Innovative Biogas Plant Concepts For Future Energy Systems - A Techno-Economic Analysis

Dr. Henning Hahn

Biogas in der Direktvermarktung und Flexibilisierung der Produktion, Paris am 13. Oktober 2016

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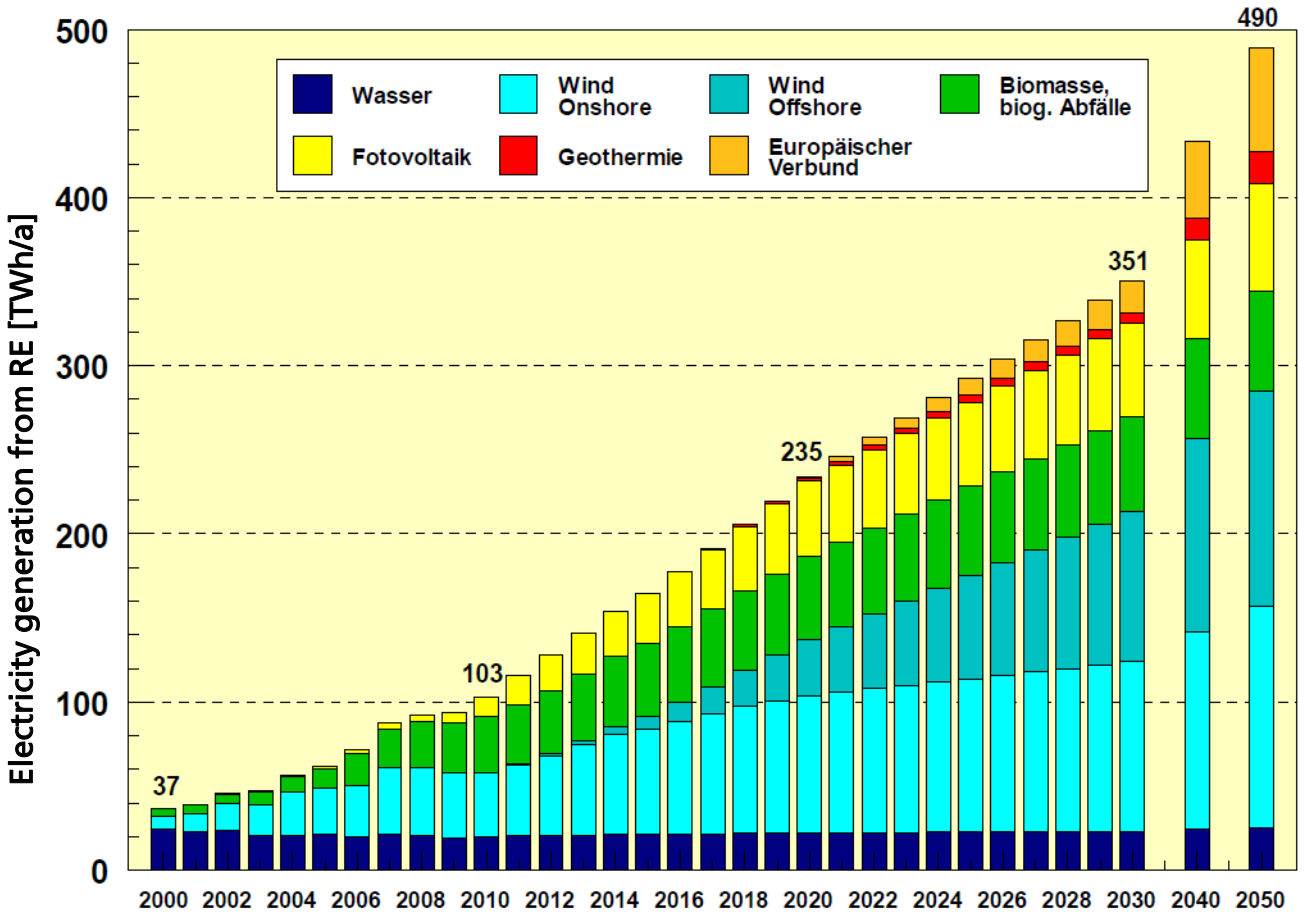
1) Transformation of the energy system



Source: Langfristszenarien 2011; DLR, IWES

Proportion of electricity from RE at the gross power generation:

- Today: 20%
- Target 2050: 80%
- Displayed: 100%

Further development:

- Main pillar will be fluctuating, weather dependent RE sources
- Dynamic expansion of PV and wind energy plants

-> Increased challenges to cover the varying energy demand with fluctuating energies!

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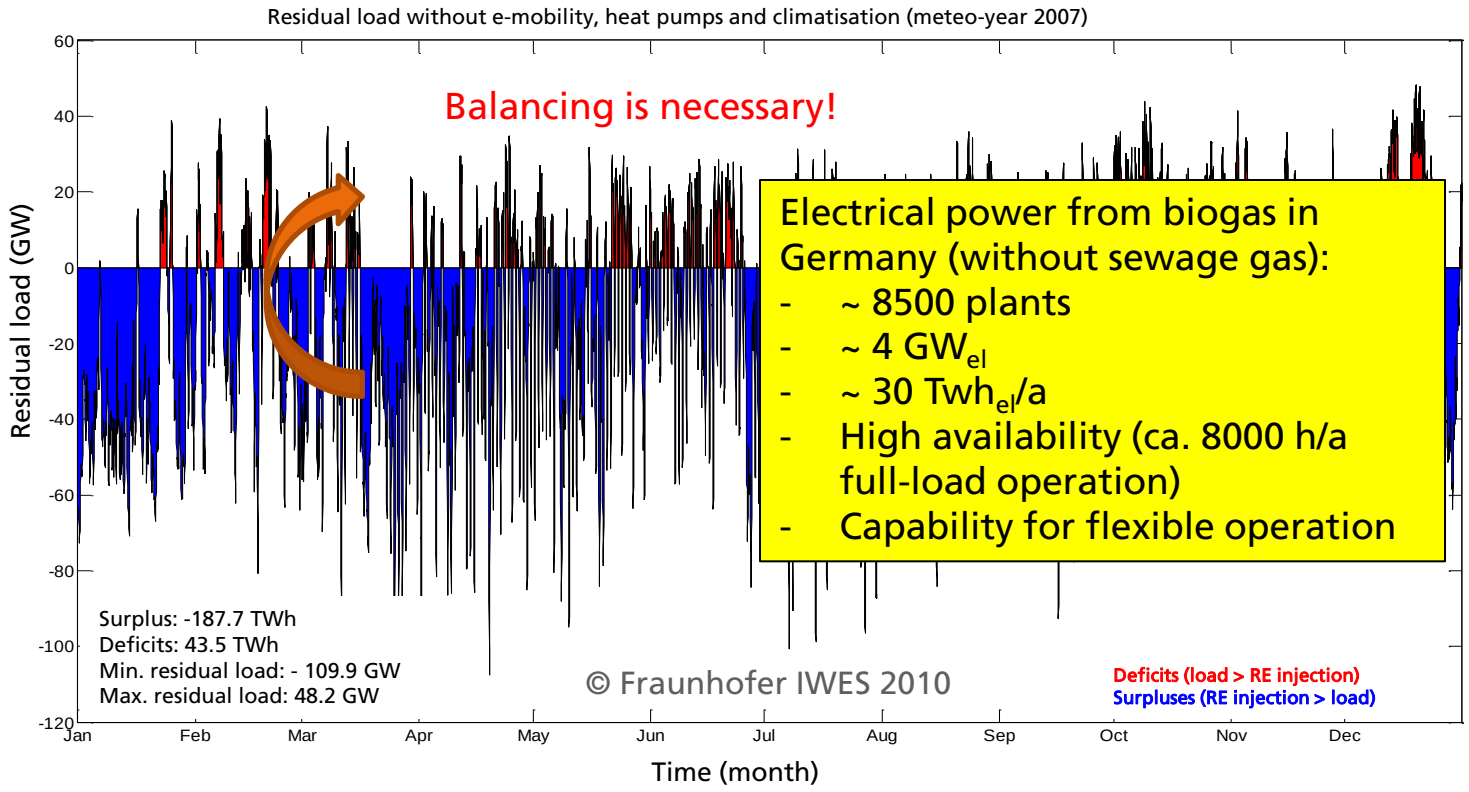
1) Transformation of the energy system

Future balancing power demand in German power grids



Source: IWES-calculation for UBA Energy goal 100% electricity from RE

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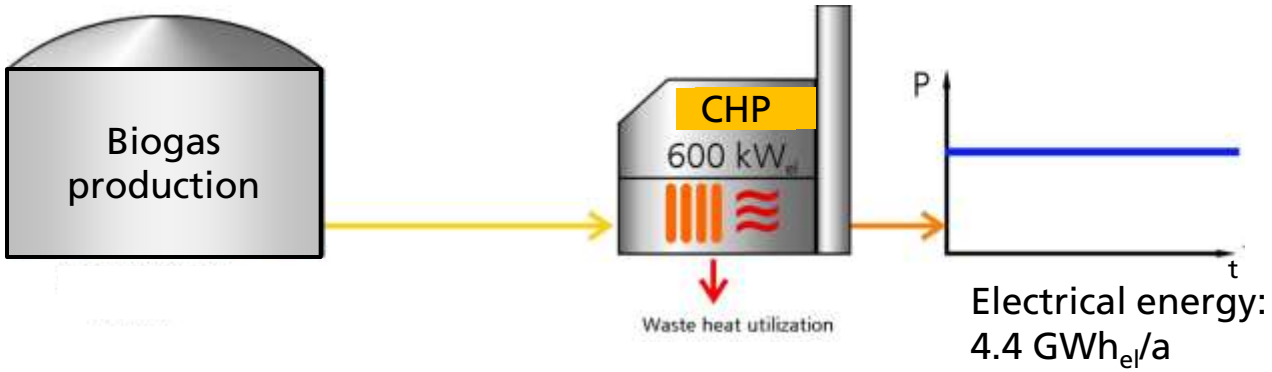
2) Biogas plant concepts for flexible power generation

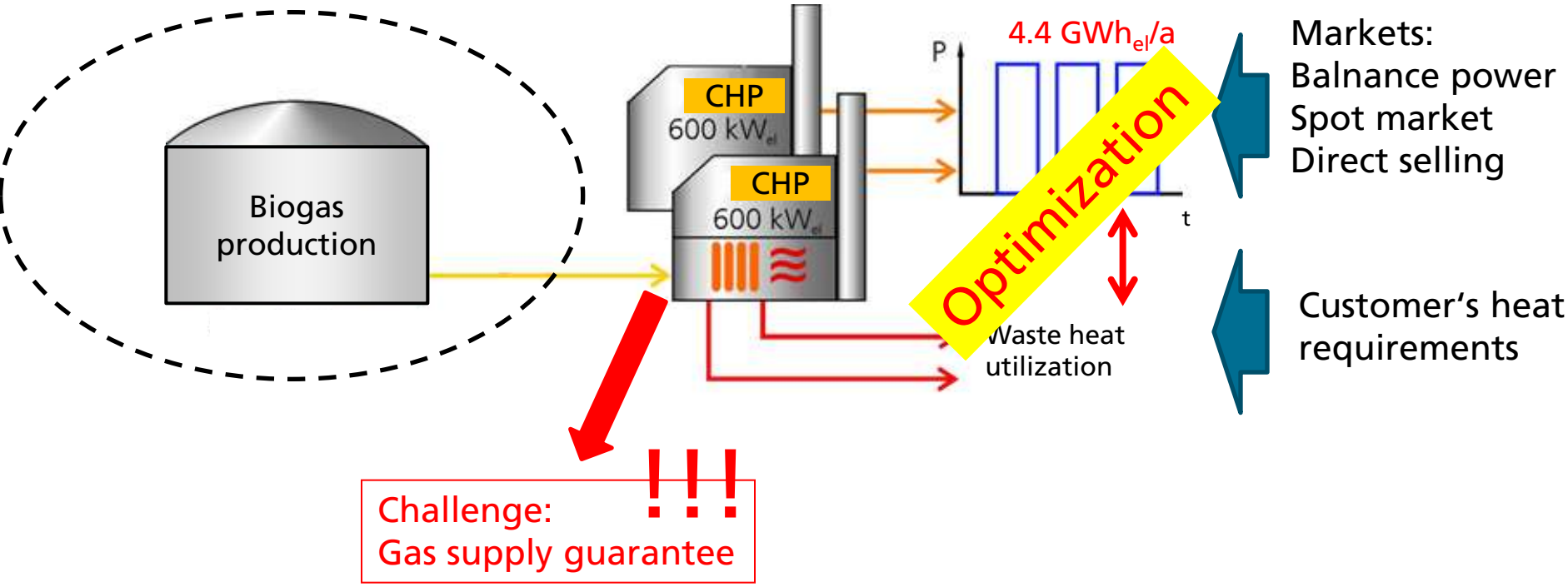
Conventional biogas plant configuration:



continuous biogas production continuous power generation
average power = installed power

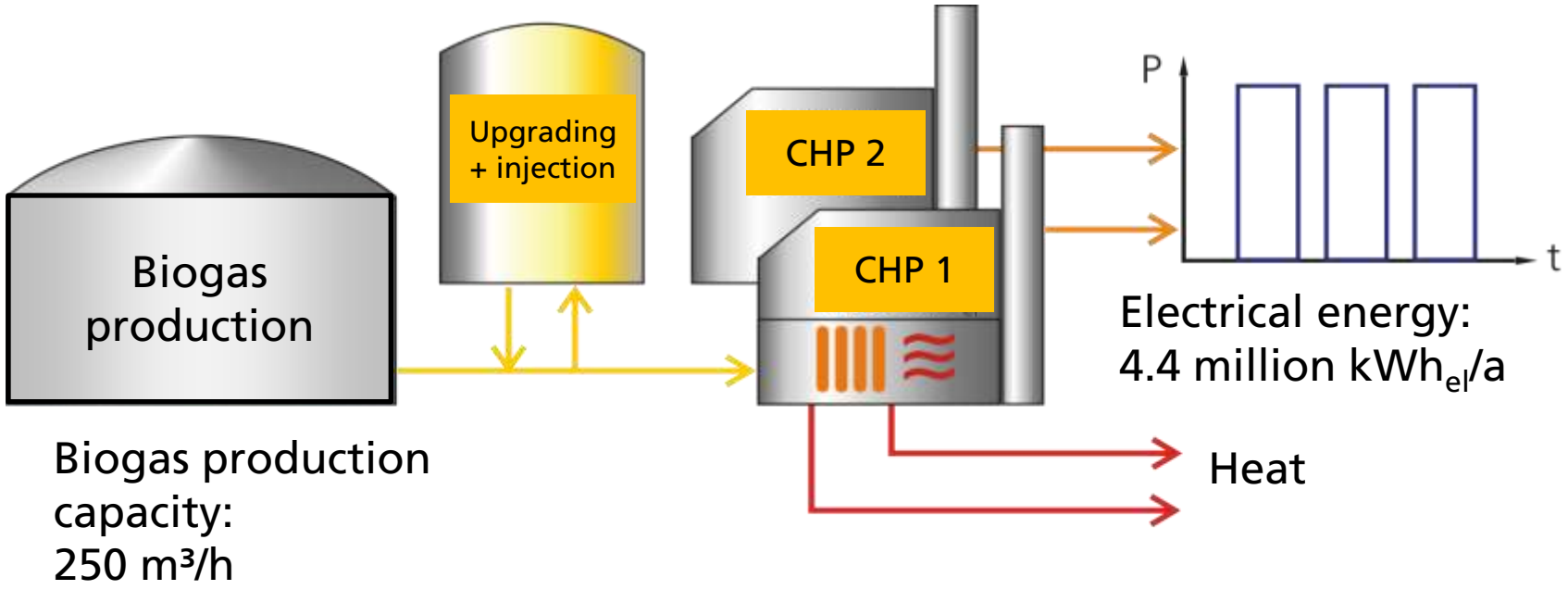
2) Biogas plant concepts for flexible power generation

Biogas plant for flexible power generation:



2) Biogas plant concepts for flexible power generation

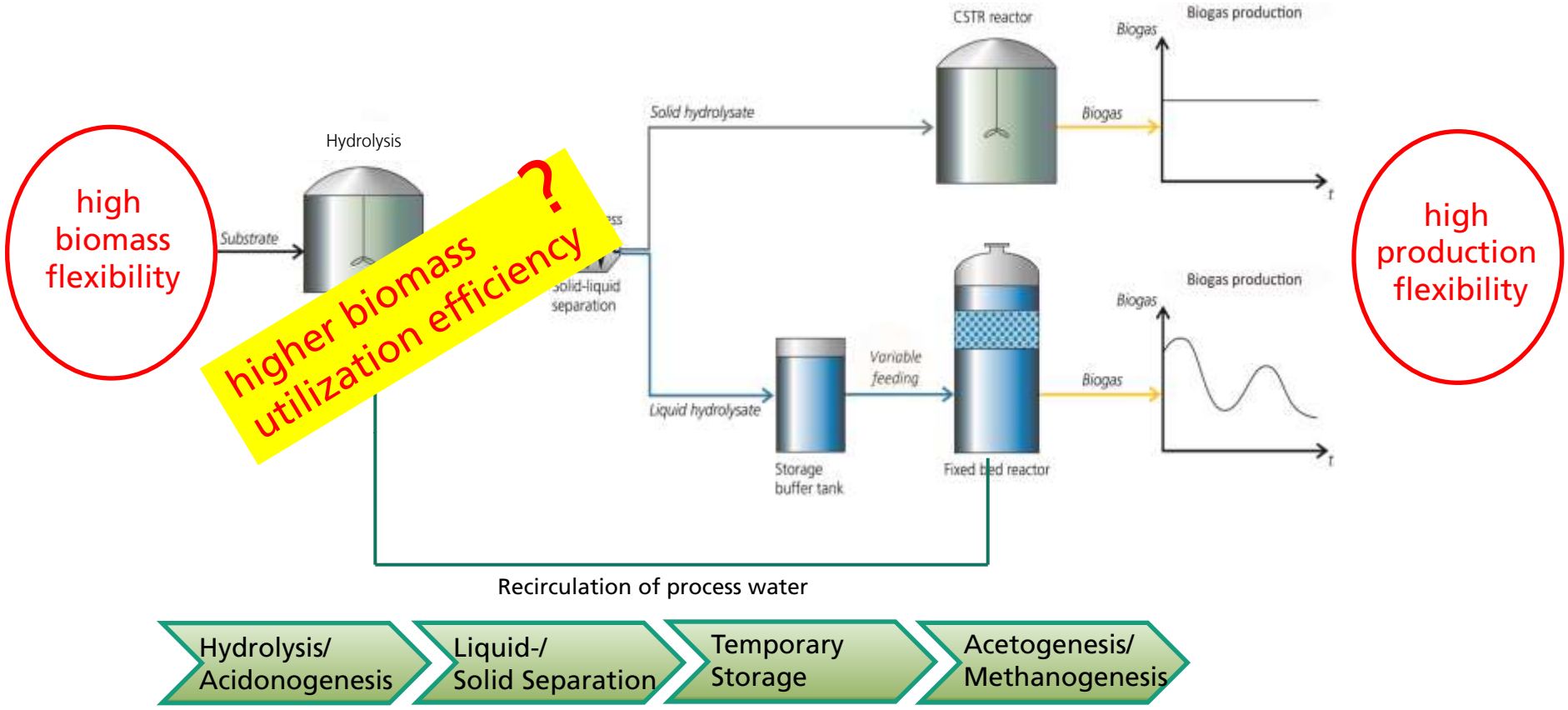
Biogas storing



continuous biogas production demand driven power generation
installed power = multiple average power

2) Biogas plant concepts for flexible power generation

Flexible biogas production - ReBi – Regelbare Biogasanlage



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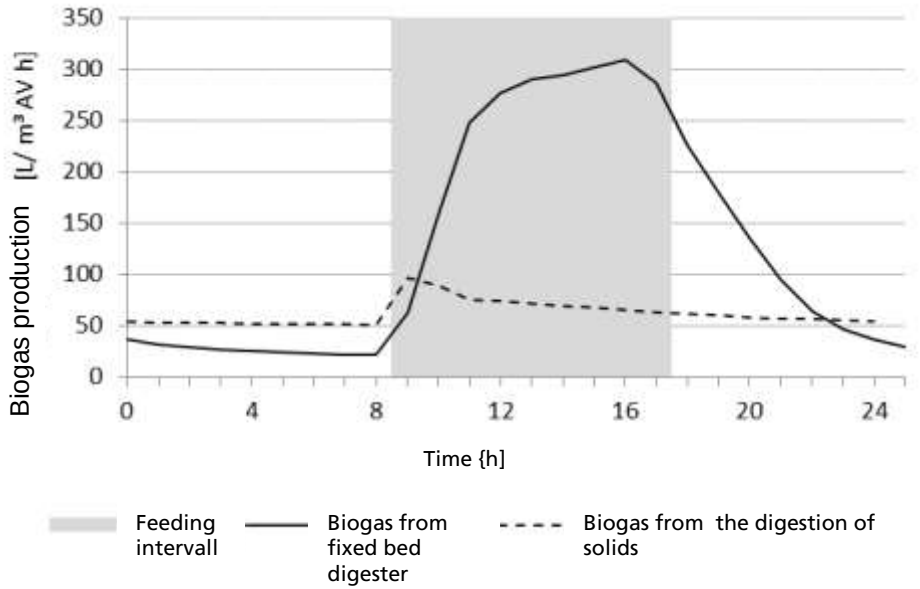
2) Biogas plant concepts for flexible power generation

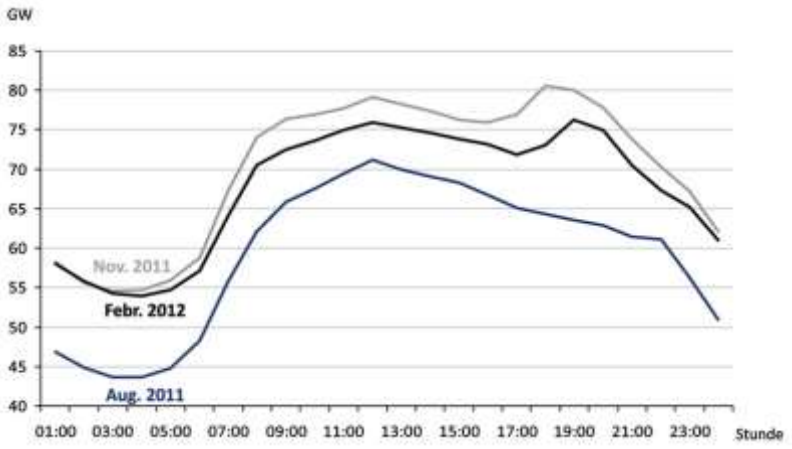
ReBi – Flexible biogas production

Focus: Daily demand

Biogas production in the course of one day



Daily electricity consumption of different seasons



Source: ReBi, IWES, HAWK Göttingen, W. Ganagin 2014

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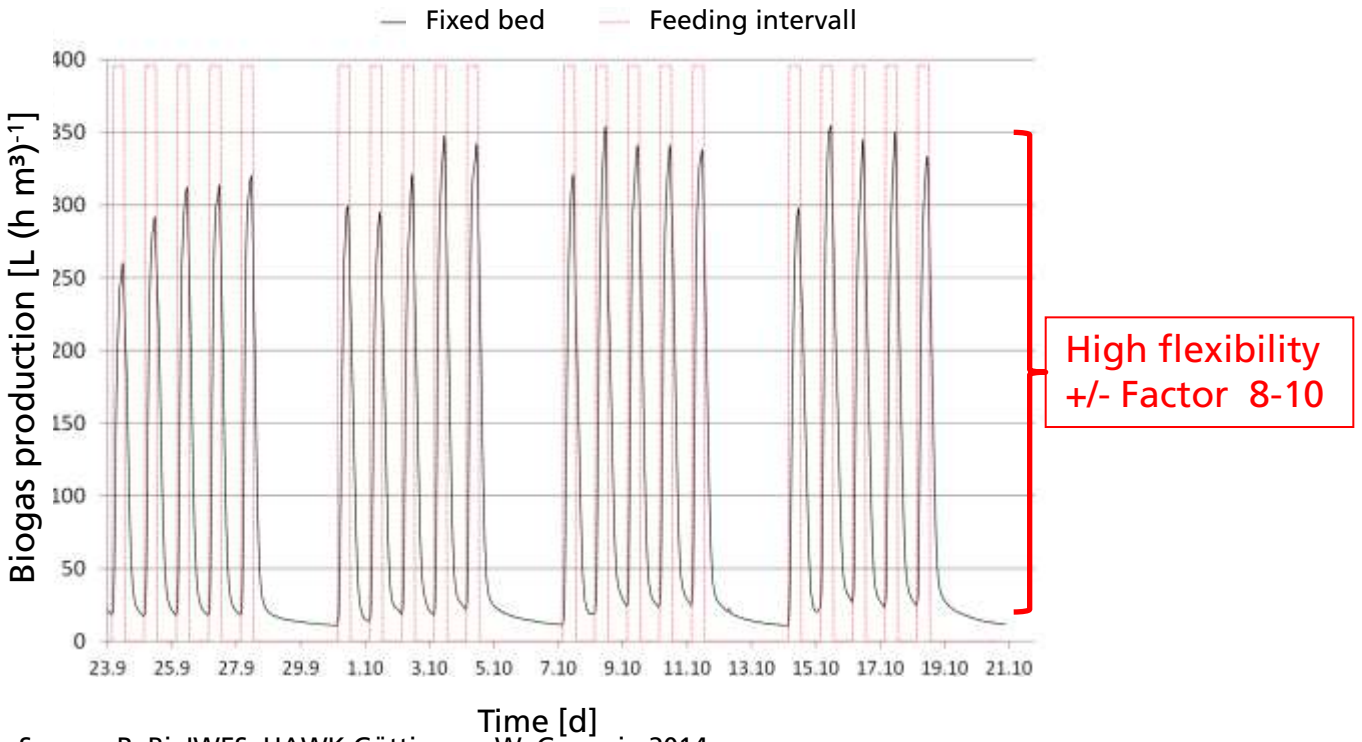
2) Biogas plant concepts for flexible power generation

ReBi – Flexible biogas production

Focus: Weekly demand

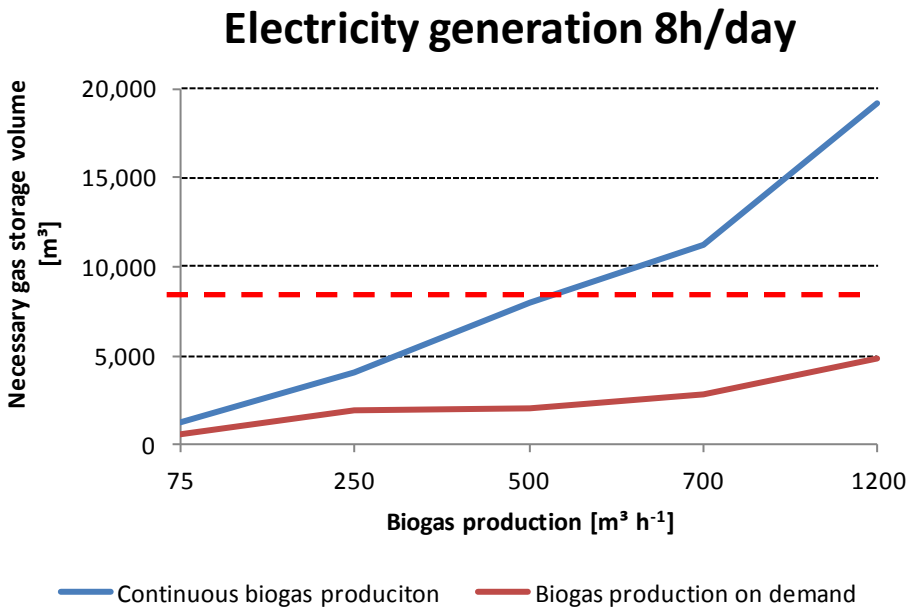


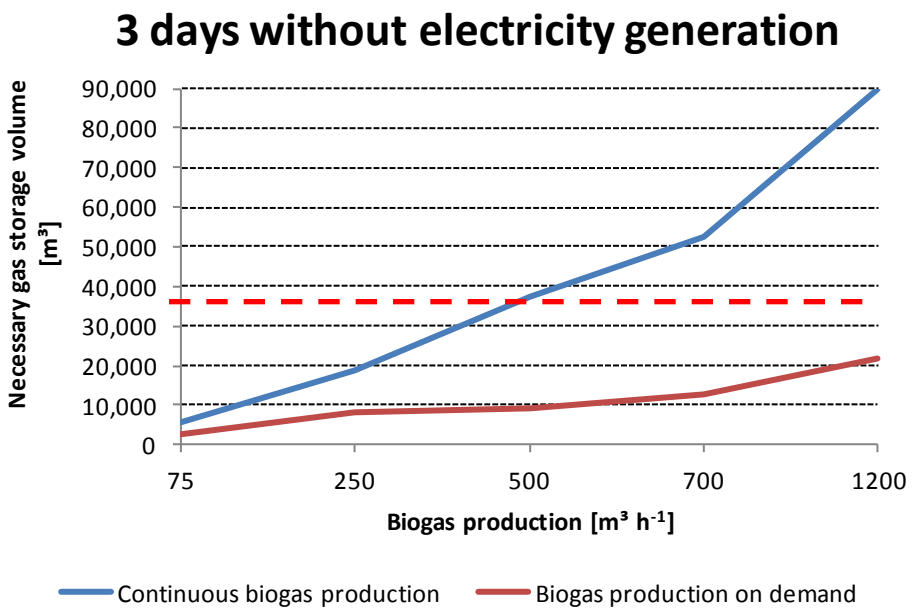
Source: ReBi, IWES, HAWK Göttingen, W. Ganagin 2014

2) Biogas plant concepts for flexible power generation

ReBi – Storage capacity savings

Figure: Comparison of required on site biogas storage capacity with continues and flexible gas production





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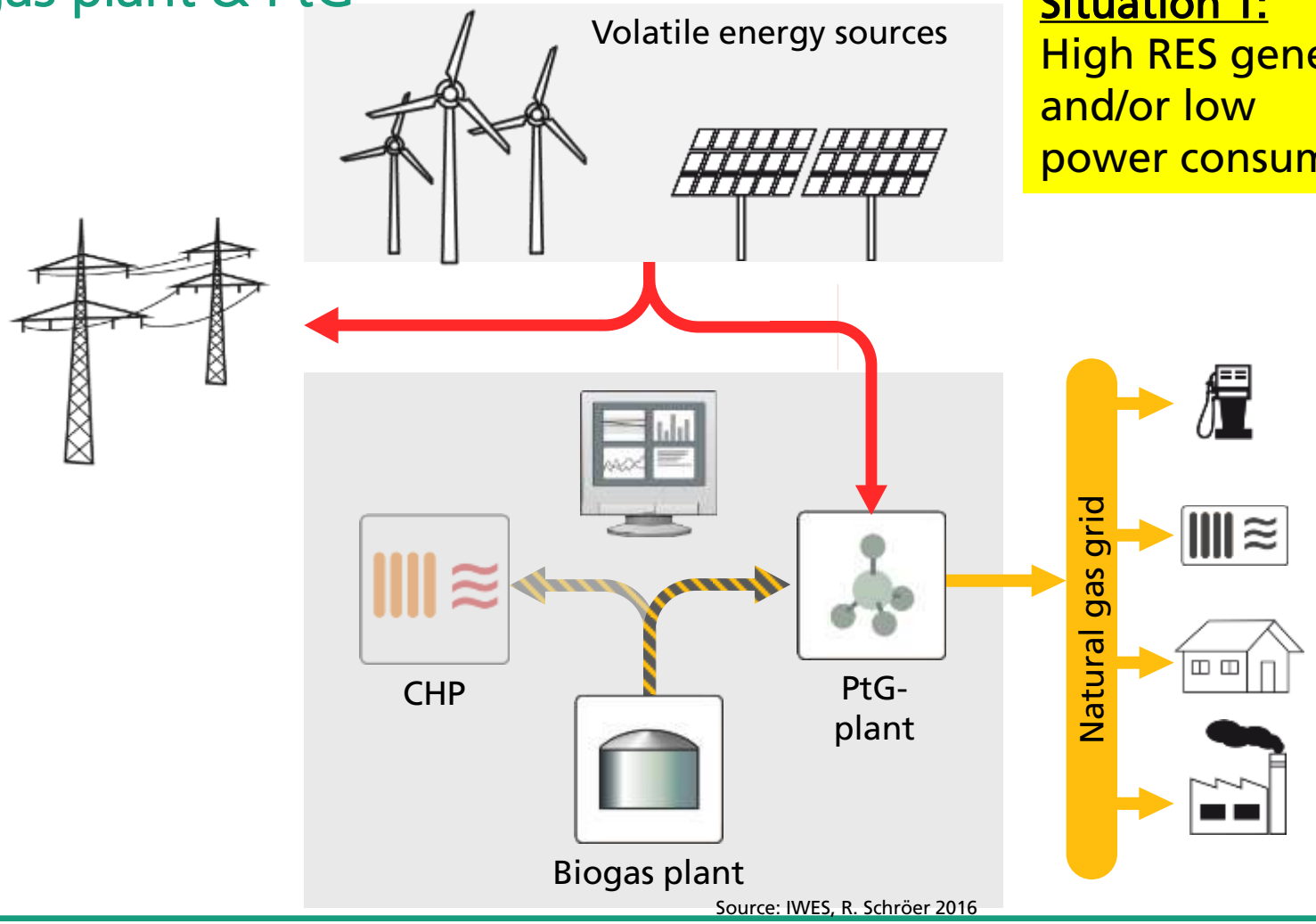
2) Biogas plant concepts for flexible power generation

Biogas plant & PtG

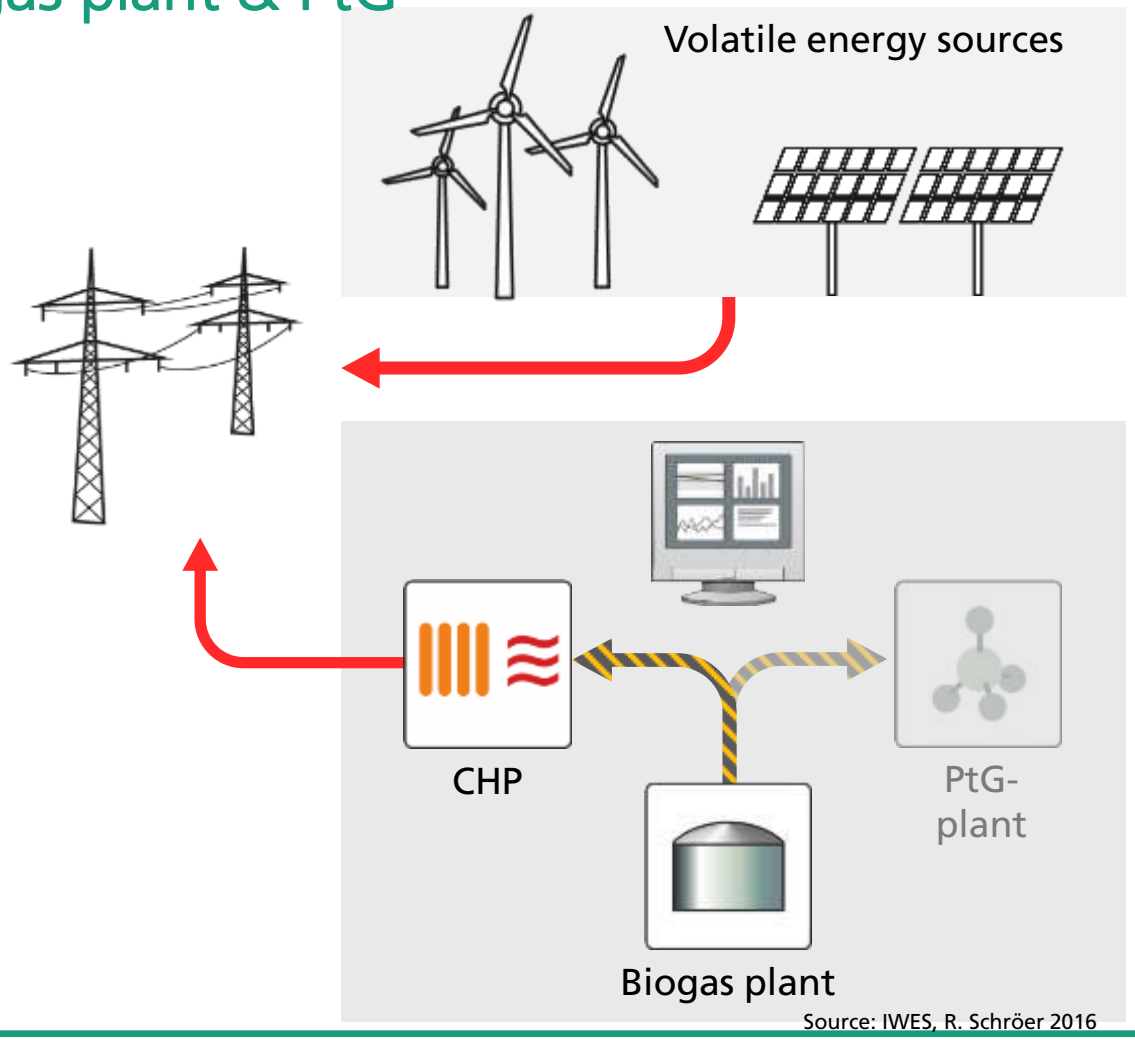
Situation 1:
High RES generation and/or low power consumption



Source: IWES, R. Schröer 2016

2) Biogas plant concepts for flexible power generation

Biogas plant & PtG



Source: IWES, R. Schröer 2016

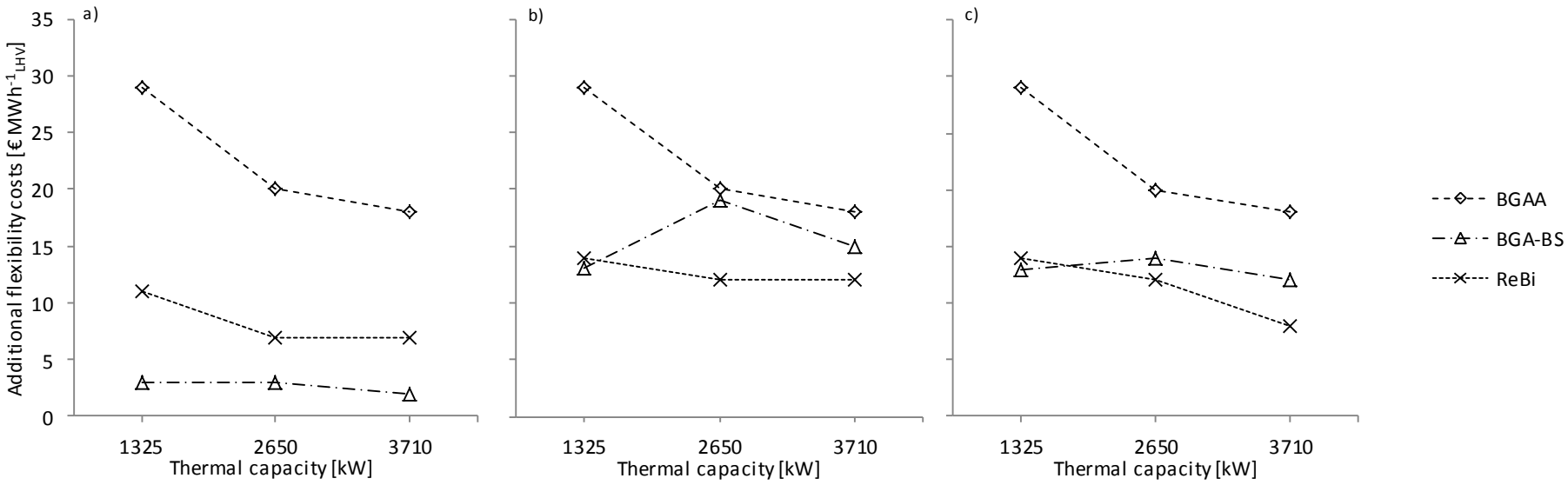
Situation 2:
Low RES generation and/or high power consumption

3) Biogas supply – cost comparison

a) Biogas demand 8 h/d

b) 72 h without biogas demand

c) = b) without gas storage limit



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4) Conclusion

- Flexible power generation from biogas is one technical solution to balance power generation and demand while increasing its worth

  → Future flexibility demand will determine its price on the market

- Biogas plants with flexible biogas production reduce gas storage capacity demands and increase the overall generation flexibility

  → Highly flexible biogas plants will benefit from the competition with expensive long-term energy storage systems

- Future biogas plant configurations will be designed to meet the demand of heat and electricity markets

- New biogas substrates for flexible biogas production will increase the country specific biogas potential and bring additional benefit into environmental (agricultural) systems

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Thank you … !

Contact:

Dr. Henning Hahn
Henning.Hahn@iwes.fraunhofer.de
+49-561-7294-261
Specialist: Techno-Economic Analysis Of Flexible Power Plants & Energy Storage Systems
Fraunhofer Institute for Wind Energy and Energy System Technology
Division Energy Process Technology
Königstor 59, 34119 Kassel, Germany