8	2.8	2.9	2.8	2.6
OM excreted, kg/month	79	70	88	14	44	37	14	49	51	51	43	25	88	17	67	80
OM excreted at pasture, kg/month					44	37	14	49	51	51	43	25	88	17		
OM excreted during housing, kg/month	79	70	88	14											67	80

2003, Region 2: Suckler cows (spring cows, empty).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Dry, up to calving	Dry	Rest of April	Rest of first 4 weeks	Rest of May						Out	Housed	Dry
Days in month or period	31	28	31	5	25	3	28	30	31	31	30	31	6	24	31
Cow weight at start of period, kg	578	566	554	542	540	550	551	562	574	586	598	609	622	600	590
Cow weight at end of period, kg	566	554	542	540	550	551	562	574	586	598	609	622	624	590	578
Cow weight average over period, kg	572	560	548	541	545	550	556	568	580	592	604	615	623	595	584
Milk production, kg/day	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Milk yield/month, kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Energy milk, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy for pregnancy, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy for maintenance, MJ NE_l/day	34.7	34.2	33.7	33.4	33.6	33.8	34.1	34.6	35.1	35.6	36.1	36.7	37.0	35.7	35.3
Body-weight change, kg/day	–0.4	–0.4	–0.4	–0.4	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	–0.4	–0.4
Energy body-weight change, MJ NE_l/day	–10.0	–10.0	–10.0	–10.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	–10.0	–10.0
Body-weight change/period, kg	–12.4	–11.2	–12.4	–2.0	9.8	1.2	10.9	11.7	12.1	12.1	11.7	12.1	2.3	–9.6	–12.4
Energy requirement, MJ NE_l/day	24.8	24.3	23.8	23.5	46.1	46.3	46.6	47.1	47.6	48.1	48.6	49.1	49.5	25.8	25.3
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	0.0	0.0								0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	6.2	6.3	6.3	6.5	6.6	6.6	7.0	7.1	7.1		
Estimated silage intake, kg/day	5.0	4.9	4.8	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	5.1
Total DMI, kg/day	5.0	4.9	4.8	4.7	6.2	6.3	6.3	6.5	6.6	6.6	7.0	7.1	7.1	5.2	5.1
Concentrate intake, kg DM/period	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	155	138	149	24	0	0	0	0	0	0	0	0	0	125	159
Pasture intake, kg/period	0	0	0	0	156	19	176	195	203	206	209	219	43	0	0
Gross energy intake, MJ/day	92	90	88	87	117	118	118	122	123	125	131	133	133	96	94
Feeding level	0.7	0.7	0.7	0.7										0.7	0.7
DEI, MJ/day	55	54	53	52										58	57
Methane output (Yan *et al.*, 2000), MJ/day	7.9	7.8	7.6	7.5										8.2	8.1
Methane output (0.065 of GEI), MJ/day					7.6	7.7	7.7	7.9	8.0	8.1	8.5	8.6	8.7		
Methane, kg/day	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.15	0.14
Methane/animal/month, kg	4.4	3.9	4.3	0.7	3.4	0.4	3.9	4.3	4.5	4.5	4.6	4.8	0.9	3.5	4.5
Methane, proportion of GEI	0.086	0.086	0.086	0.086	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.085	0.085
Estimated total OM intake, kg/day	4.5	4.5	4.4	4.3	5.7	5.8	5.8	6.0	6.0	6.1	6.4	6.5	6.5	4.7	4.6
Total diet DOMD, kg/day	2.9	2.8	2.7	2.7	4.6	4.6	4.6	4.7	4.7	4.8	4.8	4.8	4.8	3.0	2.9
OM excreted, kg/day	1.7	1.6	1.6	1.6	1.1	1.2	1.2	1.3	1.3	1.3	1.7	1.7	1.7	1.7	1.7
OM excreted, kg/month	52	46	50	8	29	3	32	39	41	42	50	52	10	42	53
OM excreted at pasture, kg/month					29	3	32	39	41	42	50	52	10		
OM excreted during housing, kg/month	52	46	50	8										42	53

2003, Region 2: Suckler cows (spring cow, stillborn and early calf deaths)

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Nov	Dec
Cow status/notes		Dry, up to calving	Dry, up to calving	Dry, up to calving	Rest of April	Rest of first 4 weeks	Rest of May						Out	Housed	Dry
Days in month or period	31	28	31	5	25	3	28	30	31	31	30	31	6	24	31
Cow weight at start of period, kg	578	566	554	542	540	550	551	562	574	586	598	609	622	600	590
Cow weight at end of period, kg	566	554	542	540	550	551	562	574	586	598	609	622	624	590	578
Cow weight average over period, kg	572	560	548	541	545	550	556	568	580	592	604	615	623	595	584
Milk production, kg/day	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Milk yield/month, kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Energy milk, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy for pregnancy, MJ NE_l/day	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
Energy for maintenance, MJ NE_l/day	34.7	34.2	33.7	33.4	33.6	33.8	34.1	34.6	35.1	35.6	36.1	36.7	37.0	35.7	35.3
Body-weight change, kg/day	–0.4	–0.4	–0.4	–0.4	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	–0.4	–0.4
Energy body-weight change, MJ NE_l/day	–10.0	–10.0	–10.0	–10.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	–10.0	–10.0
Body-weight change/period, kg	–12.4	–11.2	–12.4	–2.0	9.8	1.2	10.9	11.7	12.1	12.1	11.7	12.1	2.3	–9.6	–12.4
Energy requirement, MJ NE_l/day	36.2	35.6	35.1	34.8	46.1	46.3	46.6	47.1	47.6	48.1	48.6	49.1	49.5	25.8	34.9
ConcentratesConcentrates fed, kg/day	0.0	0.0	0.0	0.0	0.0	0.0								0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	6.2	6.3	6.3	6.5	6.6	6.6	7.0	7.1	7.1		
Estimated silage intake, kg/day	7.3	7.2	7.1	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	7.1
Total DMI, kg/day	7.3	7.2	7.1	7.0	6.2	6.3	6.3	6.5	6.6	6.6	7.0	7.1	7.1	5.2	7.1
Concentrate intake, kg DM/period	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	227	202	220	35	0	0	0	0	0	0	0	0	0	125	219
Pasture intake, kg/period	0	0	0	0	156	19	176	195	203	206	209	219	43	0	0
Gross energy intake, MJ/day	135	133	131	130	117	118	118	122	123	125	131	133	133	96	130
Feeding level	1.0	1.0	1.0	1.0										0.7	1.0
DEI, MJ/day	81	80	79	78										58	78
Methane output (Yan *et al.*, 2000), MJ/day	10.5	10.3	10.2	10.1										8.2	10.2
Methane output (0.065 of GEI), MJ/day					7.6	7.7	7.7	7.9	8.0	8.1	8.5	8.6	8.7		
Methane, kg/day	0.19	0.19	0.18	0.18	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.15	0.18
Methane/animal/month, kg	5.8	5.2	5.7	0.9	3.4	0.4	3.9	4.3	4.5	4.5	4.6	4.8	0.9	3.5	5.7
Methane, proportion of GEI	0.078	0.078	0.078	0.078	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.085	0.079
Estimated total OM intake, kg/day	6.6	6.5	6.4	6.4	5.7	5.8	5.8	6.0	6.0	6.1	6.4	6.5	6.5	4.7	6.4
Total diet DOMD, kg/day	4.2	4.1	4.1	4.0	4.6	4.6	4.6	4.7	4.7	4.8	4.8	4.8	4.8	3.0	4.0
OM excreted, kg/day	2.5	2.4	2.4	2.4	1.1	1.2	1.2	1.3	1.3	1.3	1.7	1.7	1.7	1.7	2.4
OM excreted, kg/month	76	68	74	12	29	3	32	39	41	42	50	52	10	42	73
OM excreted at pasture, kg/month					29	3	32	39	41	42	50	52	10		
OM excreted during housing, kg/month	76	68	74	12										42	73

2003, Region 3: Suckler cows (first third of herd to calve).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Dec
Cow status/notes		Dry, up to calving	Calved pre-turnout	Calved pre-turnout	Out, rest of April	Rest of first 4 weeks	Rest of May						Housed, weaned	Dry
Days in month or period	31	28	31	13	17	11	20	30	31	31	30	31	30	31
Cow weight at start of period, kg	578	566	556	545	540	547	552	560	573	586	598	611	600	589
Cow weight at end of period, kg	566	556	545	540	547	552	560	573	586	598	611	624	589	578
Cow weight average over period, kg	572	561	550	542	544	549	556	566	579	592	605	618	595	583
Milk production, kg/day	0	0	7	7	10	10	10	9	8	7	6	6	0	0
Milk yield/month, kg	0	0	217	91	170	110	200	270	248	217	180	186	0	0
Energy milk, MJ NE_l/day	0.0	0.0	20.8	20.8	29.7	29.7	29.7	26.7	23.8	20.8	17.8	17.8	0.0	0.0
Energy for pregnancy, MJ NE_l/day	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	11.4
Energy for maintenance, MJ NE_l/day	34.2	33.7	36.9	36.6	37.3	37.6	37.9	38.4	39.0	39.6	40.2	40.8	35.1	34.6
Body-weight change, kg/day	–0.366	–0.366	–0.366	–0.366	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	–0.366	–0.366
Energy body-weight change, MJ NE_l/day	–9.1	–9.1	–9.1	–9.1	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	–9.1	–9.1
Body-weight change/period, kg	–11.3	–10.2	–11.3	–4.8	7.1	4.6	8.4	12.5	13.0	13.0	12.5	13.0	–11.0	–11.3
Energy requirement, MJ NE_l/day	36.4	36.0	48.6	48.2	80.3	80.6	80.9	78.5	76.1	73.8	71.4	72.0	37.4	36.9
Concentrates fed, kg/day	0.0	0.0	1.2	1.2	0.5	0.5							0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	1.1	1.1	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	10.4	10.5	10.9	10.8	10.5	10.2	10.2	10.3		
Estimated silage intake, kg/day	7.4	7.3	8.2	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	7.5
Total DMI, kg/day	7.4	7.3	9.3	9.2	10.9	10.9	10.9	10.8	10.5	10.2	10.2	10.3	7.6	7.5
Concentrate intake, kg DM/period	0	0	33	14	7	5	0	0	0	0	0	0	0	0
Silage intake, kg/period	228	204	254	106	0	0	0	0	0	0	0	0	227	232
Pasture intake, kg/period	0	0	0	0	177	115	219	325	325	315	307	320	0	0
Gross energy intake, MJ/day	136	134	171	170	204	205	206	203	197	191	193	194	139	137
Feeding level	1.1	1.1	1.3	1.3									1.1	1.1
DEI, MJ/day	81	80	106	105									84	82
Methane output (Yan *et al.*, 2000), MJ/day	10.5	10.4	12.8	12.6									10.8	10.7
Methane output (0.065 of GEI), MJ/day					13.3	13.3	13.4	13.2	12.8	12.4	12.5	12.6		
Methane, kg/day	0.19	0.19	0.23	0.23	0.24	0.24	0.24	0.24	0.23	0.22	0.23	0.23	0.19	0.19
Methane/animal/month, kg	5.9	5.2	7.1	3.0	4.1	2.6	4.8	7.1	7.1	6.9	6.8	7.0	5.8	5.9
Methane, proportion of GEI	0.077	0.077	0.075	0.075	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.078	0.078
Estimated total OM intake, kg/day	6.7	6.6	8.4	8.4	10.0	10.0	10.1	10.0	9.7	9.4	9.4	9.5	6.9	6.8
Total diet DOMD, kg/day	4.2	4.2	5.5	5.4	8.0	8.0	8.1	7.8	7.5	7.3	7.0	7.0	4.3	4.3
OM excreted, kg/day	2.5	2.4	3.0	2.9	2.0	2.0	2.0	2.2	2.1	2.1	2.5	2.5	2.5	2.5
OM excreted, kg/month	77	68	92	38	34	22	40	66	66	64	74	77	76	78
OM excreted at pasture, kg/month					34	22	40	66	66	64	74	77		
OM excreted during housing, kg/month	77	68	92	38									76	78

2003, Region 3: Suckler cows (second third of herd to calve).

	Jan	Feb	March	April	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Dec
Cow status/notes		Dry, up to calving	Dry, up to calving	Dry, up to calving	Calved pre-turnout	Rest of April, out	Rest of first 4 weeks	Rest of May					Out, with calf	Housed, weaned	Dry
Days in month or period	31	28	31	5	8	17	11	20	30	31	31	30	31	30	31
Cow weight at start of period, kg	578	566	556	545	543	540	547	552	560	573	586	598	611	600	589
Cow weight at end of period, kg	566	556	545	543	540	547	552	560	573	586	598	611	624	589	578
Cow weight average over period, kg	572	561	550	544	541	544	549	556	566	579	592	605	618	595	583
Milk production, kg/day	0	0	0	0	7	10	10	10	9	8	7	6	6	0	0
Milk yield/month, kg	0	0	0	0	56	170	110	200	270	248	217	180	186	0	0
Energy milk, MJ NE_l/day	0.0	0.0	0.0	0.0	20.8	29.7	29.7	29.7	26.7	23.8	20.8	17.8	17.8	0.0	0.0
Energy for pregnancy, MJ NE_l/day	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
Energy for maintenance, MJ NE_l/day	34.2	33.7	33.2	33.0	36.5	37.3	37.6	37.9	38.4	39.0	39.6	40.2	40.8	35.1	34.6
Body-weight change, kg/day	–0.366	–0.366	–0.366	–0.366	–0.366	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	–0.366	–0.366
Energy body-weight change, MJ NE_l/day	–9.1	–9.1	–9.1	–9.1	–9.1	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	–9.1	–9.1
Body-weight change/period, kg	–11.3	–10.2	–11.3	–1.8	–2.9	7.1	4.6	8.4	12.5	13.0	13.0	12.5	13.0	–11.0	–11.3
Energy requirement, MJ NE_l/day	36.4	36.0	35.5	35.2	48.2	80.3	80.6	80.9	78.5	76.1	73.8	71.4	72.0	26.0	35.1
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	1.2	0.5	0.5							0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	1.1	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	0.0	10.4	10.5	10.9	10.8	10.5	10.2	10.2	10.3		
Estimated silage intake, kg/day	7.4	7.3	7.2	7.1	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	7.1
Total DMI, kg/day	7.4	7.3	7.2	7.1	9.2	10.9	10.9	10.9	10.8	10.5	10.2	10.2	10.3	5.3	7.1
Concentrate intake, kg DM/period	0	0	0	0	8	7	5	0	0	0	0	0	0	0	0
Silage intake, kg/period	228	204	223	36	65	0	0	0	0	0	0	0	0	158	220
Pasture intake, kg/period	0	0	0	0	0	177	115	219	325	325	315	307	320	0	0
Gross energy intake, MJ/day	136	134	132	131	169	204	205	206	203	197	191	193	194	97	131
Feeding level	1.1	1.1	1.1	1.1	1.3									0.7	1.0
DEI, MJ/day	81	80	79	79	105									58	78
Methane output (Yan *et al.*, 2000), MJ/day	10.5	10.4	10.2	10.2	12.6									8.2	10.2
Methane output (0.065 of GEI), MJ/day						13.3	13.3	13.4	13.2	12.8	12.4	12.5	12.6		
Methane, kg/day	0.19	0.19	0.18	0.18	0.23	0.24	0.24	0.24	0.24	0.23	0.22	0.23	0.23	0.15	0.18
Methane/animal/month, kg	5.9	5.2	5.7	0.9	1.8	4.1	2.6	4.8	7.1	7.1	6.9	6.8	7.0	4.4	5.7
Methane, proportion of GEI	0.077	0.077	0.077	0.077	0.075	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.085	0.078
Estimated total OM intake, kg/day	6.7	6.6	6.5	6.5	8.4	10.0	10.0	10.1	10.0	9.7	9.4	9.4	9.5	4.8	6.4
Total diet DOMD, kg/day	4.2	4.2	4.1	4.1	5.4	8.0	8.0	8.1	7.8	7.5	7.3	7.0	7.0	3.0	4.1
OM excreted, kg/day	2.5	2.4	2.4	2.4	2.9	2.0	2.0	2.0	2.2	2.1	2.1	2.5	2.5	1.8	2.4
OM excreted, kg/month	77	68	75	12	24	34	22	40	66	66	64	74	77	53	74
OM excreted at pasture, kg/month						34	22	40	66	66	64	74	77		
OM excreted during housing, kg/month	77	68	75	12	24									53	74

2003, Region 3: Suckler cows (last third of herd to calve).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Dec
Cow status/notes	Dry, up to calving	Dry, up to calving	Dry, up to calving	Dry, up to calving	Out, dry, up to calving	Dry, up to calving	Rest of May						Housed, weaned	Dry
Days in month or period	31	28	31	13	17	10	21	30	31	31	30	31	30	31
Cow weight at start of period, kg	578	566	556	545	540	547	551	560	573	586	598	611	600	589
Cow weight at end of period, kg	566	556	545	540	547	551	560	573	586	598	611	624	589	578
Cow weight average over period, kg	572	561	550	542	544	549	556	566	579	592	605	618	595	583
Milk production, kg/day	0	0	0	0	0	0	10	10	9	8	7	6	0	0
Milk yield/month, kg	0	0	0	0	0	0	210	300	279	248	210	186	0	0
Energy milk, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	0.0	29.7	29.7	26.7	23.8	20.8	17.8	0.0	0.0
Energy for pregnancy, MJ NE_l/day	7.7	11.4	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy for maintenance, MJ NE_l/day	34.2	33.7	33.2	32.9	33.6	33.8	37.9	38.4	39.0	39.6	40.2	40.8	35.1	34.6
Body-weight change, kg/day	–0.366	–0.366	–0.366	–0.366	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	–0.366	–0.366
Energy body-weight change, MJ NE_l/day	–9.1	–9.1	–9.1	–9.1	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	–9.1	–9.1
Body-weight change/period, kg	–11.3	–10.2	–11.3	–4.8	7.1	4.2	8.8	12.5	13.0	13.0	12.5	13.0	–11.0	–11.3
Energy requirement, MJ NE_l/day	32.8	36.0	35.5	35.2	58.3	58.5	80.9	81.4	79.1	76.7	74.4	72.0	26.0	25.5
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	0.0	0.0							0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	7.9	7.9	10.9	11.2	10.9	10.6	10.7	10.3		
Estimated silage intake, kg/day	6.6	7.3	7.2	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	5.2
Total DMI, kg/day	6.6	7.3	7.2	7.1	7.9	7.9	10.9	11.2	10.9	10.6	10.7	10.3	5.3	5.2
Concentrate intake, kg DM/period	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	205	204	223	93	0	0	0	0	0	0	0	0	158	160
Pasture intake, kg/period	0	0	0	0	134	79	230	337	338	328	320	320	0	0
Gross energy intake, MJ/day	122	134	132	131	148	149	206	211	205	199	201	194	97	95
Feeding level	1.0	1.1	1.1	1.1									0.7	0.7
DEI, MJ/day	73	80	79	79									58	57
Methane output (Yan *et al.*, 2000), MJ/day	9.7	10.4	10.2	10.1									8.2	8.1
Methane output (0.065 of GEI), MJ/day					9.6	9.7	13.4	13.7	13.3	12.9	13.0	12.6		
Methane, kg/day	0.17	0.19	0.18	0.18	0.17	0.17	0.24	0.25	0.24	0.23	0.23	0.23	0.15	0.15
Methane/animal/month, kg	5.4	5.2	5.7	2.4	2.9	1.7	5.0	7.4	7.4	7.2	7.0	7.0	4.4	4.5
Methane, proportion of GEI	0.079	0.077	0.077	0.077	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.085	0.085
Estimated total OM intake, kg/day	6.0	6.6	6.5	6.4	7.3	7.3	10.1	10.3	10.0	9.7	9.8	9.5	4.8	4.7
Total diet DOMD, kg/day	3.8	4.2	4.1	4.1	5.8	5.8	8.1	8.1	7.8	7.6	7.3	7.0	3.0	2.9
OM excreted, kg/day	2.2	2.4	2.4	2.4	1.5	1.5	2.0	2.3	2.2	2.1	2.6	2.5	1.8	1.7
OM excreted, kg/month	68.9	68.3	74.7	31.0	24.7	14.6	42.3	68.2	68.4	66.4	76.6	76.6	52.9	53.7
OM excreted at pasture, kg/month					24.7	14.6	42.3	68.2	68.4	66.4	76.6	76.6		
OM excreted during housing, kg/month	68.9	68.3	74.7	31.0									52.9	53.7

2003, Region 3: Suckler cows (autumn-calving cows).

	Jan	Feb	March	April	April	May	May	June	July	Aug	Sept	Sept	Oct	Nov	Dec
Cow status/notes					Out to grass		Dry	Dry	Dry	Dry	Dry	Calved		Housed	
Days in month or period	31	28	31	13	17	21	10	30	31	31	21	9	31	30	31
Cow weight at start of period, kg	578	566	556	545	540	547	556	560	573	586	598	607	611	600	589
Cow weight at end of period, kg	566	556	545	540	547	556	560	573	586	598	607	611	624	589	578
Cow weight average over period, kg	572	561	550	542	544	551	558	566	579	592	603	609	618	595	583
Milk production, kg/day	7	7	7	7	7	7	0	0	0	0	0	10	10	8	7
Milk yield/month, kg	217	196	217	91	119	147	0	0	0	0	0	90	310	240	217
Energy milk, MJ NE_l/day	20.8	20.8	20.8	20.8	20.8	20.8	0.0	0.0	0.0	0.0	0.0	29.7	29.7	23.8	20.8
Energy for pregnancy, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	0.0	11.4	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0
Energy for maintenance, MJ NE_l/day	37.9	37.4	36.9	36.6	37.3	37.7	34.2	34.5	35.1	35.6	36.1	40.4	40.8	39.0	38.5
Body-weight change, kg/day	–0.366	–0.366	–0.366	–0.366	0.418	0.418	0.39	0.418	0.418	0.418	0.418	0.418	0.418	–0.366	–0.366
Energy body-weight change, MJ NE_l/day	–9.1	–9.1	–9.1	–9.1	13.4	13.4	12.5	13.4	13.4	13.4	13.4	13.4	13.4	–9.1	–9.1
Body-weight change/period, kg	–11.3	–10.2	–11.3	–4.8	7.1	8.8	3.9	12.5	13.0	13.0	8.8	3.8	13.0	–11.0	–11.3
Energy requirement, MJ NE_l/day	49.6	49.1	48.6	48.2	71.4	71.8	58.0	59.3	59.8	60.4	60.9	83.5	83.9	53.7	50.2
Concentrates fed, kg/day	1.8	1.8	0.0	0.0	0.0	0.0								1.8	1.8
Concentrate DM fed, kg DM/day	1.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.6
Estimated grass input	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	9.7	9.7	7.8	8.2	8.3	8.3	8.7	12.0	12.0		
Estimated silage intake, kg/day	7.2	7.1	9.3	9.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	7.3
Total DMI, kg/day	8.8	8.7	9.3	9.3	9.7	9.7	7.8	8.2	8.3	8.3	8.7	12.0	12.0	9.6	8.9
Concentrate intake, kg DM/period	49	44	0	0	0	0	0	0	0	0	0	0	0	47	49
Silage intake, kg/period	224	200	289	120	0	0	0	0	0	0	0	0	0	240	227
Pasture intake, kg/period	0	0	0	0	164	204	78	245	256	258	183	108	373	0	0
Gross energy intake, MJ/day	163	161	172	170	182	183	148	154	155	157	164	225	226	177	164
Feeding level	1.3	1.3	1.3	1.3										1.4	1.3
DEI, MJ/day	107	106	108	107										116	108
Methane output (Yan *et al.*, 2000), MJ/day	12.6	12.5	13.4	13.3										13.6	12.8
Methane output (0.065 of GEI), MJ/day					11.8	11.9	9.6	10.0	10.1	10.2	10.7	14.6	14.7		
Methane, kg/day	0.23	0.22	0.24	0.24	0.21	0.21	0.17	0.18	0.18	0.18	0.19	0.26	0.26	0.25	0.23
Methane/animal/month, kg	7.0	6.3	7.5	3.1	3.6	4.5	1.7	5.4	5.6	5.7	4.0	2.4	8.2	7.4	7.1
Methane, proportion of GEI	0.078	0.078	0.078	0.078	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.077	0.078
Estimated total OM intake, kg/day	8.0	7.9	8.5	8.4	8.9	8.9	7.2	7.5	7.6	7.7	8.0	11.0	11.1	8.7	8.1
Total diet DOMD, kg/day	5.5	5.4	5.6	5.5	7.1	7.1	5.8	5.9	5.9	6.0	5.9	8.2	8.2	5.9	5.5
OM excreted, kg/day	2.5	2.5	2.9	2.9	1.8	1.8	1.4	1.7	1.7	1.7	2.1	2.9	2.9	2.8	2.6
OM excreted, kg/month	79	71	89	37	30	38	14	50	52	52	44	26	89	84	80
OM excreted at pasture, kg/month					30	38	14	50	52	52	44	26	89		
OM excreted during housing, kg/month	79	71	89	37										84	80

2003, Region 3: Suckler cows (spring cows, empty).

	Jan	Feb	March	April	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Dec
Cow status/notes		Dry	Dry	Dry	Dry	Rest of April, out	Rest of first 4 weeks	Rest of May					Out	Housed	Dry
Days in month or period	31	28	31	5	8	17	11	20	30	31	31	30	31	30	31
Cow weight at start of period, kg	578	566	556	545	543	540	547	552	560	573	586	598	611	600	589
Cow weight at end of period, kg	566	556	545	543	540	547	552	560	573	586	598	611	624	589	578
Cow weight average over period, kg	572	561	550	544	541	544	549	556	566	579	592	605	618	595	583
Milk production, kg/day	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Milk yield/month, kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Energy milk, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy for pregnancy, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy for maintenance, MJ NE_l/day	34.2	33.7	33.2	33.0	32.9	33.6	33.8	34.1	34.5	35.1	35.6	36.2	36.8	35.1	34.6
Body-weight change, kg/day	–0.366	–0.366	–0.366	–0.366	–0.366	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	–0.366	–0.366
Energy body-weight change, MJ NE_l/day	–9.1	–9.1	–9.1	–9.1	–9.1	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	–9.1	–9.1
Body-weight change/period, kg	–11.3	–10.2	–11.3	–1.8	–2.9	7.1	4.6	8.4	12.5	13.0	13.0	12.5	13.0	–11.0	–11.3
Energy requirement, MJ NE_l/day	25.0	24.6	24.1	23.9	23.8	46.9	47.2	47.5	47.9	48.5	49.0	49.6	50.1	26.0	25.5
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0							0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	0.0	6.3	6.4	6.4	6.6	6.7	6.8	7.1	7.2		
Estimated silage intake, kg/day	5.1	5.0	4.9	4.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	5.2
Total DMI, kg/day	5.1	5.0	4.9	4.8	4.8	6.3	6.4	6.4	6.6	6.7	6.8	7.1	7.2	5.3	5.2
Concentrate intake, kg DM/period	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	157	139	151	24	38	0	0	0	0	0	0	0	0	158	160
Pasture intake, kg/period	0	0	0	0	0	108	70	128	198	207	210	213	223	0	0
Gross energy intake, MJ/day	93	92	90	89	88	119	120	121	124	126	127	134	135	97	95
Feeding level	0.7	0.7	0.7	0.7	0.7									0.7	0.7
DEI, MJ/day	56	55	54	53	53									58	57
Methane output (Yan *et al.*, 2000), MJ/day	7.9	7.8	7.7	7.6	7.6									8.2	8.1
Methane output (0.065 of GEI), MJ/day						7.8	7.8	7.8	8.1	8.2	8.3	8.7	8.8		
Methane, kg/day	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.16	0.15	0.15
Methane/animal/month, kg	4.4	3.9	4.3	0.7	1.1	2.4	1.5	2.8	4.4	4.5	4.6	4.7	4.9	4.4	4.5
Methane, proportion of GEI	0.085	0.085	0.086	0.086	0.086	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.085	0.085
Estimated total OM intake, kg/day	4.6	4.5	4.4	4.4	4.4	5.8	5.9	5.9	6.1	6.1	6.2	6.5	6.6	4.8	4.7
Total diet DOMD, kg/day	2.9	2.8	2.8	2.8	2.7	4.7	4.7	4.7	4.7	4.8	4.9	4.8	4.9	3.0	2.9
OM excreted, kg/day	1.7	1.7	1.6	1.6	1.6	1.2	1.2	1.2	1.3	1.4	1.4	1.7	1.7	1.8	1.7
OM excreted, kg/month	53	47	51	8	13	20	13	24	40	42	42	51	53	53	54
OM excreted at pasture, kg/month						20	13	24	40	42	42	51	53		
OM excreted during housing, kg/month	53	47	51	8	13									53	54

2003, Region 3: Suckler cows (spring cow, stillborn and early calf deaths).

	Jan	Feb	March	April	April	April	May	May	June	July	Aug	Sept	Oct	Nov	Dec
Cow status/notes		Dry, up to calving	Dry, up to calving	Dry, up to calving	Calved pre-turnout	Rest of April, out	Rest of first 4 weeks	Rest of May					Out	Housed, weaned	Dry
Days in month or period	31	28	31	5	8	17	11	20	30	31	31	30	31	30	31
Cow weight at start of period, kg	578	566	556	545	543	540	547	552	560	573	586	598	611	600	589
Cow weight at end of period, kg	566	556	545	543	540	547	552	560	573	586	598	611	624	589	578
Cow weight average over period, kg	572	561	550	544	541	544	549	556	566	579	592	605	618	595	583
Milk production, kg/day	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Milk yield/month, kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Energy milk, MJ NE_l/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy for pregnancy, MJ NE_l/day	11.4	11.4	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5
Energy for maintenance, MJ NE_l/day	34.2	33.7	33.2	33.0	32.9	33.6	33.8	34.1	34.5	35.1	35.6	36.2	36.8	35.1	34.6
Body-weight change, kg/day	–0.366	–0.366	–0.366	–0.366	–0.366	0.418	0.418	0.418	0.418	0.418	0.418	0.418	0.418	–0.366	–0.366
Energy body-weight change, MJ NE_l/day	–9.1	–9.1	–9.1	–9.1	–9.1	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	–9.1	–9.1
Body-weight change/period, kg	–11.3	–10.2	–11.3	–1.8	–2.9	7.1	4.6	8.4	12.5	13.0	13.0	12.5	13.0	–11.0	–11.3
Energy requirement, MJ NE_l/day	36.4	36.0	35.5	35.2	23.8	46.9	47.2	47.5	47.9	48.5	49.0	49.6	50.1	26.0	35.1
Concentrates fed, kg/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0							0.0	0.0
Concentrate DM fed, kg DM/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Estimated grass input	none	none	none	none	none	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	all – conc.	none	none
Estimated grass intake, kg/day	0.0	0.0	0.0	0.0	0.0	6.3	6.4	6.4	6.6	6.7	6.8	7.1	7.2		
Estimated silage intake, kg/day	7.4	7.3	7.2	7.1	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	7.1
Total DMI, kg/day	7.4	7.3	7.2	7.1	4.8	6.3	6.4	6.4	6.6	6.7	6.8	7.1	7.2	5.3	7.1
Concentrate intake, kg DM/period	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silage intake, kg/period	228	204	223	36	38	0	0	0	0	0	0	0	0	158	220
Pasture intake, kg/period	0	0	0	0	0	108	70	128	198	207	210	213	223	0	0
Gross energy intake, MJ/day	136	134	132	131	88	119	120	121	124	126	127	134	135	97	131
Feeding level	1.1	1.1	1.1	1.1	0.7									0.7	1.0
DEI, MJ/day	81	80	79	79	53									58	78
Methane output (Yan *et al.*, 2000), MJ/day	10.5	10.4	10.2	10.2	7.6									8.2	10.2
Methane output (0.065 of GEI), MJ/day						7.8	7.8	7.8	8.1	8.2	8.3	8.7	8.8		
Methane, kg/day	0.19	0.19	0.18	0.18	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.16	0.15	0.18
Methane/animal/month, kg	5.9	5.2	5.7	0.9	1.1	2.4	1.5	2.8	4.4	4.5	4.6	4.7	4.9	4.4	5.7
Methane, proportion of GEI	0.077	0.077	0.077	0.077	0.086	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.085	0.078
Estimated total OM intake, kg/day	6.7	6.6	6.5	6.5	4.4	5.8	5.9	5.9	6.1	6.1	6.2	6.5	6.6	4.8	6.4
Total diet DOMD, kg/day	4.2	4.2	4.1	4.1	2.7	4.7	4.7	4.7	4.7	4.8	4.9	4.8	4.9	3.0	4.1
OM excreted, kg/day	2.5	2.4	2.4	2.4	1.6	1.2	1.2	1.2	1.3	1.4	1.4	1.7	1.7	1.8	2.4
OM excreted, kg/month	77	68	75	12	13	20	13	24	40	42	42	51	53	53	74
OM excreted at pasture, kg/month						20	13	24	40	42	42	51	53		
OM excreted during housing, kg/month	77	68	75	12	13									53	74

Appendix 5 Explanation of Number of Heifers/Category for 2003

Category 1 – Early-maturing beef breed heifers slaughtered/died off grass at c. 18 months old.

Sum of females that were slaughtered or had died on farm in the months May to October, inclusive, and which were categorised as being 12–18 months old or 18–24 months old.

	12–18 months	18–24 months	Total
Slaughtered factory	23,896	36,540	60,436
Slaughtered abattoir	14,210	11,474	25,684
On-farm deaths	2,647	965	3,612
Total	40,753	48,979	89,732

Categories 2 and 3 – Late- and early-maturing beef breed heifers slaughtered/died at 21–26 months old after indoor feeding during second winter.

Sum of females that were slaughtered or had died on farm in the months November to April, inclusive, and which were categorised as being 18–24 months old or 24–30 months old, plus females that were slaughtered or had died in November–December and which were categorised as 12–18 months. These heifers were partitioned between late- and early-maturing beef breeds in a ratio of 0.67:0.33.

	12–18 months	18–24 months	24–30 months	Total
Slaughtered factory	4,964	131,517	44,957	181,438
Slaughtered abattoir	1,751	30,675	8,041	40,467
On-farm deaths	332	2,184	959	3,475
Total	7,047	164,376	53,957	225,380

Category 4 – Late-maturing beef breed heifers slaughtered/exported/died off grass at 24+ months old (i.e. third grazing season).

Sum of females that were slaughtered, exported or had died on farm in the months May to October, inclusive, and which were categorised as being 24–30 months old.

Slaughtered factory	95,513
Slaughtered abattoir	16,915
Exported live	1,501
On-farm deaths	1,568
Total	115,497

Category 5 – Late-maturing beef breed heifers slaughtered at less than 15 months of age.

Sum of females slaughtered at less than 12 months old plus females in the age category 12–18 months which were slaughtered during the months January to April inclusive.

	0-12 months	12-18 months	Total
Slaughtered factory	21,960	5,489	27,449
Slaughtered abattoir	4,064	3,568	7,632
Total	26,024	9,057	35,081

Categories 6 to 10.

Taken directly from CMMS statistics (2003).

Category 11 – Beef breed in-calf heifers.

Average of June and December survey (CSO, 2004).

Appendix 6 Explanation of Number of Male Beef Cattle/Category for 2003

Category 12 – Early-maturing beef breed cattle slaughtered/died off grass at c. 18 months old.

Sum of male cattle that were slaughtered or had died on farm in the months May to October, inclusive, and which were categorised as being 12–18 months old or 18–24 months old.

	12–18 months	18–24 months	Total
Slaughtered factory – beef	14,988	20,924	35,912
Slaughtered factory – dairy	4,128	5,651	9,779
On-farm deaths – beef	3,174	899	4,073
On-farm deaths – dairy	961	365	1,326
Total	23,251	27,839	51,090

Categories 13 and 14 – Late- and early-maturing beef breed cattle slaughtered/died at 21–26 months old after indoor feeding during second winter.

Sum of male cattle that were slaughtered or had died on farm in the months November to April, inclusive, that were categorised as being 18–24 months old or 24–30 months old, plus male cattle that were slaughtered or had died in November to December and which were categorised as 12–18 months. These male cattle were partitioned between late- and early-maturing beef breeds in a ratio of 0.2:0.8. Within the early-maturing cattle (i.e. Category 14) 0.4 were classified as pure Friesians, and the remainder were split 0.69:0.31 between cattle of suckler and dairy dams.

	12–18 months	18–24 months	24–30 months	Total
Slaughtered factory – beef	6,453	98,098	124,679	229,230
Slaughtered factory – dairy	1,815	37,864	3,570	43,249
On-farm deaths – beef	1,648	2,468	757	4,873
On-farm deaths – dairy	1,095	859	512	2,466
Total	11,011	139,289	129,518	279,818

Category 15 – Late-maturing beef breed cattle slaughtered/exported/died at 30+ months old after indoor feeding during third winter.

Sum of male cattle that were slaughtered, exported or had died on farm in the months November to April, inclusive, and which were categorised as being 30+ months old.

	30+ months
Slaughtered factory – beef	105,408
Slaughtered factory – dairy	19,800
On-farm deaths – beef	1,247
On-farm deaths – dairy	261
Exported – beef	245
Exported – dairy	14
Total	126,975

Category 16 – Late-maturing beef breed cattle slaughtered/exported/died off grass at 24+ months old (i.e. third grazing season).

Sum of male cattle that were slaughtered, exported or had died on farm in the months May to October, inclusive, and which were categorised as being 24–30 months old. 0.3 were classified as pure Friesians, and the remainder were split 0.69:0.31 between cattle of suckler and dairy dams.

	24–30 months	30+ months	Total
Slaughtered factory – beef	301,289	77,367	378,656
Slaughtered factory – dairy	71,884	24,659	96,543
On-farm deaths – beef	1,255	924	2,179
On-farm deaths – dairy	390	182	572
Total	374,818	103,132	477,950

Category 17 – Late-maturing beef breed cattle slaughtered as bulls at less than 15 months of age.

Sum of male cattle slaughtered at less than 12 months old plus male cattle in the age category 12–18 months that were slaughtered during the months January to April inclusive.

	0–12 months	12–18 months	Total
Slaughtered factory – beef	14,222	4,601	18,823
Slaughtered factory – dairy	2,017	1,251	3,268
Total	16,239	5,852	22,091

Categories 18 to 21.

Taken directly from CMMS statistics (2003).

Appendix 7 Coefficients Used for Calculating Maintenance Requirements of Beef Cattle

Maintenance requirement calculated by multiplying live weight (LW)$^{0.75}$ by the appropriate coefficient.

Maintenance requirement	
Females	
Growing Fr (UFL/kg LW$^{0.75}$)	0.0467
Growing Ch × Fr (UFL/kg LW$^{0.75}$)	0.0446
Growing Hr × Fr (UFL/kg LW$^{0.75}$)	0.0446
Growing Ch (UFL/kg LW$^{0.75}$)	0.0424
Finishing Fr (UFV/kg LW$^{0.75}$)	0.051
Finishing Ch × Fr (UFV/kg LW$^{0.75}$)	0.0486
Finishing Hr × Fr (UFV/kg LW$^{0.75}$)	0.0486
Finishing Ch (UFV/kg LW$^{0.75}$)	0.0469
Males	
Growing Fr (UFL/kg LW$^{0.75}$)	0.0467
Growing Ch × Fr (UFL/kg LW$^{0.75}$)	0.0446
Growing Hr × Fr (UFL/kg LW$^{0.75}$)	0.0446
Growing Ch (UFL/kg LW$^{0.75}$)	0.0424
Finishing Fr (UFV/kg LW$^{0.75}$)	0.051
Finishing Ch × Fr (UFV/kg LW$^{0.75}$)	0.0486
Finishing Hr × Fr (UFV/kg LW$^{0.75}$)	0.0486
Finishing Ch (UFV/kg LW$^{0.75}$)	0.0469

Appendix 8 Intake, Energy Requirements and Methane Emissions of Female Beef Cattle by Category

Category 1 – DAIRY Early-maturing beef breeds slaughtered off grass at c. 18 months.

	Calf stage	1st grazing season	1st winter	2nd grazing season
Start date	13 Mar	15 May	12 Nov	05 Apr
Days in month or period	63	180	144	133
Start weight, kg	50	60	270	360
Live-weight gain, kg/day	0.8	0.829	0.556	0.902
Live-weight gain/period, kg	50	149	80	120
End weight, kg	90	240	320	440
Average weight, kg	65	165	280	380
Diet				
Concentrates fed, kg/day			1.92	
Adjusted conc. level, kg DM/day		0.0	1.7	0.0
Energy required, MJ/day/day		26.7	32.9	50.7
Energy required, UFL/V/day		3.8	4.6	6.7
Grass intake, kg DM/day	0.0	3.7		6.8
Silage intake, kg DM/day from INRAtion			3.9	
Total DMI, kg/day		3.7	5.6	6.8
Total DMI, kg/period		669	799	904
Grass intake, kg DM/period		669	0	904
Silage intake, kg DM/period		0	562	0
Conc. intake, kg DM/period		0.00	238	0
Intake as % of body weight		2.25	1.99	1.79
DEI, MJ/day		52	72	98
GEI, MJ/day		70	104	128
Energy maintenance, MJ/day	7.3	14.6	21.7	31.8
Energy maintenance, UFL/V/day	1.0	2.1	3.0	4.2
Feeding level (multiples of maintenance)		1.8	1.5	1.6
Methane, MJ/day		4.5	7.5	8.3
Methane, kg/day		0.08	0.14	0.15
Methane, kg/period		14.7	19.5	19.9
Methane g/kg DM		22.0	24.4	22.0
Methane, proportion of GEI		0.065	0.073	0.065
Estimated total OM intake, kg/day		3.4	5.1	6.3
Total diet DOMD, kg/day		2.6	3.7	4.9
OM excreted, kg/day		0.8	1.4	1.3
OM excreted, kg/month		140	199	174
OM excreted at pasture, kg		140		174
OM excreted during housing, kg			199	

Category 1 – SUCKLER Early-maturing beef breeds slaughtered off grass at c. 18 months.

	Calf pre-turnout	Calf stage	1st winter	2nd grazing season
Start date	05 Apr	15 Apr	12 Nov	05 Apr
Days in month or period	10	211	144	133
Start weight, kg	50	60	270	360
Live-weight gain, kg/day	1	0.995	0.625	0.902
Live-weight gain/period, kg	10	210	90	120
End weight, kg	60	270	360	480
Average weight, kg		165	315	420
Diet				
Concentrates fed, kg/day			1.9	
Adjusted conc. level, kg DM/day		0.0	1.7	0.0
Energy required, MJ/day			39.2	54.8
Energy required, UFL/V/day			5.5	7.2
Grass intake, kg DM/day		2.2		7.4
Silage intake, kg DM/day from INRAtion			4.6	
Total DMI, kg/day		2.2	6.3	7.4
Total DMI, kg/period		464	900	978
Grass intake, kg DM/period		464	0	978
Silage intake, kg DM/period		0	662	0
Conc. intake, kg DM/period		0	238	0
Intake as % of body weight			1.98	1.75
DEI, MJ/day		31	81	105
GEI, MJ/day		41	117	138
Energy maintenance, MJ/day		14.6	23.7	34.3
Energy maintenance, UFL/V/day		2.1	3.3	4.5
Feeding level (multiples of maintenance)		0.00	1.65	1.60
Methane, MJ/day		2.7	8.4	9.0
Methane, kg/day		0.05	0.15	0.16
Methane, kg/period		10.2	21.6	21.5
Methane g/kg DM		22.0	24.0	22.0
Methane, proportion of GEI		0.065	0.072	0.065
Estimated total OM intake, kg/day		2.0	5.7	6.8
Total diet DOMD, kg/day		1.6	4.1	5.2
OM excreted, kg/day		0.5	1.6	1.5
OM excreted, kg/month		97	229	204
OM excreted at pasture, kg		97		204
OM excreted during housing, kg			229	

Category 2 – DAIRY Late-maturing beef breeds slaughtered at 21–26 months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter
Start date	13 Mar	15 May	12 Nov	05 Apr	12 Nov
Days in month or period	63	180	144	210	83
Start weight, kg	40	90	220	300	460
Live-weight gain, kg/day	0.8	0.718	0.556	0.762	0.723
Live-weight gain/period, kg	50	129	80	160	60
End weight, kg	90	220	300	460	520
Average weight, kg	65	155	260	380	490
Diet					
Concentrates fed, kg/day			1.9		3.5
Adjusted conc. level, kg DM/day	0.00	0.0	1.7	0.0	3.0
Energy required, MJ/day		23.0	29.6	50.5	53.3
Energy required, UFL/V/day		3.2	4.2	7.1	7.0
Grass intake, kg DM/day		3.2		7.0	
Silage intake, kg DM/day from INRAtion			3.3		5.2
Total DMI, kg/day		3.2	5.0	7.0	8.2
Total DMI, kg/period		578	713	1476	681
Grass intake, kg DM/period		578	0	1476	0
Silage intake, kg DM/period		0	475	0	432
Conc. intake, kg DM/period		0	238	0	250
Intake as % of body weight		2.07	1.91	1.85	1.68
DEI, MJ/day		45	62	99	108
GEI, MJ/day		60	91	132	153
Energy maintenance, MJ/day	7.28	13.9	20.5	27.3	38.5
Energy maintenance, UFL/V/day	1.02	2.0	2.9	3.8	5.1
Feeding level (multiples of maintenance)		1.65	1.45	1.85	1.38
Methane, MJ/day		3.9	6.4	8.6	11.9
Methane, kg/day		0.07	0.11	0.15	0.21
Methane, kg/period		12.7	16.6	32.4	17.7
Methane g/kg DM		22.0	23.2	22.0	26.0
Methane, proportion of GEI		0.065	0.070	0.065	0.078
Estimated total OM intake, kg/day		3.0	4.5	6.5	7.5
Total diet DOMD, kg/day		2.3	3.2	5.0	5.5
OM excreted, kg/day		0.7	1.3	1.5	2.0
OM excreted, kg/month		120	189	308	166
OM excreted at pasture, kg		120		308	
OM excreted during housing, kg			189		166

Category 2 – SUCKLER Late-maturing beef breeds slaughtered at 21–26 months.

	Calf pre-turnout	Calf stage	1st winter	2nd grazing season	2nd winter
Start date	05 Apr	15 Apr	12 Nov	05 Apr	12 Nov
Days in month or period	10	211	144	210	83
Start weight, kg	50	60	250	330	500
Live-weight gain, kg/day	1	0.9	0.556	0.81	0.964
Live-weight gain/period, kg	10	190	80	170	80
End weight, kg	60	250	330	500	580
Average weight, kg		155	290	415	540
Diet					
Concentrates fed, kg/day			1.9		3.5
Adjusted conc. level, kg DM/day		0.0	1.7	0.0	3.0
Energy required, MJ/day			30.4	52.4	59.6
Energy required, UFL/V/day			4.3	7.4	7.8
Grass intake, kg DM/day		2.0		7.3	
Silage intake, kg DM/day from INRAtion			3.4		6.3
Energy from theoretical conc., UFL/day					0.15
Adjusted silage intake, kg DM/day		0.0	3.4	0.0	6.5
Total DMI, kg/day		2.0	5.1	7.3	9.5
Total DMI, kg/period		422	727	1533	790
Grass intake, kg DM/period		422	0	1533	0
Silage intake, kg DM/period		0	490	0	540
Conc. intake, kg DM/period		0	238	0	250
Intake as % of body weight			1.74	1.76	1.76
DEI, MJ/day		28	63	103	124
GEI, MJ/day		38	93	137	178
Energy maintenance, MJ/day		13.2	21.2	27.7	36.1
Energy maintenance, UFL/V/day	0.00	1.9	3.0	3.9	4.8
Feeding level (multiples of maintenance)		0.00	1.44	1.89	1.65
Methane, MJ/day		2.4	6.6	8.9	13.4
Methane, kg/day		0.04	0.12	0.16	0.24
Methane, kg/period		9.3	17.0	33.7	20.0
Methane g/kg DM		22.0	23.4	22.0	25.3
Methane, proportion of GEI		0.065	0.071	0.065	0.075
Estimated total OM intake, kg/day		1.8	4.6	6.7	8.7
Total diet DOMD, kg/day		1.4	3.3	5.2	6.3
OM excreted, kg/day		0.4	1.3	1.5	2.4
OM excreted, kg/month		88	193	320	197
OM excreted at pasture, kg		88		320	
OM excreted during housing, kg			193		197

Category 3 – DAIRY Early-maturing beef breeds slaughtered at 21–26 months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter
Start date	13 Mar	15 May	12 Nov	05 Apr	12 Nov
Days in month or period	63	180	144	210	83
Start weight, kg	40	90	200	270	410
Live-weight gain, kg/day	0.8	0.608	0.486	0.667	0.723
Live-weight gain/period, kg	50	109	70	140	60
End weight, kg	90	200	270	410	470
Average weight, kg	65	145	235	340	440
Diet					
Concentrates fed, kg/day			1.9		3.5
Adjusted conc. level, kg DM/day	0.00	0.0	1.7	0.0	3.0
Energy required, MJ/day		21.3	26.9	44.3	54.8
Energy required, UFL/V/day		3.0	3.8	6.2	7.2
Grass intake, kg DM/day		3.0		6.2	
Silage intake, kg DM/day from INRAtion			2.7		5.3
Total DMI, kg/day		3.0	4.4	6.2	8.3
Total DMI, kg/period		535	627	1296	690
Grass intake, kg DM/period		535	0	1296	0
Silage intake, kg DM/period		0	389	0	440
Conc. intake, kg DM/period		0	238	0	250
Intake as % of body weight		2.05	1.85	1.82	1.89
DEI, MJ/day		42	55	88	109
GEI, MJ/day		56	80	116	155
Energy maintenance, MJ/day	7.3	13.3	19.0	25.1	35.5
Energy maintenance, UFL/V/day	1.0	1.9	2.7	3.5	4.7
Feeding level (multiples of maintenance)		1.61	1.42	1.76	1.54
Methane, MJ/day		3.6	5.5	7.5	11.7
Methane, kg/day		0.07	0.10	0.14	0.21
Methane, kg/period		11.7	14.3	28.5	17.4
Methane g/kg DM		22.0	22.9	22.0	25.3
Methane, proportion of GEI		0.065	0.069	0.065	0.075
Estimated total OM intake, kg/day		2.7	4.0	5.7	7.6
Total diet DOMD, kg/day		2.1	2.8	4.4	5.6
OM excreted, kg/day		0.6	1.1	1.3	2.0
OM excreted, kg/month		111	162	270	169
OM excreted at pasture, kg		111		270	
OM excreted during housing, kg			162		169

Category 3 – SUCKLER Early-maturing beef breeds slaughtered at 21–26 months.

	Calf pre-turnout	Calf stage	1st winter	2nd grazing season	2nd winter
Start date	05 Apr	15 Apr	12 Nov	05 Apr	12 Nov
Days in month or period	10	211	144	210	83
Start weight, kg	50	60	220	300	440
Live-weight gain, kg/day	1	0.758	0.556	0.667	0.843
Live-weight gain/period, kg	10	160	80	140	70
End weight, kg	60	220	300	440	510
Average weight, kg		140	260	370	475
Diet					
Concentrates fed, kg/day			1.9		3.5
Adjusted conc. level, kg DM/day		0.0	1.7	0.0	3.0
Energy required, MJ/day			30.9	49.1	54.4
Energy required, UFL/V/day			4.4	6.9	7.2
Grass intake, kg DM/day		1.8		6.9	
Silage intake, kg DM/day from INRAtion			3.51		5.6
Total DMI, kg/day		1.8	5.2	6.9	8.6
Total DMI, kg/period		380	743	1439	715
Grass intake, kg DM/period		380	0	1439	0
Silage intake, kg DM/period		0	505	0	465
Conc. intake, kg DM/period		0	238	0	250
Intake as % of body weight			1.99	1.85	1.81
DEI, MJ/day		25	65	97	113
GEI, MJ/day		34	95	129	161
Energy maintenance, MJ/day		12.9	20.5	26.8	37.6
Energy maintenance, UFL/V/day	0.00	1.8	2.9	3.8	4.9
Feeding level (multiples of maintenance)		0.00	1.51	1.84	1.45
Methane, MJ/day		2.2	6.6	8.4	12.4
Methane, kg/day		0.04	0.12	0.15	0.22
Methane, kg/period		8.3	17.0	31.6	18.5
Methane g/kg DM		22.0	22.9	22.0	25.9
Methane, proportion of GEI		0.065	0.069	0.065	0.077
Estimated total OM intake, kg/day		1.7	4.7	6.3	7.9
Total diet DOMD, kg/day		1.3	3.3	4.9	5.8
OM excreted, kg/day		0.4	1.4	1.4	2.1
OM excreted, kg/month		79	198	300	176
OM excreted at pasture, kg		79		300	
OM excreted during housing, kg			198		176

Category 4 – DAIRY Late-maturing beef breeds slaughtered off grass at 24+ months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter	3rd grazing season
Start date	13 Mar	15 May	12 Nov	05 Apr	12 Nov	05 Apr
Days in month or period	63	181	144	221	144	112
Start weight, kg	40	90	200	270	407	477
Live-weight gain, kg/day	0.8	0.608	0.486	0.619	0.486	0.83
Live-weight gain/period, kg	50	110	70	137	70	93
End weight, kg	90	200	270	407	477	570
Average weight, kg	65	145	235	339	442	524
Diet						
Concentrates fed, kg/day			1.9			
Adjusted conc. level, kg DM/day			1.7			
Energy required, MJ/day		20.9	26.2	39.1	41.5	59.2
Energy required, UFL/V/day		2.9	3.7	5.5	5.8	7.8
Grass intake, kg DM/day		2.9		5.4		7.9
Silage intake, kg DM/day from INRAtion			2.6		8	
Total DMI, kg/day		2.9	4.3	5.4	8.0	7.9
Total DMI, kg/period		528	612	1202	1152	889
Grass intake, kg DM/period		528	0	1202	0	889
Silage intake, kg DM/period		0	374	0	1152	0
Conc. intake, kg DM/period		0	238	0	0	0
Intake as % of body weight		2.00	1.81	1.61	1.81	1.52
DEI, MJ/day		41	54	77	93	112
GEI, MJ/day		55	78	102	147	149
Energy maintenance, MJ/day		13.3	19.1	25.0	30.6	40.5
Feeding level (multiples of maintenance)		1.57	1.37	1.56	1.36	1.46
Methane, MJ/day		3.6	5.5	6.6	11.3	9.7
Methane, kg/day		0.06	0.10	0.12	0.20	0.17
Methane, kg/period		11.6	14.2	26.4	29.3	19.5
Methane g/kg DM		22.0	23.2	22.0	25.4	22.0
Methane, proportion of GEI		0.065	0.070	0.065	0.077	0.065
Estimated total OM intake, kg/day		2.7	3.9	5.0	7.2	7.3
Total diet DOMD, kg/day		2.1	2.8	3.9	4.8	5.6
OM excreted, kg/day		0.6	1.1	1.1	2.5	1.7
OM excreted, kg/month		110	158	251	355	185
OM excreted at pasture, kg		110		251		185
OM excreted during housing, kg			158		355	

Category 4 – SUCKLER Late-maturing beef breeds slaughtered off grass at 24+ months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter	3rd grazing season
Start date	05 Apr	15 May	12 Nov	05 Apr	12 Nov	05 Apr
Days in month or period	10	211	144	221	144	112
Start weight, kg	50	60	220	300	458	528
Live-weight gain, kg/day	1	0.758	0.556	0.714	0.486	0.91
Live-weight gain/period, kg	10	160	80	158	70	102
End weight, kg	60	220	300	458	528	630
Average weight, kg	55	140	260	379	493	579
Diet						
Concentrates fed, kg/day			1.9			
Adjusted conc. level, kg DM/day	0.00	0.0	1.7	0.0	0.0	0.0
Energy required, MJ/day			28.1	43.1	44.1	69.1
Energy required, UFL/V/day			4.0	6.1	6.2	9.1
Grass intake, kg DM/day		2.0		6.0		9.7
Silage intake, kg DM/day from INRAtion			3		8.5	
Total DMI, kg/day		2.0	4.7	6.0	8.5	9.7
Total DMI, kg/period		422	670	1326	1224	1083
Grass intake, kg DM/period		422	0	1326	0	1083
Silage intake, kg DM/period		0	432	0	1224	0
Conc. intake, kg DM/period		0	238	0	0	0
Intake as % of body weight		1.43	1.79	1.58	1.72	1.67
DEI, MJ/day		28	59	85	99	136
GEI, MJ/day		38	86	113	156	182
Energy maintenance, MJ/day	6.1	12.3	19.5	25.9	31.5	42.1
Energy maintenance, UFL/V/day	0.9	1.7	2.7	3.6	4.4	5.5
Feeding level (multiples of maintenance)		0.00	1.44	1.66	1.40	1.64
Methane, MJ/day		2.4	6.0	7.3	12.0	11.8
Methane, kg/day		0.04	0.11	0.13	0.22	0.21
Methane, kg/period		9.3	15.4	29.1	31.0	23.8
Methane g/kg DM		22.0	23.0	22.0	25.4	22.0
Methane, proportion of GEI		0.065	0.069	0.065	0.077	0.065
Estimated total OM intake, kg/day		1.8	4.2	5.5	7.7	8.9
Total diet DOMD, kg/day		1.4	3.0	4.3	5.1	6.9
OM excreted, kg/day		0.4	1.2	1.3	2.6	2.0
OM excreted, kg/month		88	176	277	377	226
OM excreted at pasture, kg		88		277		226
OM excreted during housing, kg			176		377	

Category 5 – DAIRY Late beef breeds slaughtered at <15 months.

	Calf stage	1st grazing season	1st winter	1st winter, part 2
Start date	13 Mar	15 May	12 Nov	05 Apr
Days in month or period	63	180	144	51
Start weight, kg	40	90	240	330
Live-weight gain, kg/day	0.8	0.829	0.625	0.98
Live-weight gain/period, kg	50	149	90	50
End weight, kg	90	240	330	380
Average weight, kg	65	165	285	355
Diet				
Concentrates fed, kg/day		0.0	3.0	6.4
Adjusted conc. level, kg DM/day	0.00	0.0	2.6	5.5
Energy required, MJ/day		25.8	33.6	42.7
Energy required, UFL/V/day		3.6	4.7	6.0
Grass intake, kg DM/day		3.6		
Silage intake, kg DM/day from INRAtion			2.6	1.0
Total DMI, kg/day		3.6	5.2	6.5
Total DMI, kg/period		648	747	331
Grass intake, kg DM/period		648	0	0
Silage intake, kg DM/period		0	376	51
Conc. intake, kg DM/period		0	372	280
Intake as % of body weight		2.18	1.82	1.83
DEI, MJ/day		51	70	92
GEI, MJ/day		68	97	120
Energy maintenance, MJ/day	7.3	14.6	23.9	28.2
Energy maintenance, UFL/V/day	1.0	2.1	3.4	4.0
Feeding level (multiples of maintenance)		1.77	1.40	1.51
Methane, MJ/day		4.4	7.0	4.8
Methane, kg/day		0.08	0.13	0.09
Methane, kg/period		14.2	18.1	4.4
Methane g/kg DM		22.0	24.2	13.3
Methane, proportion of GEI		0.065	0.072	0.040
Estimated total OM intake, kg/day		3.3	4.8	6.0
Total diet DOMD, kg/day		2.6	3.6	4.7
OM excreted, kg/day		0.8	1.2	1.3
OM excreted, kg/month		135	173	64
OM excreted at pasture, kg		135		
OM excreted during housing, kg			173	64

Category 5 – SUCKLER Late beef breeds slaughtered at <15 months.

	Calf pre-turnout	Calf stage	1st winter	1st winter, part 2
Start date	05 Apr	15 Apr	12 Nov	05 Apr
Days in month or period	10	211	144	51
Start weight, kg	50	60	270	360
Live-weight gain, kg/day	1	0.995	0.625	1.176
Live-weight gain/period, kg	10	210	90	60
End weight, kg	60	270	360	420
Average weight, kg		165	315	390
Diet				
Concentrates fed, kg/day			3.0	7.5
Adjusted conc. level, kg DM/day		0.0	2.6	6.5
Energy required, MJ/day			34.0	53.3
Energy required, UFL/V/day			4.8	7.5
Grass intake, kg DM/day		2.2		
Silage intake, kg DM/day from INRAtion			2.6	1
Total DMI, kg/day		2.2	5.2	7.5
Total DMI, kg/period		464	746	380
Grass intake, kg DM/period		464	0	0
Silage intake, kg DM/period		0	374	51
Conc. intake, kg DM/period		0	372	329
Intake as % of body weight			1.64	1.91
DEI, MJ/day		31	68	106
GEI, MJ/day		41	95	138
Energy maintenance, MJ/day		13.9	22.5	29.3
Energy maintenance, UFL/V/day	0.00	2.0	3.2	4.1
Feeding level (multiples of maintenance)		0.00	1.51	1.82
Methane, MJ/day		2.7	6.5	5.5
Methane, kg/day		0.05	0.12	0.10
Methane, kg/period		10.2	16.8	5.0
Methane g/kg DM		22.0	22.6	13.3
Methane, proportion of GEI		0.065	0.068	0.040
Estimated total OM intake, kg/day		2.0	4.7	6.9
Total diet DOMD, kg/day		1.6	3.5	5.4
OM excreted, kg/day		0.5	1.3	1.5
OM excreted, kg/month		97	182	75
OM excreted at pasture, kg		97		
OM excreted during housing, kg			182	75

Category 11 – DAIRY Late-maturing beef breed replacements.

	Calf stage	1st grazing season	1st winter
Start date	13 Mar	15 May	12 Nov
Days in month or period	63	180	144
Start weight, kg	40	90	220
Live-weight gain, kg/day	0.8	0.718	0.556
Live-weight gain/period, kg	50	129	80
End weight, kg	90	220	300
Average weight, kg	65	155	260
Diet			
Concentrates fed, kg/day			1.9
Adjusted conc. level, kg DM/day	0.00	0.0	1.7
Energy required, MJ/day		23.0	29.6
Energy required, UFL/V/day		3.2	4.2
Grass intake, kg DM/day		3.2	
Silage intake, kg DM/day from INRAtion			3.3
Total DMI, kg/day		3.2	5.0
Total DMI, kg/period		578	713
Grass intake, kg DM/period		578	0
Silage intake, kg DM/period		0	475
Conc. intake, kg DM/period		0.00	238
Intake as % of body weight		2.07	1.91
DEI, MJ/day		45	62
GEI, MJ/day		60	91
Energy maintenance, MJ/day	7.3	13.9	20.5
Energy maintenance, UFL/V/day	1.0	2.0	2.9
Feeding level (multiples of maintenance)		1.65	1.45
Methane, MJ/day		3.9	6.4
Methane, kg/day		0.07	0.11
Methane, kg/period		12.7	16.6
Methane g/kg DM		22.0	23.2
Methane, proportion of GEI		0.065	0.070
Estimated total OM intake, kg/day		3.0	4.5
Total diet DOMD, kg/day		2.3	3.2
OM excreted, kg/day		0.7	1.3
OM excreted, kg/month		120	189
OM excreted at pasture, kg		120	
OM excreted during housing, kg			189

Category 11 – SUCKLER Late-maturing beef breed replacements.

	Calf stage	1st grazing season	1st winter
Start date	05 Apr	15 May	12 Nov
Days in month or period	10	211	144
Start weight, kg	50	60	250
Live-weight gain, kg/day	1	0.9	0.556
Live-weight gain/period, kg	10	190	80
End weight, kg	60	250	330
Average weight, kg		155	290
Diet			
Concentrates fed, kg/day			1.9
Adjusted conc. level, kg DM/day		0.0	1.7
Energy required, MJ/day			30.4
Energy required, UFL/V/day			4.3
Grass intake, kg DM/day		2.0	
Silage intake, kg DM/day from INRAtion			3.4
Total DMI, kg/day		2.0	5.1
Total DMI, kg/period		422	727
Grass intake, kg DM/period		422	0
Silage intake, kg DM/period		0	490
Conc. intake, kg DM/period		0.00	238
Intake as % of body weight			1.74
DEI, MJ/day		28	63
GEI, MJ/day		38	93
Energy maintenance, MJ/day		13.2	21.2
Energy maintenance, UFL/V/day		1.9	3.0
Feeding level (multiples of maintenance)		0.00	1.44
Methane, MJ/day		2.4	6.6
Methane, kg/day		0.04	0.12
Methane, kg/period		9.3	17.0
Methane g/kg DM		22.0	23.4
Methane, proportion of GEI		0.065	0.071
Estimated total OM intake, kg/day		1.8	4.6
Total diet DOMD, kg/day		1.4	3.3
OM excreted, kg/day		0.4	1.3
OM excreted, kg/month		88	193
OM excreted at pasture, kg		88	
OM excreted during housing, kg			193

Appendix 9 Intake, Energy Requirements and Methane Emissions of Male Beef Cattle by Category

Category 12 – DAIRY Early-maturing beef breeds slaughtered off grass at c. 18 months.

	Calf stage	1st grazing season	1st winter	2nd grazing season
Start date	13 Mar	15 May	12 Nov	05 Apr
Days in month or period	63	180	144	106
Start weight, kg	40	90	279	399
Live-weight gain, kg/day	0.8	1.05	0.833	1.038
Live-weight gain/period, kg	50	189	120	110
End weight, kg	90	279	399	509
Average weight, kg	65	185	339	454
Diet				
Concentrates fed, kg/day		0.0	1.9	
Adjusted conc. level, kg DM/day	0.0	0.0	1.7	0.0
Energy required, MJ/day		32.2	39.1	57.4
Energy required, UFL/V/day		4.5	5.5	7.5
Grass intake, kg DM/day		4.5		7.8
Adjusted silage intake, kg DM/day		0.00	5.10	0.00
Total DMI, kg/day		4.5	6.8	7.8
Total DMI, kg/period		807	972	828
Grass intake, kg DM/period		807	0	828
Silage intake, kg DM/period		0	734	0
Conc. intake, kg DM/period		0.00	238	0.00
Intake as % of body weight		2.42	1.99	1.72
DEI, MJ/day		63	87	112
GEI, MJ/day		84	126	147
Energy maintenance, MJ/day	7.3	15.9	25.1	36.4
Energy maintenance, UFL/V/day	1.0	2.2	3.5	4.8
Feeding level (multiples of maintenance)		2.03	1.56	1.58
Methane, MJ/day		5.5	9.4	9.5
Methane, kg/day		0.10	0.17	0.17
Methane, kg/period		17.7	24.3	18.2
Methane g/kg DM		22.0	25.0	22.0
Methane, proportion of GEI		0.065	0.074	0.065
Estimated total OM intake, kg/day		4.1	6.1	7.2
Total diet DOMD, kg/day		3.2	4.4	5.7
OM excreted, kg/day		0.9	1.7	1.5
OM excreted, kg/month		168	247	159
OM excreted at pasture, kg		168		159
OM excreted during housing, kg			247	

Category 12 – SUCKLER Early-maturing beef breeds slaughtered off grass at c. 18 months.

	Calf pre-turnout	Calf stage	1st winter	2nd grazing season
Start date	05 Apr	15 Apr	12 Nov	05 Apr
Days in month or period	10	211	144	106
Start weight, kg	50	60	320	440
Live-weight gain, kg/day	1	1.232	0.833	1.038
Live-weight gain/period, kg	10	260	120	110
End weight, kg	60	320	440	550
Average weight, kg		190	380	495
Diet				
Concentrates fed, kg/day			1.9	
Adjusted conc. level, kg DM/day		0.0	1.7	0.0
Energy required, MJ/day			42.7	62.6
Energy required, UFL/V/day			6.0	8.2
Grass intake, kg DM/day		2.2		8.6
Silage intake, kg DM/day from INRAtion			5.8	
Total DMI, kg/day		2.2	7.5	8.6
Total DMI, kg/period		464	1073	913
Grass intake, kg DM/period		464	0	913
Silage intake, kg DM/period		0	835	0
Conc. intake, kg DM/period		0.00	238	0.00
Intake as % of body weight			1.96	1.74
DEI, MJ/day		31	96	123
GEI, MJ/day		41	139	162
Energy maintenance, MJ/day		16.2	27.3	38.8
Energy maintenance, UFL/V/day	0.00	2.3	3.8	5.1
Feeding level (multiples of maintenance)		0.00	1.56	1.61
Methane, MJ/day		2.7	10.5	10.5
Methane, kg/day		0.05	0.19	0.19
Methane, kg/period		10.2	27.2	20.0
Methane g/kg DM		22.0	25.4	22.0
Methane, proportion of GEI		0.065	0.075	0.065
Estimated total OM intake, kg/day		2.0	6.8	7.9
Total diet DOMD, kg/day		1.6	4.9	6.1
OM excreted, kg/day		0.5	1.9	1.8
OM excreted, kg/month		97	278	190
OM excreted at pasture, kg		97		190
OM excreted during housing, kg			278	

Category 13 – DAIRY Late-maturing beef breeds slaughtered at 21–26 months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter
Start date	13 Mar	15 May	12 Nov	05 Apr	12 Nov
Days in month or period	63	180	144	210	100
Start weight, kg	40	90	240	320	500
Live-weight gain, kg/day	0.8	0.829	0.556	0.857	1
Live-weight gain/period, kg	50	149	80	180	100
End weight, kg	90	240	320	500	600
Average weight, kg	65	165	280	410	550
Diet					
Concentrates fed, kg/day			1.9		4.7
Adjusted conc. level, kg DM/day	0.00	0.0	1.7	0.0	4.0
Energy required, MJ/day		25.6	30.8	57.9	64.2
Energy required, UFL/V/day		3.6	4.3	8.1	8.4
Grass intake, kg DM/day		3.6		8.1	
Silage intake, kg DM/day from INRAtion			3.5		5.9
Energy from theoretical conc., UFL/day					0.1
Adjusted silage intake, kg DM/day		0.0	3.5	0.0	6.1
Total DMI, kg/day		3.6	5.2	8.1	10.1
Total DMI, kg/period		642	742	1693	1008
Grass intake, kg DM/period		642	0	1693	0
Silage intake, kg DM/period		0	504	0	607
Conc. intake, kg DM/period		0	238	0	402
Intake as % of body weight		2.16	1.84	1.97	1.83
DEI, MJ/day		50	64	114	133
GEI, MJ/day		67	95	152	188
Energy maintenance, MJ/day	7.3	14.6	21.7	28.9	42.0
Energy maintenance, UFL/V/day	1.0	2.1	3.0	4.1	5.5
Feeding level (multiples of maintenance)		1.75	1.42	2.00	1.53
Methane, MJ/day		4.4	6.8	9.8	14.4
Methane, kg/day		0.08	0.12	0.18	0.26
Methane, kg/period		14.1	17.5	37.2	25.9
Methane g/kg DM		22.0	23.6	22.0	25.7
Methane, proportion of GEI		0.065	0.071	0.065	0.077
Estimated total OM intake, kg/day		3.3	4.7	7.4	9.2
Total diet DOMD, kg/day		2.5	3.3	5.7	6.8
OM excreted, kg/day		0.7	1.4	1.7	2.4
OM excreted, kg/month		134	198	353	243
OM excreted at pasture, kg		134		353	
OM excreted during housing, kg			198		243

Category 13 – SUCKLER Late-maturing beef breeds slaughtered at 21–26 months.

	Calf pre-turnout	Calf stage	1st winter	2nd grazing season – part 1	2nd winter
Start date	05 Apr	15 Apr	12 Nov	05 Apr	12 Nov
Days in month or period	10	211	144	210	100
Start weight, kg	50	60	300	380	560
Live-weight gain, kg/day	1	1.137	0.556	0.857	1
Live-weight gain/period, kg	10	240	80	180	100
End weight, kg	60	300	380	560	660
Average weight, kg		180	340	470	610
Diet					
Concentrates fed, kg/day			1.9		4.7
Adjusted conc. level, kg DM/day		0.0	1.7	0.0	4.0
Energy required, MJ/day			34.0	61.3	65.6
Energy required, UFL/V/day			4.8	8.6	8.6
Grass intake, kg DM/day		2.0		8.5	
Energy maint. underestimate				0.1	
Additional grass req., kg/day				0.1	
Total grass intake, kg/day		2.0		8.6	
Silage intake, kg DM/day from INRAtion			4.1		5.8
Energy from theoretical conc., UFL/day					0.36
Adjusted silage intake, kg DM/day		0.0	4.1	0.0	6.3
Total DMI, kg/day		2.0	5.8	8.6	10.3
Total DMI, kg/period		422	828	1815	1031
Grass intake, kg DM/period		422	0	1815	0
Silage intake, kg DM/period		0	590	0	630
Conc. intake, kg DM/period		0	238	0	402
Intake as % of body weight			1.69	1.84	1.69
DEI, MJ/day		28	71	122	136
GEI, MJ/day		38	106	163	192
Energy maintenance, MJ/day		14.8	23.9	30.4	43.8
Energy maintenance, UFL/V/day	0.00	2.1	3.4	4.3	5.8
Feeding level (multiples of maintenance)		0.00	1.42	2.01	1.50
Methane, MJ/day		2.4	7.7	10.6	14.9
Methane, kg/day		0.04	0.14	0.19	0.27
Methane, kg/period		9.3	19.8	39.9	26.7
Methane g/kg DM		22.0	24.0	22.0	25.9
Methane, proportion of GEI		0.065	0.072	0.065	0.077
Estimated total OM intake, kg/day		1.8	5.2	8.0	9.4
Total diet DOMD, kg/day		1.4	3.7	6.1	7.0
OM excreted, kg/day		0.4	1.6	1.8	2.5
OM excreted, kg/month		88	224	379	249
OM excreted at pasture, kg		88		379	
OM excreted during housing, kg			224		249

Category 14 – DAIRY Early-maturing beef breeds slaughtered at 21–26 months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter
Start date	13 Mar	15 May	12 Nov	05 Apr	12 Nov
Days in month or period	63	180	144	210	100
Start weight, kg	40	90	230	300	470
Live-weight gain, kg/day	0.8	0.773	0.486	0.81	0.9
Live-weight gain/period, kg	50	139	70	170	90
End weight, kg	90	230	300	470	560
Average weight, kg	65	160	265	385	515
Diet					
Concentrates fed, kg/day			1.9		4.7
Adjusted conc. level, kg DM/day	0.00	0.0	1.7	0.0	4.0
Energy required, MJ/day		25.0	29.2	53.8	60.5
Energy required, UFL/V/day		3.5	4.1	7.6	8.0
Grass intake, kg DM/day		3.5		7.5	
Silage intake, kg DM/day from INRAtion			3.2		5.2
Total DMI, kg/day		3.5	4.9	7.5	9.2
Total DMI, kg/period		626	699	1575	922
Grass intake, kg DM/period		626	0	1575	0
Silage intake, kg DM/period		0	461	0	520
Conc. intake, kg DM/period		0	238	0	402
Intake as % of body weight		2.17	1.83	1.95	1.79
DEI, MJ/day		49	61	108	123
GEI, MJ/day		65	89	141	172
Energy maintenance, MJ/day	7.3	14.3	20.8	27.5	40.0
Energy maintenance, UFL/V/day	1.0	2.0	2.9	3.9	5.3
Feeding level (multiples of maintenance)		1.75	1.40	1.95	1.51
Methane, MJ/day		4.3	6.3	9.2	13.0
Methane, kg/day		0.08	0.11	0.16	0.23
Methane, kg/period		13.8	16.4	34.6	23.4
Methane g/kg DM		22.0	23.5	22.0	25.4
Methane, proportion of GEI		0.065	0.071	0.065	0.076
Estimated total OM intake, kg/day		3.2	4.4	6.9	8.5
Total diet DOMD, kg/day		2.5	3.1	5.3	6.3
OM excreted, kg/day		0.7	1.3	1.6	2.2
OM excreted, kg/month		131	185	328	219
OM excreted at pasture, kg		131		328	
OM excreted during housing, kg			185		219

Category 14 – SUCKLER Early-maturing beef breeds slaughtered at 21–26 months.

	Calf pre-turnout	Calf stage	1st winter	2nd grazing season	2nd winter
Start date	05 Apr	15 Apr	12 Nov	05 Apr	12 Nov
Days in month or period	10	211	144	210	100
Start weight, kg	50	60	260	330	510
Live-weight gain, kg/day	1	0.948	0.486	0.857	0.9
Live-weight gain/period, kg	10	200	70	180	90
End weight, kg	60	260	330	510	600
Average weight, kg		160	295	420	555
Diet					
Concentrates fed, kg/day			1.9		4.7
Adjusted conc. level, kg DM/day		0.0	1.7	0.0	4.0
Energy required, MJ/day			31.9	57.5	65.7
Energy required, UFL/V/day			4.5	8.1	8.6
Grass intake, kg DM/day		1.8		8.0	
Energy maint. underestimate				0.2	
Additional grass req., kg/day				0.2	
Total grass intake, kg/day		1.8		8.2	
Silage intake, kg DM/day from INRAtion			3.7		6.2
Energy from theoretical conc., UFL/day					0.07
Adjusted silage intake, kg DM/day		0.0	3.7	0.0	6.3
Total DMI, kg/day		1.8	5.4	8.2	10.3
Total DMI, kg/period		380	771	1726	1031
Grass intake, kg DM/period		380	0	1726	0
Silage intake, kg DM/period		0	533	0	630
Conc. intake, kg DM/period		0	238	0	402
Intake as % of body weight			1.81	1.96	1.86
DEI, MJ/day		25	67	116	136
GEI, MJ/day		34	99	155	192
Energy maintenance, MJ/day		14.3	22.6	29.4	42.3
Energy maintenance, UFL/V/day		2.0	3.2	4.1	5.6
Feeding level (multiples of maintenance)		0.00	1.41	1.95	1.55
Methane, MJ/day		2.2	7.1	10.0	14.7
Methane, kg/day		0.04	0.13	0.18	0.26
Methane, kg/period		8.3	18.3	37.9	26.5
Methane g/kg DM		22.0	23.8	22.0	25.7
Methane, proportion of GEI		0.065	0.072	0.065	0.077
Estimated total OM intake, kg/day		1.7	4.9	7.6	9.4
Total diet DOMD, kg/day		1.3	3.4	5.8	7.0
OM excreted, kg/day		0.4	1.4	1.7	2.5
OM excreted, kg/month		79	207	360	250
OM excreted at pasture, kg		79		360	
OM excreted during housing, kg			207		250

Category 14 – DAIRY FRIESIANS slaughtered at 21–26 months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter
Start date	13 Mar	15 May	12 Nov	05 Apr	12 Nov
Days in month or period	63	180	144	210	100
Start weight, kg	40	90	230	300	470
Live-weight gain, kg/day	0.8	0.773	0.486	0.81	0.9
Live-weight gain/period, kg	50	139	70	170	90
End weight, kg	90	230	300	470	560
Average weight, kg	65	160	265	385	515
Diet					
Concentrates fed, kg/day			1.9		4.7
Adjusted conc. level, kg DM/day	0.00	0.0	1.7	0.0	4.0
Energy required, MJ/day		25.2	29.9	54.2	62.3
Energy required, UFL/V/day		3.6	4.2	7.6	8.2
Grass intake, kg DM/day		3.5		7.6	
Silage intake, kg DM/day from INRAtion			3.3		5.54
Energy from theoretical conc., UFL/day					
Adjusted silage intake, kg DM/day		0.0	3.3	0.0	5.5
Total DMI, kg/day		3.5	5.0	7.6	9.6
Total DMI, kg/period		632	713	1586	956
Grass intake, kg DM/period		632	0	1586	0
Silage intake, kg DM/period		0	475	0	554
Conc. intake, kg DM/period		0	238	0	402
Intake as % of body weight		2.19	1.87	1.96	1.86
DEI, MJ/day		49	62	108	127
GEI, MJ/day		66	91	142	178
Energy maintenance, MJ/day	7.3	14.9	21.8	28.8	41.9
Energy maintenance, UFL/V/day	1.0	2.1	3.1	4.1	5.5
Feeding level (multiples of maintenance)		1.69	1.37	1.88	1.49
Methane, MJ/day		4.3	6.6	9.2	13.6
Methane, kg/day		0.08	0.12	0.17	0.25
Methane, kg/period		13.9	17.0	34.8	24.5
Methane g/kg DM		22.0	23.8	22.0	25.7
Methane, proportion of GEI		0.065	0.072	0.065	0.077
Estimated total OM intake, kg/day		3.2	4.5	6.9	8.8
Total diet DOMD, kg/day		2.5	3.2	5.4	6.5
OM excreted, kg/day		0.7	1.3	1.6	2.3
OM excreted, kg/month		132	189	331	228
OM excreted at pasture, kg		132		331	
OM excreted during housing, kg			189		228

Category 15 – DAIRY Late-maturing beef breeds slaughtered at 30+ months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter	3rd grazing season	3rd winter
Start date	13 Mar	15 May	12 Nov	05 Apr	12 Nov	05 Apr	12 Nov
Days in month or period	63	181	144	221	144	221	54
Start weight, kg	40	90	230	290	448	498	675
Live-weight gain, kg/day	0.8	0.773	0.417	0.714	0.347	0.8	0.8
Live-weight gain/period, kg	50	140	60	158	50	177	43
End weight, kg	90	230	290	448	498	675	718
Average weight, kg	65	160	260	369	473	587	697
Diet							
Concentrates fed, kg/day			1.9				3.8
Adjusted conc. level, kg DM/day	0.00	0.0	1.7	0.0	0.0	0.0	3.3
Energy required, MJ/day		24.3	26.7	42.0	39.5	63.6	74.2
Energy required, UFL/V/day		3.4	3.8	5.9	5.6	8.9	9.8
Grass intake, kg DM/day		3.4		6.2		9.6	
Silage intake, kg DM/day from INRAtion			2.7		7.6		7.7
Energy from theoretical conc., UFL/day							0.98
Adjusted silage intake, kg DM/day		0.0	2.7	0.0	7.6	0.0	9.0
Total DMI, kg/day		3.4	4.4	6.2	7.6	9.6	12.3
Total DMI, kg/period		612	627	1375	1098	2122	664
Grass intake, kg DM/period		612	0	1375	0	2122	0
Silage intake, kg DM/period		0	389	0	1098	0	489
Conc. intake, kg DM/period		0	238	0	0	0	176
Intake as % of body weight		2.11	1.67	1.68	1.61	1.64	1.77
DEI, MJ/day		48	55	89	88	135	159
GEI, MJ/day		64	80	117	140	180	230
Energy maintenance, MJ/day	7.3	14.3	20.6	26.7	32.2	41.2	50.1
Energy maintenance, UFL/V/day	1.0	2.0	2.9	3.8	4.5	5.8	6.6
Feeding level (multiples of maintenance)		1.70	1.30	1.57	1.23	1.54	1.48
Methane, MJ/day		4.1	5.8	7.6	11.0	11.7	18.3
Methane, kg/day		0.07	0.10	0.14	0.20	0.21	0.33
Methane, kg/period		13.4	15.0	30.2	28.6	46.6	17.8
Methane g/kg DM		22.0	24.0	22.0	26.0	22.0	26.7
Methane, proportion of GEI		0.065	0.073	0.065	0.079	0.065	0.080
Estimated total OM intake, kg/day		3.1	4.0	5.7	6.9	8.8	11.2
Total diet DOMD, kg/day		2.4	2.8	4.4	4.6	6.8	8.1
OM excreted, kg/day		0.7	1.1	1.3	2.3	2.0	3.1
OM excreted, kg/month		128	162	287	338	442	169
OM excreted at pasture, kg		128		287		442	
OM excreted during housing, kg			162		338		169

Category 15 – SUCKLER Late-maturing beef breeds slaughtered at 30+ months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter	3rd grazing season	3rd winter
Start date	05 Apr	15 May	12 Nov	05 Apr	12 Nov	05 Apr	12 Nov
Days in month or period	10	211	144	221	144	221	54
Start weight, kg	50	60	280.1	350.2	508	558	735
Live-weight gain, kg/day	1	1.043	0.487	0.714	0.347	0.8	0.8
Live-weight gain/period, kg	10	220	70	158	50	177	43
End weight, kg	60	280	350	508	558	735	778
Average weight, kg	55	170	315	429	533	646	756
Diet							
Concentrates fed, kg/day			1.9				3.8
Adjusted conc. level, kg DM/day	0.0	0.0	1.7	0.0	0.0	0.0	3.3
Energy required, MJ/day			30.6	48.7	41.5	71.1	75.7
Energy required, UFL/V/day			4.3	6.9	5.8	10.0	10.0
Grass intake, kg DM/day		2.0		6.8		10.2	
Silage intake, kg DM/day from INRAtion			3.4		8		7.7
Energy from theoretical conc., UFL/day							1.01
Adjusted silage intake, kg DM/day		0.0	3.4	0.0	8.0	0.0	9.1
Total DMI, kg/day		2.0	5.1	6.8	8.0	10.2	12.3
Total DMI, kg/period		422	727	1498	1152	2254	666
Grass intake, kg DM/period		422	0	1498	0	2254	0
Silage intake, kg DM/period		0	490	0	1152	0	491
Conc. intake, kg DM/period		0	238	0	0	0	176
Intake as % of body weight		1.18	1.60	1.58	1.50	1.58	1.63
DEI, MJ/day		28	63	96	93	144	160
GEI, MJ/day		38	93	127	147	192	231
Energy maintenance, MJ/day	6.1	14.2	22.5	28.4	33.4	42.7	51.5
Energy maintenance, UFL/V/day	0.9	2.0	3.2	4.0	4.7	6.0	6.8
Feeding level (multiples of maintenance)			1.36	1.71	1.24	1.66	1.47
Methane, MJ/day		2.4	6.8	8.3	11.6	12.5	18.4
Methane, kg/day		0.04	0.12	0.15	0.21	0.22	0.33
Methane, kg/period		9.3	17.5	32.9	30.0	49.5	17.8
Methane g/kg DM		22.0	24.0	22.0	26.0	22.0	26.8
Methane, proportion of GEI		0.065	0.073	0.065	0.079	0.065	0.080
Estimated total OM intake, kg/day		1.8	4.6	6.2	7.2	9.4	11.3
Total diet DOMD, kg/day		1.4	3.3	4.8	4.8	7.3	8.1
OM excreted, kg/day		0.4	1.3	1.4	2.5	2.1	3.1
OM excreted, kg/month		88	193	312	355	470	170
OM excreted at pasture, kg		88		312		470	
OM excreted during housing, kg			193		355		170

Category 16 – DAIRY Late-maturing beef breeds slaughtered off grass at 24+ months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter	3rd grazing season
Start date	13 Mar	15 May	12 Nov	05 Apr	12 Nov	05 Apr
Days in month or period	63	181	144	221	144	129
Start weight, kg	40	90	240	300	469	519
Live-weight gain, kg/day	0.8	0.829	0.417	0.762	0.347	0.853
Live-weight gain/period, kg	50	150	60	168	50	110
End weight, kg	90	240	300	469	519	629
Average weight, kg	65	165	270	385	494	574
Diet						
Concentrates fed, kg/day			1.9			
Adjusted conc. level, kg DM/day			1.7			
Energy required, UFL/V/day		25.7	27.4	46.0	41.5	58.2
Energy required, UFL/V/day		3.6	3.9	6.5	5.8	8.2
Grass intake, kg DM/day		3.6		6.8		8.7
Silage intake, kg DM/day from INRAtion			2.8		8	
Total DMI, kg/day		3.6	4.5	6.8	8.0	8.7
Total DMI, kg/period		648	641	1505	1152	1127
Grass intake, kg DM/period		648	0	1505	0	1127
Silage intake, kg DM/period		0	403	0	1152	0
Conc. intake, kg DM/period		0	238	0	0	0
Intake as % of body weight		2.16	1.65	1.77	1.62	1.52
DEI, MJ/day		50	56	96	93	123
GEI, MJ/day		67	82	128	147	164
Energy maintenance, MJ/day	7.3	14.6	21.1	27.5	33.2	40.5
Energy maintenance, UFL/V/day	1.0	2.1	3.0	3.9	4.7	5.7
Feeding level (multiples of maintenance)		1.75	1.30	1.67	1.25	1.44
Methane, MJ/day		4.4	6.0	8.3	11.6	10.7
Methane, kg/day		0.08	0.11	0.15	0.21	0.19
Methane, kg/period		14.2	15.4	33.0	29.9	24.7
Methane g/kg DM		22.0	24.1	22.0	26.0	22.0
Methane, proportion of GEI		0.065	0.073	0.065	0.079	0.065
Estimated total OM intake, kg/day		3.3	4.1	6.3	7.2	8.0
Total diet DOMD, kg/day		2.5	2.9	4.8	4.8	6.2
OM excreted, kg/day		0.7	1.2	1.4	2.5	1.8
OM excreted, kg/month		135	167	314	355	235
OM excreted at pasture, kg		135		314		235
OM excreted during housing, kg			167		355	

Category 16 – SUCKLER Late-maturing beef breeds slaughtered off grass at 24+ months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter	3rd grazing season
Start date	05 Apr	15 May	12 Nov	05 Apr	12 Nov	05 Apr
Days in month or period	10	211	144	221	144	129
Start weight, kg	50	60	300	360	528	578
Live-weight gain, kg/day	1	1.137	0.417	0.762	0.347	0.853
Live-weight gain/period, kg	10	240	60	168	50	110
End weight, kg	60	300	360	528	578	688
Average weight, kg	55	180	330	444	553	633
Diet						
Concentrates fed, kg/day			1.9			
Adjusted conc. level, kg DM/day	0.00	0.0	1.7	0.0	0.0	0.0
Energy required, MJ/day			30.3	53.7	44.1	59.2
Energy required, UFL/V/day			4.3	7.6	6.2	8.3
Grass intake, kg DM/day		2.0		7.5		8.9
Silage intake, kg DM/day from INRAtion			3.4		8.5	
Total DMI, kg/day		2.0	5.1	7.5	8.5	8.9
Total DMI, kg/period		422	727	1653	1224	1146
Grass intake, kg DM/period		422	0	1653	0	1146
Silage intake, kg DM/period		0	490	0	1224	0
Conc. intake, kg DM/period		0	238	0	0	0
Intake as % of body weight		1.11	1.53	1.68	1.54	1.40
DEI, MJ/day		28	63	105	99	125
GEI, MJ/day		38	93	141	156	167
Energy maintenance, MJ/day	6.1	14.8	23.3	29.2	34.4	42.1
Energy maintenance, UFL/V/day	0.9	2.1	3.3	4.1	4.8	5.9
Feeding level (multiples of maintenance)			1.30	1.84	1.28	1.41
Methane, MJ/day		2.4	6.9	9.1	12.3	10.9
Methane, kg/day		0.04	0.12	0.16	0.22	0.20
Methane, kg/period		9.3	17.8	36.3	31.7	25.2
Methane g/kg DM		22.0	24.5	22.0	25.9	22.0
Methane, proportion of GEI		0.065	0.074	0.065	0.078	0.065
Estimated total OM intake, kg/day		1.8	4.6	6.9	7.7	8.2
Total diet DOMD, kg/day		1.4	3.3	5.3	5.1	6.3
OM excreted, kg/day		0.4	1.3	1.6	2.6	1.9
OM excreted, kg/month		88	193	345	377	239
OM excreted at pasture, kg		88		345		239
OM excreted during housing, kg			193		377	

Category 16 – DAIRY FRIESIANS slaughtered off grass at 24+ months.

	Calf stage	1st grazing season	1st winter	2nd grazing season	2nd winter	3rd grazing season
Start date	13 Mar	15 May	12 Nov	05 Apr	12 Nov	05 Apr
Days in month or period	63	181	144	221	144	129
Start weight, kg	40	90	240	300	469	519
Live-weight gain, kg/day	0.8	0.829	0.417	0.762	0.347	0.853
Live-weight gain/period, kg	50	150	60	168	50	110
End weight, kg	90	240	300	469	519	629
Average weight, kg	65	165	270	385	494	574
Diet						
Concentrates fed, kg/day			1.9			
Adjusted conc. level, kg DM/day			1.7			
Energy required, MJ/day		26.7	29.0	54.5	41.5	63.5
Energy required, UFL/V/day		3.8	4.1	7.7	5.8	8.9
Grass intake, kg DM/day		3.7		7.6		9.7
Silage intake, kg DM/day from INRAtion			3.1		8	
Total DMI, kg/day		3.7	4.8	7.6	8.0	9.7
Total DMI, kg/period		673	684	1677	1152	1245
Grass intake, kg DM/period		673	0	1677	0	1245
Silage intake, kg DM/period		0	446	0	1152	0
Conc. intake, kg DM/period		0.00	238	0.00	0.00	0.00
Intake as % of body weight		2.25	1.76	1.97	1.62	1.68
DEI, MJ/day		52.4	59.9	106.9	92.7	136.0
GEI, MJ/day		69.9	87.5	142.7	147.2	181.4
Energy maintenance, MJ/day	7.6	15.3	22.1	28.8	34.8	42.5
Energy maintenance, UFL/V/day	1.1	2.2	3.1	4.1	4.9	6.0
Feeding level (multiples of maintenance)		1.74	1.31	1.89	1.19	1.49
Methane, MJ/day		4.5	6.4	9.3	11.7	11.8
Methane, kg/day		0.08	0.12	0.17	0.21	0.21
Methane, kg/period		14.8	16.6	36.8	30.3	27.3
Methane g/kg DM		22.0	24.2	22.0	26.3	22.0
Methane, proportion of GEI		0.065	0.073	0.065	0.080	0.065
Estimated total OM intake, kg/day		3.4	4.3	7.0	7.2	8.9
Total diet DOMD, kg/day		2.6	3.1	5.4	4.8	6.9
OM excreted, kg/day		0.8	1.3	1.6	2.5	2.0
OM excreted, kg/month		140	180	350	355	260
OM excreted at pasture, kg		140		350		260
OM excreted during housing, kg			180		355	

Category 17 – DAIRY Late beef breeds slaughtered at <15 months.

	Calf stage	1st grazing season	1st winter	1st winter, part 2
Start date	13 Mar	15 May	12 Nov	05 Apr
Days in month or period	63	180	144	54
Start weight, kg	40	90	279	399
Live-weight gain, kg/day	0.8	1.05	0.833	1.224
Live-weight gain/period, kg	50	189	120	66
End weight, kg	90	279	399	465
Average weight, kg	65	185	339	432
Diet				
Concentrates fed, kg/day		0.0	3.0	8.1
Adjusted conc. level, kg DM/day	0.00	0.0	2.6	7.0
Energy required, MJ/day		32.2	49.1	56.2
Energy required, UFL/V/day		4.5	6.9	7.4
Grass intake, kg DM/day		4.5		
Silage intake, kg DM/day from INRAtion			2	1
Adjusted silage intake, kg DM/day		0.0	3.2	1.0
Total DMI, kg/day		4.5	5.7	8.0
Total DMI, kg/period		807	827	430
Grass intake, kg DM/period		807	0	0
Silage intake, kg DM/period		0	455	54
Conc. intake, kg DM/period		0	372	376
Intake as % of body weight		2.42	1.69	1.84
DEI, MJ/day		63	77	113
GEI, MJ/day		84	107	147
Energy maintenance, MJ/day	7.3	15.9	27.3	35.1
Energy maintenance, UFL/V/day	1.0	2.2	3.8	4.6
Feeding level (multiples of maintenance)		2.03	1.80	1.60
Methane, MJ/day		5.5	7.0	5.9
Methane, kg/day		0.10	0.13	0.11
Methane, kg/period		17.7	18.1	5.7
Methane g/kg DM		22.0	21.9	13.3
Methane, proportion of GEI		0.065	0.065	0.040
Estimated total OM intake, kg/day		4.1	5.3	7.4
Total diet DOMD, kg/day		3.2	3.9	5.8
OM excreted, kg/day		0.9	1.4	1.5
OM excreted, kg/month		168	195	83
OM excreted at pasture, kg		168		
OM excreted during housing, kg			195	83

Category 17 – SUCKLER Late beef breeds slaughtered at <15 months.

	Calf pre-turnout	Calf stage	1st winter	1st winter, part 2
Start date	05 Apr	15 Apr	12 Nov	05 Apr
Days in month or period	10	211	144	54
Start weight, kg	50	60	330	460
Live-weight gain, kg/day	1	1.28	0.903	1.384
Live-weight gain/period, kg	10	270	130	75
End weight, kg	60	330	460	535
Average weight, kg		195	395	497
Diet				
Concentrates fed, kg/day			5.0	8.6
Adjusted conc. level, kg DM/day		0.0	4.3	7.4
Energy required, MJ/day			50.8	62.4
Energy required, UFL/V/day			7.2	8.2
Grass intake, kg DM/day		2.2		
Silage intake, kg DM/day from INRAtion			3.2	0.8
Total DMI, kg/day		2.2	7.5	8.2
Total DMI, kg/period		464	1076	440
Grass intake, kg DM/period		464	0	0
Silage intake, kg DM/period		0	456	43
Conc. intake, kg DM/period		0	619	397
Intake as % of body weight			1.89	1.64
DEI, MJ/day		31	99	116
GEI, MJ/day		41	138	151
Energy maintenance, MJ/day		15.7	26.7	37.6
Energy maintenance, UFL/V/day		2.2	3.8	4.9
Feeding level (multiples of maintenance)		0.00	1.90	1.66
Methane, MJ/day		2.7	8.9	6.0
Methane, kg/day		0.05	0.16	0.11
Methane, kg/period		10.2	23.0	5.8
Methane g/kg DM		22.0	21.4	13.3
Methane, proportion of GEI		0.065	0.065	0.040
Estimated total OM intake, kg/day		2.0	6.9	7.5
Total diet DOMD, kg/day		1.6	5.1	6.0
OM excreted, kg/day		0.5	1.7	1.6
OM excreted, kg/month		97	251	84
OM excreted at pasture, kg		97		
OM excreted during housing, kg			251	84