

The German Energy Transition
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Friday July 19, 2019
WI Distributed Resources Collaborative



***Observations from abroad
and a look at the future***

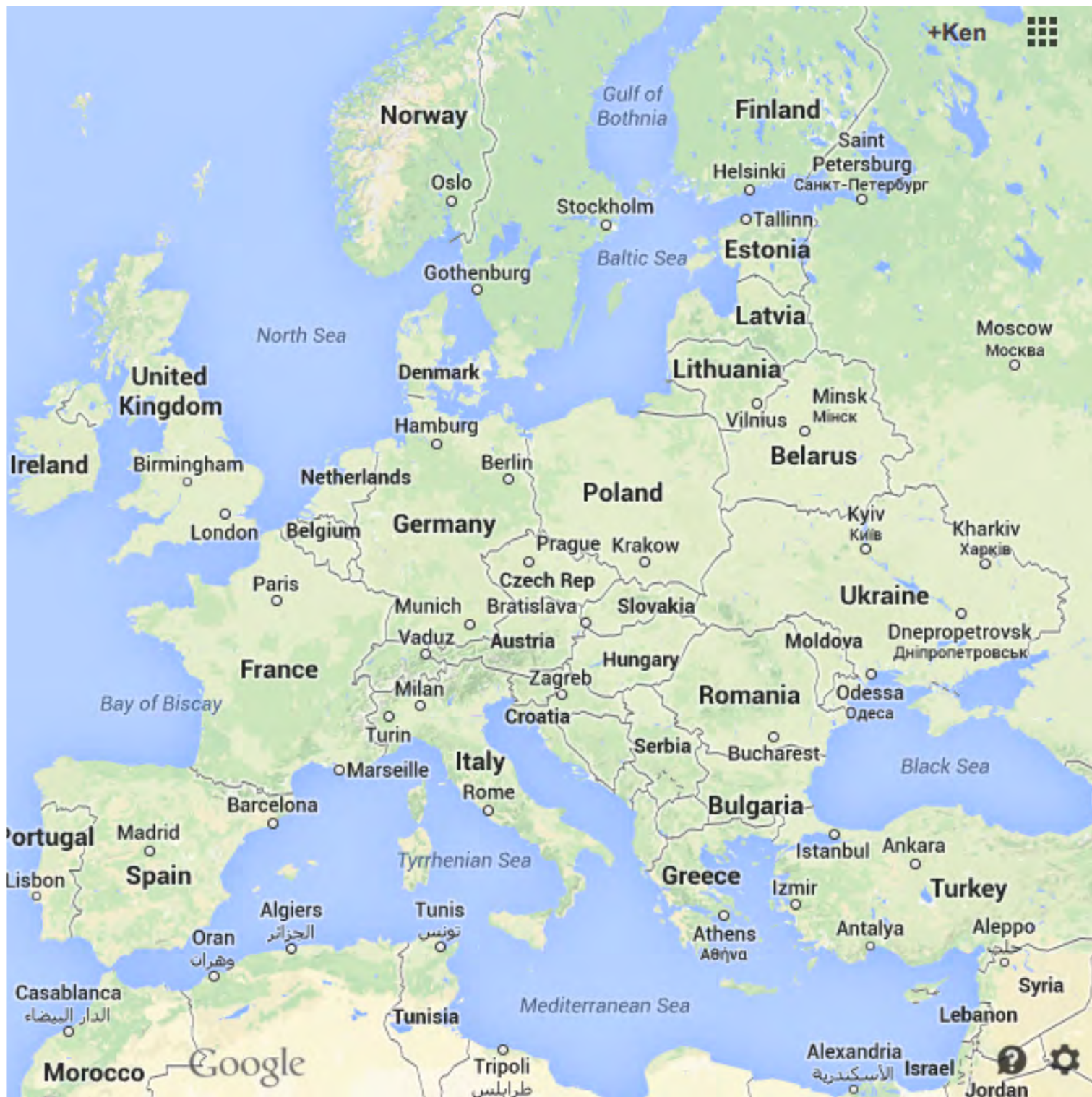
CREATE Energy Storage Project



The goal of the CREATE Energy Storage Project is to advance the field of renewable energy by integrating energy storage technology into existing two-year college programs. This goal will be accomplished through four objectives:



Disclaimer: this work was supported by the National Science Foundation through the advanced technological education program. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.













Three Pillars of the *Energiewende*



RENEWABLE ENERGY SOURCES

- Rapid, continuous expansion
- Cost-efficient and environmentally friendly



ENERGY EFFICIENCY

- Reduce energy consumption
- Ensure efficiency



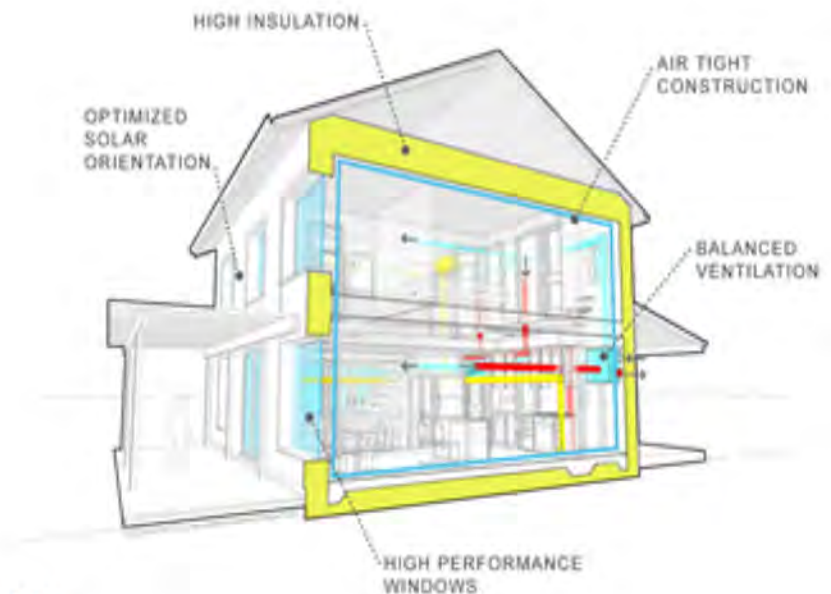
FLEXIBILITY AND FUTURE GRID NETWORK

- Flexible grids and high capacity
- Integration of electricity from renewable sources



Passivhaus, Net Zero, and Plus Energy homes

- **Passive House (Passivhaus)**
 - Design to use *much* less energy than a standard home
 - Up to 90% savings!
- **Net Zero Energy (NZE)**
 - Energy Produced = Energy Consumed
 - One year time period
- **Net Positive Energy**
 - Energy Produced > Energy Consumed
 - One year time period
 - Offset electric vehicle use, embodied energy of building, etc.



Heliotrope (1994)

Cost \$243,000 in 1994
(\$420,000 in today's dollars)

200 square meters (2150 sq ft)
Produces 5X the energy it consumes

- Passive house
- Dual axis solar + rotation
 - 30% more solar production
 - Goes flat when storm is predicted
- Timber construction
 - <carbon footprint than concrete
- Solar thermal for showers and washing machine

Only four Heliotropes were built, all paid for in cash (impossible to mortgage)



Solar Settlement (2000)



- First neighborhood of plus energy houses
- 50 houses, 52 units (one is a two-family unit)
- Privately financed, investment scheme through a chocolatier turned energy & insulation entrepreneur
- Building costs extra 12% in construction
- 150 m² (1614 ft²) unit costs €890,000

Bugginger Strasse 50 Bldg - Worlds First Passiv Haus Low Income High Rise



Original 1968 – 21,500 BTU/ sq ft

Renovation 2009 → 4,700 BTU/ sq ft

Sunship (2006)



- Home to Ökoinstitut (EcoInstitute)
 - Also shops, bank, other offices
- Night cooling with ventilation only
 - No mechanical cooling
- Vacuum capsule walls
- Manual ventilation for daytime
- Phase-change, paraffin plaster boards
- External blinds

Freiburg Town Hall – World's First Plus Energy Municipal Building

Opened in 2017



280,000 sq ft bldg.

220 kW of solar PV panels

Geothermal heat pumps for heat/cool

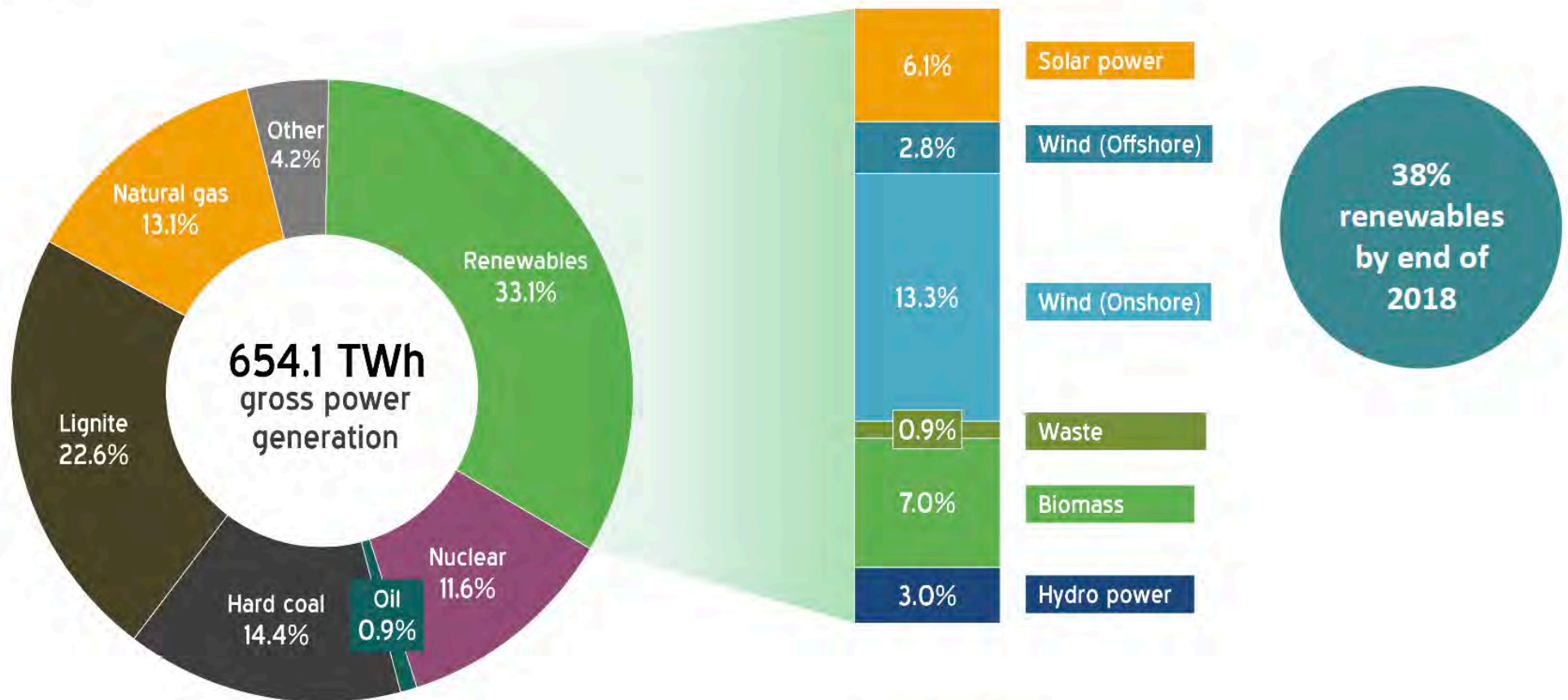
Hybrid solar PV//thermal panels for hot water & improved PV efficiency



Germany reaches 33.1 percent renewable power in 2017

Gross power generation mix

Source: AGEB



24 Apr 2019, 17:27 [Julian Wettengel](#)

Renewables hit record 77 percent of German power on Easter Monday

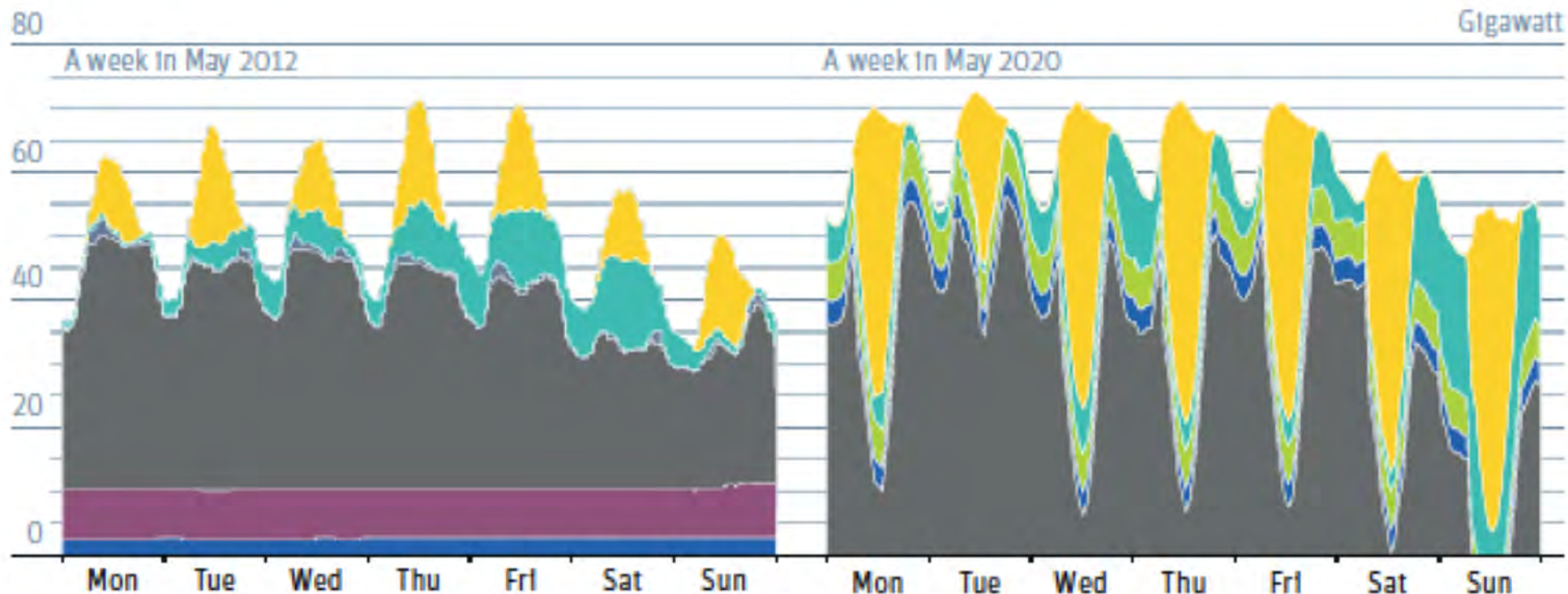
Wind provided 40% of total net power, solar 20%, and biomass 10%



Renewables need flexible backup, not baseload

Estimated power demand over a week in 2012 and 2020, Germany

Source: Volker Quaschnig, HTW Berlin



Key technologies?

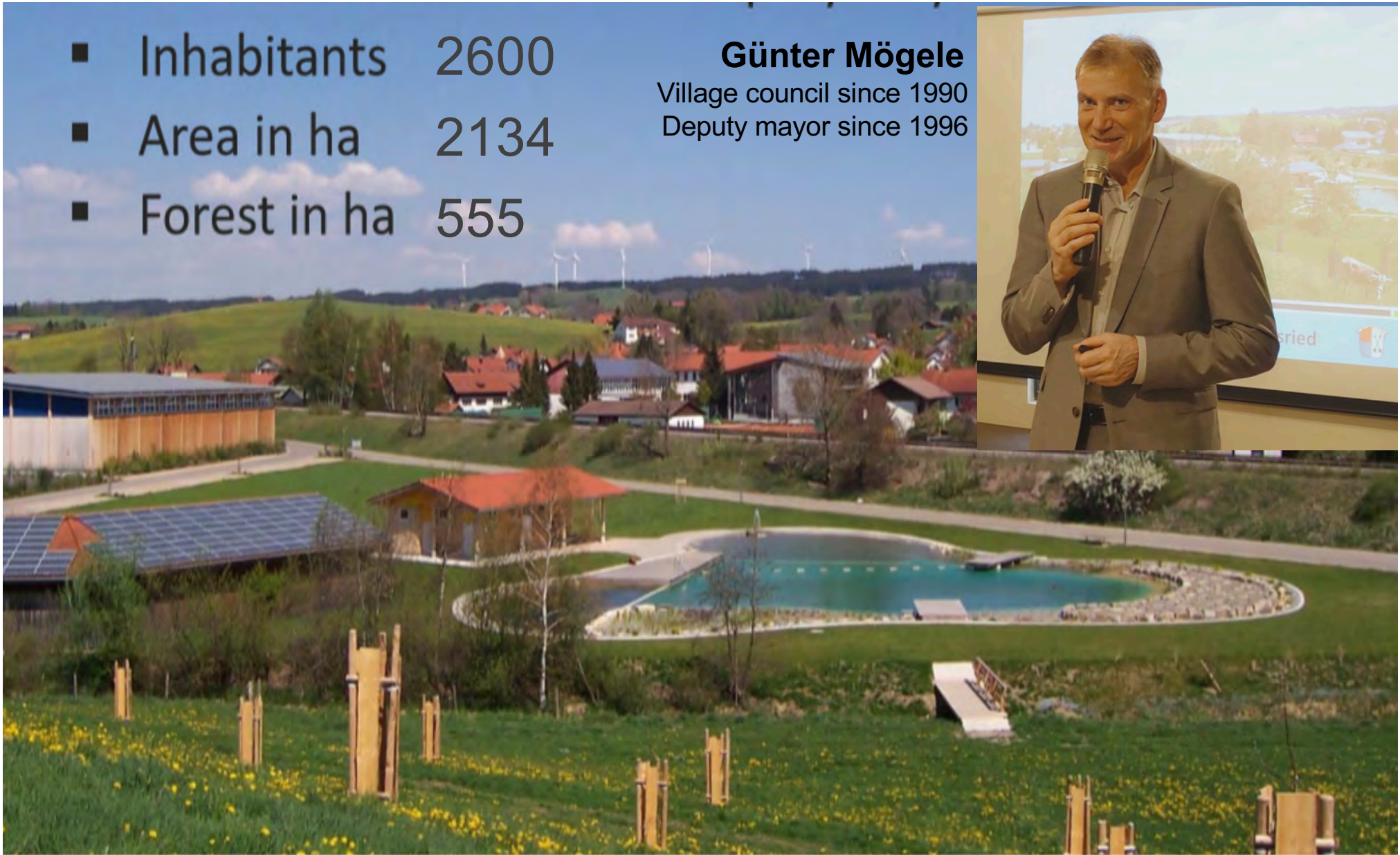
- Better and Smarter Grids
- Smart inverters and interconnections
- Storage
- Demand side management

Wildpoldsried, Germany



- Inhabitants 2600
- Area in ha 2134
- Forest in ha 555

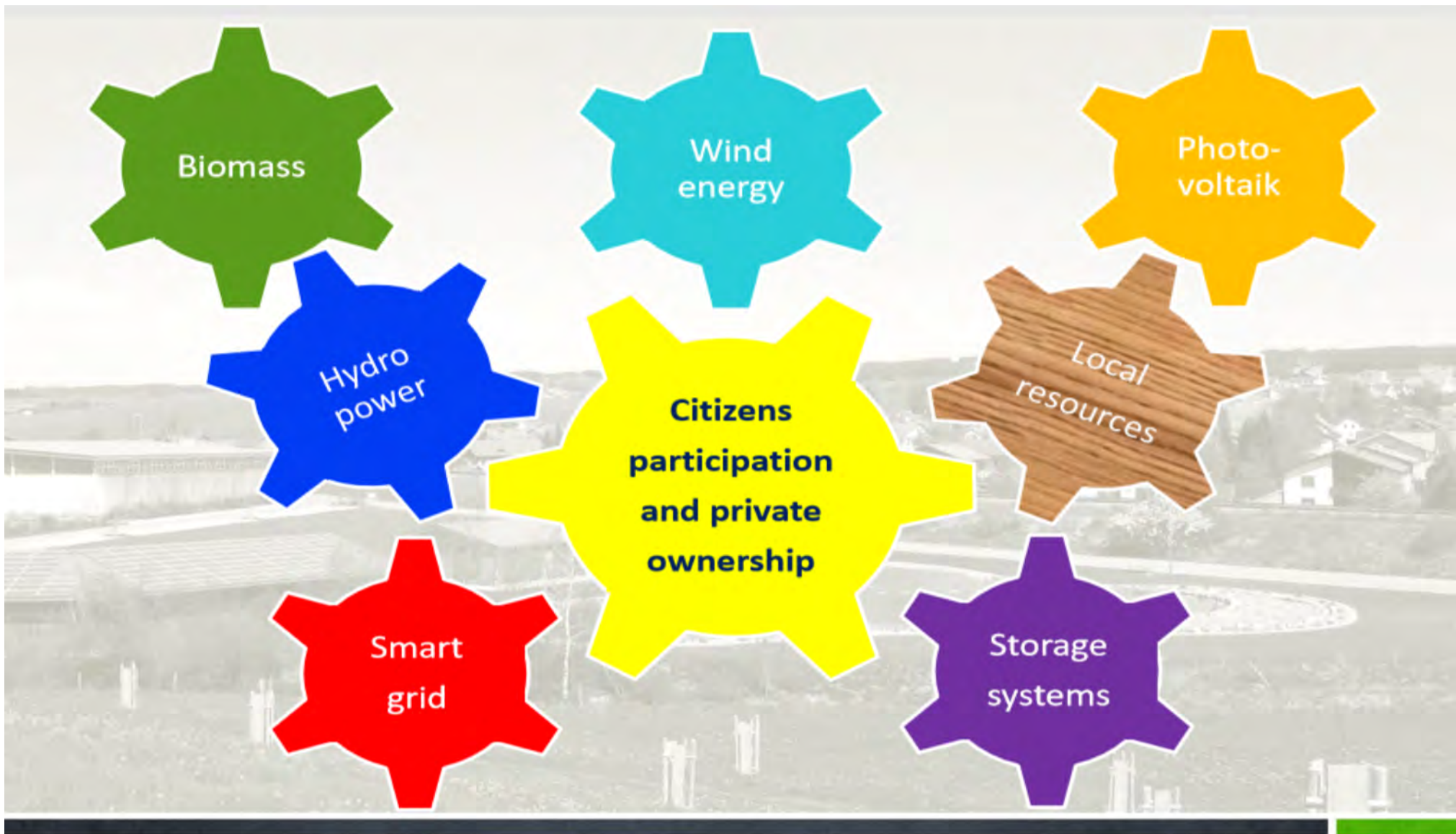
Günter Mögele
Village council since 1990
Deputy mayor since 1996



The energy village of Wildpoldsried



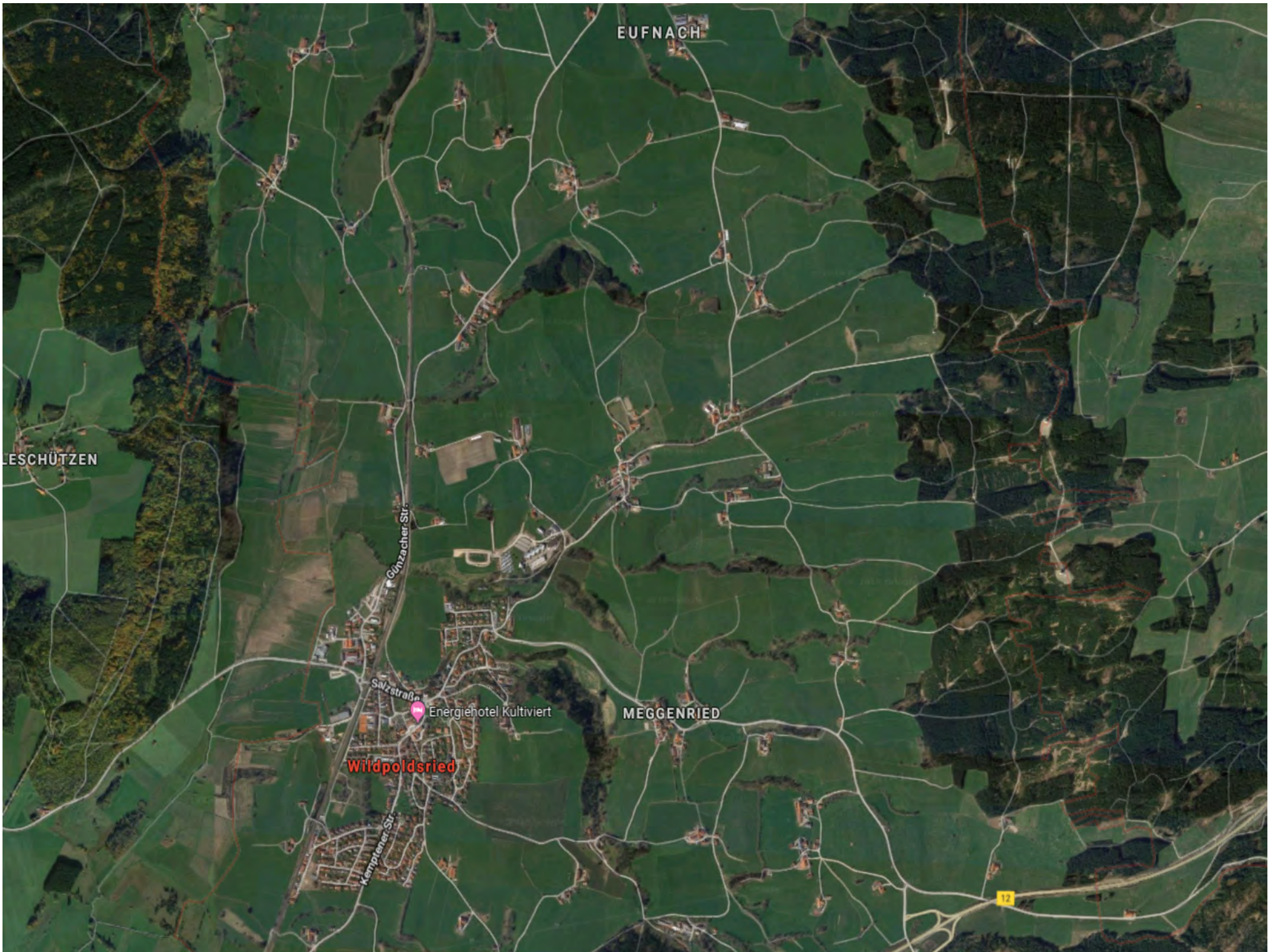
Goal: Meet **ALL** Energy needs with renewables (Electricity, Heat, and Transportation)



driven by the most important gear



Allgäu



EUFNACH

LESCHÜTZEN

MEGGENRIED

Wildpoldsried

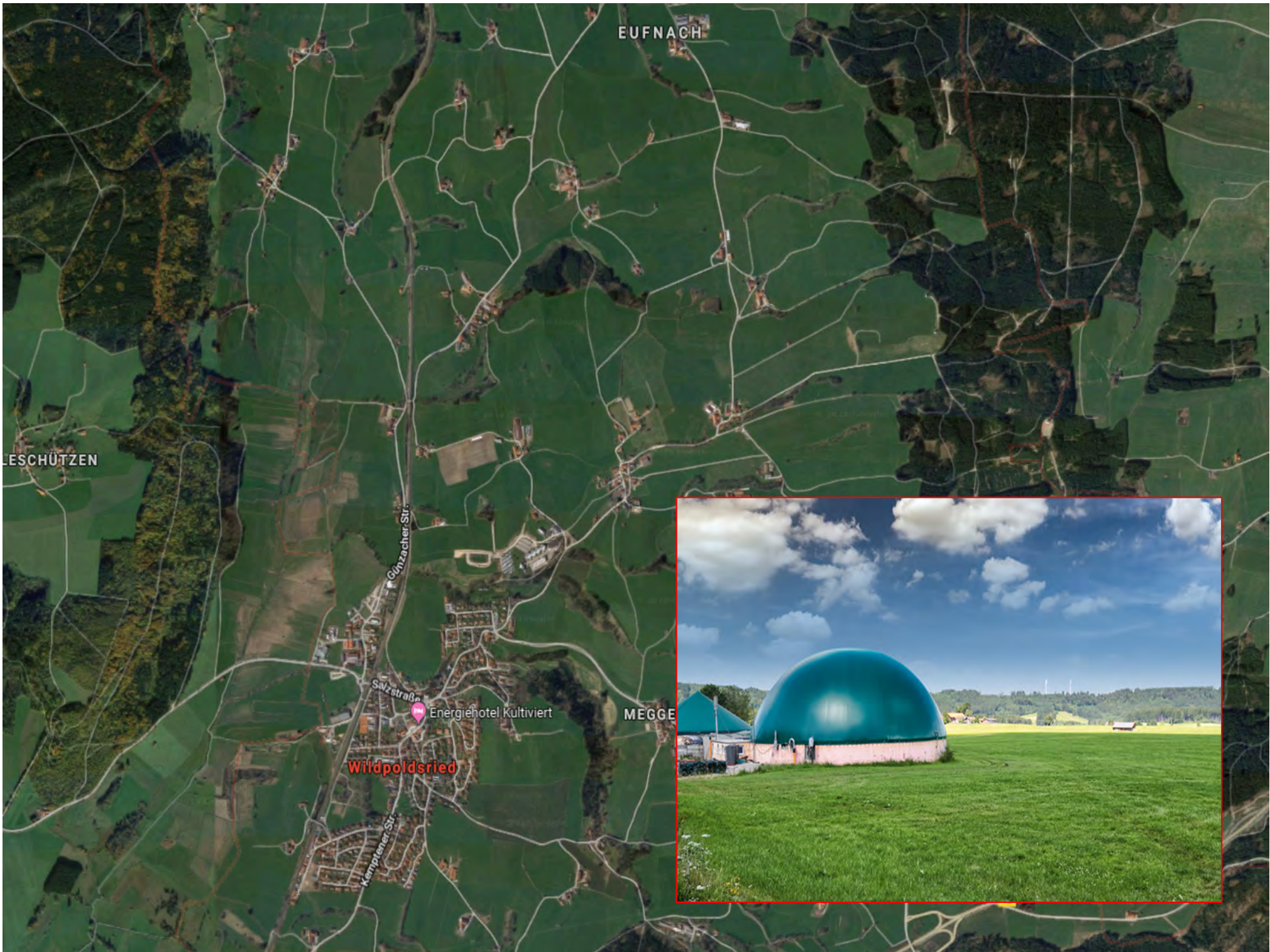
Energiehotel Kultiviert

Günzacher Str.

Salzstraße

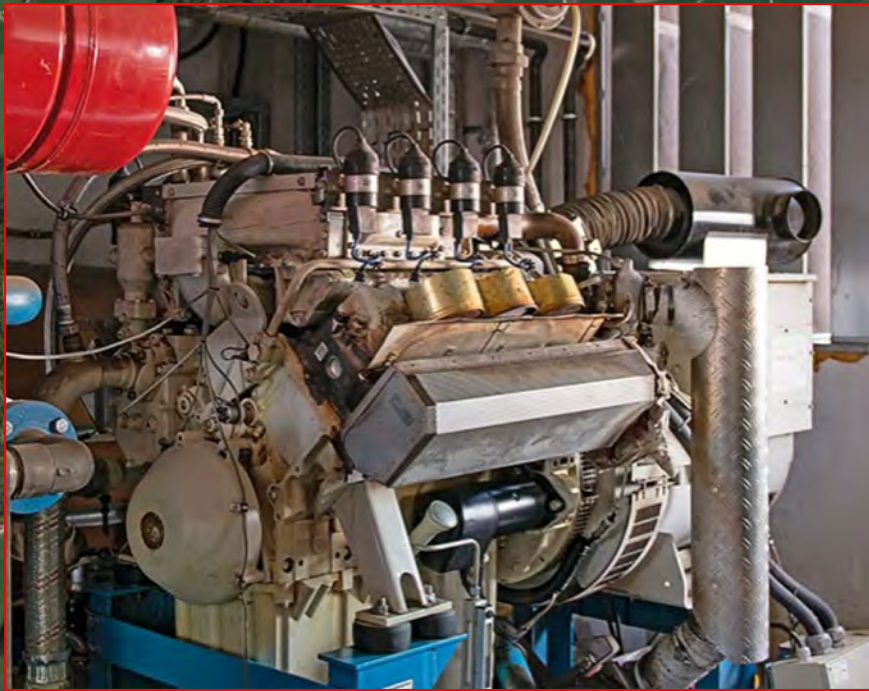
Kemptener Str.

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Village heating

CHP

Biogas plant

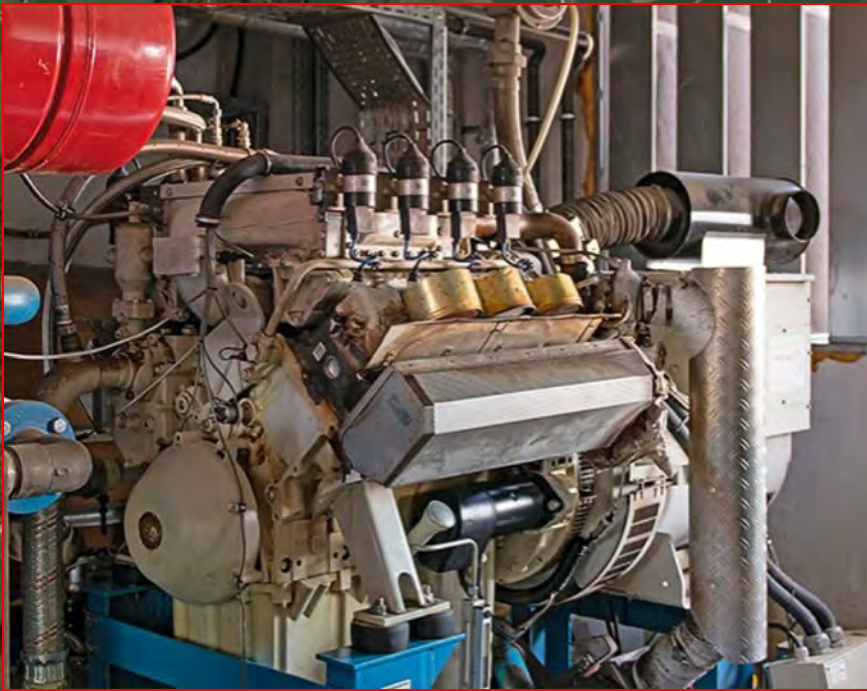
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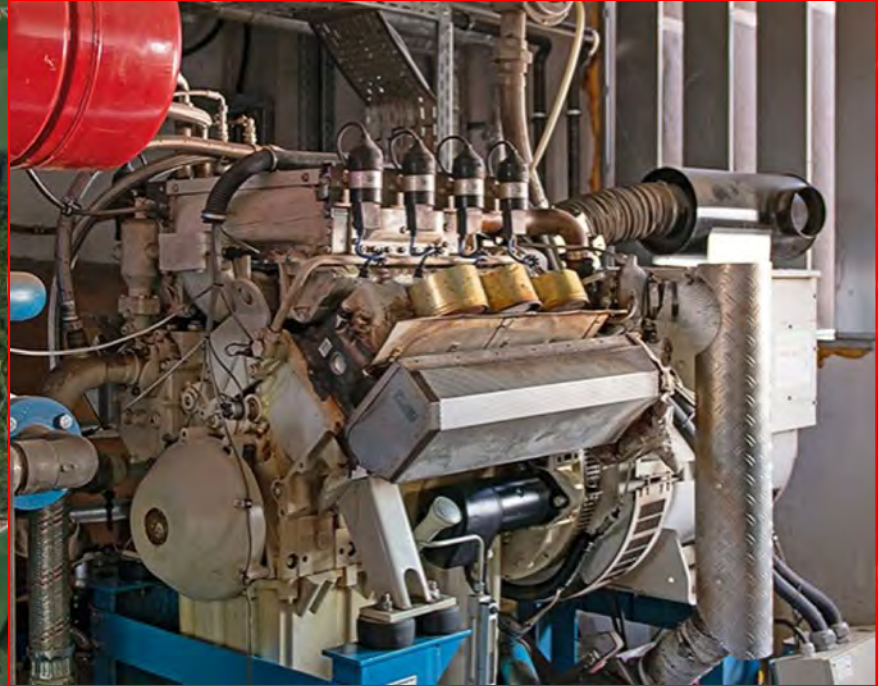
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LESCHÜTZ

Wildpoldsried

Günzacher Str.

Sulzstraße

Energiehotel Kultiviert

Kernptener Str.

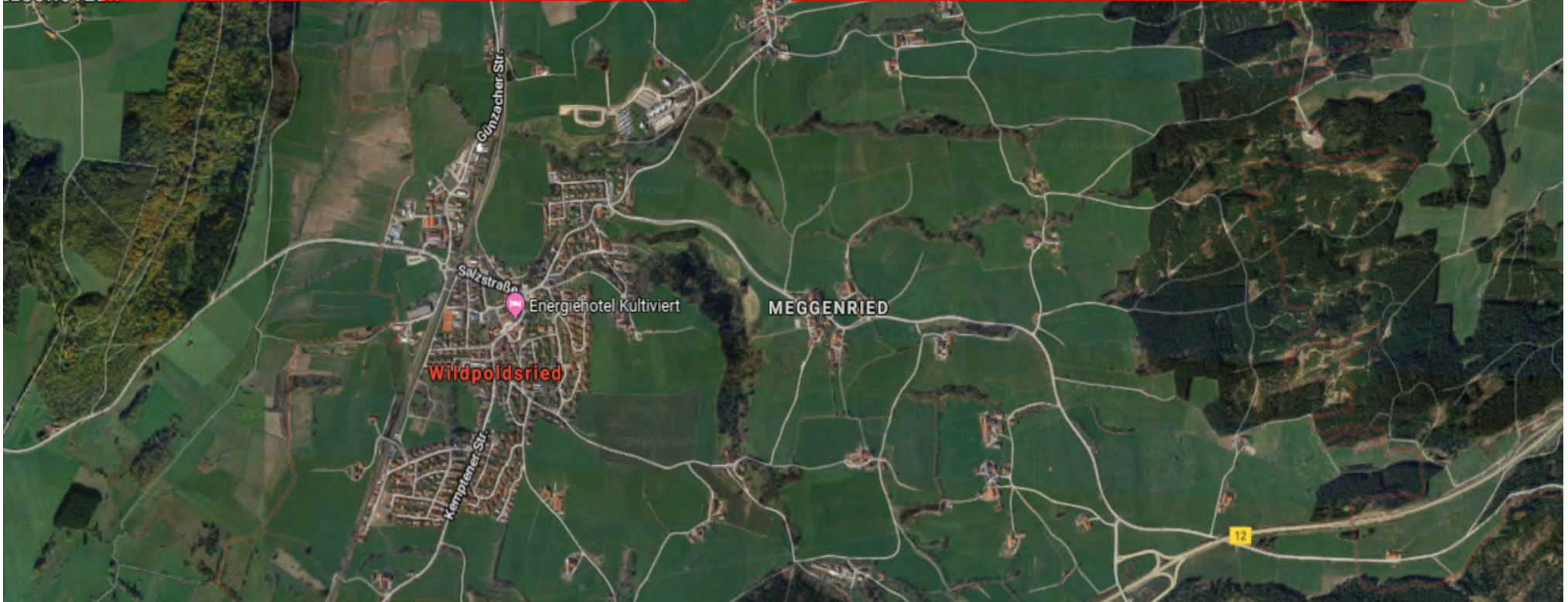
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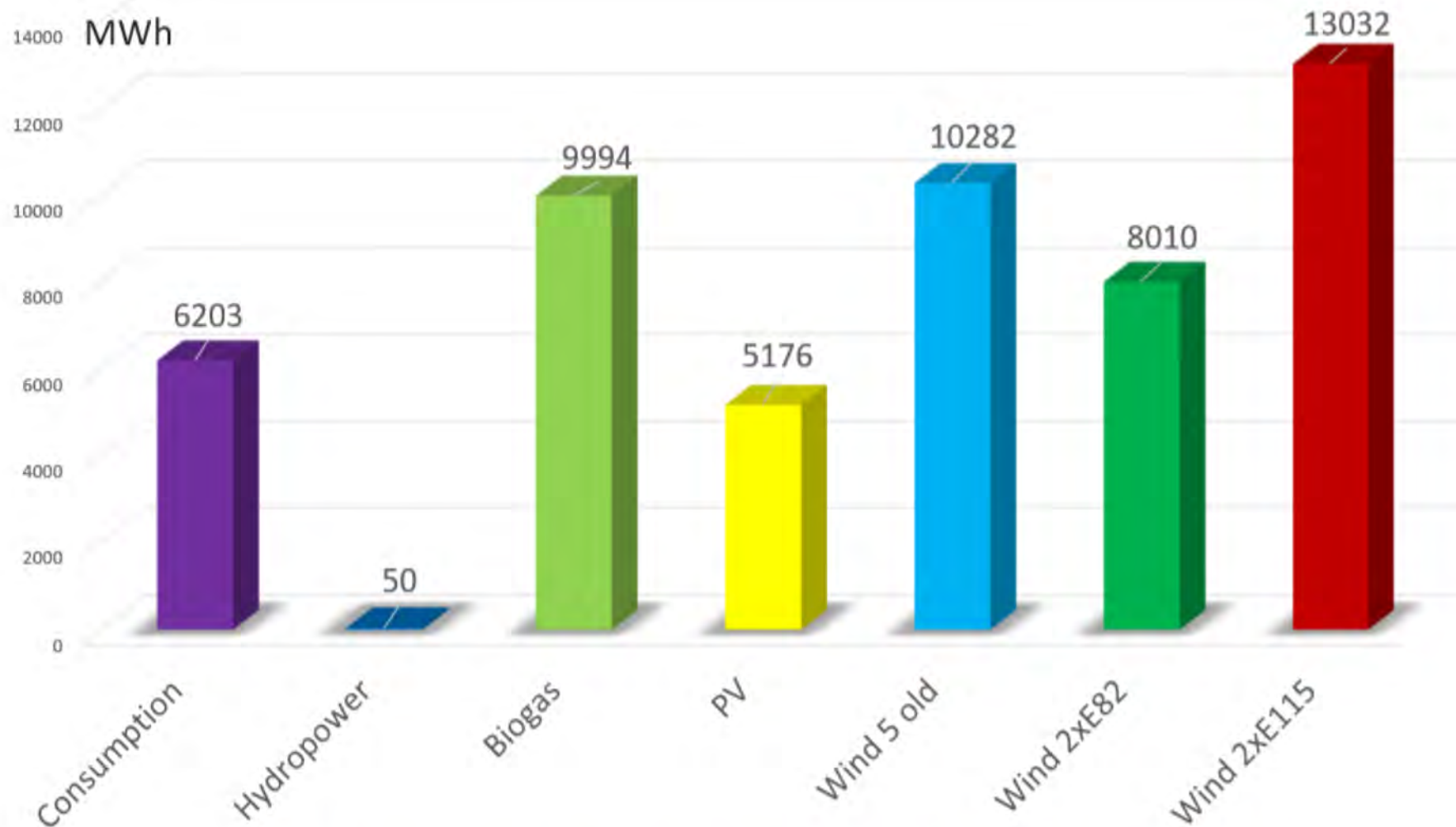
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Wildpoldsreid Energy Production



together about 46544 MWh = 750%

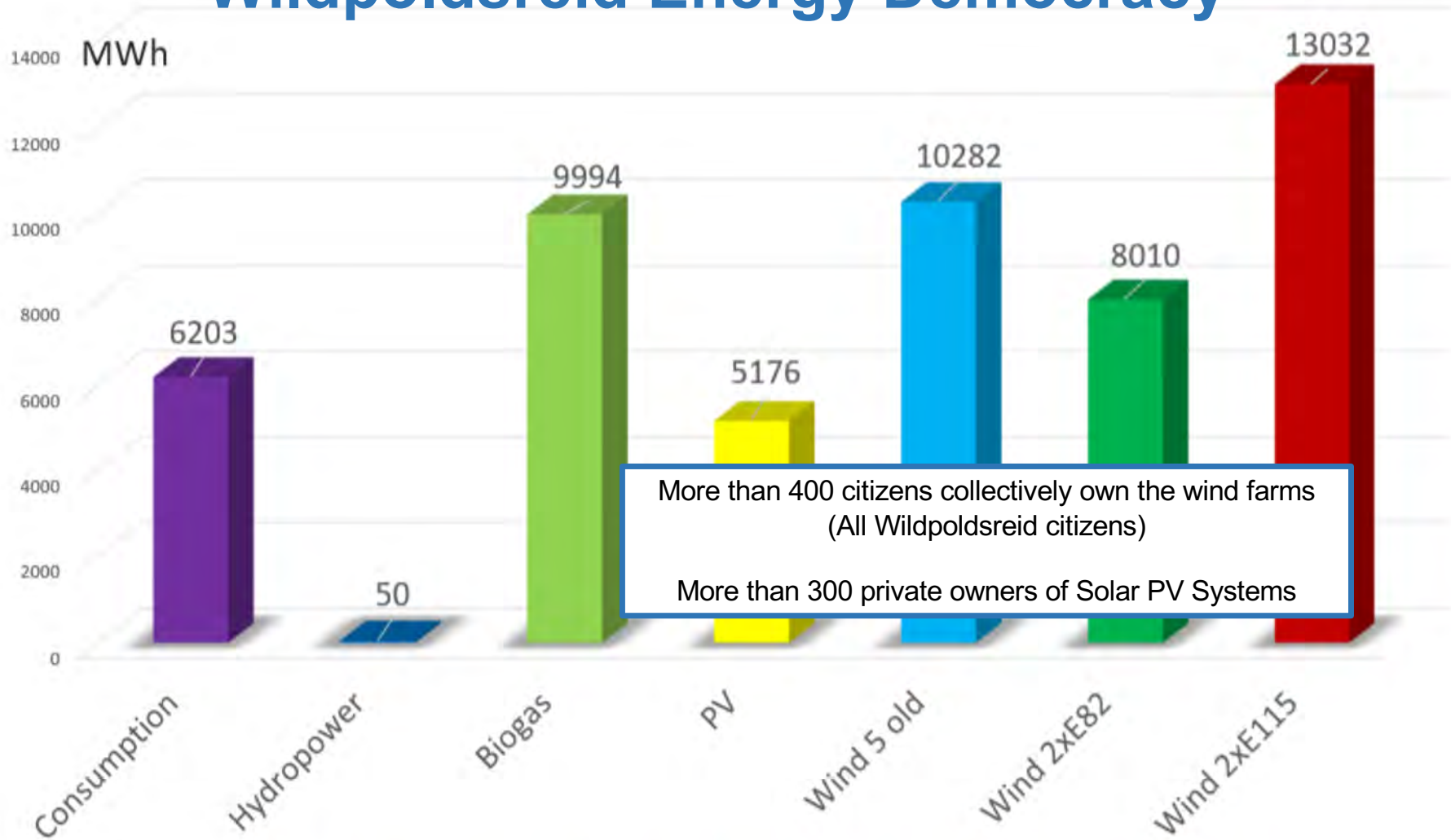
Electricity

Balance of electric energy 2018



Allgäu

Wildpoldsreid Energy Democracy



together about 46544 MWh = 750%

Electricity

Balance of electric energy 2018



Allgäu



SIEMENS

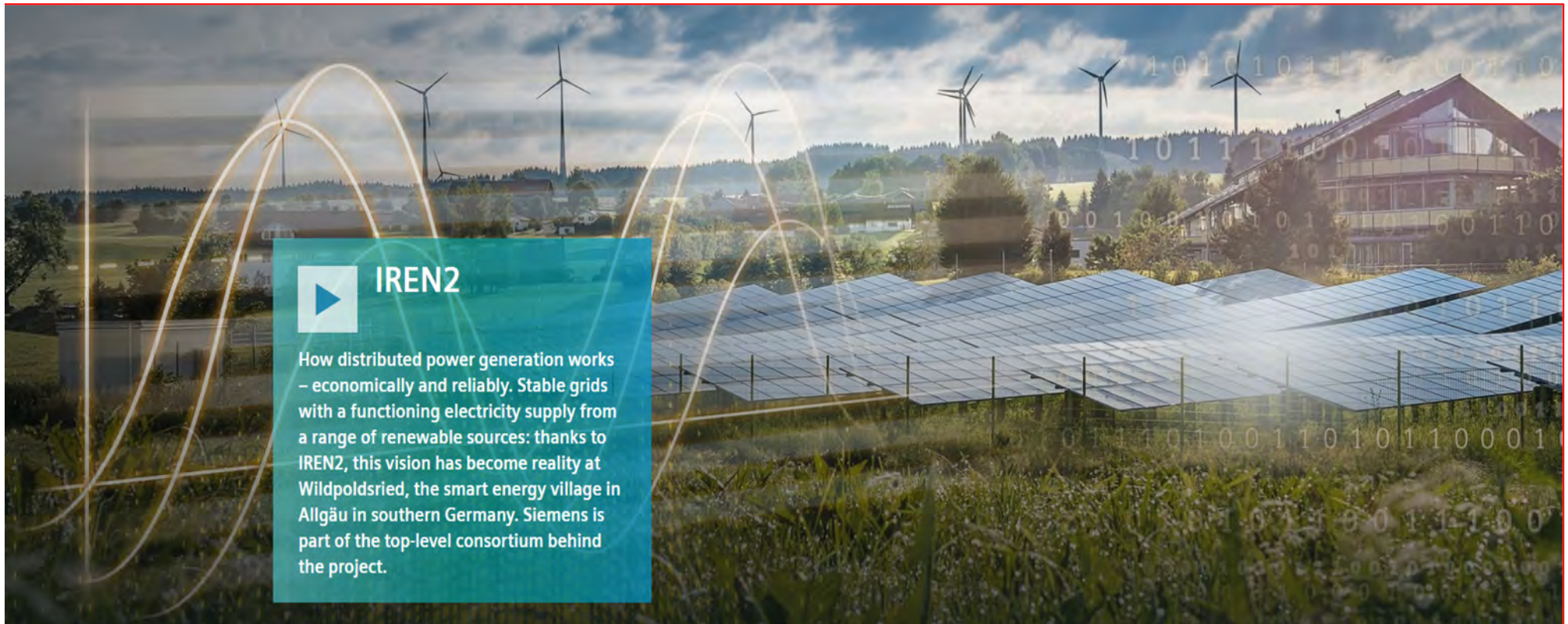
RWTHAACHEN
UNIVERSITY



Smart Grid pilot project from 2011 to 2013

IREN2 Goals:

- Microgrid feasibility
- Storage as distributed & dispatchable power plants
- Integration of local grid management and power market participation



IREN2

How distributed power generation works – economically and reliably. Stable grids with a functioning electricity supply from a range of renewable sources: thanks to IREN2, this vision has become reality at Wildpoldsried, the smart energy village in Allgäu in southern Germany. Siemens is part of the top-level consortium behind the project.



- Made in „Wildpoldsried“
- lithium ion battery storage system
- fully integrated and smart
- automatically maximises self-consumption
- from 2 – 16 kWh
- 10000 charge cycles
- 10 years warranty
- starts at 3500€



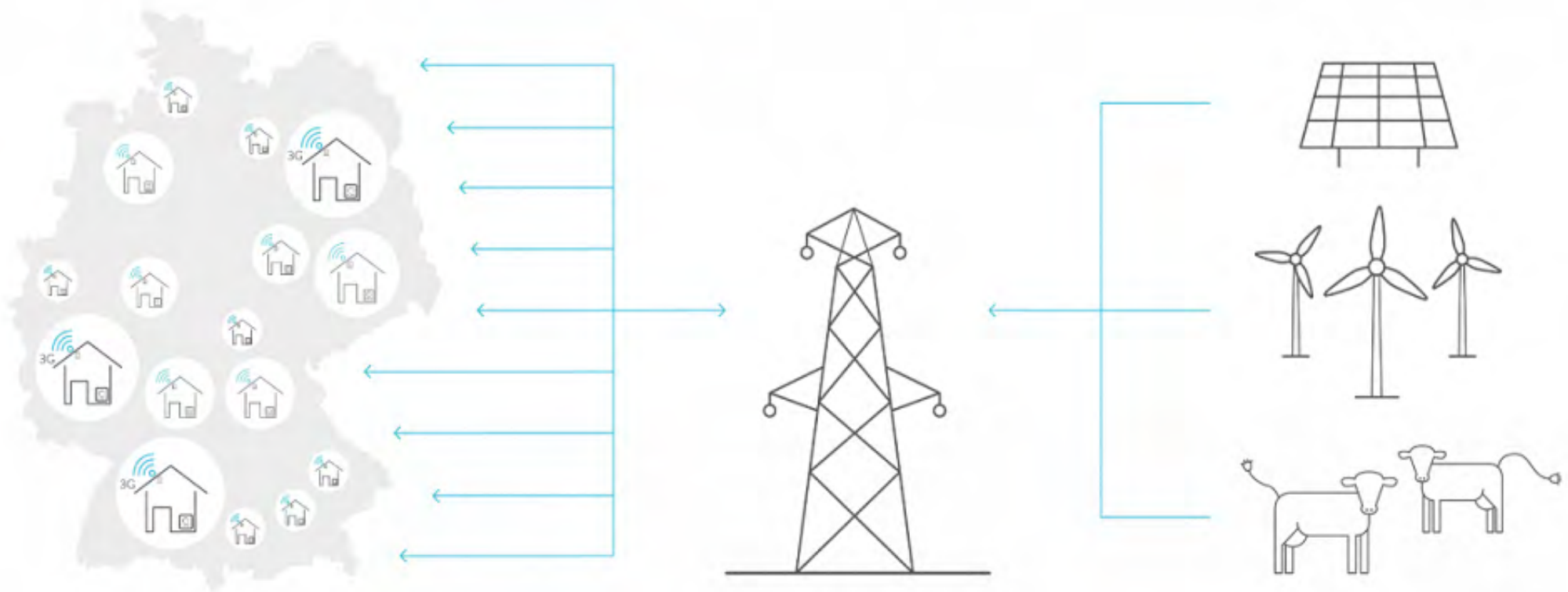
Storage

The “sonnen battery”



Allgäu

Sonnen Virtual Utility



A pool of sonnenBatteries -
connected by the sonnenFlat - Box

Delivery and supply in real time
to stabilize the power grid

Power generation from
renewable energies

The Sonnen community connects thousands of SonnenBatterie users and combines many individual home storages into a giant pool of batteries. This “virtual storage” is large enough to buffer vast amounts of energy thereby helping to stabilize the public power grid.



- **Development of a local platform for energy tradings, based on blockchain technology**
- Development of business models for the **local energy market of the future**
- **More efficient use** of the energy grid through motivation to “grid friendly behaviour” of the participants
- Savings in the energy grid through active identification of **prosumer activities...**

Lessons Learned?

Visionary pioneers can inspire communities and create movements that quickly gain momentum

There is a powerful motivation for citizens to pursue self-sufficiency in meeting their own energy needs

The greatest benefits are realized when energy producers and consumers embrace distributed generation & smart controls

The U.S. is well positioned to follow Germany's lead. This may be a preview of what we might expect here

Can Freiburg and Wildpoldsreid be a model for WI?

**Thank you for
your attention!**

Questions?

For more info, please see our
Germany Study Abroad Blog at:

www.CreateEnergy.org

