Energy Economics – Winter Term 2020/21

- Getting started -

Chair of Energy Systems | Department of Energy Systems
Technische Universität Berlin

All course material is available on the ISIS course webpage EE 20/21

Lectures and tutorials on Monday, Wednesday & Thursday

Lecture and tutorials

- Mondays, 14-16 h
- Wednesdays, 14-16 h
- Thursdays, 12-14 h

- First lecture in 20: 2 November
- Last lecture in 20: 17 December
- First lecture in 21: 4 January
- Last lecture in 21: 25 February

Exam

- 6 ECTS for a written exam of 90 minutes
- Date to-be-confirmed
- Location to-be-confirmed

In this class, offer for additional seminar

stand alone (3 ECTS each) or module Energiesysteme (9 ECTS)

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Vortragsreihe „Neue Entwicklungen auf den Energiemärkten“ / Lecture series „New developments on the Energy Markets“

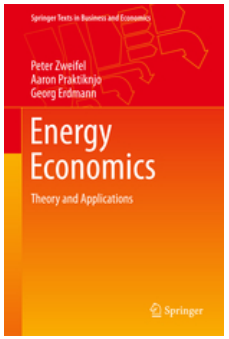
- Lecture series and discussion on current topics in energy economics and systems
- Language: German / English
- ISIS: Vortragsreihe WS 20/21 | Password: Meritorder20
- Please register via the course database to facilitate a smooth planning process

- Introduction of the topics will be within this lecture on 26 November 2020
- The dates for your presentation will be planned thereafter with your supervisor

Questions?

- What are the parts of this module?
- Where do I find information and news concerning this module?
- Where do I find the material for the lecture and the tutorial?
- When is the exam?
- Who do I contact with unclarities?

Reading recommendation



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English

- Erdmann, G., Praktiknjo, A., Zweifel, P. (2017) Energy Economics – Theory and Applications, Berlin, etc.: Springer
- Bhattacharyya, Subhes C. (2011) Energy Economics. Concepts, Issues, Markets and Governance. Springer
- Dahl, C. A. (2004) International Energy Markets: Understanding Pricing, Policies, and Profits. Tulsa (Oklahoma): PennWell
- Stoft, S. (2002) Power System Economics: Designing Markets for Electricity. Piscataway (N.Y.): IEEE Press

German

- Erdmann, G., Zweifel, P. (2007) Energieökonomik - Theorie und Anwendungen, Berlin, etc.: Springer
- Hensing, I.; Pfaffenberger, W.; Ströbele, W. (1998) Energiewirtschaft. Einführung in Theorie und Politik. München: Oldenbourg
- BNetzA/BKartA (2016) Monitoring-Bericht Strom und Gas

Economic Fundamentals

- Hal R. Varian, "Intermediate Microeconomics: A Modern Approach - Ninth Edition", W. W. Norton & Company, Inc., New York, USA, April 9, 2014
- K. Spremann, "Wirtschaft, Investition und Finanzierung", München: Oldenbourg, 6. Auflage 2013.(ISBN 3-486-23565-6) (German)

Topics in class

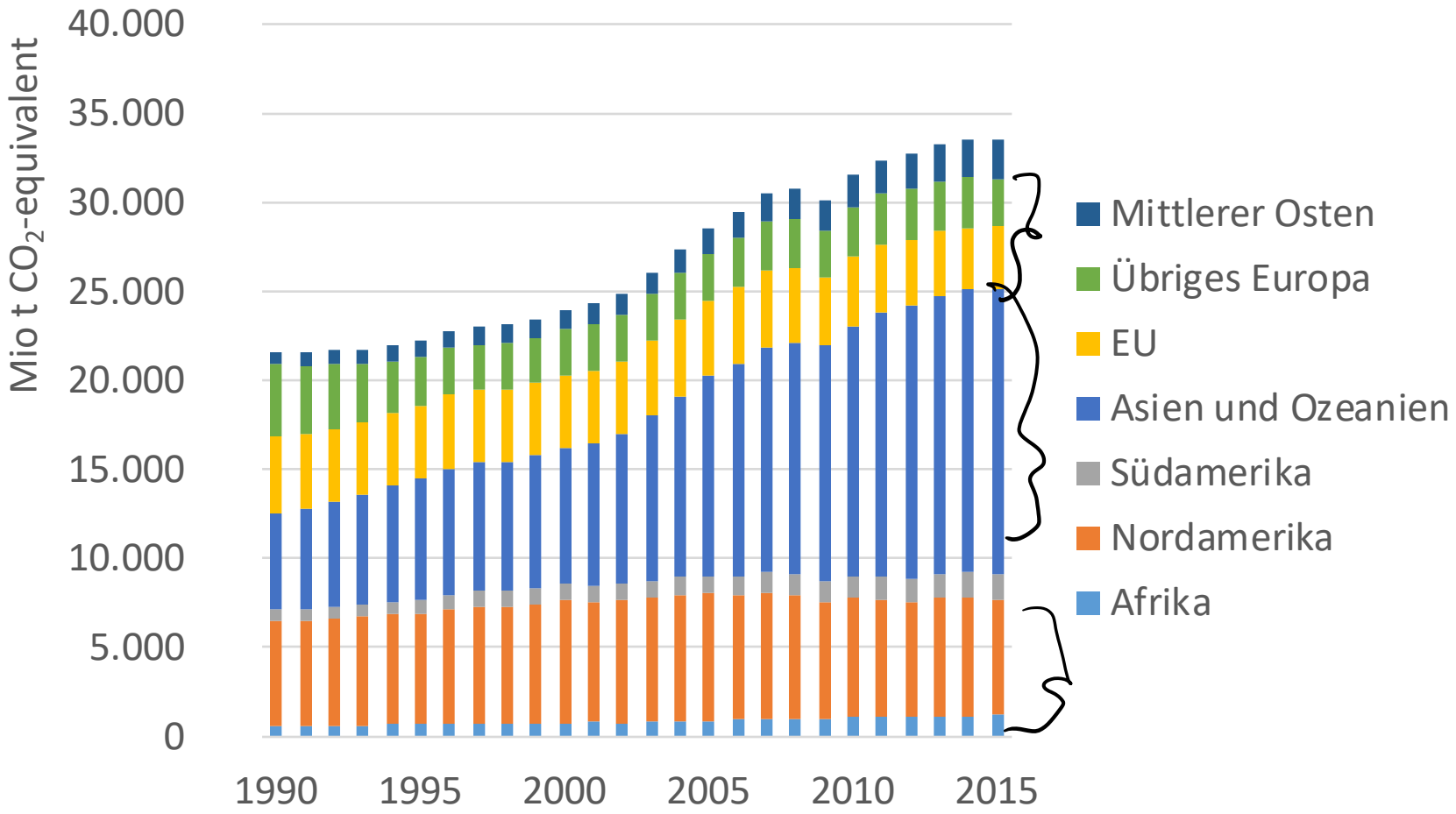
1. Energy Balances
2. Economic Fundamentals
3. Financial Management
4. Electricity Markets
5. One class – presentation of seminar “new development on energy markets”
6. Electricity grid
7. Homework and self-paced study time
8. Retail Markets
9. Emissions markets
10. Resources and Sustainability
11. Oil Markets
12. Gas Markets
13. Energy and Development
14. Exam Preparation

Homework on a class relevant topic

- Voluntary group work (up to 5 students)
- Report and possibly a presentation
- Rewards: Deeper understanding of the topic, methodological competence and extra bonus points for the exam
- Dates probably from 4-Jan-21 to 11-Feb-21

Let's start with a look into the past

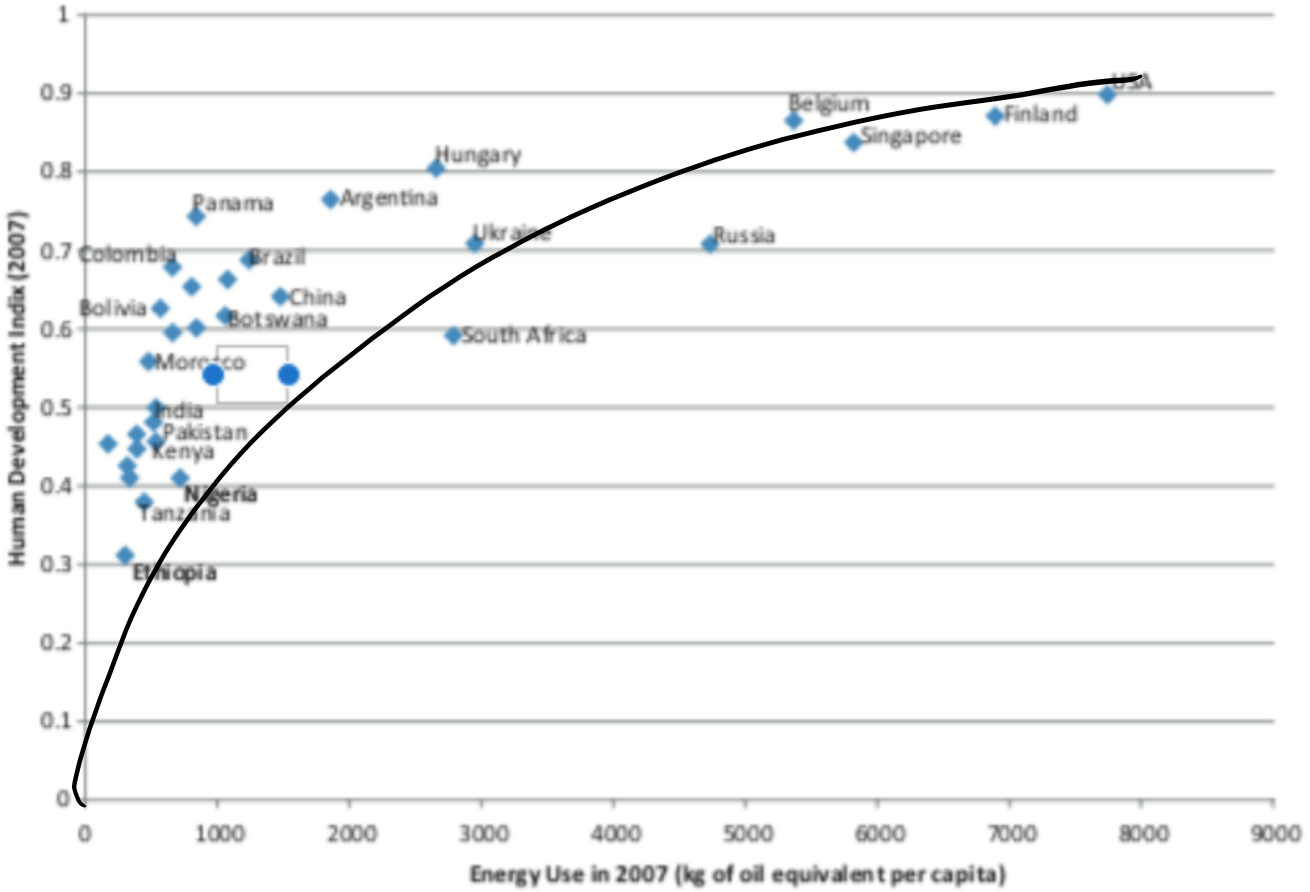
-Energy-related CO_2 emissions in regions-



What goes together

-Economic development and energy consumption-

The prosperity of our society depends on a functioning energy supply. Modern life would be unimaginable without electricity, warmth, and mobility



A closer look at Germany

-Energy-related emissions-

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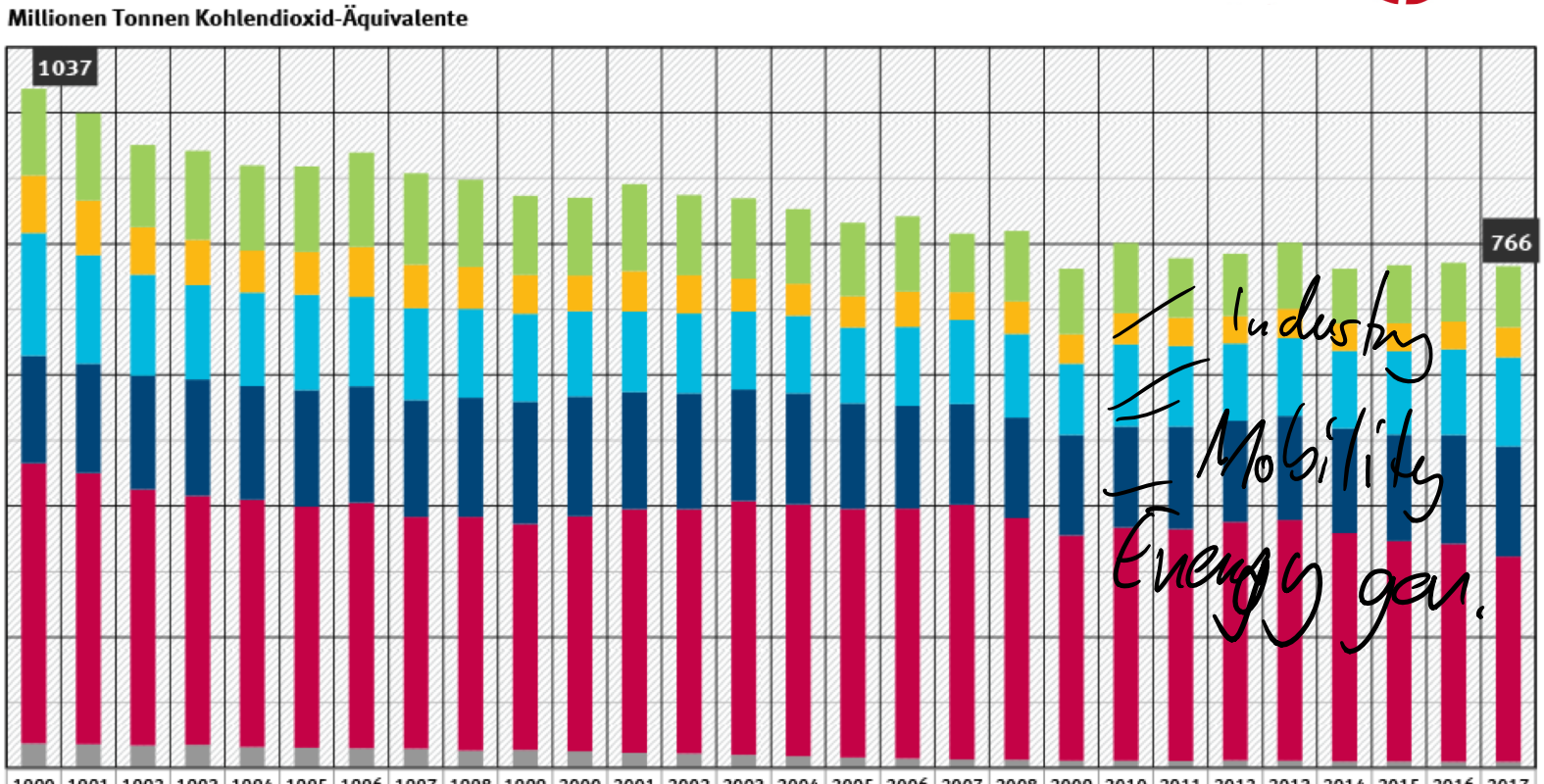

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Haushalte	132	134	125	136	130	130	144	140	133	121	119	132	122	123	114	112	114	89	108	100	107	91	95	101	83	88	89	93
Gewerbe, Handel, Dienstleistung [2]	88	83	72	69	64	65	76	66	64	59	54	62	58	50	48	48	54	42	50	45	48	43	42	45	42	43	42	46
Industrie [3]	187	165	155	144	142	146	136	141	136	134	130	123	122	119	118	115	120	128	127	109	125	123	118	118	118	127	130	136
Verkehr	164	167	173	178	174	178	178	178	181	187	183	179	176	170	169	161	157	154	154	153	154	156	155	159	160	163	166	168
Energiewirtschaft	427	413	391	380	377	368	375	354	356	345	358	371	373	387	384	379	381	388	368	344	356	354	364	367	348	336	333	313
Diffuse Emissionen [4]	38	37	35	36	33	31	31	30	27	28	26	24	23	21	18	16	15	13	13	11	11	11	12	12	11	11	10	10
Summe	1037	1000	951	942	919	918	939	908	898	873	870	891	874	870	853	832	842	815	820	762	801	778	785	802	762	767	771	766

Overview

-The German Energy Transition-

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→ The burning of fossil fuels generates heat and releases the greenhouse gas carbon dioxide - a serious pollutant and major contributor to global warming

→ The key to climate mitigation is an energy transition that reduces our consumption of fossil fuels, through the increased use of renewable energies and a more efficient use of fossil fuels

→ The realization of a sustainable energy supply depends on a reduction in our consumption of fossil fuels such as oil, gas, and coal

→ Essential tool in increasing energy efficiency is, power-heat coupling, where exhaust heat from the production of electricity is used for heating, or in production processes (combined heat and power)

Wind, water and solar power – renewable energies are the key to sustainable energy supply

A big step in the right direction

-The German Energy Transition-

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Renewable energies, such as hydro and solar power, wind and geothermal power, and regenerative resources are replacing fossil fuels

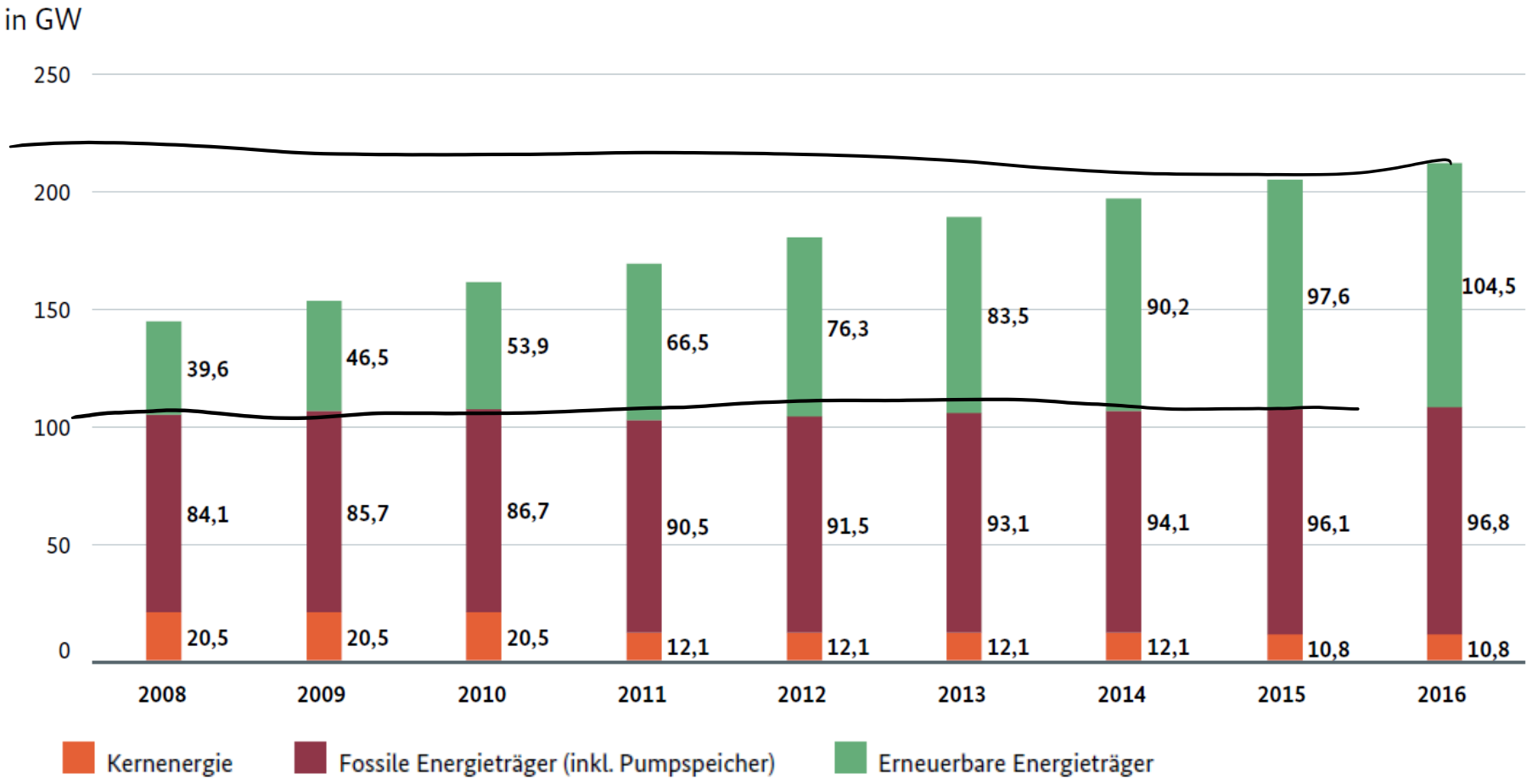
→ by 2050 renewable energies should make up 60 percent of final consumption of energy, and 80 percent of the gross electricity consumption

Energy efficiency is following the expansion of renewable energy supplies. Potential solutions range from the modernization of power stations, to energy efficient motors and energy saving industrial processes, to energy efficient building renovation and household goods

→ by 2020 a 20 percent reduction in primary energy consumption, and 50 percent reduction by 2050, compared to 2008

Snapshots

-Production capacity for electricity in Germany-



Quelle: Monitoringbericht 2016

Electricity production in Germany

-high share of renewable electricity at times-

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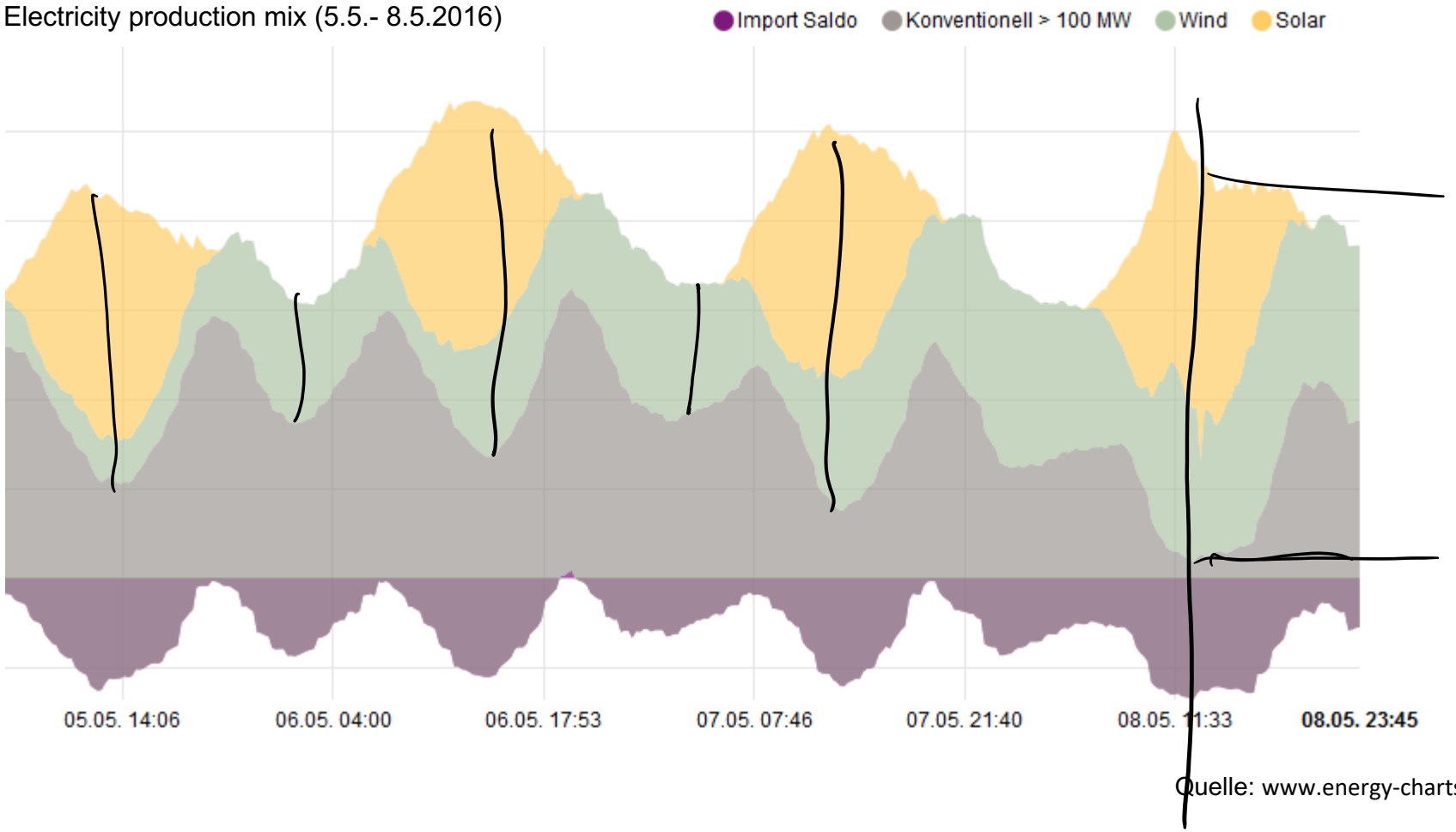
Electricity production mix (5.5.- 8.5.2016)



Quelle: www.energy-charts.de

Central elements of a renewable energy system

-Energy storage-

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Developing storage solutions

→ New storage concepts

→ Intelligent power grids

Wind and solar power are not continuously available meaning the supply of energy is less stable compared to large traditional power stations

Power-to-X

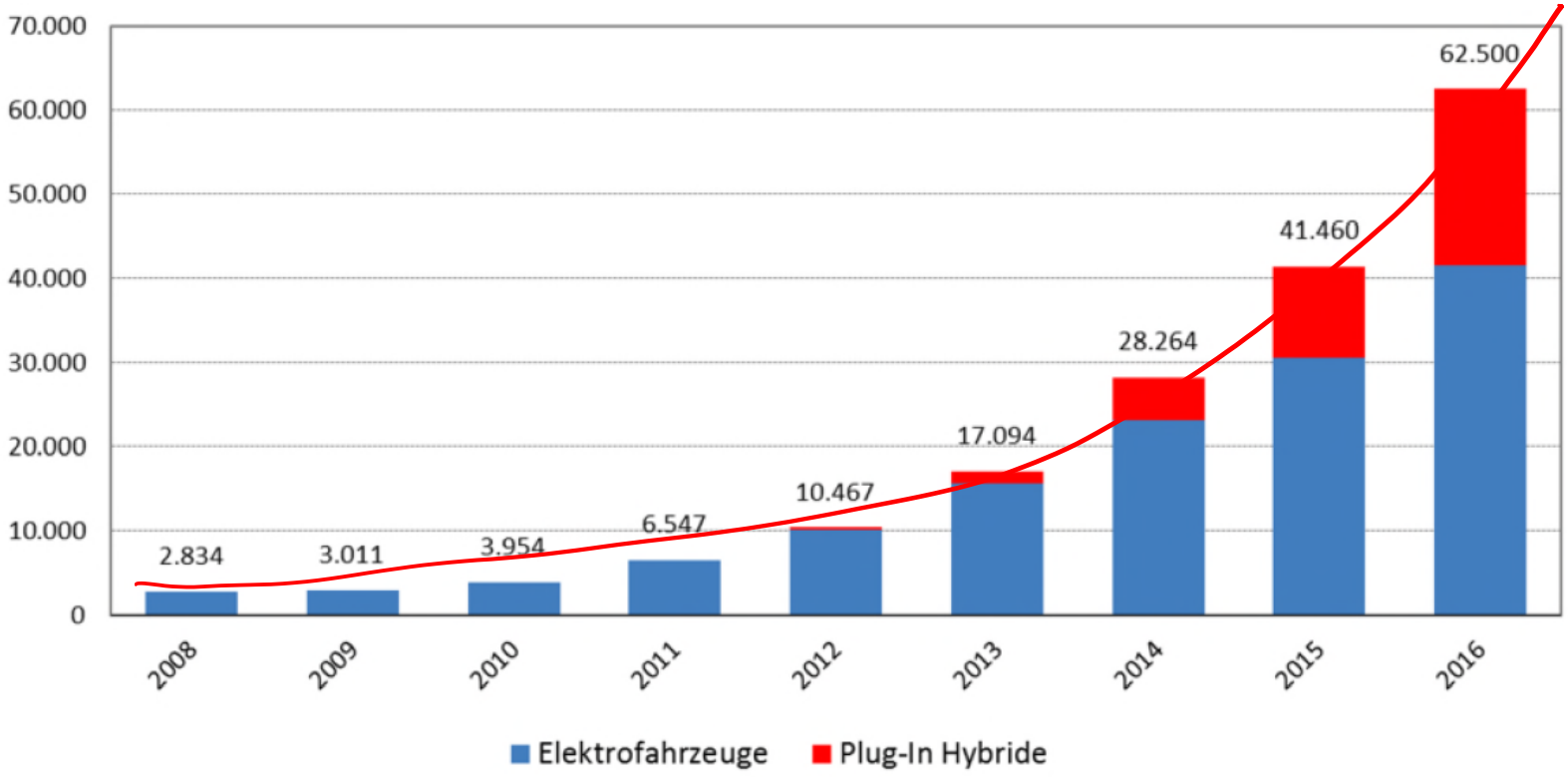
→ Usage of excess electricity to produce heat, gas or liquids

→ Transfer renewable electricity into other sectors to replace fossil energy (warmth, mobility)

Hydrogen production with wind electricity. Fuel cells convert hydrogen back to electricity when needed, or feed hydrogen into the natural gas grid

It is also conceivable that excess wind or solar power could be converted into heat (Power-to-Heat), into liquid fuels (Power-to-Fuel), or into basic chemicals (Power-to-Chemicals)

E-mobility in Germany



To keep in mind: around 45 Mio cars in Germany

Central elements of a renewable energy system

-Decentralised supply is the future-

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The nature of our energy supply system is changing

→ from a system reliant on conventional, centralized large power stations,

→ to a decentralized structure with numerous smaller power generation systems.

As the transformation continues, regional and municipal distribution networks must change too. The trend is towards smart grids that connect

→ producers

→ consumers

→ storage facilities, and

→ network structures

Decentralised supply is the future
-characteristics-

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→ **Flexibility** to adjust production to consumption of energy (more dynamic)

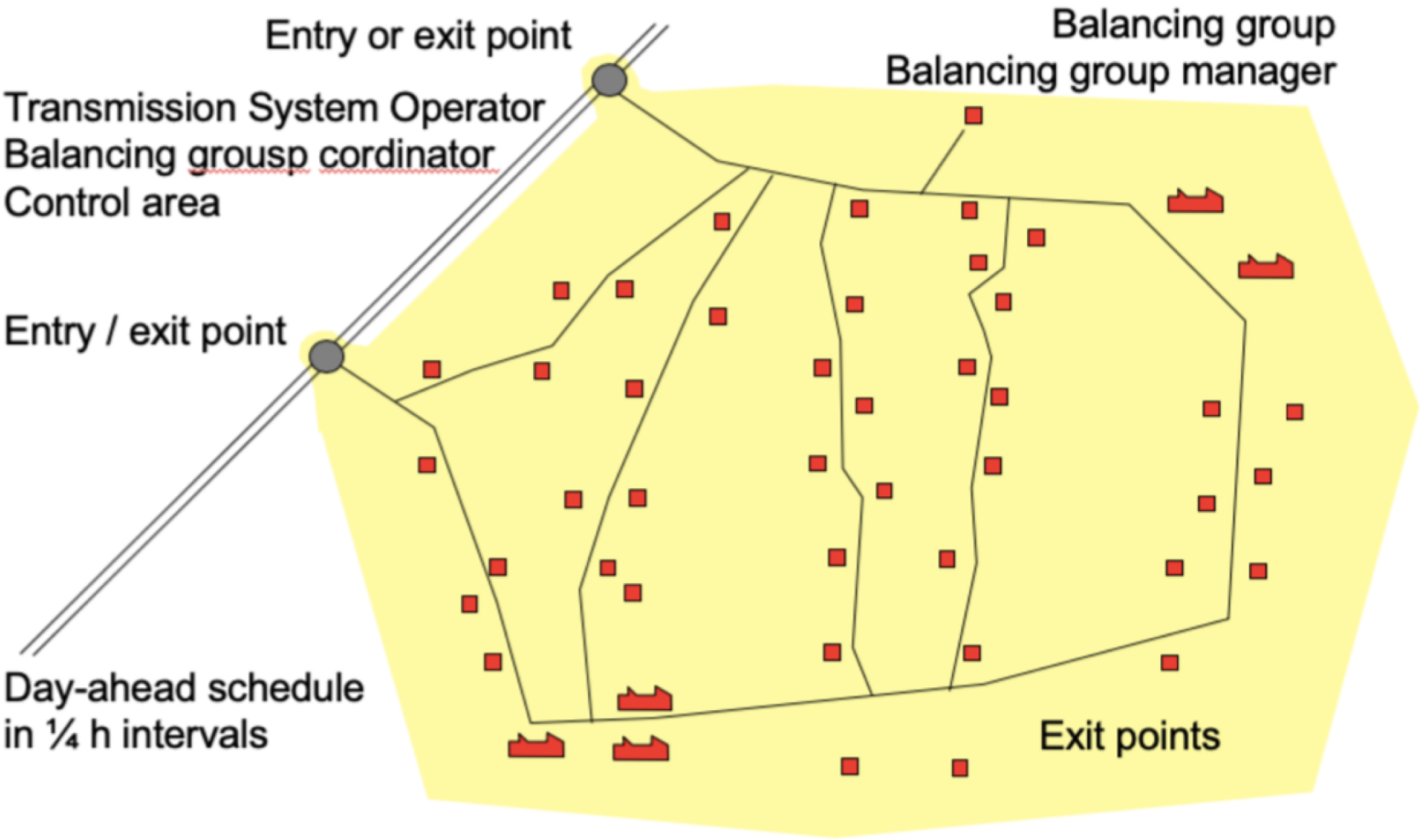
→ **Local production**, closer to consumption, potential to use excess heat (higher efficiency)

→ **Higher number** of energy systems reduce risk of outages

→ **Mass market** for energy systems and reduced costs (economies of scale)

Decentralised supply is the future

-balancing groups-



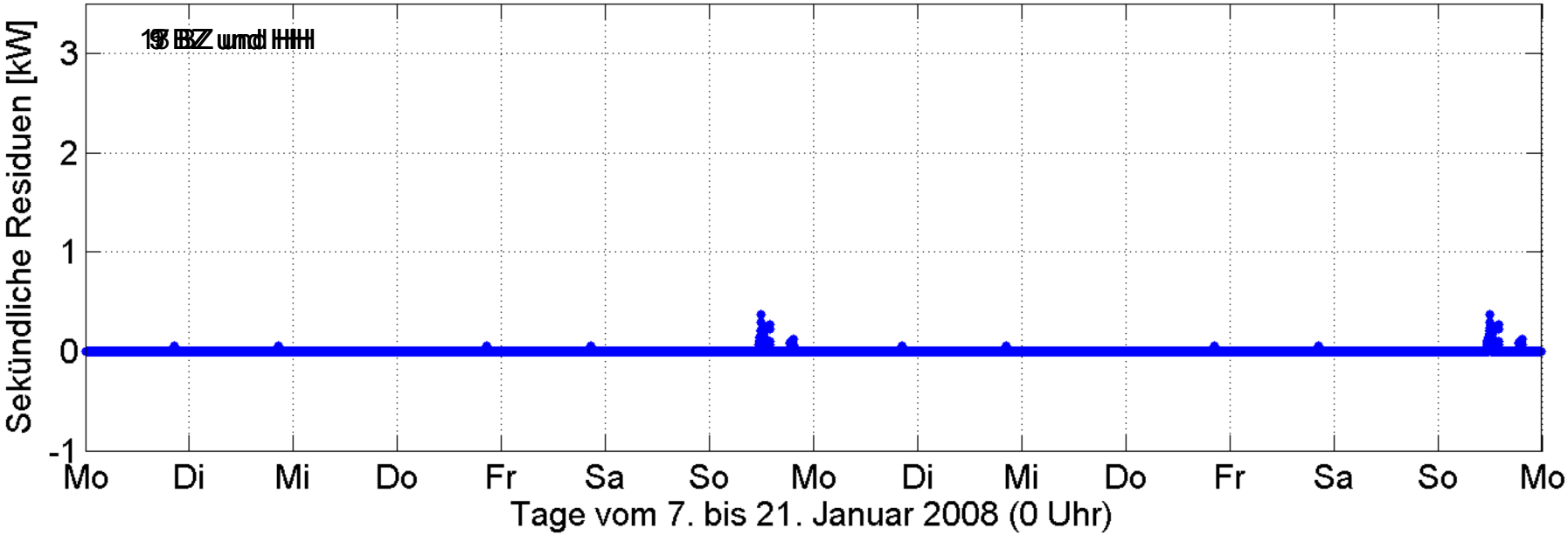
Decentralised supply is the future

-real world insights / fuel cells for energy production-

What can a small energy production system in a household do (alone / together with many)?

→ Blue dot below the line – when there is too much electricity produced for the household

→ Blue dot above the line – when there is too little electricity produced for the household



Wrap up

The energy transition has two pillars

→ More energy generation from renewable energies

→ Higher energy efficiency at the point where energy is consumed

But remember

→ More renewable energy production in the electricity sector alone won't do it

(it's called energy transition, not electricity transition!)

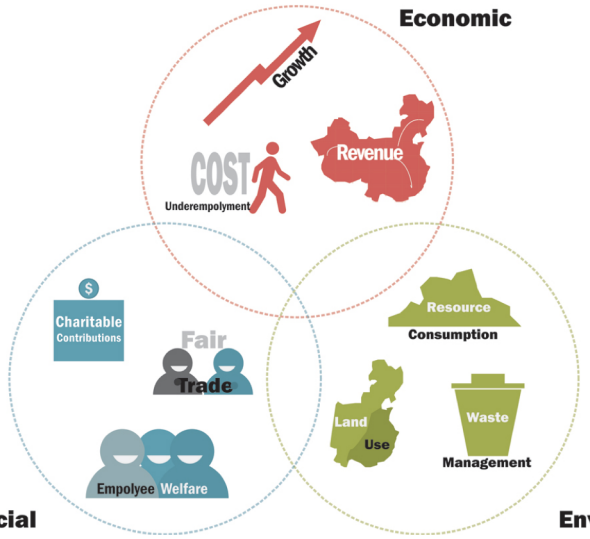
→ Mobility, warmth, industry to be included as well (Power-to-X)

Decentralized energy systems

→ Cost effective

→ Efficiency (local production/usage of byproducts)

→ Environmental friendly technologies



Next class is on Wednesday

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Time: 14 – 16 h

→ Work on “energy balances”