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Education and Training in the Field of Climate Neutral Districts in Germany

Sino-German Demonstration project on Energy Efficiency in Cities



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Preface

To achieve the goal of climate neutrality in 2045, German private and public sectors must cooperate to create a new, zero-emission ecosystem in our cities. This is where the integrated city quarters/district (hereinafter “district”) approach comes in – because the district is the most effective level for tackling concrete problems and achieving climate neutrality. Moreover, this is not just a question of requirements for energy-efficient refurbishment of buildings, renewable energy expansion and, often, far-reaching changes to energy supply systems – all of that must be implemented while also taking into account demographic, social and urban development policy issues and opportunities for civic involvement. Which means that several different roles and levels are involved in this process.

Districts offer a multitude of possible courses of action. For example, locally generated renewable energy and efficiency potential can be utilized; technical facilities and storage systems can be optimally designed, located and operated; various energy demands can be counterbalanced; and the spatial efficiency of the whole district increased. In concrete terms, this can be implemented by means of such measures as communal use of technical facilities, e.g. photovoltaics on the roof areas of buildings with low energy requirements, or also by using the waste heat from a company to supply heat for residential buildings through a district heating network. The capacity to implement all of this requires vast knowledge on the part of everybody involved in the transformation process, of a kind that did not yet exist a few years ago.

This study aims to identify the relevant stakeholders involving the plan and implementation of climate-neutral districts and analyze the required capability of different stakeholder groups. Then, based on further interview from selected actors of different stakeholders, the requirement of education and training were found. Furthermore, the current education and training programs for different stakeholders are sorted to compare with the requirements and needs of the interviewees through a stakeholder workshop. Finally, the study aims to deliver a systematic assessment of whether the offer meets the actual needs.

The study was carried out under the framework of “Sino-German Demonstration Project on Energy Efficiency in Cities”, which was commissioned by the Federal Ministry for Economic Affairs and Climate Protection (BMWK) and the National Reform and Development Commission of the People’s Republic of China (NRDC) and jointly implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) [German Society for International Cooperation], the Deutsche Energie-Agentur (dena) – the German Energy Agency – and the Eco Product Development and Research Center of China Energy Conservation and Environmental Protection Group (CECEP-EPDRC). ZEBAU GmbH was commissioned by dena to prepare the study. The specifications tie in with the dena study on climate-neutral districts.

1. Definition and Current Status of Development of Climate-neutral district in Germany

In Germany, a district [Quartier] is generally defined as an appointed scale of urban space between the 'building' and 'city' levels. To further limit and define a district environment, the Institute for Residency and Environment (IWU) describes the following criteria as built structures, infrastructural characteristics, energy sources, urban construction barriers, accessibility characteristics, infrastructure, environmental factors, demographic and socio-economic population characteristics, social interactivity and identific potential ¹.

Climate-neutral districts follow the guiding principles of climate, CO₂ and greenhouse gas neutrality. The precondition for neutrality is a significant reduction in emissions by decreasing energy consumption and increasing use of renewable energy sources and improve energy efficiency. The analysis categorized into three aspect: new construction for residential areas, urban redevelopment in perspective of energy efficiency and new construction or redevelopment commercial and industrial areas.

1.1. New construction for residential areas

By combining an energy efficient construction measurement with generation and use of renewable energy sources. Meanwhile space and resources consumed and measures to climate adaption, biodiversity and mobility shall be also taken into account, so that so that new building projects can be implemented in ways of climate friendly.

With the accession of the new federal government and the decisions of the coalition committee on 23 March 2022, it was established by law that the energy efficiency of all new buildings from 2023 onwards must equal an KfW Efficiency House 55² and, provisionally, from 2025 onwards KfW Efficiency House 40³. A **building's energy demand** can be reduced, for example, by comprehensive thermal insulation of the building envelope, ventilation system with heat recovery, optimised planning and quality assurance. Additionally, for new building projects in the residential district, the energy supply shall mainly consider **renewable energy sources**. Special focus should be placed on district-level solutions such as connection to a heating network and energy production using photovoltaic systems. Against the backdrop of space-saving urban district development, new building projects should aim at a **compact, space-efficient design** of building structures and a higher level of vertical integration of different types of use. Meanwhile, energy consumption and CO₂ emissions can be minimised sustainably by using construction materials with a low ecological footprint. Green areas on roofs and façades, greening of squares and plant cultivation for shading will on the one hand improve the microclimate through cooling and ventilation, on the other hand, promote a **diverse urban landscape** by preserving natural habitats in an urban environment. By contrast, a rainwater management system that is close to nature reduces flooding due to extreme weather events and prevents the sewerage system from overflowing. Measures to support **climate-friendly mobility** are concerned with the

¹ IWU (2021): Round table, 'New Stimuli for Sustainable Climate Protection in Building Stock'

² "KfW-Effizienzhaus 55", compared to the German Building Energy Law ("Gebäudeenergiegesetz", GEG) defined reference building it requires a maximum of 55 % of the primary energy

³ "KfW-Effizienzhaus 40", compared to the German Building Energy Law ("Gebäudeenergiegesetz", GEG) defined reference building it requires a maximum of 40 % of the primary energy

creation of spaces and infrastructures for using climate-friendly modes of mobility such as walking, cycling, public transport and electro mobility. Additionally, the implementation of mobility concepts, plus the establishment of mobility stations and a mobility management system, should be considered in newly planned residential districts.

1.2. Urban redevelopment in perspective of energy efficiency

On behalf of the Federal Republic of Germany and the federal states, the KfW is supporting different aspects of the energy transition with various funding programs, which address private households as well as municipalities and public institutions.

The KfW funding program on 'Energy-efficient Urban Redevelopment – Climate Protection and Adaptation to Climate in Urban Districts'⁴ aims to increase the energy efficiency and climate-friendly characteristics of buildings and infrastructure in existing urban districts. Achieving this requires the interconnection of various areas of activity: energy-efficient refurbishment of building stock, energy-efficient heating supplies, electricity generation and use, the use of renewable energies, climate-friendly mobility and climate-conscious consumer behaviour. Moreover, integrating energy efficient urban refurbishment into sustainable urban and regional development opens up potential for measures in the fields of adaptation to climate change and resilience, plus social issues such as barrier-free accessibility⁵.

In contrast to planners of new building projects, actors in energy efficient urban redevelopment have more restrictions to exert influence, since the necessary **changes must be implemented in existing structures**. Structures of estates and buildings, restrictions owing to protected status, constellations of property owners and links to existing supply structures, or those which must be developed, are important factors here.

1.3. New construction or redevelopment of commercial and industrial areas

Commercial areas are an important control mechanism when developing climate-friendly cities. Similar to residential areas, various aspects need to be considered in an integrated approach.

Site-specific energy efficiency measures in the form of (technical) optimisation particularly help to reduce greenhouse gas emissions in commercial activity. When it comes to energy supply, the focus should be on **local, renewable energy sources**. When considering commercial waste heat potential and its utility, the primary concern should be creating synergies. But sector coupling also affords considerable potential for synergy and efficiency, for example if a manufacturer with constant high electricity demand achieves a good quota of energy production for PV installations. But energy-efficient **building refurbishment** also harbours great potential to reduce energy demand in the commercial sector. The "Proposal for a Directive of the European Parliament and of the Council on the energy performance of buildings" of 15 December 2021 assigns a pioneer role to non-residential buildings in this regard⁶. The aim is to reconstruct all European non-residential buildings to the standard of energy efficiency category E⁷ by 2030. Greening of roofs and façades and green operating sites demonstrate how companies can support a healthy **urban climate and biodiversity** and, in the process, improve the working environment and save energy costs. The precondition for increased use of low-emission drives is sufficient availability of charging and refilling structures

⁴ The KfW Energy-efficient Urban Redevelopment Programme: <https://www.energetische-stadtsanierung.info/en/energy-efficient-urban-redevelopment/>

⁵ Accompanying research to energy-efficient urban redevelopment: <https://www.energetische-stadtsanierung.info/en/programme-related-research/> (last accessed 12/12/2022)

⁶ Publications Office of the European Union (2021): <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0802&from=EN> (last accessed 12/12/2022)

⁷ European building energy efficiency classes are classified according to energy consumption from A+ to H. Energy class E corresponds to a building energy consumption of 130-160 kWh/(m²a): <https://www.dein-heizungsbauer.de/ratgeber/bauen-sanieren/energieeffizienzklasse-haus-berechnen/>

for electric, hydrogen and natural gas vehicles. Using a targeted company mobility management policy, companies can influence the transport choices of their staff and work towards a **sustainable mobility culture**.

Under this definition, the typical profile of many job categories in Germany is changing, or being expanded to include aspects connected with climate protection and the process of transformation towards renewable energy supply. For example, the professions of energy consultants and refurbishment managers have become established in recent years, and experts are addressing questions of sustainable processes and resources management. In order to deal with these new tasks and challenges, training and further training have become available for all stakeholder groups in the field of climate-neutral districts. This is because comprehensive training measures and suitable course content were already seen as key factors for the achievement of climate targets at an early stage. Nevertheless, there are still not enough specialists with the knowledge required to implement complex transformation processes swiftly and effectively.

This study identifies relevant stakeholder groups along the planning and implementation process at district level and investigates whether the further training measures already on offer meet the actual training needs of these stakeholder groups.

2. Methodology of training requirement analysis

To identify the relevant stakeholder groups along the planning and implementation process of climate neutral district reference was made to an existing study of dena⁸. A qualitative survey and group discussion was conducted to find out whether the training measures offered correspond to the actual qualification needs.

The execution of this study is divided into the following three steps:

- Stakeholder analysis
- Stakeholder interviews
- Stakeholder workshop

The stakeholder analysis will define different group of stakeholders during the planning and implementation of climate-neutral district. Then the study team will select representatives from each stakeholder groups and organize individual interviews on their qualifications and training requirements. Finally, a stakeholder workshop will hold to discuss on the training requirements and suggestions.

2.1. Stakeholder analysis

In terms of the ideal planning and implementation process for climate-neutral districts, the stakeholder groups are identified from the definition of 'Climate Neutral Districts' study. Stakeholder structure showed in "stakeholder map" (Figure 1) and short description of each stakeholder group are included in chapter 4.2. On the basis of the tasks and roles of these various stakeholder groups, **superordinate training areas** were defined. They form the basis for the analysis of the competences, which shall be possessed by the stakeholder in practice, in order to guarantee an ideal planning and implementation process. At the same time, research was carried out into the educational and vocational trainings on offer in the qualification areas identified, related to climate-neutral districts.

⁸ Deutsche Energie-Agentur GmbH (dena) – the German Energy Agency (2021): <https://www.dena.de/newsroom/publikationsdetail-ansicht/pub/dena-abschlussbericht-klimaneutrale-quartiere-und-areale/> (last accessed 12/12/2022)

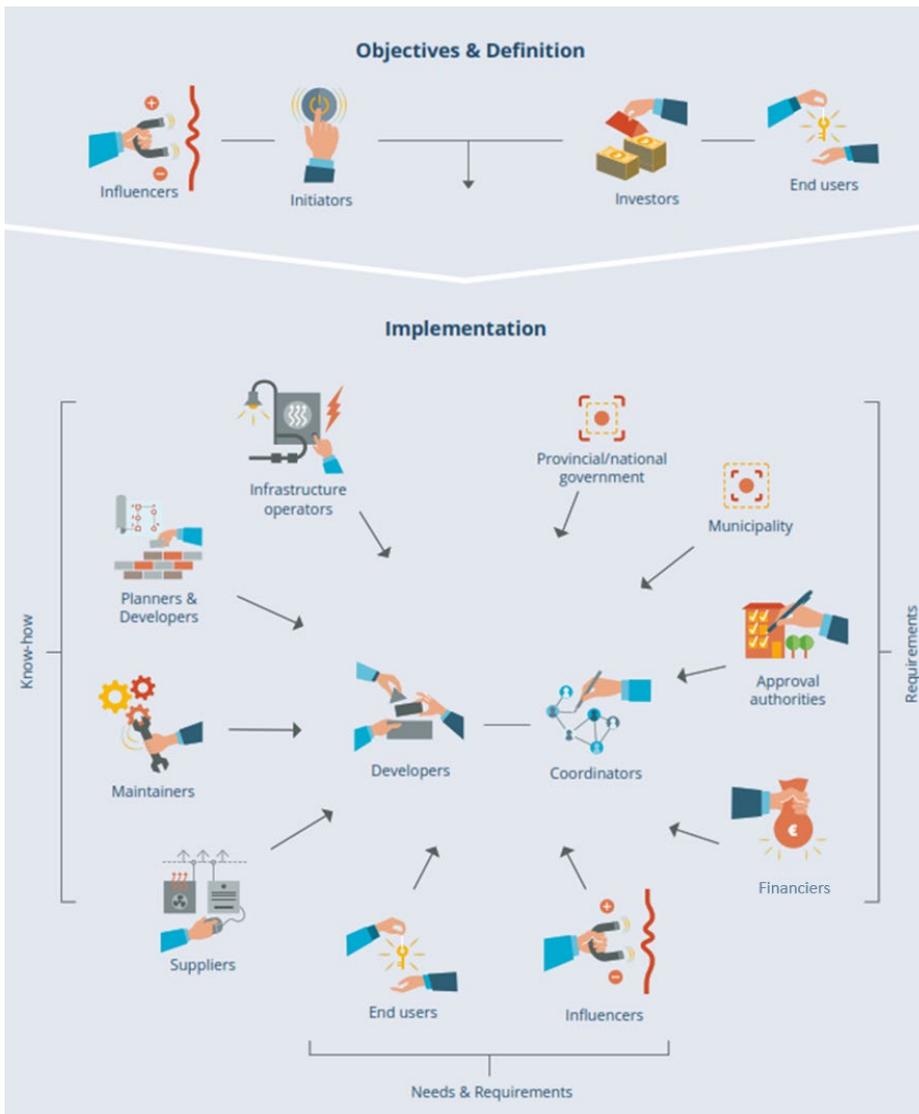


Figure 1 Stakeholder map for the definition of objectives and subsequent implementation

2.2. Stakeholder interviews

The aim of the stakeholder interviews was to identify the competencies required by the stakeholder groups and their training preferences. At the same time, it was planned to expand and review the training opportunities already researched. The study implements an online interview for **12 actors from different stakeholder groups** in November and December 2022. For this purpose, different actors involved in the topic of climate-neutral districts in various project contexts were first assigned to the stakeholder groups in a summary overview, and then selected actors were requested for the interviews. In order to quickly arrange interview dates with the selected actors, the existing network of ZEBAU GmbH was used. The actors interviewed are therefore predominantly active in North Germany and Berlin.

2.3. Stakeholder workshop

On 28 November 2022, a stakeholder workshop was held online for 2 hours with participation of all interviewed actors. The aim of the workshop was to generate discussion between the stakeholder groups regarding their training needs and further training preferences in the field of climate-neutral districts. As an introduction, the context of the brief study undertaken by the Deutsche Energie-Agentur GmbH (dena) was presented as background, along with the initial results of the interviews. The subsequent workshop phase began with a survey in which the participants were asked about any providers of training and further training measures they were aware of, their wishes for course content and their personal preferences regarding the scope and format of further training programs. In the discussion part, the participants shared training backgrounds that transcend stakeholder groups, various training requirements during new construction or reconstruction of climate-neutral districts, and the municipality as key stakeholder group.

3. Stakeholders analysis of planning and development processes of climate-neutral district

3.1. Overview of planning and development processes

Planning and implementation processes at district level differ from one another in terms of their dependence on spatial components (existing/new buildings), utilisation (commercial/private) and actors (commercial/private). In addition, the constellation of their actors is also relevant. On the one hand, only one actor can be responsible for the concept and its implementation; on the other, there are projects where concept and implementation do not originate from a single source ⁹.

This results in the following types of urban districts and areas:

- (1) Climate neutrality from a single source (new building)
- (2) Transformation to carbon neutrality from a single source (existing buildings)
- (3) Climate neutrality from several sources
- (4) Transformation to climate neutrality from several sources

Basically, the planning and implementation processes for climate-neutral districts can be categorized into the following phases:

Phase I Development stimulus (upstream strategic planning)

Development is normally triggered by strategic superordinate stimuli that allow 'normal district development' to become carbon neutral development.

Phase II Concept creation

In the concept creation phase, a common vision is created. For this purpose, it is necessary both to consider the existing building stock and to assess demands, potential and technical possibilities.

Phase III Marketing/motivation (types 3 and 4 only)

In this phase, investors are acquired and motivated. Ideally, the project goals are met.

Phase IV Planning of implementation

The implementation planning, or alternatively the detailed planning, gives the concept concrete shape in terms of actual buildings and infrastructures in the urban district.

Phase V Implementation

Implementation begins after the investors have made their decision, with tenders for the building work (based on the detailed planning), and ends with the completion of building measures and handover to the end users.

Phase VI Operation and monitoring

⁹ Deutsche Energie-Agentur GmbH (dena) – the German Energy Agency (2021): <https://www.dena.de/newsroom/publikationsdetailansicht/pub/dena-abschlussbericht-klimaneutrale-quartiere-und-areale/> (last accessed 12/12/2022)

The ambitious carbon neutrality targets should be tested through monitoring of operations. In this way, quality can be tested and, if necessary, efficiency can be increased.

3.2. Stakeholder groups involved in the process

Various actors are involved in the development, planning and implementation of climate-neutral districts. This subsection provides a brief introduction to the individual stakeholder groups¹⁰. It should be noted that in practice, stakeholder groups can overlap. For example, actors can take on various roles within a planning process and therefore find themselves in several groups accordingly.

Decision level:

As shown on the Stakeholder Map (Figure 1), the following stakeholder groups develop objectives and take decisions within the planning and implementation process.



Initiators. The stimulus for the development of the urban district is provided by the *initiators*. In addition, they stipulate the development goals and project criteria. *Initiators* include, for example: mayors; councilors, directors of residential building firms and project developers, plus private interest groups of business enterprises and owners.



Investors. *Investors* take the necessary investment and implementation decision for the concept developed by the *initiators* and provide financial resources. They are owners of ground plots, existing buildings or infrastructures.



End users. In existing buildings, the *end users* consist mostly of the current owners, tenants and business operators, whereas in new building work they are not usually known as yet, and only come into play at the end of the development.



Influence groups. *Influence groups* are locally rooted interest groups such as local associations and societies or media and NGOs. The neighbourhoods affected and the general public are particularly significant, since for them the development of their district represents a transformation of their everyday living space.

Implementation level:

¹⁰ Deutsche Energie-Agentur GmbH (dena) – the German Energy Agency (2021): <https://www.dena.de/newsroom/publikationsdetailansicht/pub/dena-abschlussbericht-klimaneutrale-quartiere-und-areale/> (last accessed 12/12/2022)

As shown on the Stakeholder Map (Figure 1), the following stakeholder groups providing specific commercial and technical services within the planning and implementation process.



Developers. The *developers* are contracted by the *initiators* and are responsible for the overall coordination of the project. The role of *developers* can be contracted externally, e.g. to an engineering firm, or refurbishment and development agency, or internally, depending on competencies.



Facilitators. The *facilitators* form a point of contact for all stakeholders, and thus support internal and external communications and motivate participation. Generally speaking, the role is assumed by the core team of the *investors* and *initiators*.



Infrastructure operators. Besides the infrastructure for water supply, energy supply and data transmission, and for water disposal, the *infrastructure operators* also provide the necessary expertise.



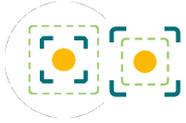
Planners and implementers. The *planners and implementers* bear the responsibility for the quality of the planning and physical implementation of the project, and for achieving the prescribed project aims. The various disciplines involved here include architecture, urban planning, energy planning, traffic planning, open space and landscape planning, research institutions and universities, skilled crafts and mobility providers and, in a supporting capacity if necessary, marketing and communications providers, certification providers, business developers, energy agencies and chambers of industry and commerce.



Operators. The *operators* of the buildings and infrastructures are responsible for smooth, expedient operation of the systems and components planned and installed.



Suppliers. Besides delivering technologies, components and systems, *suppliers* also assume a consultancy role, since they have in-depth experience of innovative technologies. Suppliers include product manufacturers, their intermediaries and wholesalers, retailers and also skilled crafts firms.



Superordinate authorities setting frameworks: *Federal government, states and municipalities* set the framework conditions for urban district projects by defining energy and climate policy targets and initiatives and creating overarching concepts.



Licensing authorities. In order to implement a climate-neutral district, approvals are required for the physical construction project and the use of specific technologies. The question of which *licensing authorities* must be involved in the development process depends to a major extent on the conception of the project and conditions on-site.



Financiers. The *financiers* provide the necessary financial resources for the development process, often under specific conditions. In the case of new construction projects, this role is normally assumed by classical financial institutions such as banks, whereas in the field of existing building refurbishment, there is a greater diversity of *financial backers*, e.g. cooperatives.

4. Stakeholder Interview

4.1. Interview partners / Interviewees

When selecting interview partners (interviewees), criteria was taken to cover as broad a spectrum of actors within the stakeholder groups as possible in order to identify the qualification demands and wishes throughout the entire planning and implementation process for climate-neutral districts. The following table provides an overview of the interview partners and their corresponding stakeholder group.

| Stakeholder group | Institution | Role/field |
|--|--|---|
| Municipalities | BUKEA Hamburg (Environment, Climate, Energy and Agriculture Authority of Hamburg) | Department for renewable energy and municipal heating planning |
| Developers | IBA Hamburg GmbH | Project management of energy and environment |
| Developers | HafenCity GmbH | Project management for sustainable construction |
| Facilitators | Hamburg-Altona District Authority | Active refurbishment management of Iserbrook/Sülldorf district concepts |
| Facilitators | City of Glinde | Climate protection management |
| Planners and implementers | Averdung Ingenieure & Berater | Divisional management of consultancy and concepts |
| Planners and implementers | Berliner Energieagentur GmbH (Berlin Energy Agency) | Service point for energy-efficient district development |
| Planners and implementers | eza! Energie- und Umweltzentrum gGmbH Allgäu | Business management |
| Planners and implementers | Hamburg Chamber of Skilled Crafts | ZEWU Task Domain Management |
| Planners and implementers/ Developers | Bauverein der Elbgemeinden eG | Technical and divisional management for the project development field |
| Planners and implementers/ Developers | KpHG Kommunalpartner Hamburg GmbH | Business management |
| (Infrastructure) operators | Hamburger Energiewerke GmbH | Decentralised projects/ districts |

Table 1 Overview of the interview partners

4.2. Interview guide

To conduct the stakeholder interviews, an interview guide was created, which contained guiding questions about the interviewee's qualification path and existing plus desired training opportunities. The guide served as a support

tool in the interviews, so that aspects outside the pre-formulated questions could also be addressed. The interview guide contained the following questions:

- How are you involved the planning and implementation of climate-neutral districts? What are your specific activities?
- What is your own personal training path and career (and/or that of your colleagues)? From what background do you approach the topic?
- Do you know what training program other people in similar positions have, and is there a network for exchanging ideas with one another?
- To what extent has your job/task profile changed as a result of the requirements of the energy transition?
- Which qualification offers have you personally already made use of and/or use regularly? Which ones do you know of beyond these (and – if applicable – why don't you use these)?
- Which training opportunities would you personally like to see?
- In your view, which qualification offers are useful in general and for different stakeholder groups in order to facilitate the cooperation with these groups and the implementation of your activities?

5. Analysis on competence requirement based on different stakeholder groups

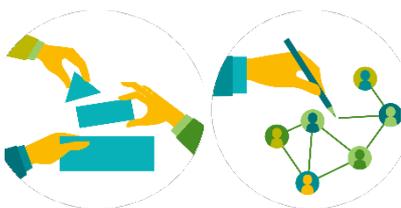
5.1. Areas of training and competencies

The areas of training required by the stakeholder groups can be subdivided into two categories. Professional *factual and methodological competencies*, include broad basic knowledge, subject-specific theoretical knowledge, practical knowledge, interdisciplinary thinking, project management, analytic skills, work organisation abilities and media competence. In addition there are *communicative, social and personal competencies*, which include, for example, the ability to work in a team, strong communication skills, ability to motivate, conflict management skills, negotiation skills, empathy, appearance, self-expression, creativity, willingness to learn and flexibility.

The following competencies of the stakeholder groups were derived from the results of the interviews and stakeholder workshops.

5.2. Professional, factual and methodological competence

With varying points of emphasis, broad-based educational and training backgrounds, which were not always topic-specific, could be identified in all stakeholder groups. This is attributable to the fact that no unified education and training path has been mapped out for climate-neutral districts.



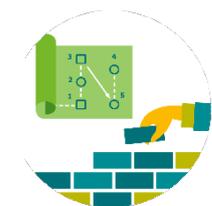
Developers and facilitators:

The *developers* and *facilitators* should be equipped with **broad-based subject-specific competence** as a result of their studies and/or previous professional career. However, in practice the specialised knowledge is usually confined to individual topic areas within the broader field of climate-neutral urban districts. For example, *developers* and *facilitators* with a background in engineering sciences and architecture possess specialist knowledge in the field of technical issues such as energy efficient building refurbishment, heating supplies and renewable energies. By contrast, urban planners and sustainability experts are less knowledgeable when it comes to questions of technical expertise or, for example, greenhouse gas balancing. Their specialist skills lie in topic areas such as mobility, adaptation to climate change, green planning or the social aspects of the district. To perform their roles, *developers* and *facilitators* should ideally be equipped with broad subject-specific knowledge and interdisciplinary thinking. In this way, situations can be better assessed and *planners* can be involved in a consulting rather than a decision-making role. Therefore, basic training courses and qualification opportunities that create **an interface between urban planning and energy topics** are particularly desired.

In addition to specialist engagement with topics related to climate-neutral districts, obtaining (application for) funding and contracting of services and other partners are core activities of *developers* and *facilitators*. Here too, there is potential for further expanding technical competence and, if desired, further training. The principal difficulty here is maintaining an overview of the constantly changing **funding opportunities and requirements**.

The roles of *developers* and *facilitators* are often located in administration departments. At the start, therefore, there is the challenge of finding one's way around the existing administrative structures. Additional training opportunities in this area would be welcome.

The relevant methodological skills of the *developers* and *facilitators* include competencies such as project management and work organisation, since the coordination of the project and, therefore, of all actors involved often lies in their hands. Important stakeholder groups with whom the *developers* and *facilitators* repeatedly come into contact are the *end users* or *influence groups*. In order to involve these in the development process for climate-neutral districts, concrete further education courses in **public relations**, particularly with a practical component, would make sense. The same applies to the organisation of consulting sessions and event series in the urban district.



Planners and implementers

Particularly as a result of the requirements of the energy transition, the roles of *planners and implementers* have become more closely linked with one another, since detailed planning must increasingly be configured with a view to implementation. In contrast to *developers* and *facilitators*, *planners and implementers* require **subject-specific knowledge**. Their basic education usually includes an **engineering degree**, which provides them with a good overview of technologies, but also treats topics such as the use of wind energy that have virtually no relevance at the urban district level. Those with professional experience bring considerable project experience to the table, but for the most part have little specialist knowledge in the field of new technologies. *Planners and implementers* of climate-neutral urban districts are therefore faced with the challenge of constantly deepening and expanding their specialist subject knowledge and bringing it up to date. At the technical level in particular, there are constant new developments and innovations that have

to be considered in order to design an ambitious, climate-neutral district. In this course of the brief study, the unavoidable confrontation with the complex of topics relating to heat pumps was addressed, and in particular, the use of heat pumps at district level. An understanding of the interplay of technologies is also important. On the one hand, therefore, training opportunities should be **increasingly devoted to innovative single technologies**, on the other hand, it should make *planners and implementers* **aware of opportunities for synergy**. At the same time, even today this stakeholder group has a shortage of qualified specialist staff who could increasingly progress the implementation of climate-neutral districts.

Planners and implementers must additionally possess expertise in the field of **funding opportunities**, since they must ensure that the detailed plan they have drawn up are compatible with the actual funding conditions. The same applies to the legal framework associated with this. Both areas are constantly undergoing change – hence the necessity for ongoing further training. A certain overview of projects currently being implemented in practice, functioning as **examples of best practice**, might help convince other stakeholder groups to undertake innovative projects. Expertise in the field of administrative work need not be so highly developed, but nevertheless a basic understanding is recommended in the interests of good cooperation.

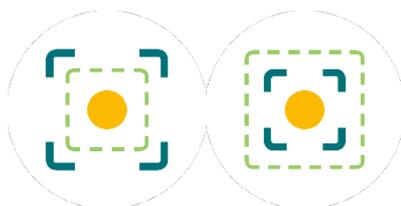
In the field of methodological skills, the ability to handle various **software programs** should be singled out first. These include, for example, geoinformation systems and energy system modelling programs, and the ability to use these must be acquired mainly with an emphasis on the spatial aspect of the urban district. Project management skills must be in place to organise one's own workload.



(Infrastructure) operators and suppliers

The *(infrastructure) operators and suppliers* require skills in both **the technical field and in sales**. The degree to which this expertise is specific depends on the relevant task profile of the staff member in question. However, particular emphasis was placed on the desire for training in new technologies such as heat pumps and low-temperature grids. Expertise in dynamic funding requirements, regulatory frameworks and tax affairs is also helpful for *(infrastructure) operators and suppliers*. Also required is a basic understanding of how planning processes proceed and how planning periods are configured, in order to simplify cooperation with *planners and implementers, developers and facilitators*. By contrast, the **product portfolio** of *(infrastructure) operators and suppliers* determines which technologies are implemented. Therefore, there is great potential for implementing innovative and ambitious concepts.

Specific methodological skills of *(infrastructure) operators and suppliers* include, on the one hand, **innovation management**. On the other hand, work organisation and coordination skills are required in order, for example, to combine the expansion of infrastructures with other measures in climate-neutral districts.



Superordinate framework-setting authorities
(municipalities, federal government, federal states)

The competencies of *superordinate framework-setting authorities* are similar to those of *developers* and *facilitators*. They, too, need **comprehensive expertise and subject-specific knowledge**, for example of energy technology and urban planning. These must be accompanied by an understanding of climate protection and adaptation to climate, plus an acceptance that these topic areas are no longer optional, and that *federal government, federal states* and *municipalities* are responsible for the implementation of climate-neutral districts. In addition, they must understand the entire planning and development process, including implementation, and identify potential obstacles within it. This forms the basis for **identifying the needs of the other stakeholder groups** as the superordinate framework-setting authority and in this way, for example, creating planning security for funding and regulatory frameworks. At the same time, this kind of overview at urban district level enables improved coordination, e.g. of infrastructure work. At the level of *municipalities*, additional expertise in the areas of **funding opportunities and legislation** is a *sine qua non* for implementing climate-neutral districts in their own administrative area.

A methodological competency of *federal government, federal states* and *municipalities* that should be emphasised here is **change management**, in order to exhaust potential and react to innovation. But expertise in information technology (IT) and **digitisation** of processes is also necessary.



Licensing authorities

The *licensing authorities* are equipped with in-depth specialist knowledge in specific areas, e.g. soil and water protection or listed buildings. Expertise in the fields of carbon neutrality, climate protection and adaptation to climate, and an understanding of its relevance, are mostly only present as a personal interest of individuals. In modern times, therefore, *licensing authorities* need at least a **basic understanding in the field of climate-neutral districts** and with regard to the impact of new technologies on assets worth protecting, in order to advance these projects through rapid approval procedures, e.g. in urban development planning. However, the training required here is not enough on its own. In addition to this, there must be more unified approval procedures, and the role fulfilled by the *licensing authorities* in the context of planning and development processes for climate-neutral districts expanded to include the **service concept**.



End users and influence groups

End users and *influence groups* should possess **basic knowledge** in the area of climate-neutral districts. It helps if this is accompanied by an understanding of necessary changes, such as urban district redevelopment and climate protection measures, and the benefits associated with these. However, the experiences of other stakeholder groups indicate that there is still a need for training here. The question of whether this can be addressed by autonomous awareness of further training programs or information initiatives on the part of other stakeholder groups must be resolved elsewhere. However, the aim should be to create a level of training such that *end users* and *influence groups* **do not oppose the transformation process towards climate-neutral districts, but rather positively support it.**

5.3. Communication, social and personal skills

In the interviews conducted it became clear that communication, social and personal skills play an important role for all stakeholder groups. Moreover, it is possible to assert that, in terms of communication, social and personal skills, there is no essential difference between the stakeholder groups. Descriptions of separate skills for each stakeholder group will therefore be omitted.

For the stakeholder groups of the *municipality, developer, facilitator, planner and implementer* in particular, **good communication skills, ability to convince and ability to motivate** are essential in order to advance the development and planning of climate-neutral districts. Here it is a question of communication both with *end users* and *influence groups* and with *operators* or, for example, policymakers. The stakeholder groups must be able to **communicate content to the right audience** and assert themselves against other stakeholders if they are to implement ambitious goals. To achieve this, empathy and the ability to create trust are just as important as negotiating skills. At the same time, *influence groups, end users and licensing authorities* must be **open to change**. To make climate-neutral districts a reality, perseverance and/or **staying power** is demanded of all stakeholder groups, because planning and development processes often take several years. In particular, the superordinate authorities responsible for setting the frameworks – such as *federal government, states and municipalities* – should not **lose sight of the objectives** even in difficult situations or under changed regulatory frameworks, but continue to pursue them with commitment. Because of the demands of working with other actors in a planning and development process, and communicating with one's own team, a certain level of willingness to communicate, **willingness to cooperate** and teamwork skills are demanded of all stakeholder groups. At the same time, conflict management skills are also required to handle differing interests and points of view in a constructive manner. Since regulatory frameworks change and innovations occur regularly during the development of climate-neutral districts, the stakeholder groups must always remain **flexible and ready to adapt**, and bring to the process a great interest in new developments and information and a willingness to learn about these. In this regard, despite the current time pressure, it makes sense to preserve a certain ability for reflection. But it also does no harm to have an unobstructed view beyond one's own concerns, or beyond the district boundary.

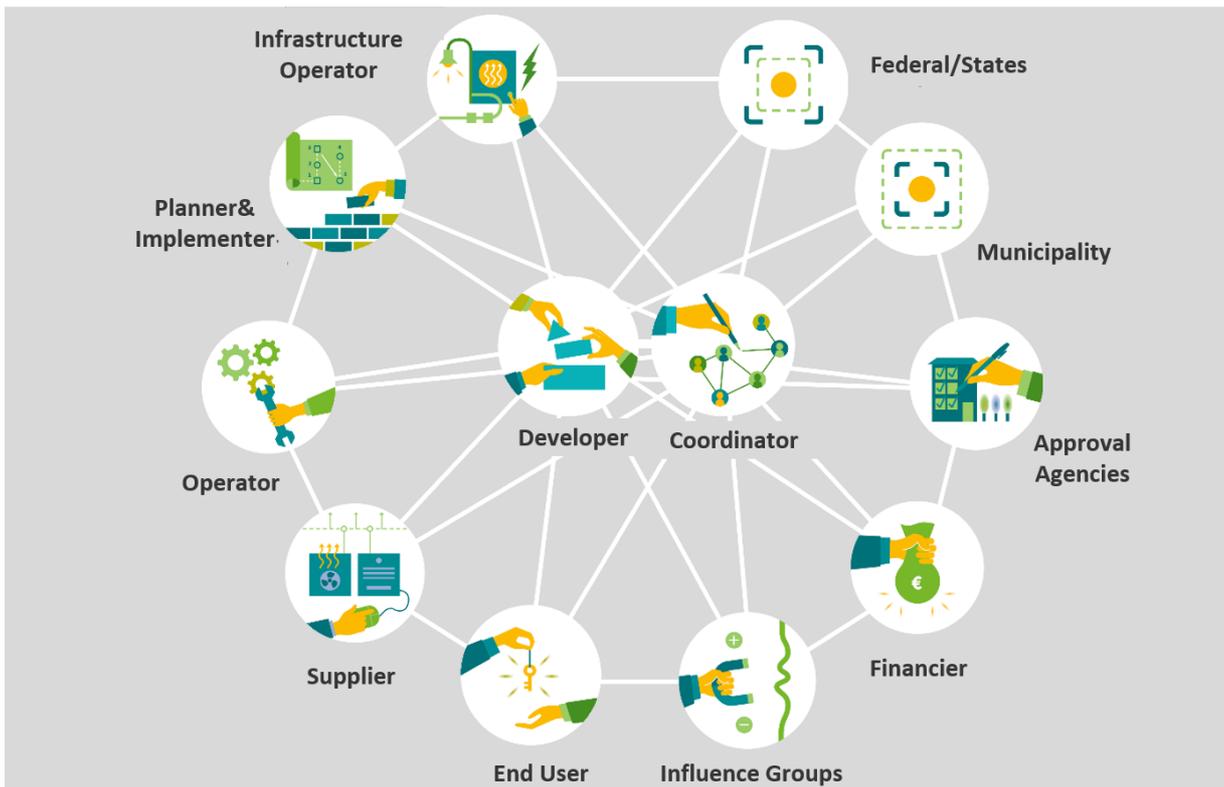


Figure 2 Networking of the stakeholder groups (source: ZEBAU GmbH)

6. How existing training opportunities match the professional requirements of stakeholder groups

During the research into existing education and further training offers in Germany, it very quickly became clear that there are scarcely any training opportunities that are devoted exclusively to the field of climate-neutral districts. Therefore, the research also took into consideration training opportunities that belonged to the cluster of topics surrounding climate neutrality, climate protection and the energy transition. Additionally, in the course of the interviews and stakeholder workshop, factors such as the cost of training programs, the time outlay required for them and the demand for them were discussed.

Attendance at training and further training programs always entails **costs**. Therefore, not all training programs in Germany are free of charge. Depending on scope and format, the costs can vary from around 50 to 2,000 Euros. Moreover, it is noticeable when comparing the cost structure of different providers that associations and networks often offer their further training programs at lower prices than professional institutions.

Additionally, besides any expense claims they entail, travelling to and from courses, and taking part in them, costs valuable **time** that is not always available during the working day. In this regard, the digitisation of training and further training programs due to the coronavirus pandemic represents a considerable alleviation. In the stakeholder workshop, therefore, short-duration courses (time outlay 1–2 hours) were only insignificantly preferred to more time-intensive programs, and in-person events only marginally preferred to online seminars. As a whole, however, there was a consensus that the length and depth of training programs depended on the topic they concentrated on, and ought to be appropriate and suitable for this.

The heightened need for the energy transition in Germany owing to the geopolitical situation, and the constant foreshortening of the time window for acting on climate protection are increasing the demands on all stakeholder groups and the pressure to start acting more quickly. For these reasons, a **high level of demand** for training opportunities relating to energy issues can be observed at present. To cope with the need for training in the long term, qualified lecturers capable of inspiring enthusiasm will be particularly in demand.

In the interviews it became clear that all the actors questioned have a higher education background and in the course of their careers have made use of various training and further training programs. However, since the education and study programs and professional training opportunities in the field of climate-neutral districts in Germany are very extensive, only a selection will be presented below. A selective overview of study programs in North Germany and the training programmers in Germany that was researched can be found in the Appendix.

6.1. Degree education

The programs at German universities and polytechnics in the field of climate-neutral districts, and their corresponding study and education outcomes, take diverse forms. Over the past few years, the programs have constantly evolved and become more specialized. Alongside classical engineering courses, e.g. engineering science, industrial engineering and mechanical engineering, there is a plethora of newer study programs which focus on topics such as renewable energy sources, renewable resources and supply and building technology. In addition to this, there is a broad range of study programs in the fields of architecture, urban planning and development, sustainability, environmental and natural sciences, communications and management science. In addition, there is a wide range of craft and technical training in Germany.

6.2. Part-time training and further training

The field of in-service training and further training is very diverse and can be subdivided into various levels.

For the area of superordinate, municipal climate protection, the BMWK offers various activities on the topic of municipal climate protection as part of the **national climate protection initiative**. The opportunities include an entry-point program for climate protection managers and events that provide information on funding opportunities within the framework of the municipal guideline. In addition, the Federal Ministry of Housing, Urban Development and the Building Industry (BMWSB), in conjunction with the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) and KfW, offers various training opportunities for planning and implementation at urban district level as part of the **accompanying research to energy efficient urban redevelopment**. These mainly consist of expert discussion on various topics and presentation of practical examples. The **Green District Heating Platform** of the Energieeffizienzverband für Wärme, Kälte und KWK e.V. (AGFW) offers events on the topic of the transition to CO₂-saving, climate-friendly heating supply using district heating. The **Centre of Expertise for the Municipal Heating Transition (KWW)** offers advice in the field of decarbonising the heating supply.

Those offering training courses on **energy efficient aspects** of the development of climate-neutral districts include the energy agencies (e.g. dena), the chambers of skilled crafts (e.g. Elbcampus Hamburg), the association of architects, individual manufacturers and, for example, Heinze, the TÜV (Technical Supervision Association), Aktionskreis Energie (online, plus visits to practical examples), Energie Brain pool, the German Sustainable Building Council (including further education to become a consultant) and the Association of German Engineers. The AFGW offers various staff training programs, particularly in the field of review of expert reports (for energy-efficiency performance indicators according to AGFW FW 309-1 and FW 309-5, and for specific CO₂ emissions factors according to AGFW 309-6).

The **energy consultancy courses** on offer is highly diversified. Those offering training opportunities include the Deutsches Energieberater-Netzwerk e.V., the TÜV Akademie GmbH, the ina Planungsgesellschaft (TU Darmstadt), Studiengemeinschaft Darmstadt, Ils, Fernakademie für Erwachsenenbildung, the chambers of skilled crafts (e.g. Munich and Upper Bavaria, Koblenz, Hannover, Hamburg Elbcampus), "G.I.H. Gebäudeenergieberater, Ingenieure Handwerker e.V. Stuttgart" (e.g. together with Schwerin Chamber of Skilled Crafts), "Öko-Zentrum NRW GmbH" (Akademie 24) and "eza! gGmbH Kempten".

The Federal Employment Agency lists 4430 results under the heading energy-efficient construction and redevelopment. These include the following qualifications: energy consultant for existing non-residential buildings, professional energy consultant, and energy consultancy software – software for energy efficiency experts, energy efficient construction and redevelopment, energy efficiency experts for residential buildings.

In the **housing and real estate sector** there are also various further training programs on offer that are directly or indirectly related to climate-neutral districts. The Verband norddeutscher Wohnungsunternehmen e.V. offers conferences and seminars on relevant topics. Forthcoming events, for example, Current energy efficiency issues or the future of supply. In addition, some non-governmental organizations on federal state level in the field of building and real estate periodically offer conferences and seminars on changing topics. To mention some examples, there is Climate Neutrality – Strategy and Approaches to Solutions for Housing Enterprises (including sustainable buildings, municipal heating planning), Climate Protection 2030/2045 (short-time measures until 2030, systems concepts and district heating networks until 2045) or Optimising Existing Properties Economically and Ecologically.

In addition, various institutions organise offers on diverse topics at a national, regional or local level. For example, the **Informations- und Kompetenzzentrum für zukunftsgerechtes Bauen** offers various training programs on behalf of the Federal Ministry. In 2022, overarching topic areas included 'Energy-efficient House Plus', 'The Building Stock Challenge', 'Planning, Design and Technology with Innovations', 'Prospects for Sustainable Transport' and 'The Energy Transition in the Building Sector'. In addition to the federal government, states, municipalities and cities offer various further training courses and opportunities for exchanging ideas. These include Bauinfo Berlin, the Schleswig-Holstein Energy and Climate Protection initiative or the Energy Working Group of the City of Herrenberg.

Besides the range of seminars, courses and workshops on offer, there are also a few **periodically recurring conferences**. These include, in particular, the German Heating Conference and the Berlin Energy Conference. Additionally, **universities** and **research institutions**, e.g. the Fraunhofer Institute ISE, also offer various series of events.

In addition to this, mention should be made of the use of various *networks* as an adjunct to ‘classical’ training and further training options. These constitute, both locally and throughout Germany, an important exchange platform, and in recent years they have already established themselves in connection with various focal topics. Moreover, networking of existing networks and the actors active within them offers further potential for meeting existing training needs.

In the field of **communication, personal and social skills** there is a wide-ranging selection on offer that addresses the competencies required by the stakeholder groups. For example, programs in this field are also offered by municipal and local authority further education providers. However, almost all training opportunities are detached from the topic area of climate-neutral districts. One of the few on offer are the workshops on the topic of climate communications provided by the German Meteorological Society.

7. Summary and suggestions

The field of climate-neutral districts is on the one hand fairly new and, at the same time, highly versatile. Surmounting the steps in the process of achieving climate protection targets in urban districts has only begun to develop into a defined field of activity in recent years. Here there is a need to create guidelines for generally binding principles for action, implementation methods and success criteria.

This study paper shows that actors within the planning and implementation process for climate-neutral districts in practice take on a wide range of tasks and roles and, therefore, are almost always reencountered in more than one of the stakeholder groups that were identified as part of the ‘Carbon Neutral Urban Districts and Areas’¹¹ study. As a whole, however, it emerges that all stakeholder groups with *subject-specific, factual and methodological competencies* on the one hand and *communication, social and personal skills* on the other must meet the requirements of two areas of training in order to live up to their role in the process of planning and implementing climate-neutral districts. Moreover, the training needs – i.e., the required skills – differ between the stakeholder groups. In the field of subject-specific and factual competencies, *developers, facilitators, federal government, states and municipalities* require comprehensive, subject-specific knowledge in various topic areas combined with interdisciplinary thinking. The *planners and implementers* and, in part, the *(infrastructure) operators and suppliers*, by contrast, require subject-specific knowledge, particularly in the technical field. *Licensing authorities, end users and influence groups* should possess a certain basic understanding in the field of climate-neutral districts in order to support their implementation. The methodological skills range from project management and work organization (*developers and facilitators*) to the use of software programs (*planners and implementers*), increased digitalization (*federal government, states and municipalities*) and innovation management (*(infrastructure) operators and suppliers*). The key *communication, social and personal skills* across all stakeholder groups are: an interest in the subject area, the will to become involved in the implementation of climate-neutral districts and, the associated stamina to pursue these ambitious targets consistently and yet with agility. Achieving this requires a certain ability to inspire others, which is disseminated to other stakeholder groups through appropriate communication.

In theory, many of the competencies described above can be learned through appropriate training programs. However, a great deal is demanded of the stakeholder groups in the field of climate-neutral districts, and the actual characteristics of the competencies depend in the personality in question. For this reason, several actors work together in teams in order to bundle subject-specific and social/personal skills. But the **exchange of ideas** in the course of planning and implementation processes involving other stakeholder groups and **networking** also play a decisive role here. Only if each stakeholder group understands their own role and that of the others and, at the same time, there is a good relationship between one another and a certain bond between the various stakeholder groups, the implementation of climate-neutral districts in Germany can be successful.

The training and further training initiatives in the field of climate-neutral districts in Germany are already highly diverse and basically meet the training needs of the stakeholder groups that have been identified. Besides the federal ministries, energy agencies, chambers of skilled crafts and of architects, individual manufacturers, associations, universities and research institutions, for example, offer a range of further training at state and regional level covering a diverse range of topics. Moreover, many training programs in Germany are topic-focused and already demand in-depth subject knowledge. For *developers, facilitators and municipalities*, however, it is essential that **teaching the basics** through appropriate training programs to ensure broad subject-specific competence. When starting work, in particular, there is a need for a structured introduction to these contents. The training opportunities for climate protection managers by the national climate protection initiative is going in the right direction in this regard. Additionally, it has become clear that **training for innovative technologies and how to use**

¹¹ Deutsche Energie-Agentur GmbH (dena) – the German Energy Agency (2021): <https://www.dena.de/newsroom/publikationsdetailansicht/pub/dena-abschlussbericht-klimaneutrale-quartiere-und-areale/> (last accessed 12/12/2022)

them is lacking. At present, there is a demand among *planners and implementers* for the topic of heat pumps in particular. But the application of technologies and concepts at the **district level** has hardly been addressed by German training to date, or not at all.

Possible approaches to satisfying the training preferences identified would be, for example, increased cooperation between providers of further training programs with the aim of staging common events as well as thinking about competence transfer in new projects with innovative solutions right from the start. But also combining specialised content to illustrate synergies and more programs for communication, would be desirable.

Appendix

1. Relevant study programs (focus on North Germany)

| | |
|---------------------------------------|---|
| University of Flensburg | B.Eng. in Energy Sciences, M.Eng. in Systems |
| Europa Universität Flensburg | M.Eng. in Energy and Environmental Management |
| Christian Albrecht University of Kiel | M.Eng. in Environmental Management M.Sc. in Urban and Regional Development M.Eng. in Industrial Engineering |
| Kiel University of Applied Sciences | B.Eng. in Civil Engineering B.A. in public relations and corporate communications, B.Eng. in Industrial Engineering, B.Eng. in Electrical Engineering, M.A. in applied communications sciences, M.Eng. in Industrial Engineering |
| Lübeck University of Applied Sciences | B.Sc. in General Electrical Engineering, B.Eng. in Civil Engineering B.A. in architecture, B.Sc. in Electrical Engineering – Energy Systems and Automation, B.Eng. in Sustainable Building Technology, B.Eng. in Renewable Energy Sources, B.Sc. in Urban Planning, B.Sc. in Environmental Engineering and Management, B.Eng. in Industrial Engineering, M.Eng. in Civil Engineering M.A. in architecture, M.Sc. in Urban Planning, M.Eng. in Industrial Engineering, |
| HafenCity University Hamburg | B.Eng. in Civil Engineering B.A. in architecture, |

| | |
|--|---|
| | <p>B.Sc. in Urban Planning,</p> <p>B.Sc. in Bachelor in Technical Building Equipment with Digital Infrastructure ('TGA mit DI')</p> <p>M.Eng. in Architectural / Infrastructural Engineering</p> <p>M.Eng. in Resource Efficiency in Architecture and Planning (REAP),</p> <p>M.A. in architecture,</p> <p>M.Sc. in Urban Planning,</p> |
| Hamburg University of Applied Sciences (HAW) | <p>B.Sc. in Energy and Plant systems</p> <p>B.Sc. in Environmental Technology</p> <p>B.Sc. in Industrial Engineering</p> <p>B.Sc. in Renewable Energy Systems and Energy Management</p> <p>M.Sc. in Renewable Energy Systems – Environmental and Process Engineering</p> <p>M.Sc. in Industrial Engineering</p> |
| Hamburg University of Technology | <p>B.Eng. in General Engineering Science</p> <p>B.Eng. in Civil and Environmental Engineering</p> <p>B.Eng. in Green Technologies: Energy, Water, Climate</p> <p>M.Eng. in Electrical Engineering</p> <p>M.Eng. in Energy Systems</p> <p>M.Eng. in Environmental Engineering</p> <p>M.Eng. in Renewable Energy Sources</p> |
| Leuphana University Lüneburg | <p>B.Sc. in Global Environmental and Sustainability Studies</p> <p>B.Sc. in Environmental Sciences,</p> <p>M.Sc. in Sustainability Sciences</p> |
| Hochschule 21 Buxtehude | <p>B.Eng. in Architecture,</p> <p>B.Eng. in Civil Engineering</p> <p>B.Eng. in Building Technology Engineering</p> |

2. Overview of existing training opportunities (selected)

| Provider | Overview of event offerings |
|---|--|
| National Climate Protection Initiative | https://www.klimaschutz.de/de/service/veranstaltungen |
| Energieeffizienzverband für Wärme, Kälte und KWK e.V. | https://www.agfw.de/technik-normung/zertifizierungqualifizierung |
| 'Green Heating Initiative' of the AGFW | https://www.gruene-fernwaerme.de/orientierung-geben/unsere-wissensangebote |
| Association of Landlords with Values | https://bildung.vnw.de/sitepages/veranstaltungen.aspx |
| Akademie der Wohnungs- und Immobilienwirtschaft GmbH | https://awi-vbw.de/tagungen/auf-dem-weg-zur-klimaneutralitaet-strategien-und-loesungs.html |
| Mitteldeutsche Fachakademie der Immobilienwirtschaft e.V. | https://www.mfa-erfurt.de/seminarkategorie/technik |
| Südwestdeutsche Fachakademie der Immobilienwirtschaft e.V. | https://www.sfa-immo.de/sfa-veranstaltungen |
| Europäisches Bildungszentrum der Wohnungs- und Immobilienwirtschaft (EBZ) | https://ebz-training.de/?page=3 |
| Quartiers Akademie – Baden-Württemberg | https://www.quartiersakademie.de/veranstaltungsangebot/ |
| Haustec Academy | https://www.haustec.de/weiterbildungsangebote-und-aufzeichnungen |
| DGNB Academy (central training/further training platform of Deutsche Gesellschaft für Nachhaltiges Bauen - DGNB e.V.) | https://www.dgnb-akademie.de/akademie/ |
| Deutsches Energieberater-Netzwerk e.V | https://www.deutsches-energieberaternetzwerk.de/den-akademie/lehrgaenge/ |
| TÜV Akademie GmbH | https://die-tuev-akademie.de/energieberater-tuev-euet001 |
| Ina Planungsgesellschaft GmbH (in cooperation with TU Darmstadt) | https://energieberatung-ausbildung.de/ |
| Studiengemeinschaft Darmstadt | https://www.sgd.de/kursseite/gebaeudeenergieberaterin-hwk |
| Institut für Lernsysteme | https://www.ils.de/fernkurse/gebaeudeenergieberater-hwk |
| Fernakademie für Erwachsenenbildung | https://www.fernakademie-klett.de/technik-it/klimaschutz-nachhaltigkeit-energie/gebaeudeenergieberater-hwk/ |
| Chambers of Skilled Crafts | e.g. https://www.elbcampus.de/weiterbildung/basismodul-wohngebaeude-und-nichtwohngebaeude-energieeffizienz-experte-dena-anerkannt |
| ZEBAU GmbH | https://www.zebau.de/projekte/energieberaterinnen-gesucht/ https://www.zebau.de/fortbildung/ |

| | |
|---|---|
| Bundesverband Gebäudeenergie- berater, Ingenieure Handwerker e.V. | https://www.gih.de/gih-grundkurs-energieberatung/ |
| Eco-Center North Rhine-West- phalia | www.oekozentrum.nrw |
| Eza! Energie und Umweltzentrum Allgäu | www.eza-allgaeu.de |
| Energy-efficient Urban Redevel- opment Programme | https://www.energetische-stadtsanierung.info/ |

Website



Wechat

