GTAI GERMANY TRADE & INVEST

ENERGIEWENDE GOES DIGITAL AND EFFICIENCY FIRST

CLEANTECH CAPITAL DAY, OSLO, APRIL 3, 2017

Flérida Regueira Cortizo
Senior Manager Environmental Technologies
Germany Trade & Invest

Who we are

Foreign trade and inward investment agency
of the Federal Republic of Germany

GTAI GERMANY TRADE & INVEST

Shareholder

Federal Ministry
for Economic Affairs
and Energy

Agenda

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1. Market Highlights
2. Promising Business Opportunities

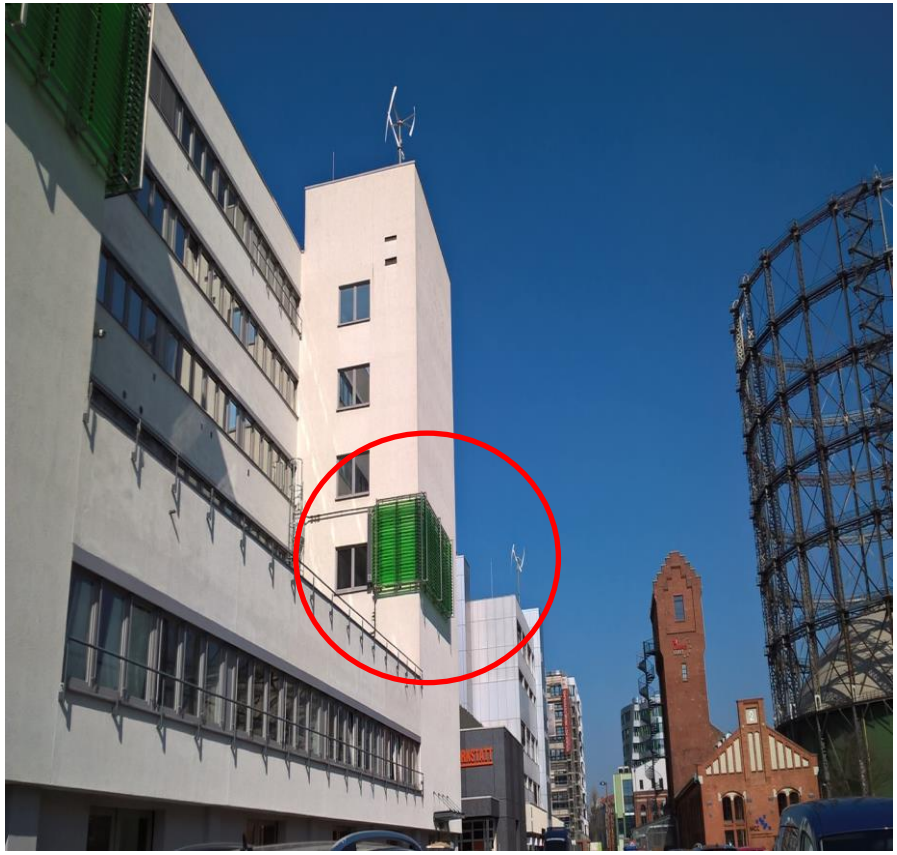
Invented in Germany!

Microalgae Integration MINT

Closing energy cycles

The photobioreactor can parallel function as a thermal solar energy system. As hybrid operation it can be used both for extracting biomass as well as generating heat.

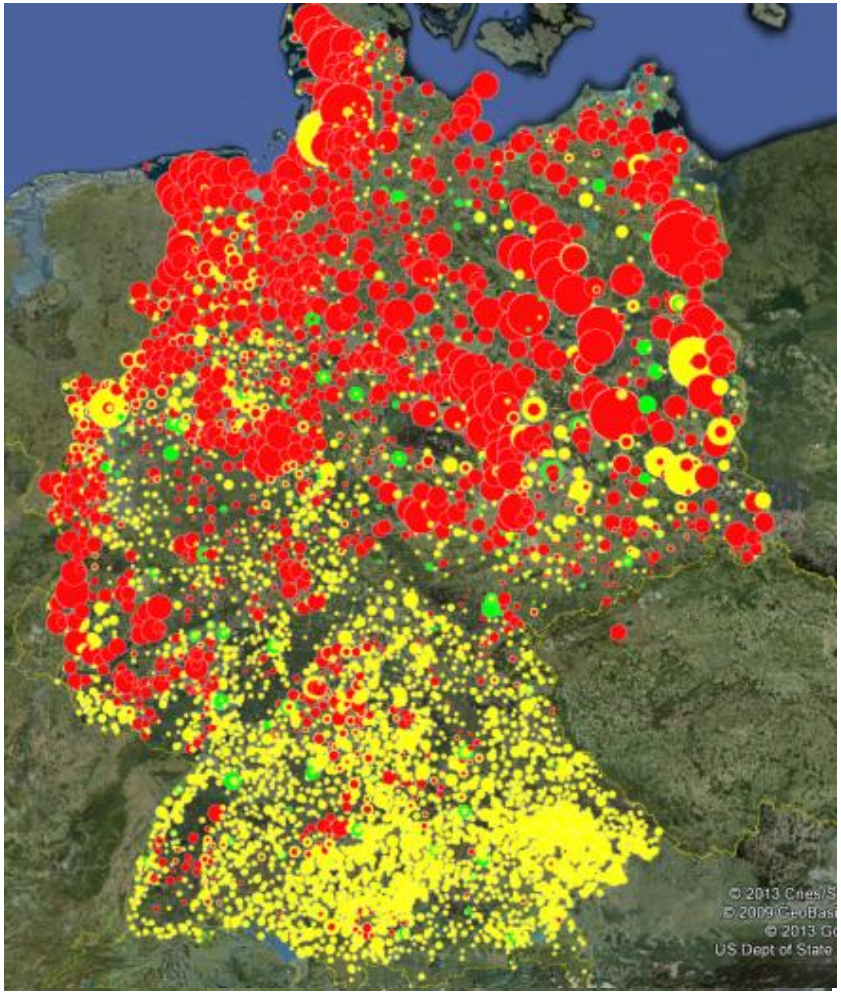
1. Saving and using thermal solar energy inside the house (p.e. for heating or hot water)
2. The algae medium acts as heat transfer media
3. Favouring the bio-process by preventing overheating
4. Possibility of using cryophilic algae in winter



Source: MINT Engineering GmbH / CEO Gunnar Mühlstädt

Development of Renewable Energy Systems

Feed-in-Tariff causes dynamic growth



Total capacity of renewables (End 2015)

> 1.600.000 installations

Wind energy

PV

Biomass

The circle **diameter** is proportional to the electrical capacity

Sources: 50HertzT, TenneT, Amprion, TransnetBW, internal data

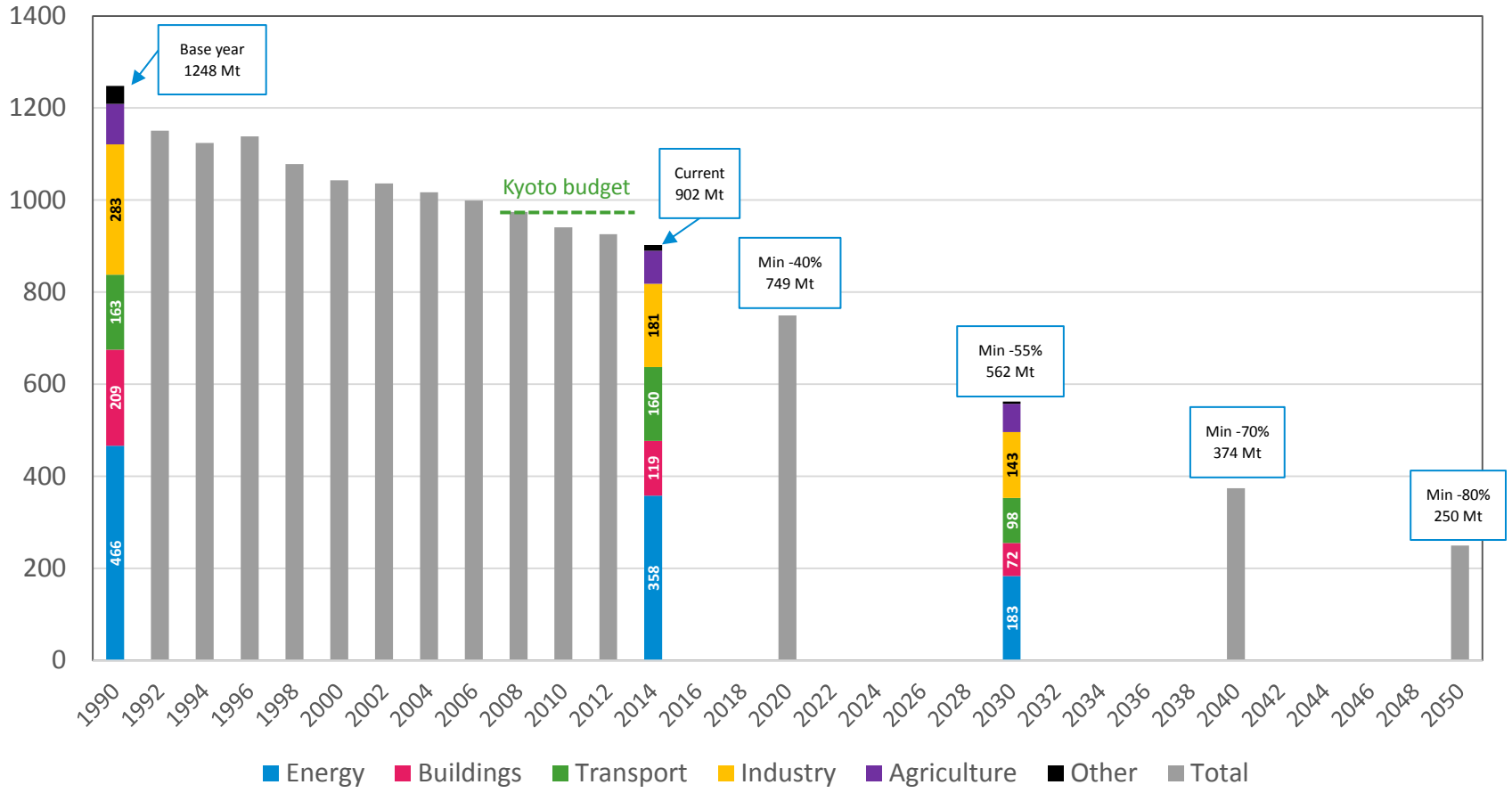
German Energy Concept (2010)

Main Objectives

Climate protection measures	2020	2050
GHG cuts vs. 1990	-40%	-80%
Renewable share of...	**2020 (2025)**	**2050**
Total energy consumption	18%	60%
Electricity consumption	35% (40-45%)	80%
Heat generation	14%	60%
Energy efficiency measures		
Increase in energy productiveness		2.1% p.a.
Reduction of energy consumption		-50% (2050 vs. 2008)
Reduction of electricity consumption		-25% (2050 vs. 2008)
Renovation rate		2% p.a.
Reduction of energy consumption for transportation		-10% (2020 vs. 2005) -40% (2050 vs. 2005)

GHG emission reduction targets in Germany

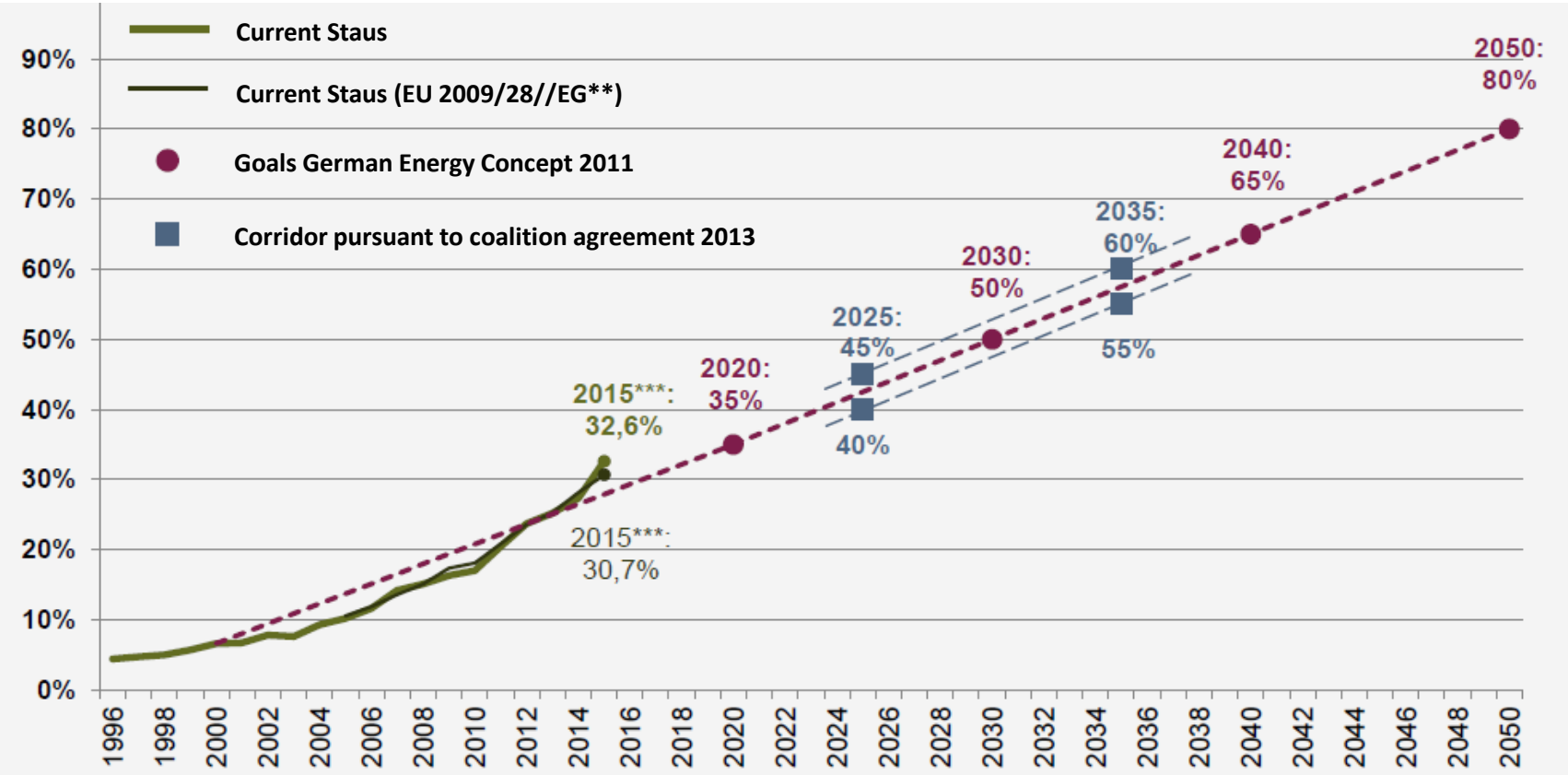
In million tonnes (Mt) CO2 equivalent



2020, 2040, 2050: "Energiekonzept 2010"; 2030: "Klimaschutzplan 2050". Other values: Federal Environment Agency, 2016. Values shown are top end of target ranges: e.g. 2030 target for energy is 175-183 Mt; 2050 target range is 80-95% reduction. GTAI accepts no liability for the actuality, accuracy, or completeness of the information provided.

Goals of Renewable Consumption

Developments on Target

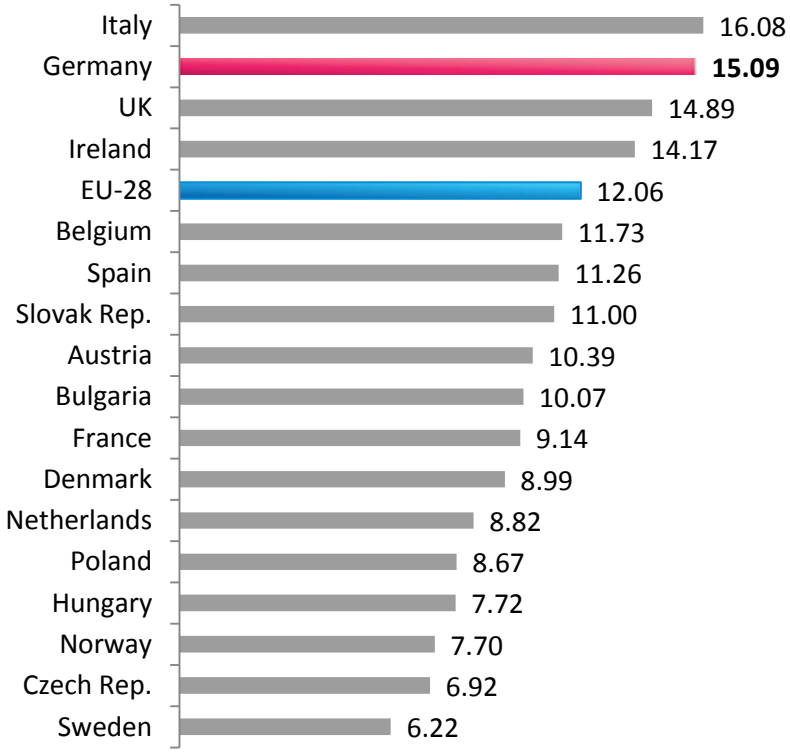


Source: BDEW 2016

Industrial Electricity Prices

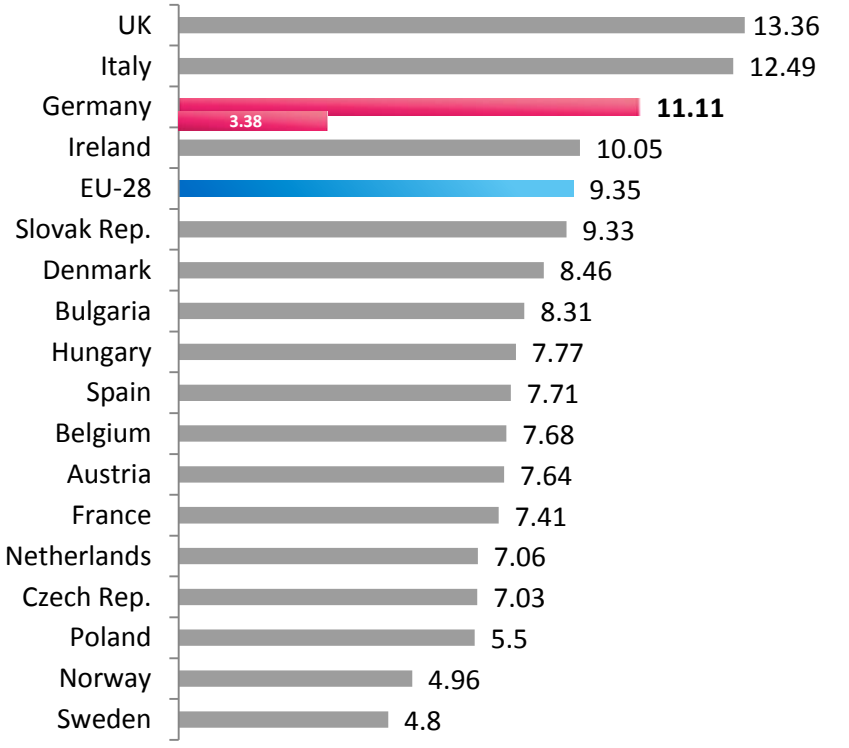
Industrial Consumer Costs in Germany among the Highest and Lowest in EU

Average annual industrial electricity prices with a consumption of 500-2,000 MWh[1]



Note: [1]2016 (first half), including taxes except VAT. All data in EUR-cent per kilowatt hour. Source: Eurostat 2017

Average annual industrial electricity prices with a consumption of 20,000-70,000 MWh[1]

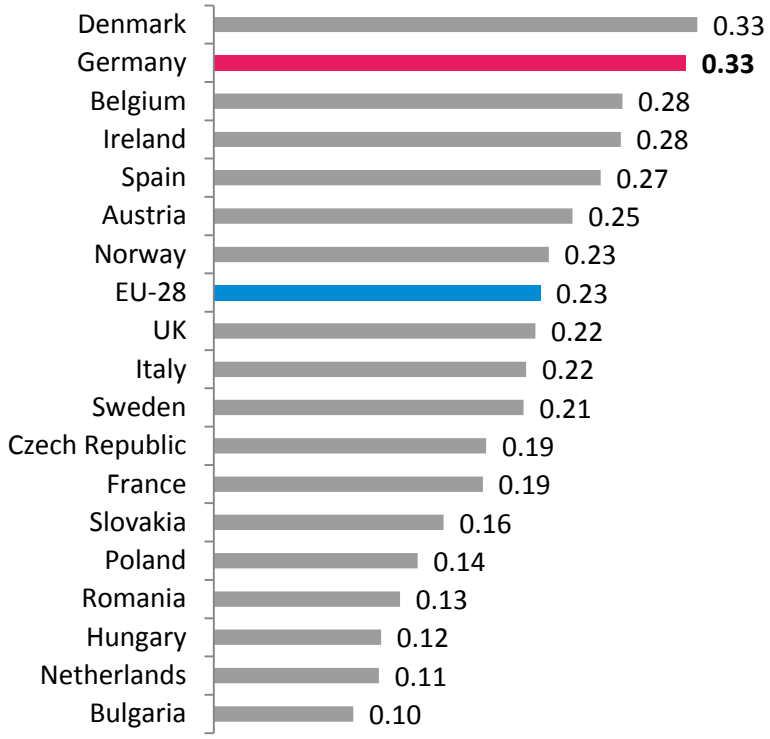


Note: [1]2016 (first half), including taxes except VAT. All data in EUR-cent per kilowatt hour. Source: Eurostat 2016

Electricity Prices for Private Households

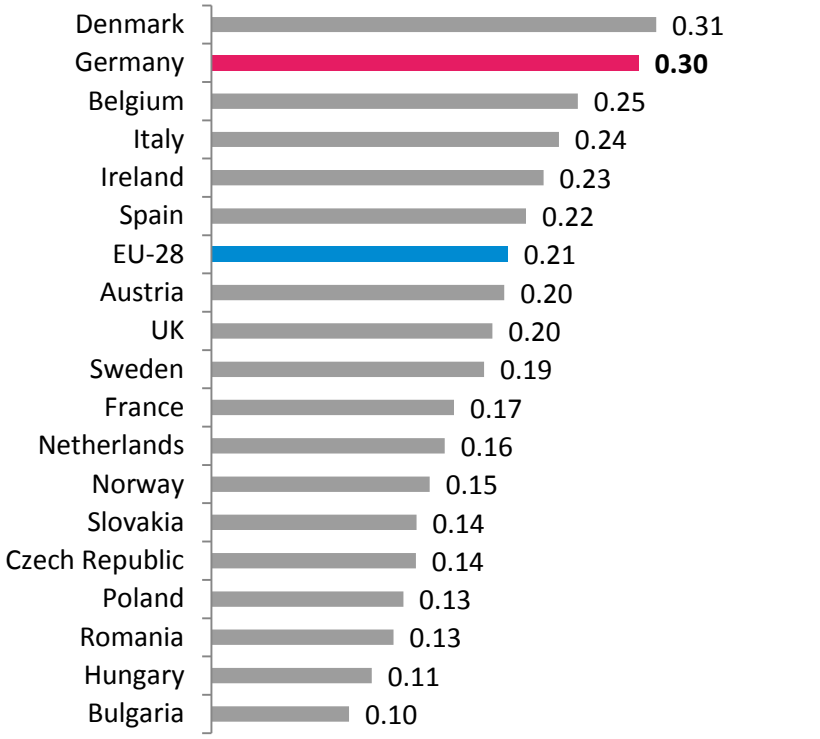
High Cost Leads to Energy Efficiency Consumer Demand and Own Consumption

Avg. annual electricity prices for private households with a consumption of 1,000-2,500 kWh[1]



Note: [1]2016 (first half), including all taxes. All data in EUR-cent per kilowatt hour.
Source: Eurostat 2016

Avg. annual electricity prices for private households with a consumption of 2,500-5,000 kWh[1]

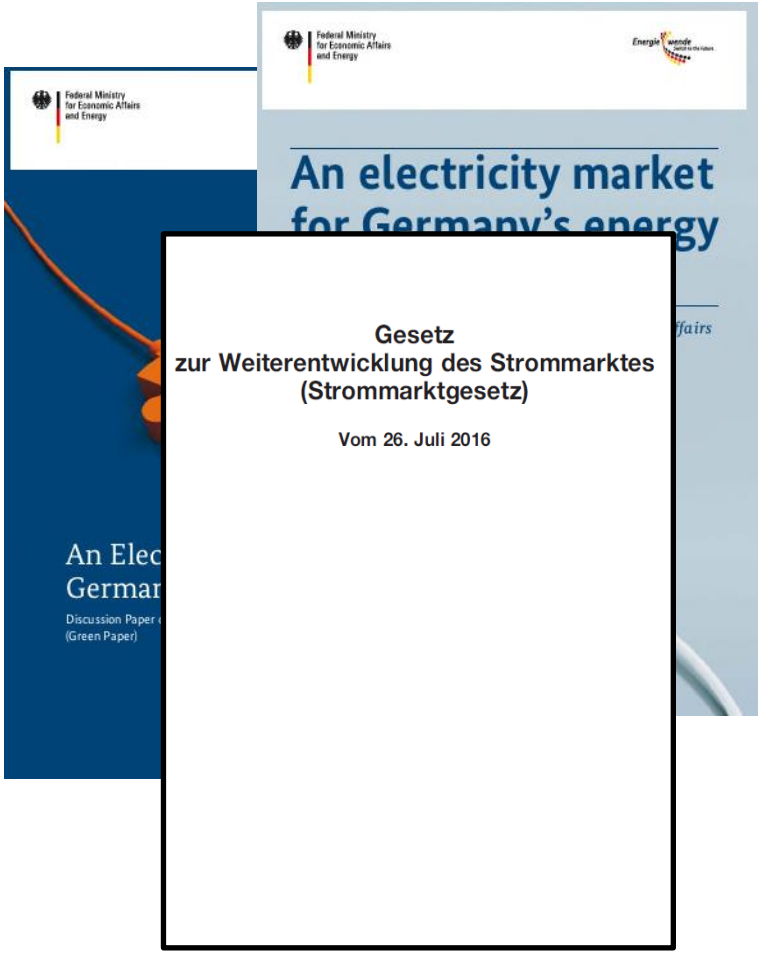


Note: [1]2016 (first half), including all taxes. All data in EUR-cent per kilowatt hour.
Source: Eurostat 2016

Codification of Electricity Market Act

White Paper Issues due for Legislation, which Aim at Integrating Additional Renewable Energy Capacity

- Open up balancing markets for new providers
- Strengthen obligations to uphold balancing group commitments
- Guarantee free price formation
- Capacity reserve
- From 2021 up to 2 GW new and flexible power plants for South Germany
- Alternative use of renewable energy power ("Power-to-X"-technologies)



Source: BMWi Sophie Müller-Godeffroy / IIIB1 General Issues of Electricity and Security of Supply

Smart Meter Roll-Out

Smart Metering Systems to be rolled out in Germany from 2017

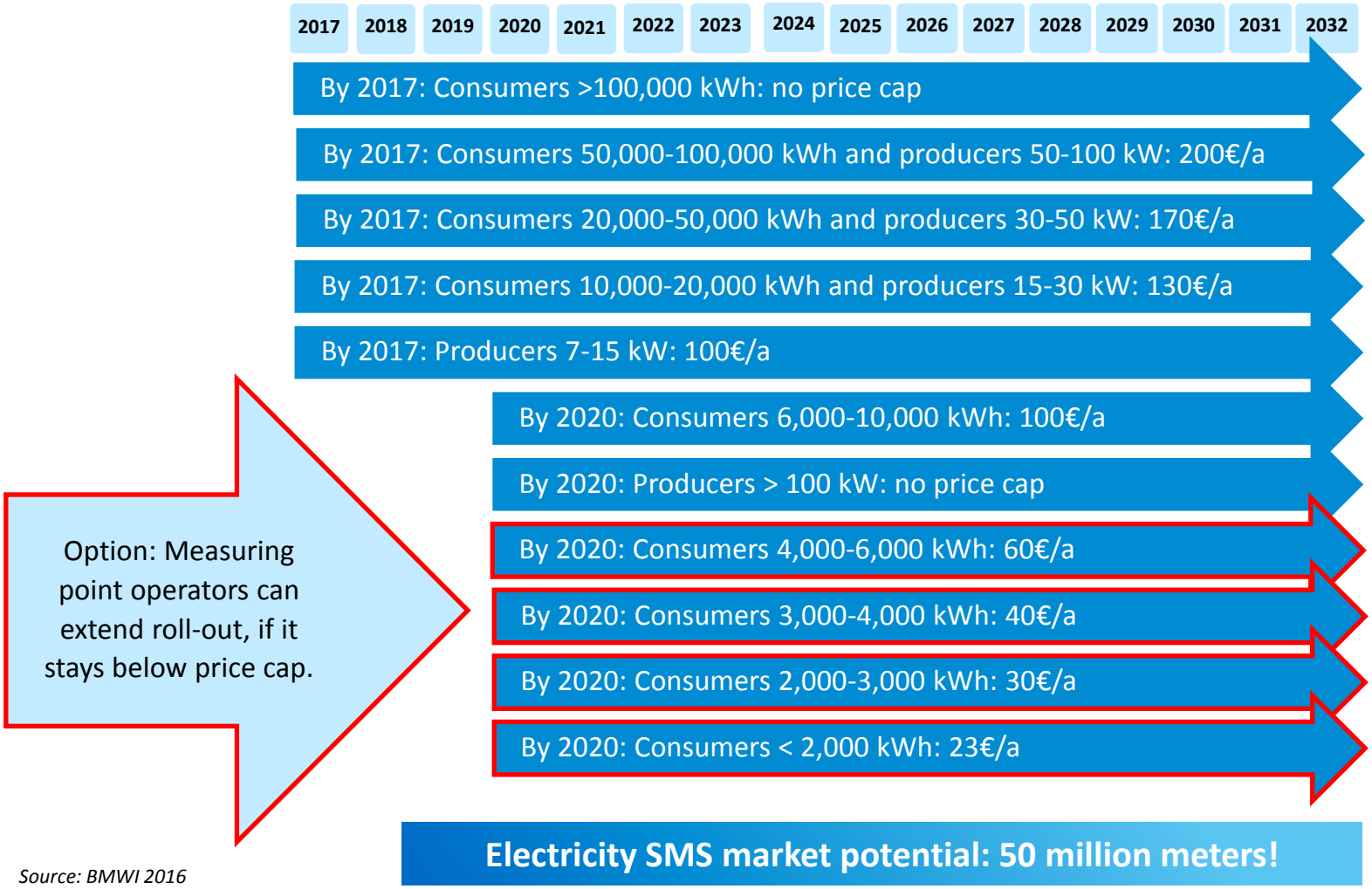
Source: Landis + Gyr

New draft law "Digitizing the Energy Transition":

- Smart Metering System (SMS) = Electronic Meter + Secure Communication Gateway
- Electronic meters new standard in 16-year meter replacement cycle for all users
- Mandatory roll-out of full SMS starts 2017 with large users > 10,000 kWh/a and producers with installed capacity between 7 and 100 kW
- From 2020 possibility to require other consumers and producers to install SMS
- Price ceilings apply when equipment is installed
- SMS can always be fitted on a voluntary basis

Smart Meter Roll-Out

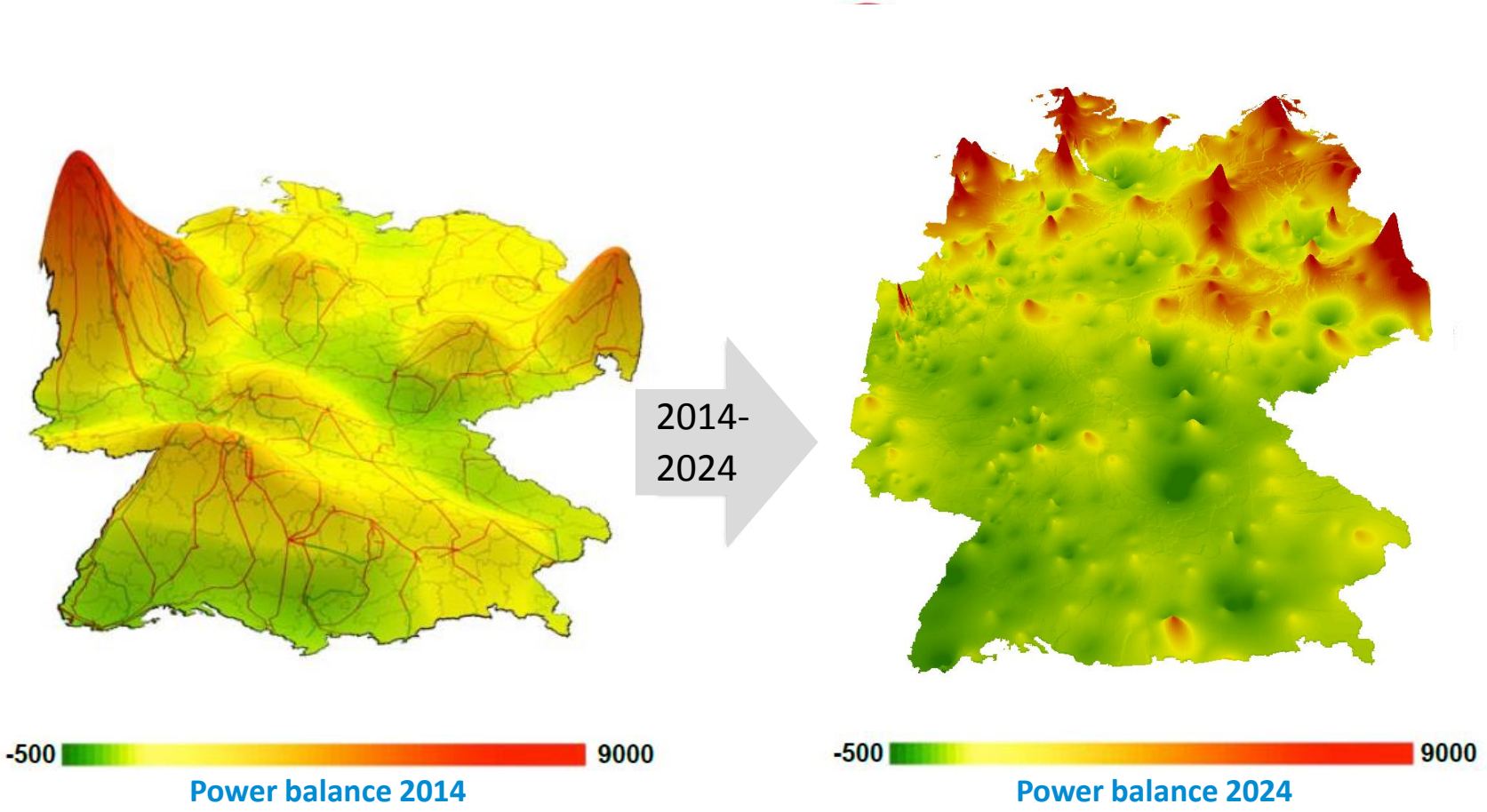
Systems to be required first for Energy Producers and large Energy Users



Source: BMWI 2016

The Smart Grid Market Overview

New power structures will lead to bottle necks in Germany as the new generation centers will be far from load centers.



Source: Bundesnetzagentur 2016

Expansion of the electricity grid in Germany

An enormous expansion of the high voltage grid system is required by 2024

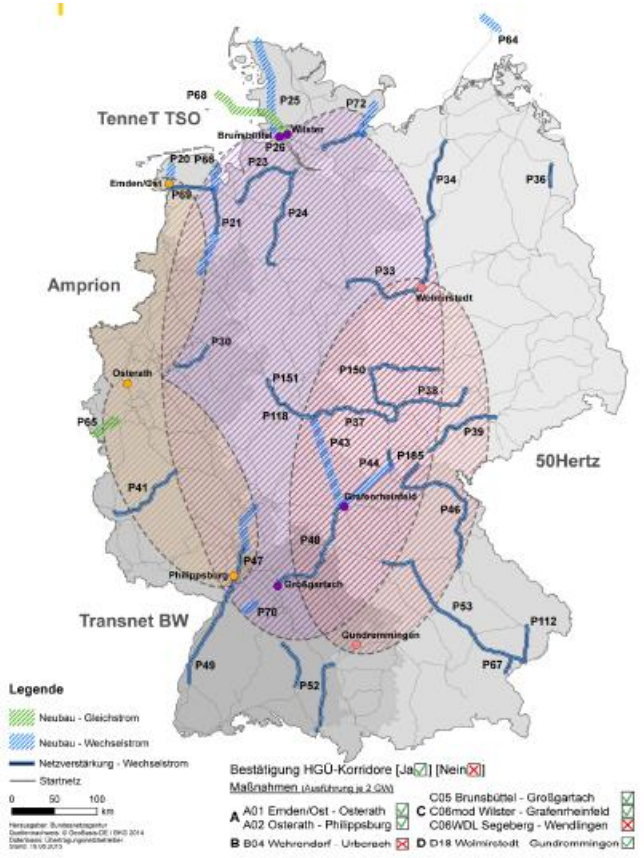
Grid Expansion	Distance in Km.
AC-New Construction	648
DC-Corridor	1,750
DC-New Interconnections	350
AC- Grid Reinforcement	2,750
AC-DC Convertor	300
Total	**5,798**

Expansion and Reinforcement

Transmission grid

Baseline scenario with overhead lines requires: **22 bn €**

Additionally the connection of the offshore-grid is estimated to **10-12 bn €**

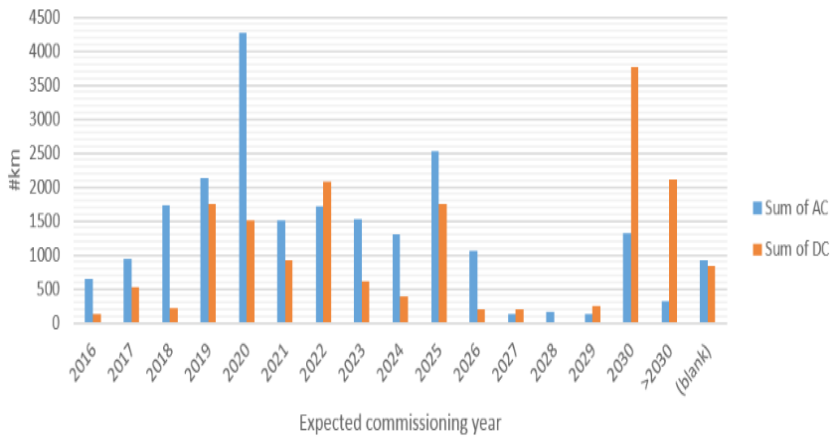


Note: Data is based on the German Network Development Plan B2024 Szenario Fossil: 84.9 GW Renewable 138.6 GW / Offshore transmission capacity 2x900 plus 1x500MW. The plan is re-evaluated and updated every two years, next update in 2017. Source: BNetzA 2015

European Grid Extension projects

Ten-Year Network Development Plan 2016

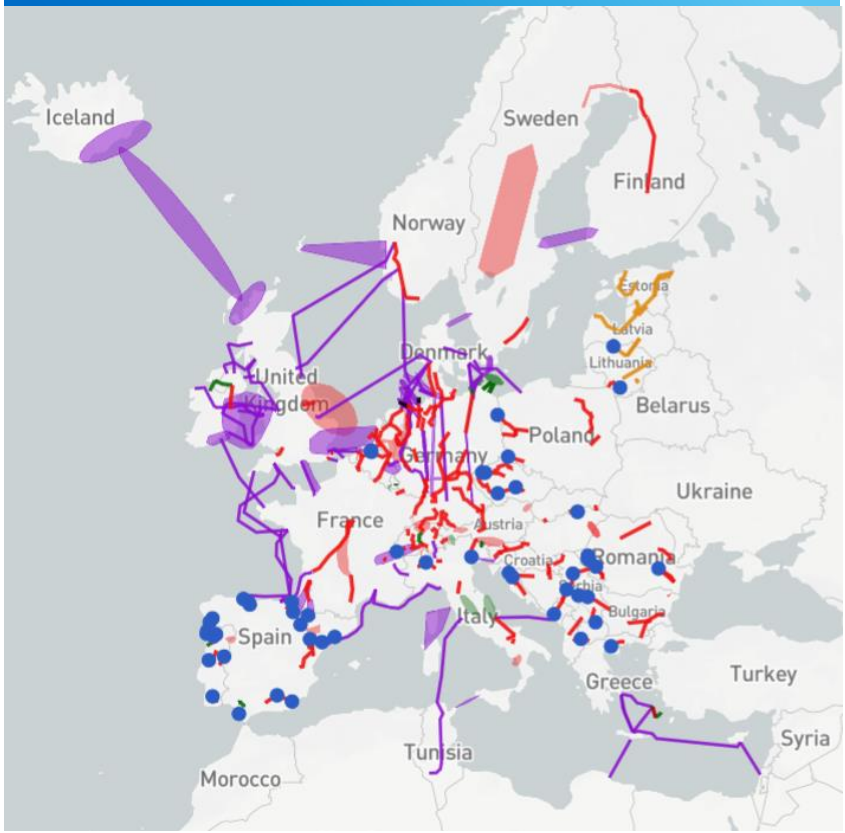
TYNDP 2016 investment portfolio – breakdown per year of commissioning



- € 150 billion grid expansion proposed by the TYNDP 2016
- Enhanced market integration will reduce bulk power prices by 1.5 to 5 €/MWh

Source: TYNDP 2016 Ten-year network development plan ENTSO-E

Pan-European Significance investments – mid- and long-term horizon



Source: ENTSO-E 2016

The Electricity Market Act ("Strommarktgesetz")

German Government has paved the Way to Efficiently use Surplus Renewable Energy Instead of Disconnecting

What is the purpose of the change in legislation?

- A large amount of renewable energy power is lost due to curtailment
- The new legislation enables system operators to purchase the surplus energy
- The purchasing price will be considerably lower than usual electricity prices because consumers will not have to pay any levies, taxes or even costs for generation and distribution

How will it work?

- Online tendering platform with monthly calls of tenders for loads of up to 3,000 MW in total
- Other conditions:
  - Minimum load of 10 MW
  - Remuneration < cost of supply disruptions
- Initially, only existing power-to-heat systems will be able to participate in the tendering procedure

Source: Electricity Market Act (Passed on 26 July 2016), Federal Ministry for Economic Affairs and Energy 2016.

SINTEG – New Smart Energy Program

EUR 600* Million for 5 showcase regions from 2016 to 2020

1. **C/sells:** interconnected, regional energy systems with cellular structure and focus on PV integration that balance each other
2. **Designnetz:** decentralized renewable power supplied flexibly to urban and industrial load centers
3. **Enera:** Stabilizing the grid by improved measurement and data analysis coupled with new market mechanisms
4. **NEW 4.0:** Maximizing the efficient use of regional wind power overproduction by flexible demand response and inter-regional trade in electricity
5. **WindNODE:** Sectors electricity, heat, and mobility are integrated to flexibly accomo-date fluctuating regional wind power

Source: BMWi, 2016 **Including EUR 230 million state support*

Kopernikus Research Projects

Cutting-edge research on technological solutions for the transition of the German energy system

"ENSURE"

The project aims to identify an efficient structure of the energy grid by integrating new technologies and combining centralized and decentralized energy supply to an integrated system.

"SynErgie"

Customization of traditional production processes in energy-intensive industries to synchronize the energy demand with the volatile supply by renewable energies.

2016-2025:
230 partners
400 million EUR
state funding

"P2X"

Development of innovative solutions for "Power-to-X"-technologies to efficiently store, distribute and convert renewable energies to gas, heat or chemicals.

"ENavi"

Development of a navigation instrument to assess the short- and long-term impact of economic and political measures on the energy system.

Source: Federal Ministry for Education and Research 2016.

Why companies choose Germany: enersis suisse

GTAI-supported energy software company enersis wants to “make a substantial contribution to the ‘Energiewende’“

Dr. Christina Wuerthner, Chief Finance & Strategy Officer, enersis europe GmbH

“The German capital region is strategically well located to conquer the energy market in all of Europe […]. The **market potential**, the **support of GTAI** and the Brandenburg Economic Development Board, the **proximity to important political decisions** in Berlin, **space to grow** and the access to **highly-skilled labor** locally, as well as from all over Europe, eventually all counted for our decision.”

Investment > EUR 5 m in 5 years

USP: State-of-the-art Big Data management & easy to use graphical user interface

100-150 employees by 2020/21

2004 Foundation of enersis GmbH

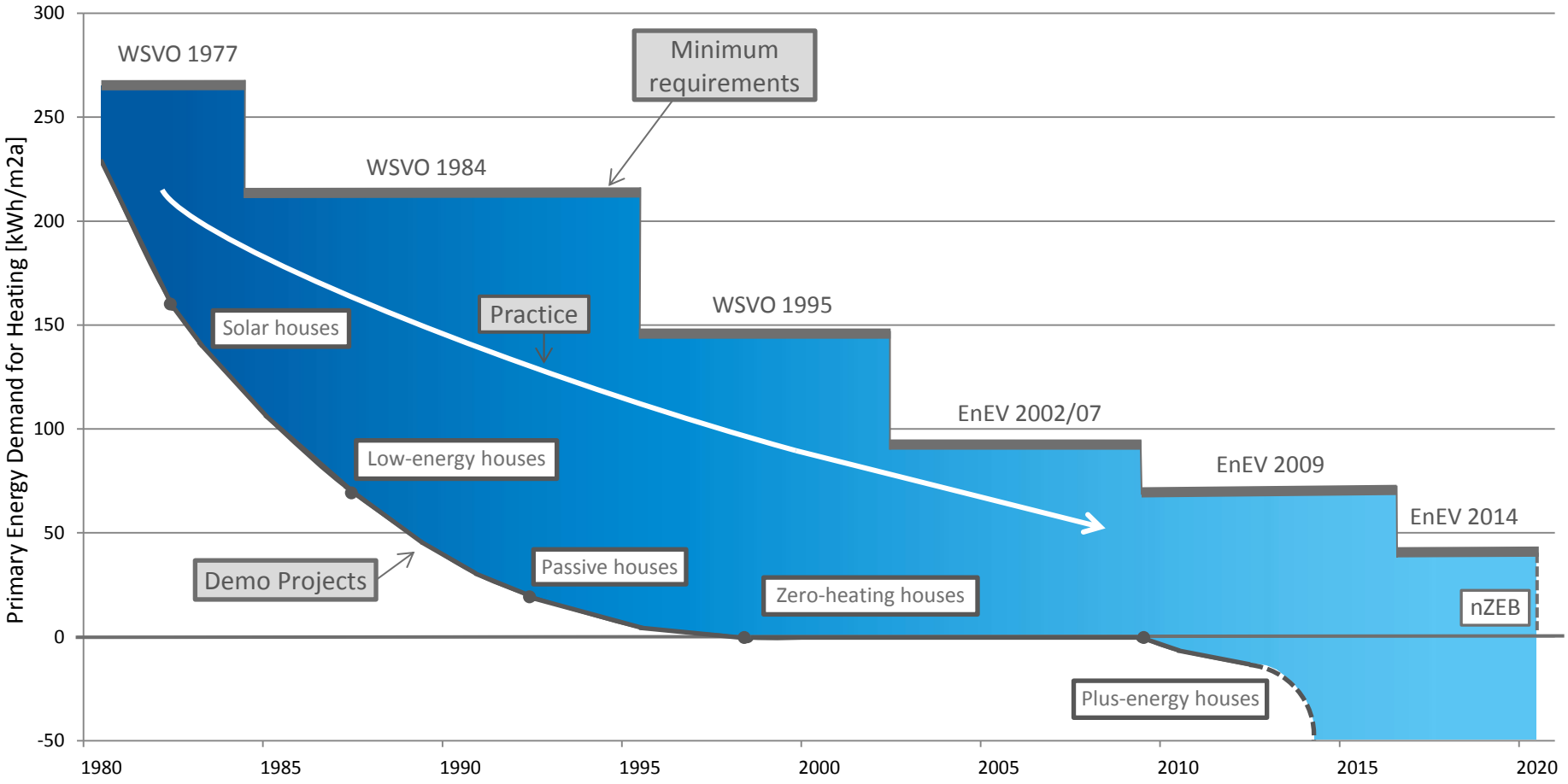
2009 Foundation of enersis suisse AG & business transfer to CH

2011 Start of Big Data software development for utilities

2015 Growth financing for software business & establishment of enersis europe GmbH in Kleinmachnow, Brandenburg

History of energy-efficient building in Germany

Integrated approach of R&D, incentives, and standards

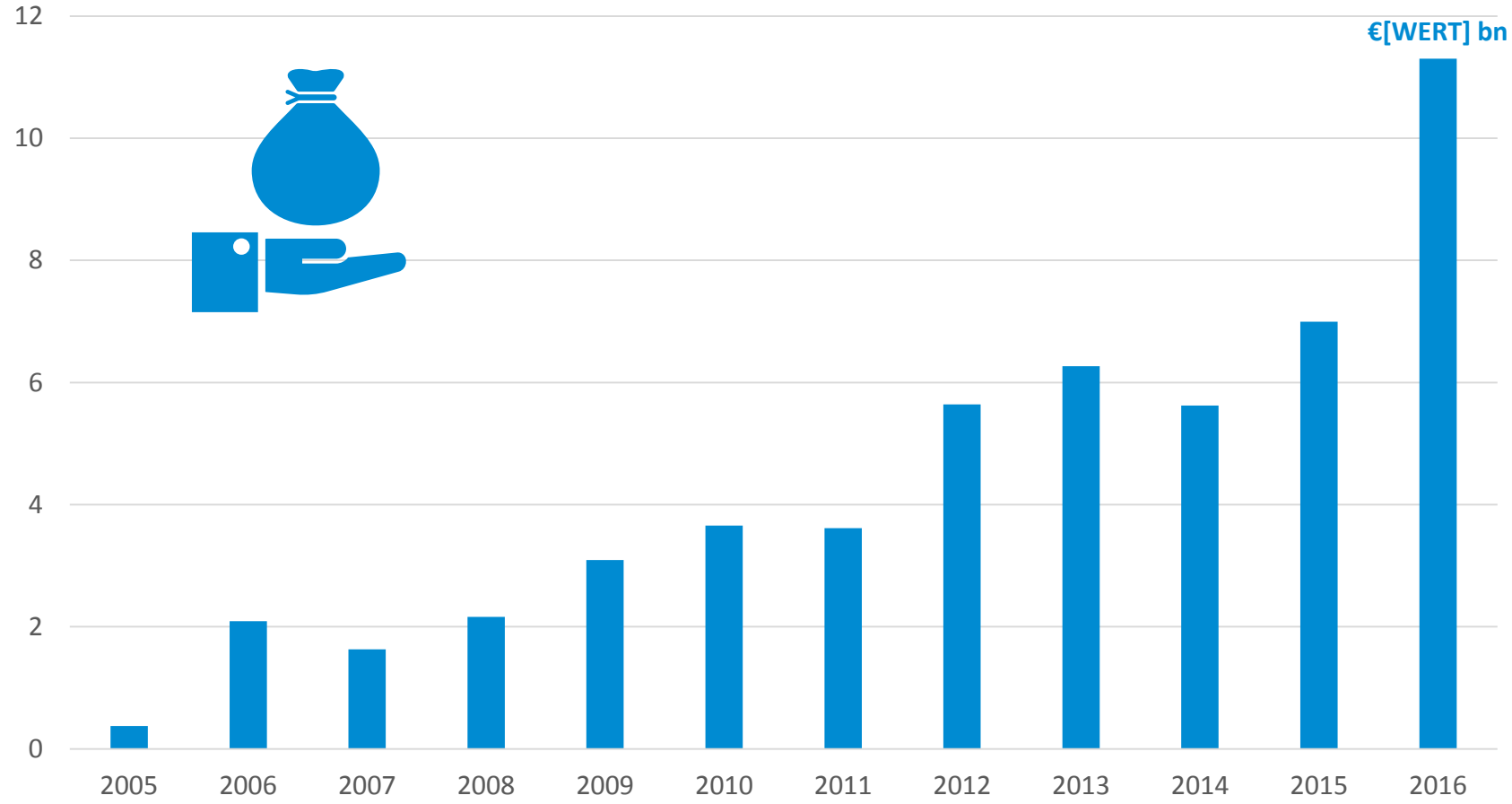


Source: Based on data from Fraunhofer IBP

Generous incentives

Commitments under KfW “Energy-Efficient Construction Programme”

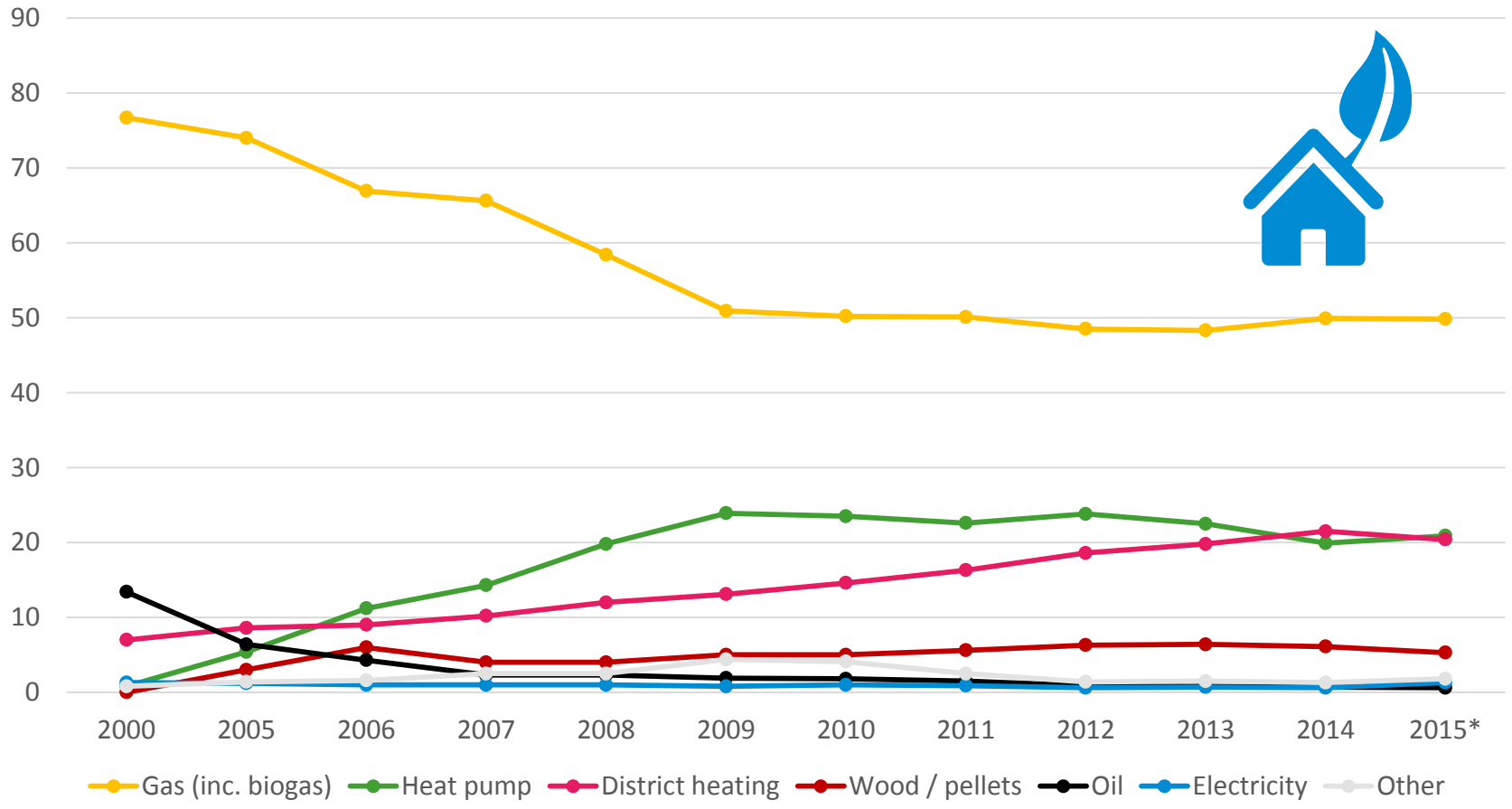
In EUR bn



Source: KfW - Geschäftsbericht 2015, May 2016; 2016 KfW press release, February 2017

Heating systems in new residential buildings

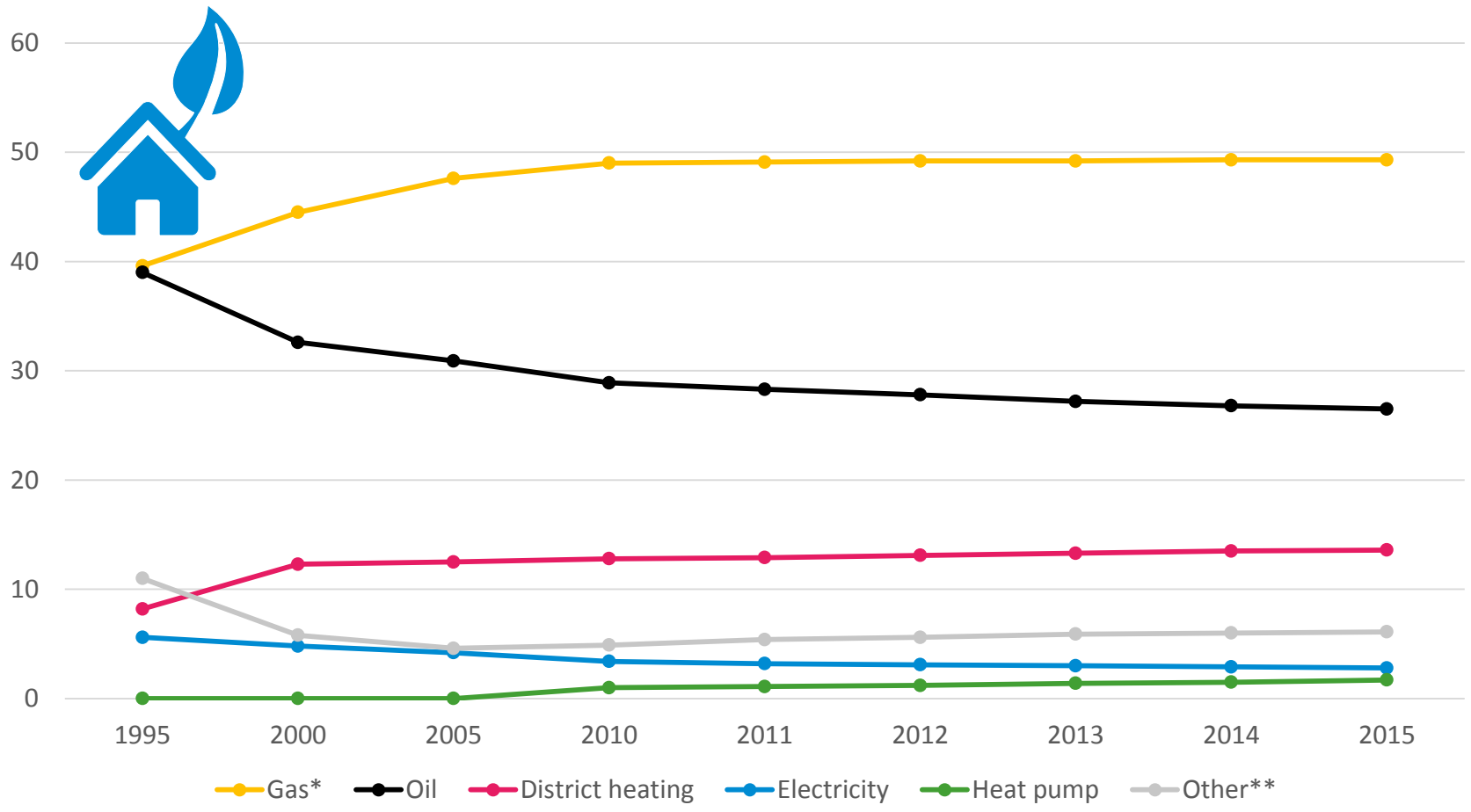
Half of all residential buildings are heated with gas



Source: BDEW, 2016

Heating systems in the German housing stock

Half of all residential buildings are heated with gas



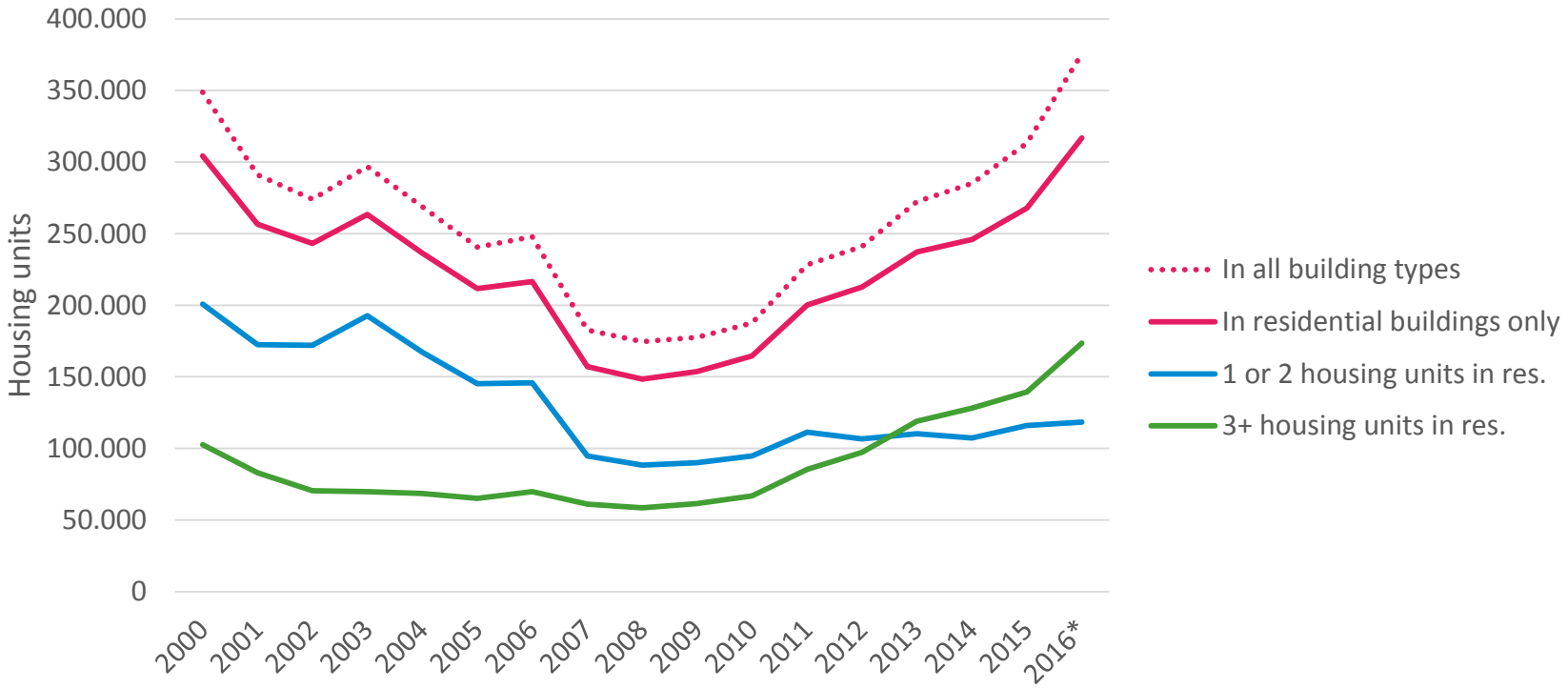
Source: BDEW, 2016

Residential new-build construction permits

There is a clear trend towards building apartment blocks in Germany

Construction permits granted annually for new residential housing units in Germany

2000 – 2016



Source: Federal Statistical Office, March 2017

Contact Us

Germany Trade & Invest is the economic development agency of the Federal Republic of Germany. The company helps create and secure extra employment opportunities, strengthening Germany as a business location. With more than 50 offices in Germany and abroad and its network of partners throughout the world, Germany Trade & Invest supports German companies setting up in foreign markets, promotes Germany as a business location and assists foreign companies setting up in Germany.

Contact
Flérida Regueira Cortizo
T +49 (0)30 200 099-230
www.gtai.com
Flerida.regueira@gtai.com

Berlin
Friedrichstraße 60
10117 Berlin

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