life farm4more

Climate Action | Green Feed | Biorefinery

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WHAT YOU CAN EXPECT…

- Project Team
- Project scope and objectives
- Biochar and Green Biorefinery technology
- Biorefinery products characteristics
- Feeding tests and preliminary results
- Outlook

FARM4MORE CONSORTIUM

In total 6 partners from Ireland and Austria

UCD DUBLIN

tbw RESEARCH

BRID

HBLFA Raumberg-Gumpenstein Landwirtschaft

BANTRY MARINE RESEARCH STATION

biocharNergy

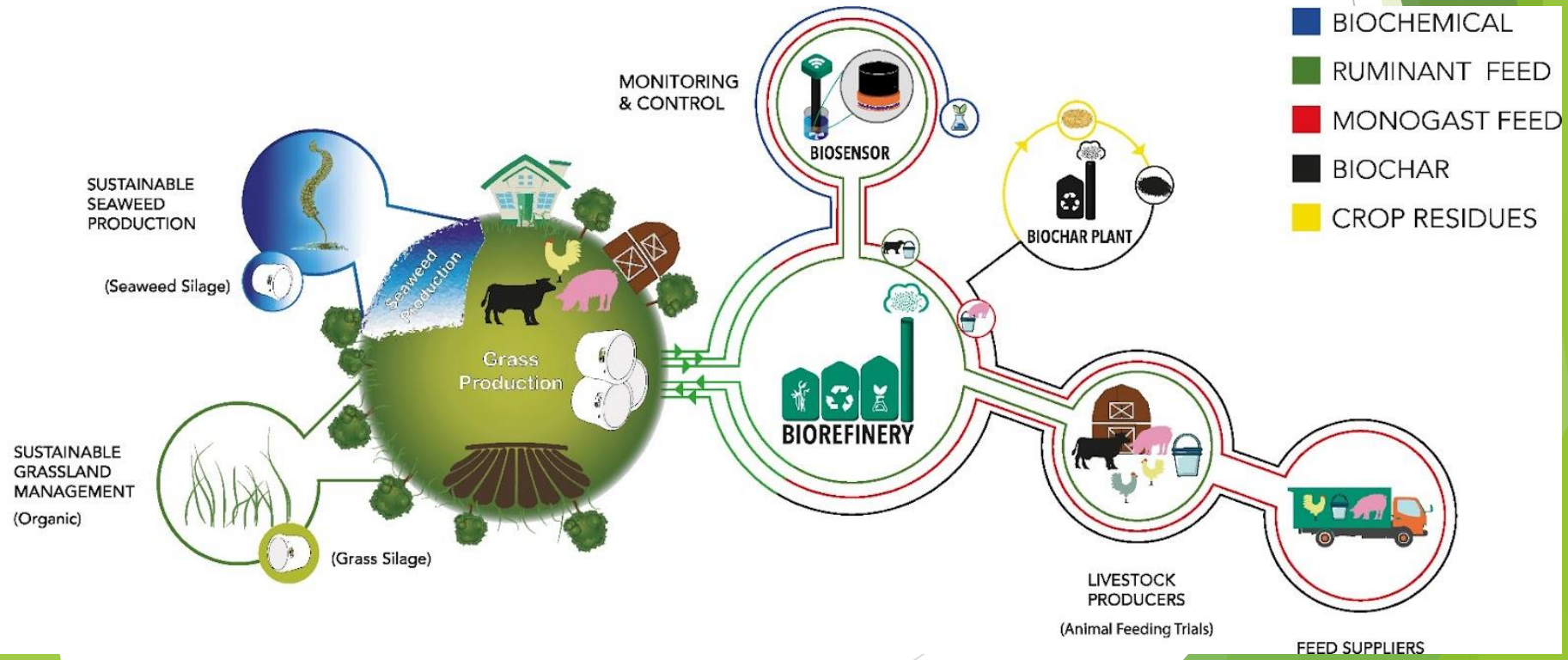
Fundings from

An Roinn Comhshaoil, Aeráide agus Cumarsáide
Department of the Environment, Climate and Communications

Life

PROJECT SCOPE

- Demonstration of a **Green Biorefinery process** for organic feeds: ruminates (cattle) & monogastric (chicken, pigs..)
- Demonstration of a **small scale Biochar process** to deliver high quality biochar suitable as feed additive
- **Impact Assessment** of value chain (LCA, technical& economical& environmental assessment)
- **Prepare implementation** - define scenarios - stakeholder interaction



PROJECT OBJECTIVES

- **Key objective**
  Delivering on climate mitigation impacts in farming by demonstration new feed strategies
  - **implementing products from green biorefining and biochar**
    - grass press cake as dairy feed
    - protein/ polypeptides/ amino acids concentrates for chicken and pigs feed products
    - biochar as feed additive
  - **Perform feed test** with "new feeds" to evaluate performance
  - To **deliver on reduced emissions** (GHG, ammonia and phosphor) in farming/dairy farming/animal production
  - Provide **strategies and scenarios for implementation**
  - Dissemination and **stakeholder involvement**

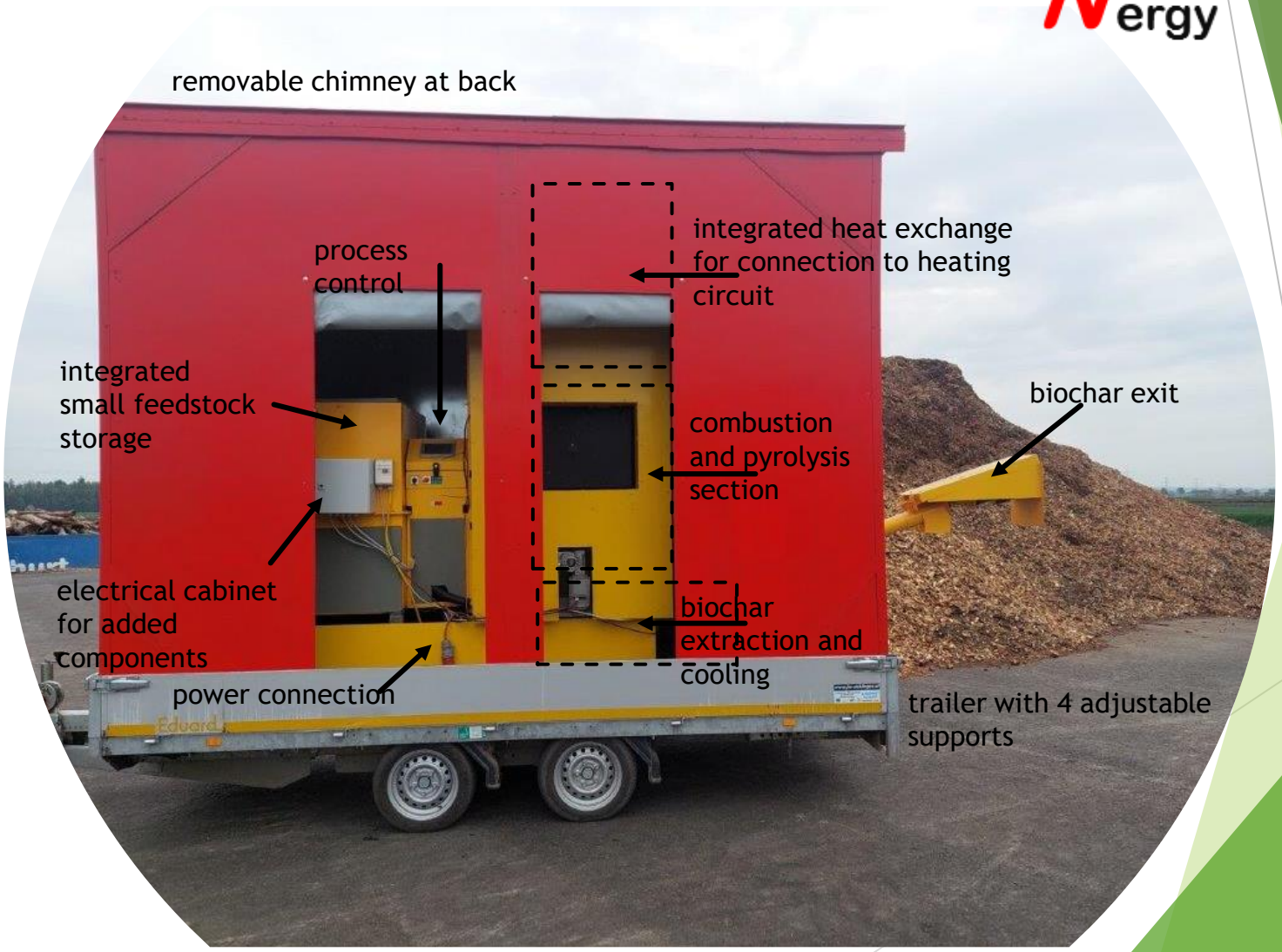
SMALL SCALE BIOCHAR PROTOTYPE

biocharNergy

- Biochar prototype has app.100 KW $_{thm}$ output
- Feedstocks: wood ships/pellets and husks
- Biochar quality is highly dependent on process parameters
- Mobile prototype
- Status of Implementation
  Prototype in commissioning phase
  EBC – European Biochar Certificate audit in progress
- Commercialisation Strategy
  Numbering up by offering low-cost implementation

SMALL SCALE BIOCHAR PROTOTYPE

biocharNergy



Green Biorefinery

- **Demonstration of a green biorefinery for organic certified feed products**
  - **Raw materials: grass/clover/legumes mixtures**
  - **Process steps**
    - High quality silage making
    - Extraction process/ pressing: → juice & pulp (solids)
    - Juice processing to accomplish feed properties, evaporation to concentrate (60-65%dm) for monogastric feed applications
    - Grass pulp conservation (ensiling, drying)
    - Alternative use of pulp for biogas process
  - **Products**
    - Hydrolysed protein (PPs/AAs) concentrates as alternative Protein
    - Grass press cake for feed (direct use/silage/ dried & pelletised

GREEN BIOREFINERY IMPLEMENTATION

- Implementation of green biorefinery is executed in 2 phases

  1st phase: small scale mobile pilot
  (1000kg/h) to generate prototype products for feed tests

  2nd phase: full scale green biorefinery
  to process 10.000 t/a organic feedstocks located in Japons

GREEN BIOREFINERY PROTOTYPING

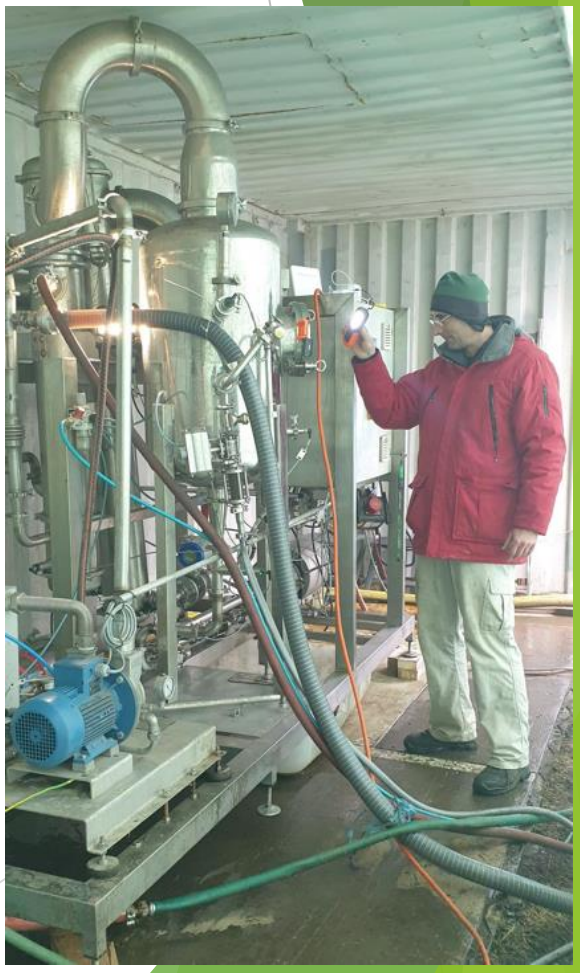
- July 2021 – GBR campaigning at HBLFA Raumberg - Gumpenstein

Green Biorefining Campaign at HBLFA –Raumberg - Gumpenstein

…and who will do the dishes?

EVAPORATION TRAILS AT DIFFERENT SCALES

- Industrial scale: 3-effect fall film evaporator
- Pilot scale- on site evaporation



PROTOTYPE - NEW CHICKEN FEEDS

- Mixing 14 % AA-concentrate into 3 tons of pre-mixed feed, homogeneously!

- Final feed pellet including AA concentrates

Overview Feeding Tests

- **Biochar as feed additive** for ruminates and chicken to evaluate
  - reduction of methane emission in cattle breeding,
  - reduction of ammonia emission in chicken fattening.

- Characterisation/ feed value of press cake and CP/AA concentrates
- Storability / Re-ensiling of press cake

- **Grass silage press cake** as ruminates feed (dairy cows, organic)
- **CP/AA concentrates** integrated in chicken feed

- Feeding test nearly finished, but data not yet complete analyzed

RE-ENSILING

Re-ensiling of **silage press-cakes after extraction**
small scale (60L) and round bales scale (app 800-1000kg)

RE-ENSILING

Re-ensiling of **silage press-cake works well** without additives needed if done properly and within 1 day

parameter	abbrev.	unit	silage absolut (benchmark)			re-ensiled presscake absolut			re-ensiled presscake relative difference to benchmark [%]		
			grass (pre trial)	grass/clover	red clover	grass (pre trial)	grass/clover	red clover	grass (pre trial)	grass/clover	red clover
Dry matter	DM	g/kg FM	419.6^{C}	316.3^{B}	249.4^{A}	372.0^{a}	369.2^{a}	372.3^{a}	88.7^{a}	116.9^{b}	149.3^{c}
nutrients											
Crude protein	XP	g/kg DM	135.1^{A}	145.8^{A}	158.8^{B}	101.7^{a}	116.2^{b}	126.0^{c}	75.4^{a}	79.7^{a}	79.5^{a}
Ammonia	NH_4	g/kg DM	1.8^{A}	2.3^{AB}	2.7^{B}	1.2^{a}	1.3^{a}	1.2^{a}	67.0^{b}	54.5^{ab}	47.1^{a}
NH_4 of N_{total}		%	8.3^{A}	9.8^{A}	10.3^{B}	7.3^{b}	6.7^{ab}	6.0^{a}	87.9^{b}	68.3^{a}	59.8^{a}
Neutral detergent fiber	NDF	g/kg DM	496.3^{C}	390.2^{B}	342.8^{A}	634.5^{c}	492.5^{b}	440.0^{a}	127.9^{a}	126.2^{a}	128.5^{a}
Acid detergent fiber	ADF	g/kg DM	336.3^{C}	294.9^{A}	309.0^{AB}	433.7^{a}	402.8^{a}	411.8^{a}	129.2^{a}	136.8^{a}	133.4^{a}
Acid detergent lignin	ADL	g/kg DM	41.0^{A}	32.9^{A}	39.3^{A}	49.3^{b}	40.5^{a}	47.6^{b}	122.5^{a}	123.3^{a}	121.5^{a}
Non fibre carbohydrates	NFC	g/kg DM	198.8^{A}	280.6^{B}	279.6^{B}	102.3^{a}	184.0^{b}	228.8^{b}	51.4^{a}	65.7^{b}	82.0^{c}
Sugar	XZ	g/kg DM		86.7^{B}	40.4^{A}		6.5^{a}	5.5^{a}		7.6^{a}	13.7^{b}
Crude fiber	XF	g/kg DM	292.3^{B}	236.1^{A}	229.8^{A}	374.2^{b}	300.4^{a}	288.6^{a}	128.4^{a}	127.3^{a}	125.9^{a}
Crude fat	XL	g/kg DM	21.6^{B}	17.5^{A}	22.3^{B}	22.0^{a}	28.1^{b}	27.1^{b}	101.7^{a}	160.5^{c}	121.6^{b}
Crude ash	XA	g/kg DM	87.1^{A}	106.7^{B}	110.7^{C}	63.0^{a}	81.2^{b}	884.4^{b}	72.4^{a}	76.2^{a}	76.2^{a}
minerals											
Calcium	Ca	g/kg DM	8.4^{A}	12.3^{B}	14.5^{C}	6.3^{a}	10.2^{b}	12.3^{c}	75.1^{a}	82.9^{b}	84.8^{b}
Phosphorus	P	g/kg DM	3.08^{A}	3.02^{A}	3.03^{A}	1.8^{a}	1.5^{a}	1.5^{a}	58.6^{a}	50.5^{a}	50.0^{a}
Magnesia	Mg	g/kg DM	1.9^{A}	2.3^{B}	2.8^{C}	1.3^{a}	1.5^{a}	1.9^{b}	66.9^{a}	66.0^{a}	66.8^{a}
Potassium	K	g/kg DM	28.1^{A}	30.2^{AB}	31.7^{B}	13.4^{a}	17.2^{b}	18.1^{b}	48.6^{a}	58.2^{a}	58.8^{a}
Sodium	Na	mg/kg DM	129^{A}	93^{A}	105^{A}	135^{a}	172^{a}	138^{a}	110.0^{a}	193.9^{a}	143.1^{a}
Iron	Fe	mg/kg DM	900^{B}	447^{A}	519^{A}	1087^{a}	676^{a}	743^{a}	121.7^{a}	152.1^{a}	143.4^{a}
Mangan	Mn	mg/kg DM	76.6^{B}	50.8^{A}	44.7^{A}	60.1^{b}	40.7^{a}	37.5^{a}	83.8^{a}	80.3^{a}	79.0^{a}
Zinc	Zn	mg/kg DM	24.1^{A}	25.7^{A}	28.1^{B}	96.9^{b}	19.2^{a}	21.0^{a}	403^{b}	74.7^{a}	75.0^{a}
Copper	Cu	mg/kg DM	6.2^{A}	6.9^{B}	8.6^{C}	6.5^{a}	6.9^{a}	8.8^{b}	104.8^{a}	99.7^{a}	102.1^{a}
fermentation											
pH			4.68^{A}	4.75^{A}	4.58^{A}	4.16^{b}	4.10^{a}	4.22^{c}	88.9^{ab}	86.2^{a}	92.1^{b}
Lactic acid	La	g/kg DM	35.8^{A}	36.5^{A}	56.9^{B}	57.1^{a}	75.3^{b}	71.3^{ab}	170.1^{a}	210.0^{a}	126.2^{a}
Acetic acid	Aa	g/kg DM	11.0^{A}	11.4^{A}	14.2^{B}	11.9^{a}	14.0^{b}	13.4^{b}	108.8^{ab}	123.3^{b}	94.5^{a}
Propionic acid	Pa	g/kg DM	1.5^{AB}	1.5^{A}	2.1^{B}	0.84^{a}	0.95^{a}	0.96^{a}	56.7^{a}	61.8^{a}	46.0^{a}
Butyric acid	Ba	g/kg DM	2.2^{A}	3.5^{A}	6.0^{B}	1.6^{a}	2.9^{b}	3.9^{b}	70.9^{a}	81.6^{a}	65.4^{a}
Ethanol	Eth	g/kg DM	10.7^{A}	6.1^{A}	6.7^{A}	5.1^{a}	4.9^{a}	4.2^{a}	58.3^{a}	80.1^{a}	63.0^{a}
Volatile organic compounds	VOC	g/kg DM	61.2^{A}	59.1^{B}	85.9^{C}	76.5^{a}	93.7^{b}	98.0^{b}	134.4^{a}	167.5^{a}	109.4^{a}

Reference: R. Resch et al, proceedings, 76. ALVA-Tagung, 30.-31.5.2022, Graz

PRESS JUICE

composition of raw **silage press juice**

Juice is further polished for feed application

			silage absolut (benchmark)			raw juice absolut			raw juice relative difference to benchmark [%]		
parameter	**abbrev.**	**unit**	grass (pre trial)	grass/clover	red clover	grass (pre trial)	grass/clover	red clover	grass (pre trial)	grass/clover	red clover
Dry matter	DM	g/kg FM	419.6^{C}	316.3^{B}	249.4^{A}	102.0^{a}	114.8^{a}	123.3^{a}	24.3^{a}	36.2^{b}	49.4^{c}
nutrients											
Crude protein	XP	g/kg DM	135.1^{A}	145.8^{A}	158.8^{B}	235.9^{b}	230.9^{a}	208.3^{a}	174.8^{c}	139.9^{b}	131.3^{a}
Ammonia	NH_4	g/kg DM	1.8^{A}	2.3^{AB}	2.7^{B}	4.9^{a}	5.9^{b}	6.3^{b}	273.0^{a}	253.6^{a}	240.7^{a}
NH_4 of N_{total}		%	8.3^{A}	9.8^{A}	10.3^{B}	12.4^{a}	17.2^{b}	17.9^{b}	150.1^{a}	176.8^{a}	178.3^{a}
Neutral detergent fiber	NDF	g/kg DM	496.3^{C}	390.2^{B}	342.8^{A}						
Acid detergent fiber	ADF	g/kg DM	336.3^{C}	294.9^{A}	309.0^{AB}						
Acid detergent lignin	ADL	g/kg DM	41.0^{A}	32.9^{A}	39.3^{A}						
Non fibre carbohydrates	NFC	g/kg DM	198.8^{A}	280.6^{B}	279.6^{B}	416.9^{a}	479.3^{b}	414.0^{a}	210.3^{c}	170.7^{b}	148.3^{a}
Sugar	XZ	g/kg DM		86.7^{B}	40.4^{A}		42.4^{b}	17.6^{a}		49.0^{b}	44.5^{a}
Crude fiber	XF	g/kg DM	292.3^{B}	236.1^{A}	229.8^{A}						
Crude fat	XL	g/kg DM	21.6^{B}	17.5^{A}	22.3^{B}						
Crude ash	XA	g/kg DM	87.1^{A}	106.7^{B}	110.7^{C}	184.4^{a}	183.7^{a}	185.9^{a}	211.7^{c}	172.3^{b}	167.9^{b}
minerals											
Calcium	Ca	g/kg DM	8.4^{A}	12.3^{B}	14.5^{C}	14.2^{a}	16.6^{b}	18.3^{c}	170.1^{c}	135.2^{b}	126.6^{a}
Phosphorus	P	g/kg DM	3.08^{A}	3.02^{A}	3.03^{A}	8.3^{b}	6.6^{a}	6.3^{a}	269.7^{b}	218.8^{a}	209.8^{a}
Magnesia	Mg	g/kg DM	1.9^{A}	2.3^{B}	2.8^{C}	4.3^{a}	4.4^{a}	4.9^{b}	227.9^{b}	189.5^{a}	175.8^{a}
Potassium	K	g/kg DM	28.1^{A}	30.2^{AB}	31.7^{B}	64.1^{b}	53.2^{a}	52.9^{a}	231.6^{b}	179.9^{a}	171.9^{a}
Sodium	Na	mg/kg DM	129^{A}	93^{A}	105^{A}	493^{a}	550^{a}	439^{a}	399.4^{a}	473.0^{a}	643.8^{a}
Iron	Fe	mg/kg DM	900^{B}	447^{A}	519^{A}	2234^{b}	840^{a}	911^{a}	252.3^{b}	189.4^{ab}	175.0^{a}
Mangan	Mn	mg/kg DM	76.6^{B}	50.8^{A}	44.7^{A}	150.8^{c}	84.9^{b}	68.6^{a}	197.2^{c}	167.2^{b}	153.7^{a}
Zinc	Zn	mg/kg DM	24.1^{A}	25.7^{A}	28.1^{B}	55.5^{a}	70.9^{a}	66.7^{a}	230.5^{a}	276.2^{a}	238.1^{a}
Copper	Cu	mg/kg DM	6.2^{A}	6.9^{B}	8.6^{C}	5.3^{a}	6.1^{b}	7.1^{c}	84.7^{a}	87.2^{a}	82.4^{a}
fermentation											
pH			4.68^{A}	4.75^{A}	4.58^{A}	5.00^{b}	4.75^{a}	4.63^{a}	106.9^{a}	99.9^{a}	101.1^{a}
Lactic acid	La	g/kg DM	35.8^{A}	36.5^{A}	56.9^{B}	106.5^{ab}	81.3^{a}	128.2^{b}	316.7^{a}	221.5^{a}	225.3^{a}
Acetic acid	Aa	g/kg DM	11.0^{A}	11.4^{A}	14.2^{B}	31.3^{a}	26.9^{a}	31.2^{a}	287.5^{b}	234.6^{ab}	221.0^{a}
Propionic acid	Pa	g/kg DM	1.5^{AB}	1.5^{A}	2.1^{B}	3.7^{a}	4.5^{a}	4.2^{a}	247.6^{ab}	291.2^{b}	201.0^{a}
Butyric acid	Ba	g/kg DM	2.2^{A}	3.5^{A}	6.0^{B}	7.5^{a}	8.6^{a}	14.6^{b}	335.3^{b}	244.6^{a}	247.1^{ab}
Ethanol	Eth	g/kg DM	10.7^{A}	6.1^{A}	6.7^{A}	13.8^{a}	11.8^{a}	13.5^{a}	160.9^{a}	195.5^{a}	201.4^{a}
Volatile organic compounds	VOC	g/kg DM	61.2^{A}	59.1^{B}	85.9^{C}	162.8^{ab}	133.1^{a}	191.7^{b}	284.8^{a}	223.7^{a}	223.2^{a}

Preliminary Results from Feeding Tests

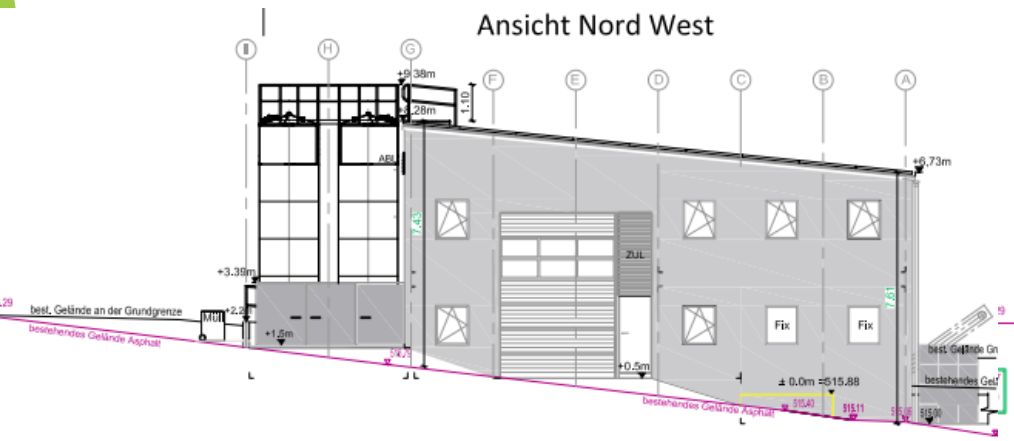
- Biochar as feed additive for ruminates/chickens
  - NO reduction of methane emission in cattle breeding;
  - NO reduction of ammonia emission in chicken fattening.

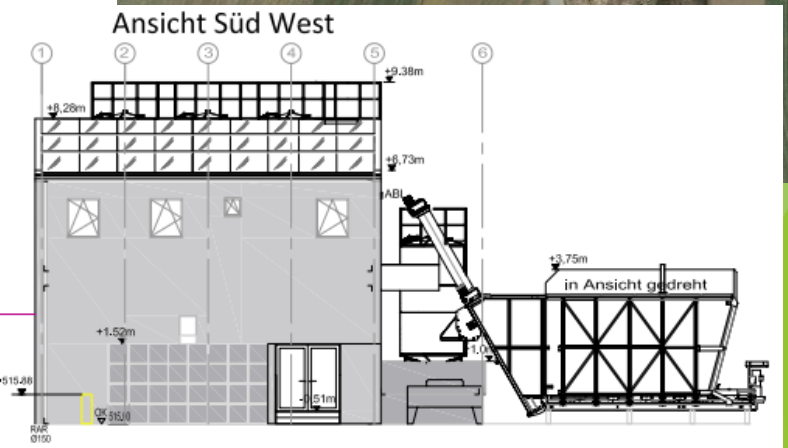
- Grass silage press cake for dairy cows (organic)
- No significant reduction in milk yield investigated
  when 50% of forage was replaced by press cake;
  press cake suitable fodder for cattle; long run trails needed.

- CP/AA concentrates integrated in chicken feed
  ongoing - final results pending;
  - 10% inclusion rate for concentrate in feed mixture
  - daily weight gains similar to reference group.

FULL-SCALE GREEN BIOREFINERY IMPLEMENTATION

- Implementation of full scale green biorefinery is progressing (Gewerberechtliche Genehmigung)
- Cooperation with *BioEnergie aus Japons*
- Supply chain 10.000 t/a organic silage
- Green biorefinery will be integrated at existing biogas plant Japons to share feedstock supply, utilities and surplus heat





ACKNOWLEDGEMENTS

Thank you!
More information on Farm4more
https://www.farm4more.ie

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This project has received funding from the Executive Agency for Small and Medium Sized Enterprises (EASME) under grant agreement LIFE18 CCM/IE/001195 and from the Department of The Environment, Climate & Communication (DECC). The EASME receives support from the European Union's LIFE Programme.

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