

# Energy Requirements for Milk Production

## Assessing the Dependency on Yield Intensity

*Increasing yields and technology cause rising energy consumption in agriculture. This study presents the influence of the age of first calving, reproduction rate and milk yield on the feed energy requirements and the cumulative energy demand (CED) for feed supply in milk production, including reproduction.*

The feed energy requirements were calculated on the basis of the known standards from animal nutrition [1, 4]. The relationship between age of first calving, service life and milk yields of the animals was analysed on the basis of data of the state milk recording association Brandenburg (LKV) for one county.

A method for energy balancing in animal husbandry was developed according to the VDI guideline 4600 "Cumulative energy demand." For scenario estimates a standard technology for dairy farming was defined. This standard technology is characterized by the husbandry in a cubicle housing system with liquid manure disposal, a milk yield of 8000 kg FCM per cow and year and the feeding with a total mixed ration (TMR) [3]. The determination of the cumulative energy demand for feed supply includes direct and indirect energy inputs in the production processes of crop farming.

### Results

Economic, breeding and technical production conditions, possibilities and requirements of milk production have changed substantially since the early 90's. Over the last ten years, the milk production in the New Federal States of Germany increased by approximately 3000 kg FCM per cow and year. The results of Milk Recording in the Federal State Brandenburg have shown an increase of milk yield by approximately 2600 kg FCM per cow and year with a concurrent decrease of the animal stock (Table 1).

### Age of first calving and service life

The increase of the milk production was accompanied by an increase of the reproduction rate up to 40 %, which, in connection with an age of first calving of 24 months, makes the selection within the raising of female cattle very difficult [7].

Table 1: Development of dairy cow stock (in 1000) and results of milk yield recording in Brandenburg (target day: May 5<sup>th</sup>)

	1995	1999	2001	2003	2005
Number of dairy cows	228.0	198.8	182.4	178.6	174.0
Milk yield kg FCM/cow and year	5759	6797	7616	7966	8347

Sources: [5, 6]

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### Keywords

Feed energy requirement, cumulative energy demand, milk yield, reproduction rate, age of first calving

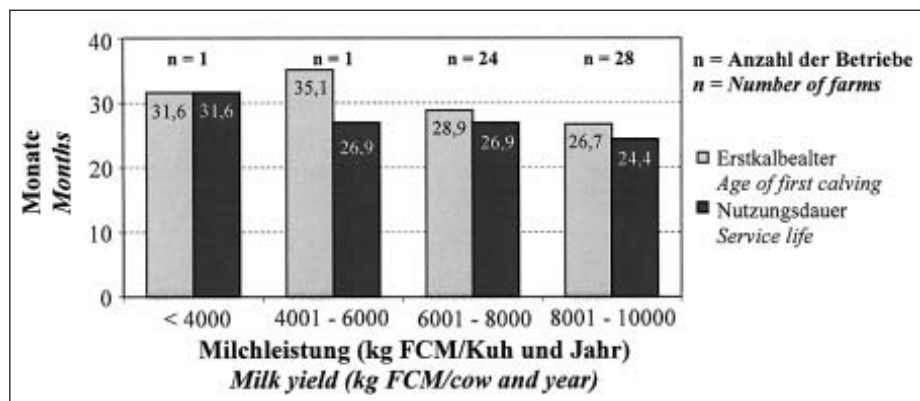


Fig. 1: Age of first calving and productive life and different milk yields in Uckermark county, state of Brandenburg

Reproduction rate %	Milk yield kg FCM/cow and year		
	5000	7000	9000
50	8.16	6.73	6.15
45	8.00	6.62	6.07
40	7.85	6.51	5.98
35	7.70	6.40	5.90
30	7.55	6.30	5.81
25	7.39	6.19	5.73
20	7.24	6.08	5.64
15	7.09	5.97	5.56
10	6.94	5.86	5.47

Source: own calculations acc. to [4]

Table 2: Rearing and fodder energy requirement (MJ NEL) per kg FCM with an age of first calving of 24 months and different milk yields

With a rising milk yield, the cumulative energy demand for feed per animal increases. But the specific cumulative energy demand per produced kg FCM decreases with a rising milk production (Fig. 2). With higher milk yields this effect is diminishing. With an increasing reproduction rate, the cumulative energy demand for the specific feed supply per kg milk increases within all milk performances in an almost linear way.

On the basis of the data from 54 farms of the county Uckermark (state of Brandenburg), Figure 1 shows that with rising milk production the age of first calving and the service life decrease.

### Feed energy requirements

With an increasing performance, the energy and nutrient requirements of the animals rise. But with increasing milk yield the specific feed energy requirement per kg of produced milk decreases (Table 2). This effect diminishes gradually with higher milk yields. In contrast, the increase of the reproduction rate by which the rising milk yield is

accompanied increases the specific feed energy requirement in an approximately linear way.

The specific feed energy expenditure for 1 kg FCM with an annual milk yield of 7000 kg FCM and a reproduction rate of 15 % is identical with the specific feed energy requirement with an annual milk yield of 9000 kg FCM and a reproduction rate of 40 % (Table 2).

### Cumulative energy demand in dependence on feed basis and yield

The energy demand for the supply of the substantial components of diets is presented in Table 3.

Table 3: Nitrogen fertiliser, yields and cumulative energy demand for feed production and provision for different feed-stuffs

feed-stuff	nitrogen fertiliser kg N ha <sup>-1</sup>	DMY <sup>f</sup> dt ha <sup>-1</sup>	CED <sup>g</sup> comparison feed-stuffs		CED <sup>g</sup> comparison feed-stuffs		CED <sup>g</sup> comparison feed-stuffs	
			MJ kg <sup>-1</sup> TM	%	MJ kg <sup>-1</sup> TM	%	MJ kg <sup>-1</sup> TM	%
Maize silage	132	110	1.66 <sup>a</sup>	84	0.259 <sup>a</sup>	80	0.013 <sup>a</sup>	88
Triticale	135	50	2.64	133	0.318	97	0.016	107
Gras silage <sup>d</sup>	65	70	1.99 <sup>b</sup>	100	0.326 <sup>b</sup>	100	0.015 <sup>b</sup>	100
Pasture	80	60	0.84	42	0.131	40	0.006	40
Hay <sup>e</sup>	74	70	1.78 <sup>c</sup>	90	0.336 <sup>c</sup>	103	0.015 <sup>c</sup>	101

<sup>a</sup> 15 % losses    <sup>b</sup> 20 % losses    <sup>c</sup> 30 % losses  
<sup>d</sup> 3 cuts    <sup>e</sup> 2 cuts    <sup>f</sup> Dry matter yield  
<sup>g</sup> Cumulative energy demand    Source: own calculations acc. to [2]

### Conclusions

On the basis of the data from the county Uckermark, referring to the age of first calving and the service life of the dairy cows as well as the calculations for the specific feed energy requirement and cumulative energy demand per produced milk, it can be concluded that an increase of the milk yield from 7000 to 9000 kg FCM per cow and year, the specific feed energy requirement and cumulative energy demand per produced milk decrease even if the reproduction rate increases by 10 %.

### Literature

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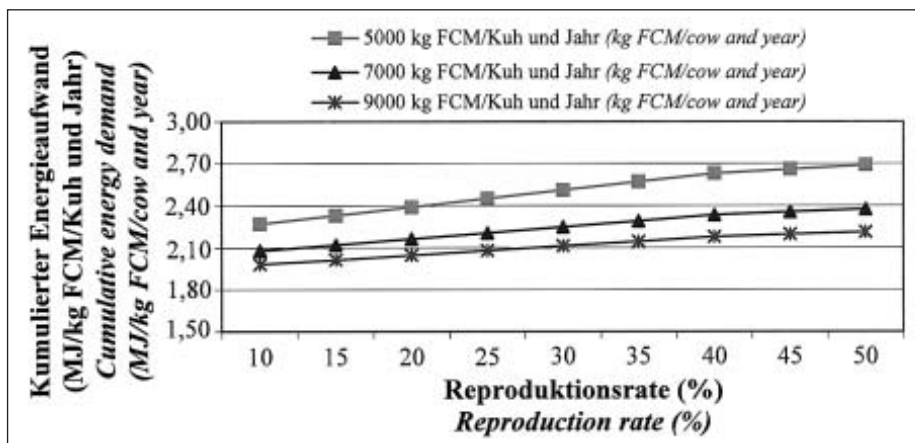


Fig. 2: Cumulative energy demand for feed production and provision, depending on reproduction rate for milk yields of 5,000, 7,000 and 9,000 kg FCM per cow and year