BUILDING ENERGY 15

MARCH 3-5, 2015 AT THE SEAPORT WORLD TRADE CENTER

AIA Provider: Northeast Sustainable Energy Association

Provider Number: G338

Renewable Energy Powering Local Self-Reliance: Case Studies from Germany

Andrew Dey

5March2015

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

Over 150 villages in Germany produce all of the electricity and most of the heat they consume. In these so-called "bioenergy villages," renewable energy systems are driving economic growth.

This session will provide an overview of the growing movement in Germany toward communally-developed and owned energy systems, focusing particularly on two villages in northern Germany.

The development process for these villages will be explored, as will the factors contributing to their success.

Learning Objectives

At the end of the this course, participants will be able to:

1. Appreciate in general terms the context for the development of energy self-reliant communities in Germany
2. Understand the meaning of “bioenergy village,” as applied to communities in Germany
3. Describe the technologies and systems often employed by villages in Germany to achieve energy independence
4. Understand the development process typically followed by bioenergy villages – and the most significant factors contributing to success

Community-owned Renewable Energy Systems in Germany

An Engine for Self-Reliance and Economic Development

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NESEA Conference
March 5, 2015
Boston, MA

Outline

1. Germany's *Energiewende*
2. Bioenergy Village of Feldheim
3. Bioenergy Village of Bollewick
4. Neustrelitz, a City Powered by "Future Energy"
5. Development of Community-owned Energy Systems

Germany and the US

US Population: 315 million

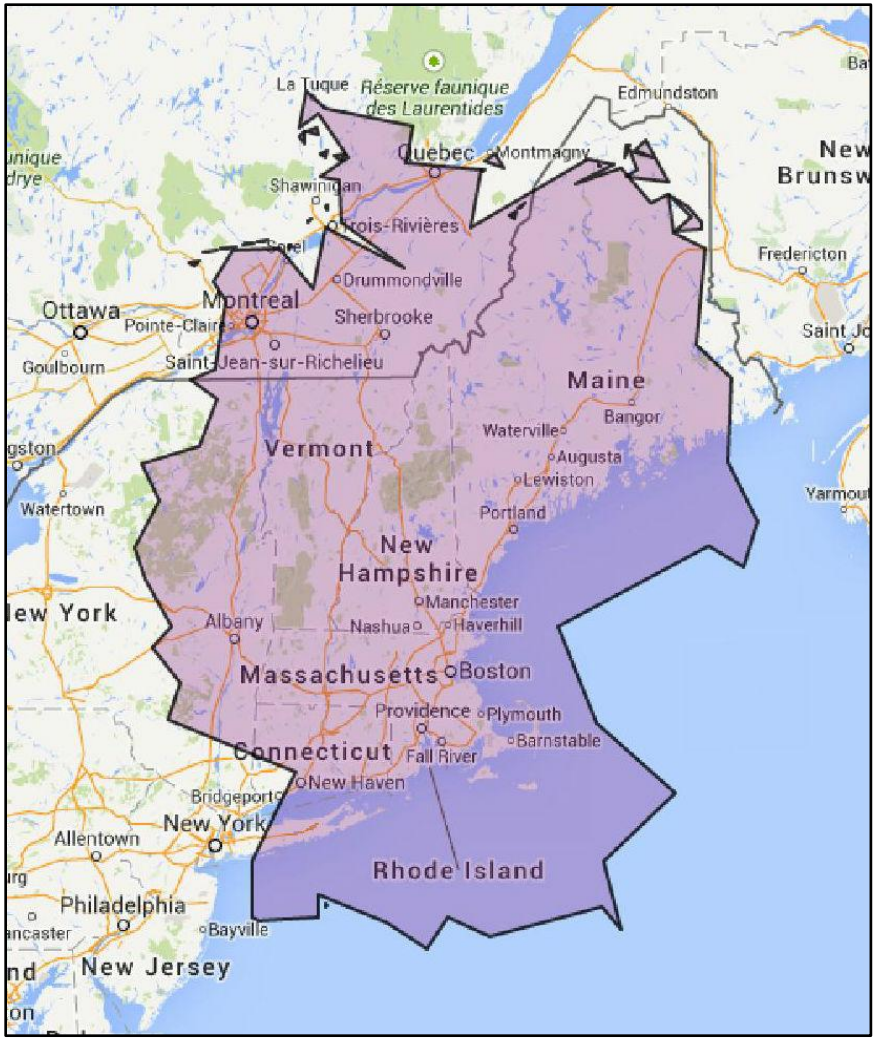
Germany Population: 81 million

German States

13 Federal States

3 City States

Germany and New England



Land Area

Germany: 138,000 sq miles

New England: 72,000 sq miles

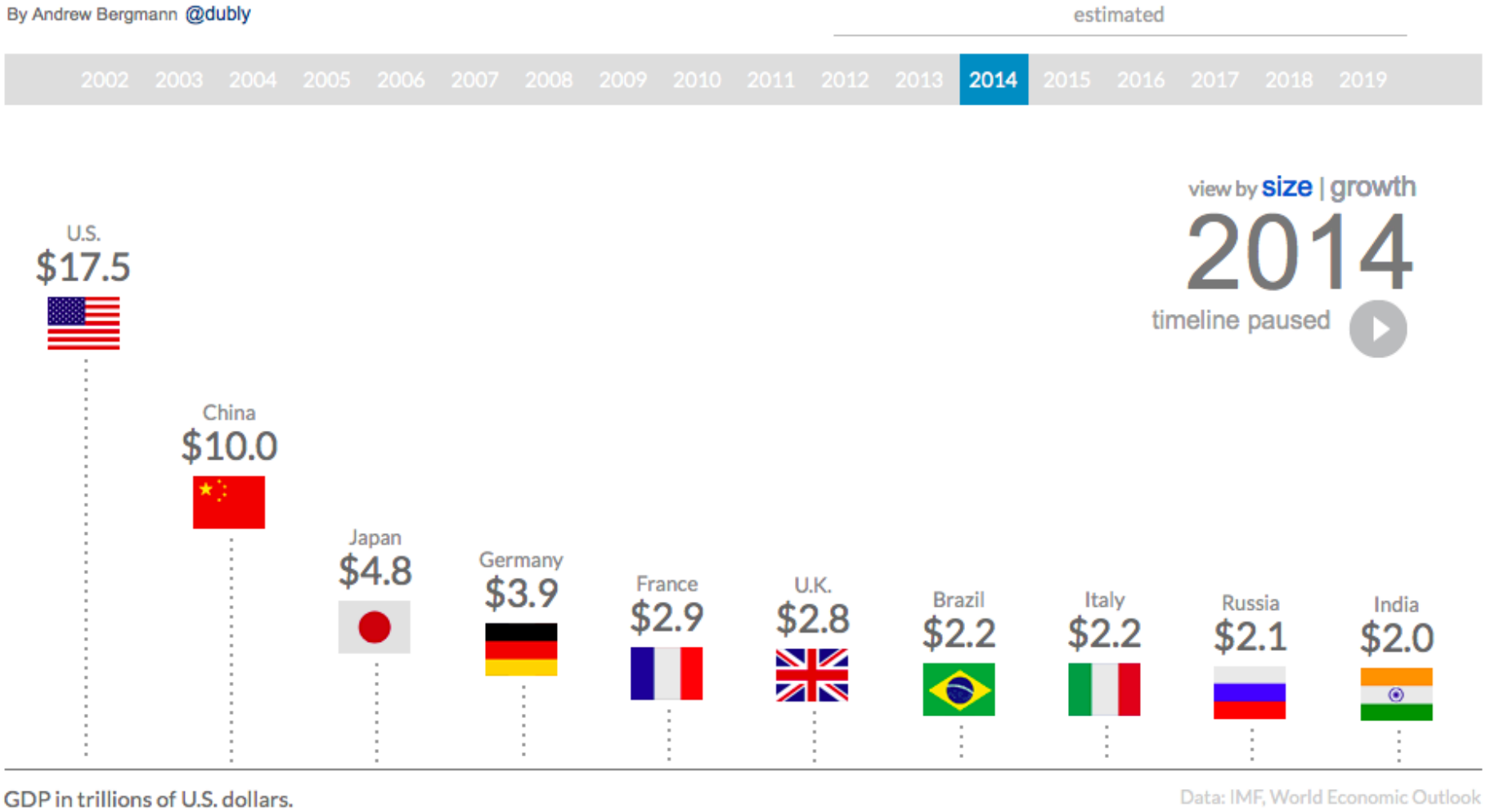
Population

Germany: 81 million

New England: 15 million

World's largest economies

By Andrew Bergmann @dubly

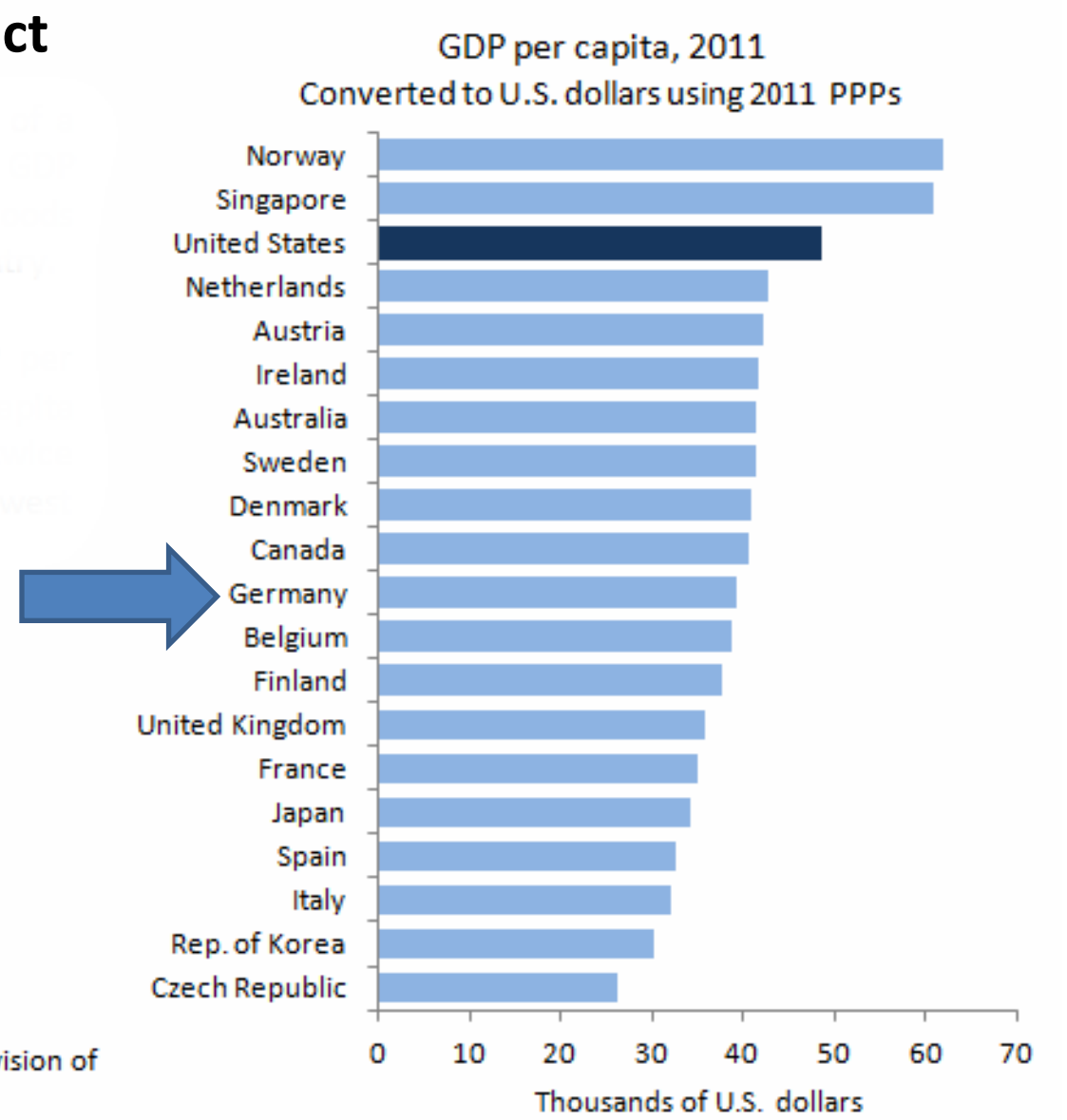


GDP in trillions of U.S. dollars.

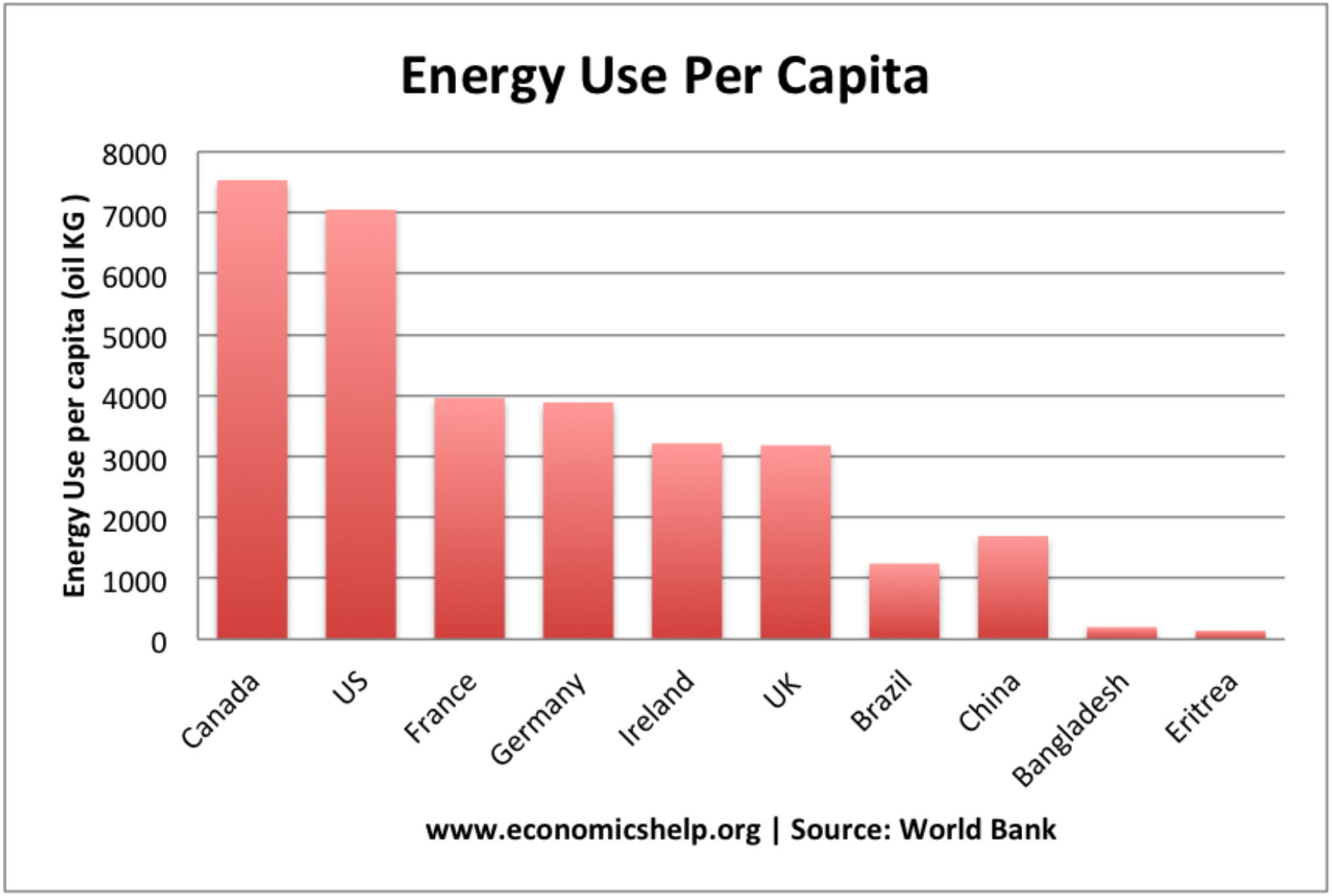
Data: IMF, World Economic Outlook

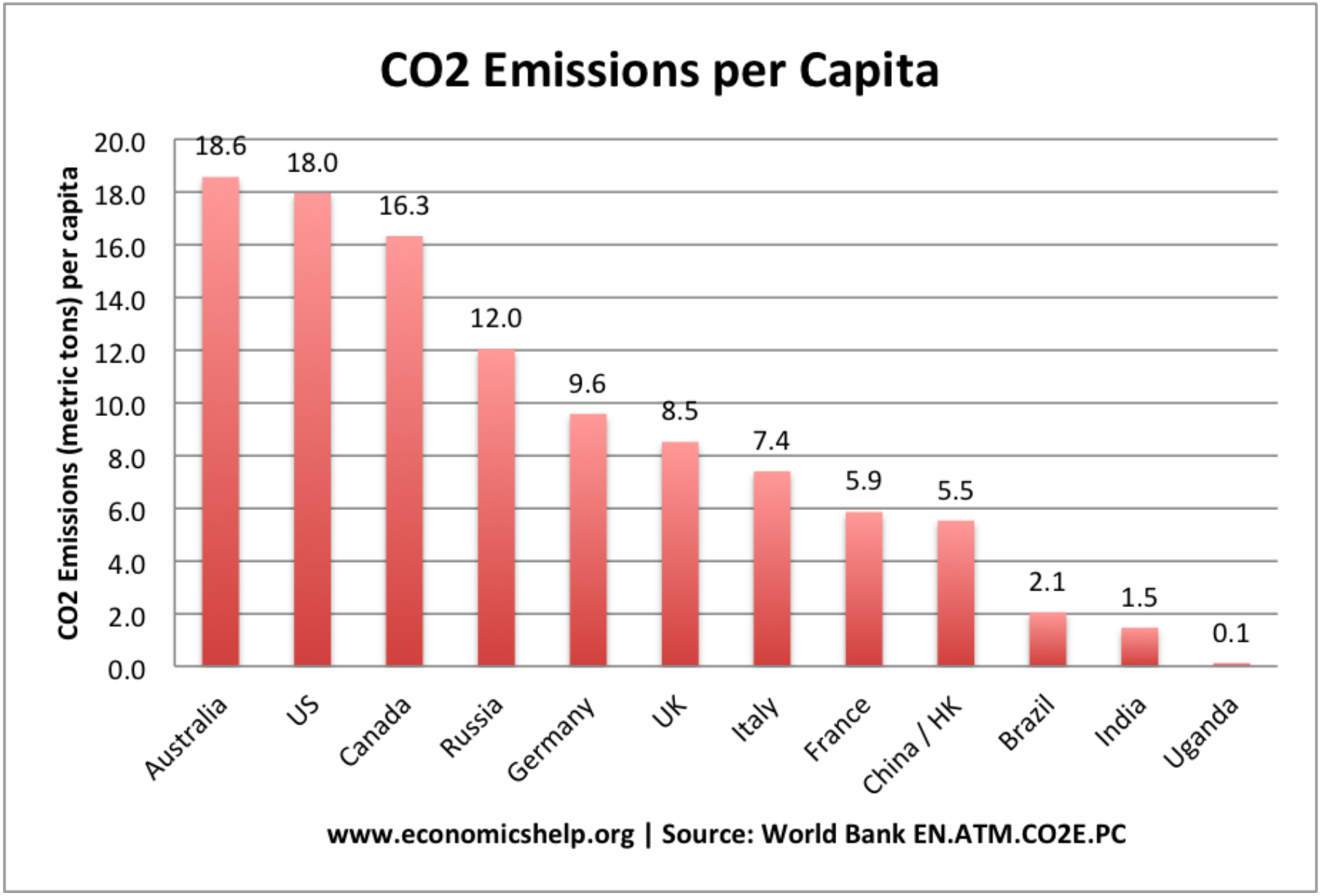
http://money.cnn.com/news/economy/world_economies_gdp/

Gross Domestic Product Per Capita

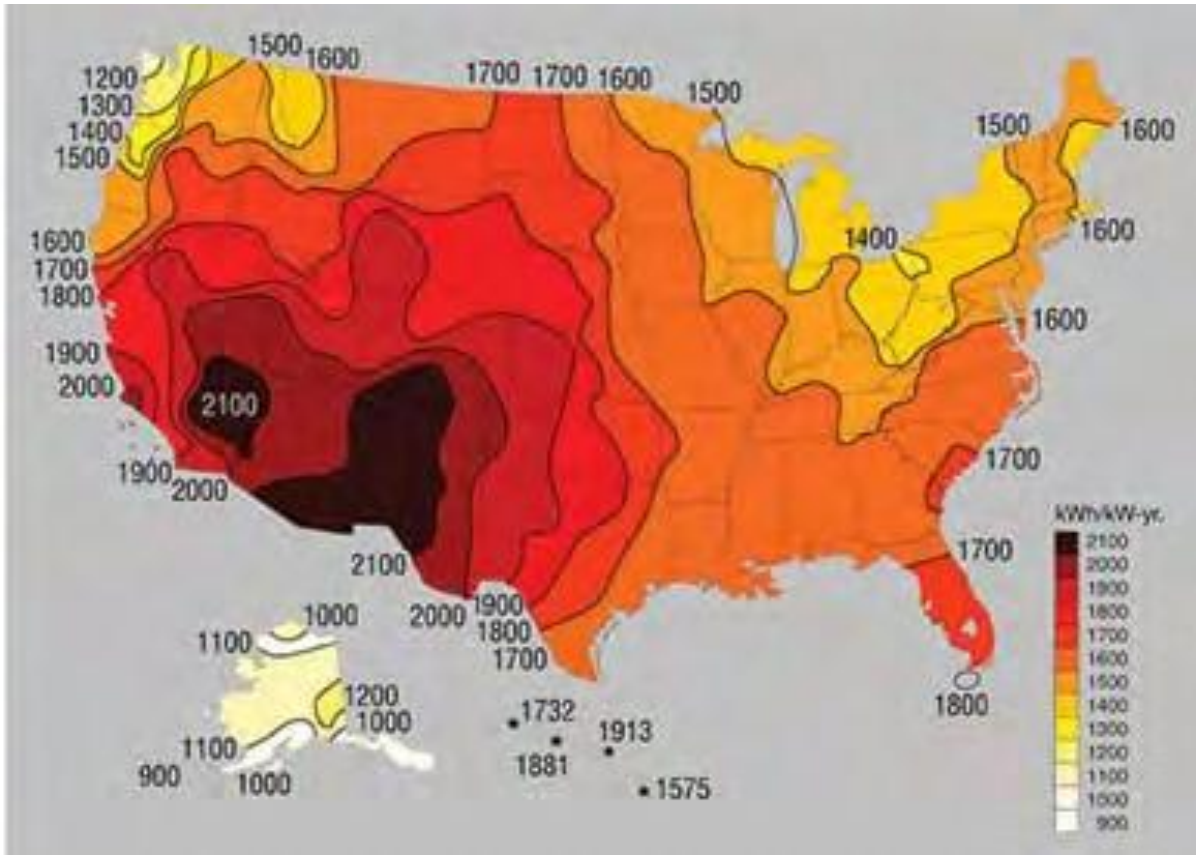


SOURCE: U.S. Bureau of Labor Statistics, Division of International Labor Comparisons


Energy Use Per Capita
Energy Use per capita (oil KG)
8000
7000
6000
5000
4000
3000
2000
1000
0
Canada
US
France
Germany
Ireland
UK
Brazil
China
Bangladesh
Eritrea
www.economicshelp.org | Source: World Bank


CO2 Emissions per Capita
CO2 Emissions (metric tons) per capita
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
18.6
18.0
16.3
12.0
9.6
8.5
7.4
5.9
5.5
2.1
1.5
0.1
Australia
US
Canada
Russia
Germany
UK
Italy
France
China / HK
Brazil
India
Uganda
www.economicshelp.org | Source: World Bank EN.ATM.CO2E.PC

Insolation: US versus Germany



www.acore.org
"Outlook on Renewable Energy in America," January 2007

Heating Degree Days

5 year average, 2010 to 2014

Boston: 5419 HDD

Berlin: 5783 HDD

Electricity Costs

Average Retail Costs in US cents/kWh

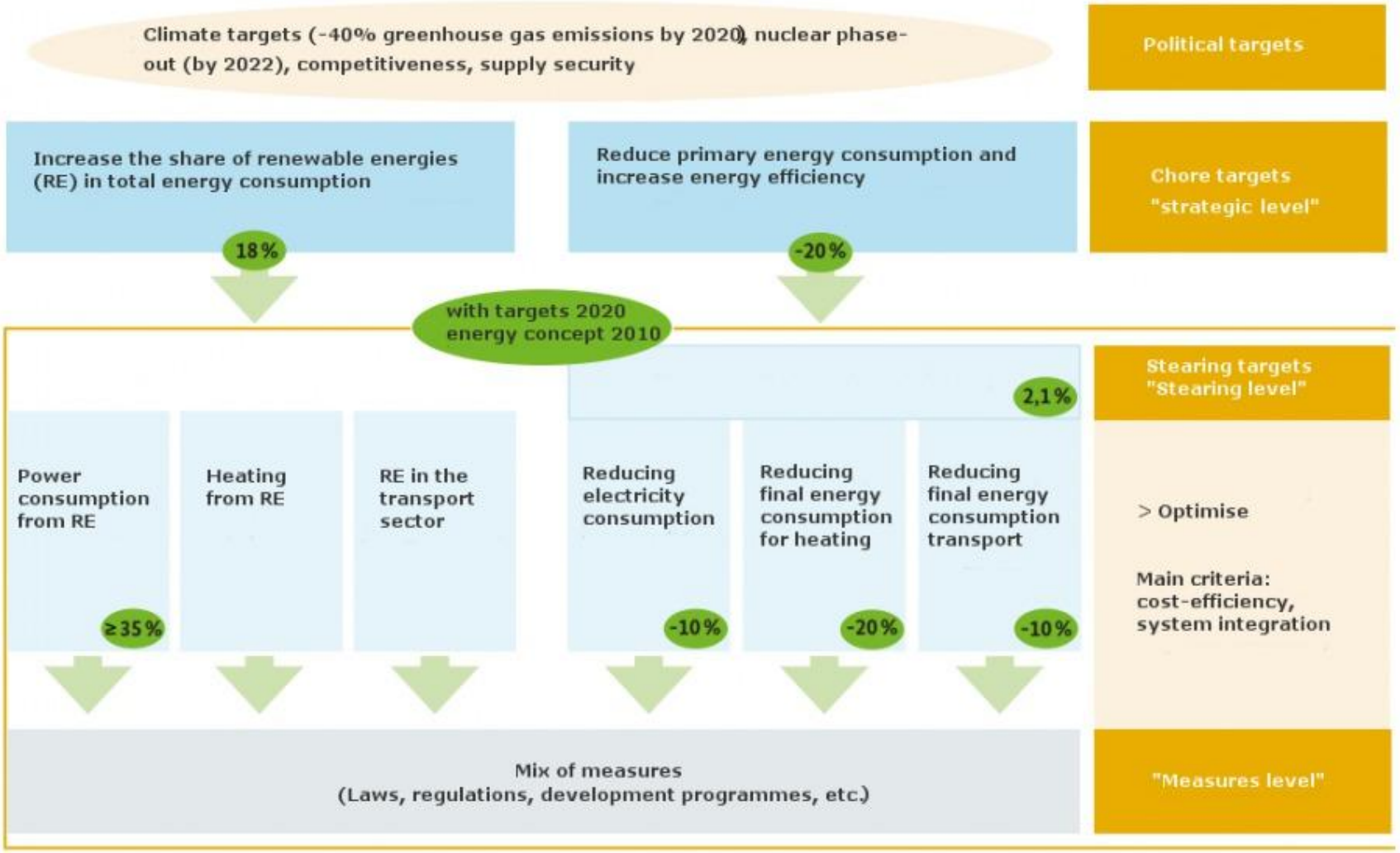
Germany	36
United States	8-17
My most recent bill from Liberty Utilities	24

Germany's Energy Policy Goals

	2011	2020	2050
Greenhouse Gas Emissions			
GHG (against 1990)	-26.4%	-40%	-80% to -95%
Efficiency			
Primary energy use (against 2008)	-6%	-20%	-50%
Electricity demand (against 2008)	-2.1%	-10%	-25%
Heat in residential sector	n.a.	-20%	
Energy use in transport (against 2005)	-0.5%	-10%	-40%
Renewable Energy			
Share of electricity consumption	20.3%	>35%	>80%
Share of total energy use	12.1%	18%	60%

"This is not a problem, this is a task"

Strategic Plan



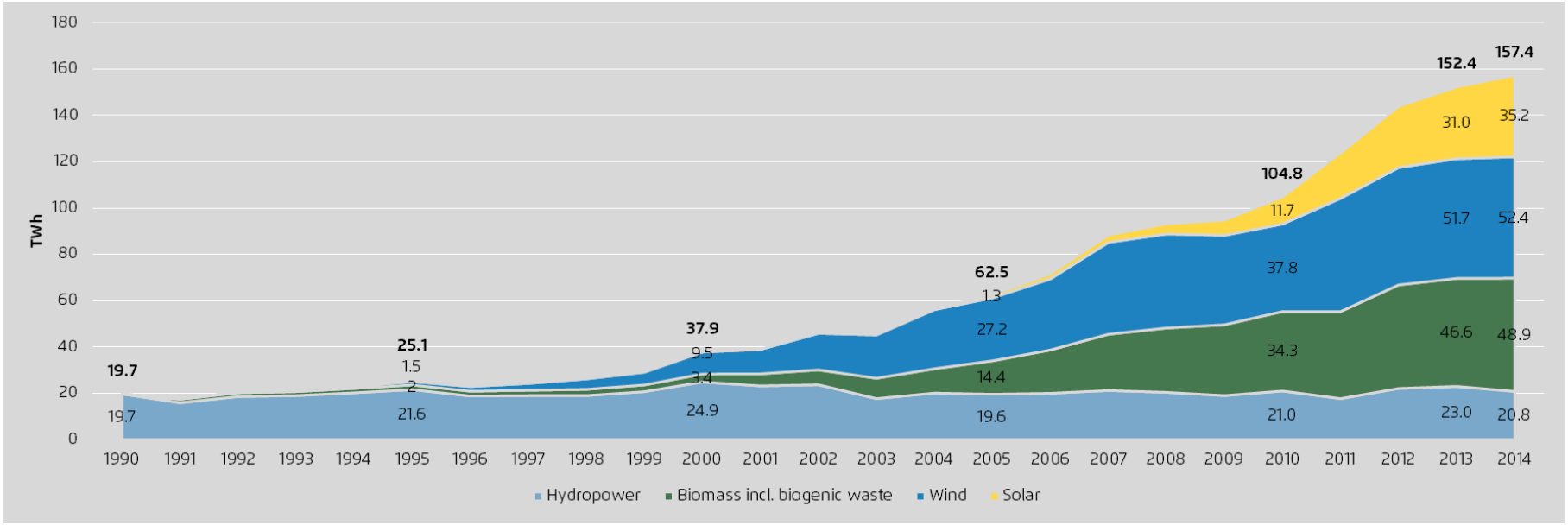
http://www.cleanenergywire.org/factsheets/government-progress-report-energiewende-spells-out-political-goals
http://www.bmwi.de/DE/Themen/Energie/Energiewende/fortschrittsbericht,did=672424.html – p. 97

Progress Toward Goals

	2013	2020	On track?
Climate change			
Greenhouse gases (GHGs) (base year 1990)	-23,80%	at least -40%	✗
Renewables			
Share of electricity consumption	25,40%	at least 35%	✓
Share of energy consumption	12,30%	18%	✓
Energy efficiency			
Energy consumption (base year 2008)	-3,30%	-20%	✗

Source: Bundesministerium für Wirtschaft und Energie, EEA and Umweltbundesambt

Growth of Renewables



The Energiewende in the Power Sector: State of Affairs 2014, 7Jan2015
Agora Energiewende

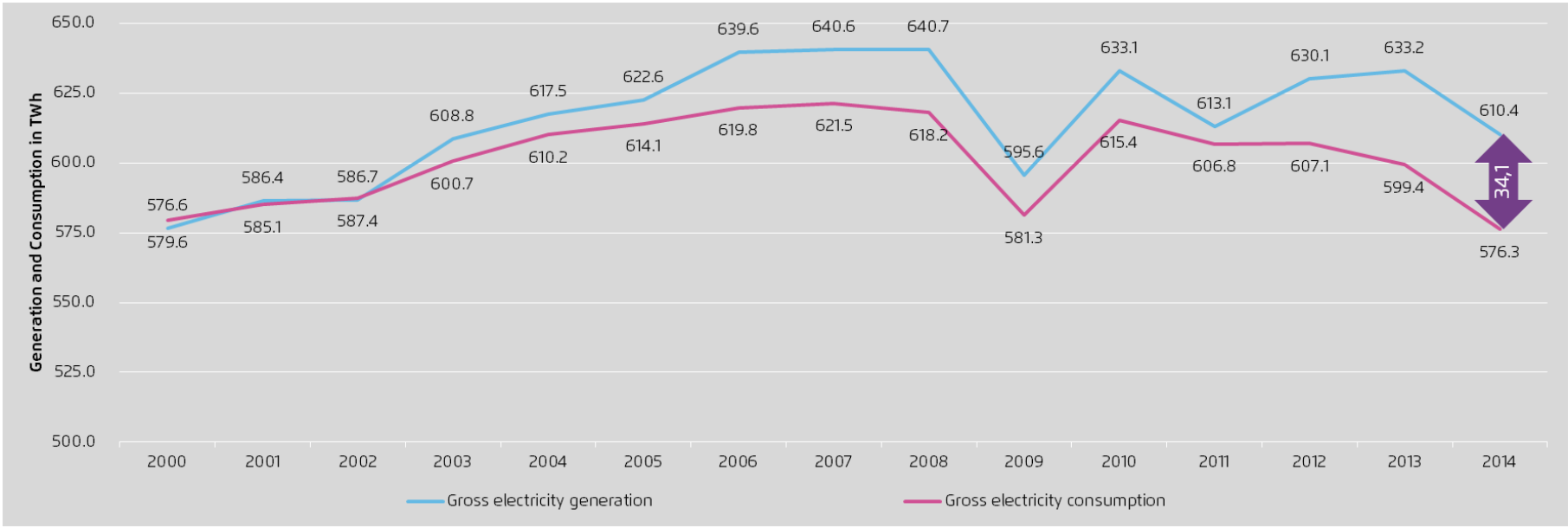
Highlights of 2014 for Power Sector

- Renewable energies were the number 1 source of power production for the first time ever
- Power demand fell dramatically in 2014, by around 4%
- Hard coal and gas are the big losers in the power mix
- Greenhouse gas emissions fell considerably in 2014

The Energiewende in the Power Sector: State of Affairs 2014, 7Jan2015
Agora Energiewende

Electricity Generation vs Demand

Germany becomes top power exporter in Europe



The Energiewende in the Power Sector: State of Affairs 2014, 7Jan2015
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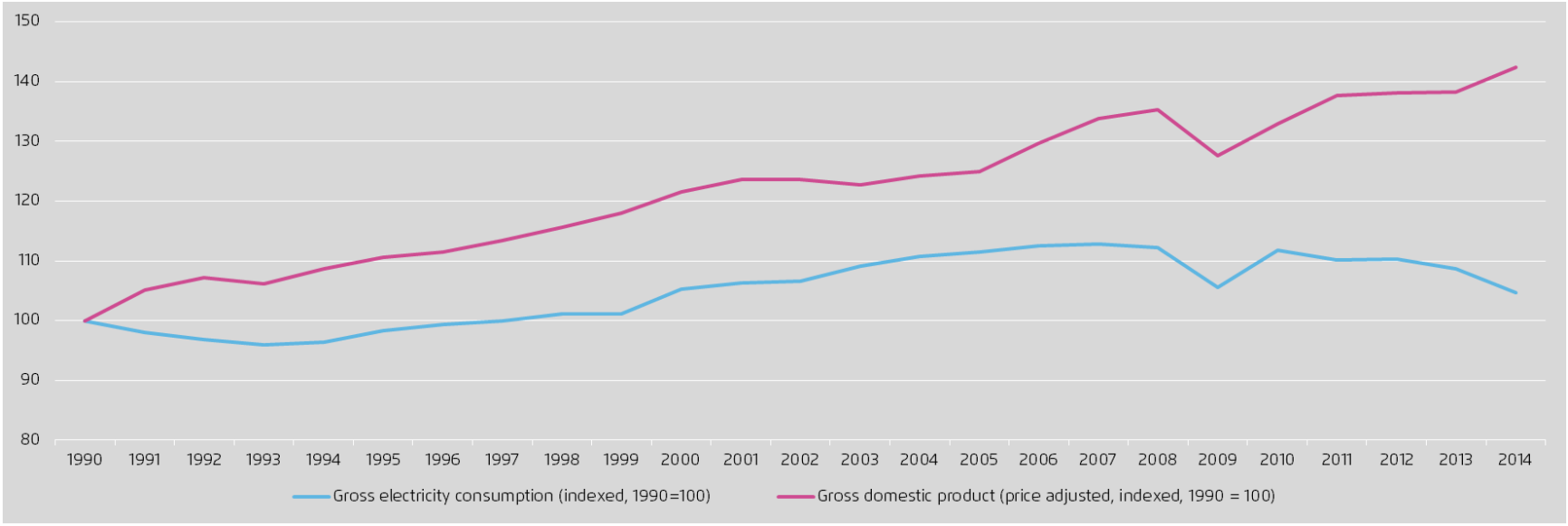
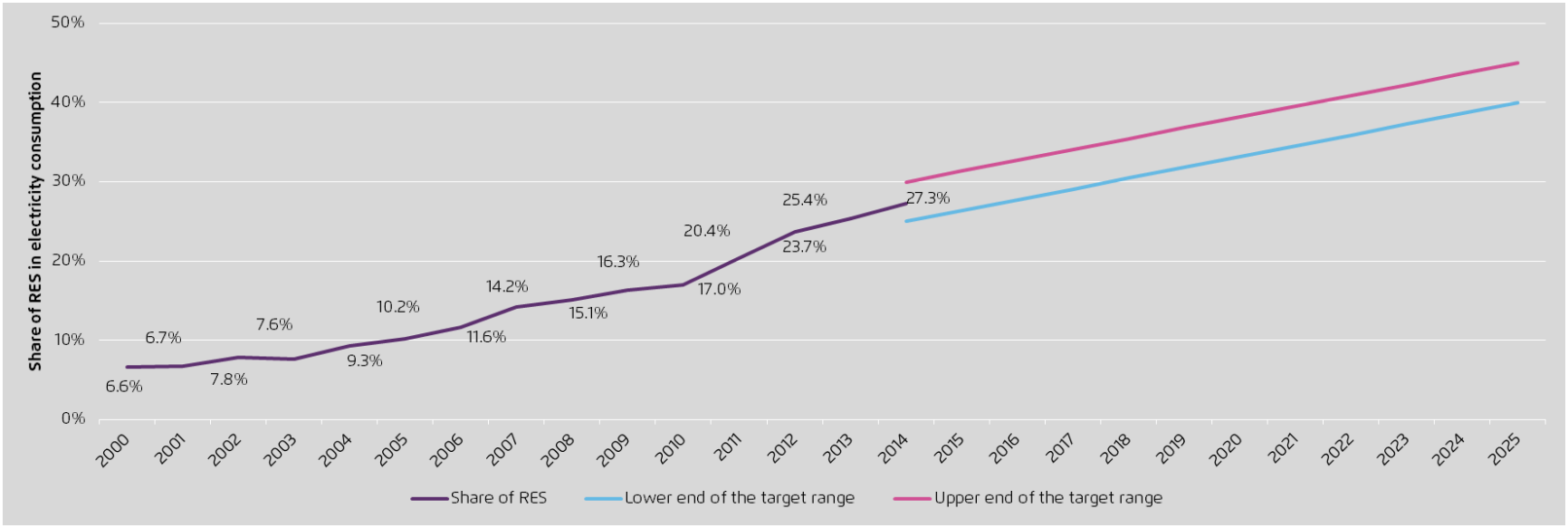
Economic Growth decoupled from Electricity Demand



The Energiewende in the Power Sector: State of Affairs 2014, 7Jan2015
Agora Energiewende

Growth of Renewable Energy on Track

40-45% renewables share by 2025

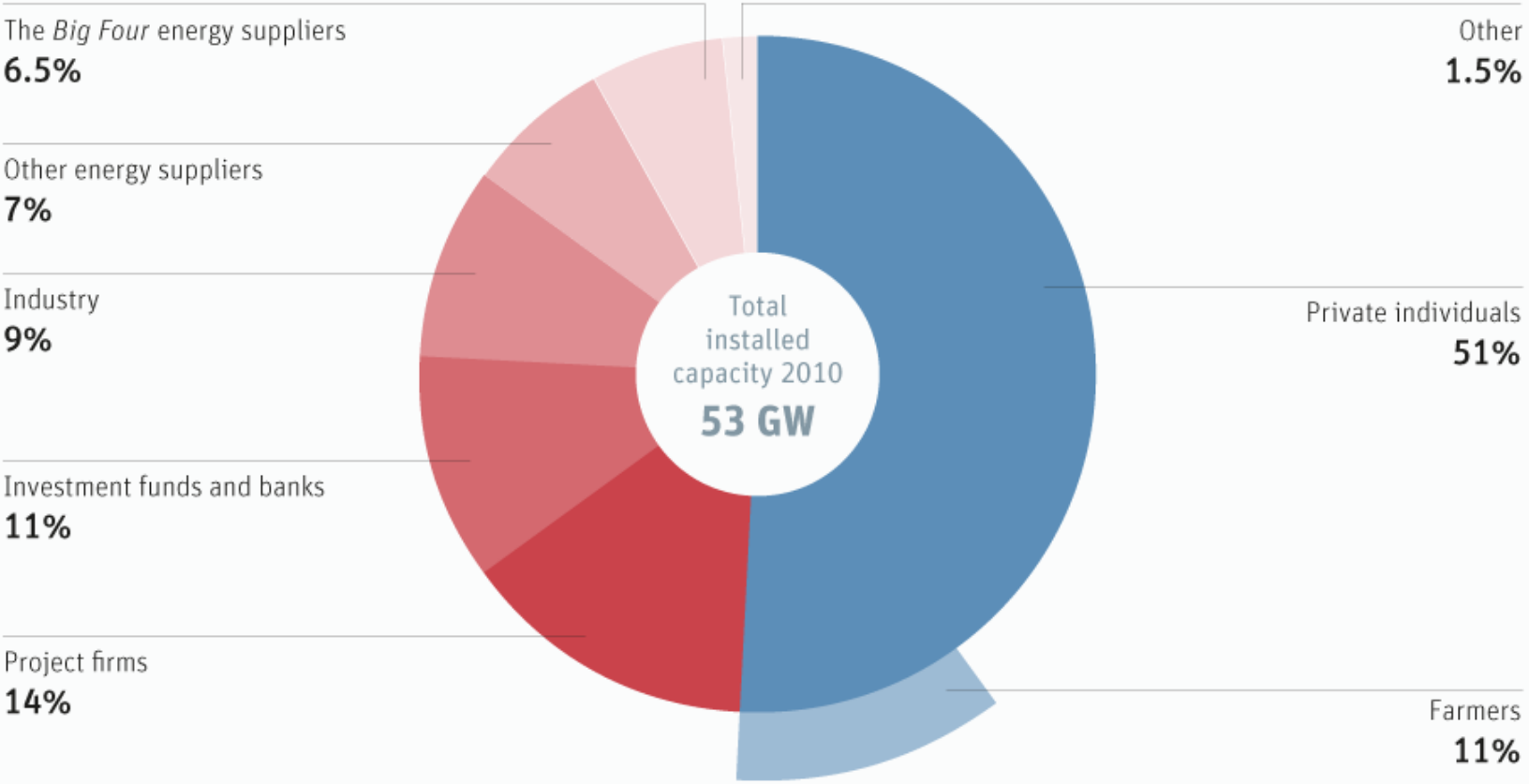


The Energiewende in the Power Sector: State of Affairs 2014, 7Jan2015
Agora Energiewende

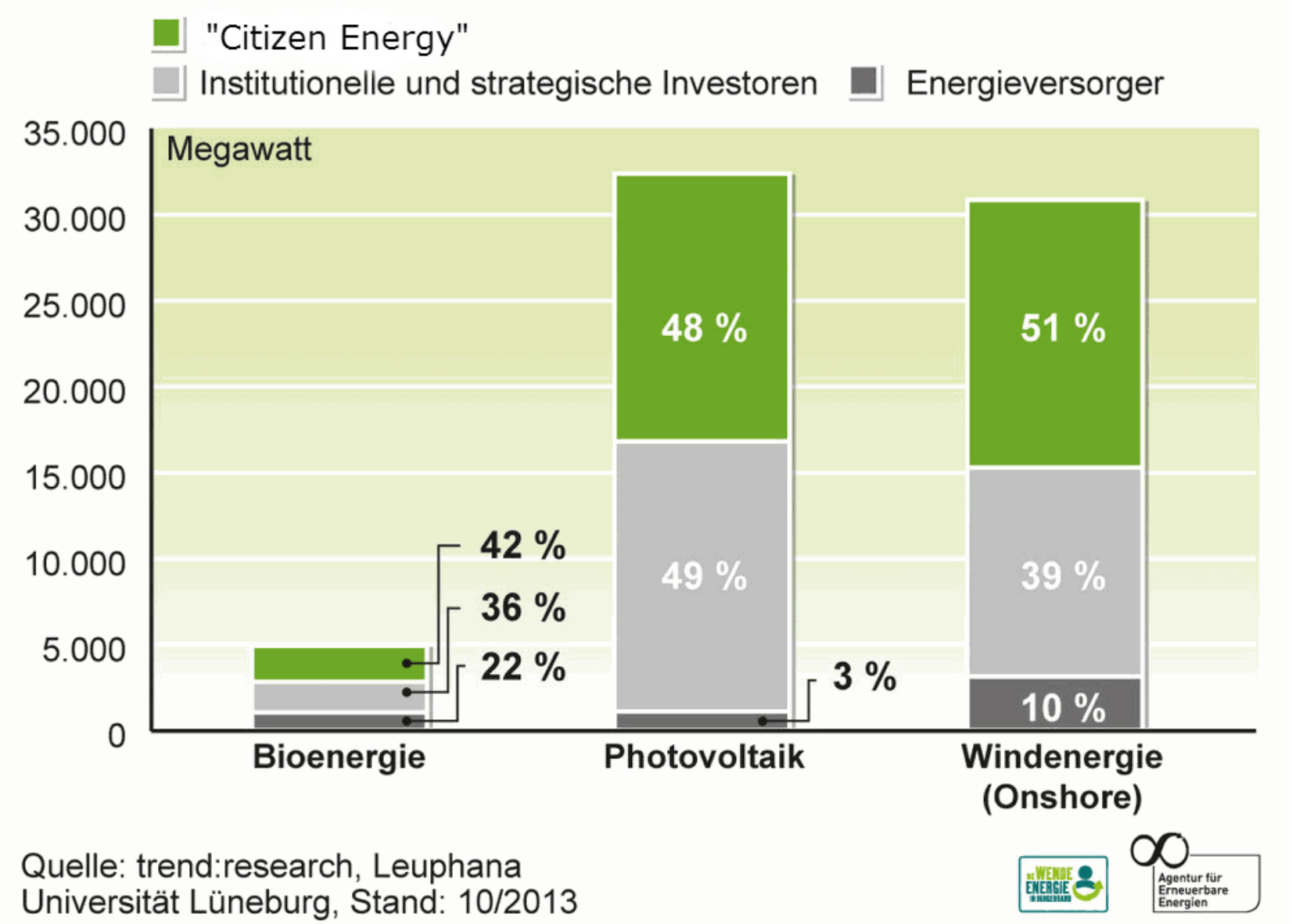
Renewables in the hands of the people

Ownership of renewables installed capacity in Germany, 2010

Source: www.unendlich-viel-energie.de



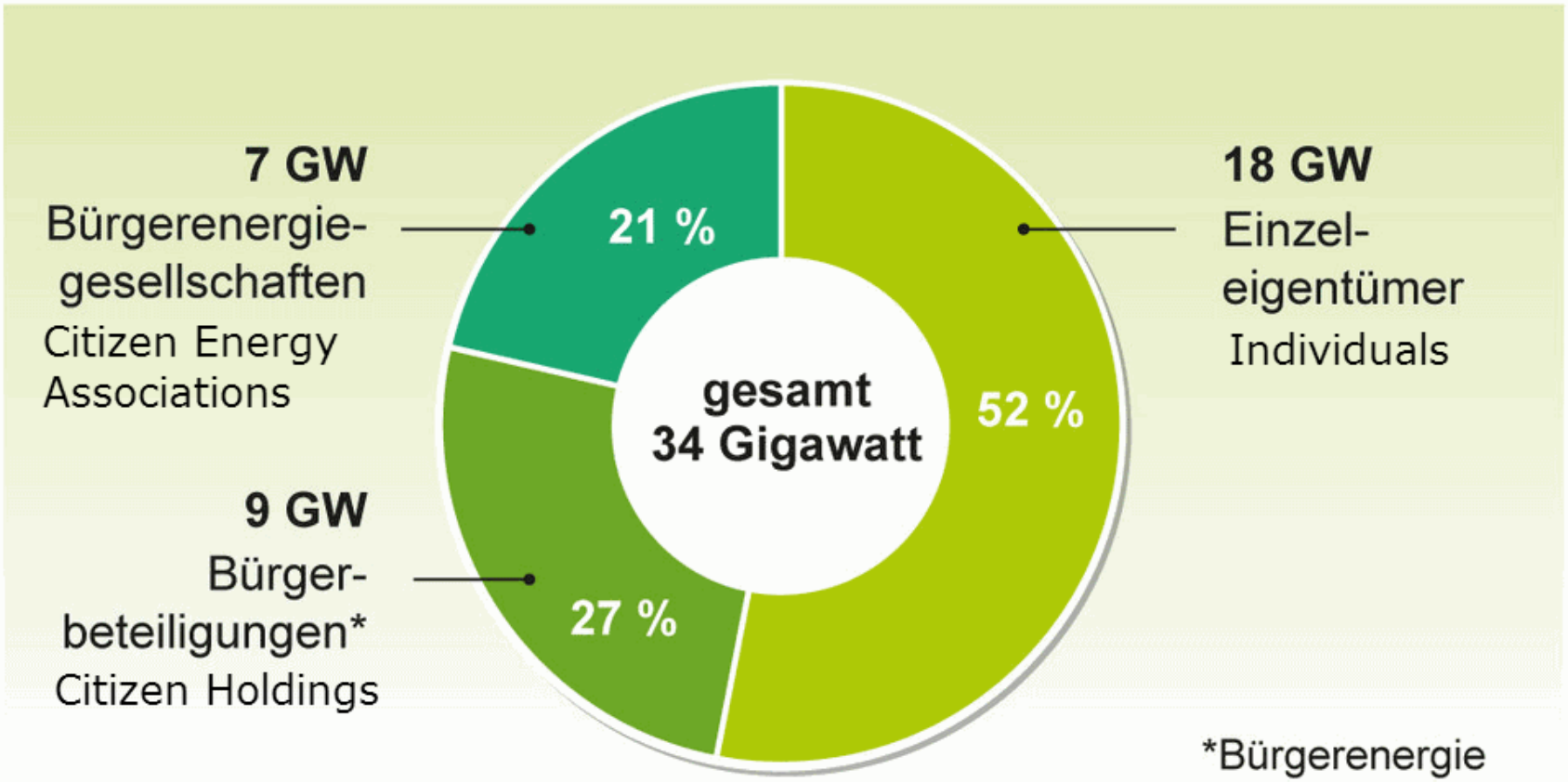
Ownership by Renewable Energy Type



Quelle: trend:research, Leuphana Universität Lüneburg, Stand: 10/2013

Agentur für Erneuerbare Energien

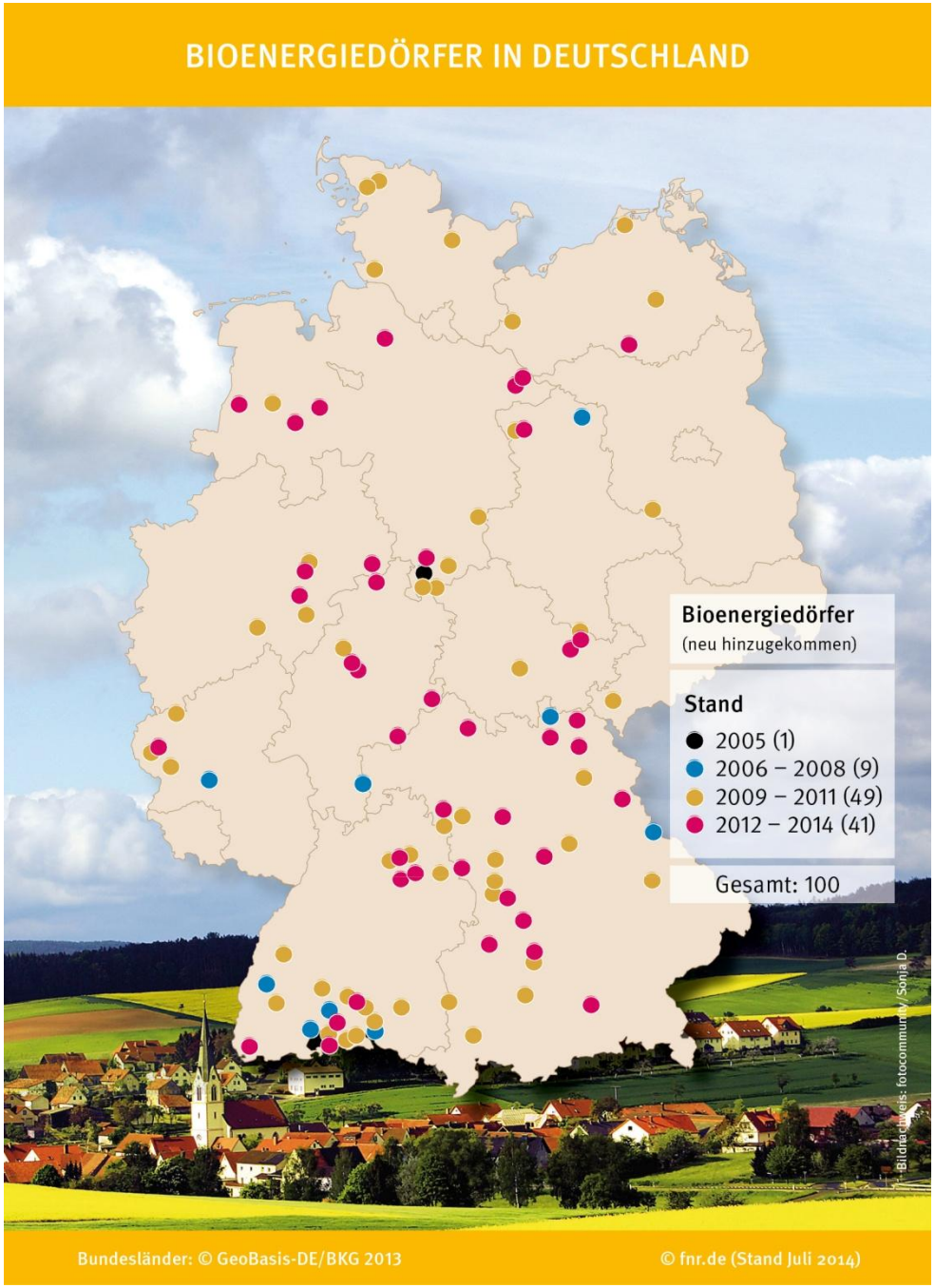
Installed Capacity of “Citizen Energy” by Ownership Group in 2012

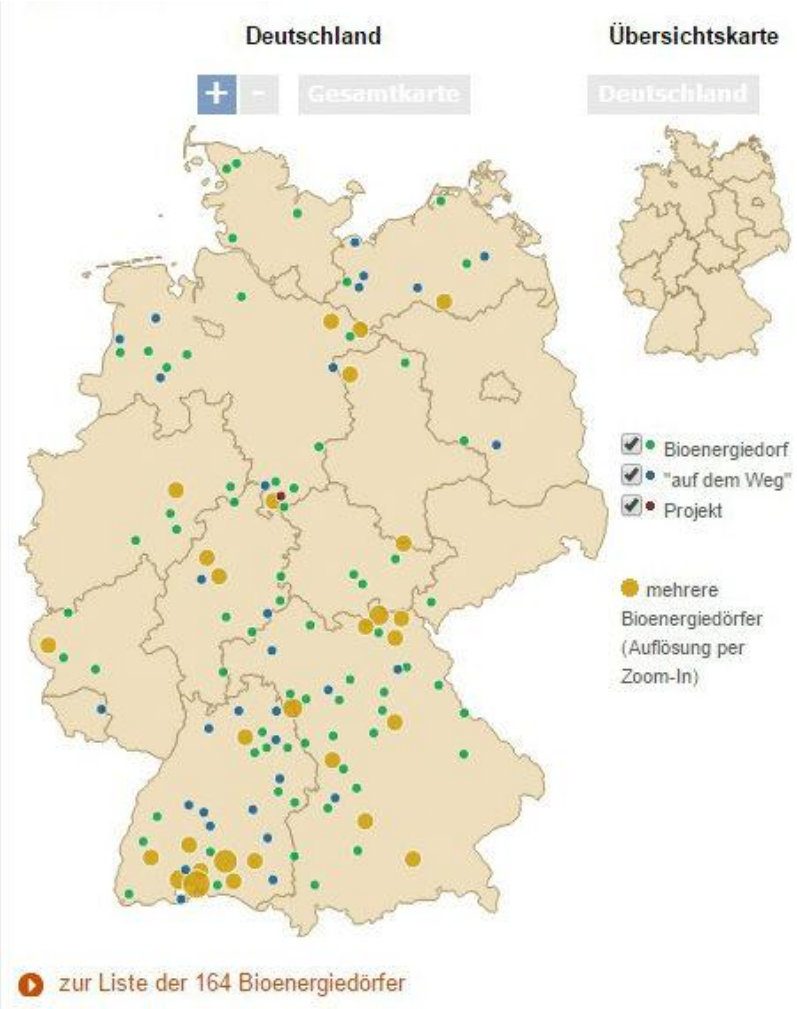


Quelle: trend:research, Leuphana Universität Lüneburg, Stand: 10/2013

Agentur für Erneuerbare Energien

Bioenergy Villages

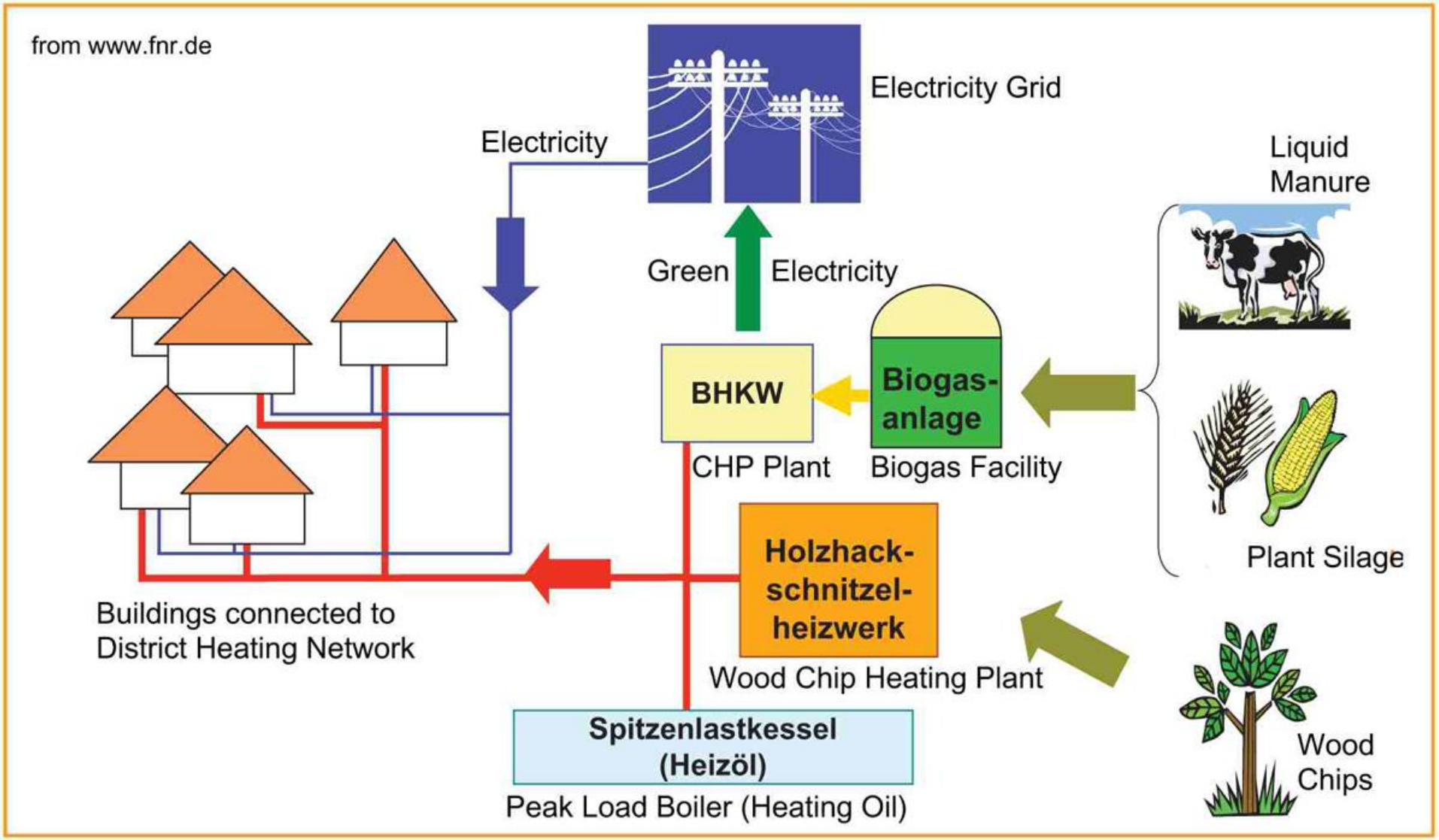




Defining a “Bioenergy Village”

- At least 50% of the community’s energy needs (electricity and heat) are supplied by locally produced bioenergy (typically silage plants and/or wood chips)
- Local citizens are actively involved in developing the ideas and making the decisions
- The biomass used as a resource is owned at least partially by the villagers, and is grown and harvested locally, in a sustainable manner
- Other renewable energy sources may supplement the generation of power and heat from biomass
- Energy efficiency and energy conservation measures are regularly considered and implemented
- Value is created locally, and the benefits extend regionally

Typical Systems/Technologies



Biomass as an Energy Source

- Generally forestry and agriculture
- Versatile: heat, electricity and fuel (liquid, solid, gas)
- Easily storable and dispatchable
- Risk: biomass requires strict management to be sustainable
  - Potential for resource depletion
  - Monocultures reduce biodiversity
  - Energy needs balanced with food needs
- Germany: potential for bioenergy to supply roughly 10% of energy needs (at current levels of consumption)
- In the long term, biomass likely to be particularly important in two areas:
  - Fuel for transportation
  - Cogeneration of heat and electricity

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Feldheim: a District of Treuenbrietzen

Population: 128

Homes, Farms, Communal Buildings and Light Industry

Bioenergiedorf Feldheim

A Tradition of Wind Energy

Feldheim Wind Farm

- First turbine commissioned 1995
- 43 turbines
- Total power capacity: 74.1 MW
- Total annual output: 129,000 MWh

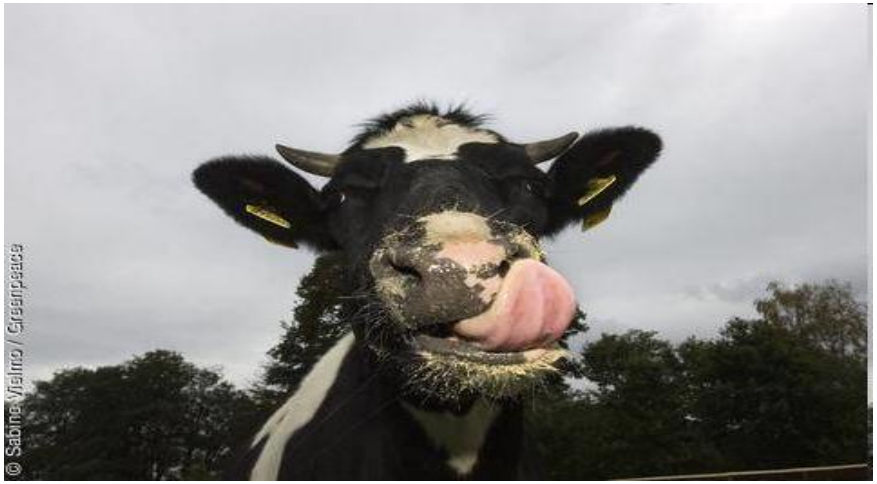
Repowering

1994: 500 kW

2014: 3.0 MW

Agriculture and Livestock

- Farming co-operative
  Agrargenossenschaft "Fläming" eG Feldheim
- 30 Members
- 1,700 hectares of agricultural land, potatoes, sugar beet and cereals
- Liquid manure, a by-product of pig and cattle farming, was spread on the fields as fertilizer
- 2004: prices for crops and milk falling, energy costs rising



Biogas plant

- Power capacity 500 kW
- Input: 8,600 m³/a manure
  8,700 t/a corn silage
  190 t/a ground grains

- Commissioned December 2008
- Energy Output: 4.15 million kWh/a electric power
  2.28 million kWh/a thermal power
- Organic Fertilizer Output: 15,500 m³/a

Biogas Fermentation Plant

Biogas Fermenter Control Center

Cogeneration/CHP System

Growth Industry

Pump and Piping for District Heat

Feldheim District Heating Grid

- Operational: 2009
- Piping: 3,000 meters
- Supplied:

  35 homes

  1 industrial building

  2 communal buildings

  4 agricultural buildings

- Prices
  - –Electricity: monthly standing charge of €5.95, plus 16.6 cents/ kWh
  - –Heat: monthly standing charge of €1.50, plus 7.5 cents/kWh

Biomass Heating Plant

- Woodchip fired
- Uses by-products of timber harvesting in local forests
- Provides back-up heat in very cold weather
- Includes hot water storage tanks

- Heat distribution center
- Includes hot water storage tanks

Local Resources

Feldheim Smart Power and Heat Grid

Die Energieversorgung des Energieautarken Dorfes Feldheim über private Nahwärme- und Stromnetze
Energy supply to the energy-efficient village of Feldheim via private local heating and power grids

Strom

Windpark Feldheim:
43 Windkraftanlagen mit einer elektrischen Leistung von 74,1 MW, sowie das separate Stromnetz werden von der Energiequelle GmbH und Co. WP Feldheim 2006 KG betrieben.

Feldheim wind farm:
43 wind turbines with a power capacity of 74.1 MW, as well the separate power grid, are operated by Energiequelle GmbH und Co. WP Feldheim 2006 KG.

Batteriespeicher (in Planung):
Speicherung überschüssiger Strommengen, die bei Bedarf zugeschaltet werden können.

Battery storage (planned): *Storage of surplus amounts of power that can be brought online when needed.*

Wärme

Biogasanlage:
Elektrische Leistung: 500 kW; Wärmeleistung: 533 kW; Inputmaterial ist Rinder- u. Schweinegülle, sowie Maissilage und Getreideschrot als NaWaRo, die vor Ort produziert werden.

Biogas plant:
Electrical capacity: 500 kW; heat capacity: 533 kW; input material is cattle or pig slurry, as well as maize silage and crushed cereal as renewable raw material that is locally produced.

Holzhackschnitzel-Heizung:
Wird in Spitzenzeiten zur Wärmeproduktion zugeschaltet.

Woodchips:
Used during peak heating periods to produce heat.

Verbraucher, Haushalte:
37 angeschlossene Haushalte mit 145 Bewohnern.

Consumers, households:
37 connected households, with 145 residents.

Verbraucher, Gewerbe und Kommune:
2 Gewerbeeinheiten mit 30 Arbeitsplätzen und 2 kommunale Einheiten.

Consumers, businesses and local authorities: *2 business entities with a workforce of 30 and 2 local authority entities.*

Verbraucher, Agrarbetriebe:
3 Agrarbetriebsanschlüsse.

Consumers, agricultural enterprises:
3 farm connections.

Nahwärme-Netz Feldheim
In der Feldheim Energie GmbH & Co. KG sind Hausbesitzer, Gewerbe- u. Agrarbetriebe und die Stadt Treuenbrietzen Gesellschafter.

Feldheim local heating grid
Homeowners, businesses, farms and the municipality of Treuenbrietzen are all partners in Feldheim Energie GmbH & Co. KG.

Förderung des Fernwärmenetzes Feldheim durch:

Feldheim Energie GmbH & Co KG (Limited)

• 49 partners: the residents of Feldheim, the town of Treuenbrietzen, and Energiequelle Management Ltd. (general partner with full personal liability)

• Partner contribution €3,000

• Committee of five represents the interests of all partners.

Funding the District Heating Network

Overall investment costs: € 1,725,000

Limited Partnership: € 138,000

Public Subsidies: € 830,000

Balance of Funding: conventional financing

Funding the Local Electricity Grid

Overall investment costs: € 450,000

Public Subsidies: none

Majority of Funding: Energiequelle

Solar Farm Selterhof

- Ex-military telecommunications center and depot
- 9,844 photovoltaic modules
- 284 trackers

- Total power capacity 2.25 MWp
- Annual output 2,748 MWh
- Electricity supply for 600 households

Re-purposed Brownfield

Eco-learning Destination

Wind turbine nacelle installed in courtyard October, 2014

Energiequelle

One of Germany's First Energy Self-reliant Villages

- 100% Co2-neutral
- 100% independent, direct energy supply
- Winner of Federal Award "Bioenergy Village of the Year 2010"
  Prizewinner "365 Landmarks in the Land of Ideas 2011"

Benefits of Energy Self-Reliance

- Diversification and commercial use of agricultural products
- Job creation and security in the local farming cooperative and beyond
- Economical and sustainable energy production: electricity price fixed for 10 years
- Value remains in the region, as inputs are locally produced
- The "import " of 160,000 liters (42,000 gallons) of heating oil has been eliminated
- Business tax revenues are generated from wind farm and biogas plant
- Potential for arrival of other "green-tech" industries
- "New Energy Forum Feldheim (NEF): Education and Information Center“
- The town of Treuenbrietzen positions itself as a center of excellence in the field of renewable energies

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Bioenergiedorf Bollewick

Bioenergiedorf Bollewick

- 647 residents, 3 kindergartens, 1 senior living community
- Germany's largest fieldstone barn
- 5 farming operations
- 2 woodworking shops
- Local agricultural products – organic meat, etc.

Bioenergiedorf Bollewick

“It all started with a barn”

The Barn

Built in 1881

Agriculturally used until 1990

Barn Renovations

Gutted in 1990-94 and "revived," since 2008 with renewable energy

The Barn

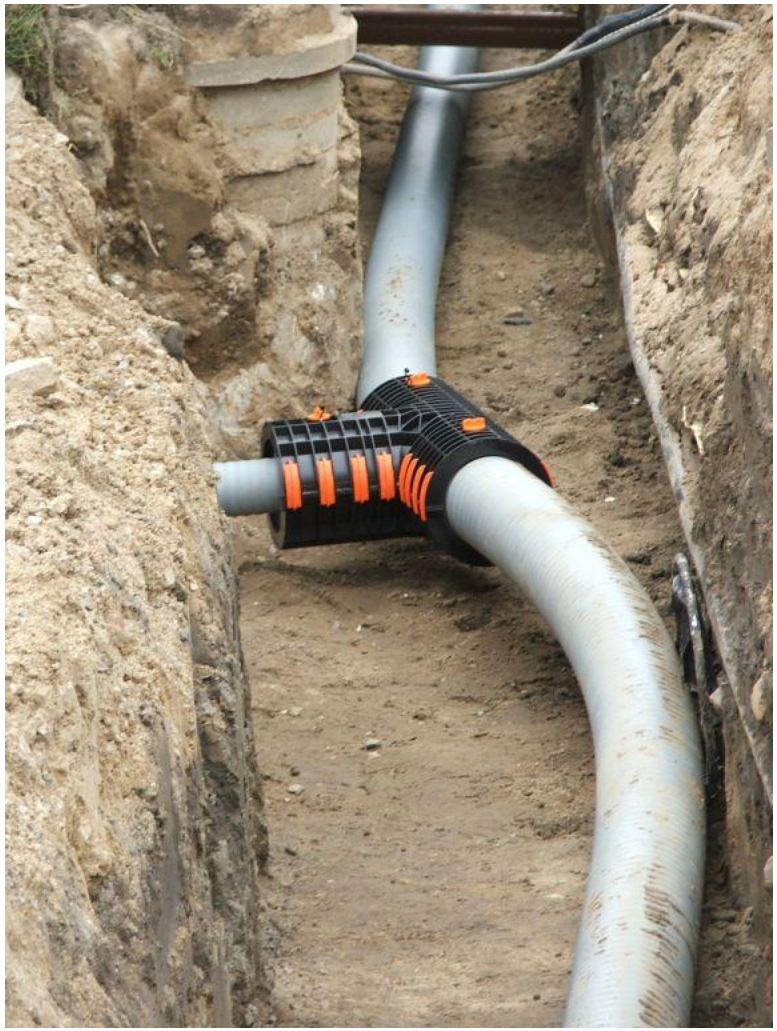
- 125 m x 34 m
- 8,800 m^2 of floor area
- 4 areas:
  - Administration
  - Retail/crafts
  - Events
  - Hotel/restaurant
- Approximately 120,000 visitors per year
- Welcome Center for region
- Roughly 50,000 liters/yr (13,000 gallons/yr) of heating oil and €65,000/yr ($74,000) saved through district heating system

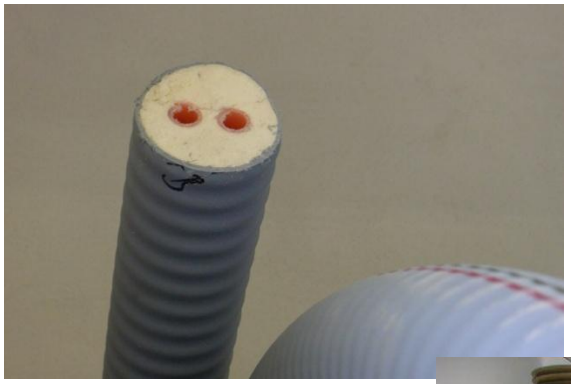
Biogas Fermenters

District Heating Network

- 3,800 meters of piping
- 54 connections
- 1,175 MW output capacity
- 3 power plants
  - 3 x Biogas Combined Heat and Power, 850 kW
  - 1 x Reserve 680 kW oil boiler
  - 150 kW Warm water storage tank
- 623 t/yr CO2 eliminated

District Heating Network





District Heating Network

District Heating Network

District Heating Network Costs

Component	Cost in Euros	Responsible Party
CHP Connection	180,000	Farmers
District Heating Network	570,000	Community (Town)
Controls	78,000	
Storage, pumps, etc.	127,000	
Design/Engineering	85,000	
Distribution Station	190,000	Consumers
Total	**1,230,000**	
Per kW Connection	**1,076** **(without subsidies)**	

For comparison:

Oil	€700/kW
Gas	€540/kW
Pellet	€1,200/kW

Therefore the federal and state governments provide incentives for switching to bio-heat in existing buildings

Sample Cost Calculation for Consumer
(based on a typical 15-20kW connection)

- One-time construction cost €4,500
  - minus KfW (federal) incentive -1,800
  - Less village renewal subsidy -1,215

  Amount paid by participant €1,485

Participant pays for removing and properly disposing of existing boiler

Annual basic price per kW connection € 69.97/kW

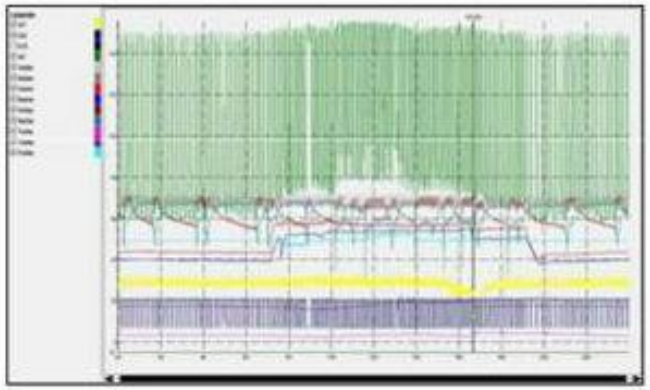
Heating price per kWh consumed € 0.0393/kWh

Economic Advantages of District Heat

- Inclusive contract includes heat, maintenance and 24 hour service
- After payback of initial capital, price for heat can be substantially reduced
- Cost of bio-heat is more predictable, because based on pricing of local agricultural commodities, not on fossil fuels
- The pricing system is transparent, and does not include hidden costs and profits

Bollewick: Comprehensive Approach

31 % of heat energy requirements covered



148 LED street lights installed

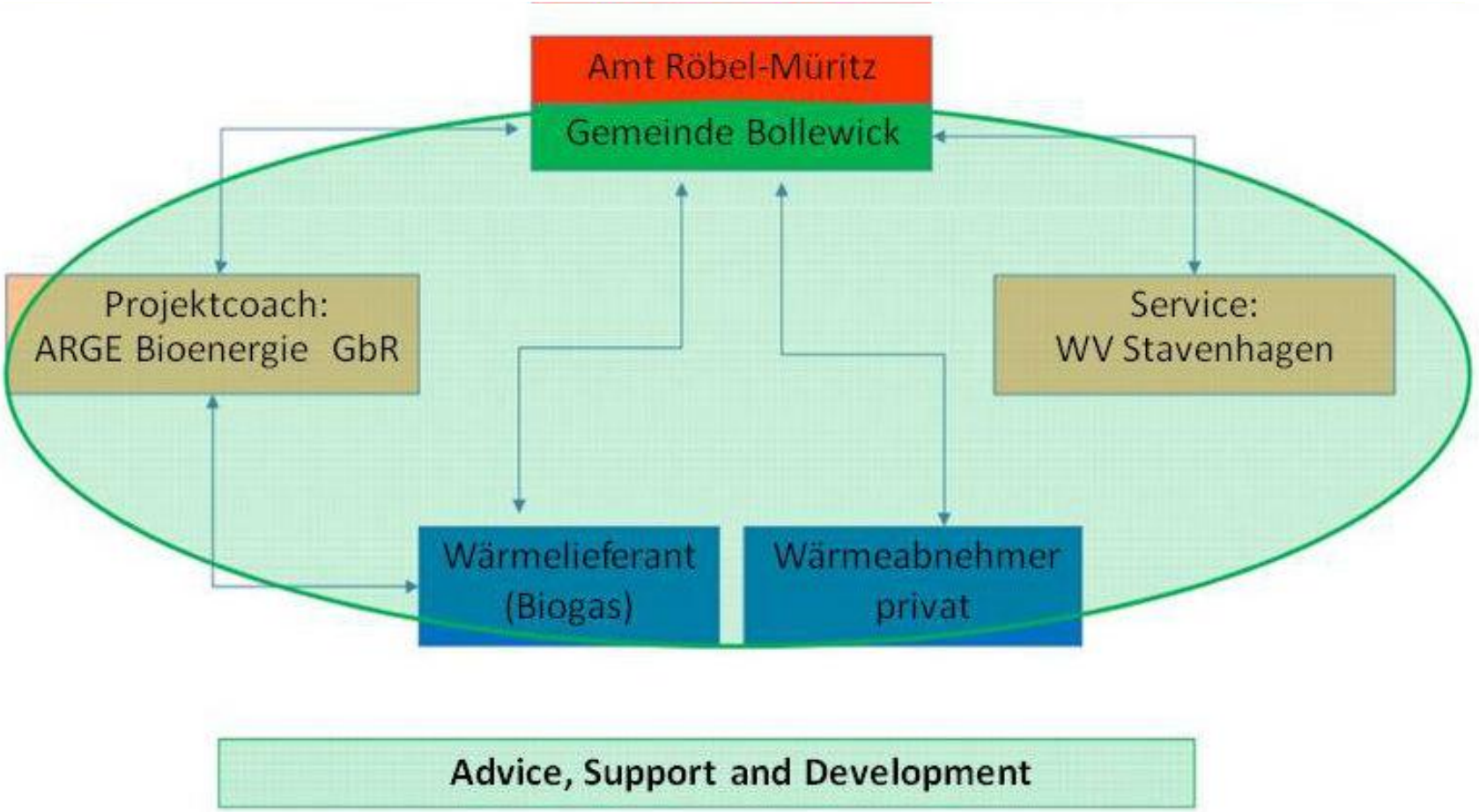
Solar village: 140 kWp on community buildings

Broad Perspective on Sustainability

“55+” Retirement Community

- 22 building sites
- 12 sold
- 1 multi-generational house
- 10 low-energy use houses

Key Players in Bollewick



Energiekonzept Bollewick

- Construction of district heating network in village of Kambs and connection to private houses in 2013
- Further development of Bollewick's heating network (2nd phase 2013/14)
- "Transparent" village energy: visible & tangible
- Intelligent use of excess heat and heat services
- Alternative bioenergy sources: agriculture, local wood waste
- Is a Smart Grid the solution for the independent (self-) supply of renewable energy in Bollewick?
- Can we solarize our local mobility?

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Neustrelitz

- Founded in 1733
- Residents: 21,000
- Visitors/tourists: over 50,000 overnights/year
- Müritz National Park; Feldberg Lakes Park
- Part of Mecklenburg Lakes Bioenergy Region
- “Energy Community of the Month” in Oct. 2008

A City on a Mission

Renewable Energy is a key component of the mission/strategy of Neustrelitz

- Between March and May, 2010, a working group focused on the theme of renewable energy

- In April of 2011 the document resulting from this work was officially accepted by the city government

  - long-term security of a renewable energy supply
  - optimal energy supply for the city area
  - supporting a regional network for bioenergy development
  - supporting economic development, research and education

Leitbild: Mittelzentrum Neustrelitz - Mecklenburg-Strelitzer Residenz mit Flair

Leitthese 1	Leitthese 2	Leitthese 3	Leitthese 4
Barocker Stern / Residenzstadt zum Wohlfühlen	Kulturzentrum der Mecklenburgischen Seenplatte / Bindeglied in der Nationalpark-region	Technologie-schwerpunkt mit Zukunft / Zentrum der Bioenergieregion / Moderner Wirtschafts- und Dienstleistungs-standort	Ort sozialer Nachhaltigkeit / Lebensmittelpunkt mit familien-, senioren- und bürgerfreundlichem Klima
Zielbereiche:	**Zielbereiche:**	**Zielbereiche:**	**Zielbereiche:**
Wohnen	Tourismus / Naherholung / Freizeit	Gewerbe	Soziales
Grünflächen/ Spielplätze	Kultur	Einzelhandel	Bildung und Erziehung
Umweltschutz/ Klimaschutz	Gewässer / Wald / Bäume	öffentliche Verwaltung	Gesundheit
		Verkehr	Sport
		technische Infrastruktur	
		erneuerbare Energien	

On the Path to Energy Self-Reliance

As of 2012, Neustrelitz was covering:

- 100% of its electricity needs with renewable power
- 40% of its space heating needs with renewable power (in the area of the district heating system, over 70%)

Water Power Gas Heat

Services of the Neustrelitz Public Works Department (*Stadtwerke Neustrelitz GmbH*)

Neustrelitz Public Works Dept

Best-practice installations of the Stadtwerke Neustrelitz GmbH:

- communal energy supply company
- 131 employees
- reliable and client-oriented gas, power, water and heat supply

- Woodchip Biomass Combined Heat and Power (CHP) Plant
- District Heating Network
- Biogas Installation
- Solar Farm

Neustrelitz Biomass CHP Plant

- Owner/operator: Stadtwerke Neustrelitz GmbH
- Operating since: January, 2006
- Installed power: 7.5 MW electricity; 17 MW heat
- Annual production: 45,000 MWh electricity; 63,000 MWh heat
- Raw material: wood chips from forestry management and logging waste
- CO2 savings: 14.6 tons/year
- Total investment: €17.6 million
- Financial support: European Fund for Regional Development
  State of Mecklenburg-Vorpommern (€2 million)
- Goal: The motivation was rising oil and gas prices. The goal of the Stadtwerke was to be able to provide the residents of Neustrelitz with predictable and affordable pricing for heat.

Biomass CHP Plant

- Delivery of wood chips from radius of 150 – 200 km
- Approx. 15 delivery trucks per day
- Daily requirement: about 200 tons
- Annual requirement: about 80,000 tons

Biomass CHP Plant – Local and Regional Economic Development

- Approx. 100 jobs were created in plant operation, forest management, resource harvesting and logistics
- 10 companies, including 5 small local family businesses, provide the wood chips
- The system creates favorable conditions for the relocation of businesses that can use the waste heat
- By successfully building and operating this biomass CHP plant, the Stadtwerke Neustrelitz GmbH has generated worldwide interest, and enhanced to role of Mecklenburg-Vorpommern in the Energiewende

Neustrelitz Biogas Installation

Neustrelitz Solar Farm

Energy Retrofits of Local Schools

All of the public schools in Neustrelitz have received energy retrofits (*sanierung*)

Grundschule Daniel Sanders in Strelitz - Alt

Grundschule Kiefernheide

Grundschule Sandberg

Jawaharlal-Nehru Schule

Public Housing

Best-practice installations by the Neustrelitz Housing Administration – the largest landlord in the city

Photovoltaik- und thermische Solaranlage in der Ernst-Moritz-Arndt-Straße (1. Solarexpedition im Rahmen der „Woche der Sonne “)

Größte auf dem Dach montierte Photovoltaik-Anlage der NEUWO GmbH

Fernwärmebeheizte Kleinwohnungen in Kiefernheide

Der Vermieter an der Basis – beide sind mit dem Erreichten zufrieden

Citizen-owned Solar Installations

Bürgersolaranlage auf der Integrierten Gesamtschule

Photovoltaik-Park von IBC Solar
(1. Solarexpedition im Rahmen der „Woche der Sonne“)

Wärmepumpe im Wassersportverein Einheit Neustrelitz e.V.

MV State Center for Renewable Energy (Leea)

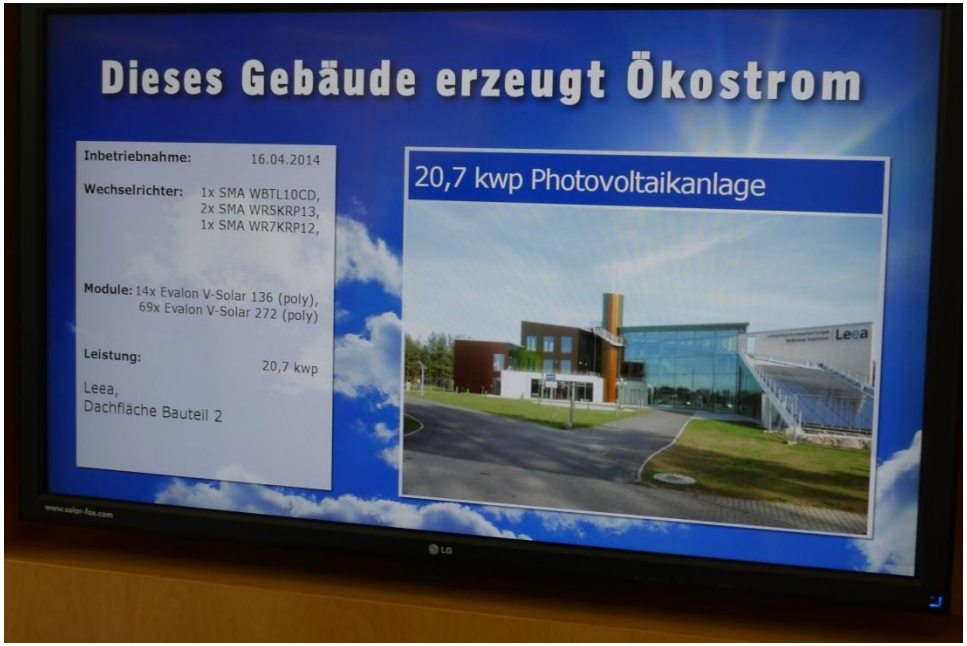
“Only those who show their face will be seen”

- Coordinating the flood of individual initiatives into a systematic energy network, engaged and transparent under one roof, dedicated to the theme of renewable energy and therefore to the protection of the environment.
- A center of competence that not only clarifies and informs, but also actively supports commerce

“Experience – Understand - Join “

Leea – “Energy Made Touchable”

“Visitors experience the exciting world of the future through interactive exhibits and touch-screen terminals. Energy and technology are brought to life.”



Leea – Motivation for Commerce

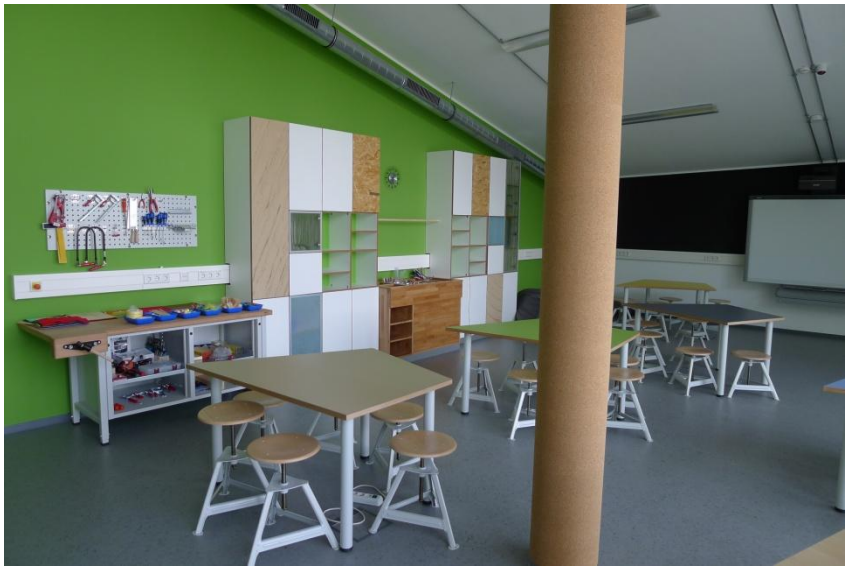
"Company exhibits and presentations allow visitors to compare products and services and learn more about the competencies of companies and craftspeople."

Leea – Knowledge Transfer

"The modern, attractive seminar rooms allow for group-specific education in the arena of energy and the environment."

Leea – Experimentation and Research

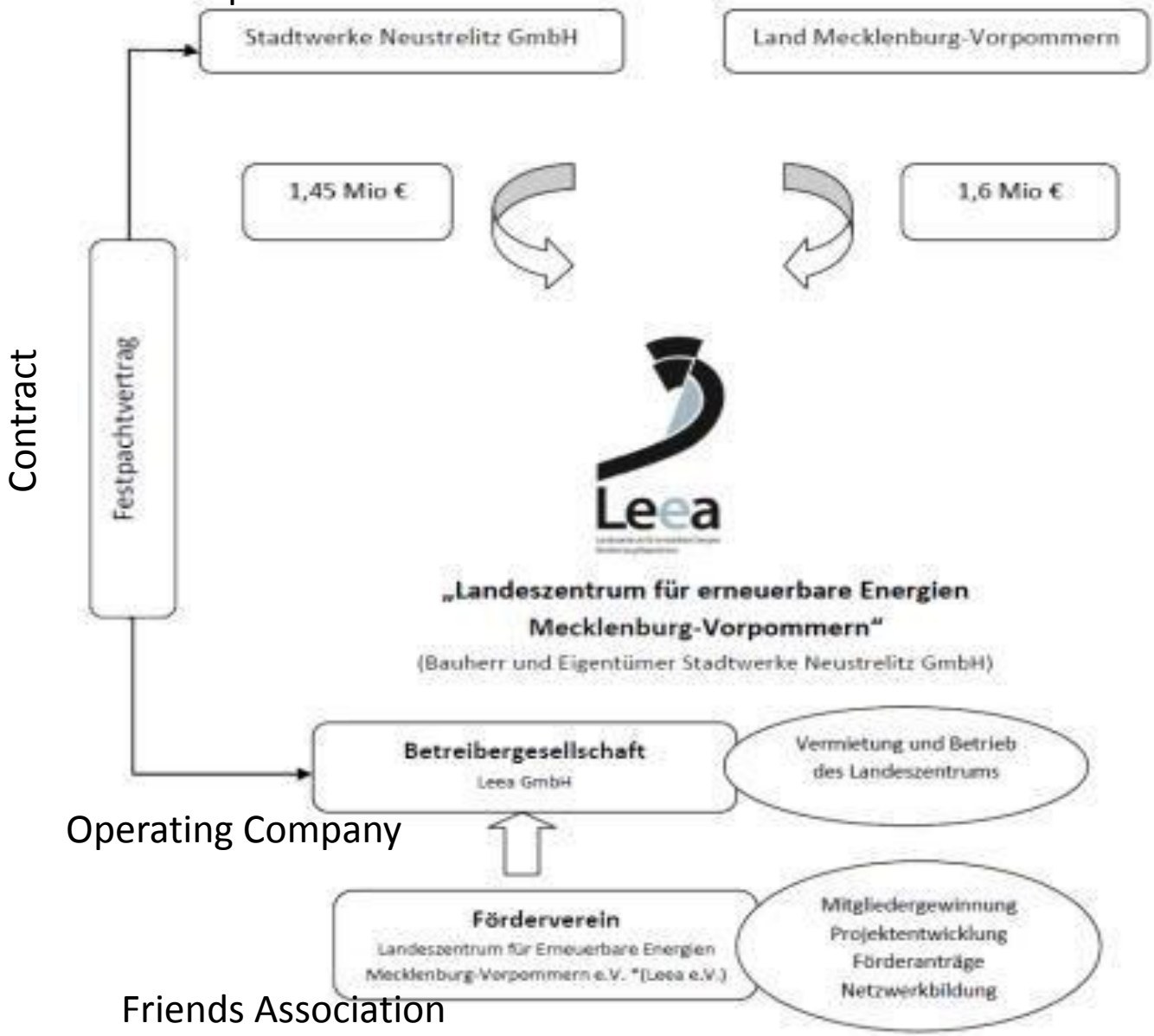
"In the energy laboratory, students can deepen their understanding and knowledge."



Leea – Financing

Public Works Dept

State of Meck-Pomm



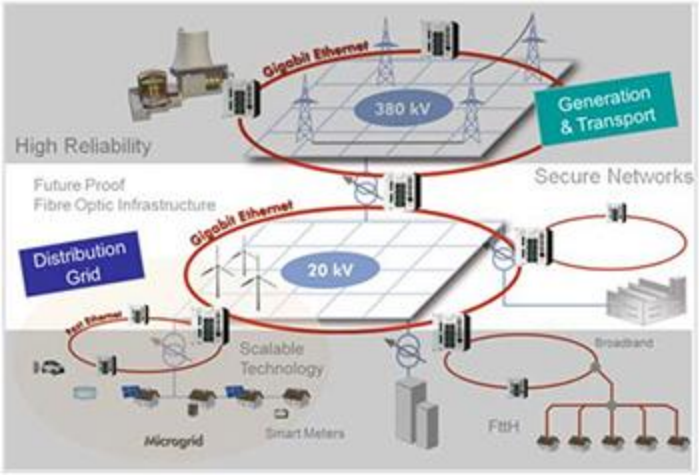
Contract

Operating Company

Friends Association

Stadwerke Neustrelitz – Ongoing Projects

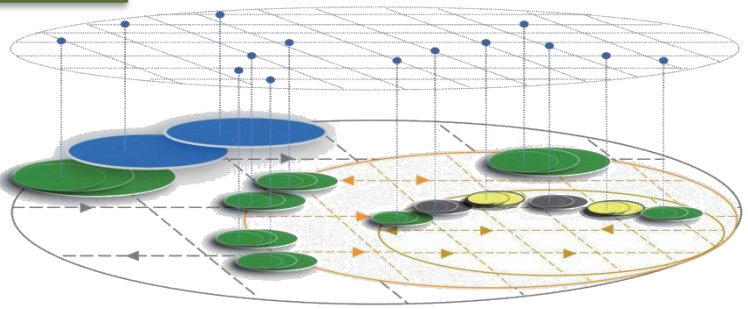
- Coordination and cooperation with other public works departments in the region to develop and implement sustainable energy projects
- Exchange knowledge and experience through participating in national competitions
- Key player in federal “Smart Microgrid” initiative



www.nexans.de

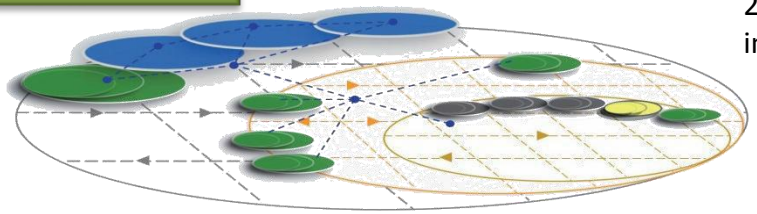
Energy System of the Future

2020: Koordination aller Akteure in intelligenten Energienetzen



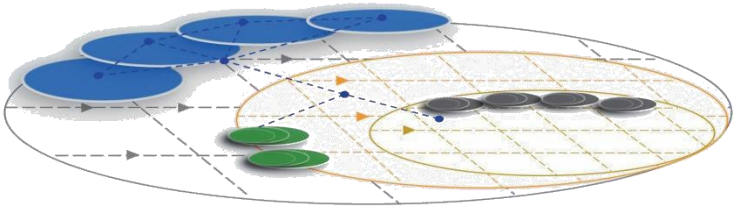
2020: all of the players are coordinated in an intelligent energy net

2015: Verbraucher werden zu Produzenten



2015: consumers become producers

Heute: Wenige Großerzeuger bedienen viele Verbraucher



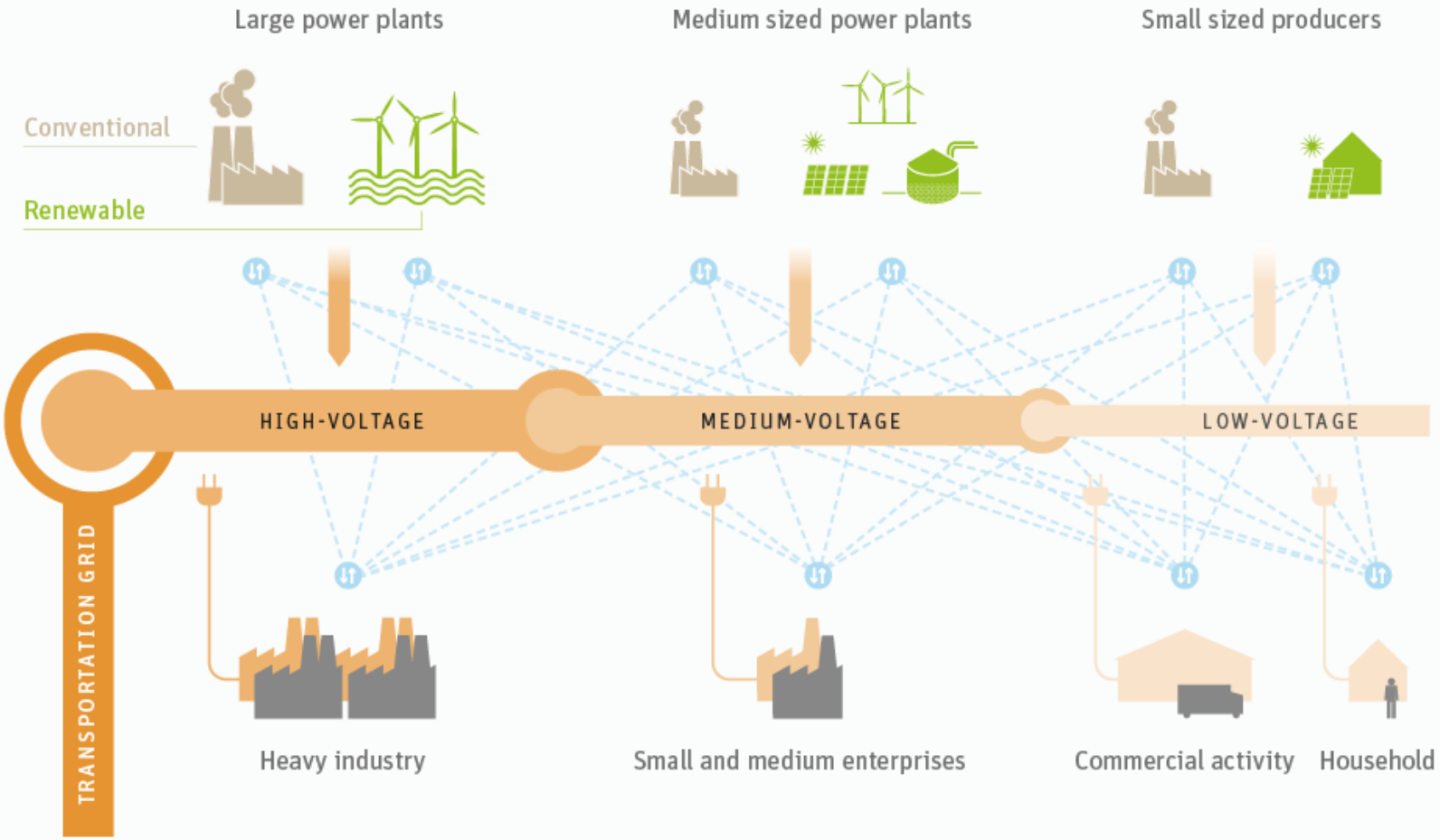
Today: a few large producers serve many consumers

Source: BDI, Die Energiewirtschaft auf dem Weg ins Internetzeitalter

The future power grid will be bidirectional and intelligent

Electricity and information flow in power grid

Source: IFEU



German Energy Transition energytransition.de CC BY SA

http://energytransition.de/2012/10/the-grid-and-power-storage/

Outline

1. Germany's *Energiewende*
2. Bioenergy Village of Feldheim
3. Bioenergy Village of Bollewick
4. Neustrelitz, a City Powered by "Future Energy"
5. Development of Community-owned Energy Systems

The Road to Community Energy Self-Sufficiency

1. Initiation
2. Preliminary Planning and Groundwork
3. Detailed Planning and Construction
4. Operating and Optimizing
5. Further Development

1. Initiation

- Analysis of energy needs and potentials
- Survey interest among residents
- Clarify motivation and goals
- Build foundation of trust

www.brattleborodevelopment.com

2. Preliminary Planning and Groundwork

- Create necessary organizations (cooperatives, non-profits, companies, etc.)
- Research and refine technical concepts
- Research and pursue financing and support

3. Detailed Planning and Construction

- Comprehensive feasibility study
- Scopes of work established
- Pricing determined
- Financing secured
- Contracts finalized
- Construction

4. Operation and Optimization

- Training personnel
- Optimizing system performance
- Expanded connections with additional buildings

5. Broader Development

- Innovation
- Education and outreach
- Expansion with PV and wind
- Knowledge Transfer

Success Factors

- One or more *Zugpferde* (“draft horses”) — citizens and groups who tirelessly champion the project
- A strong sense of community spirit and trust
- Clear and frequent communication, and transparent processes
- Broad and strong engagement of community members
- A comprehensive and reliable feasibility study
- Efficient and determined planning and implementation
- Relatively low connection costs to the district heating system; resultant heating costs that are competitive with (or lower than) the status quo

Additional Resources

- www.energytransition.de
- www.neue-energien-forum-feldheim.de/index.php/en
- www.wege-zum-bioenergiedorf.de/
- http://go100re.net/

What are the possibilities/potentials here in our region?

What are the constraints?

Thanks for your attention!

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This concludes The American Institute of Architects
Continuing Education Systems Course

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