Feeding and Energy Efficiency MIR (FeMIR) Report - the new MIR advisory tool

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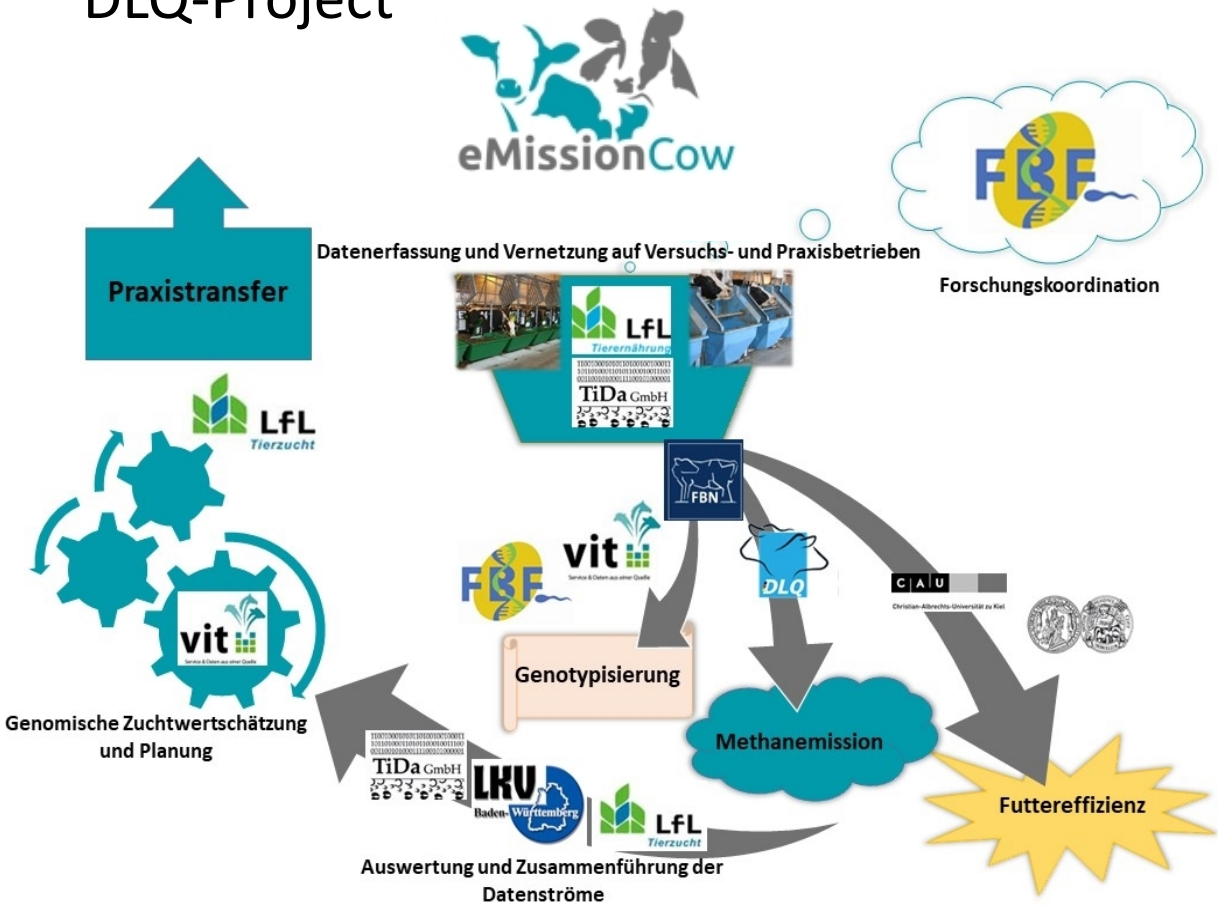
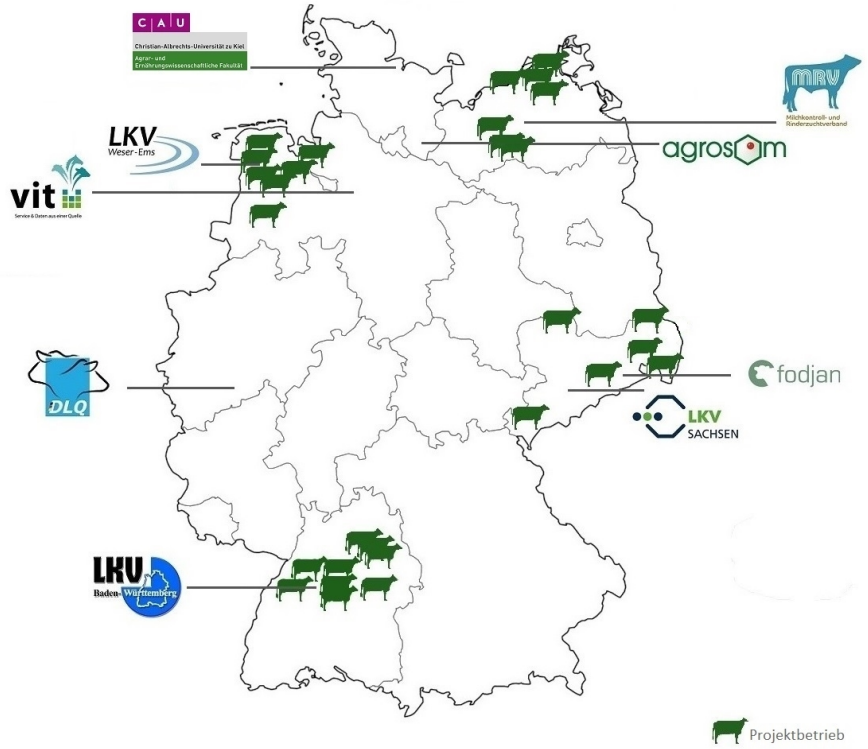
DLQ-Project



Methane emission and feed efficiency at individual animal level

DLQ-Project

REMISSION DAIRY



Methane emission and feed efficiency in feeding advice

LKV BW – MIR - Spectral Data - Current Projects

Milk analysis using mid-infrared spectra (MIR)

Fig.1: Milk Sample

Fig.2: Bentley FTS-Milk Analysis Instrument (Source: Bentley-Instruments)

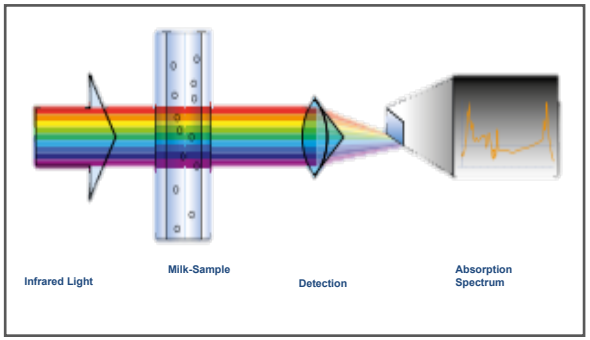


Fig.3: Infrared analysis of milk Scheme (Photo: Bentley-Instruments)

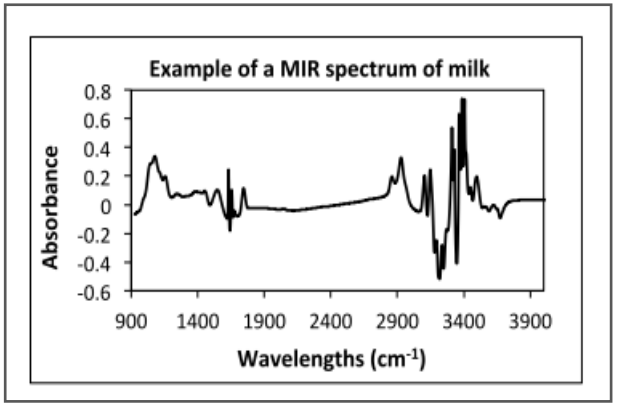


Fig.4: Typical Milk MIR- Absorption Spectrum (Source: OptiMIR)

Main components:
Fat, protein, lactose, urea ...

Fine components:
Fatty acids, minerals, Lactoferrin, BHB, acetone ...

Complex components:
Energy Deficit / Ketosis, Mastitis, CH4, Pregnancy ...

Milk-MIR-Models:
Energy Balance – Feed/Energy Efficiency - Methan-Emission

Energy Balance (EB): optiKuh/DLQ - (L. Dale 2019)

Milk Biomarker	Unit	#LV	ϕ	SD	SEC	R^2c	SECV	R^2cv	RPDcv	Use
EB – NEL*	[MJ/d]	12	2.47	17.29	8.27	0.75	8.27	0.75	2.001	0
EB – ME**	[MJ/d]	12	0.08	23.54	8.99	0.85	8.94	0.85	2.580	0

Feed/Energy Efficiency (FE) (EE): optiKuh/eMissionCow/DLQ - (L. Dale 2021)

Milch Biomarker	Unit	#LV	ϕ	SD	SEC	R^2c	SECV	R^2cv	RPDcv	Use
EE – NEL*	[MJ/ECM]	7	4.69	0.62	0.27	0.81	0.28	0.81	2.271	0
EE – ME**	[MJ/ECM]	7	7.67	1.03	0.39	0.86	0.39	0.91	2.669	0
FE	[ECM/DM kg]	10	1.55	0.25	0.09	0.90	0.08	0.89	3.131	+

Methane Emission: eMissionCow/DLQ - (Vanlierde A. et al. 2019. L. Dale)

Phenotypes	Unit	#LV	ϕ	SD	SEC	R^2c	SECV	R^2cv	RPDcv	Use
Methane Emission	[g/d]	10	1089	102	58	0.68	61	0.64	1.7	-
GLMNET- Methane Emission	**[g/d]**	**12**	**1266**	**97**	**50**	**0.73**	**54**	**0.69**	**1.8**	-

*** GfE (2001), ** Susenbeth (2018)**

New applications for the farmer and consultant
Feed/Energy Efficiency - Report

FeMIR

- Feed Efficiency
- Energie Efficiency
- Fatty acids
- Energie Balance
- N - Efficiency
- Methane

New applications for the farmer and consultant
Feed/Energy Efficiency - Report

FE-MIR - Mittelwerte Berateransicht

Betrieb:

EB: Energiebilanz-NEL [MJ]

KM (KetoMIR): Anteile der Ketosis-Gefährdungsklassen (KM2) = gefährdet < 20% (KM3) = stark gefährdet < 5%

Table 2: Herdendurchschnitte der MIR-Inhaltstoffe und -Parameter

Abschn.	Status	Anz. Tiere	Anz. Lakt.	L-Tage	Mkg	ECM	F%	E%	H	L%	ZZ	FEQ	F-DN	F-PF	NE	EB	EE	EA	FE	CH4-ECM	KM2 %	KM3 %
1-120	F	10	1	66	25.2	26.0	4.32	3.34	19	5.00	73	1.30	22	40	34	5	0.230	113	1.75	16	10	0
121-240	F	9	1	197	24.7	26.5	4.41	3.80	18	4.84	125	1.16	24	35	29	9	0.190	142	1.33	16		
>240	F	14	1	286	21.3	22.8	4.45	3.80	16	4.92	115	1.17	23	38	29	6	0.190	120	1.36	19		
1-120	K	21	4	58	34.1	35.1	4.30	3.28	17	4.90	192	1.32	21	44	36	-9	0.240	146	1.86	12	28.6	4.8
121-240	K	20	3	181	29.2	31.0	4.41	3.69	18	4.74	419	1.20	24	36	30	11	0.200	159	1.42	16		
>240	K	18	4	297	21.8	23.2	4.50	3.94	15	4.47	278	1.14	22	41	31	23	0.180	128	1.41	21		
alle	F	33	1	195	23.4	24.8	4.40	3.66	17	4.92	105	1.21	23	38	30	6	0.200	124	1.47	17	10	0
alle	K	59	3	173	28.7	30.1	4.40	3.62	17	4.71	295	1.22	22	40	32	8	0.210	145	1.58	16	28.6	4.8
alle	alle	92	3	181	26.8	28.2	4.40	3.64	17	4.79	227	1.22	23	40	31	7	0.210	137	1.54	16	22.6	3.2

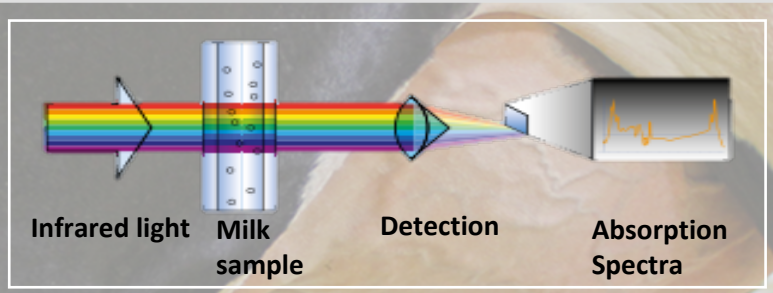
Field test phase FeMIR -report (paper) *

January - December 2022: 3 consultants, 4 field workers, 9 farms

Conclusions (preliminary)

- ✓ In addition to the handling and use of the report, the limits of each parameter were determined and established to be able to define an optimal framework in which a farm should be.
- ✓ At this step, the respective physical constitution of the animals, as found on site, confirmed the experts' expectations, which they had derived from the efficiency and energy parameters in the report.
- ✓ On all farms this assessment could be found, which is why the FeMIR report was also rated by all participants as a valuable and suitable management tool for feeding and monitoring the animals' metabolism.

Online tool for monitoring the animals in the herd manager



Systematic monitoring of animal metabolism via MIR spectral data

Improved feed management

Methane emission reduction

LKVBW Herd Manager Online System

FE-MIR - Mittelwerte Berateransicht

Betrieb:

EB: Energiebilanz-NEL [MJ]

KM (KetoMIR): Anteile der Ketosis-Gefährdungsklassen (KM2) = gefährdet < 20% (KM3) = stark gefährdet < 5%

Table 2: Herdendurchschnitte der MIR-Inhaltstoffe und -Parameter

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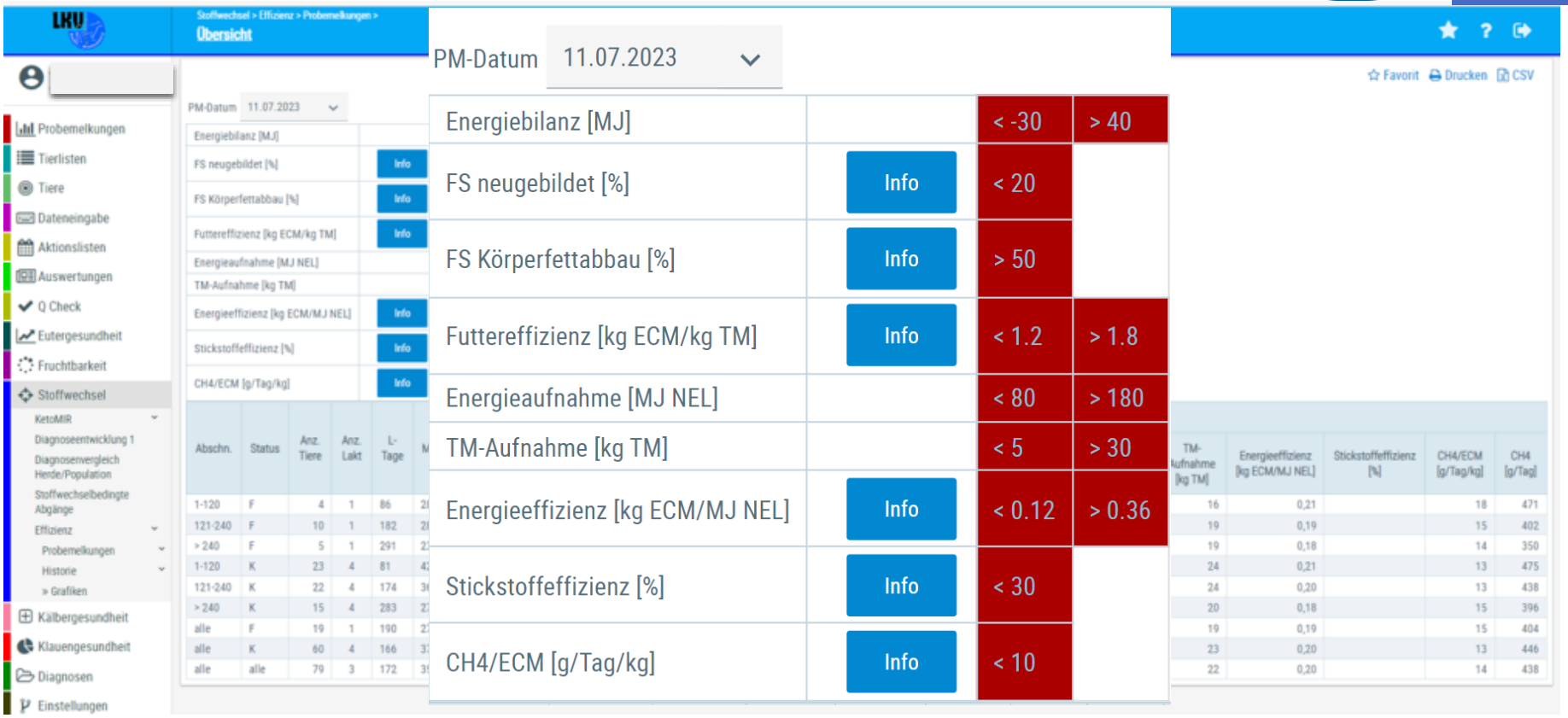
121-240	F	9	1	197	24.7	26.5	4.41	3.80	18	4.84	125	1.16	24	35	29	9	0.190	142	1.33	16		
>240	F	14	1	286	21.3	22.8	4.45	3.80	16	4.92	115	1.17	23	38	29	6	0.190	120	1.36	19		
1-120	K	21	4	58	34.1	35.1	4.30	3.28	17	4.90	192	1.32	21	44	36	-9	0.240	146	1.86	12	28.6	4.8
121-240	K	20	3	181	29.2	31.0	4.41	3.69	18	4.74	419	1.20	24	36	30	11	0.200	159	1.42	16		
>240	K	18	4	297	21.8	23.2	4.50	3.94	15	4.47	278	1.14	22	41	31	23	0.180	128	1.41	21		
alle	F	33	1	195	23.4	24.8	4.40	3.66	17	4.92	105	1.21	23	38	30	6	0.200	124	1.47	17	10	0
alle	K	59	3	173	28.7	30.1	4.40	3.62	17	4.71	295	1.22	22	40	32	8	0.210	145	1.58	16	28.6	4.8
alle	alle	92	3	181	26.8	28.2	4.40	3.64	17	4.79	227	1.22	23	40	31	7	0.210	137	1.54	16	22.6	3.2

FE – Feed Efficiency - in the LKV Herd Manager*



* The LKV herd manager is developed within the RDV cooperation and is in use at every RDV partner - FeMIR could be used for all RDV cows in the future (approx. 2.3 mio.)

FE – Feed Efficiency - in the LKV Herd Manager

- Is the ratio of the amount of milk produced (kg ECM) to the amount of feed consumed (kg DM).
- Provides information on the conversion of the ingested feed quantity into ECM
- Method to calculate the FE: $$\textbf{FE} = \frac{\textbf{ECM kg cow/day}}{\textbf{kg DMI cow/day}}$$
- Warning values: < 1,2 to > 1,8 (kg ECM/kg DMI)

➡ Estimated from milk spectral data, allows for group-level interpretation to finer screening

FE – Feed Efficiency - in the LKV Herd Manager

Parameter: Futtereffizienz [kg ECM/kg TM]

Futtereffizienz [kg ECM/kg TM] | Info | < 1.2 | > 1.8

Abschn.	Status	Anz. Tiere	Anz. Lakt	L-Tage	MKg	ECM	F%	E%	L%	H	Anteil KM2	Anteil KM3	Futtereffizienz [kg ECM/kg TM]											
													11.07.23	06.06.23	09.05.23	12.04.23	10.03.23	07.02.23	04.01.23	06.12.22	03.11.22	04.10.22	01.09.22	04.07.22
1-120	F	13	1	69	27,2	25	3,89	3,35	4,87	22	0,0	0,0	1,64	1,87	1,86	1,90	1,76	2,13	1,51	1,67	1,77	1,74	1,60	
121-240	F	11	1	177	27,7	26	3,79	3,52	4,85	16	0,0	0,0	1,43	1,49	1,59	1,63	1,77	1,64	1,61	2,02				
> 240	F	7	1	289	22,2	24	4,62	3,83	4,81	17	0,0	0,0	1,30	1,29	1,32	1,36	1,41	1,41	1,44	1,56	1,70	1,69	1,87	
1-120	K	32	4	72	41,3	38	3,50	3,30	4,82	19	3,1	3,1	1,61	1,78	1,90	1,86	1,28	1,29	1,33	1,37	1,49	1,42	1,51	1,62
121-240	K	30	4	176	35,6	33	3,65	3,39	4,76	19	0,0	0,0	1,47	1,51	1,57	1,67	1,67	1,69	1,51	1,39	1,38	1,38	1,42	1,52
> 240	K	27	4	298	24,8	24	4,07	3,62	4,70	18	0,0	0,0	1,33	1,37	1,36	1,45	1,45	1,47	1,51	1,62	1,73	1,72	1,54	1,39
alle	F	31	1	157	26,3	25	4,01	3,51	4,85	19	0,0	0,0	1,44	1,52	1,55	1,58	1,66	1,59	1,50	1,66	1,72	1,71	1,82	
alle	K	89	4	176	35,6	32	3,68	3,40	4,77	19	1,1	1,1	1,50	1,57	1,62	1,64	1,51	1,47	1,44	1,44	1,52	1,45	1,48	1,54
alle	alle	120	3	171	33,6	30	3,75	3,43	4,79	19	0,8	0,8	1,49	1,56	1,61	1,63	1,55	1,49	1,45	1,47	1,54	1,47	1,48	1,54

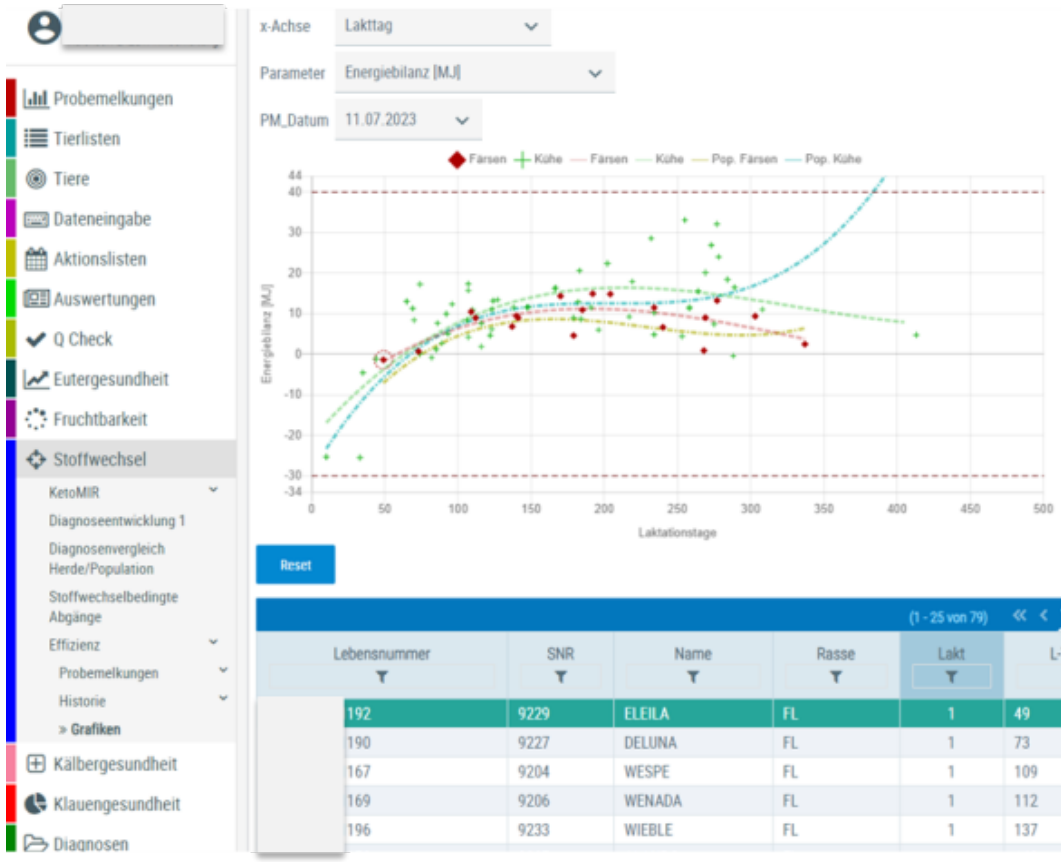
FE – Feed Efficiency - in the LKV Herd Manager

FE – Feed Efficiency - in the LKV Herd Manager*

- Low values when cows do not sufficiently convert the feed they consume into milk.
  - ✓ Consequence: fatty degeneration of the cow or alternative use of energy in the body.
- High values, when cows take in too little feed and break down body substance.
  - ✓ Consequence: Weight loss of the cow or alternative use of energy in the body.

- Factors influencing too low / too high energy efficiency
  - ✓ Milk quantity
  - ✓ Persistence
  - ✓ No optimal feed intake:
    i. feed table condition
    ii. animal feeding ratio
    iii. feed availability
    iv. feed quality

Energy Balance - in the LKV Herd Manager

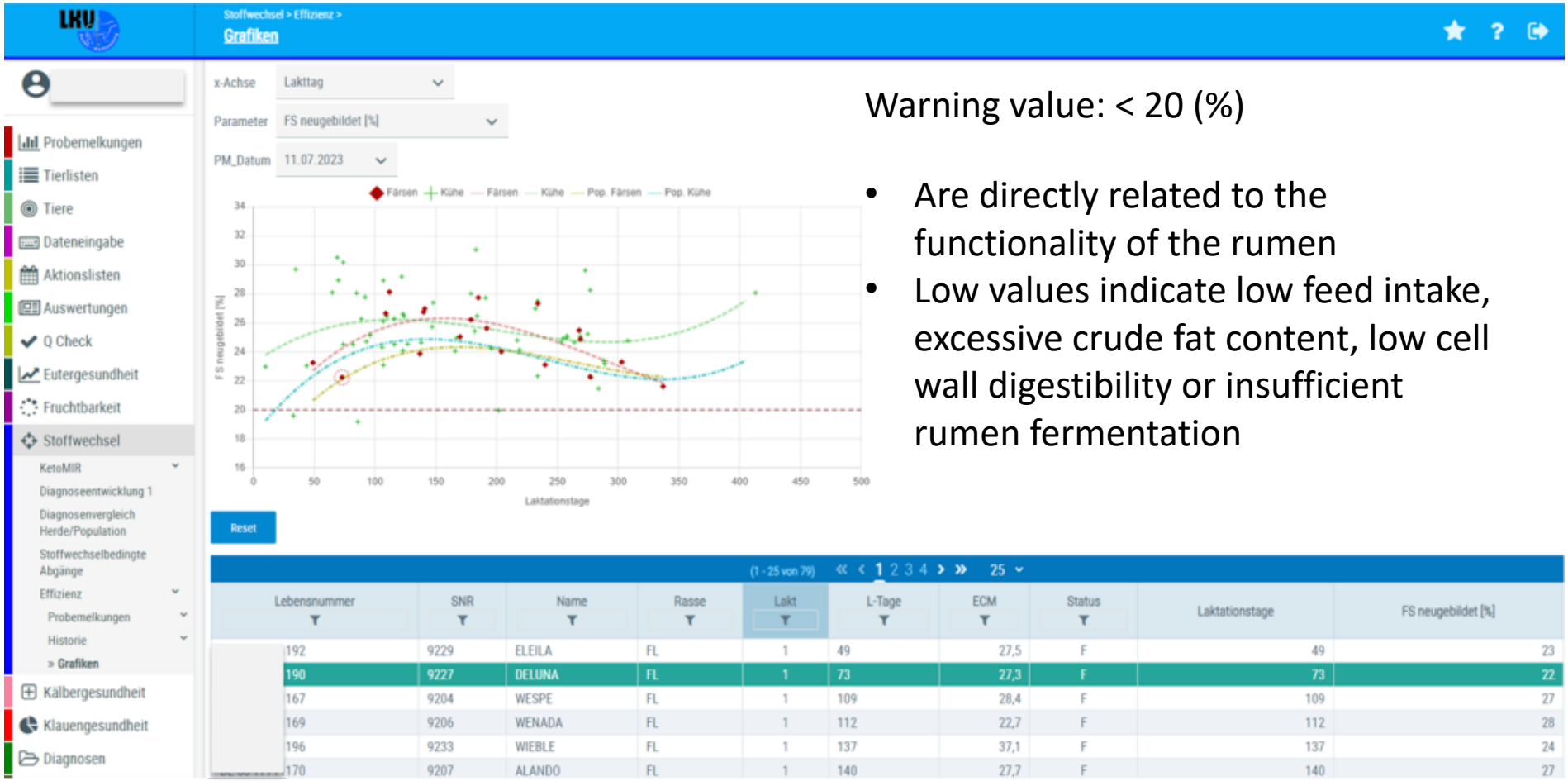


Lebensnummer	SNR	Name	Rasse	Lakt	L-Tage	ECM	Status	Laktationstage	Energiebilanz [MJ]
192	9229	ELEILA	FL	1	49	27,5	F	49	-1
190	9227	DELUNA	FL	1	73	27,3	F	73	1
167	9204	WESPE	FL	1	109	28,4	F	109	11
169	9206	WENADA	FL	1	112	22,7	F	112	9
196	9233	WIEBLE	FL	1	137	37,1	F	137	7

Warning value: < -30 to > 40 (MJ NEL/d)

Energy Balance = Energy Intake – (energy required for body maintenance + production and gestation)

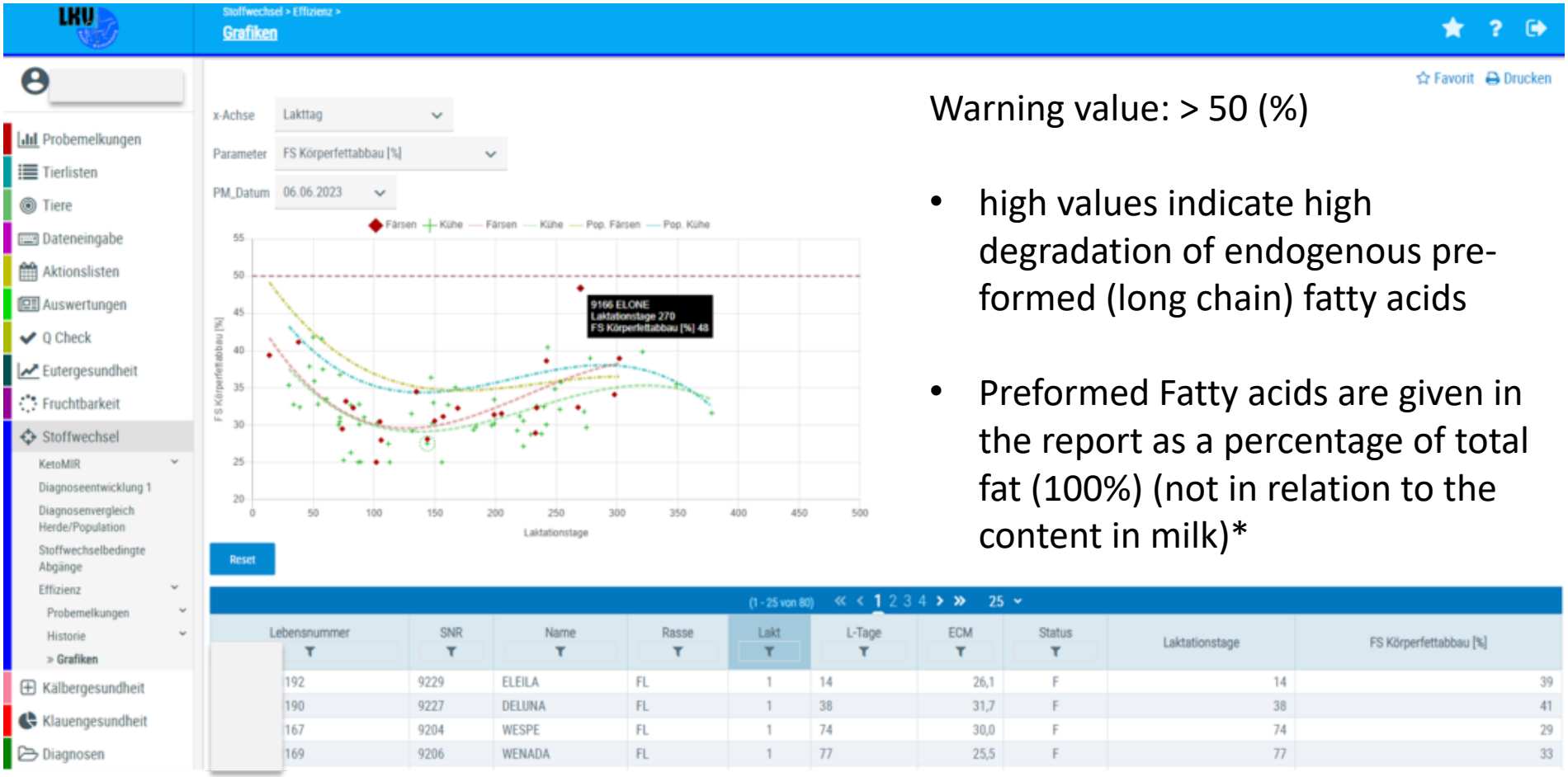
DeNovo FA - in the LKV Herd Manager



Warning value: < 20 (%)

- Are directly related to the functionality of the rumen
- Low values indicate low feed intake, excessive crude fat content, low cell wall digestibility or insufficient rumen fermentation

Preformed FA - in the LKV Herd Manager

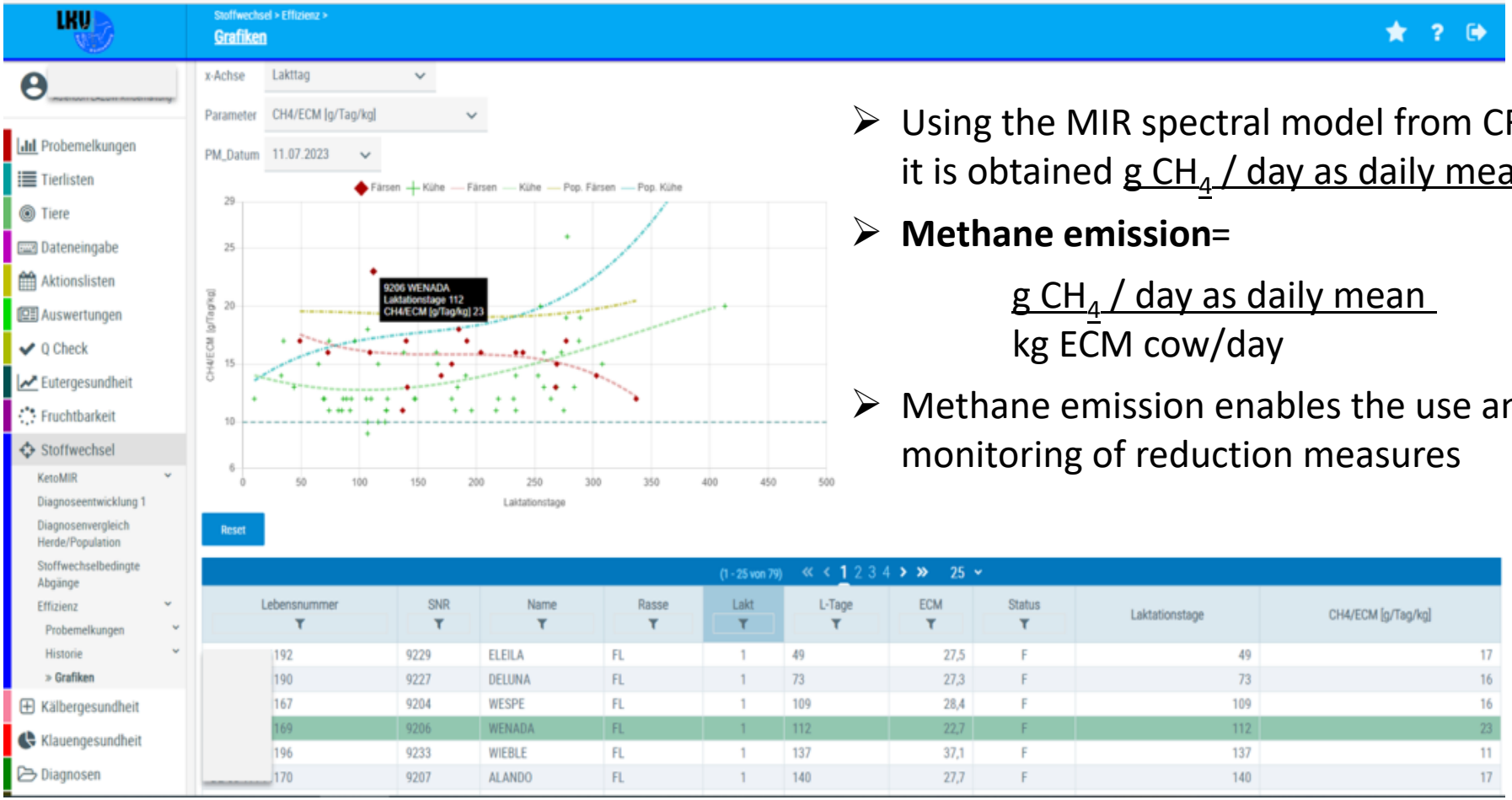


Warning value: > 50 (%)

- high values indicate high degradation of endogenous pre-formed (long chain) fatty acids
- Preformed Fatty acids are given in the report as a percentage of total fat (100%) (not in relation to the content in milk)*

*Barbano, 2019 New milk mid-FTIR metrisch for dairy cattle management. DLQ-Milch bietet mehr!

Methane/ECM - in the LKV Herd Manager*



- Using the MIR spectral model from CRA-W it is obtained g CH_4 / day as daily mean
- **Methane emission**=

  g CH_4 / day as daily mean
  kg ECM cow/day
- Methane emission enables the use and monitoring of reduction measures

Next Steps FeMIR-Feed/Energy Efficiency - Report

Further action in Baden-Württemberg:

- Implementation of continuous training
- Preparation of leaflets
- Producing of short videos

Outlook for RDV Partners

- Adoption of FeMIR formulas
  - ReMissionDairy (remission-dairy.de)
  - Fütterungsmonitoring – Die Milchkontrolle - Infothek (die-milchkontrolle.de)
- Adoption in Herd Manager of Efficiency Tool

Feeding and Energy Efficiency MIR (FeMIR) Report - the new MIR advisory tool