

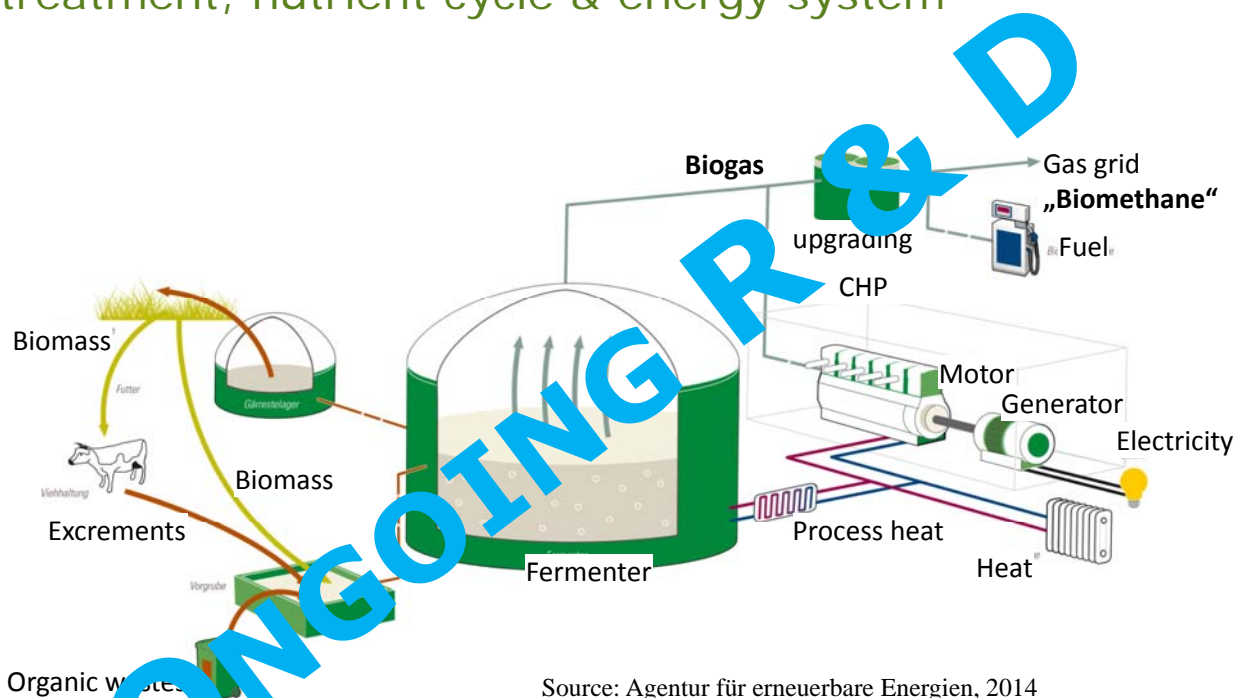
# Future directions of technical developments in the European biogas industry

Prof. Dr.-Ing. Frank Scholwin



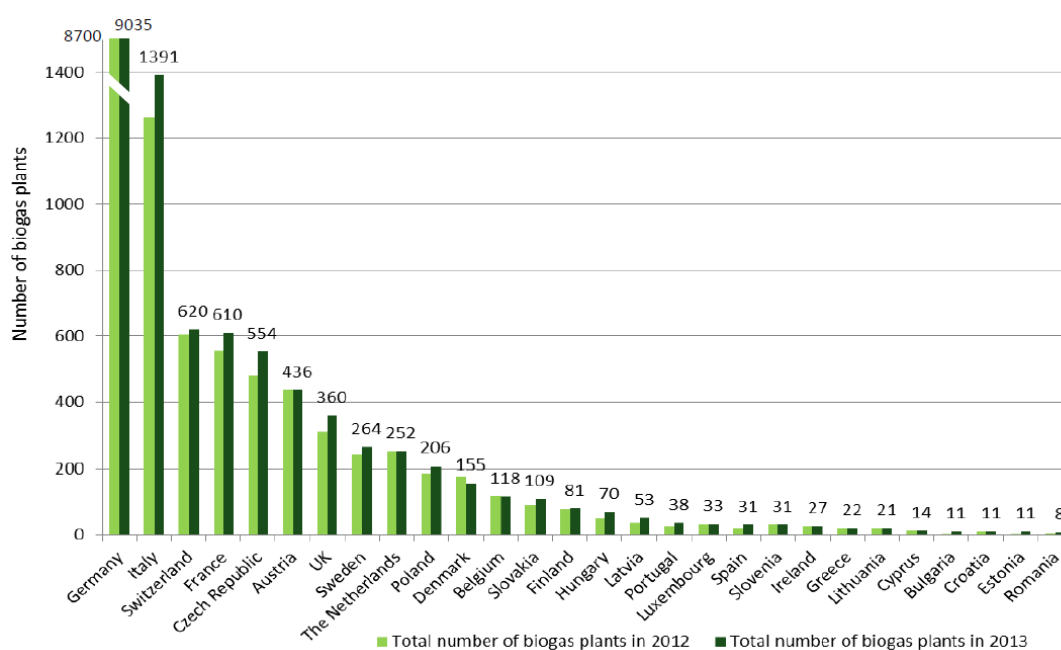
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## Biogas – solutions in waste management, wastewater treatment, nutrient cycle & energy system



Source: Agentur für erneuerbare Energien, 2014

## More than 14 500 biogas plants in Europe in 2013 and more than 7 800 MW<sub>el</sub> of installed capacity



Source: EBA, 2015

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## The Bottlenecks

There are major bottlenecks for the deployment of biogas & biomethane:

1. The post 2030 targets proposed by the Commission
2. **Biogas production costs**
3. Harmonisation of legal requirements (Waste, Wastewater, Agriculture, Environment, Energy)
4. **The sustainability criteria**
5. The cross-border trade

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# Substrates



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## Developments – substrates for biogas plants

- Increased range of substrates
  - Concepts for small scale agricultural by products
  - Structurous substrates / with longer fibres
  - Lignocellulosic substrates
- Increased yields from substrates, increased technical availability
  - Mechanical, thermal, chemical, biological pretreatment
  - Pretreatment for adapted easier technologies
- Decresed losses through improved supply chains / storage
- Energy crops breeding / energy crops farming systems



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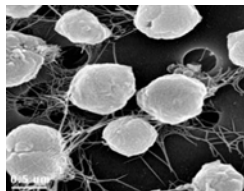
## Developments – biogas production

- Innovative digester concepts / stirring concepts
- Separated liquid / solid digestion
- Application of process models and automatic control devices
- Application of innovative sensors
- Control of biogas production intensity
- Decrease of energy demand



## Developments – The black box of the biological process

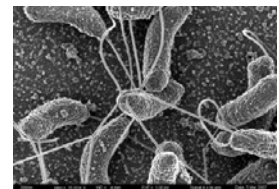
- Knowledge improvement in process biology
- Interaction of the large amount of microorganisms
- Combinations of microbiological processes (biomass supply, pretreatment, process optimisation and control)
- Biogas production is applied biotechnology!!!!



*Methanococcus jannaschii* ( Electron microscope lab)



*Methanosarcina acetivorans*  
(Methanosarcina Project Information)



*Desulfovibrio vulgaris* -  
(Fonte: Chemistrytimes)



## Developments – biogas from agricultural wastes

- Mostly easily digestible
- High security of supply
- Clean biogas
- Developments:
  - Biomass supply and storage
  - Standardised biogas plants
  - Increased automatics

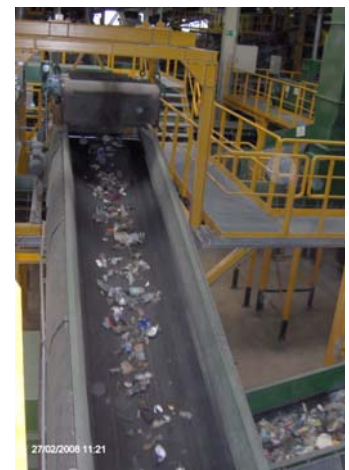


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## Developments – biogas from municipal wastes

- High security of supply
- Mostly clean biogas
- Changing amounts over the year
- Developments:
  - Separation of organic municipal solid waste & pretreatment
  - Improved digester systems



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## Developments – biogas from wastewater (sludge)

- Highest security of supply
- Mostly clean biogas, but siloxanes possible

- Developments:

- Sludge pretreatment
- Increased dewatering
- Optimisation primary/secondary sludge
- Co-fermentation with other waste
- Nutrients recycling (e.g. P)



## Developments – biogas from landfills

- High security of supply
- Biogas contains impurities (organics, siloxanes), Nitrogen, Oxygen

- Developments:

- Continuous gas quality
- Most important outside EU



# Biogas as energy carrier – the joker in the energy matrix

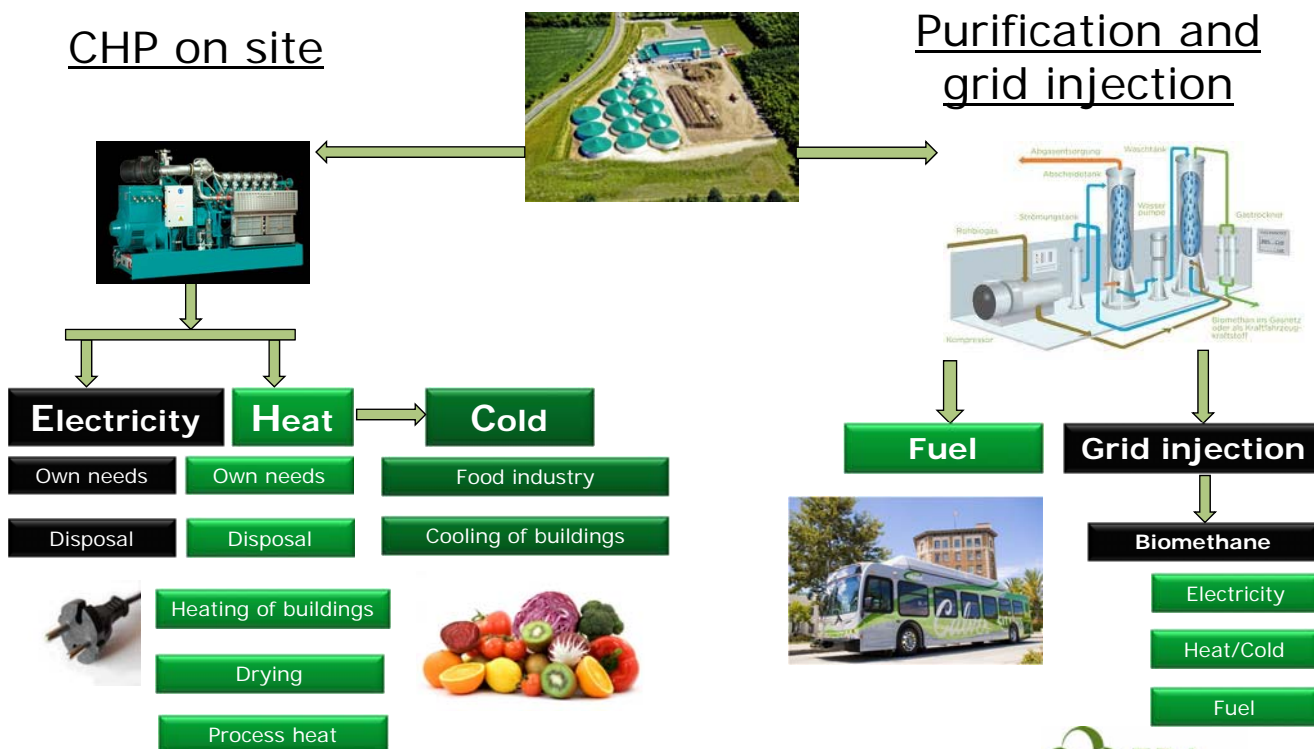
- Multiple use (electricity, heat/cold, fuel, chemicals)
- Efficient use possible (cogeneration)
- Storable (one of a few renewable energies)
  - can be used for balancing fluctuating energy production from wind, solar or hydro power
- Portable (gas grid, gas bottles, storage tanks)
- Sustainable (renewable, low greenhouse-gas emissions, recycling of waste)



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## Options for the use of biogas



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# Electricity production technologies



Parameter	Motor- CHP (Biogas)	Gas Turbine	Micro turbine	Motor Stirling	Fuel cell
Electrical capacity (kW <sub>el</sub> )	30 – 3000	3500 – 15000	30 – 300	< 150	300 – 1500
El. Efficiency (%)	30 – 45	25 – 40	25 – 30	30 – 40	40 – 45
Need for purification	medium	medium	medium	Low-medium	high
Investment (EUR/kW <sub>el</sub> )	400 – 1100	900 – 1500	600 – 1200	1300 – 1500	3000 – 4000
Maintenance (EUR/kWh)	0,01 – 0,02	0,005 – 0,010	0,008 – 0,015	0,003 – 0,005	0,003 – 0,010

Source: Wellinger, 2013

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## Biogas upgrading to natural gas quality

- ~ 300 upgrading units
- PSA, Water scrubber, Amine scrubber, physical adsorption, membranes, cryogenic separation...
- > 20 suppliers
- Local fuel or gas grid injection
- LNG / LBG



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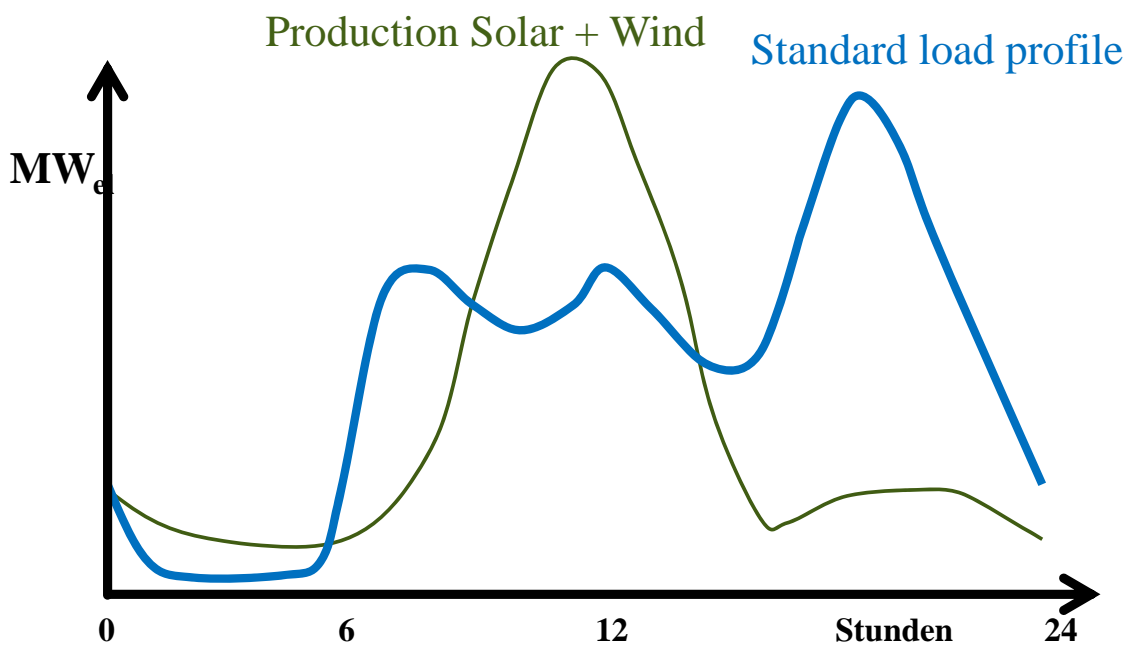
## Developments – the overall concept

- Most important: Operational plant & process management including knowledge expansion
- Integration into local structures
- Integration into biorefinery processes / biogas plant as biorefinery
- Emission reduction (Management, technology, efficiency)
- Efficient application of digestate as high value fertiliser
- **Biogas as resource for energy system stability**

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## Developments – contribution to the future energy system



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## The way forward

- Biogas and Biomethane production will increase necessarily
- Technologies are mature and reliable but raise in overall efficiency is expected
- Utilisation technologies are very sensitive to the political framework / incentives to grow
- Some political and technical hurdles give a few head ache

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## Biogas – Key technology in Energy and material cycle of the future

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More about  
Biogas upgrading:



2<sup>nd</sup> International Conference on  
Renewable Energy Gas  
Technology  
7-8 May 2015; Barcelona,  
Spain

[www.regatec.org](http://www.regatec.org)

[www.biogasundenergie.de](http://www.biogasundenergie.de)

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