Country Report GERMANY

ENGLER-BUNTE-INSTITUT Fuel Technology, EBI ceb
Institute for TECHNICAL CHEMISTRY, Gasification Technology, ITC vgt

Thomas Kolb

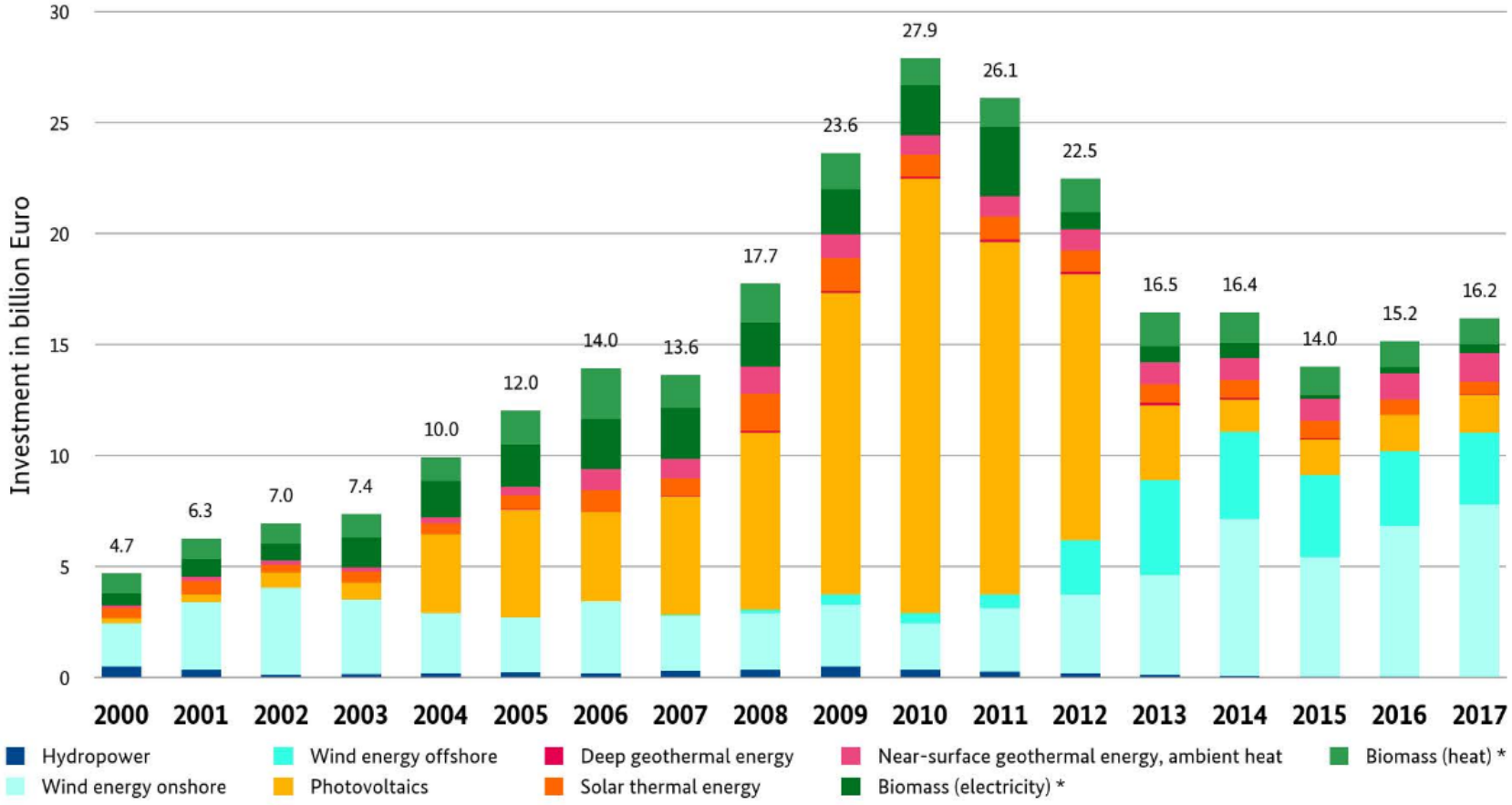
IEA Bioenergy: Task 33 Thermal Gasification of Biomass

Task meeting, May 5th 2018, Petten, Netherlands

Federal Ministry
for Economic Affairs
and Energy

AGEE Stat
Arbeitsgruppe Erneuerbare Energien - Statistik

Development of investment in construction of renewable energy plants in Germany



* Solid, liquid and gaseous biomass; BMWi based on Centre for Solar Energy and Hydrogen Research Baden Wuerttemberg (ZSW); as at February 2018; all figures provisional

Federal Ministry
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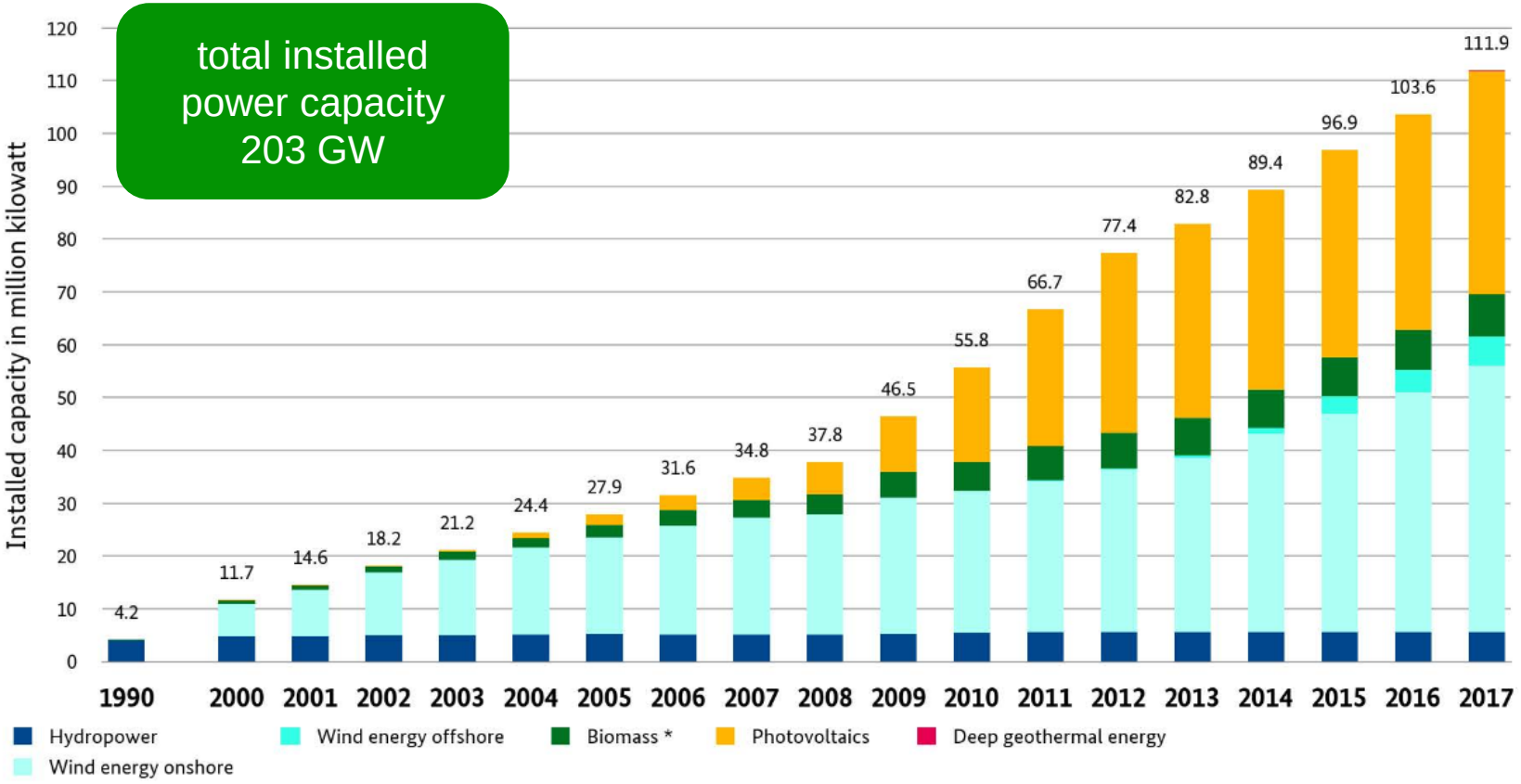
→ 218 TWh
→ 36% of overall gross power generation

AGEE Stat
Arbeitsgruppe Erneuerbare Energien - Statistik

Development of installed capacity for renewables-based electricity generation in Germany

total installed power capacity 203 GW



* incl. solid and liquid biomass, biogas incl. biomethane, landfill gas and sewage gas, excl. biogenic fraction of waste; BMWi based on Working Group on Renewable Energy-Statistics (AGEE-Stat); as at February 2018; all figures provisional

Source: https://www.erneuerbare-energien.de/EE/Redaktion/DE/Bilderstrecken/entwicklung-der-erneuerbaren-energien-in-deutschland-im-jahr-englisch.html

Federal Ministry
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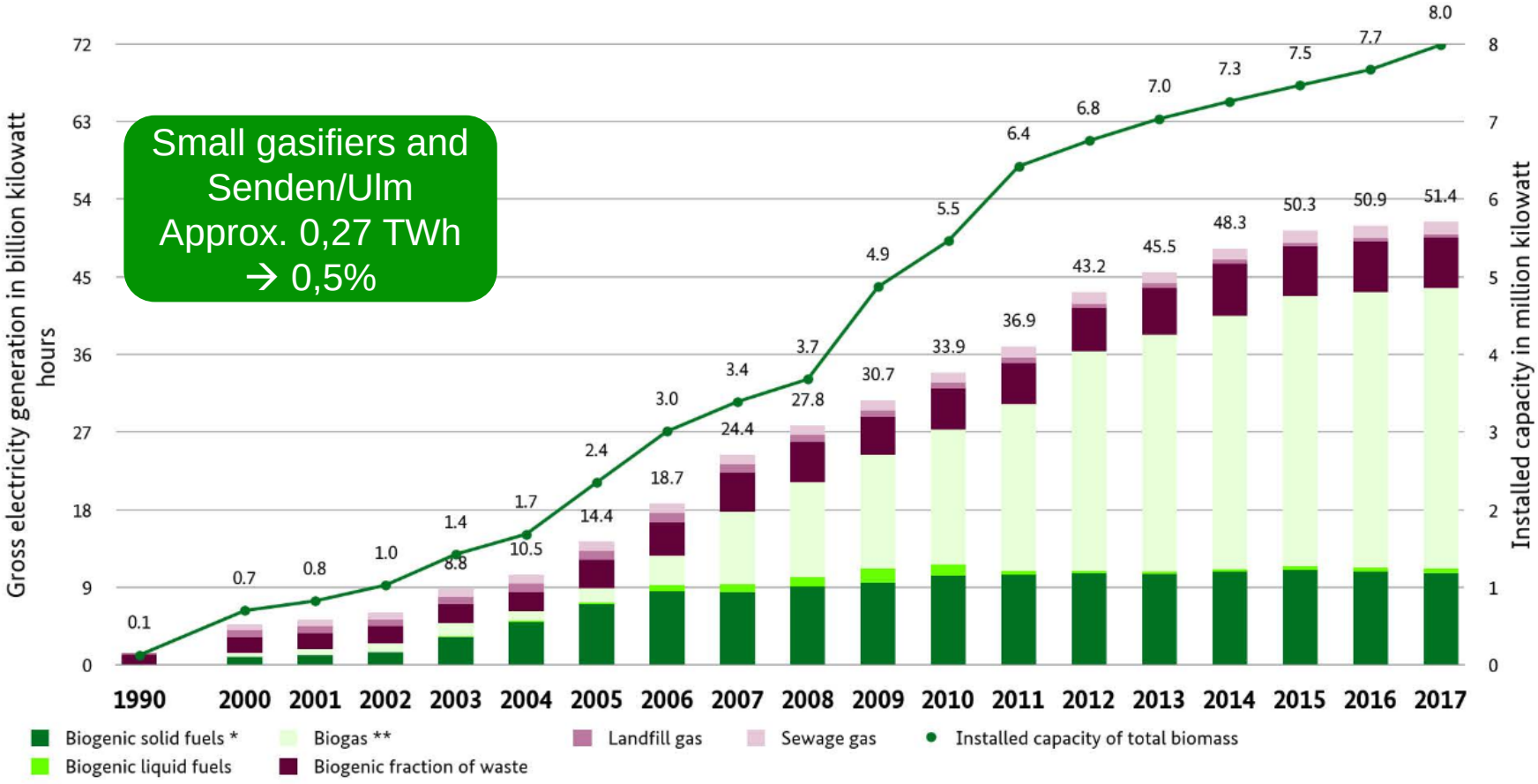
51.4 TWh → 8,5% of overall gross electricity generation

Small gasifiers and Senden/Ulm Approx. 0,27 TWh → 0,5%

Development of electricity generation and installed capacity of biomass plants in Germany



* from 2010 incl. sewage sludge; ** incl. biomethane; BMWi based on Working Group on Renewable Energy-Statistics (AGEE-Stat); as at February 2018; all figures provisional

Source: https://www.erneuerbare-energien.de/EE/Redaktion/DE/Bilderstrecken/entwicklung-der-erneuerbaren-energien-in-deutschland-im-jahr-englisch.html

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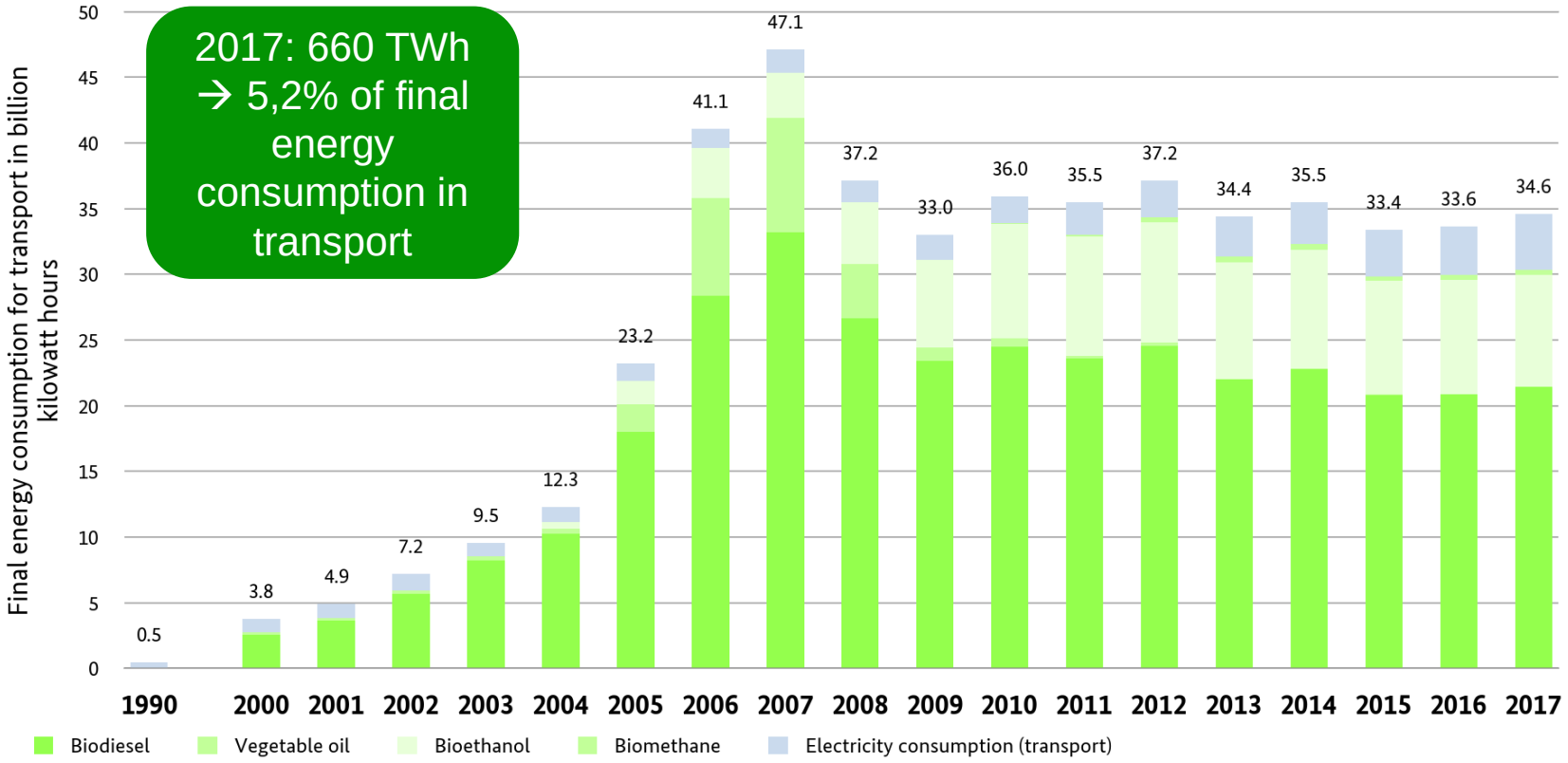
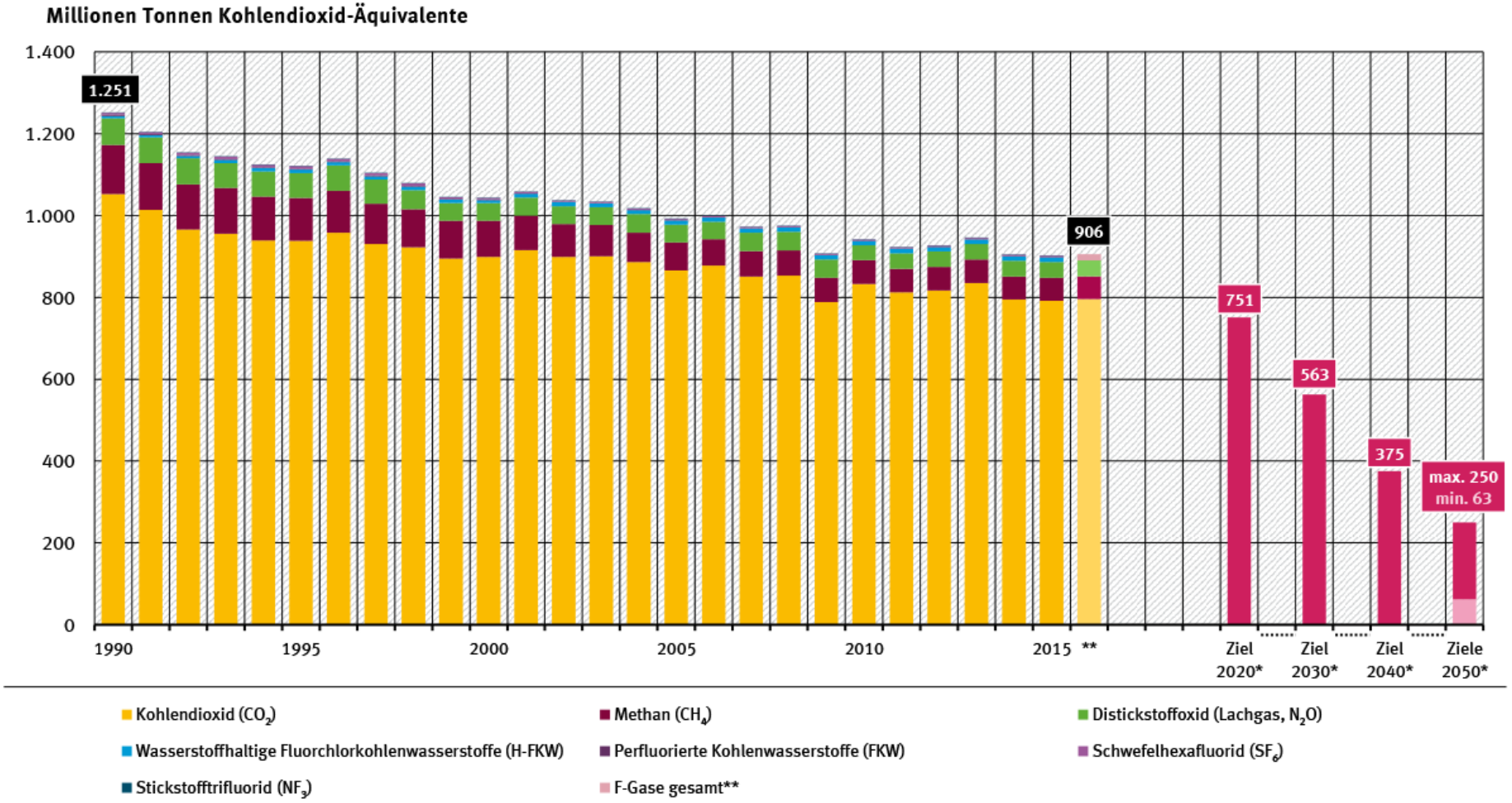
Development of final energy consumption in transport from renewable energy sources in Germany



BMWi based on Working Group on Renewable Energy-Statistics (AGEE-Stat); as at February 2018; all figures provisional

Source: https://www.erneuerbare-energien.de/EE/Redaktion/DE/Bilderstrecken/entwicklung-der-erneuerbaren-energien-in-deutschland-im-jahr-englisch.html

Treibhausgas-Emissionen seit 1990 nach Gasen



* Ziele 2020 bis 2050: Energiekonzept der Bundesregierung (2010)
** Schätzung 2016

Quelle: Umweltbundesamt, Nationale Treibhausgas-Inventare 1990 bis 2015 (Stand 02/2017) und Schätzung für 2016 (Stand 03/2017)

Regulation:

EEG – The Renewable Energy Source Act

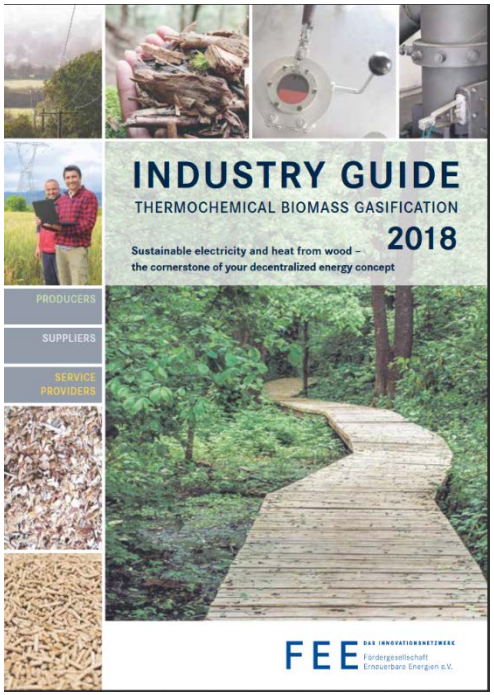
- put into force in 2000, adapted in 2004, 2009
- novelled in 2012, 2016 and 2017

base fee biomass (ct/kWh)

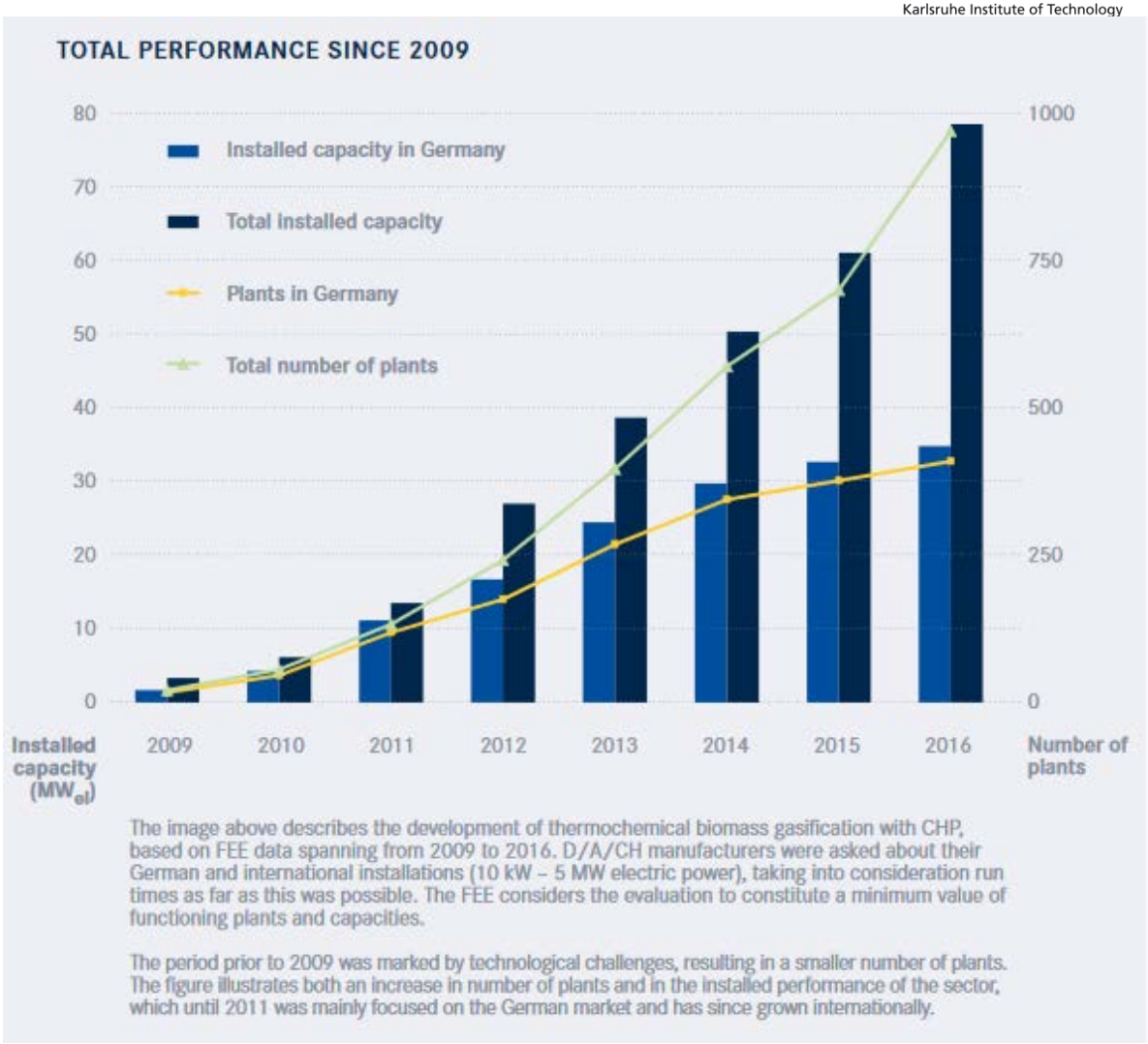
	EEG 2000	EEG 2004	EEG 2009	EEG 2012	EEG 2016	EEG 2017
Up to 150 kW_{el}	10,23	11,50	11,67	14,3	13,66	13,32
150 kW_{el} up to 500 kW_{el}		9,90	9,18	12,3	11,78	competitive bidding
500 kW_{el} up to 5 MW_{el}		8,90	8,25	11	10,55	9,6 - 16,9
5 MW_{el} up to 20 MW_{el}	8,7	8,40 only with CHP	7,79 only with CHP	6 only with CHP	5,85	

Source: https://www.erneuerbare-energien.de/EE/Redaktion/DE/Standardartikel/EEG/eeg-2017.html

Industry Guide Thermochemical Biomass Gasification 2018



Source: Fördergesellschaft Erneuerbare Energien e.V. (FEE), Industry Guide Thermochemical Biomass Gasification, Berlin, Germany, 2018



http://fee-ev.de/11_Branchenguide/2018_Industry_Guide_Biomass_Gasification_EN.pdf

Biomass gasification plants

Manufakturer	Technology	Feedstock	Grid feeding plants	Note
Biotech Energietechnik GmbH (A)	Fixed-bed process, co-current	wood chips	4	
BR Engineering GmbH (CH)	Fixed-bed process (optional: moving bed) in combination of co-current and countercurrent flow	Unadulterated wood, wood chips, other biomasses (among others hogged fuel)	2	• Since 1997 • Cold gas efficiency: up to 90% • Production of biochar • USP: proven for demolition wood/ ash free of char
Burkhardt GmbH (D)	Fluidized bed process in co-current flow	Pellets	200	• Since 2011 • wood gas cogeneration plants • wood gasifier with downstream CHP • Electric efficiency of more than 30 %
Glock Ökoenergie GmbH (A)	Fixed-bed process, co-current	wood chips	13	• Since 2010 • Distributing countries: D, A, CH
Holzenergie Wegscheid GmbH (D)	Fixed-bed process in co-current flow	Unadulterated wood, briquettes & maxi-sized pellets, wood chips	120	• Distributing countries: EU, JP, CA, ID, CH
ReGaWatt GmbH	Fixed-bed in counter-current flow	Wood chips from various sources up to 30 % bark and landscape management chips	6	• Since 2010 • Distributing countries: EU

Source: Fördergesellschaft Erneuerbare Energien e.V. (FEE), Industry Guide Thermochemical Biomass Gasification, Berlin, Germany, July 2015 ; Update 2018 USP: Unique selling point

Biomass gasification plants

Manufakturer	Technology	Feedstock	Grid feeding plants	Note
LiPRO Energy &CO KG (D)	Pyrolysis with moving bed	wood chips	5	• Since 2016
Spanner Re² GmbH	Fixed-bed process in co-current flow	Unadulterated wood, forest chips (at 30 kWel), wood chips	>700	• Spanner Re² wood cogeneration plants • Since 2008 • Distributing countries: D, A, CH, I, CZ, SLO, LV, CDN, GB, FIN, HR, J, PL
Stadtwerke Rosenheim GmbH & Co. KG	Fluidized bed and tiered process, combination of co-current and eddy flow (Rosenheimer Process)	Unadulterated wood, wood chips		• Since 2015 • Distributing countries: DE, AT, I
SynCraft (A)	Tiered process in co-current flow (floating fixed-bed)	Unadulterated wood, tree and shrub cuttings, waste wood class A, wood chips	6	• By-product bio char • Fuel flexibility • No additives needed • Electric efficiency 30 %
Xyloenergy GmbH	Fixed-bed process in co-current flow	Unadulterated wood, wood chips	1	• capacity via 100 % diesel/ bio-diesel as well; • utilization of waste wood • Distributing countries: EU

Source: Fördergesellschaft Erneuerbare Energien e.V. (FEE), Industry Guide Thermochemical Biomass Gasification, Berlin, Germany, July 2015; Update 2018

Biomass gasification plants

Manufakturer	Technology	Feedstock	Grid feeding plants	Note
Ettenberger GmbH & Co. KG	Tiered gasification process in combination	Unadulterated wood, wood chips, short rotation plants	3	
KOPF SynGas GmbH & Co. KG	Fluidized bed process	Sewage sludge (10 % moist. cont.)	2	• Since 2000
Wood Gasifier System Werner	Fixed-bed process in co-current flow	Unadulterated wood, wood chips	1	
Ligento green power GmbH	Fixed-bed process in co-current flow	Unadulterated wood, residual wood from forestry, short rotation plants, wood chips	2	
Meva Energy (S)	Entrained flow in co-current flow	Unadulterated wood, wood chips, pellets, saw dust, husks, straw	1	
Qalovis GmbH	Fixed-bed process in co-current flow	Unadulterated wood, residual wood from forestry and landscape conservation, wood chips, pellets	1	• USP: no scrubbing of gas needed
URBAS Maschinenfabrik GmbH (A)	Fixed-bed process in concurrent flow	Unadulterated wood, wood chips	19	• Since 2008

Source: Fördergesellschaft Erneuerbare Energien e.V. (FEE), Industry Guide Thermochemical Biomass Gasification, Berlin, Germany, July 2015; Update 2018

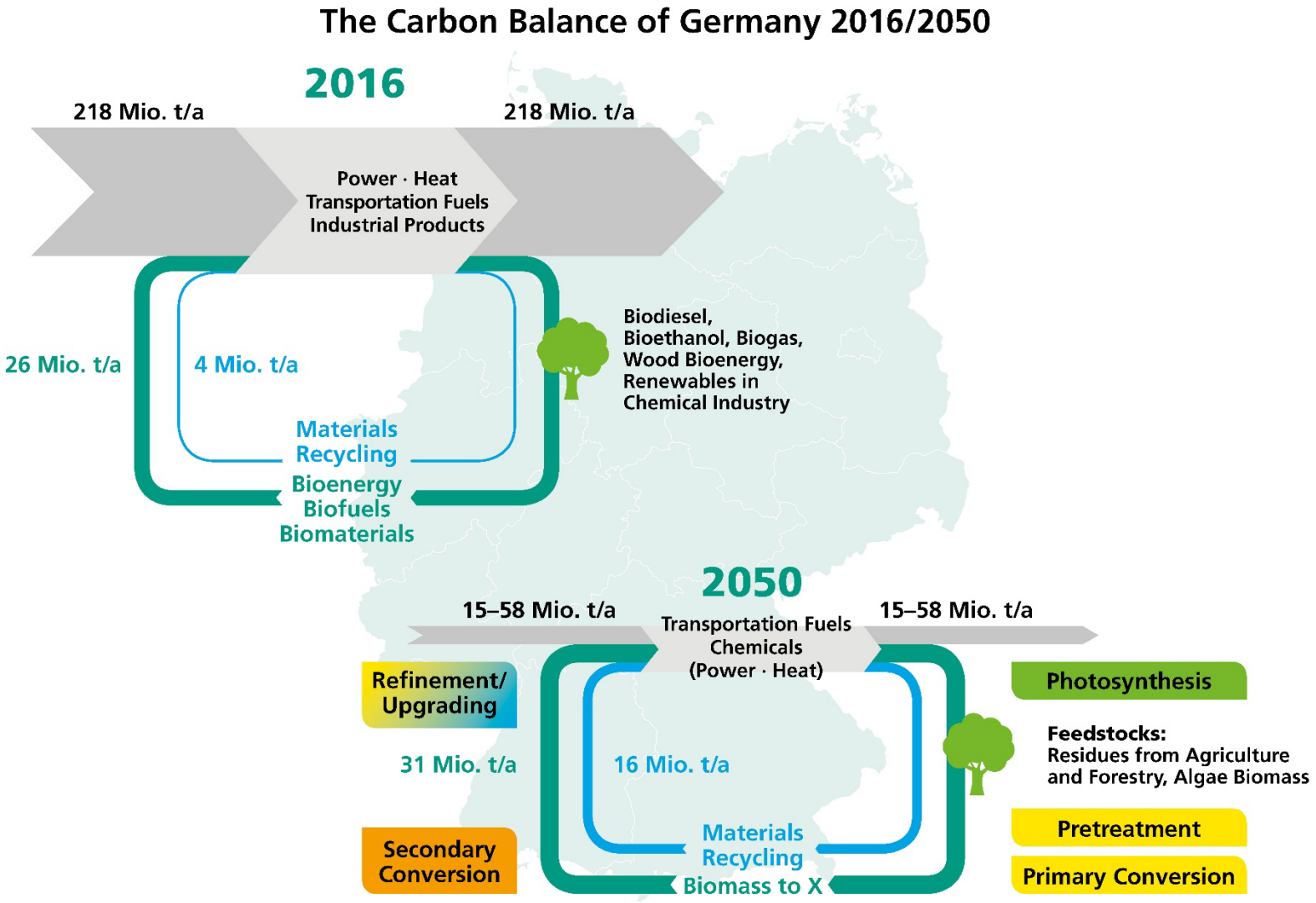
State of the bioliq®-Project

- campaign for the whole process chain in November 2017
  - New catalyst in DME and gasoline syntheses
  - New ramming mass on cooling screen
  - Integration of a slag crusher in the gasifier quench bath

→ **Production of 700l fuel**

- campaign for the whole process chain in April 2018
  - Still ongoing

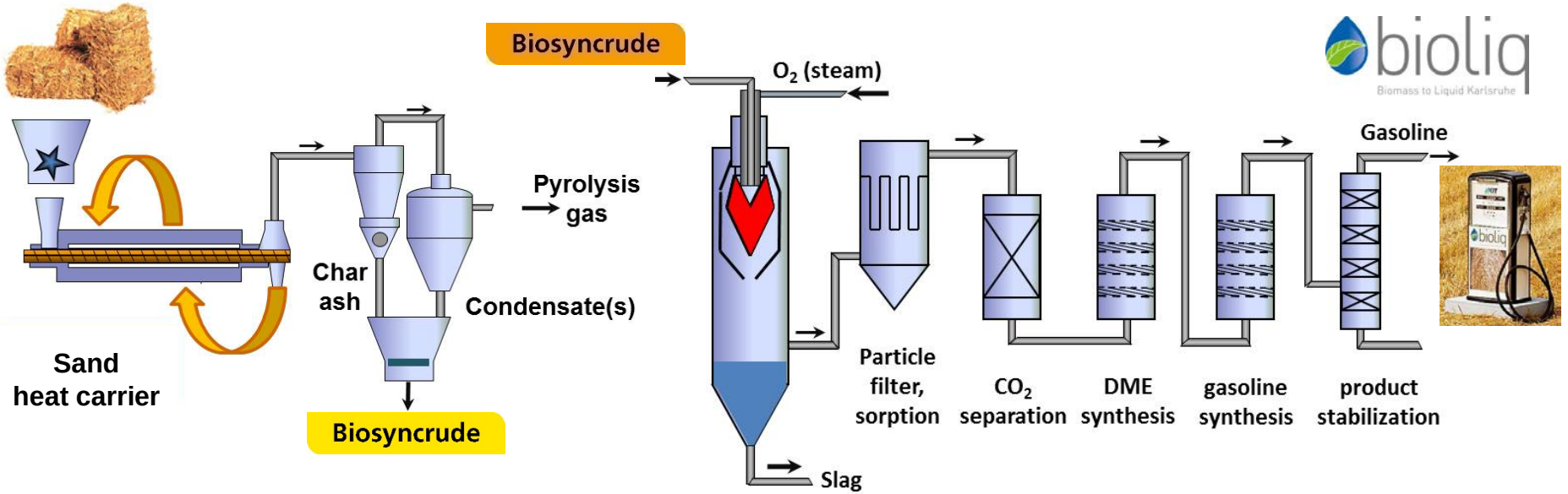
The Energy Transition will change the German Carbon Balance drastically



Jörg Sauer – Dieter Stapf

Engler-Bunte-Institut, Fuel Technology
Institute for Technical Chemistry, Gasification Technology

Flagship Infrastructure bioliq®



- Scaleable through innovative logistics concept
- Feedstock flexible including ash-rich feedstocks
- Increased conversion efficiency

Key Figures:
Investment: 64 Mio€
Execution: 2005-14
Staff for Operation: 42

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Engler-Bunte-Institut, Fuel Technology
Institute for Technical Chemistry, Gasification Technology

Fund for Energy and Climate „Energie- und Klimafonds (EKF)

Promotion of environmental friendly, reliable and affordable energy

Promotion Topic: „Reduction of GHG-emissions“

Issues:
→innovative conversion processes for biomass and bio-waste
→Biomass design
→New biofuels and integratted e-mobility
→Scientific knowledge transfer
→Reducing emission at biomass combustion
→Recycling and treatment of mineral matter
→Contribution to carbon-cycle

Promotion Topic: „System integration of bioenergy“

Issues:
→Flexible and efficient CHP from biomass
→Integration of bioenergy
→Energy storage and energy grids
→Decentral bioenergy systems in combination with other renewables
→Sector Coupling
→Combined material and energetic use of biomass
→Light house concepts – practical proof of concept and evaluation