Natural gas: option for biogas integration, source of efficient distributed generation, and storage of excess green power

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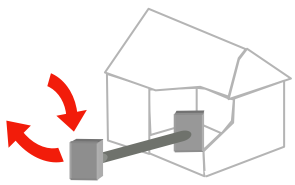
Content

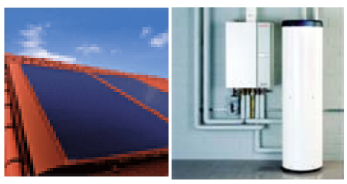
Natural gas – the cleanest fossil fuel: today and tomorrow

Natural gas allowing integration of bio fuel, renewable heat, and solar power

Biomethane



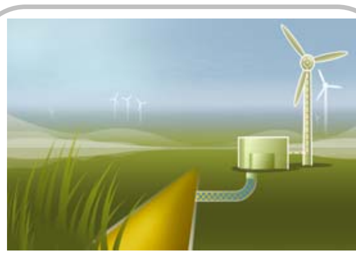
Gas heat pump



Natural gas & solar

Gas-based distributed generation to stabilize the power grid
Natural gas infrastructure to store H_2 from excess wind energy

Distributed generation



H_2 storage

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Bio Methane

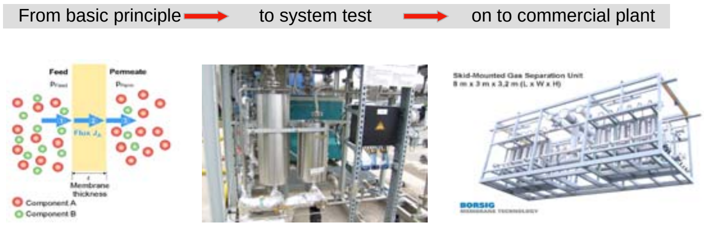
Exploring the future of "green gas"

Facts in Germany

- Approx. 50 plants in operation; 500 m³/h average size with an annual production of 50 million kWh each
- Approx. 3 billion kWh total annual production
- Standards in place (for individual process components like conditioning and grid injection plants)

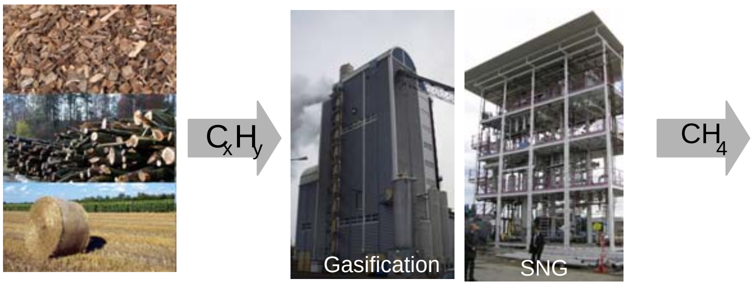
Optimization of biomethane technology

- Optimization of plant performance and measurement costs
- Development and testing of innovative biogas upgrading technology



Alternative energy sources and fuels

- Identification and evaluation of new energy sources
- Technical and economic evaluation of innovative conversion chains



Solid biomass **Bio SNG production plant**

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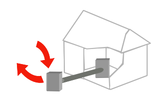

Gas Heat Pump

Gas heat pump technologies in Germany - Market and R&D

ROBUR konsequent umweltbewusst

> 15 - 40 kW for new and existing buildings

- High efficiency demonstrated
- Operational safety and long-term stability confirmed
- **Market launch in 2009**

BOSCH

- Newly developed appliance generation tested
- High efficiency demonstrated
- Further optimization still required for all components
- First field test installations in late 2010
- ***Market launch planned for late 2011***

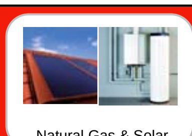
Vaillant

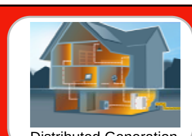
> 10 kW for new and existing buildings

- Operational safety and long-term stability confirmed
- **Market launch of solar-assisted gas heat pump in March 2010**
- Test rig trials to continue for optimization of efficiency

VIESSMANN climate of innovation

- Component tests to continue
- First prototype available since late 2009
- Field test installations planned for 2010/2011 heating season
- ***Market launch planned for 2012***


Natural Gas & Solar


Distributed Generation

Natural gas applications: standards and innovations to reduce emissions


Natural Gas & Solar

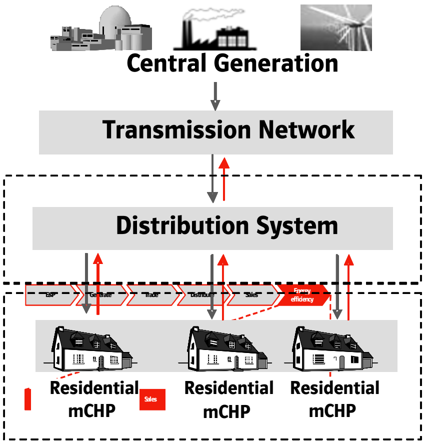
Condensing boiler & solar

- Proven technology
- Highest efficiency
- 2.7 million condensing boilers installed in Germany (partly in combination with solar)


Distributed Generation

µ-CHP (for one- and two-family homes)

- Close to market launch
- Goal: keep overall efficiency near to 90% but increase electrical efficiency from 20% today to 60%
- Rationale: set up a virtual power plant via a cluster of µ-CHP applications (to replace a coal-fired central power plant or to balance PV fluctuations)



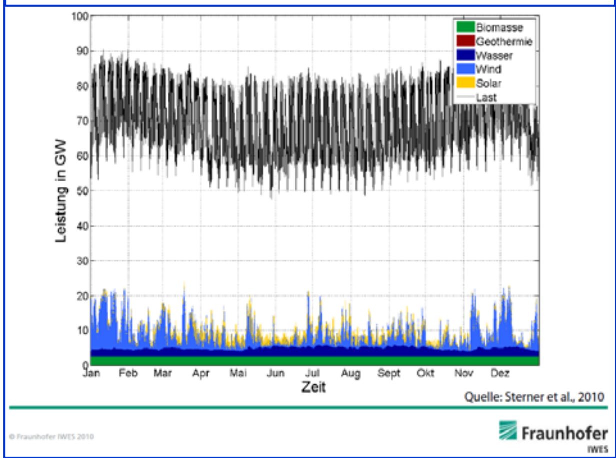

H_2 Storage

Increasing number of wind & PV plants and, as a result, more volatile intermittent generation - a challenge for power grid operators

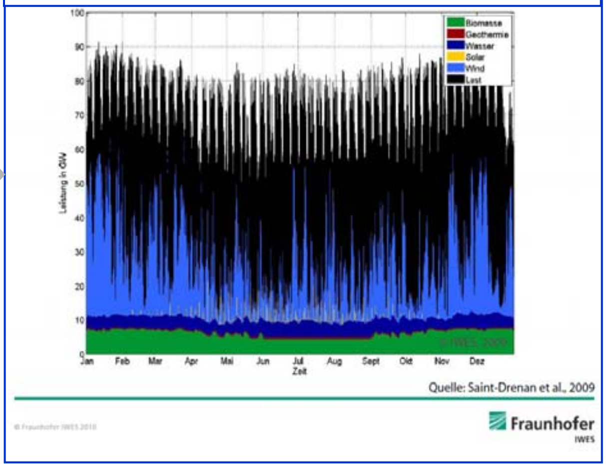
	Installed power (Germany)			
Year	2010	2020	2030	2050
GW	27	42	60	86-100

Ref: **dena** study “PSW-Integration 2007/2008” et alias

2007: demand & intermittent generation (wind ■)



2020: demand & intermittent generation (wind ■)



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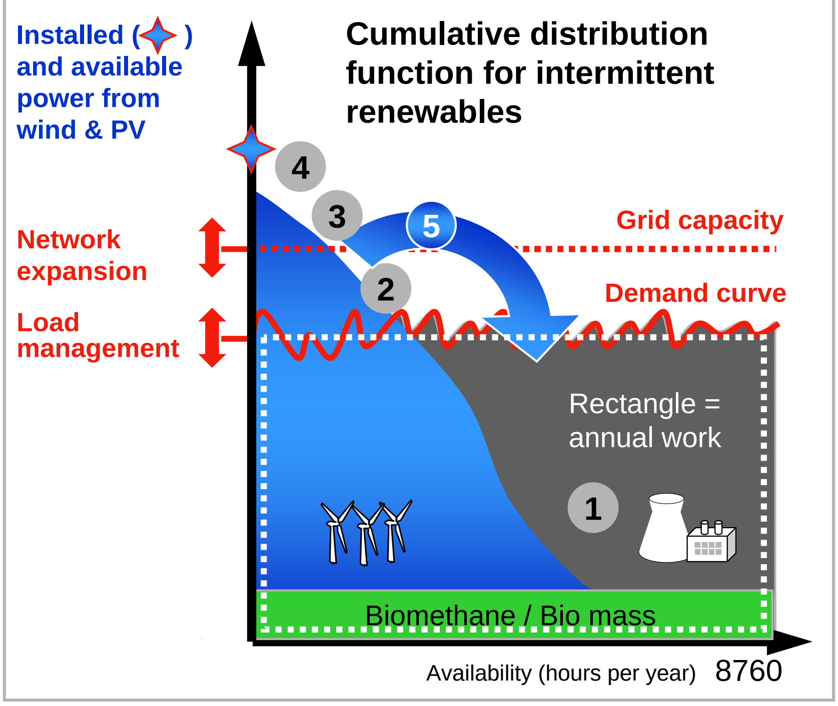
Upgrading of power grid (copper plate) or – alternatively – storing of electricity to integrate intermittent availability of wind & PV



Problems (and solutions)

1. **Conventional generation increasingly uneconomic, but still indispensable**
2. **Load management flexibility fully utilized**
3. **Transmission capacity insufficient; lengthy capacity expansion procedure (10 years including approval)**
4. **Oversupply: plants to be shut down; but idle power to be paid for (according to regulatory framework)**
5. **Energy storage:** **Flattening of "inclined" distribution function for wind & PV possible; energy shifted to phases of lower generation**

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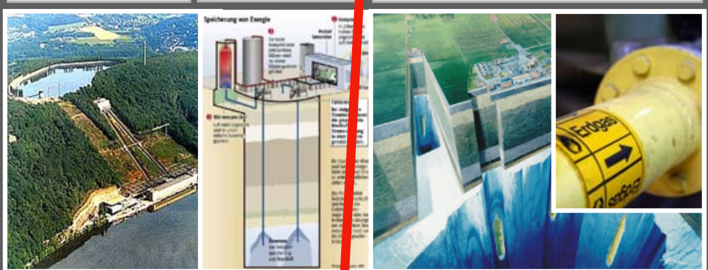
Power storage

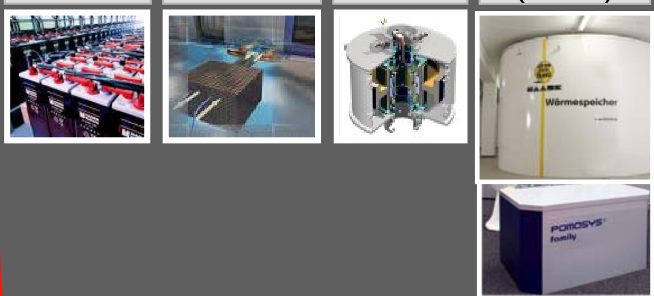
Long-term storage

Proven technology	Room for improvement	New technologies
Water reservoirs	CAES	H_2 integration in NG



Short-term storage

Known technologies with potential for improvement			
Battery	Supercap	Fly wheel	Heat (latent)



Evaluation

- In Germany, limited potential
- Adiabatic storages
- Wide range of options based on existing gas grid; methanation as an option
- Important for e-mobility
- Need for further R&D
- Important for CHP optimization

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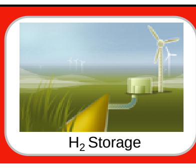
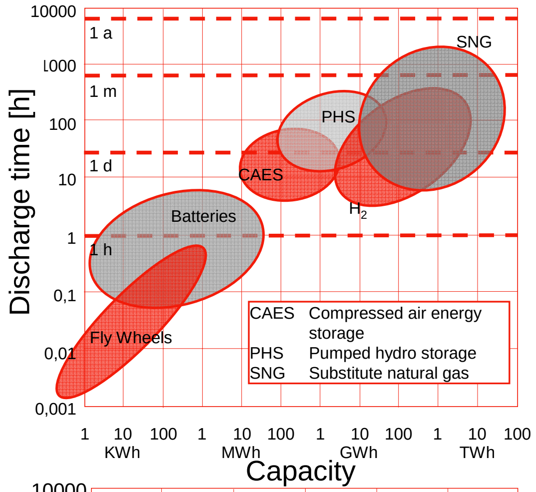
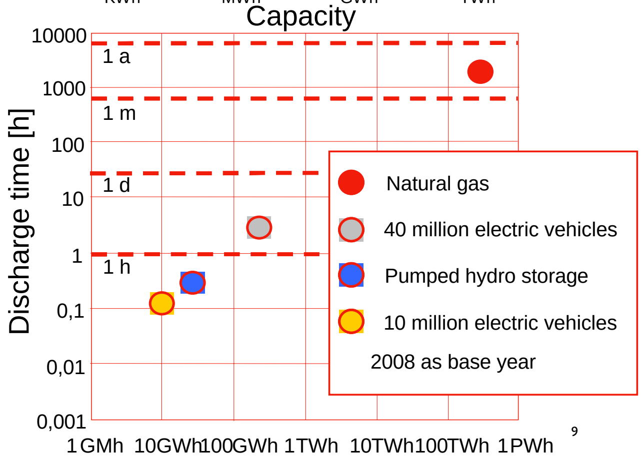


Natural gas systems as a huge storage reservoir

Storage capacities (Germany)

		Electricity	Natural gas
Consumption	TWh/a	619	930
Average power	GW	70	106
Storage capacity	TWh	0.04	217
Cal. operating range	h	0.6	2000





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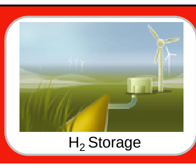
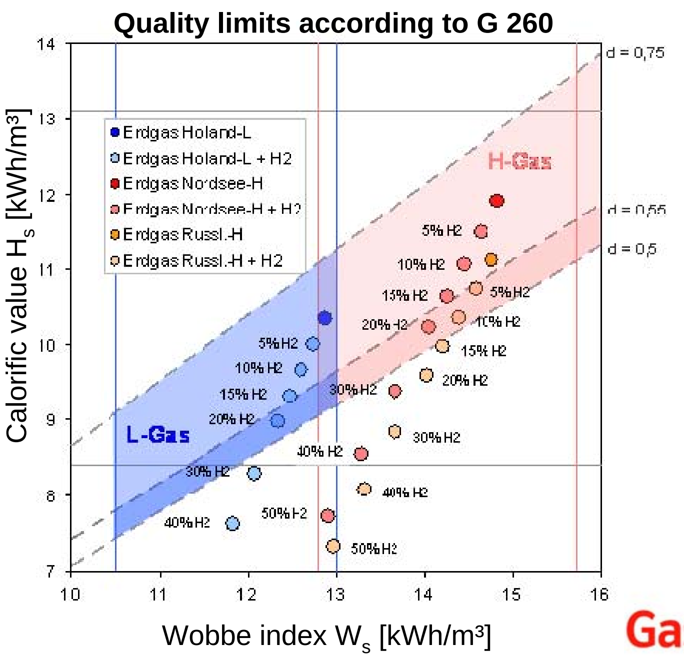


H_2 concentration in natural gas systems: limits

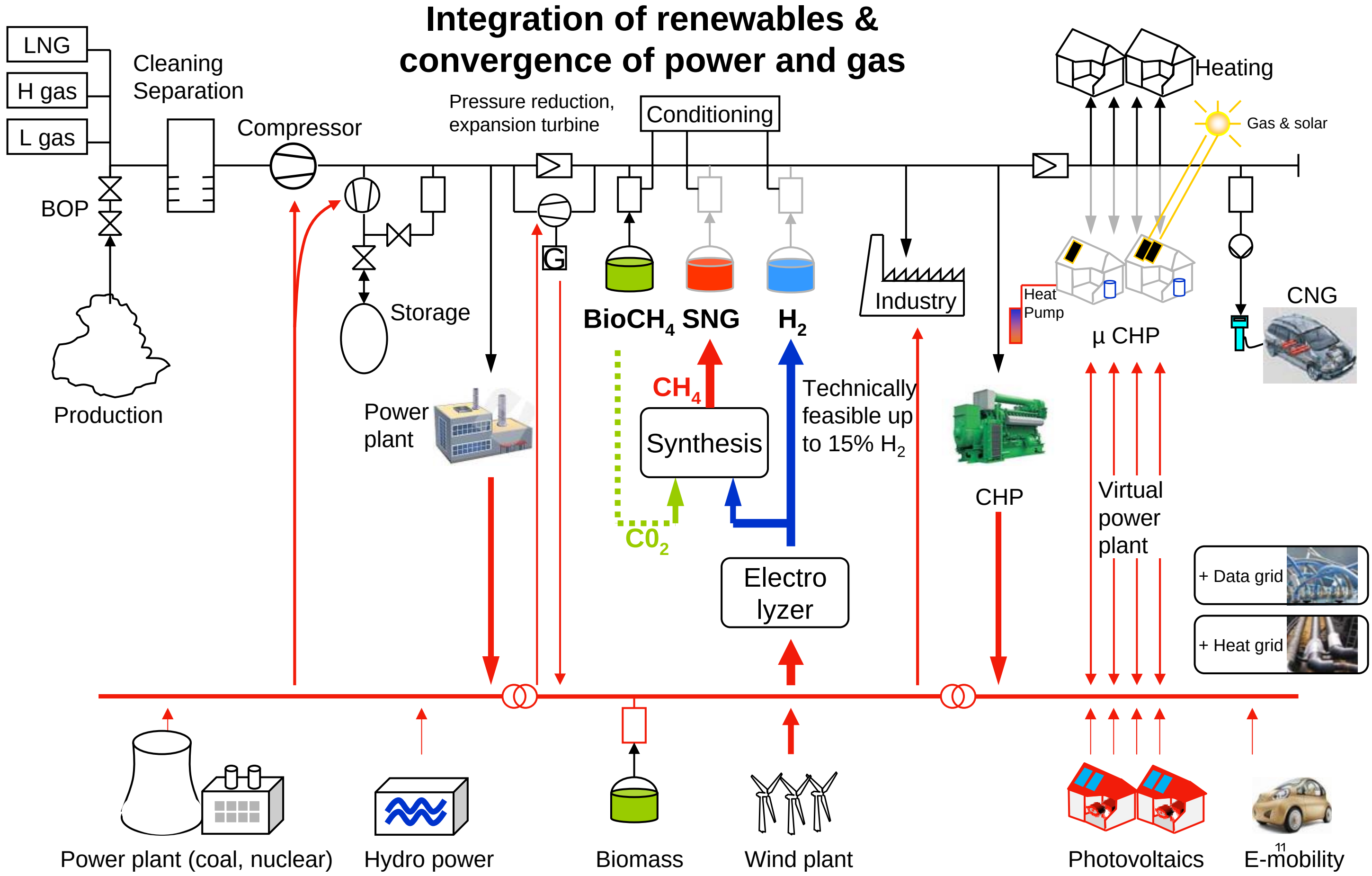
A mixture of up to 15% H_2 and 85% natural gas is a product (hythane) with properties (calorific value and Wobbe index) that meet all requirements under DVGW Code G260 (gas quality specifications)



<u>Germany:</u>
15% H_2 in the natural gas grid equals approx. 15 bcm.
33 GW excess wind power over 2000 h/a would be necessary to generate this amount of energy.

GasCalc

Integration of renewables & convergence of power and gas

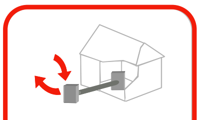


Summary

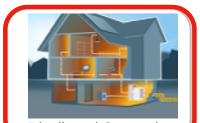
Natural gas

- … is the cleanest fossil fuel
- … has a renewable share (biomethane)
- … can be combined with geothermal energy (gas heat pump)
- … offers proven technology to integrate solar power
- … enhances energy efficiency (via distributed generation) and can compensate local power fluctuations


Bio Methane


Gas Heat Pump


Natural Gas & Solar


Distributed Generation


H_2 Storage

The environmental footprint of natural gas can be designed

- … by increasing the share of biomethane
- … by hydrogen integration (hythane from excess wind power)
- … by applying CCS technologies

Natural gas contributes to solving the problem of power storage

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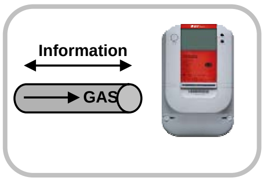

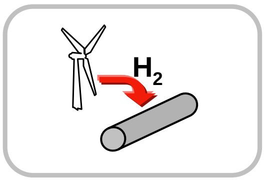

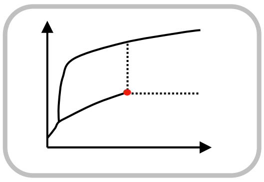

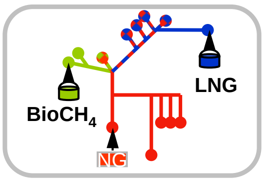

Stone age is not over because we ran out of stones – we evolved.

Thanks for your attention.