Based on a review of other energy systems (e.g., ARC, 1980), a linear relationship between digestible energy and net energy was derived for digestibilities below 65 per cent as follows (see Appendix C):

EQUATION 11

$$NE/DE = 0.298 + (0.00335 \times DE\%)$$

EQUATION 12

$$NE_g/DE = -0.036 + (0.00535 \times DE\%)$$

Given the estimates for feed digestibility (from Step 1) and equations 9 through 12, the gross energy intake (GE in MJ/day) can be estimated as follows:

EQUATION 13

$$GE = \frac{\left(NE_m + NE_{feed} + NE_l + NE_{draft} + NE_{pregnancy}\right) \times \left(100 / DE\%\right)}{\left(NE / DE\right) + \left(NE_g / \{NE_g / DE\}\right)}$$

where:

{NE/DE} is computed from equation 9 for digestibility greater than 65 per cent and from equation 11 for digestibility less than or equal to 65 per cent;

{NE_g/DE} is computed from equation 10 for digestibility greater than 65 per cent and from equation 12 for digestibility less than or equal to 65 per cent; and

DE% is digestibility in per cent (e.g., 60%).

To check the estimate of daily gross energy intake from Equation 13, the estimate can be converted in daily intake in kilograms by dividing by 18.45 MJ/kg. This estimate of intake in kilograms should generally be between 1.5 per cent and 3.0 per cent of the animal's weight.

Using Equation 13 and the cattle data summarised in Appendix A, Gibbs and Johnson (1993) found that the intake estimates are consistent with expected intakes as a percentage of body weight and previously published values. For example, the intake estimate for Indian cattle is the equivalent of about 10,000 MJ per year of metabolisable energy (ME). Winrock (1978) estimates the average ME requirements for Indian cattle at 10,600 MJ per year. Similarly, the ME values implied for U.S.A dairy and non-dairy cows are 58,000 MJ and 31,000 MJ per year, respectively, which are similar to estimates of 62,000 MJ and 31,700 MJ derived in US EPA (1993). Consequently, for a diverse set of conditions, the intake estimates correspond to reasonably expected ranges from previously published estimates.

To estimate the emission factor for each cattle type, the feed intake is multiplied by the methane conversion rate (from Step 1) as follows:

EQUATION 14
Emissions (kg/yr) = [Intake (MJ/day) x Y_m x (365 days/yr)] / [55.65 MJ/kg of methane]

where Y_m is the methane conversion rate expressed in decimal form (such as 0.06 for 6 per cent). The result of this step of the method is an emission factor for each cattle type defined in Step 1.

ENTERIC FERMENTATION
TIER 2: STEP 3 – TOTAL EMISSIONS

To estimate total emissions the selected emission factors are multiplied by the associated animal population and summed. As described above under Tier 1, the emissions estimates should be reported in gigagrams (Gg).

4.2.5 Tier 2 Approach for Methane Emissions from Manure Management

The Tier 2 approach provides a more detailed method for estimating methane emissions from manure management systems. The Tier 2 approach is recommended for countries with large cattle, buffalo and swine populations managed under confined conditions. Compared to the Tier 1 approach, this method requires additional detailed information on animal characteristics and the manner in which manure is managed. Using this additional information, emission factors are estimated that are specific to the conditions of the country, and the default emission factors from Tier 1 are not used.

The Tier 2 approach is similar to the original OECD method described in OECD (1991). Improvements to the method have been made to incorporate more recent figures on methane conversion factors and to link the method more closely to the animal characteristic data collected for estimating enteric fermentation.

MANURE MANAGEMENT
TIER 2: STEP 1 – LIVESTOCK POPULATIONS

To develop precise estimates of emissions, the animals should be divided into relatively homogeneous groups. For each category a representative animal is chosen and characterised for purposes of estimating an emission factor. Suggested categories for cattle are discussed above under the enteric fermentation Tier 2 method and are summarised in Table 4-7. Similar categories can be used for buffalo. Categories for swine could include sows, boars, and growing animals (farrows to finishers). For each of the representative animal types defined, the following information is required:

- annual average population (number of head) by climate region (cool, temperate, and warm);
- average daily volatile solids (VS) excretion (kg of dry matter per day);[11]

[11] Volatile solids (VS) are the degradable organic material in livestock manure.

- methane-producing potential (B_o) of the manure (cubic metres (m^3) of methane per kg of VS);
- manure management system usage (percentage of manure managed with each management system).

Population data are generally available from country-specific livestock census reports. As described above under Tier 1, the portion of each animal population in cool, temperate, and warm climate regions is required.

Often, data on average daily VS excretion are not available. Consequently, the VS values may need to be estimated from feed intake levels. The enteric fermentation Tier 2 method should be used to estimate feed intake levels for cattle and buffalo.[12] For swine, country-specific swine production data may be required to estimate feed intake. To develop the default emission factors for swine presented in Tier 1, average feed intake estimates for swine in developed and developing countries were used from Crutzen et al. (1986) (see Appendix B, at the end of this section).

Once feed intake is estimated, the VS excretion rate is estimated as:[13]

EQUATION 15
VS (kg dm/day) = Intake (MJ/day) x (1 kg/18.45 MJ) x (1 - DE%/100) x (1-ASH%/100)

where:

VS	=	VS excretion per day on a dry weight basis;
dm	=	dry matter;
Intake	=	the estimated daily average feed intake in MJ/day;
DE%	=	the digestibility of the feed in per cent (e.g., 60%);
ASH%	=	the ash content of the manure in per cent (e.g., 8%).

For cattle, the DE% value used should be the same value used to implement Tier 2 for enteric fermentation. The ash content of cattle and buffalo manure is generally around 8 per cent. For swine, the default emission factors were estimated using 75 per cent and 50 per cent digestibility for developed and developing countries, respectively, and an ash content of 2 per cent and 4 per cent for developed and developing countries, respectively. Appendix B summarises the data used to estimate the VS excretion rates for cattle, buffalo, and swine.

The maximum methane-producing capacity for the manure (B_o) varies by species and diet. Country-specific data should be used where feasible. A range of representative B_o values

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[12] By using the enteric fermentation Tier 2 method to estimate feed intake, consistency is assured in the data underlying the emissions estimates for both enteric fermentation and manure management.

[13] The energy density of feed is about 18.45 MJ per kg of dry matter. This value is relatively constant across a wide range of forage and grain-based feeds commonly consumed by livestock.

for cattle, buffalo, and swine populations were used to develop the default emission factors as follows (see Appendix B):

- Dairy Cattle
  - Developed Countries: 0.24 m^3/kg VS
  - Developing Countries: 0.13 m^3/kg VS
- Non-dairy Cattle
  - Developed Countries: 0.17 m^3/kg VS
  - Developing Countries: 0.10 m^3/kg VS
- Buffalo in all regions: 0.10 m^3/kg VS
- Swine
  - Developed Countries: 0.45 m^3/kg VS
  - Developing Countries: 0.29 m^3/kg VS

The portion of manure managed in each manure management system must also be collected for each representative animal type. Table 4-8 summarises the main types of manure management systems. The first four types in the table, pasture, daily spread, solid storage, and drylot, are all dry manure management systems. These systems produce little or no methane. The wet manure management systems, liquid/slurry, anaerobic lagoon, and pit storage, are the primary sources of manure methane emissions. To implement this Tier 2 method, at a minimum the proportion of manure managed in wet and dry systems must be estimated.

TABLE 4-8
MANURE MANAGEMENT SYSTEMS AND METHANE CONVERSION FACTORS (MCFS)

System	MCF by Climate[a] Cool	Temperate	Warm	Source
Pasture/Range/Paddock: the manure from pasture and range grazing animals is allowed to lie as is, and is not managed.	1%	1.5%	2%	b
Daily Spread: manure is collected in solid form by some means such as scraping. The collected manure is applied to fields regularly (usually daily).	0.1%	0.5%	1%	b
Solid Storage: manure is collected as in the daily spread system, but is stored in bulk for a long period of time (months) before any disposal.	1%	1.5%	2%	b
Drylot: in dry climates animals may be kept on unpaved feedlots where the manure is allowed to dry until it is periodically removed. Upon removal the manure may be spread on fields.	1%	1.5%	5%	b
Liquid/Slurry: these systems are characterised by large concrete lined tanks built into the ground. Manure is stored in the tank for six or more months until it can be applied to fields. To facilitate handling as a liquid, water may be added to the manure.	10%	35%	65%	b
Anaerobic Lagoon: anaerobic lagoon systems are characterised by flush systems that use water to transport manure to lagoons. The manure resides in the lagoon for periods from 30 days to over 200 days. The water from the lagoon may be recycled as flush water or used to irrigate and fertilise fields.	90%	90%	90%	c
Pit Storage: liquid swine manure may be stored in a pit while awaiting final disposal. The length of storage time varies, and for this analysis is divided into two categories: less than one month or greater than one month. — < 30 Days	5%	18%	33%	b
Pit Storage — > 30 Days	10%	35%	65%	b
Anaerobic Digester: the manure, in liquid or slurry form, is anaerobically digested to produce methane gas for energy. Emissions are from leakage and vary with the type of digester.	5-15%	5-15%	5-15%	d
Burned for Fuel: manure is collected and dried in cakes and burned for heating or cooking. Emissions occur while the manure is stored before it is burned. Methane emission associated with the combustion of the manure are not considered here. Combustion-related emissions are estimated in the *Traditional Biomass Fuels* Section of the *Energy* chapter.	5-10%	5-10%	5-10%	e

a Cool climates have an average temperature below 15°C; temperate climates have an average temperature from 15°C to 25°C inclusive; warm climates have an average temperature above 25°C.
b Hashimoto and Steed (1993).
c Safley et al., (1992) and Safley and Westerman (1992).
d Yancun et al. (1985), Stuckey (1984) and Lichtman (1983).
e Safley et al. (1992).

The default emission factors presented in Tier 1 are based on manure management system usage data collected by Safley et al. (1992). Appendix B presents these data by region for cattle, buffalo and swine. Although the data in Appendix B can be used as defaults, country-specific data, e.g., obtained through a survey, would improve the basis for implementing the Tier 2 method. The resulting estimates must show the portion of manure from each animal type managed within each management system, by climate region.

MANURE MANAGEMENT
TIER 2: STEP 2 – EMISSION FACTORS

Emission factors are estimated for each animal type based using the data collected in Step 1 and the methane conversion factors (MCFs) for each manure management system. The MCF defines the portion of the methane producing potential (B_o) that is achieved. The MCF varies by manure management system and climate and can range between 0 and 100 per cent. Table 4-8 presents the latest available MCF estimates for the major manure management systems that have been developed.

To calculate the emission factor for each animal type, a weighted average methane conversion factor (MCF) is calculated using the estimates of the manure managed by waste system within each climate region. The average MCF is then multiplied by the VS excretion rate and the B_o for the animal type. In equation form, the estimate is as follows:

EQUATION 16

$$EF_i = VS_i \times 365 \text{ days/yr} \times B_{oi} \times 0.67 \text{ kg/m}^3 \times \sum_{jK} MCF_{jK} \times MS\%_{ijK}$$

where:

EF_i	=	annual emission factor (kg) for animal type *i* (e.g., dairy cows);
VS_i	=	daily VS excreted (kg) for animal type *i*;
B_{oi}	=	maximum methane producing capacity (m^3/kg of VS) for manure produced by animal type *i*;
MCF_{jk}	=	methane conversion factors for each manure management system *j* by climate region *k*; and
$MS\%_{ijk}$	=	fraction of animal type *i*'s manure handled using manure system *j* in climate region *k*.

MANURE MANAGEMENT
TIER 2: STEP 3 – TOTAL EMISSIONS

To estimate total emissions the selected emission factors are multiplied by the associated animal population and summed. As described above under Tier 1, the emissions estimates should be reported in gigagrams (Gg).

4.2.6 Beyond Tier 2 for Methane

The default values used in the Tier 1 and 2 methods were derived from available livestock and manure management data and are generally representative of regional conditions. Because livestock and manure management conditions can vary significantly across and within countries, the default values may not reflect adequately the conditions in a given country. Additionally, the variability of conditions has not been well characterised to date.

The emissions estimates can be improved by going beyond the Tier 2 default data and collecting key country- or region-specific data. Data elements that would benefit from data collection initiatives (such as targeted surveys of major livestock types) include the following:

- *Cattle weight*
  In many regions the weights of cattle are not well quantified.

- *Feed intake*
  Field data on feed intake would be valuable for validating the feed intake estimates made under Tier 2 for cattle.
- *Manure production*
  Field data on manure production by livestock would be valuable for validating the manure production estimates made under Tier 2.
- *Manure management*
  Field data on manure management system usage would improve the basis for making the estimates. Considerations of seasonal management practices could be incorporated into the data.

In addition to these data collection initiatives, measurement programmes can be used to improve the basis for making the estimates. In particular, measurements of emissions from manure management systems under field conditions is needed. Techniques for making these measurements are described in IAEA (1992). Additionally, measurements of the maximum methane producing ability of manure (B_o) from livestock in tropical regions is needed.

Additionally, new techniques are being deployed to measure emissions from cattle under field conditions (Johnson et al., 1993). Using these techniques, coefficients used in Tier 2 can be verified (such as the methane conversion rate) and the emissions estimates can be validated. Targeted assessments of tropical cattle populations would be most valuable.

4.2.7 Inventory Method for Nitrous Oxide - Overview

The method for estimating N_2O emissions from manure management is described in detail in Section 4.5.3 of this Reference Manual, where emissions from several animal waste management systems are considered. All emissions of N_2O taking place before the manure is added to soils are to be reported under ''Manure Management''. These include emissions from anaerobic lagoons, liquid systems, solid storage and drylot, and ''other systems''. Emissions resulting from manure used for fuel are included in the Energy Chapter. All manure-induced soil emissions are considered soil emissions here.

Appendix A

Data Underlying Methane Default Emission Factors For Enteric Fermentation

This appendix presents the data used to develop the default emission factors for methane emissions from enteric fermentation. The detailed information presented for cattle and buffalo was developed in Gibbs and Johnson (1993). The Tier 2 method was implemented with these data to estimate the default emission factors for cattle and buffalo. Also presented are the summary data from Crutzen et al. (1986) that were used to estimate the emission factors for the other species.

TABLE A-1
DATA FOR ESTIMATING ENTERIC FERMENTATION EMISSION FACTORS FOR DAIRY CATTLE

Regions	Weight kg	Weight Gain kg/day	Feeding Situation	Milk kg/day	Work hrs/day	% Pregnant	Digestibility of Feed %	CH_4 Conversion %
North America[a]	600	0	Stall Fed	18.4	0	90%	65%	6%
Western Europe	550	0	Stall Fed	11.5	0	90%	60%	6%
Eastern Europe[b]	550	0	Stall Fed	7.0	0	80%	60%	6%
Oceania[c]	500	0	Stall Fed	4.7	0	80%	60%	6%
Latin America[d]	400	0	Pasture/Range	2.2	0	80%	60%	6%
Asia[e]	350	0	Stall Fed	4.5	0	80%	60%	6%
Africa & Middle East	275	0	Stall Fed	1.3	0	67%	60%	6%
Indian Subcontinent[f]	275	0	Stall Fed	2.5	0	50%	55%	6%

a Based on estimates for the United States
b Based on estimates for the former USSR
c Based on estimates for Australia.
d Based on estimates for Brazil.
e Based on estimates for China.
f Based on estimates for India.
Source: Gibbs and Johnson (1993).

TABLE A-2
DATA FOR ESTIMATING ENTERIC FERMENTATION EMISSION FACTORS FOR NON-DAIRY CATTLE

Type	Weight kg	Weight Gain kg/day	Feeding Situation	Milk kg/day	Work hrs/day	Pregnant %	Digestibility of Feed %	CH_4 Conversion %	Day Weighted Population Mix %	Emission Factors kg/head/yr
North America[a]										
Mature Females	500	0.0	Pasture/Range	3.3	0.0	80%	60%	6.0%	36%	69
Mature Males	800	0.0	Pasture/Range	0.0	0.0	0%	60%	6.0%	2%	75
Calves on milk	100	0.9	Pasture/Range	0.0	0.0	0%	NA	0.0%	16%	0
Calves on forage	185	0.9	Pasture/Range	0.0	0.0	0%	65%	6.0%	8%	42
Growing heifers/steers	265	0.7	Pasture/Range	0.0	0.0	0%	65%	6.0%	17%	47
Replacement/growing	375	0.4	Pasture/Range	0.0	0.0	0%	60%	6.0%	11%	56
Feedlot cattle	415	1.3	Stall Fed	0.0	0.0	0%	75%	3.5%	11%	37
Western Europe										
Mature Males	600	0.0	Pasture/Range	0.0	0.0	0%	60%	6.0%	22%	60
Replacement/growing	400	0.4	Pasture/Range	0.0	0.0	0%	60%	6.0%	54%	84
Calves on milk	230	0.3	Pasture/Range	0.0	0.0	0%	65%	0.0%	15%	0
Calves on forage	230	0.3	Pasture/Range	0.0	0.0	0%	65%	6.0%	8%	33
Eastern Europe[b]										
Mature Females	500	0.0	Pasture/Range	3.3	0.0	67%	60%	6.5%	30%	74
Mature Males	600	0.0	Pasture/Range	0.0	0.0	0%	60%	6.5%	22%	65
Young	230	0.4	Pasture/Range	0.0	0.0	0%	60%	6.0%	48%	40
Oceania[c]										
Mature Females	400	0.0	Pasture/Range	2.4	0.0	67%	55%	6.0%	51%	63
Mature Males	450	0.0	Pasture/Range	0.0	0.0	0%	55%	6.0%	11%	55
Young	200	0.3	Pasture/Range	0.0	0.0	0%	55%	6.0%	38%	39

a Based on estimates for the United States.
b Based on estimates for the former USSR.
c Based on estimates for Australia.

TABLE A-2 (CONTINUED)
DATA FOR ESTIMATING ENTERIC FERMENTATION EMISSION FACTORS FOR NON-DAIRY CATTLE

Type	Weight kg	Weight Gain kg/day	Feeding Situation	Milk kg/day	Work hrs/day	Pregnant %	Digestibility of Feed %	CH_4 Conversion %	Day Weighted Population Mix %	Emission Factors kg/head/yr
Latin America[d]										
Mature Females	400	0.0	Large Areas	1.1	0.0	67%	60%	6.0%	37%	58
Mature Males	450	0.0	Large Areas	0.0	0.0	0%	60%	6.0%	6%	57
Young	230	0.3	Large Areas	0.0	0.0	0%	60%	6.0%	58%	42
Asia[e]										
Mature Females-Farming	325	0.0	Stall Fed	1.1	0.55	33%	55%	6.5%	27%	48
Mature Females-Grazing	300	0.0	Pasture/Range	1.1	0.00	50%	60%	6.0%	9%	41
Mature Males-Farming	450	0.0	Stall Fed	0.0	1.37	0%	55%	6.5%	24%	58
Mature Males-Grazing	400	0.0	Pasture/Range	0.0	0.00	0%	60%	6.0%	8%	44
Young	200	0.2	Pasture/Range	0.0	0.00	0%	60%	6.0%	32%	31
Africa										
Mature Females	200	0.0	Stall Fed	0.3	0.55	33%	55%	6.5%	13%	31
Draft Bullocks	275	0.0	Stall Fed	0.0	1.37	0%	55%	6.5%	13%	40
Mature Females-Grazing	200	0.0	Large Areas	0.3	0.00	33%	55%	7.5%	6%	46
Bulls - Grazing	275	0.0	Large Areas	0.0	0.00	0%	55%	7.5%	25%	55
Young	75	0.1	Pasture/Range	0.0	0.00	0%	60%	6.0%	44%	14
Indian Subcontinent[f]										
Mature Females	125	0.0	Stall Fed	0.6	0.00	33%	50%	7.5%	40%	31
Mature Males	200	0.0	Stall Fed	0.0	2.74	0%	50%	7.5%	10%	41
Young	80	0.1	Stall Fed	0.0	0.00	0%	50%	6.0%	50%	17

d Based on estimates for the Brazil.
e Based on estimates for the China.
f Based on estimates for India.
Source: Gibbs and Johnson (1993)

TABLE A-3
DATA FOR ESTIMATING ENTERIC FERMENTATION EMISSION FACTORS FOR BUFFALO

Type	Weight kg	Weight Gain kg/day	Feeding Situation	Milk kg/day	Work hrs/day	Pregnant %	Digestibility of Feed %	CH_4 Conversion %	Day Weighed Population Mix %	Emissions Factors kg/head/yr
Indian Subcontinent[a]										
Adult Males	350 - 550	0.00	Stall Fed	0.00	1.37	0%	55%	7.5	14%	55 - 77
Adult Females	250 - 450	0.00	Stall Fed	2.70	0.55	33%	55%	7.5	40%	57 - 80
Young	100 - 300	0.15	Stall Fed	0.00	0.00	0%	55%	7.5	46%	23 - 50
Other Countries[b]										
Adult Males	350 - 550	0.00	Stall Fed	0.00	1.37	0%	55%	7.5	45%	55 - 77
Adult Females	250 - 450	0.00	Stall Fed	0.00	0.55	25%	55%	7.5	45%	45 - 67
Young	100 - 300	0.15	Stall Fed	0.15	0.00	0%	55%	7.5	10%	23 - 50

a Based on estimates for India.
b Based on estimates for China.
Source: Gibbs and Johnson (1993).

TABLE A-4
DATA FOR ESTIMATING ENTERIC FERMENTATION EMISSION FACTORS FOR OTHER ANIMALS

Animal Type		Feed Intake (MJ/head/day)	Methane Conversion Factor (%)
Sheep	Developed Countries	20	6%
	Developing Countries	13	6%
Goats	Developed Countries	14	5%
	Developing Countries	14	5%
Camels	Developed Countries	100	7%
	Developing Countries	100	7%
Horses	Developed Countries	110	2.5%
	Developing Countries	110	2.5%
Mules/Asses	Developed Countries	60	2.5%
	Developing Countries	60	2.5%
Swine	Developed Countries	38	0.6%
	Developing Countries	13	1.3%
Poultry	Developed Countries	Not Estimated	
	Developing Countries		

Sources: Feed intake and methane conversion for all animals from Crutzen et al (1986). Methane conversion for camels modified as in Gibbs and Johnson (1993).

Appendix B

Data Underlying Methane Default Emission Factors for Manure Management

This appendix presents the data used to develop the default emission factors for methane emissions from manure management. The detailed information presented for cattle and buffalo was developed in Gibbs and Johnson (1993). The swine feed intake data are from Crutzen et al. (1986). The manure management system usage data and B_o estimates are from Safley et al. (1992). The methane conversion factor (MCF) data are from Woodbury and Hashimoto (1993). The Tier 2 method was implemented with these data to estimate the default emission factors for cattle, buffalo, and swine. Also presented are the summary feed intake data from Crutzen et al. (1986) and the manure-related data from Safley et al. (1992) and Woodbury and Hashimoto (1993) that were used to estimate the emission factors for the other species.

TABLE B-1
FEED INTAKE AND MANURE PRODUCTION FOR CATTLE

Region	Livestock Category	Sub-Population	Mass (kg)	Feed Digest (%)	Energy Intake (MJ/day)	Feed Intake (kg/day)	Category Population %	Manure (kg/h/d dm)	VS (kg/h/d)	B_o (m^3 CH_4/kg VS)
North America	Dairy Cattle	Average	600	65%	299.5	16.2	100%	5.68	5.23	0.24
	Non-dairy Cattle	Mature Females	500	60%	174.0	9.4	36%	3.77	3.47	0.17
		Mature Males	800	60%	189.3	10.3	2%	4.10	3.78	0.17
		Young on milk	100	NA	NA	NA	15%	negligible	negligible	0.17
		Young	185	65%	107.2	5.8	8%	2.03	1.87	0.17
		Young	265	65%	120.1	6.5	17%	2.28	2.10	0.17
		Young	375	60%	143.2	7.8	11%	3.10	2.86	0.17
		Feedlot	415	75%	161.8	8.8	11%	2.19	2.02	0.17
		Avg. Non-dairy Cattle	357	53%	128.0	6.9	100%	2.55	2.35	0.17
Western Europe	Dairy Cattle	Average	550	60%	254.7	13.8	100%	5.52	5.08	0.24
	Non-dairy Cattle	Mature Males	600	60%	152.5	8.3	22%	3.31	3.04	0.17
		Young Replacements	400	60%	149.8	8.1	55%	3.25	2.99	0.17
		Young Calves	230	65%	83.7	4.5	23%	1.59	1.46	0.17
		Avg. Non-dairy Cattle	405	61%	135.1	7.3	100%	2.88	2.65	0.17

TABLE B-1 (CONTINUED)
FEED INTAKE AND MANURE PRODUCTION FOR CATTLE

Region	Livestock Category	Sub-Population	Mass (kg)	Feed Digestibility (%)	Energy Intake (MJ/day)	Feed Intake (kg/day)	Category Population %	Manure (kg/h/d dm)	VS (kg/h/d)	B_o (m^3 CH4/kg VS)
Eastern Europe	Dairy Cattle	Average	550	60%	207.2	11.2	100%	4.49	4.13	0.24
	Non-dairy Cattle	Mature Females	500	60%	172.9	9.4	30%	3.75	3.45	0.17
		Mature Males	600	60%	152.5	8.3	21%	3.31	3.04	0.17
		Young	230	60%	102.2	5.5	49%	2.22	2.04	0.17
		Avg. Non-dairy Cattle	391	60%	134.4	7.3	100%	2.91	2.68	0.17
Oceania	Dairy Cattle	Average	500	60%	174.1	9.4	100%	3.77	3.47	0.24
	Non-dairy Cattle	Mature Females	400	55%	160.5	8.7	52%	3.91	3.60	0.17
		Mature Males	450	55%	138.8	7.5	10%	3.38	3.11	0.17
		Young	200	55%	98.6	5.3	38%	2.41	2.21	0.17
		Avg. Non-dairy Cattle	330	55%	134.9	7.3	100%	3.29	3.03	0.17
Latin America	Dairy Cattle	Average	400	60%	145.9	7.9	100%	3.16	2.91	0.13
	Non-dairy Cattle	Mature Females	400	60%	148.0	8.0	37%	3.21	2.95	0.10
		Mature Males	450	60%	144.0	7.8	5%	3.12	2.87	0.10
		Young	230	60%	107.5	5.8	58%	2.33	2.14	0.10
		Avg. Non-dairy Cattle	305	60%	124.4	6.7	100%	2.70	2.48	0.10