

Influences of bioenergy production and use on the agribusiness in Northwest Germany

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Biomass Collaborative
UC Davis**

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ISPA – University of Vechta

- **Institute of Spatial Analysis and Planning in Areas of Intensive Agriculture (ISPA)**
- **Departments (Director Professor Dr. Hans-Wilhelm Windhorst)**
 - Comparative spatial analysis
 - Geo- and agroecology with main focus soil science
 - Learning in rural areas and environmental education
- **Main research activities (selection)**
 - Comparable analysis of the socioeconomic structure of rural areas, especially areas with intensive agriculture in northwest Germany, Germany, the European Union and the USA
 - Basic research in the field of socioeconomic and geoecological problems in regions with very intensive production of crops and animals, development of concepts and strategies to reduce the occurring problems, especially the surplus of the biotic waste, the increasing epidemic risk and the production of bioenergy

ISPA – University of Vechta

- Institute of Spatial Analysis and Planning in Areas of Intensive Agriculture (ISPA)



Live stocks in the County of Cloppenburg

- Live stocks: The County of Cloppenburg in comparison

	Cloppenburg County	Lower Saxony total	Germany total
Cattle (total)	(4) 164,440	2,566,079	13,034,470
Swine (total)	(1) 1,347,535	8,836,771	25,857,700
Poultry (total)	(3) 11,662,457	73,116,514	120,550,800
Laying hens	(4) 1,237,154	20,606,231	50,496,000
Chicken	(2) 6,865,424	44,403,953	56,762,300
Turkey	(1) 2,965,114	6,516,428	10,611,000

Live stocks in the County of Cloppenburg

- Live stocks: Communities in comparison (rang 1- 10 in Lower Saxony)

	Boesel		Garrel		Friesoythe	
Cattle (total)					(2)	26,081
Calves			(4)	7,906	(2)	9,003
Swine (total)			(10)	126,626	(3)	162,624
Swine (breeding)					(3)	12,473
Piglets					(3)	50,258
Chickens					(1)	3,124,303
Turkeys	(2)	642,430	(1)	935,618	(3)	425,462

Livestocke unit per ha agricultural area	(2)	5.08	(1)	5.14		
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Background – German perspective

- **Seventies: Oil crisis and its global effects**
- **End of the last century**
 - Increasing prices for energy
 - Green party „Die Gruenen“ together with the SPD leads Germany
- **2001: IPCC publishes scenarios about global warming and climate change**
- **October 2006: Nicholas Stern publishes his report: Review on the Economics of Climate Change**
- **February 2007: IPCC publishes scenarios about the development of the climate in this century**

Consequences

- **Climate change is the main topic – other global changes are loosing importance**
- **Politicians, scientists and especially the media outperform each other in climate change scenarios**
- **Bioenergy is pronounced to be the „climate saver“ and according to the green party „Die Gruenen“ the farmer is „tomorrows oil sheik“**
- **Promotion of renewable energies and especially of biomass, without estimating the possible influences on existent structures**
- **„Planless planned economy “ in the field of energy policy**

Arguments for bioenergy

- **Strategic aspect**
 - Independent on oil imports ?
- **Ecological aspect**
 - Climate protection ?
- **Economic aspect**
 - Additional income for farmers ?
- **Psychologic aspect**
 - Image of the agriculture in the public ?

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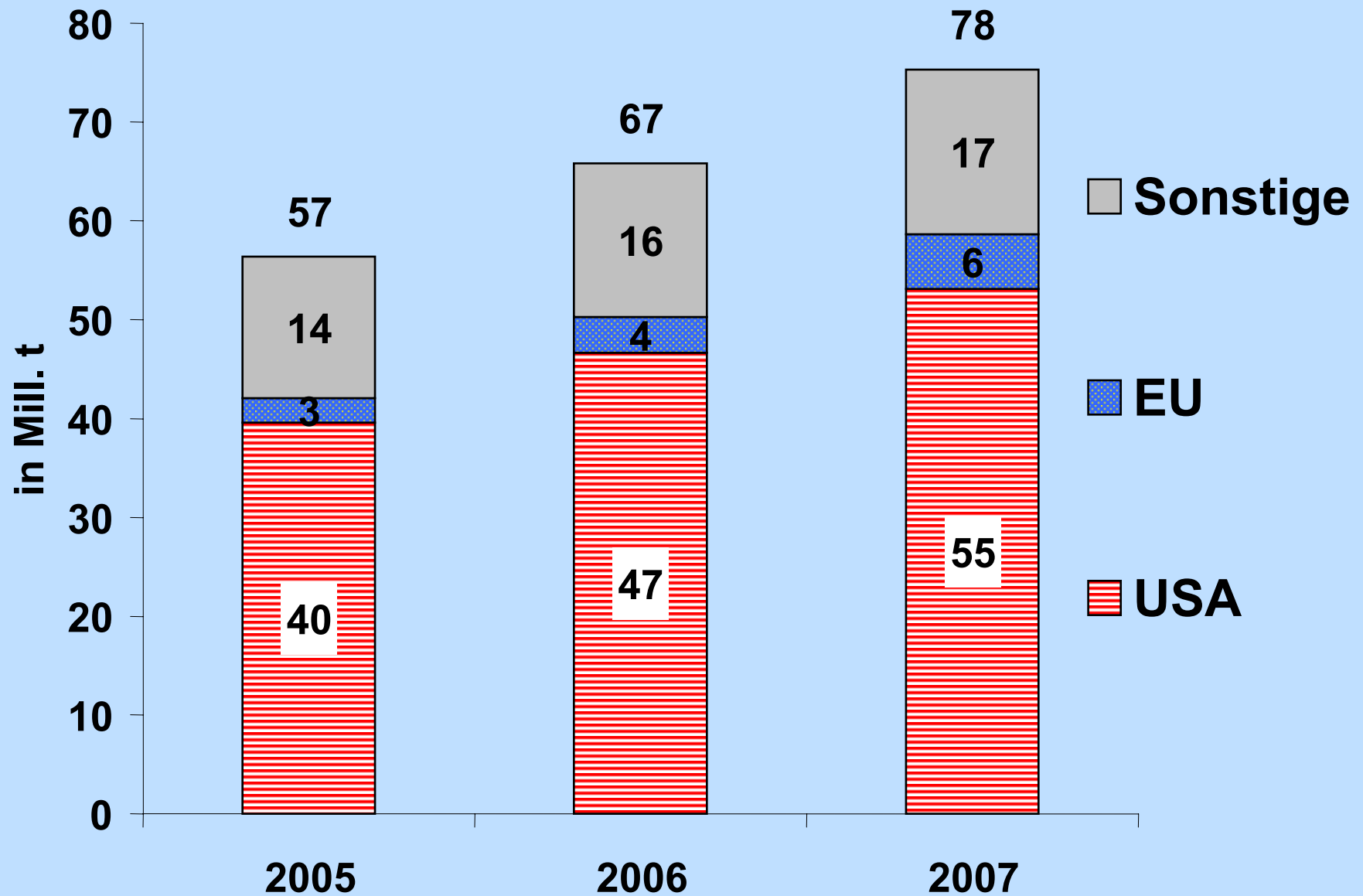
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- **Bioethanol**
 - Ethanol, from renewable resources (plantmaterial (sugary, starchy), but also waste and residual materials)
 - 1 l bioethanol substitutes 0.65 l petrol (lower heating value)
 - Production in large-scale facilities
- **Main production**
 - USA:
 - legal regulations (mandatory blending)
 - broad basis of raw materials
 - Brazil:
 - well-engineered technology and infrastructure
 - excellent basis of raw materials (sugar cane)

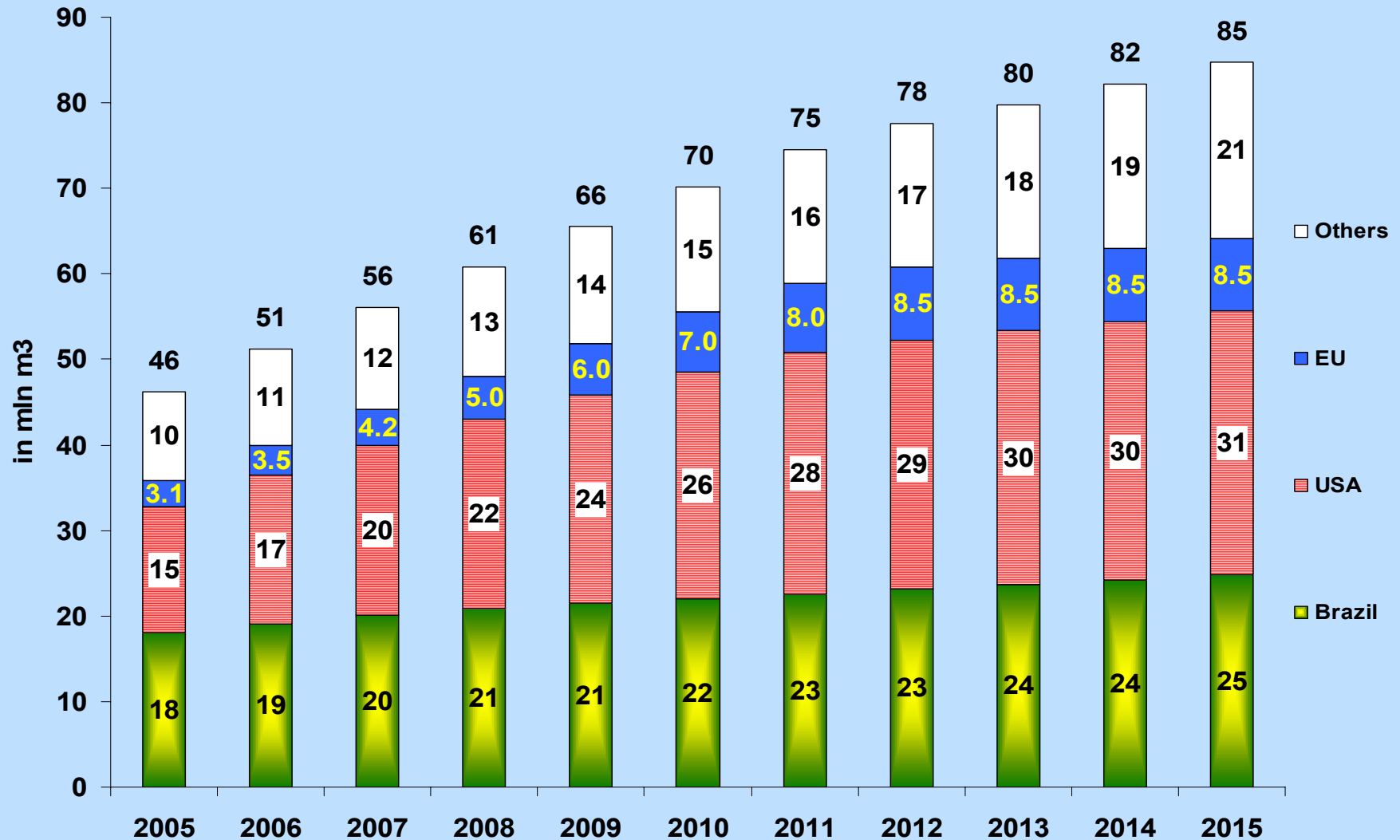
Die zehn führenden Staaten in der Ethanolproduktion (2006)

Staat	Produktion (1.000 t)	% der Welterzeugung
USA	15.579	39,1
Brasilien	13.429	33,3
China	3.041	7,5
Indien	1.501	3,7
Frankreich	751	1,9
Deutschland	604	1,5
Russland	511	1,3
Kanada	457	1,1
Spanien	365	0,9
Südafrika	305	0,8
10 Staaten	36.743	91,1
Welt	40.334	100,0

Getreideverbrauch in der Ethanolherzeugung

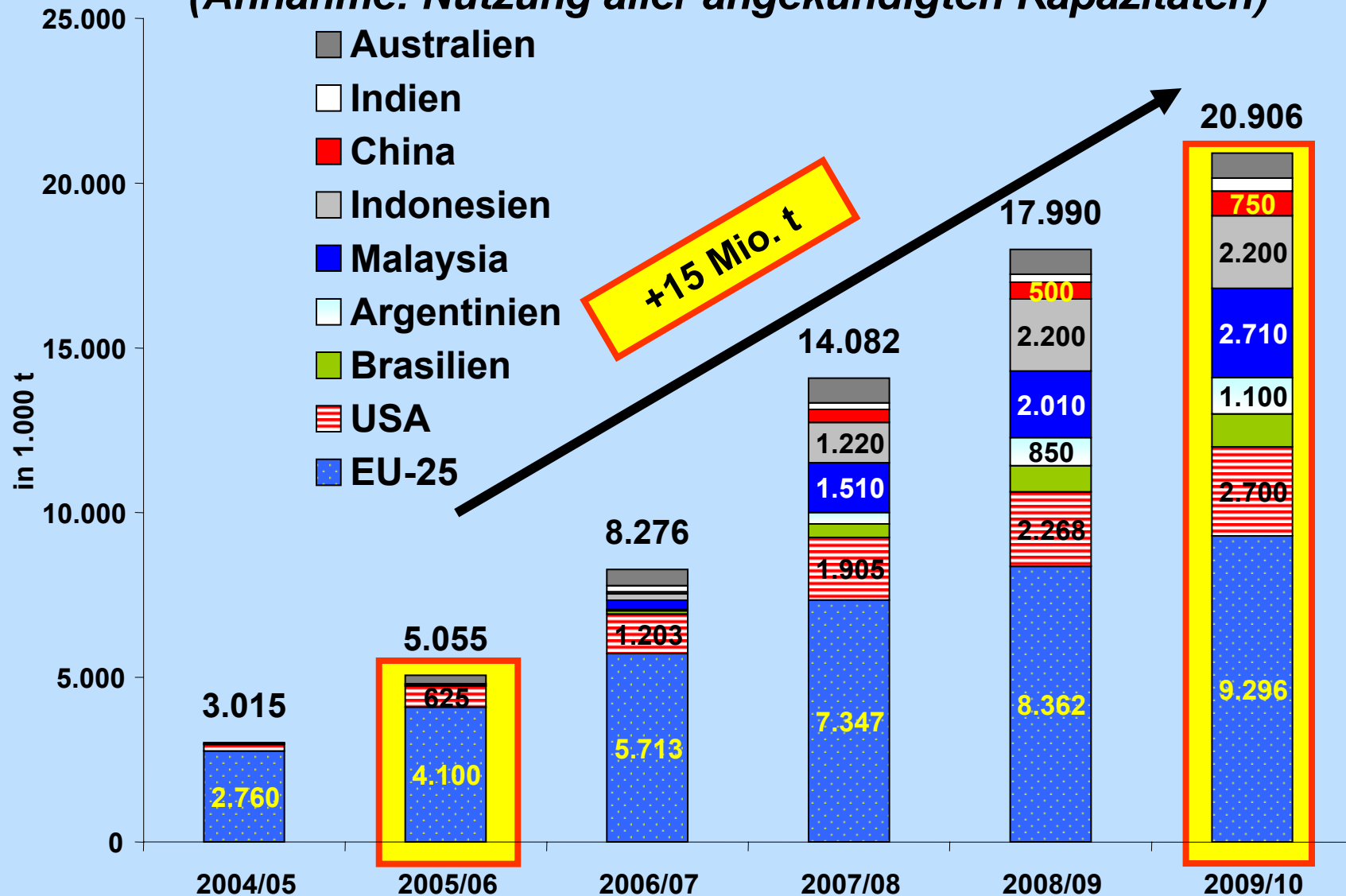


Weltproduktion von Ethanol- plus 39 Mio. m³ (85 %) in 10 Jahren



- **Biodiesel**
 - Transesterification of plant oil with methanol
→ glycerin separation
 - Oil plants e.g. rape seed oil, sunflower oil, soy bean oil, palm-oil, castor-oil
 - 1 l biodiesel substitutes 0.91 l diesel (lower heating value)
- **Main production**
 - Germany:
 - legal regulations
 - well-engineered technology and infrastructure
- **„Renewable Energy Law“ promotion for oil plant CHP**
- **Use in buses and trucks**

Projektion des Welt-Biodieselsverbrauchs im Jahr 2010 (Annahme: Nutzung aller angekündigten Kapazitäten)



Benötigte Ackerflächen für den prognostizierten Bedarf an Biodiesel bis zum Jahr 2010

Jahr	Biodiesel- verbrauch (1.000 t)	Benötigtes Ackerland (1.000 ha)	Zunahme (%)
2005/06	5.055	3.220	-
2006/07	8.267	5.266	63,5
2007/08	14.082	8.969	70,3
2008/09	17.990	11.459	31,8
2009/10	20.906	13.316	16,2
Zunahme (%)	314,6	313,5	-

▪ Biogas

- Product of the anaerobic fermentation of organic material (e.g. energy plants (maize, sorghum, crop,...), manure, slaughter waste)
- 50-60 % methane, 40-50 % carbon dioxide
- 1 kg biomethane substitutes 1.5 l petrol and 1.3 l diesel (1 m³ substitutes 0.94 l petrol and 1.08 l diesel)
- Use as fuel by gas purification or in a CHP for the production of electricity and heat

▪ Main production

- Germany:
 - legal regulations („EEG“)
 - well-engineered technology
 - up to now high acceptance

Biogas production

- **Legal basis** (Renewable Energy Law („EEG“) from 2000 resp. 2004)

	Allowance in [Euro Cent/kWh]				
	2004	2005	2006	2007	2008
up to 150 kW	11.5	11.33	11.16	10.99	10.83
from 150 to 500 kW	9.9	9.75	9.61	9.46	9.32
from 500 to 5 MW	8.9	8.77	8.64	8.51	8.38
from 5 MW to 20 MW	8.4	8.27	8.15	8.03	7.91
Biomass-bonus					
up to 500 kW	6				
from 500 kW to 5 MW	4				

- **Amendment*** of the „EEG“:
 - Use of manure (more than 30% excrements: additional 3 Ct/kWh)

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Biodiesel und Ethanolerzeugung in ausgewählten Staaten der EU (2003/05)

Staat	Biodiesel (1.000 t)	Ethanol (1.000 t)	Gesamt (1.000 t)	Anteil (%) an EU (25)
Deutschland	1.850	200	2.050	64,3
Frankreich	370	111	481	15,1
Spanien	65	202	267	8,4
Schweden	1	147	148	4,6
Polen	2	60	62	1,9
Österreich	55	0	55	1,7
Tschech. Rp.	47	0	47	1,5
Dänemark	45	0	45	1,4
Ungarn	2	4	6	0,2
Niederlande	4	0	4	0,1
Slowakei	3	0	3	0,1
Lettland	3	0	3	0,1
EU (25)	2.460	726	3.186	100,0

Scenario 2010 for the biofuel production and demand of crop land in the EU (27)

- **Biofuel production 24 Mill. t**
 - Perspective: 50 % own production, 50 % imports
 - Aimed fraction of biofuels: 5.75 % (EU-Regulation 2003/30/EU)
- **Total demand (crop land) 15 - 18 Mill. ha**
 - Fraction of crop land of the EU (27): 13-15 %
 - 50 % own production: 8.25 Mill. ha ~ 7 - 8 % of total crop land of the EU (27)
- **8.25 Mill. ha – from where?**
 - 4 Mill. ha set-aside of agricultural land
 - 3 Mill. ha new cultured crop land
 - 1.25 Mill. ha former sugar beets

Scenario 2020 for the biofuel production and demand of crop land in the EU (27)

- **Target 20 % of the total fuel production**
- **Total demand (crop land) 57 - 60 Mill. ha**
 - Fraction of crop land of the EU (27): 50 - 55 %
 - 50 % own production: 30 Mill. ha ~ 25 - 27 % of total crop land of the EU (27)
- **30 Mill. ha – from where?**
 - ???
- **In comparison***
 - In the EU (25) there lie 7.3 Mill. ha idle, thereof 2.8 Mill. ha voluntarily set-aside agricultural land
 - On estimated 1 Mill. ha thereof grow renewable resources

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Bioenergy production in Germany

- **Renewable Energy Law („EEG“)**
 - Grants are the basis for the fast development of renewable energies in Germany
- **Fraction of renewable energies on the energy supply (2006):**
 - 5.3 % on the primary energy consumption
 - 11.85 % fraction of gross power consumption (target 12.5 % for 2010)
 - around 6 % fraction of the total heat production
 - 5.8 % fraction of the fuel consumption (EU-target 5.75 % until 2010)

Thought experiment

- **Thought experiment:**
 - Review of the claims of environment minister S. Gabriel
- **Framework:**
 - The input materials are only taken from Germany
 - State-of-the-art technology is assumed
 - Numbers are not to be analysed by the absolute value, but more by the tendency
- **Claims (2020)**
 - Biofuels: 17 % fraction of the total fuel consumption
 - Biogas: 10 % of the power consumption by biogas
 - Cultivation of special energy plants and alternative cultivation methods

Procedural initial values – thought experiment

product	harvest [l/t FM bzw. m³/t FM]	energy [kWh/t FM]
crop (bioethanol)	360	2,117
rape-seed (biooil)	344	3,788
maize (biogas)	105	1,048 elec.: 419

Energy demand to achieve claims of the environment minister:

form of energy	consumption [bill. kWh/year]	target (%) for fraction of biofuel and biogas	necessary production [bill. kWh/year]
petrol*	188.6	17	32.1
diesel*	341.4	17	58
elect. **	570	10	57

*MWV (2006) Prognose 2020,

**Leitstudie 2007, own calculations

crop land demand to achieve claims of the environment minister:

biomass	demand [Mill. t]	harvest [t FM/ha]	required crop land [Mill. Ha]
crop	15.2	7.0	2.2
rape-seed	15.3	3.5	4.4
maize	136	40	3.4

▪ Conclusions

- By using state-of-the-art technology 10 Mill. ha crop land would be necessary to fulfill the claims
- The total crop land in Germany is about 12 Mill. ha
- This is a fraction of around 83%!

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Biogas in Germany

- **Biogas production (2006)***
 - 3300 biogas plants with around 1 GW elec. power
 - 6.5 TWh/a potential annual power production
 - 5.4 TWh/a effective annual power production
 - Fraction of german power production 0.9 %

- **Biogas production (2020) – „Fachverband Biogas e.V.“**
 - Biogas production with around 9.5 GW elec. power
 - 76 TWh/a annual power production
 - Fraction of german power production 7 %

Biogas in Germany

- **Crop land for maize**
 - 400,000 ha (2006) – 3.3 % of the total crop land
 - 3.8 Mill. ha (2020) - 32 % of the total crop land

- **Crop production on this area**
 - 2.8 Mill. t (2006)
 - 26.6 Mill. t (2020)

- **In comparison**
 - German animal feed imports in 2006 approx. 6 Mill. t*
 - Official statistics for the cultivation of energy maize in 2006 approx. 162,000 ha (Deutsches Maiskomitee e.V.) – 1.4% of total crop land

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Biogas in our region

- **Biogas plants in the County of Cloppenburg**

- 80 biogas plants approved, 68 biogas plants at work

	Friesoythe	Garrel	Bösel
Biogas plants	29	7	6
power [kW]	13,587	2,883	2,830
Ø [kW]	468.5	411.8	471.7
crop land demand maize [ha]	5,434.8	1,153.2	1,132

- **Biogas plants in the County of Vechta**

- 12 biogas plants approved, 11 biogas plants at work

- **Bio-Biogas – Biogas from ecologically farming**
(requests for a better promotion)
- **Voluntary agreements of the natural gas economy**
(transport sector)
 - until 2010 substitute 10 % natural gas by biomethane
 - until 2020 substitute 20 % natural gas by biomethane

Nr. 170/36

Financial Times Deutschland



Bioerdgas hat viele Talente.

E.ON fördert aktiv die Erdgaserzeugung aus Biomasse. Denn dieser erneuerbare Energieträger trägt dazu bei, den CO₂-Ausstoß deutlich zu reduzieren. Bioerdgas kann ganzjährig produziert und problemlos gespeichert werden. In das bestehende Erdgasnetz eingespeist, kann Bioerdgas vielfältig genutzt werden: z. B. an Erdgastankstellen, in Erdgasheizungen und in Kraftwerken. So werden Kraftwerke durch die Nutzung von Bioerdgas noch effizienter in Sachen Klimaschutz. Einfach eine saubere Sache.

Mehr zur Zukunft von Bioerdgas erfahren Sie unter www.eon.com

e-on
Neue Energie

Biokraftstoffe im Vergleich

So weit kommt ein Pkw mit Biokraftstoffen von 1 Hektar Anbaufläche



Biomethan

67 600 km



BtL (Biomass-to-Liquid)

64 000 km



Rapsöl

23 300 km

+ 17 600 km*



Biodiesel

23 300 km

+ 17 600 km*



Bioethanol

22 400 km

+ 14 400 km*

*Biomethan aus Nebenprodukten (Rapskuchen, Schlempe, Stroh)

Pkw-Kraftstoffverbrauch: Otto 7,4 l/100 km, Diesel 6,1 l/100 km

Quelle: Fachagentur Nachwachsende Rohstoffe e. V. (FNR)

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Positive aspects for bioenergy

- **Bioenergy production and use can**
 - reduce the import dependence from oil exporting countries
 - reduce the energy-based greenhouse gas emissions
 - offer farmers an additional and higher income
 - result in a sustainable use of natural resources
 - create innovations and job opportunities
 - create regional supply chains (e.g. Bioenergy Village Juehnde in Lower Saxony)

Negative aspects for bioenergy

- **Bioenergy production and use can**
 - create a import dependence to biomass exporting countries
 - reduce the crop land available for bread and animal feed
 - result in increasing prices for mineral fertiliser, animal feed, land and lease as well as food
 - hurt developing countries disproportionately high
 - result in negative ecological impacts:
 - clearing of tropical rain forests
 - spreading of plant diseases and vermins
 - soil damages
 - threat to the groundwater quality

Biogas production in renewable resource biogas plants

- **„EEG“ resulted in a biogas-boom based on renewable resources**
- **relatively high crop land demand (and costs)**
 - production of input materials 40-50 ha / 100 kW → purchase
 - output of digester material → manure transports
- **high investment needs 3000 €/kW_{el} → because of the interest payments farmers cannot invest in other branches and modernise these!**
- **dependent on promotions**
- **In the centers of „animal production“**
 - „Battle for crop land“ → high prices for land and maize, bad crop rotation (specialised crops!), increased animal feed,...
 - increasing epizootic risk → increasing number of vermins,...
 - animal body removal → some biogas plants are approved for the use of slaughter waste, companies have problems to run there factories economically (results in problems in case of a disease)

Concluding words - Requests

- **Perception of the problem „climate change“ is biased**
 - reasonable basis for discussions
 - other global changes have to be considered
 - cost-benefit analyses for further promotions
- **„Energy economy as a planless planned economy “**
 - development of a strategic concept for the future energy supply in Germany
 - energy future – intensify research
 - instruments like electricity exchange market and emission certificates market have to be reformed
- **Estimation of consequences about the impacts of promotions, e.g. „EEG“**

Concluding words - Requests

- **Onesided discussion about the use of renewable energies – energy reduction and energy efficiency!**
- **Bioenergy production and use have to be sustainable and the growing world population has to be taken into account**
- **Farmers should not launch themselves into new dependencies**

Thank you for your attention!

M.Sc. Henning Mueller

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