



**Sino-German  
Urbanisation  
Partnership**

**giz** Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH

On behalf of:



Federal Ministry  
for the Environment, Nature Conservation  
and Nuclear Safety

of the Federal Republic of Germany

# ENERGY EFFICIENCY OF BUILDINGS & DISTRICTS IN URBAN RENEWAL

KEYSTONE PAPER 2



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This document is part of five keystone papers looking at current emerging topics in the building and city sector, focusing on energy efficiency and resilience. The keystone papers were developed within the framework of the Sino-German Urbanisation Partnership as a basis for the forthcoming working period and cover following topics:



01

Plus Energy Buildings  
and Districts



02

Energy Efficiency  
of Buildings and  
Districts in Urban  
Renewal



03

Transformative  
City



04

Climate Risk  
Management  
in Cities



05

Urban Renewal  
in Districts

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## ABBREVIATIONS

BMU	Federal Ministry of the Environment, Nature Conservation and Nuclear Safety
BMWi	Federal Ministry for Economic Affairs and Energy
CHP plants	Combined heat and power plants
COHERENO	Collaboration for Housing nearly zero-energy renovation
DGNB	German Sustainable Building Council (Deutsche Gesellschaft für Nachhaltiges Bauen)
EEG	Renewable Energy Act (Erneuerbare Energien Gesetz)
EEWärmeG	Renewable Energies Heat Act (Erneuerbare-Energien-Wärmegesetz)
ELENA	European Local Energy Assistance
EnEG	Energy Savings Act (Energieeinsparungsgesetz)
EnEV	Energy Saving Ordinance (Energieeinsparverordnung)
EPBD 2010	European Energy Performance of Buildings Directive 2010
ERDF	European Regional Development Fund
ESG	Strategy on Energy Efficiency in Buildings
EU	European Union
GEG	Energy Building Law (Gebäudeenergiegesetz)
GHG	greenhouse gas
IBA	International Architecture Exhibition (Internationale Bauausstellung)
IKI	International Climate Initiative
KfW	Kreditanstalt für Wiederaufbau (Germany's government-owned development bank)
kWh	kilowatt-hour(s)
NAPE	National Action Plan on Energy Efficiency
NKI	National Climate Initiative
nZEB	nearly Zero Energy Building
PV	Photovoltaic
WSVO	Thermal Insulation Ordinance (Wärmeschutzverordnung)





## 0. EXECUTIVE SUMMARY

The German government aims to reduce total greenhouse-gas (GHG) emissions by 55% until 2030 compared to 1990, and to become extensively carbon neutral by 2050. The building sector is highlighted as one of the main focal areas to achieve this ambitious goal, as outlined in Germany's Climate Action Plan 2050. It is responsible for around 30% of Germany's total GHG emissions and 40% of the final energy consumption. The Action Plan aims to reduce emissions by 40% until 2020 compared to the level of 1990, by to 67% until 2030 and to become extensively carbon-neutral by 2050.

Residential buildings account for around 63% of the total primary energy consumption of the sector. Around two thirds of them were constructed before introduction of the first regulation on energy performance in Germany, the Thermal Insulation Ordinance (WSVO) of 1977, thus established without any regard of legally binding frameworks for insulation and energy saving. To enhance energy performance of the building sector, besides implementing high standards for new constructions, especially deep refurbishments of buildings older than 40 years need to be taken into consideration. The current renovation rate of around 1% needs to be enhanced towards 2%, to achieve the goal of a carbon-free building sector until 2050.

Today's building energy codes in Germany date back to the oil crisis of the 1970s and the related increase of energy cost. With WSVO, thermal regulations concerning envelope, air permeability of windows and other building joints came into effect. WSVO was eventually replaced by the Energy Saving Ordinance (EnEV) in 2002. It introduced the combination of requirements for both construction and heating into one ordinance. It was revised several times, most importantly in 2014, when requirements of the EU Directive on the Energy Performance of Buildings 2010 (EPBD 2010) were included, considering the need for action to stabilise the global climate. Other regulations complementing EnEV are the Energy Savings Act (EnEG), and the Renewable Energies Heat Act (EEWärmeG).

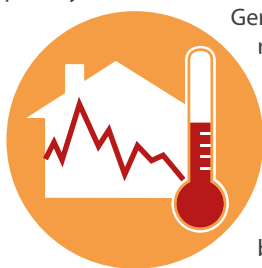
Several subsidy programmes for GHG mitigation by reducing energy demand in the building sector exist in Germany. The most important regarding the building sector are issued by

Kreditanstalt für Wiederaufbau (KfW), the government-owned development bank. KfW offers grants and low-interest loans for energy-efficient new constructions and improvement of thermal performance of existing individual buildings or neighbourhoods. Through economies of scale, extensive refurbishment of a large number of individual buildings at the same time can reduce overall cost while providing potentially large energy and emission savings.

With the potential for energy savings regarding heat losses through insulation of building envelopes largely being exhausted, most savings in new buildings are thus possible through enhancing use of electricity and appliances. The utilisation of CO<sub>2</sub> emissions as key parameter in assessments of energy efficiency in buildings and introduction can further enhance ambitions of private developers to consider climate protective construction and refurbishments. Nonetheless, upon implementation of refurbishments, despite the decrease of operating cost, transfers on base rents need to be taken account, with more than half of

Germany's households being tenants. For comprehensive reduction of emissions in the building sector, also the increase of living space, and accompanying rising energy demand per capita needs to be considered.

To achieve Germany's goals on the building sector, the regulatory framework both for new buildings and refurbishments of existing ones needs to be progressively updated and implemented. The residential building sector is responsible for the largest proportion of emissions. Here, especially the existing stock needs to be targeted and refurbished. This requires additional incentives for private building owners, such as increased counselling services, tax exemptions or additional subsidies. While Germany already has a strong regulatory framework for building energy efficiency, further enhancement of the standards towards nearly Zero Energy Buildings (nZEB) as required by EPBD 2010 would be necessary. The current debate on GEG, however, shows that economic interest strongly influences the process to enhance energy standards. Despite initial reduction of energy efficiency standards in buildings might seem attractive, over the long term, they result in shift towards increased cost for consumers of energy and impede achievement of climate goals in the sector.



# 1. SETTING THE SCENE

The building sector is one of the main focal areas for greenhouse gas (GHG) mitigation measures in Germany's Climate Action Plan for 2050. Currently, the building sector accounts for around 30% of the country's carbon emissions and approximately 40% of the total energy consumption. The target for Germany's building sector is to reduce emissions by 40% until 2020 compared to the level of 1990, by to 67% until 2030 and to become extensively carbon-neutral by 2050<sup>1</sup>. Thermal refurbishment of the existing building stock as well as setting high standards for new buildings therefore has a prominent role in reaching the country's climate targets.

## 1.1 GERMANY'S STRATEGY FOR ENERGY EFFICIENCY IN THE BUILDING SECTOR

Enhancement of energy performance of Germany's building stock focuses on two main strategies: first, the reduction of primary energy demand by enhanced energy efficiency, and second, the increase of the proportion of renewable energy in the total energy mix. Those aspects are also the core of Germany's path towards **energy transition/Energiewende**.

The efforts to increase energy efficiency are outlined in the Federal Government's National Action Plan on Energy Efficiency (NAPE). NAPE includes measures for private households as well as industry, business, trade and services. A large proportion of measures in NAPE targets the building sector, comprising actions in legislation, financial incentives, and information campaigns. NAPE suggests following crucial actions for implementation:

- Establishment of an innovative competitive tendering scheme for energy efficiency measures, using market mechanisms to increase cost-effectiveness of solutions in different sectors
- Increase available federal and subnational subsidies for thermal rehabilitation of both residential and non-residential buildings, and additionally implement fiscal incentives for property owners
- Establish stakeholder networks between public and private stakeholders from industry and business<sup>2</sup>

The Federal Government's Strategy on Energy Efficiency in Buildings (ESG) further specifies on Germany's approaches on climate and energy policy in the building sector. ESG targets both, existing and new buildings. By 2050, the strategy aims to reduce the primary energy demand of residential buildings to 40 kWh/m<sup>2</sup> per year, and energy demand of non-residential buildings to 52 kWh/m<sup>2</sup> per year.<sup>3</sup> To achieve those targets, building codes for new constructions are to be improved, measures and funding options to renovate the existing building stock to be implemented, and fossil heating systems to be progressively upgraded.

## 1.2 REFURBISHMENT OF GERMANY'S EXISTING BUILDING STOCK

In 2017, around 19 million residential and roughly 2.7 million non-residential (including offices, hotels and commercial) buildings existed in Germany. While the number of residential buildings exceeds the non-residential sector by far, due to the large floor area of many individual non-residential buildings, they still account for approximately 37% of the sector's total primary energy consumption. Concerning residential buildings, one- and two family homes are the predominant typology with 15.6 million units or 83% of the total stock. On average, they also account for the largest floor areas, and highest energy demand per square metre.<sup>4</sup>

The current stock of individual flats in Germany is at around 40.5 million. In 2017, around 245,000 new flats were constructed, accounting for about 0.6% of the total existing units.<sup>5</sup> While about two thirds of today's existing residential buildings were established before the adoption of Germany's first *Thermal Insulation Ordinance (WSVO)* in 1977, especially triggered through increased construction activity after World War II and strong economic growth in the 1950s, new constructions are required to comply with current energy standards, such as the *Energy Saving Ordinance (EnEV)*. Therefore, the largest proportion of today's existing housing units was constructed without any legally binding regulations for thermal insulation and energy savings. As a result, renovation of the existing stock built under consideration of outdated energy regulations or no regulations at all, plays a prominent role in achieving a carbon-free building sector. By

1 BMU (2016): Climate Action Plan 2050. Source: [https://www.bmu.de/fileadmin/Daten\\_BMU/Pool/Broschueren/klimaschutzplan\\_2050\\_en\\_bf.pdf](https://www.bmu.de/fileadmin/Daten_BMU/Pool/Broschueren/klimaschutzplan_2050_en_bf.pdf)

2 BMWi (2014): National Action Plan on Energy Efficiency (NAPE). Source: [https://www.bmwi.de/Redaktion/EN/Publikationen/nape-national-action-plan-on-energy-efficiency.pdf?\\_\\_blob=publicationFile&v=1](https://www.bmwi.de/Redaktion/EN/Publikationen/nape-national-action-plan-on-energy-efficiency.pdf?__blob=publicationFile&v=1)

3 BMWi (2015): Energieeffizienzstrategie Gebäude (ESG). Source: [https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/energieeffizienzstrategie-gebaeude.pdf?\\_\\_blob=publicationFile&v=25](https://www.bmwi.de/Redaktion/DE/Publikationen/Energie/energieeffizienzstrategie-gebaeude.pdf?__blob=publicationFile&v=25)

4 Deutsche Energie-Agentur (2018): dena-Gebäudereport Kompakt 2018. Berlin. Source: [https://shop.dena.de/fileadmin/denashop/media/Downloads\\_Dateien/bau/9254\\_Gebaeudereport\\_dena\\_kompakt\\_2018.pdf](https://shop.dena.de/fileadmin/denashop/media/Downloads_Dateien/bau/9254_Gebaeudereport_dena_kompakt_2018.pdf)

5 Statistisches Bundesamt (2018): Gebäude und Wohnungen. Bestand an Wohnungen und Wohngebäuden. Source: [https://www.destatis.de/DE/Publikationen/Thematisch/Bauen/Wohnsituation/FortschreibungWohnungsbestandPDF\\_5312301.pdf?\\_\\_blob=publicationFile](https://www.destatis.de/DE/Publikationen/Thematisch/Bauen/Wohnsituation/FortschreibungWohnungsbestandPDF_5312301.pdf?__blob=publicationFile)

major refurbishments, energy consumption of existing buildings can be reduced significantly, comparably to new buildings compliant with the current regulations.

While a number of noteworthy incentives in form of subsidy schemes for refurbishment of buildings exist in Germany, the **current renovation rate of around 1%** (for residential buildings) is considered as too low to achieve the goal of a climate-neutral building stock by 2050. At the current rate, it would take about a

century to rehabilitate. Moreover, in many cases, refurbishments do not harness the full potential regarding enhancement of energy performance. Therefore, **to enhance energy efficiency of the residential stock in Germany towards the desired extent, the current refurbishment rate needs to double to 2%**. To increase the rate, implementation of additional incentive systems, as well as further ambitions for target-oriented, accessible subsidy programmes are required.<sup>6</sup>

## Mio. Buildings

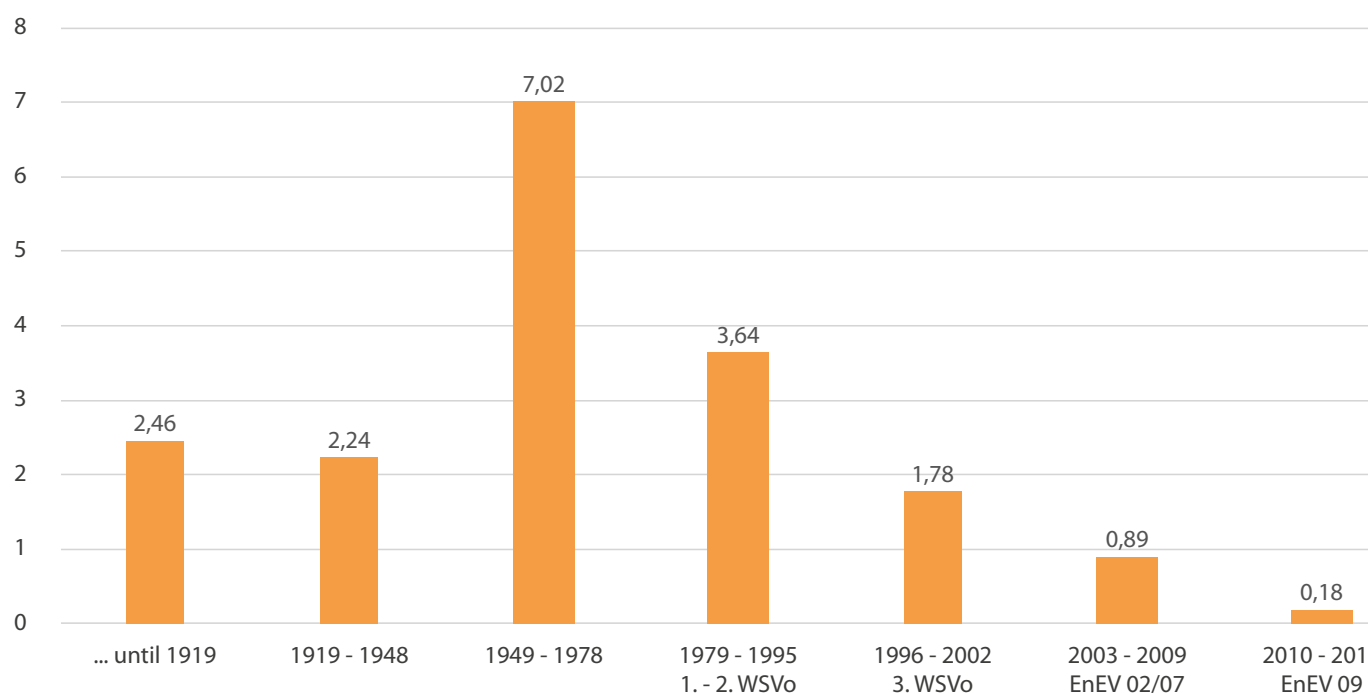


Figure 01: Distribution of residential building stock in Germany (BMU, 2014, adapted by BuroHappold)

<sup>6</sup> Deutsche Energie-Agentur (2018): dena-Gebäudereport Kompakt 2018.

## 2. REGULATORY FRAMEWORKS

Today's high energy-efficiency standards of buildings in Germany date back to the oil crisis of the 1970s and the related increase of energy cost. Introduction of energy regulations aimed to reduce oil and gas consumption and to increase independency regarding energy supply. Since then, regulatory frameworks for energy performance of buildings have been amended, updated and improved several times.

### 2.1 GERMAN LEGISLATION FOR ENERGY EFFICIENT CONSTRUCTION AND REFURBISHMENT OF BUILDINGS

With the introduction of the first WSV, for the first time, thermal regulations concerning envelope, air permeability of windows and other building joints came into effect. The WSV was amended twice, in 1984 and in 1995, and eventually replaced by the EnEV in 2002. EnEV introduced the combination of requirements for both construction and heating into one single ordinance. It defines the minimum energy standards for new construction and refurbished buildings in Germany. Since its introduction in 2002, EnEV was revised several times, with the latest review coming into force in 2014, when the requirements of the EU Directive on the *Energy Performance of Buildings 2010 (EPBD 2010)* were included, considering aspects of the *Kyoto Protocol* and the need for action to stabilise the global climate.

To comply with EnEV is mandatory for new constructions and major refurbishments of existing buildings, for both public and private developments. Besides setting standards for building envelopes, EnEV also applies for HVAC, heating and cooling systems, and in case of non-residential buildings, also lighting technology. Furthermore, EnEV includes specifications for *Energy Performance Certificates (EPCs)*, their layout, content, and liabilities.

For existing buildings, EnEV 2014 includes mandatory obligations to retrofit specific elements. So-called retrofit obligations (*Nachrüstverpflichtung*) define periods for replacement of old, energy intensive heating systems, insulation of existing pipes, or thermal insulation of ceilings and roofs. If building owners do not comply with the respective guidelines until the set deadlines, penalty fees are issued.<sup>1</sup>

*The Energy Savings Act (EnEG)* builds the framework for EnEV's implementation, and further addresses thermal regulations for buildings. Since 2009, new constructed buildings with floor areas larger than 50 m<sup>2</sup> are required to achieve the specifications of the *EEWärmeG*. Building owners need to include a certain proportion of energy generated by renewable sources into their energy mix. Owners are able to select their preferred energy source, however, need to comply with the given percentages, depending on the renewable source (see *Keystone Paper #1: Plus Energy Buildings and Districts*).

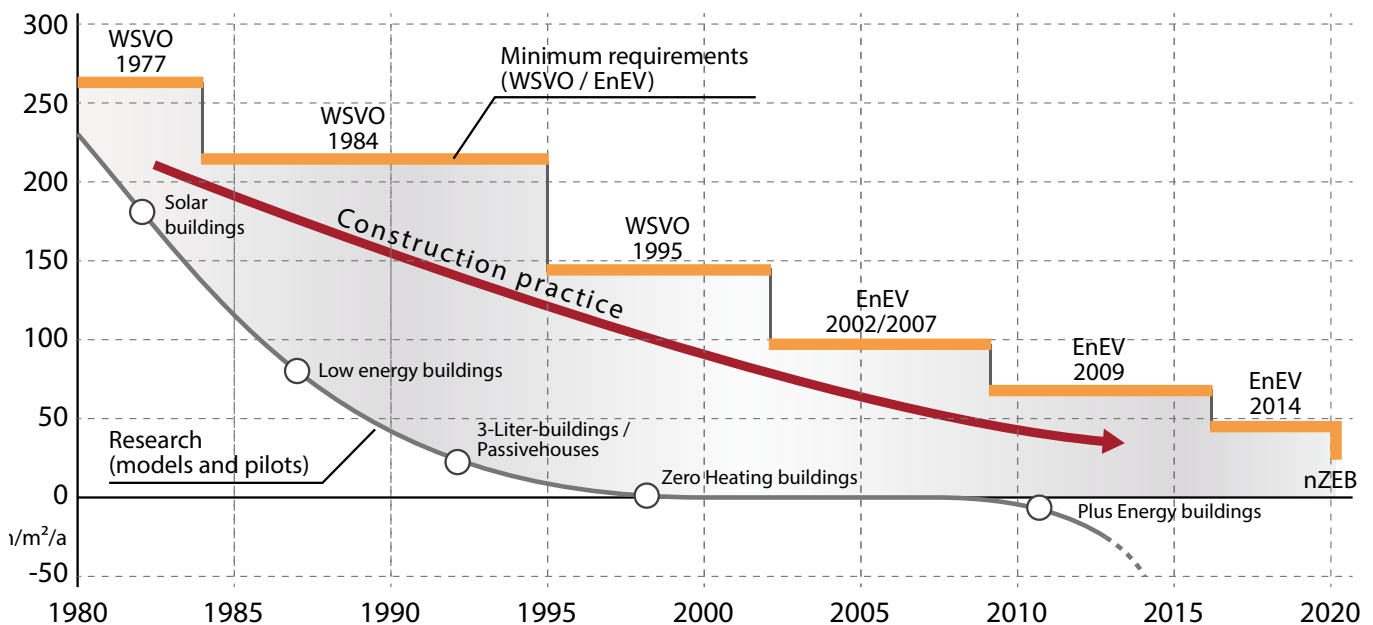


Figure 02: Evolution of energy standards in Germany and reduction of primary energy demand (Fraunhofer Institut, 2016, adapted by BuroHappold)

<sup>1</sup> Tuschinski, Melita (2015) EnEV 2014: EnEV-Nachrüstpflichten im Bestand. Source: [http://www.enev-online.com/enev\\_praxishilfen/151220\\_enev\\_altbau\\_bestand\\_baubestand\\_plichten\\_heizung\\_daemmung\\_thermostate.htm](http://www.enev-online.com/enev_praxishilfen/151220_enev_altbau_bestand_baubestand_plichten_heizung_daemmung_thermostate.htm)

## 2.2 KfW'S EFFICIENCY HOUSE CLASSES

Further guiding definitions for energy efficiency in buildings are included in the requirements of the loan and grant schemes of *Kreditanstalt für Wiederaufbau* (KfW), Germany's government-owned development bank. KfW categorises buildings in several *Efficiency House* classes. KfW's *Efficiency House* classes distinguish between new constructions and refurbishments. For new buildings, the classes of *KfW 55*, *KfW 40*, and *KfW 40 Plus* apply. Regarding existing buildings, the classes distinguish between *KfW 55*, *KfW 70*, *KfW 85*, *KfW 100*, and *KfW 115*, with the latter applying for listed buildings only. The numbers outline the respective building's primary energy use when constructed or refurbished, in comparison to a building established only with the mandatory EnEV standard. For instance, a new building constructed with the KfW Efficiency Standard 40, has an energy consumption of only 40% of the primary energy consumed by a building constructed with minimum standards of EnEV.<sup>2</sup> Further details on KfW's efficiency classes are included in *Keystone Paper #1: Plus Energy Buildings and Districts*.

## 2.3 EUROPEAN UNION'S REGULATIONS ON ENERGY EFFICIENCY IN BUILDINGS

The national legislation on energy performance of buildings in Germany and member states of the EU in general is embedded within the framework of the EU's goals of climate and energy savings. EPBD 2010 aims to integrate those ambitions into national legislation. Since EPBD 2010 was adopted, EU member states are required to progressively improve their energy codes for buildings, regarding predefined timeframes.

By 2019, EPBD 2010 requires that *nearly Zero-Energy Buildings* (nZEBs) become the new mandatory standard for public, and by 2021 for private buildings. In Germany, the new Building Energy Law (GEG) is currently in development, to integrate nZEBs into German legislation. GEG plans to combine the existing regulations to one single ordinance. EPBD defines a nZEB as a "*building that has a very high energy performance*". The low amount of energy amount remaining, "*should be covered to a very significant extent by energy from renewable sources, including energy (...) produced on-site or nearby*"<sup>3</sup>. While a variant of different definitions exist, the current German definition of a nZEB derives from the KfW categories described above. The Collaboration for Housing nearly zero-energy renovation (COHERENO), an EU programme on energy efficiency in buildings, outlines a **nZEB as a building meeting at least the requirements of a KfW Efficiency House 55**.<sup>4</sup> However, this definition is likely to be adapted, with the final version of the GEG and thus the definition of nZEBs for Germany being still open for discussion. For example, the current draft law (GEG 2.0) defines a nZEB as a building meeting the requirements defined in the EnEV 2016.<sup>5</sup>

2 KfW (2018): Was ist ein KfW-Effizienzhaus?. Source: <https://www.kfw.de/inlandsfoerderung/Privatpersonen/Bestandsimmobilie/Energieeffizient-Sanieren/Das-KfW-Effizienzhaus/>

3 Energy Performance on Buildings Directive 2010. Article 2.

4 Dena (2018): COHERENO – Definition Niedrigstenergiehaus. Source: <https://effizienzhaus.zukunft-haus.info/aktivitaeten/cohereno/definition-niedrigstenergiehaus/>

5 Karwatzki, Jan (2018): Zusammenfassung zum Entwurf des Gebäudeenergiegesetzes (GEG). Source: [http://www.oekozentrum-nrw.de/fileadmin/Medienablage/PDF-Dokumente/181125\\_Zusammenfassung\\_GEG-Entwurf.pdf](http://www.oekozentrum-nrw.de/fileadmin/Medienablage/PDF-Dokumente/181125_Zusammenfassung_GEG-Entwurf.pdf)

### 3. FINANCIAL INCENTIVES AND SUBSIDIES

Germany's subsidy schemes for energy efficiency measures in the building sector are considered as some of the most ambitious throughout the EU and widely used as good practice examples in the international context. KfW manages and issues the most important financial support schemes for both new constructions and refurbishment of existing buildings. KfW financially supports building projects through subsidised loans and grants. Applicants are required to fulfil predefined efficiency classes that exceed the minimum standards of EnEV. The more ambitious a respective project, the higher the potential amount of subsidy. Throughout Germany, around half of all new constructed residential units, and about a third of all refurbishments are subsidised by a KfW programme.<sup>1</sup> Since 2007, a total sum of around 100 billion Euro was issued by KfW to beneficiaries as grants or loans. Since then, total investment sums in energy efficiency measures, both regarding new constructions and refurbishments, gradually increased, also having positive effects on local economic development.<sup>2</sup> The implemented energy efficiency measures resulted in mitigation of around 9 million tons of CO<sub>2</sub> per year.<sup>3</sup>

#### 3.1 ENERGY-EFFICIENT URBAN REFURBISHMENT PROGRAMME OF KfW FOR DISTRICTS

Besides KfW's financial support programmes aiming towards individual public and private buildings, the development bank also offers the Energy-efficient Urban Refurbishment Programme (Energetische Stadtsanierung) targeting neighbourhood and districts. In the programme, the district level is considered as key to the holistic improvement of energy efficiency in buildings, and as instrument to reduce carbon-emissions on a large scale. The subsidy scheme targets municipalities, and their municipal companies. In total, the scheme covers 65% of the total cost.<sup>4</sup>

The Energy-efficient Urban Refurbishment Programme rests on two pillars: the development of energy-efficient, Integrated Urban Renewal Concepts and implementation of an urban renovation management. In an Integrated Urban Renewal Concept, the existing building stock of a district is analysed and mitigation potential concerning energy potential and

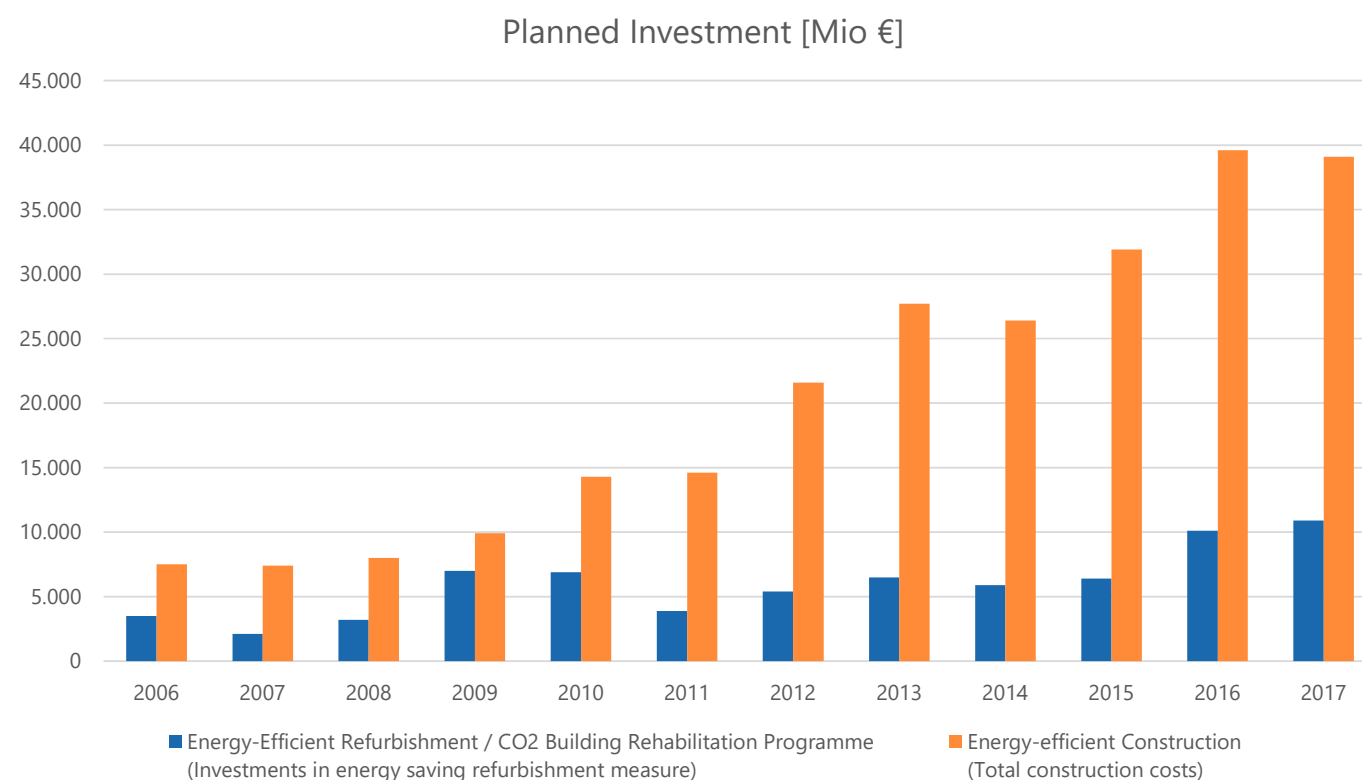
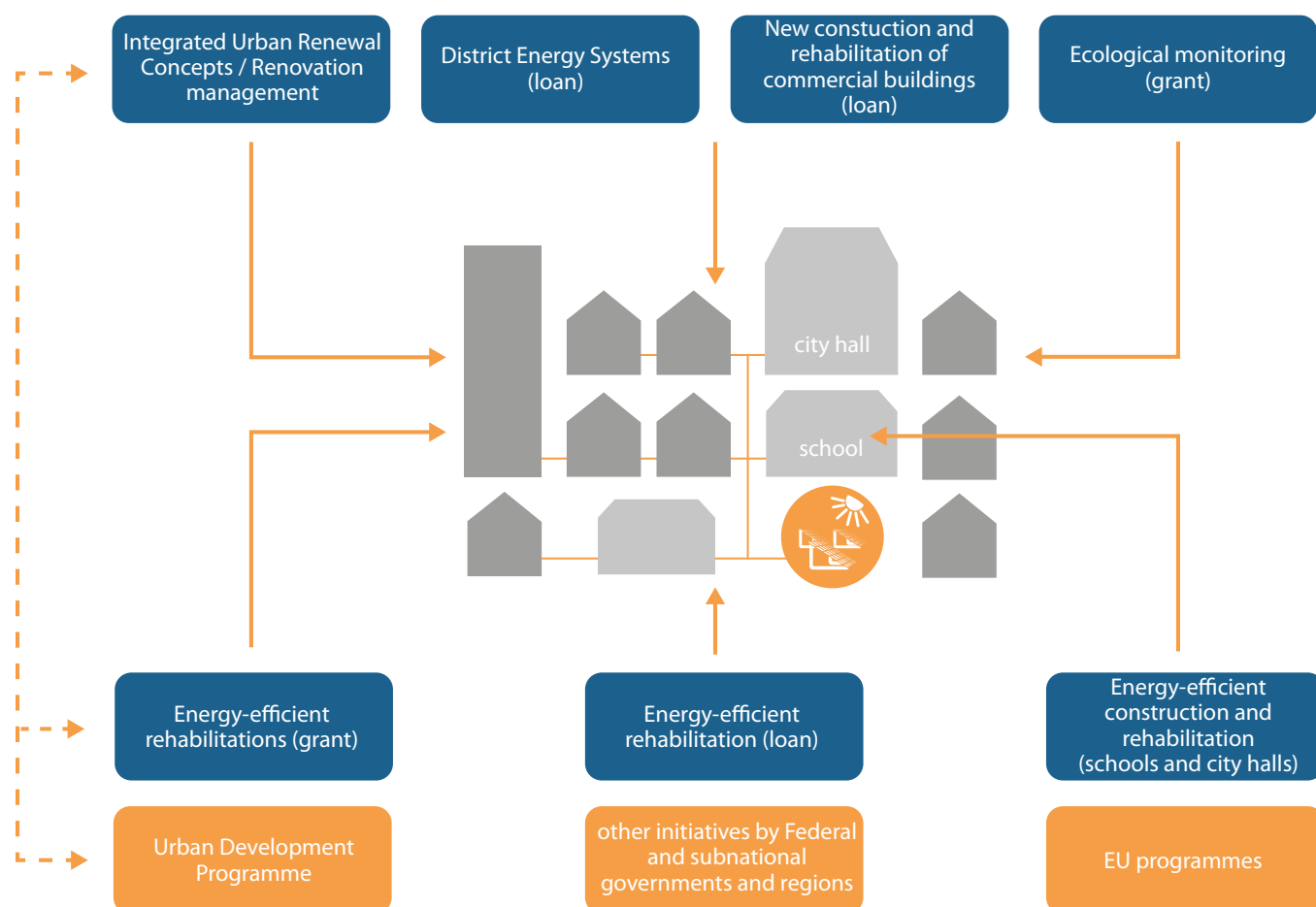


Figure 03: Total investments triggered through KfW programmes regarding energy efficient construction and refurbishments (Data source: KfW, 2018)

- 1 BPIE (2015): Renovating Germany's Building Stock. An Economic Appraisal from the Investor's Perspective. Source: [http://bpie.eu/wp-content/uploads/2016/02/BPIE\\_Renovating-Germany-s-Building-Stock\\_EN\\_09.pdf](http://bpie.eu/wp-content/uploads/2016/02/BPIE_Renovating-Germany-s-Building-Stock_EN_09.pdf)
- 2 KfW (2018): Monitoring der KfW-Programme "Energieeffizient Sanieren" und „Energieeffizient Bauen“ 2017. Source: <https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-alle-Evaluationen/Monitoring-der-KfW-Programme-EBS-2017.pdf>
- 3 KfW (2017): Zehn Jahre KfW Programmfamilie "Energieeffizient Bauen und Sanieren". Source: [https://www.kfw.de/KfW-Konzern/Newsroom/Aktuelles/Pressemitteilungen-Details\\_403200.html](https://www.kfw.de/KfW-Konzern/Newsroom/Aktuelles/Pressemitteilungen-Details_403200.html)
- 4 KfW (2015): Merkblatt Energetische Stadtsanierung – Zuschuss 432. Source: [https://www.kfw.de/Download-Center/F%C3%B6rderprogramme-\(Inlandsf%C3%B6rderung\)/PDF-Dokumente/6000002110-M-Energetische-Stadtsanierung-432.pdf](https://www.kfw.de/Download-Center/F%C3%B6rderprogramme-(Inlandsf%C3%B6rderung)/PDF-Dokumente/6000002110-M-Energetische-Stadtsanierung-432.pdf)



**Figure 03: Potential synergies between urban renovation programmes of KfW, Federal Government and European Union (BMU / KfW / BBSR, 2017; adapted by BuroHappold)**

GHG emissions identified. Furthermore, socio-economic and demographic analyses are taken into account with challenges in urban design, housing, and infrastructure. In addition, analyses are complemented with requirements of different sectors. Subsequently, measures and strategies included in the integrated development concepts are detailed out for implementation. The Energy-efficient Urban Refurbishment Programme supports the establishment of an urban renovation management that coordinates and manages, and supports implementation of the measures outlined in the Integrated Urban Renewal Concept for the respective area. Moreover, the renovation management connects individual stakeholders and is responsible for communication and integration of the public throughout the rehabilitation process.<sup>5</sup>

### 3.2 INTERLINKING FINANCIAL SUBSIDIES FOR DISTRICT REFURBISHMENT

The Energy-efficient Urban Refurbishment Programme forms the starting point for large-scale rehabilitation projects in districts and neighbourhoods. The programme defines the overall framework for district rehabilitation, to streamline the development process, and to outline concepts and strategy planning. To harness the full potential of neighbourhood refurbishment, the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) suggests a combination of different schemes of KfW and further subsidy (see figure 03).<sup>6</sup> For example, further subsidy programmes of KfW, the Federal Government, subnational governments, municipalities and the EU can be interlinked for district rehabilitation. Moreover, private and public stakeholders, such as municipalities, energy providers, project developers,

<sup>5</sup> KfW (2015): Merkblatt: Energetische Stadtsanierung – Zuschuss 432.

<sup>6</sup> BMU (2015): Energetische Stadtsanierung in der Praxis I. Grundlagen zum KfW-Programm 432. Berlin. Source: [https://www.bmi.bund.de/SharedDocs/downloads/DE/publikationen/themen/bauen/energetische-stadtsanierung-1.pdf?\\_\\_blob=publicationFile&v=4](https://www.bmi.bund.de/SharedDocs/downloads/DE/publikationen/themen/bauen/energetische-stadtsanierung-1.pdf?__blob=publicationFile&v=4)



as well as private and public building owners should be integrated in the process, and their potential investment opportunities taken into account.

KfW's other programmes to be combined with the Energy-efficient Urban Refurbishment Programme include:

- Loans to support improvement of district energy supply systems, including cooling, heating, and water and wastewater management, and programmes for infrastructure improvement in municipalities,
- Grants and loans for energy efficient new construction and rehabilitation of individual buildings,
- Loans for municipalities, companies owned by municipalities, and welfare organisations, targeting new constructions as well as rehabilitation of energy performance of non-residential buildings owned by municipalities (schools, city halls, etc.),
- Loans for new constructions and rehabilitation of commercial buildings for private owners,
- Grants for ecological construction support and monitoring of implementation of measures in residential buildings already supported by other of KfW's programmes.

In addition to financial support offered by KfW, the Federal Government's Urban Development programmes (Städtebauförderung) hold several options for rehabilitation projects of districts. The Urban Development programmes offer grants for construction of public infrastructure and on a case-by-case basis for private developments. Districts that have already experienced refurbishments via the Urban Development Programme, or for districts where actions are currently in development, measures for improvement of thermal performance can be easily combined.

### 3.3 ADDITIONAL SUBSIDY PROGRAMMES FOR ENERGY-EFFICIENT CONSTRUCTION

Overall, energy efficiency measures always target the mitigation of GHG emissions. Hence, besides KfW's programmes, subsidy programmes of BMU for reduction of carbon-emissions can be utilised as well for district refurbishment.

For example, the *National Climate Initiative (NKI)* subsidises initiatives and programmes within Germany, targeting mitigation of GHG emissions. For example, NKI offers financial support for German municipalities, which plan implement dedicated GHG mitigation projects. Other sub-programmes of NKI include support of sustainable transportation infrastructure, such as charging stations for e-bikes and construction of bike lanes, a subsidy for hybrid e-buses, or energy infrastructure such as the establishment of small-scale cogeneration units. Amongst others, these can be considered as highly relevant during development of rehabilitation strategies for districts and neighbourhoods.

Other funds for climate-mitigation and energy-efficiency projects include dedicated programmes of the EU, such as the *European Regional Development Fund (ERDF)*. Amongst others, the ERDF supports energy-efficiency in public and private buildings, and low-carbon strategies for urban areas. Funds are routed via subnational governments. Another EU programme, the *European Local Energy Assistance (ELENA)*, is subsidising technical assistance and project development. ELENA targets energy efficiency projects, decentralised energy generation from renewables, as well as urban mobility. In addition to support of the EU, German subnational governments and municipalities offer specialised funding options that can be taken into account for energy-efficient urban renovation projects.<sup>7</sup>

In addition to programmes targeting the national level, BMU also supports programmes on the international level. Here, one of the most significant initiatives is the *International Climate Initiative (IKI)*, funding projects and programmes all over the world, such as the *Sino-German Urbanisation Partnership*, a project implemented by the GIZ.

<sup>7</sup> BMU (2015): Energetische Stadtsanierung in der Praxis I. Grundlagen zum KfW-Programm 432.



## 4. BEST PRACTICE

## CASE STUDY

### 4.1 IBA SOFT HOUSE, HAMBURG



Figure 05: IBA Soft House, Hamburg, Wilhelmsburg © Gunnar Ries

The IBA Soft House is an innovative approach on a classic three-storey terrace building, consisting of four housing units with 180 m<sup>2</sup> each, and small courtyards in the ground floor area. For the house, novel technology was used to establish a series of housing units with outstanding energy-efficiency and comfort levels. The project was established during the International Architecture Exhibition (IBA) in the district of Wilhelmsburg in Hamburg, Germany, as part of an urban renewal process. In the area around the Soft House, future possibilities of urban housing were examined. The project was constructed from 2011 to 2013, in a collaboration between Kennedy & Violic Architecture, Boston, and BuroHappold, Berlin.

The term 'soft' refers not only to the integral use of textiles, but also to the user experience inside the house. Here, energy saving-systems and complex technology can be intuitively controlled by users. As an ultra-low energy building, the Soft House reduces its dependence on the grid by generating 25% of its annual energy demand from flexible, thin-film PV cells that are integrated into the external dynamic membrane covering on the roof. The exterior roof structure holds flexible photovoltaic cells, so called "twisters", which can adapt during daytime, moving around their own axis, towards the changing position of the sun.<sup>1</sup> In addition, they function as shading elements for the terraces located on the first

floor and can be controlled by the building's users individually. Renewable energy generated through them is either immediately used by the building, or transferred to a battery storage for later use.

The IBA Soft House's supporting structure is made of timber, for which only locally available wood materials were used. The solid timber construction highlights the planner's aspiration towards sustainability and reduction of GHG emissions. In the interior of the building, solid wooden surfaces further support the room atmosphere. Through a highly insulated envelope, the building's heat losses are reduced to a minimum, achieving Passive House Standard. Furthermore, a dynamic, highly energy-efficient air condition system is integrated to achieve thermal comfort. In addition, mechanical ventilation with a heat recovery system is integrated, further reducing energy demand. In addition, geothermal heating and cooling was integrated.

On the interior of the Soft House, transparent, movable curtains are supplied with low-voltage through the rooftop solar cells, also reflecting the exterior design of the building. Users are able to move the curtains according to their individual requirements, changing room layouts. In addition, those soft walls have integrated LED lights, that can be activated by the building's users.

1 Maier, Florian (2013): Bewegliche PV-Membranen: Soft House in Hamburg. In: Detail. <https://www.detail.de/artikel/bewegliche-pv-membranen-soft-house-in-hamburg-8881/>

## CASE STUDY

### 4.2 REFURBISHMENT OF HEINRICH-LÜBKE NEIGHBOURHOOD, FRANKFURT



Figure 06: Refurbished Heinrich-Lübke-Neighbourhood, Frankfurt-Praunheim ([https://de.wikipedia.org/wiki/Datei:Frankfurt-Praunheim\\_A22.jpg](https://de.wikipedia.org/wiki/Datei:Frankfurt-Praunheim_A22.jpg))

The Heinrich-Lübke-Neighbourhood (Heinrich-Lübke-Siedlung) is a residential complex, located in the district of Frankfurt-Praunheim of Frankfurt, was constructed in the 1970's consisting of 600 apartments for around 2,000 residents. An integral renovation and redevelopment of the Heinrich Lübke Neighbourhood was carried out as by Jo Franzke and Albert Speer + Partner Architects, Frankfurt, as part of the strategic urban development guidelines of the master plan, called Frankfurt for Everybody. Frankfurt for Everybody is a strategic master plan for Frankfurt, which formulates recommendations for the further development of the city, aiming to develop a high-quality urban environment for Frankfurt's citizens. In this context, a qualitative upgrading strategy of housing estates of the 1950's to 1970's was developed. As pioneering project of the city, the renovation of the Heinrich Lübke Neighbourhood was conceived as a model for sustainable renovation for large, outdated housing estates.<sup>1</sup>

The concept developed for the neighbourhood intended strengthening qualities of the existing residential buildings. Heinrich Lübke Neighbourhood was notorious for its dark and poorly visible passages and lacking opportunities for local businesses and supply. Most of the existing shopping centres in the neighbourhood were vacant.<sup>2</sup> Through implementation of different technical, structural and social measures integrated within an energy and renewal concept, CO<sub>2</sub> emissions were reduced by over 90% in the neighbourhood. Furthermore, energy demand was reduced by more than 80%.

Measures included renovation of the existing buildings' by enlargement of windows, and optimisation of the thermal insulation according to the EnEV 2009 standard for new constructions. Loggias, which used to be thermally exposed in the original design, were integrated into the apartments and replaced by extended balconies. The existing parking garage was upgraded through a photovoltaic system for energy production and thermal solar systems were installed on suitable buildings. In addition, a new local heat distribution network supported in reducing energy losses. The implementation of a carbon-offset program completed the integral approach. Furthermore, the strategy included construction of a number of new residential buildings in Passive House standard.

The renewal concept also enhanced overall accessibility of the neighbourhood, and developed specific designs of individual courtyards. These measures intended to strengthen formation of a local identity, and to increase sense of security. Accompanying the process, integration of local residents was an important role for understanding at the socio-cultural level. Thus, a comprehensive evaluation of the resident's and tenants of the buildings needs was carried out, including personal interviews. While rehabilitation of the existing buildings increased base rents for residents, at the same time, decreases in costs for heating resulted in only slightly higher rents.<sup>3</sup>

1 ABG Frankfurt Holding (2013): Von der konventionellen Gebäudesanierung zur integralen Quartiersmodernisierung. BDA-Symposium zur energetischen Sanierung am 28.02.2013 in Hannover. Source: [https://bda-bund.de/wp-content/uploads/2015/12/ABG\\_Frankfurt\\_Holding\\_Juncker.pdf](https://bda-bund.de/wp-content/uploads/2015/12/ABG_Frankfurt_Holding_Juncker.pdf)

2 AS+P (2018): Außenanlagenplanung Heinrich-Lübke-Siedlung. Frankfurt am Main. Source: <http://www.as-p.de/projekte/project/aussenanlagenplanung-heinrich-luebke-siedlung-171/show/>

3 Riebsamen, Hans (2012): Heinrich-Lübke-Siedlung. Vom Problemfall zum Vorzeigequartier. In: Frankfurter Allgemeine Zeitung (FAZ), Frankfurt. Source: <http://www.faz.net/aktuell/rhein-main/heinrich-luebke-siedlung-vom-problemfall-zum-vorzeigequartier-11774475.html>



## CASE STUDY

### 4.3 HOLISTIC REFURBISHMENT OF DREWITZ, POTSDAM



Figure 07: Holistic refurbishment of Drewitz, Potsdam © 2019 Google, Map data ©2019 GeoBasis-DE/BKG (©2009), Google

The *Drewitz-Neighbourhood* (*Großsiedlung Drewitz*) in the city of Potsdam was established in the late 1980s as a prefabricated residential neighbourhood (*Plattenbau*). The predominately 5-storey buildings in the 37 ha Drewitz-neighbourhood are currently home to 5,300 people, accommodated in 3,000 apartments. Since 2011, Drewitz has been redeveloped into a so-called “Garden City”, aiming to implement a holistic energy- and climate mitigation concept and become the first emission-free district in Potsdam. As many low-income households live in the area, a socially responsible approach is an important aspect of the implementation process. This also means ensuring affordable rents for the neighbourhood’s residents after the refurbishment.<sup>1</sup>

The overall renewal process to enhance energy efficiency and reduce carbon emissions included several measures, regarding the refurbishment of the building stock, enhancement of heat and energy supply as well as improvement of public mobility and urban open spaces. Deep refurbishments of buildings into highly energy efficient structures were conducted, including the renovation of their energy systems and installation of photovoltaic cells. Furthermore, the plan comprised of actions to reduce energy requirements in the entire district, for example through the establishment of a district heating system. To enhance sustainable modes of mobility, car-sharing schemes were initiated and bike rental stations created while the number of routes for pedestrians, cyclists and public transportation was increased. As the inclusion of the city’s residents constitutes an important part of the redevelopment, a public participation concept, in which elected citizens’ representatives are involved in decision-making and project management, was established in the process.<sup>2</sup>

The goal of becoming a carbon neutral neighbourhood requires implementing energy standards in the existing housing stock, which go beyond current specifications of EnEV. The participating communal housing companies, including ProPotsdam, agreed in performing the refurbishment works at least in a *KfW Efficiency House 70* standard, but mainly targeting the *KfW Efficiency House 55* standard. Through the modernisation of the building stock, an emissions reduction of around 80 % is projected. Further savings are possible through consistent use of solar energy, promoting and adopting energy-conscious user behavior.

The renewal project of Drewitz is financed by the public funds, private housing developers, energy providers, private owners as well as from citizen’s funds. Subsidy programmes such as the Federal Government’s *Social City Programme* and the EU’s *EFRE* complemented finance of the implemented measures. The refurbishment of energy systems and housing stock is partially financed by KfW programmes, Social City, and private funds (e.g. housing developers).<sup>3</sup> Since the beginning of the implementation, the neighborhood has been widely recognised as an innovative, green district. In 2014, Potsdam was awarded with the *Municipal Climate Protection Prize* (*Kommunaler Klimaschutz Preis*) because of the redevelopment of Drewitz to an environmental conscious district.

1 BMI, BBSR (2018): Begleitforschung Energetische Stadtsanierung: Potsdam - Drewitz. Source: <https://www.energetische-stadtsanierung.info/pilotprojekte/stellvertreter/potsdam.html>

2 KfW (2017): Potsdam Drewitz. Source: <https://www.kfw.de/stories/environment/energy-efficiency/restoration-garden-village-potsdam-drewitz>

3 Stadt Potsdam (2014): Gartenstadt Drewitz Endbericht: Kurzfassung. Source: [https://www.potsdam.de/sites/default/files/documents/iekk\\_drewitz\\_kurzf.pdf](https://www.potsdam.de/sites/default/files/documents/iekk_drewitz_kurzf.pdf)

## 5. EMERGING TRENDS

### 5.1 ELECTRICITY AS DEFINING FACTOR OF ENERGY USE IN DISTRICTS

The potential for energy savings through insulation of building envelopes has largely been exhausted by enhanced building regulations of recent years. Most energy savings are thus possible through savings in electricity and through appliances. However, ensuring ecological quality and reduction in greenhouse-gas emissions is only possible with electricity sourced from renewables.

By the use of electricity, buildings and districts do not only benefit from reduction of combustion processes and accompanying pollution, but also through *sector coupling*<sup>1</sup>. Intelligent network administration in combination with battery storage in electric cars, can store excess regenerative energy and feed it back into the grid, when it not required. Hence, energy supply of districts in the future will become electric. However, above all, it is important to solve storage problems and to ensure the low-loss transport of energy from the place of production to the consumer.

Current legislation on energy performance of buildings shows tendencies towards an increase of electricity for all building services. Potentials of heating through electricity becomes evident through reduction of primary energy factors as shown in EnEV. This is based on the assumption that the total share of renewables in the overall energy mix will increase in the coming years.<sup>2</sup>

Concerning district heating, much of the heat generated is a by-product of waste-incineration plants. As it is widely understood that waste itself is a valuable resource, and incineration might not be the best option to fully use its potential (e.g. urban mining, reuse of e-waste), it is important to consider alternatives. On the long run, changing requirements of new buildings need to be taken into consideration too. Buildings constructed with high thermal standards, require lower temperatures than the temperatures supplied by contemporary district heating plants.

### 5.2 GERMANY'S NEW BUILDING ENERGY LAW (GEG)

The current debate on introduction of afore mentioned GEG, intends to enhance thermal requirements of buildings in Germany. GEG aims to combine the existing EnEV, EnEG and EEWärmeG to one single ordinance, and implement the requirements of the EPBD 2010 on nZEBs. By 2019, the GEG and thus the nZEB standard will be mandatory for new public buildings, and from 2021 for new private buildings. While the EPBD 2010 outlines the nZEB standard in a broad manner, EU countries are required to define their nZEB standard individually.

In current thermal regulations in Germany, primary energy demand is the key parameter for assessment of a building's energy performance. Lately, this has been criticised, as the ecological quality and a building's total greenhouse-gas emissions are not considered through this assessment. As long as a building complies with the thermal regulations, it is irrelevant for a project developer if the materials used in the project themselves have a high ecological footprint, e.g. through the raw materials used or the production process itself, or not. Here, it has been suggested to replace primary energy demand with CO<sub>2</sub> emissions as the main assessment factor used in thermal regulations for buildings. For the development of the GEG the DGNB, the German Sustainable Building Council, suggested to include absolute CO<sub>2</sub> emission limits for buildings, with project developers required to pay a dedicated CO<sub>2</sub> tax if the emissions exceed the limits of the respective regulatory framework. The current draft on GEG includes a mandatory declaration of a building's total CO<sub>2</sub> emissions in the *Energy Performance Certificate* (Energieausweis). While the key parameter for energy efficiency in buildings remains the annual primary energy demand, the official adoption of CO<sub>2</sub> emissions as target value and implementation of absolute CO<sub>2</sub> limits for new buildings is foreseen for 2023.<sup>3</sup>

Regarding existing buildings in a district (for example buildings with shared heat supply), the GEG draft law includes the new option of a joint assessment respecting their common energy performance. This allows a comprehensive fulfilment of energy performance requirements, which is not necessarily based on individual buildings. This adjustment of the law encourages establishment of synergies in renewal processes on district level.

1 Sector coupling describes a holistic approach in the energy sector that is comprehensively enhancing several silos at once, such as electricity, heat, transportation and industry. It aims to identify solutions that target not only one individual sector, but considers the whole system, using synergies and increasing flexibility.

2 Hüttmann, Matthias (2015): Gebäude der Zukunft? Wärme und Strom im Haus – wie Heizen wir in Zukunft? In: IKZ – Gebäude und Energietechnik. Source: <https://www.ikz.de/nc/detail/news/detail/gebäude-der-zukunft-wärme-und-strom-im-haus-wie-heizen-wir-in-zukunft/>

3 Karwatzki, Jan (2018): Zusammenfassung zum Entwurf des Gebäudeenergiegesetzes (GEG).

### 5.3 OPERATING COST AND TENANCY IN CONTEXT OF ENERGY REFURBISHMENTS

About 55% of German households are tenants. By that, Germany is the single EU member state, where tenancy outnumbers the proportion of homeowners.<sup>4</sup> Germany renters have rather diverse socio-economic backgrounds. Around 11% of the total number of households are beneficiaries of dedicated housing allowances or recipients of subsidies of operating costs.<sup>5</sup>

The so-called “2<sup>nd</sup> rent” is the part of the rent consisting of energy cost for both electricity and heating. It is strongly dependent on global market conditions on oil and gas prices. While also in 2018, prices of fossil energy sources continue to remain comparably low, market disruptions can quickly cause unforeseen increases and strain budgets of tenants. Hence, by improving the thermal performance of a building, implementation of energy efficiency measures can reduce spending on operating cost for tenants significantly in the long term.

Despite decreasing operating cost and the 2<sup>nd</sup> rent for tenants, implementation of energy efficiency measures could also lead to an increase of basic rents (rents without operation cost). After major refurbishments, building and apartment owners can increase basic rents up to 11%, according to statutory law.<sup>6</sup> Budgets of households with incomes below average are disproportionately affected by refurbishments increasing energy performance. This could strain public budgets through the backdoor, through increasing demand for housing allowances and other welfare payments.<sup>7</sup>

### 5.4 INCREASING LIVING SPACE AND ENERGY DEMAND PER CAPITA

Since the 1980s, primary energy demand per square meter declined gradually through enhanced regulatory frameworks and improvements in building technology. In contrast, the living space per capita progressively increased in the past decades throughout Germany. While in the 1980s average living space was around 30 m<sup>2</sup>, the available living area climbed up to 46.5 m<sup>2</sup> per capita in 2017<sup>8</sup>. While this is partly caused by increased construction activity due to swift population increase in recent years, a main reason are demographic changes and accompanying increase of single-households. Despite shrinking household sizes, with growing age, many stick with their former, larger homes.

Every additional square metre of inhabited living space increases energy and resource consumption, and thus is potentially causing emissions. A household does not only use the net area of the flats, but also occupies the whole or some parts of the site where the building is constructed. Furthermore, area used for the establishment of transportation infrastructure and roads has to be taken into account, having an additional environmental impact. In many cases, sealed surfaces are irreversibly covered. Hence, it is crucial to ensure resource efficient use of soil, for example, prefer inner city developments and reuse of brownfields, instead of establishing new infrastructures on greenfields. In general, gradual increase in living space is not considered in assessment methods of current regulations on thermal performance or energy efficiency of buildings. Energy demand per square metre progressively decreased in with enhancement of overall thermal performance standards. Nonetheless, with growing living space, the total energy demand per capita is likely to remain high.<sup>9</sup>

4 Housing Europe (2017): The State of Housing in the EU 2017. Brussels. Source: <http://www.housingeurope.eu/resource-1000/the-state-of-housing-in-the-eu-2017>

5 BMWi (2015): Energieeffizienzstrategie Gebäude (ESG).

6 Bürgerliches Gesetzbuch (BGB), § 559.

7 IWO (2013): Energetische Gebäudesanierung in Deutschland. Management Summary. Studie Teil 2: Prognose der Kosten alternativer Sanierungsfahrpläne und Analyse der finanziellen Belastungen für Eigentümer und Mieter bis 2050. Hamburg. Source: [https://www.real-estate.bwl.tu-darmstadt.de/media/bwl9/dateien/arbeitspapiere/Energetische\\_Gebaededesanierung\\_in\\_Deutschland\\_gesamt.pdf](https://www.real-estate.bwl.tu-darmstadt.de/media/bwl9/dateien/arbeitspapiere/Energetische_Gebaededesanierung_in_Deutschland_gesamt.pdf)

8 Statistisches Bundesamt (2018): Wohnungsbestand in Deutschland. Source: <https://www.destatis.de/DE/ZahlenFakten/GesellschaftStaat/EinkommenKonsumLebensbedingungen/Wohnen/Tabellen/Wohnungsbestand.html>

9 Umweltbundesamt (2018): Wohnfläche. Source: <https://www.umweltbundesamt.de/daten/private-haushalte-konsum/wohnen/wohnflaeche#textpart-1>

## 6. DISCUSSION

Germany's policy framework to enhance energy efficiency in buildings aims to reduce carbon emissions in the sector to nearly zero by 2050. To achieve this goal, building energy codes have been gradually enhanced in the past decade. Enhancement of energy performance of new buildings forms one part of Germany's energy efficiency strategy. The other important pillar is the refurbishment of the existing building stock built before the first energy regulation in 1977. In the residential sector, existing buildings are responsible for the largest proportion of energy use. Through deep refurbishments, also those buildings could reach the energy performance of newly built constructions. The current renovation rate of 1 % remains too low to achieve a fully renovated building stock until 2050. The Federal government aims to double the rate until 2020, which at present remains unlikely to achieve, despite the broad framework of subsidy programmes issued by KfW, and gradual growth regarding overall investments in enhancement of energy performance,

A crucial role in the process of refurbishing the existing stock, are private building owners. In many cases, bureaucratic requirements to apply for a loan or grant are considered as a barrier for private individuals to consider refurbishments with a focus on energy. Many owners also require counselling, to appreciate the full potential of energy efficiency as a "low hanging fruit". For them, refurbishment of a building entails a number of co-benefits, not only regarding financial savings through decreased energy consumption on the long term, but also advantages such as increased room comfort. While the Federal government provides several campaigns on energy efficiency to raise awareness, increased availability of energy counselling services could further increase willingness to renovate, as outlined in NAPE.

Another measure with potential to expand extensive renovation of the building stock is implementation of tax-exemptions. While currently, only some cost in refurbishments, such as work of builders and craftsmen, are tax-deductible in Germany, widening of the scope could decrease cost for individuals when conducting

an energy-efficient refurbishment of a building. While NAPE foresees implementation of such tax-exemptions, and the Federal administration has been discussing the issue several times in recent years, it has not been realised yet. Like building owners living in their own homes, also tenants can benefit through enhancement of building energy performance through resulting decrease of energy cost. After refurbishment of a building, however, building owners are able to increase base rents to a certain extent. With more than half of the German households being renters, also here, awareness raising and potential financial benefits and increased independence of the energy markets is key. Nonetheless, for households of lower income sectors, increase of base rents could potentially cause financial hardships, a crucial factor to be considered throughout a refurbishment process. Especially by the real estate industry, it has been argued that increased energy standards might too hamper construction activity, to fulfil increased demand for housing throughout the country.<sup>1</sup> The influx of refugees of 2015 also led to a sudden need for accommodation, which resulted in the introduction of acts lowering energy standards for dedicated buildings and building extensions for three years, which would not have been possible when complying to regular EnEV. This temporary act was adopted due to a need for urgent reaction, though was also heavily criticised.

The current debate in Germany on implementation of GEG also shows that besides the ambition to lower GHG emissions, political considerations regarding economic viability are slowing down comprehensive implementation, and increased ambitions regarding the nZEB standard. Hence, the current draft of GEG, defines an nZEB as a building complying with the regulations that are already in effect through EnEV 2016. Softening of energy codes might seem attractive to reduce initial investment cost for realisation of a building, but on the long term, result only in another shift towards energy cost, impeding achievement of climate mitigation targets.

<sup>1</sup> Schüle, Rainer (2015): Gebäudeenergiestandards auf dem Prüfstand – Zurück zu den alten Vorurteilen? Source: <https://wdvs.enbausa.de/blog/gebaeudeenergiestandards-auf-dem-pruefstand-zurueck-zu-den-alten-vorurteilen.html>





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## ENERGY EFFICIENCY OF BUILDINGS & DISTRICTS IN URBAN RENEWAL



**Sino-German  
Urbanisation  
Partnership**

Keystone Paper for the key  
topics of the Sino-German  
Urbanisation Partnership

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