University of Natural Resources and Applied Life Sciences, Vienna

Biogas as a key technology within Biofuels oriented Biorefinery Concepts

Ao.Univ.Prof. Dr. Thomas Amon

University of Natural Resources
and Applied Life Sciences, Vienna

Objectives:

- To increase substantially the production of biofuels that are commercially viable, CO_2- efficient and compatible with vehicle engines.
- To promote the transition towards "second generation biofuels" which will be produced from a wider range of feedstock (including waste biomass and bio based products from industry).
- To promote the transition towards "fully integrated biorefinery concepts".
- To reduce competition for land and food. To produce biofuels in the most efficient way.

University of Natural Resources and Applied Life Sciences, Vienna

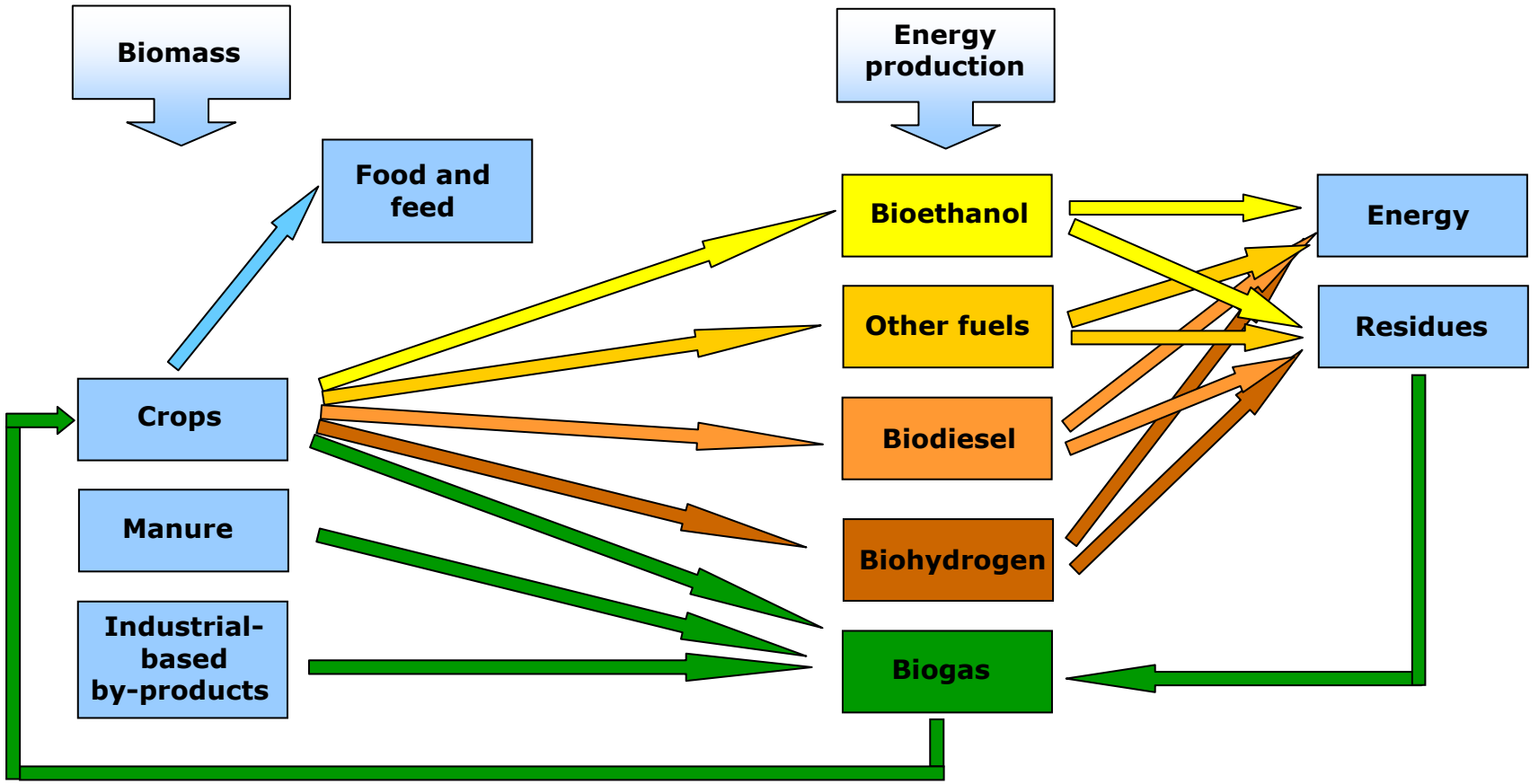
Selected ongoing projects

- Agricultural Resources for Biogas Production
- Polygeneration of bioethanol, biogas, heat and electricity by Sun Power Plant Project Ltd "S3P"
- Eu-Agro-Biogas: European biogas initiative to improve the yield of agricultural biogas plants (Coordinator)
- Can the transfer of veterinary antibiotics into soil can be reduced by biogas plants?
- Optimisation of acquisition and distribution logistics of large biogas plants

http://forschung.boku.ac.at/fis/suche.person_projekte?sprache_in=en&person_id_in=8

University of Natural Resources and Applied Life Sciences, Vienna

Fuel-oriented fully-integrated biorefinery system



University of Natural Resources and Applied Life Sciences, Vienna

Geographic allocation of field experiments in Austria

Experiments 2004 - 2005

New experiments 2006

Haidershofen
maize

Loimersdorf
wheat

Groß-Enzersdorf
maize, sunflower, sorghum

St.Margareten am Moos

Hundsheim

Lenzing, Schörfling a. AS, Schwanenstadt
wheat, rye, triticale

F.Sch.Tulln
sorghum, maize, sunflower

Irdning (Gumpenstein), **Admont** (Buchau) grass

Ruden
maize

Ludersdorf
maize, sorghum


Tulln


Stmk: Ilz


Raasdorf


Haidershofen

Maissorte: KWS 1393





1. Ernte: 18.7. 2. Ernte: 1.8. 3. Ernte: 17.8. 4. Ernte: 5.9. 5. Ernte: 28.9.

Sonnenblumensorte: PR64 H24





1. Ernte: 6.7. 2. Ernte: 18.7. 3. Ernte: 1.8. 4. Ernte: 17.8. 5. Ernte: 23.8.

University of Natural Resources and Applied Life Sciences, Vienna

Biogas production from maize:

Varieties: early or late ripening? Location?
Harvest: early or late?

1 harvest – 76 days of veg.	2 harvest – 89 days of veg.	4 harvest – 111 days of veg.	5 harvest – 132 days of veg.	6 harvest – 142 days of veg.
34 - Vierknotenstadium	51 - Rispenschieben	73 – frühe Milchreife	85 - Teigreife	89 - Vollreife

R&D Exampel 1: Polygeneration of bioethanol, biogas, heat and electricity by Sun Power Plant Project Ltd "S3P"

Feedstock and Energy output in a Fuel-oriented biorefinery concept "Bioethanol-Biogas"

University of Natural Resources and Applied Life Sciences, Vienna

Straw

11,6 t ha^{-1} a^{-1}

Maize corn

8,9 t ha^{-1} a^{-1}

Ethanol

22.560 kWh ha^{-1} a^{-1}

Stillage (DDGS)

Σ 22.560 kWh ha^{-1} a^{-1} 100%

Feedstock and Energy output in a Fuel-oriented biorefinery concept "Bioethanol-Biogas"

University of Natural Resources and Applied Life Sciences, Vienna

Straw

11,6 t ha^{-1} a^{-1}

Maize corn

8,9 t ha^{-1} a^{-1}

Biogas

Stillage

9.080 kWh ha^{-1} a^{-1}

Stillage

Ethanol

22.560 kWh ha^{-1} a^{-1}

Residue

Σ 31.640 kWh ha^{-1} a^{-1} 140%

Feedstock and Energy output in a Fuel-oriented biorefinery concept "Bioethanol-Biogas"

University of Natural Resources and Applied Life Sciences, Vienna

Straw

11,6 t ha^{-1} a^{-1}

Maize corn

8,9 t ha^{-1} a^{-1}

Biogas

Stillage

9.080 kWh ha^{-1} a^{-1}

Straw

26.510 kWh ha^{-1} a^{-1}

Stillage

Ethanol

22.560 kWh ha^{-1} a^{-1}

Residue

Σ 58.150 kWh ha^{-1} a^{-1} 258%

Feedstock and Energy output in a Fuel-oriented biorefinery concept "Bioethanol-Biogas"

University of Natural Resources and Applied Life Sciences, Vienna

Straw

11,6 t ha^{-1} a^{-1}

Maize corn

8,9 t ha^{-1} a^{-1}

Steam explosion

Biogas

Stillage

9.080 kWh ha^{-1} a^{-1}

Straw (Steam explosion)

35.980 kWh ha^{-1} a^{-1}

Stillage

Ethanol

22.560 kWh ha^{-1} a^{-1}

Residue

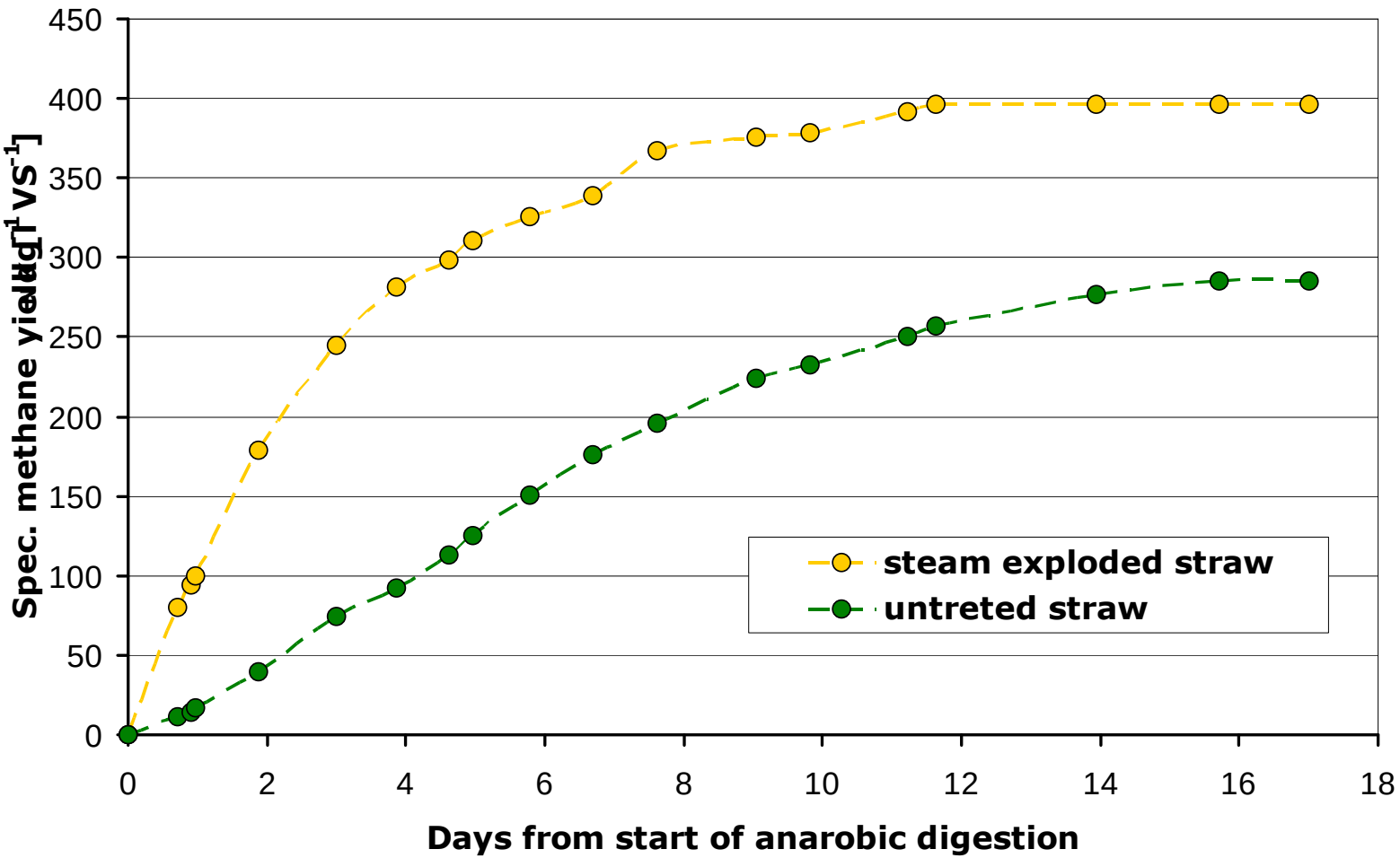
Σ 67.620 kWh ha^{-1} a^{-1} 300%

University of Natural Resources
and Applied Life Sciences, Vienna

Technical development of hydrolyses via steam-explosion

University of Natural Resources and Applied Life Sciences, Vienna

Methane yield from untreated and steam exploded wheat straw



University of Natural Resources and Applied Life Sciences, Vienna

R&D Exampel 2: Eu-Agro-Biogas; Online European substrate atlas/database

MEWM for substrates and mixtures of substrates from biorefinery systems

University of Natural Resources and Applied Life Sciences, Vienna

MEWM for substrates and mixtures of substrates from biorefinery systems

Supplement group	Supplement	Basic mixture	
		Pig manure	Maize silage
	(% FM)	(% FM)	(% FM)
Basic mixture	--	40	60
Group 1 maize draff (MD)	10	36	54
	30	28	42
	50	20	30
	70	12	18
Group 2 rape cake (RC)	10	36	54
	30	28	42
	50	20	30
	70	12	18
Group 3 crude glycerol (CG)	10	36	54
	30	28	42
	50	20	30
	70	12	18
Group 4 residues of starch production from maize (RSP maize)	10	36	54
	30	28	42
	50	20	30
	70	12	18
Group 5 residues of starch production from potatos (RSP potatos)	10	36	54
	30	28	42
	50	20	30
	70	12	18

MEVM – biofuels oriented & starch Biorefinery

Model 1: crude protein (XP), crude fat (XL), crude fiber (XF) and crude ash (XA)

Regression's equation	n	adj. r^2	r^2	Significance
CH_4 = 402,55*** (±31,05) – 3,20 (±0,74) XP*** + 4,27 (±0,87) XL*** + 0,23 (±1,61) XF – 2,27 (±1,03) XA*	50	0,7698	0,7886	***

Significance: * < 0,05; ** < 0,01; *** < 0,001

MEVM – biofuels oriented & starch Biorefinery

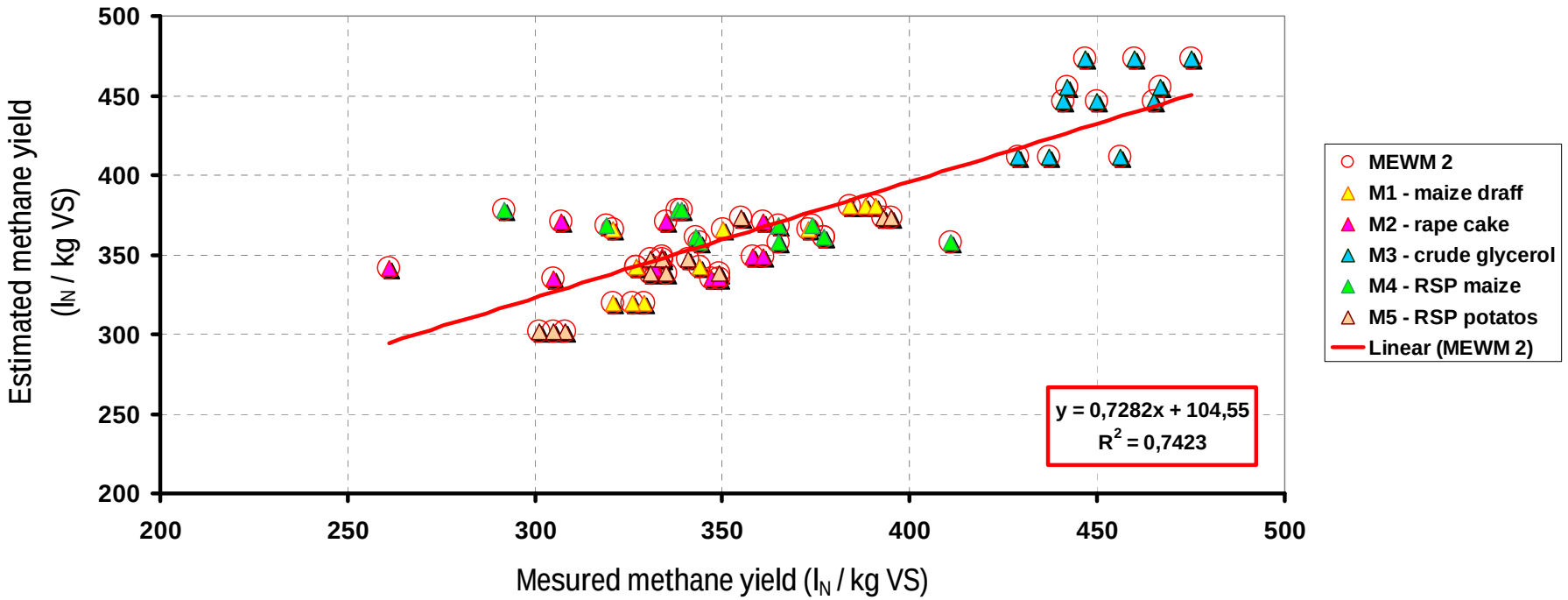
Model 2: crude protein (XP), crude fat (XL), ADL, hemicellulose (HCEL), cellulose (CEL), starch (STC) and sugar (SUG)

Regression's equation	n	adj. r^2	r^2	Significance
CH_4 = 306,03*** (±62,10) + 76,95 (±87,14) XP + 7,04 (±2,52) XL** + 1469,19 (±1523,06) ADL – 327,25 (±337,28) HCEL – 496,06 (±508,28) CEL + 454,98 (±462,2) STC – 444,58 (±486,66) SUG	50	0,8656	0,8848	***

Significance: * < 0,05; ** < 0,01; *** < 0,001

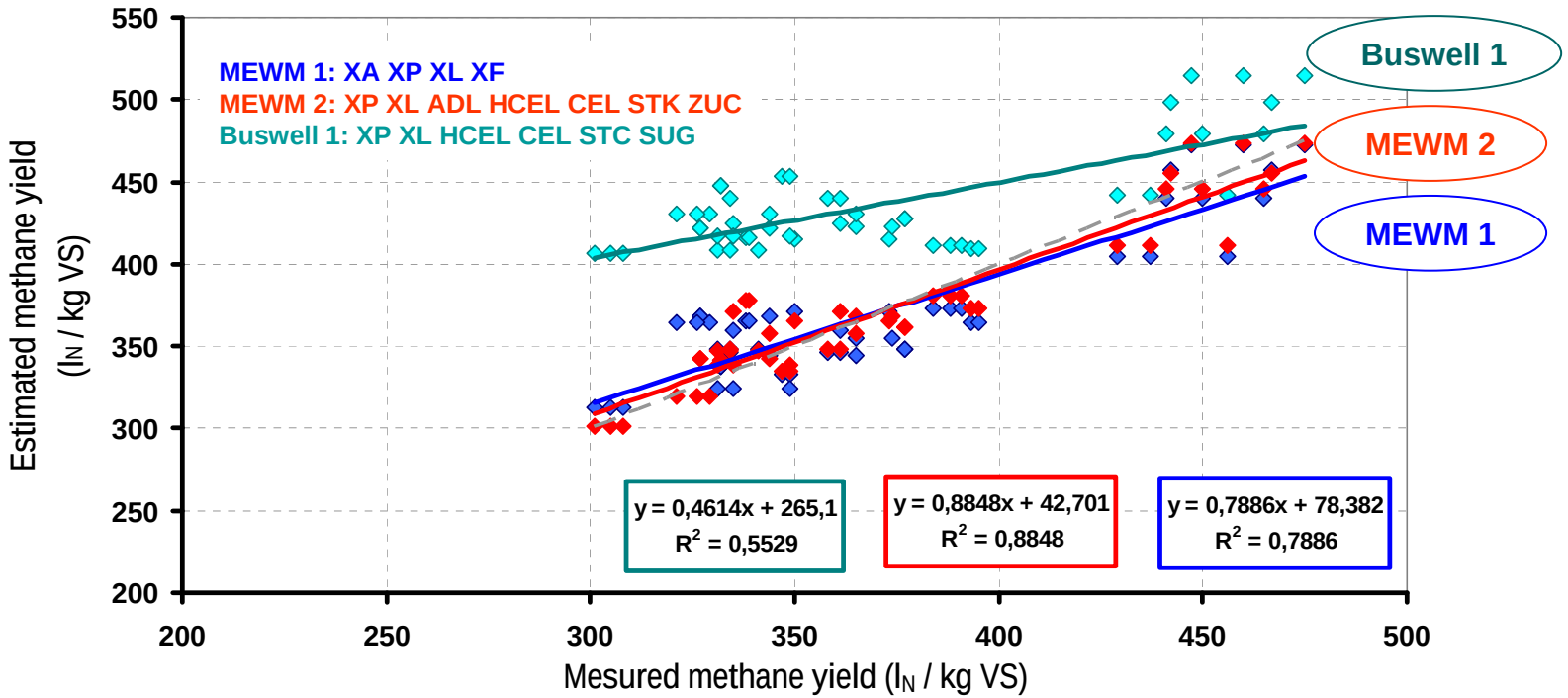
MEVM – biofuels oriented & starch Biorefinery

Comparison of mesured and estimated methane yield according MEWM 2 from diferent mixtures at the biorefinery system 2



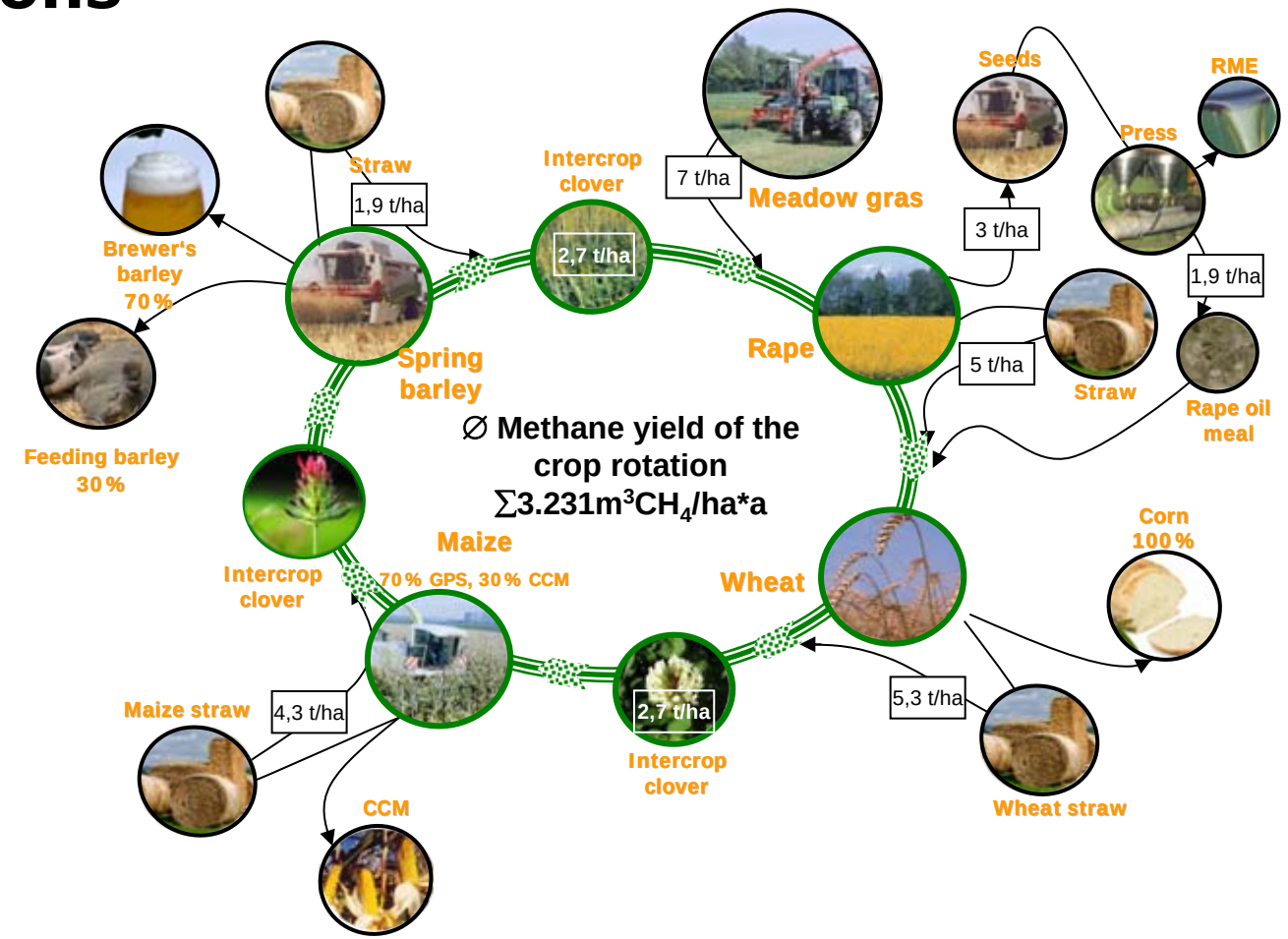
MEVM – biofuels oriented & starch Biorefinery

Comparison of mesured and estimated methane yield according MEWM 1 and 2 and Buswell equation from diferent mixtures at the biorefinery system 2



University of Natural Resources and Applied Life Sciences, Vienna

Biogas production from integrated biorefinery complexes and sustainable crop rotations



University of Natural Resources and Applied Life Sciences, Vienna

University of Natural Resources and Applied Life Sciences, Vienna

Department of Sustainable Agricultural Systems

ao.Univ.Prof. Dr. Thomas Amon
Dr. Katharina Hopfner-Sixt
DI. Alexander Bauer
DI Debora Fistarol Lyson
Dr. Vitaliy Kryvoruchko
Dr. habil. Barbara Amon
DI Vitomir Bodiroza
Dr. Dejan Milovanovic
Dr. Maximilian Götz
Mag. Violetta Simic
DI Herwig Mayr
DI Christian Leonhartsberg
Dr. Helmut Wagentristl

RTD Services

FORUM BIOGAS

founded June 2006

Peter-Jordan-Strasse 82
A-1190 Wien
Tel. +43-1-47654-3502
Fax. +43-1-47654-3527
E-mail: thomas.amon@boku.ac.at

http://www.forum-biogas.net

University of Natural Resources and Applied Life Sciences, Vienna

Biogaspotenziale in Österreich

Verfügbare Biomasse [Mio. t DM a^{-1}]	
Org. Wirtschaftsdünger	4.0
Energiepflanzen & Rückstände	13.0
Σ	**≈ 17.0**

GHG Minderung [Mio t CO_2 eq. a^{-1}]	
Energie Produktion	16.10
CH_4-Vermeidung	2.20
verbesserte Düngerqualität	0.05
Σ	**18.4**

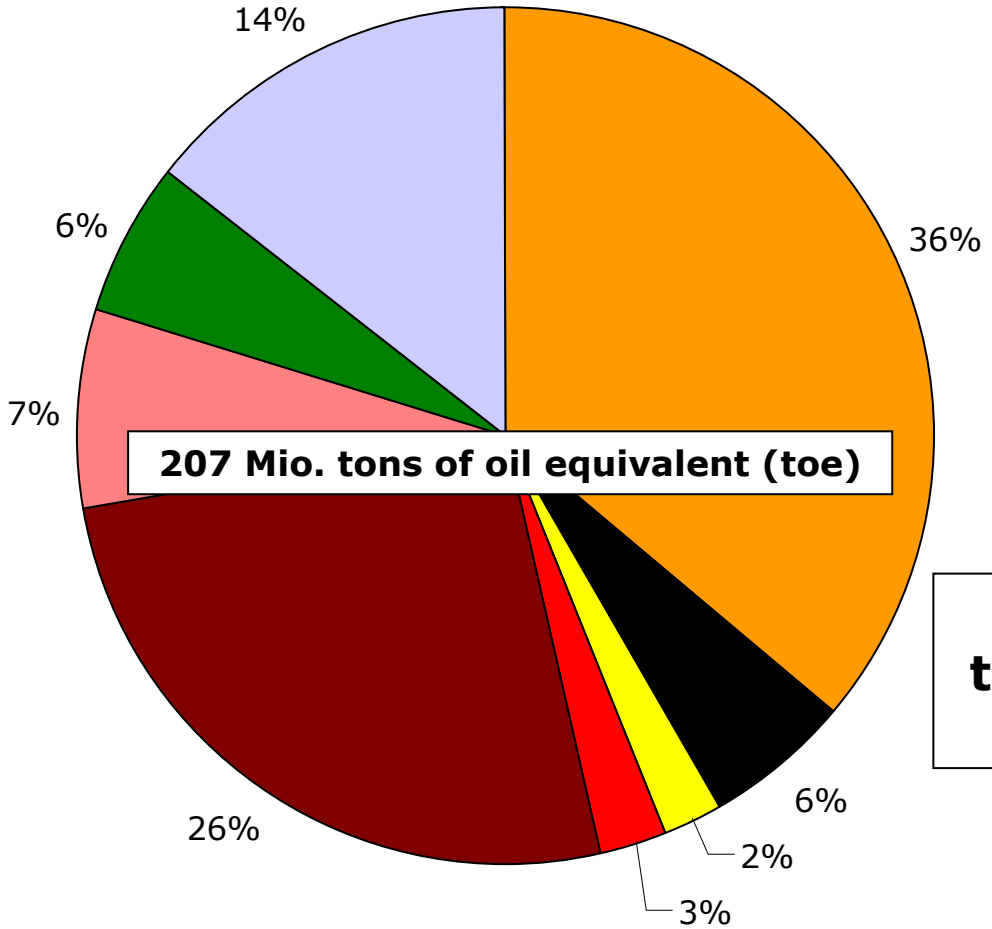
Energieproduktion (heat/power & fuel) [GWh a^{-1}]	
Wirtschaftsdünger	2.015
Grünland	5.456
Ackerkulturen & Rückstände	48.154
Σ	**55.625**
≈ power	**7.000 MW**

Sozioökonomische Auswirkungen [x 1000]	
Neue Biogasanlagen	10 – 15
zusätzliche Arbeitsplätze	12 – 16
Investitionen [Mio.€ a^{-1}]	≈ 430
Wertschöpfung [Mrd.€ a^{-1}]	2.0 – 3.0

University of Natural Resources
and Applied Life Sciences, Vienna

Methane energy potential of agricultural residues EU25 2005

(Source: Eurostat)



Energy consumption by transport of EU25 (2004) = 350 Mio. toe

(Source: Eurostat)