Financing for energy efficiency in buildings in China and Germany – a scoping study –

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Fellowship program and organization introduction

China-EU NGO Exchange Fellowship 2013: The EU and China are developing increasingly closer relations to lead the global transformation towards a low-carbon economy. Low-carbon urban development as a solution to climate change is an area for specific cooperation potential between organizations from the EU and China. To develop new partnerships for cooperation on the level of civil society, the China Association for NGO Cooperation (CANGO) and the China Civil Climate Action Network (CCAN), in cooperation with the Rhine Academic Forum e.V., organise the China-EU NGO Exchange Fellowship 2013 on Climate Change & Low-carbon Urban Development. The exchange fellowship is financially supported by Stiftung Mercator.

Greenovation Hub: G:HUB is a grass-root environmental NGO with a global outlook. G:HUB believes development should be ecological, and only by collaborative effort can environmental problems be solved. We provide innovative tools to enable wider public participation in environmental protection and foster joint power of civil society, business and government to accelerate China's green transition. The Climate and Finance Policy Center of G:HUB seeks positive changes in climate and sustainable finance via high-quality research and analysis. We promote the development and implementation of sound climate and financial policies, and encourage critical dialogue among different stakeholders.

Germanwatch e.V.: Following the motto "Observing, Analysing, Acting", Germanwatch has been actively promoting global equity and the preservation of livelihoods since 1991. In doing so, we focus on the politics and economics of the North with their worldwide consequences. The situation of marginalised people in the South is the starting point of our work. Together with our members and supporters as well as with other actors in civil society we intend to represent a strong lobby for sustainable development. We endeavour to approach our aims by advocating food security, responsible financial markets, compliance with human rights, and the prevention of dangerous climate change.
Germanwatch is funded by membership fees, donations, grants from the "Stiftung Zukunftsfähigkeit" (Foundation for Sustainability), and by grants from a number of other public and private donors.

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English summary

The energy consumption of the building sector in China as well as in Germany constitutes a large share (approximately one third) of the overall national energy consumption. Improvements in the building sector's energy performance not only have positive effects on energy savings, which contributes then to climate change mitigation efforts, but they also generate significant additional benefits, such as enhancing energy security, increasing employment, innovation and local value creation.

In both China and Germany, there is great need for improving the energy efficiency (EE) of buildings. Both countries face various challenges, with a lack of financial resources and to some extent of incentives constituting core barriers. Hence, this scoping paper identifies the financial policies existing in China and Germany at the national level for enhancing EE in buildings. Further, case studies have been conducted on the provincial/federal state and city levels in order to also reflect their contributions. The scoping paper aims at identifying potential areas where knowledge exchange and experience sharing could be valuable in order to accelerate in both countries the improvement of buildings' energy performance.
The characteristics and background situations in the building sectors of China and Germany are quite different. While China has four different climate zones which require tailor-made building policies, Germany has only one climate zone. Furthermore, whilst China faces the dual challenge of addressing both a large existing building stock as well as rapid growth in new buildings, in Germany the main focus is on the existing building stock. This is because 75% of the current building stock in Germany was built before the first thermal insulation (policy) came into force in 1979, and because building codes for new buildings are already quite strict.

Building codes exist in both countries. In China the codes differ depending on the climate zone; in Germany the Energy Saving Ordinance fulfils this purpose. Both countries also have labelling systems for greener/more efficient buildings, which go beyond the mandatory building codes. In China there is a star system (one to three stars) for new buildings, while in Germany the German development bank's (KfW) building standards apply to both existing and new buildings. However, the approaches taken towards financing EE in buildings differ between the two countries. In China, financial support from the central government is channelled to the provincial and local governments who then distribute it, potentially with additional finance from the provincial or local governments, to project developers and investors. The main instruments used are grants, but various tax reductions are also provided to material producers. It is interesting to note that, in China, low interest loans for house owners are also under discussion. In Germany, financial support is mainly channelled by KfW, in part via commercial banks, to house owners/buyers. Further support is available from the Federal Office of Economics and Export Control (BAFA). The main instruments used are concessional loans, but to some extent also grants. Income tax reductions for those retrofitting their buildings are under discussion. Private investment in China is mainly promoted by the Green Credit Policy of MEP, PBC and CBRC[1], which is targeted at encouraging commercial banks to provide more loans to EE projects. In Germany, private investment is incentivized by the funding programmes of KfW and BAFA.

[1] MEP= Ministry of Environmental Protection, PBC= People's Bank of China, CBRC= China Banking Regulatory Commission.

In China the central government provides the overall framework, policies and targets, whilst local governments are expected to conduct the measures to fulfil the assigned energy and carbon intensity targets. With regards to financial support for building EE, there is great variation at the regional level; and the differences also relate highly to the performance of different regions (provinces/cities) in regard to building EE. In Germany, the central government sets the overall targets and approaches and the federal state or city government can set additional targets or policies.

While each country has its own context and challenges to overcome regarding EE in buildings, some similar hurdles exist in China and Germany. A wide range of public financing policies and approaches have taken place at different levels in both countries, and experiences and approaches could therefore be shared. The paper concludes by proposing questions to be addressed in such an experience sharing and solution exploration.

1. Introduction

In 2009, almost 32% of the world's final energy consumption was being used in the building sector (Hilke/Ryan, 2012, 26). In the past, many public policies have focused on energy standards for buildings, and while in respect to new buildings this has been successful, it could not however avoid the overall increase in energy use in the building sector (Hilke/Ryan, 2012, 29).

Both in China and Germany, the energy use of buildings needs improvement. At the recent Major Economies Forum (MEF), both countries agreed that increasing buildings' energy performance should be the focus of MEF's first initiative and that they intend to share experiences in this regard with each other (MEF, 2013). It is crucial that this process does not only exchange business-as-usual experience, but rather creates additional dynamics for improved energy performance of buildings. While in Germany the main focus is to improve the energy renovation rate of the existing building stock from 1% to 2%, and later to 3 % per annum, for China there is foremost the dual challenge of addressing energy efficiency (EE) in both the fast growth of new buildings and in the huge stock of existing buildings. Here, many new houses are currently being constructed and it is estimated that in 2030, 40% of the buildings will have been constructed after 2010 (Liu/Meyer/Hogan, 2010 cited in Draugelis/Li, 2012). Therefore it is now crucial to ensure that these buildings have high-energy standards in order to avoid a lock-in effect for many years to come.

Improvements in EE of buildings will, on the one hand, require large-scale investments. Despite the fact that increasing EE in buildings is seen by many as one of the least-cost options in reducing greenhouse gas (GHG) emissions (Draugelis/Li, 2012), respondents to a questionnaire from the European Commission (no date), identified the lack of financing as one of the main problems for increasing EE in buildings. High investment costs and slow pay back creates a major hurdle. Despite these barriers, large-scale investments in energy efficiency provide on the other hand enormous opportunities. These opportunities are not only related to climate and energy security[2], but such investments also generate social and economic opportunities. For instance, such investments can lead to an improved living comfort (insulated buildings protect better from cold or hot outside temperatures) as well as a decrease in indoor air pollution (Richerzhagen et al., 2008, 30; Levine et al., 2007). Further, investment in energy efficiency in buildings increases construction demand and hence creates new jobs in the construction as well as the manufacturing sector (Shui/Li, 2012, 53). According to Jaeger et al. (2011, 81) the building sector offers jobs for people with a diverse set of knowledge and experience, and even allows people to "operate in this sectors after a few months of on-the-job training".[3] Finally, investment in this sector can stimulate domestic consumption and demand (Shui/Li, 2012, 53), trigger innovation as well as stimulate regional value creation. For instance, in Europe such investment has high potential to fight the

[2] See Richerzhagen et al., 2011, 26.

[3] Diefenbach et al. (2011, 56, 90) estimate for instance that in Germany in 2010 the KfW programme on energy efficient construction ("Energieeffizient Bauen") has led to investments of 14,287 million € (including the KfW support) and thereby, in regard to direct and indirect employment effects, led to the creation of 192,000 'person-years' of employment. One person-year is calculated as the employment time of one person, undertaking the sector's average working time, for one year. However, it must be noted that direct and indirect employment effects relate not only to the additional investment in energy efficiency but in general to the overall building construction. Similarly, in 2010 the retrofitting measures supported by the KfW programme for energy efficient retrofitting ("Energieeffizient Sanieren"), which had energy efficiency related investments of 6.9bn € (including the KfW support), are estimated to have led to direct and indirect employment effects of 92,500 person years (Diefenbach et al. 2011, 56 et seq.).

economic crisis.[4] A general description of potential financial tools for enhancing EE in buildings is described by Hilke/Ryan (2012).

This scoping paper looks in regard to Germany, at the EE related aspects of the physical building, such as insulation of walls (outer walls, cellar walls and roofs), windows, heating (including solar thermal) as well as air conditioning.[5] Renewable energy (RE) policies, besides those for heating, are not further described within this paper. However, they will also play an important role in making buildings "greener". Especially if reliance on electricity for heating purposes (i.e. heat pumps) increases, it will be important for the overall environmental performance of the building that the electricity is generated by RE rather than fossil fuels. Particularly the building envelope (insulation) is of great importance, since other energy efficiency measures such as those for heating and cooling are highly dependent on the state of the building envelope (Hilke/Ryan, 2012, 27).

Regarding China, this paper addresses building EE. This is often referred to in Chinese policy and research papers as a general term, which includes the various themes of energy saving in buildings, green buildings, renewable energy installations, efficient lighting, and new building materials. Although cement is one of the main contributors to CO_2 emissions, and often buildings are torn down after a decade or two (Biello, 2012), due to our scope of research, energy consumption during the construction phase is not addressed within this paper.

For both countries, the main focus of the paper will be on residential buildings, whilst public buildings will be only partially addressed. Since there are already many reports outlining targets and policies for the building sector in China and Germany, this paper aims at displaying the different fiscal policies and capital resources in place for financing building EE in China and Germany at both the national and local level. Based on this, the authors identify a diverse set of questions to facilitate knowledge and experience exchange between Chinese and German experts, which may contribute to the scaling-up of building EE in both countries.

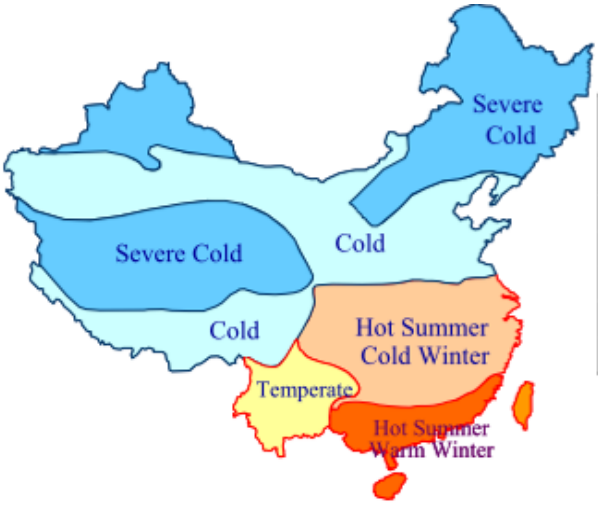
[4] For more information on this, see for instance Diefenbach et al., 2012 and Jaeger et al., 2011.
[5] See also Böhmer et al., 2013, 8.

2. Status quo of the building stock

2.1 China

In 2010, the existing building stock in China was approximately 48.6bn m², 38.7% of which was located in urban areas (Shui/Li, 2012, 12). China has a fast growing building stock, with an average of 1.7bn m² of new floor area added each year between 2000 and 2010 (Shui/Li, 2012, 34). It is estimated that China will add a further 4 to 5 billion square meters of new buildings in urban areas between 2015 and 2020 (MOHURD, 2012, 16). With slightly more than half the population already living in urban areas, China is still experiencing a building boom and urban growth. This is expected to continue, driven by the influx of an estimated 350 million people into cities over the next 20 years (Worldbank, 2012). Together with the urbanisation process, the energy demand in buildings has risen strongly – with the final energy consumption increasing by 175% between 1990 and 2005 (Rommeney, 2008). Furthermore, between 1996 and 2010, floor space used per person (in urban residential buildings) doubled from 11m² to 22m² (China Statistical Yearbook 1997-2010, cited in Schroeder/Guo, unpublished draft).

China is separated into different climatic regions, namely "cold and severely cold zones, a hot-summer and cold-winter zone, and a hot-summer and warm-winter zone" (Draugelis/Li, 2012, see figure 1). The situation of the building sector differs greatly between Northern and Southern China, as well as between rural and urban areas. Hence, the building sector's energy consumption is generally classified into four categories: (1) energy consumption for heating in northern urban buildings; (2) energy consumption of urban residential buildings (except heating in the north); (3) energy consumption in public buildings (except heating in the north); and (4) energy consumption of rural residential buildings (Qi, 2010, cited in Shui/Li, 2012, 16).



Climate Zones	Mean Monthly Temperature	
	Coldest	Hottest
Severe Cold	≤ -10 °C	≤ 25 °C
Cold	-10 - 0 °C	18-28 °C
HSCW	0- 10 °C	25 - 30 °C
HSWW	>10 °C	25 - 29 °C
Temperate	0 - 13 °F	18 - 25 °C

Figure 1 China's climatic zones
Source: Shui/Li, 2012, 16.

In China, the energy consumption of the building sector constitutes about 27.5% of the overall energy consumption (Liu, 2012). In 2008, the primary energy consumption of buildings reached almost 380 million tons of oil equivalent (excluding biomass energy), constituting an increase of 150% in comparison to 1996, with associated carbon emissions of 1,260 million tons

(Shui/Li, 2012, 10). The targets for building EE have large mitigation potential, as from 2006-2010, 20% of the overall targets for emissions reductions and energy savings were made up by the targets for building EE (Liu, 2012). The energy consumption per category can be found in table 1.

Table 1 Energy consumption in buildings per category in 2011
Source: Tsinguha University Centre for Energy Saving Studies, 2013, 4; and own calculations

Unit	Building area billion m^2	Energy consumption 10000 tce (tonnes of standard coal equivalents)	Energy consumption tce/m^2
Energy consumption for heating in Northern urban buildings	10.2	16646	0.016
Energy consumption of urban residential buildings (except heating in the north)	15.1	15350	0.010
Energy consumption for public buildings (except heating in the north)	8	17056	0.021
Energy consumption for rural residential buildings	23.8	32357	0.014
Total / average	46.9	81409	0.017

In urban residential buildings, most of the energy (47%) was being used for heating purposes in 2008 (see figure 2), with energy consumption for air conditioning also strongly increasing (Shui/Li, 2012, 28). In recent years, there has been a steady increase of energy use for heating in residential buildings in the Hot Summer Cold Winter (HSCW) zone, and the energy use for cooling purposes has also increased strongly in the Hot Summer Warm Winter (HSWW) and the HSCW zone (Shui/Li, 2012, 10). This highlights the great necessity for EE improvement in buildings, especially in cold areas.

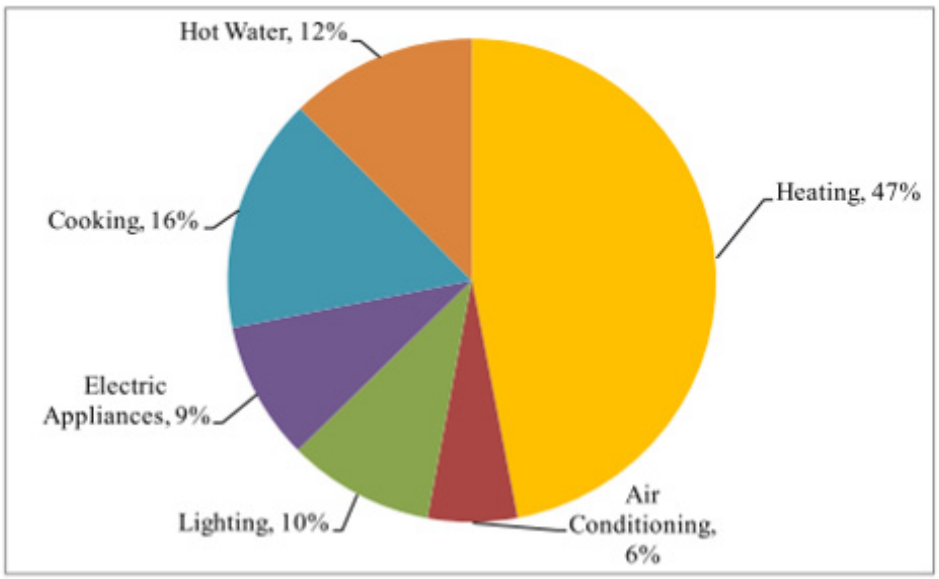


Figure 2 Energy use in urban residential buildings in China per purpose
Source: BEERC, 2011 cited in Shui/Li, 2011, 28

2.2 Germany

The main share of the building stock in Germany is residential, totalling 18.2 million residential buildings (15.1million single- or two-family buildings and 3.1million several-family-buildings) in comparison to 1.8 million non-residential buildings (DENA, 2012, 22). A study by BMWi (2011, 90) estimated that in 2011 there were 1.5 million non-residential buildings, including for instance schools, kindergartens and nurseries. However, despite having the smallest share of the building stock, non-residential buildings have, according to DENA (2012, 22), the second highest share of final energy consumption (35%) following single- or two-family-houses (41%).
In 2010, 65% of the final energy consumption of all buildings was used in residential buildings, with the largest share (85%) of final energy being used for heating purposes (DENA, 2012, 14). This is also clearly visible in a study from Shell/BDH (2013) which estimates that, between 2009-2011, heating and warm water purposes, while having declined from previous years, still account for the major share of final energy consumption in residential buildings (see figure 3).

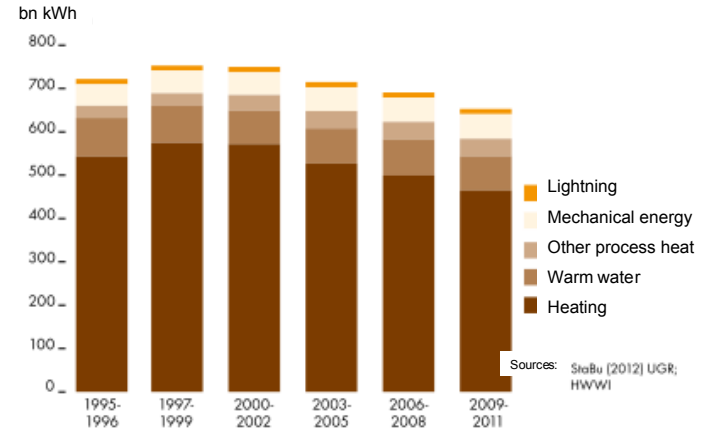


Figure 3 Development of final energy use in residential buildings per purpose
Source: Shell/BDH, 2013, 26 with translations from the authors

Of the overall building stock, about 75% has been built before 1979, the year in which the first thermal insulation act came into effect (BMU, 2011). In conjunction with the fact that only 6% of the building stock has been built between 2002 and 2009, this clearly shows the great relevance of retrofitting in Germany. On average one can assume that buildings in Germany are renovated every 30-40 years (Henger/Voigtländer, 2012). The age of the German residential building stock is displayed in figure 4. After Germany's reunification, there were tremendous efforts in improving the energy efficiency of those buildings made of prefabricated slabs in Eastern parts of Germany. According to GIZ (2011) approximately 2.1bn apartments in such buildings have been either fully or partially renovated, and hence a great deal of experience has thereby been gained in this regard.[6]

[6] While they do not specify whether this number refers to only general renovations or energetic retrofitting in particular, the respective publication is on EE in buildings, hence one can assume that a large share of these renovations will have included energetic renovations.

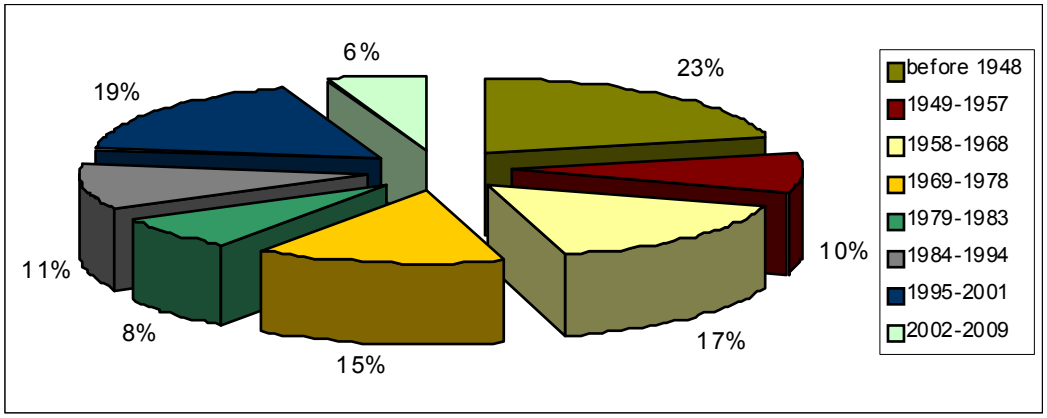


Figure 4 Time of construction of residential buildings in Germany
Source: own, based on Henger/Voigtländer (2012)

About 40% of the residential buildings are being used by home owners themselves and the remaining 60% are being rented out to tenants (Henger/Voigtländer, 2012).

2.3 Interim summary

With regard to the current building stock the situations in China and Germany are quite different. This needs to be reflected in the respective policies. China has several climatic zones that need to be responded to in its policies. According to Rommeney (2008), energy used for heating purposes in residential buildings in Northern China was more than 2-3 times that of countries in similar climatic regions of Western Europe and North America. Furthermore, while China has both a strong growth rate of new buildings and a large existing stock, in Germany the share of buildings built before 1979 constitutes 75% of the overall building stock, making retrofitting policies crucial. Therefore, policies for both new and existing buildings are of great relevance for China, whereas in Germany, greater focus needs to be put on existing buildings.

The experience of Germany in regard to the renovation of buildings made from prefabricated slabs might be of special interest to China, where there are many buildings with similar construction, albeit with other specific characteristics[7]. Already in 2007, the sharing of experiences in this regard took place within the framework of a GIZ project (Wollschläger, 2007a).[8]

[7] For a list of these characteristics, see Wollschläger, 2007a.

[8] For a detailed descriptions of experiences and recommendations on renovating buildings made of pre-fabricated slabs, see the "BEEN (Baltic Energy Efficiency Network for the building stock) practical manual" by Wollschläger (2007b). According to BEEN (2008) the BEEN-manual has also been published in Chinese, but the authors could unfortunately not find it on the website.

3. National policies to support EE in buildings

3.1 China

China has set a national goal to reduce its carbon intensity by 40-45% by 2020 in comparison to 2005. As a step towards this, the 12th Five Year Plan (FYP) has included the medium-term goal to reduce carbon intensity by 17% by 2015 in comparison to 2010 (Lewis, 2011). This has constituted one of the central principles in China's economic and social development, and has been applied by various ministries, including the Ministry of Housing and Urban-Rural Development (MOHURD) which plays a key role in China's housing development and urban planning.

3.1.1 Targets and the policies designed to reach them

Based on China's national conditions, Chinese policies on building EE focus mainly on civil buildings, including both residential and public buildings (government offices, commercial buildings, schools, and hospitals) (Shui/Li, 2012, 16). There is a broad range of codes and regulations addressing EE in buildings, with China being one of the first developing countries to set up binding codes on EE for new buildings (Draugelis/Li, 2012). In order to reflect the requirements of the different climatic zones, different codes for buildings are applicable for each region (Draugelis/Li, 2012, Shui/Li, 2012, 35). In 2003 it was decided that new residential buildings in the HSWW zone needed to have an EE improvement of 50% in comparison to buildings of the 1980s (Shui/Li, 2012, 35). Since 2010 new buildings in the Severe Cold and Cold zones, as well as Hot Summer and Cold Winter (HSCW) zone need to have an EE improvement of 65%, again compared to buildings of the 1980s (Shui/Li, 2012, 35; Liu, 2012).

Next to these codes, a standard exists for labelling green buildings according to their energy efficiency. This system, which applies to new buildings, uses one to three stars. One star means that the house is 0-15% more efficient than the relevant respective standard described above, two stars means that it is 15-30% more efficient and three stars means that it is more than 30% more efficient than required by the relevant respective standard (Shui/Li, 2012, 42). The certification of one- and two-star buildings is done by local government agencies, while three-star buildings need to be certified by central government agencies (Schroeder/Guo, unpublished draft). The green-building labelling system is based on six categories in which the buildings need to fulfil a certain number of criteria to attain one, two or three stars. These categories are "land use and outdoor environment, EE and utilization, water efficiency and utilization, material saving and utilization, indoor environment quality and operation management" (Shui/Li, 2012, 45). This system shows that the concept of a green building in China covers a broad range of foci of which EE is only one part. Furthermore, the certification can be either given for the design of the building – whereby it is then only valid for one year – or after an evaluation of the actual operation and energy savings of the building – whereby it is valid for three years (Shui/Li, 2012, 46).

The different policies that China has developed in the past few years to promote EE in the building sector are summarized in **annex I**.

Many of the policies regarding energy conservation in buildings are included in the different FYPs, which constitute China's economic and social blueprint. Currently, the "12th Five-Year Special Plan on Building Energy Efficiency (2011-2015)" and the "Implementation Opinions of Accelerating Green Building Development in China" (both released in 2012) set the overall framework for EE and RE in buildings.

The main target for energy saving in the building sector is to reach an equivalent of 116 million tce of energy savings by 2015. To meet this target new buildings will contribute a reduction of 45 million tce, heat metering and EE retrofits in existing buildings of the northern heating zones 27 million tce, public building retrofits 14 million tce and building renewable energy application 30 million tce respectively (MOHURD, 2012,17). Furthermore, it includes a plan to build within this period 800 million square meters of green buildings and to install 2.5 billion m^2 of buildings with RE (MOHURD, 2012, 19). In the northern severe cold and cold zones, the aim is to install heat meters and to retrofit 400 million m^2. Furthermore, the policy is aimed at retrofitting 50 million m^2 of residential buildings in the HSCW zone, and to retrofit 60 million m^2 of public buildings (Liu, 2012, 12, MOHURD, 2012, 19). The government also focuses on a higher level of EE for new buildings in the northern region (65% more efficiency, comparing to 50% in 11th FYP period). Mega-cities such as Beijing and Shanghai carry even higher standards, where the goal is to achieve an overall compliance rate of >95% by 2015. Public buildings are another focus area. Here, measures are expected to reduce energy consumption per square meter by 10%, by 20% within selected cities and even by 30% for large-scale buildings in these cities (MOHURD, 2012, 18).

3.1.2 Main problems to overcome

Although China has made impressive progress in promoting building EE, there are still some outstanding challenges ahead.

The heating reform

In earlier years, many apartments in China did not have independent measuring system for heating usage. Since the heating bill was not calculated on energy consumption but on heating area (m^2), there was little incentive for energy saving measures. In 2009, it was decided that all new buildings must have metering system and that a "heat supply measurement reform" should be conducted at local level (Shui/Li, 2012, 52). In 2011 it was decided that by end of 2015, all "provinces, autonomous regions and municipalit[ies][…]" must ensure that residential buildings in their area are equipped with heat metering, consumption based payment and at least 35% of the existing residential buildings in this area need to be retrofitted (Shui/Li, 2012).

Implementation of the heating reform

One major problem regarding heating systems has already started being addressed by MOHURD by introducing the heating reform. Although significant progress has been made,[9] there is still room for improvement. For instance, according to Shui/Li (2012, 73), from 2008 to 2010, less than half of the new buildings in Northern regions had meters installed, and of the buildings which had meters installed, more than half of them did not use consumption-based billing.

Institutional awareness and capacity of stakeholders

The lack of sufficient institutional awareness and capacity among stakeholders are key factors to hindering the implementation of building EE policies and programs at the local and

[9] Until the end of 2010, 80 cities in the northern heating zone, totaling 317 million m^2 of building space, had established billing systems based on consumption, (Qiu, 2011, cited in Shui/Li, 2012, 51).

project levels. While the enforcement of EE standards has been improved over the last years[10], some areas have a lack of specialized management and enforcement agencies, leading to weak policy implementation (MOHURD, 2012, 13). Furthermore, training of architects and craftsmen could be increased. In addition, building EE regulations and economic support are still yet to mature at local level. Most of the regions did not implement the matching funds, which are the local governments' funding contributions (additional to those of the central government), thereby affecting the impact of the central fiscal support (MOHURD, 2012, 13). Implementation also varies greatly between small and large cities, between less-developed and more-advanced regions, and between the design and construction phases (MOHURD 2012, 14).

Diverse ownership structure of housing

In multi-story buildings, which are very common in China, there is often a diverse owner structure of the apartments[11]. Such structure can make the retrofitting measures of existing buildings (such as the insulation of walls or ceilings which need to be conducted for the whole building rather than just for single apartments) difficult, since the agreement of all owners is necessary yet hard to achieve. Further, after the housing reform[12], some companies still own the building, yet the apartments are owned by the residents (GIZ, 2010, 59). This situation can cause the owning companies to have little interest in investing in the energy efficiency of the building (GIZ, 2010, 59). If the person investing in the building's EE is not living in the building, they will not receive the actual benefits of the energy savings, as these will go to the residents. This problem, known as the "investor-user dilemma" (Oberheitmann, 2012), becomes especially relevant if the building is sold after its construction.

Financial gap

Sufficient financial resources remain another major barrier. According to MOHURD (2012, 14), building renovation costs over 220 RMB/m^2 not including heat source transformation. Especially in the Northern regions, retrofitting is of great importance since energy consumption in the building sector of Northern regions constitutes more than 40% of China's overall energy consumption in urban buildings (Shui/Li, 2012, 53). Yet, many of the Northern regions have less-developed economies thereby making it difficult for the local government to provide the needed resources, as well as for market-based financing to fill the gap (Shui/Li, 2012, 72, see also MOHURD, 2012, 17).

For project developers, there is a lack of incentives to invest into energy-saving materials or energy-efficient building design (Zhou et al., 2011, 16). In interviews conducted by Schroeder/Guo (unpublished draft), a few project developers also identified problems in accessing subsidies and lack of information about the subsidies. The lack of transparency in the process and long processing times are also problematic.

In regard to RE installations in buildings, limited progress has been made, with RE installations accounting for merely 2% of the total energy consumption in buildings. Technological barriers, high upfront costs and risk averseness hinder large investments.

[10] With many cities having around 80% of their residential buildings which were constructed after 2008 being in compliance with the requirements of the respective code (Draugelis/Li, 2012, see also Zhou et al., 2011, 6 et seq.).

[11] For instance, in one case the structure of a company-owned house included tenants, co-tenants of one apartment, apartment owners, company employees as well as "returned households" (GIZ, 2010, 34).

[12] Until 1999, most employees in China's cities were living in an apartments owned by their employer or by the government, for which they then barely had to pay any rent. Yet in 1999 this changed and employees were encourages to buy houses or had to pay higher, unsubsidised rents (Ye, no date).

3.1.3 Financial support for achieving the targets

3.1.3.1 Public Financing

According to Richerzhagen et al. (2008, 33), since 2007 the Chinese government has changed its approach for achieving EE in buildings from utilising command and control instruments to more market based instruments.

In general, China's fiscal subsidies are formulated by the central government within its budget planning, and special funds are set up as grants for local governments. The money is then distributed to specific projects by the local government's treasury. The local government is also expected to provide extra funding. Depending on the focus, this financial support can then be received by different actors, including real estate developers and house buyers. While the current practice is still mainly focused on distributing funds to developers, the central government has given the local government room to consider the possibility of distributing funding to house buyers.

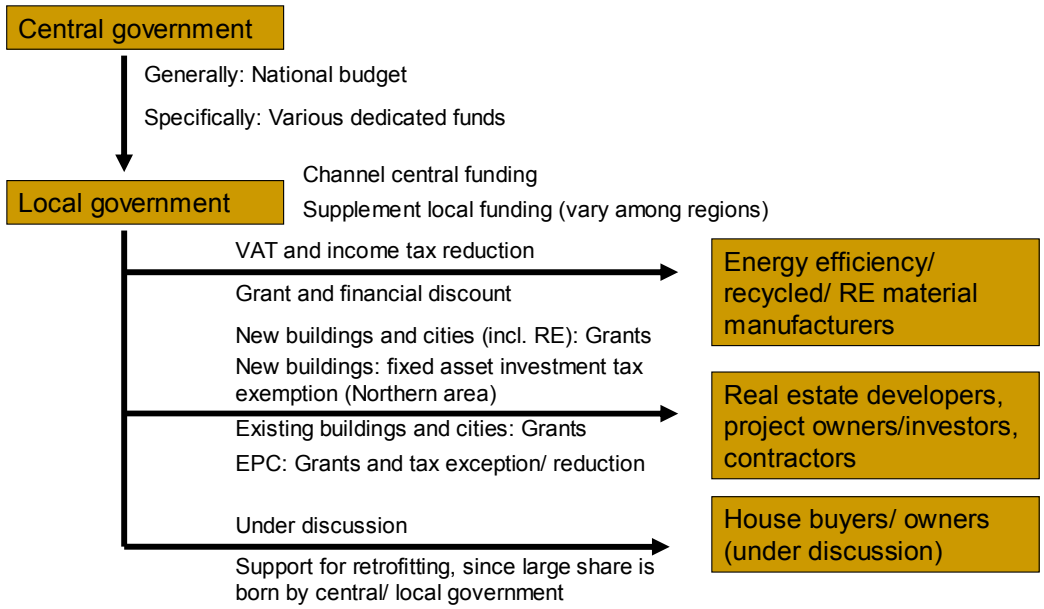


Figure 5 Financial flows from the central government for the financial support of EE in buildings
Source: own, based on BeCon, 2009 cited in Shui/Li, 2012, 40; MoF, 2008, Zhao et al., 2011; MOHURD and MoF, 2012

According to the government, during 11th FYP period, MoF and MOHURD had jointly set up various funds for supporting building EE work. These include the Renewable Energy Installation in Buildings Demonstration Project Fund, National Government Office Buildings and Large Public Building Energy Efficiency Special Fund, Heat Metering and Energy-saving Retrofit of Existing Residential Buildings in Northern China incentive funding, and the solar PV building applications financial assistance funding. In total, 15.2 bn RMB from central government were provided over five years, while provincial governments set up special funds for building EE of 6.9 bn RMB and municipal governments 6.5 bn RMB (MOHURD, 2012).

Despite this, in a survey from Schroeder/Guo (unpublished draft) almost half of the 28 respondents stated that there was a very significant lack of financial support (however some indicated that they do not know enough about the financial support to be able to rate it).

Fiscal support for new buildings

Subsidies are paid from the central government budget to the provincial finance department. Either the provincial finance department or the provincial housing department then channels these funds in the form of grants to the respective project developers of new buildings that meet the two or three star certification requirements (MOHURD, 2012, 43). For a two-star building, a project developer can receive 45RMB/m^2, and for a three-star building they can receive 80RMB/m^2 (MOHURD and MoF, 2012).[13] The subsidies are adjusted based on technical progress and cost changes over time.

For green ecological cities that are particularly focusing on the scaling up of green building development, a funding scheme, with a benchmark subsidy of 50 million RMB per city was developed in 2012 (MOHURD and MoF, 2012). The criteria for the city selection process are: 1) overall planning, detailed planning and any special plans of construction and energy systems etc. must be completed, and corresponding indicators established; 2) full implementation of the one-star level or above for the new buildings, among which more than 30% need to achieve the two star level or above, and a minimum scale of 200 million m^2 of green building construction within the coming two years (MOHURD and MoF, 2012).

China has implemented several types of tax reductions in order to incentivize EE in buildings. For instance, in 1991 the Provisional Rules on Adjustment Tax for Fixed Asset Investment included that no tax had to be paid if the fixed asset investment was being done in energy efficient residential buildings in the Northern regions (BeCon, 2009 cited in Shui/Li, 2012, 40).[14]

Further, economic incentives were provided in the forms of income tax and value added tax (VAT) adjustments. A deduction or exemption to the VAT was offered to producers of materials used for energy efficient walls through various policies in 1992, 1995, 2001 and 2004 (BeCon, 2009 cited in Shui/Li, 2012, 40).[15]

Fiscal support for the retrofit of existing buildings

Finance mechanisms with various sources have been developed for the retrofitting of residential buildings in northern severe cold and cold zones. As benchmarks the central government provides the local governments within the two zones with funding of 55RMB/m^2 and 45RMB/m^2 respectively (Liu, 2012, 8, Zhao et al., 2011, 12). This constitutes between 15% and 20% of the overall retrofitting costs (Shen et al., 2013). The formula for calculating this financial subsidy, which can then have an effect on the overall amount of the subsidy provided, is as follows:

Central funding to a region = benchmark*×[∑(its individual retrofit item content area × respective weighing of the item[16]) ×70% + its retrofit total area × energy saving result factor 30%]× progress factor (MoF, 2007)

Around 10% of the subsidy, are granted to the local government before renovations begin, with the other 90% only being released once the energy saving can be measured (Zhou et al.,

[13] One-star affordable housing programs and one-star buildings in rural areas may also receive subsidies, with no specifications on the level of the subsidy being mentioned (MOHURD and MoF, 2012).

[14] The state council modified the regulation in 2011, with the same treatment for energy efficient residential buildings in the Northern regions (State Council of China, 2001).

[15] According to the Notification on Various Preferable Policies for Cooperate Income Tax (1994) there was an exemption of the income tax for five years if the company received this through the sale of building materials (for walls) "made of coal slack, furnace cinder and fly ash" (Becon, 2009 cited in Shui/Li, 2012, 40).

[16] The weightings is as follows: building envelope energy saving renovation 60%, indoor heating system measurement and temperature control renovation 30%, and heat and heating pipe network transformation 10%.

2011, 12, MoF, 2007). Retrofitting measures in this case are "building insulation, indoor heating system meter and temperature control device installation, and heat source and network pipeline retrofit" (Zhou, 2011, 12).

In addition to this subsidy, local governments are expected to provide further funding. For example, Jilin province had secured 2.2 bn RMB in 2011 for the retrofitting of existing buildings, and Inner Mongolia and Shanxi promised to provide provincial and municipal funding to match the level of central funding (1:1:1) (Zhang, 2011). MoF and MOHURD have signed contracts with five regional governments (Tianjin, Beijing, Inner Mongolia, Shandong, and Jilin) who will receive 9.1bn RMB funds from 2011-2013 and who in return promised to complete the retrofit of 150 million m^2 (Zhang, 2011). Beijing also announced that it would provide 100RMB/m^2 for the retrofitting of buildings, which can be received in addition to central governmental support (Shui/Li, 2012, 50).[17] 200RMB per m^2 of the solar water heating system collector area could be received in Beijing if the total collector area is more than 100 m^2 (Shui/Li, 2012, 50).[18]

Overall, the central Chinese government "generated" (including direct government investments and those leveraged indirectly) a total of 24.4bn RMB for retrofitting buildings, provided in the period of the 11th FYP, with around 4.6bn RMB coming from the central government (18.9%), 9bn RMB from local governments (36.9%) and 10.8bn RMB from further leveraged social sources (Shui/Li, 2012, 50 and Zhang, 2011).

The central government has also been supporting the EE management and renovation of public buildings. As indicated above, the recent 12th FYP also includes – for the case of key cities – implementing retrofits of public buildings, for which the central government provides financial support of about 20 RMB/m^2 (Shui/Li, 2012, 56). As demonstration cities for public building EE nominated in 2011, Chongqing, Tianjin and Shenzhen are expected to receive 240 million RMB from the central government to retrofit 12 million m^2 public buildings (Qiu, 2013).

Another policy is the Energy Performance Contracting (EPC)[19] system, which targets EE retrofitting for various sectors including transport, industry and buildings (MoF and NDRC, 2010). With this financing model – if applied effectively – one could partially overcome the investor-user problem. Here, a third party – the contractor – installs for instance a RE heating installation in the building (DENA, 2013) and organizes and conducts the maintenance of the energy supply. With such a model, often more efficient energy supply systems could be used. In order to incentivize EE, the Chinese government provides one-off grants for providers of such EPC services for projects if they lead to a reduction of 100-10000 tce/year (Shen/Tan, 2013).[20] The contractor can receive at least 300 RMB/tce, with 240 RMB/tce coming from the central government and at least 60 RMB/tce coming from the local government (MoF and NDRC, 2010 and Shen/Tan, 2013). Furthermore, exceptions and reductions to value added tax, business tax and enterprise income tax were provided to Energy Service Companies (ESCOs) (MoF and State Administration of Taxation, 2010).

[17] Yet, here it remains unclear, whether this is only in regard to residential or also public buildings.
[18] Yet, here it remains unclear, whether this is only in regard to residential or also public buildings.
[19] EPC are normally offered by third parties, i.e. energy service companies which install for instance a RE heating installation in the building (DENA, 2013). The upfront costs are paid by the third party (the contractor), who receives return of his/her investment through the cost savings due to the lower energy consumption (Path, 2006).
[20] The scope of the subsidy includes EPC services and projects in industry, building, transportation and EE retrofits of public buildings.

Fiscal support for RE installations

Large-scale financial subsidies from central government are also being distributed to local governments who are actively pursuing RE application in buildings and green ecological city development. A benchmark subsidy of 50 million RMB per city (with the possibility to raise this to the maximum level of 80 million RMB) has been provided to national RE application demonstration cities by channelling it through the provincial government over three years, with 60% of the predicted budget granted in the first year and the rest then granted according to real progress (MoF and MOHURD, 2009). Criteria for application include: 1) good conditions for RE application based on resource assessment 2) a special implementation plan has been developed 3) newly installed areas in the coming two years expected to reach a certain scale, that being 2 million m^2 (or 30% of the total new area) for prefecture-level cities and 300 million m^2 for municipalities and deputy-provincial level cities (MoF and MOHURD, 2009).[21] The overall grant were/are to be spent in two categories: real projects (>=90%) and capacity building (MoF and MOHURD, 2009).

Further, subsidies have been given to developers for demonstration projects of RE in buildings (MoF and MOHURD, 2006), as well as to developers of solar PV projects in buildings, and to producers of solar PV products (MoF, 2009).

Since 2006, the central government has set up a special fund for RE application in buildings[22] with specific core support areas[23]. For pilot projects, the per unit subsidies for each technology type are determined annually, with +/-10% flexibility taking into account the incremental cost, technology advancement level, market price fluctuations and other factors (MoF and MOHURD, 2006). Projects for key technology demonstration, EE testing and labelling, as well as technical standard verification and improvement, are fully subsidized based on the approved project budget. 50% of the subsidy is released to local governments beforehand, while the remainder is released upon completion of the projects, after the acceptance and evaluation process (MoF and MOHURD, 2006).

To particularly promote solar PV application in buildings, the central government has, since 2009, set aside partial funding from the Special Fund for Renewable Energy Application in Buildings to support solar PV developers and manufacturers. This funding targets urban building integrated photovoltaic application (BIPV) projects, the promotion of photovoltaic use in buildings in rural and remote areas, the preparation of installation technology standards, and common key technology integration and promotion, with a threshold of 50kWp PV installation capacity per single project. Priority has been given to grid-connected projects[24], integrated projects and public building applications. In 2009 the subsidy benchmark level was set at 20RMB/Wp (Watt peak)[25], and in 2010 it was reduced to 17RMB/Wp for building material or component based BIPV projects and 13RMB/Wp for mounted combining with roof BIPV projects or wall BIPV projects. 70% of the subsidies were

[21] Newly installed areas are calculated to include the application of RE in new buildings and extensions, as well as in the retrofit of existing buildings, with a different rate for different technologies, e.g. × 0.5 for solar water heating areas; ×1 for heat pumps areas; and ×1.5 for solar or solar heat pump integration areas (MoF and MOHURD, 2009).

[22] Here renewable energy applications mean the use of solar energy, geothermal, sewage waste heat, wind, biomass and others to meet the various energetic needs of buildings such as heating and cooling, hot water supply, lighting and cooking (MoF and MOHURD, 2006).

[23] They include building integrated solar installations for hot water supply, heating and cooling, photovoltaic conversion, and lighting, as well as the use of ground source heat pumps and shallow groundwater source heat pumps. This fund provides support for pilot projects on, for instance, comprehensive EE testing and labelling, technical standards verification and improvement, and evaluation and supervision (MoF and MOHURD, 2006).

[24] In China, one of the greatest challenges for REN development is the grid connection.

[25] Watt peak means the maximal capacity of a PV installation.

provided to the local government for allocation beforehand, with the remainder provided only upon completion (MoF, 2009, and MOHURD, 2012, 43).

At the same time, many provinces and cities have issued local regulations for the purpose of promoting RE in buildings and local departments of finance have also issued financial support plans and relevant policies. Several local authorities have begun to implement policies making the use of RE in buildings mandatory.

Other fiscal policies

In regard to heat metering and consumption-based billing, MOHURD has since 2006 provided financial support from national fiscal revenues in order to facilitate faster deployment (Shui/Li, 2012, 51).

Other subsidies which are more indirect than the ones described above also exist, for example financial discount[26] for producers of recycled building materials or materials for EE. In 2008, the Chinese ministry of finance established a special fund, which can be accessed by producers of these materials. With this fund, the interest rate of loans is covered by the state, thereby encouraging such enterprises to increase their production capacity. The interest rate is based upon the People's Bank of China's interest rate of the respective period of borrowings and the interest is covered for no more than three years. Besides such a financial discount for the capacity expansion of manufacturers, the fund also rewards the promotion of the use of the materials, and research and development of relevant technological standards and specifications (MoF, 2008).

Another typical indirect subsidy covers a certain percentage of the bidding price (30% for large users and 50% for residential users)[27] for winners of annual bids for efficient lighting products (MoF and NDRC, 2007).[28] The subsidy is provided to the producing companies who then need to deduct it from the price, which in the end benefits the consumers (MoF and NDRC, 2007).

According to Hilke/Ryan (2012, 17) economic instruments should always be accompanied by regulatory policies as well as information policies[29] in order for to realise their full potential. In China, the economic instruments (funds provided) are set in relation to the above-mentioned building standards/codes (regulatory policies). As has been indicated, China also puts emphasis on relevant information policies, yet there are still some gaps here.

Policies and potential improvements under discussion

The Chinese government has been assessing the effectiveness and efficiency of fiscal incentive policies, as well as exploring ways for improvement and innovative approaches. According to MOHURD (2012, 33 et seq.), the following policies are currently under consideration:

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[26] Financial discounts provided by the government are a more subtle form of subsidy, whereby the government, on behalf of companies, pays part or all of the company's interest on loans.

[27] Large users are for instance, industrial and mining enterprises, offices, hospitals, schools and other places with concentrated lighting products. The energy service companies that provide contract energy management to promote efficient lighting products can also be regarded as large users. The term of residential users refers to the community or village administration as purchasers.

[28] The winners then become officially endorsed suppliers for these efficient lighting products. Such bidding happens on an annual basis.

[29] According to Weingarten, cited in Rowlands, (1997, 8)"Information policy is the set of all public laws, regulations and policies that encourage, discourage, or regulate the creation, use, storage, access, communication and dissemination of information."

- The government intends to take a more flexible approach to spending financial resources from special funds for building EE and green buildings e.g. by introducing more reward policies to replace direct subsidies in the form of grants.
- Stricter requirements for local financial matching funds (those funds provided by the local government).
- Reduction of property tax for the owners of green buildings.
- The provision of low interest rate loans (via financial institutions such as banks) to buyers of green buildings.
- Preferential treatment of green building projects in land bidding, including a floor area rate award.
- Research into piloting on trading building energy savings under an EE quota system.
- The diversification of financial resources (e.g. by leveraging financial institutes via green loans etc.), and the promotion of retrofit cost sharing for residential and public buildings between the government and building owners.

3.3.1.2 Private Financing

The banking sector plays a key role in supporting green development in China, as it provides over 80% of financing to Chinese enterprises (Motoko, 2011). Some policies and practices are in place to encourage green investment and to restrict investment in energy intensive and high polluting projects. However such "green credit" endeavours are still at the early stage of development, especially so in the case of building EE.

Green credit policy

In 2007, the Ministry of Environmental Protection (MEP), the People's Bank of China (PBC) and the China Banking Regulatory Commission (CBRC), jointly released the "Green Credit Policy" to regulate banks' lending in relation to environmental impact (MEP, PBC & CBRC, 2007). The policy is to restrict banks from issuing loans to energy intensive and high polluting projects and enterprises, and from those enterprises that violate environmental laws. At the same time, it encourages loans to environment-friendly and energy saving projects. The CBRC further released two documents in 2012 and 2013 to provide guidelines and suggestions to implement the 'green credit' policy (CBRC, 2012 and 2013). Building EE is considered as an environment-friendly activity that private banks could provide loans to. In line with the policy, some Chinese commercial banks (such as the Industrial Bank and Shanghai Pudong Development Bank) have taken initiatives in financing building EE, to develop diverse loan products for green development (China Real Estate News, 2011, Xinhua Finance, 2013).

Exemplary practices from banks

The Industrial Bank, the first bank applying the Equator Principles[30] in China and an early pioneer of green credits, claims to have invested 243bn RMB in the areas of energy saving and emission reduction, up to the end of March 2013 (Xinhua Finance, 2013). It has developed a standard Energy Management Contract financing product, to which Shenzhen Pengsangpu Solar Co. Ltd. (an Energy Saving Company (ESCO) with expertise in solar hot water project design, construction, and operation) is a beneficiary. In 2012, Pengsangpu Solar

[30] To improve the effect of the green credit policy, many international banks formulate a set of guidelines and standards. The Equator Principles is the most famous of them, developed in 2002 by the International Finance Corporation (IFC) and the Netherlands Bank, it aims at providing bases for environmental and social risks distinguishing, assessment and management of project financing.

received a total amount of 14 million RMB project loans with five year terms, and in 2013 the company received another 9 million RMB project loan (Xinhua Finance, 2013).

International financial institutions are also actively engaged in triggering investment from China's banks by providing concessional loans, introducing business models and building capacity. In 2011, Shanghai Pudong Development Bank received financial and technical support from the Asian Development Bank on building EE projects, both for new and existing buildings, with an amount of 800 million RMB which could be drawn from to share losses, in case of bad debt (China Real Estate News, 2011). Since 2006, the International Finance Corporation (IFC) has conducted its China Utility-Based Energy Efficiency Finance Program (CHUEE) that aims at enabling key players to collaborate in creating a sustainable financing model to reduce greenhouse-gas emissions and promote cleaner production (IFC CHUEE program website). Under this program, IFC provides its partnering banks such as the Industrial Bank, Bank of Beijing, Shanghai Pudong Development Bank and the Binhai Rural Commercial Bank with risk sharing mechanisms for financing green projects and an additional pool of up to 600 million USD to support Chinese banks' lending to promote EE mainly in the sectors of industry, municipal facilities and buildings, and in the renewable energy field (IFC CHUEE program website).

However, most Chinese banks are still in a 'wait-and-see' position. This is due to many reasons including insufficient, and short-lived policy signals to support the private sector in implementing green credits, a lack of established instruments to assess and control credit risk, as well as inadequate information to understand the needs of, the risks to and the long-term benefits for the building industry. Therefore, the current practices are still quite limited in terms of the number of participating banks, the size of their financial investments and their added value.[31]

3.2 Germany

Over the next several decades, Germany has set itself the goal to reduce greenhouse gas emissions as follows: 2020: -40%, 2030: -55%, 2040: -70% and 2050: -80% to -95%; all in comparison to 1990 (BMU, 2013a). Further, in 2011 Germany decided to undertake the so-called Energiewende (energy turnaround) whereby it plans to phase out nuclear power in the coming years. This amplifies the need for more RE in the electricity mix, as well as a strong increase of EE in all sectors. The energy used for heating purposes and warm water in non-residential as well as residential buildings constitutes 35% of the country's overall final energy consumption (DENA, 2012). Thus, if Germany wants to achieve both its efficiency targets (see below) and the Energiewende, it needs to invest heavily in EE in buildings.

3.2.1 Targets and the policies designed to reach them

As outlined in the Energy Concept (Energiekonzept), Germany has set targets to reduce the heating requirements of the building stock by 20% by 2020, and to reduce primary energy consumption by 80% by 2050 (BMWi, 2011) in comparison to 1990. In order to reach these targets, Germany needs to increase the annual renovation rate of its existing building stock from below 1% to 2% (BMWi, 2011). There are various policies in place for reaching these

[31] Zhao/Xu (2012) conducted a more comprehensive analysis on the green policy in China.

targets, with the underlying pillars being the Energy Saving Ordinance (Energieeinsparverordnung EnEV)[32] and the Renewable Energies Heat Regulation (Erneuerbare Energien Wärme Gesetz, EEWärmeG).

The EnEV differentiates between residential and non-residential buildings and further between existing buildings and new buildings. For new buildings, EnEV sets clear standards, for instance in regard to windows, walls, etc. (see para 3 resp. para 4 and annex 1 resp. annex 2 EnEV). If installations on/in the building produces RE, the amount of produced energy may, under certain circumstances be deducted from the final energy consumption of the building allowed under EnEV (para 5)[33]. If parts of existing buildings (e.g. windows) are to be replaced, they need to fulfil certain standards (para 9). Furthermore, in order to enhance transparency and to raise awareness, energy passports, which include information on energy requirements or energy consumption, need to be created for all new or renovated houses (para 16). A revision of the EnEV is currently underway, but at the point of writing, it has not yet been completed (Zukunft-Haus, 2013).[34]

The EEWärmeG aims at increasing the share of RE used for heating purposes. It specifies that for new buildings a certain amount of the heating electricity, with the specific share depending on the RE used, needs to come from RE (para 5)[35]. Further, it sets out that between 2009 and 2012, the national state shall provide annually 500 million EUR for the financial support for such measures (para 13). In an annex, the EEwärmeG sets out the specific requirements for each RE source. Furthermore, public buildings should be a role model in regard to RE used for heating purposes (para 1a). Finally, federal states are given the authority to establish stricter rules for their state-owned buildings, as well as for existing buildings (para 2), which has so far been done by the federal state of Baden-Württemberg (BMU, no date a). The EEWärmeG is to be updated in 2013 (DENA, 2012).

The Federal Government of Germany has set out a "modernisation campaign" for buildings with specific steps identified, which includes tightening the standard for new buildings to climate-neutral by 2020, in order to reach the goal of having an almost climate-neutral building stock by 2050 (BMU, 2011).

Within this scoping paper, only those current[36] policies are displayed where funding is provided to incentivize further private investment.

3.2.2 Main problems to overcome

Lack of financial means

One of the main problems is the provision of sufficient finance. While many experts consider EE in buildings as a low hanging fruit (hence that in this area one could achieve results easier than in other areas), the financial means nevertheless have to be generated. Furthermore, retrofitting may not, in all cases, be a low hanging fruit, since costs may differ greatly depending on the specific situation. According to Ifs (2012a), the full costs of renovation

[32] EnEV includes requirements for both insulation and heating/cooling appliances (Hilke/Ryan, 2012, 114).
[33] Höhne et al. (2009) suggested that EnEV could by improved by not allowing the EE level to be lowered if RE is being generated and used by the building, since this would constitute a lock-in to a lower than possible efficiency level.
[34] For more information on the EnEV revision, see Federal Government of Germany, 2013.
[35] In this regard Höhne et al. (2009) suggested that the EEWärmeG could be improved by expanding its scope so that there are also targets for existing buildings.
[36] More information on other policies or policies which have already ended can be found in BMWi, 2011.

(general modernization plus energy related retrofitting costs) per m² are much higher in single family houses than in multiple family houses. This may be due to the fact that a single family house has a much greater outer wall area than a living unit in a multiple family house (Ifs, 2012b). Solely energy related retrofitting costs range from 80 to 230 EUR/m² (Ifs, 2012a). Since most houses are not owned by the state, a lot of financing needs to come from the private sector, which in turn needs to be incentivized by the public sector.

Landlord-tenant problem

Another current barrier to achieving the necessary retrofitting rate arises as many of the residential house owners (60%) do not live in their houses themselves, but rather rent them as landlords to their tenants (see also the 'investor-user problem' outlined above) and therefore do not benefit from the energy savings of retrofitting. In order to incentivize landlords to invest in EE renovation measures, the landlord is allowed to increase the annual rent by a maximum of 11% of the costs of the modernization measure (§ 559 BGB). Ideally, this would not increase the warm rent (incl. electricity and heating), since the costs for electricity and heating would decrease due to the improved insulation. Yet, this is not always the case, and can lead to difficulties especially for low-income families.[37]

Contracting

A third party – the contractor – installs for instance a renewable energy heating appliance in the apartment building (DENA, 2013). The contractor covers all the investment costs as well as the costs of maintenance (DENA, 2013) and receives return to these investments through the payments of the energy users. The tenancy law has recently been revised and includes now that contracting costs for heating purposes may only be transferred to the tenants if the tenant's costs for heating and warm water do not increase as a consequence of this (DENA, no date). Furthermore, the newly installed heating systems must be more efficient than the heating systems they replace or provide heating from district heating or a block heat and power plant (DENA, no date).

Increasing floor space per person and potential rebound effects

Increasing floor space used per person increases general energy consumption through increased heating area per person. In 1989 (before re-unification) the average floor space per person in West Germany was 36.7m² and in East Germany it was 27.4m². By 2011, this figure had risen to an average floor space per person of 43m² (Ifs, 2004, Statistisches Bundesamt, 2013). Thereby even if the EE of the building itself might be increased, the overall energy consumption per person might not decrease due to an increase in floor space, which, for instance, needs to heated.

Despite funding efforts, it may be that in certain cases the energy reduction is not as high as initially envisaged. In such cases, the overall energy consumption per person in a building may not be reduced to the expected level, because the floor space per person is increased or because residents increase the room temperature in order to have more comfort than before the retrofitting measure. This is part of the so called "rebound effect". In regard to the latter point, while the energy reduction effect might not be as great, there may be other social benefits. According to Madlener/Hauertmann (2011, 15 et seq.), estimates for a rebound effect for EE measures in residential buildings in Germany are between 13% and 49%, with the former applying to house owners and the latter to low income tenants.

[37] For proposals on how to improve the current regulation, see Deutscher Mieterbund/Klimaallianz, no date.

Further obstacles

Other reasons for the insufficient retrofitting rate may include a lack of awareness of the existence of funding programmes, a lack of knowledge of the energy saving potential or individual decisions against renovation measures. For example, if a house owner knows that (s)he will not be living in the house for much longer, then there is little incentive to take up the financial and organizational burden of retrofitting. Here again the investor-user dilemma comes into place. Furthermore, a lack of predictability with regard to available financial support as well as the current regulatory framework (WWF, 2013) might further dis-incentivize investment. Further, the training of architects and craftsmen could still be increased.

Finally, Pehnt et al. (2012) suggest a timeline from 2010 to 2050 with specific steps, including but going beyond those mentioned above, which need to be achieved in the building sector for ensuring the sector's contribution to the success of the *Energiewende* in Germany (see figure 6). Hence many of these steps could be seen as currently still constituting a hurdle to achieving the EE targets for buildings.

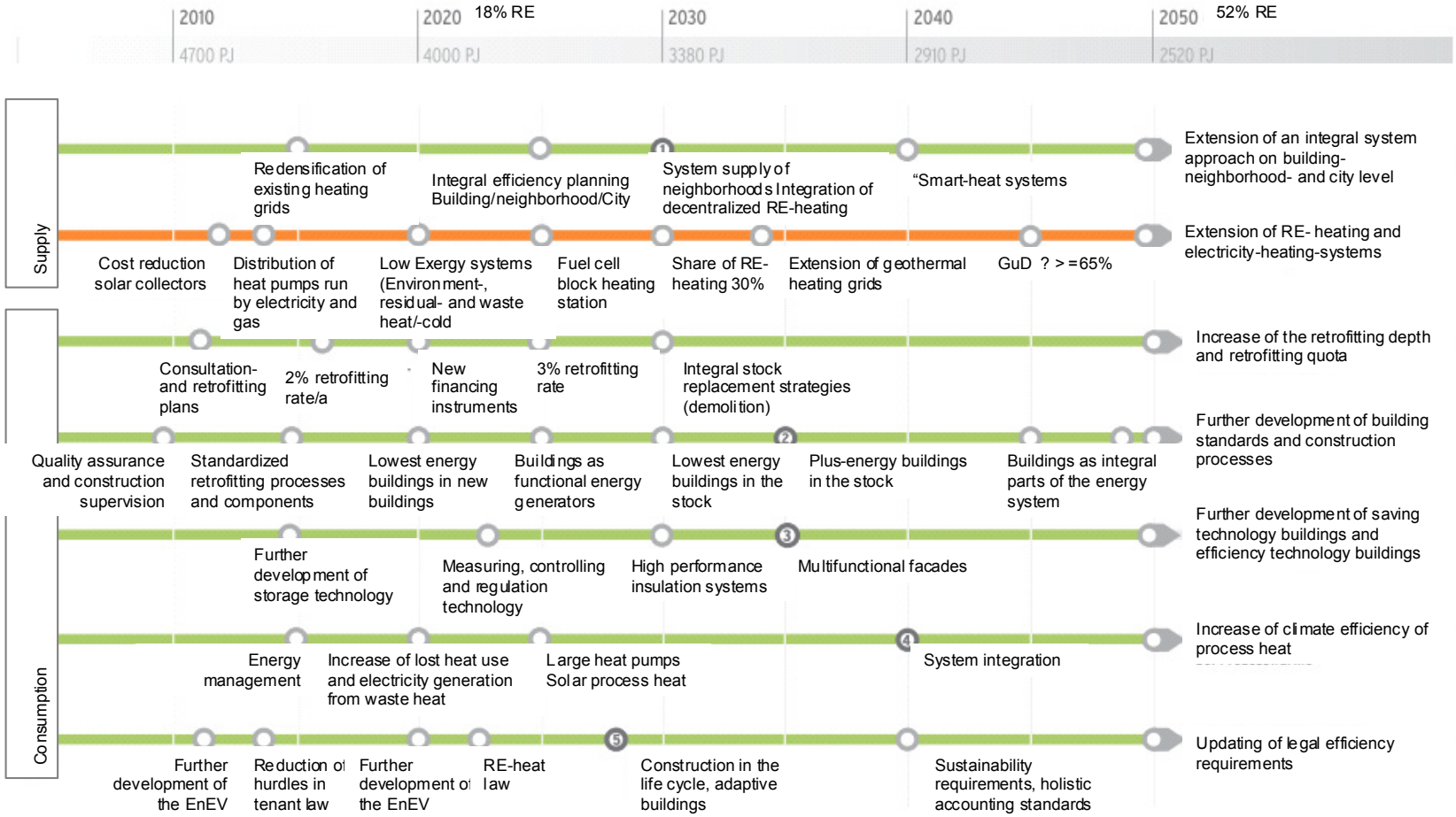

Figure 6 Necessary steps within the building sector for the success of the *Energiewende* in Germany
Source: Pehnt et al., 2012, 8 with translations from the authors

3.2.3 Financial support for achieving the targets

This section focuses on public financial support provided for incentivizing private investments for increasing EE in existing and new buildings.

3.2.3.1 Public financing

While the EU also provides financial support via various programmes for increasing EE in buildings,[38] the focus of this paper is only on financial flows from inside Germany.
For the period of 2012-2014, the German government has declared to provide annually 1.5bn EUR as commitment authorizations for KfW programmes (which are then channelled further in the form of loans and grants) on EE in buildings (BMVBS, 2013; BMF, 2013). The amount of these commitment authorizations and the actual delivery as liquid funds is then spread out across several years. In addition to this, 300million EUR shall be provided annually for eight years (starting 2012) as grants for home owners who want to retrofit the building they are living in (see also below) (BMVBS, 2013). It is worth noting that both of these funding resources come from the Special Energy and Climate Fund (Sondervermögen Energie und Klimafonds (EKF)), which is funded by the revenues of the European Union Emission Trading Scheme (EU ETS).[39] Funding for mini CHP plants (see below) with a volume of 400,000 EUR in 2012 was also provided through the EKF (BMF, 2013). Furthermore, the BMU provided 144 million EUR in 2012 via the Federal Office of Economics and Export Control (BAFA) to support small scale RE based heat generation (including amongst others the two programmes on solar thermal and heat pumps described below) (BMU, no date b). In addition, funding is available from previous commitment authorizations, of which a certain amount had been allocated for future years. The main part of the national level funding is provided through the state owned development bank KfW, or through BAFA. A detailed description of the individual programmes can be found in **annex II**. The public funding channels in Germany, together with those of the case study of the federal state of North Rhine Westphalia and the city of Bonn below are described in figure 7.

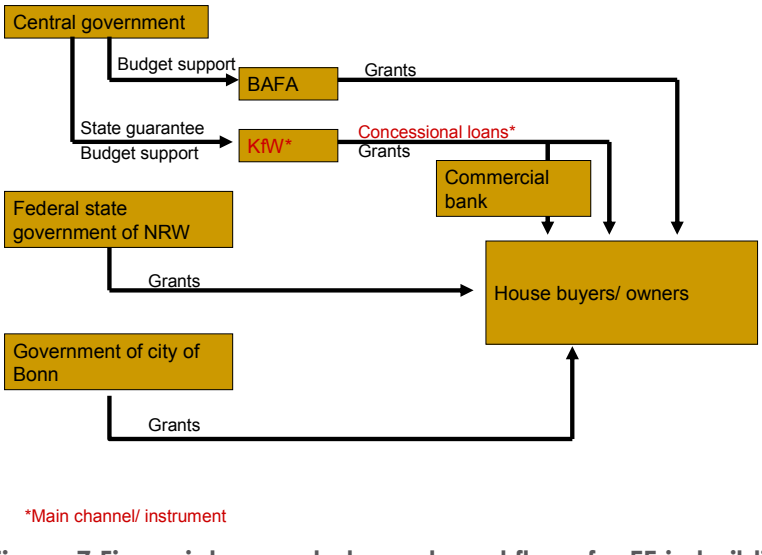

Figure 7 Financial support channels and flows for EE in buildings in Germany, specified for the case study of the federal state of North Rhine Westphalia and the city of Bonn
Source: own

[38] For more information, see EU Commission, 2013.
[39] For more information on the Special Energy and Climate Fund, see also: Esch, 2011.

Despite these already large amounts of funding, this is perceived as insufficient by Klimaallianz, who suggested in 2011 (when public support for KfW funding totalled 0.94bn EUR) that in order to achieve the 2% renovation rate of existing buildings, overall 5bn EUR should be provided by the national government via KfW loans or BAFA grants to support EE and RE heating in buildings (Klimaallianz, 2011). Also the Allianz für Gebäude Energieeffizienz (geea) have called for overall funding of 5bn EUR, and suggest that tax reductions might also be included (Zukunft-Haus, 2013). While funding has again been increased in 2013, it is still far below the 5bn EUR suggested by Klimaallianz and geea. Further, Klimaallianz (2011) criticised that the funding level was rather unstable and had in 2011 actually decreased compared to 2009[40]. They argued that, the predictability of available support is an important requirement for incentivizing investments.[41]

German bank for reconstruction – KfW

The KfW is Germany's state owned bank, with 80% being owned by the national state and 20% by the federal states (Hilke/Ryan, 2012, 87). It has different foci, including being one of the main German implementing entities for international climate finance, as well as national climate action funding. The KfW funds national climate action, for example, through EE programs for the building sector.

Applicable to all funding programmes of KfW are building standards which are oriented along the minimum requirements of the above mentioned EnEV. The following building standards exist: KfW house 55/ 70, 85/ 100/ 115 as well as a standard for historical monuments (KfW, 2013b). A house with the standard 55 is currently the highest standard, since it requires only 55% of the energy needed by a house which fulfils the EnEV minimum requirements. A house with the standard 100 has the same energy requirements as identified as minimum requirements by EnEV. The main instrument of KfW is the provision of low interest loans, however in certain cases specific grants are also provided. Most of the time, the loan has to be taken at the borrower's local commercial bank which then also has to take over full liability for the loan (KfW, 2013c). In general, there are various repayment periods possible for the credit lines of KfW. Depending on the period taken, different conditions apply to the loan (i.e. often the preferable loan is only provided for ten years. Also the number of initial years in which no repayment has to take place might differ depending on the overall duration). Some of the programmes can be applied – under certain circumstances – in combination with other support programmes.

Federal Office of Economics and Export Control

The BAFA belongs to the Federal Ministry of Economics and Technology (BMWi) and conducts different administrative tasks for the BMWi, including in the energy sector (BAFA, no date e). Here, it focuses amongst others on the promotion of EE as well as the use of RE (BAFA, no date e). Further, the BAFA conducts funding services which are part of the BMU's so called "Market Incentive Programme for Promotion of the Use of Renewable Energies (MAP)".

In contrast to KfW, all funding provided by BAFA is in the form of grants. Linked to this, funding applications can go directly to the BAFA and do not need to go via the private bank, as is the case for KfW-loans. According to BMWi (2011, 40), the BAFA programmes which are part of

[40] This fluctuation of the funding level is clearly visible in DENA, 2012. The following public funding levels for the KfW programme are described here: 2006: 1.5bn EUR, 2007: 0.85bn EUR, 2008: 1.4bn EUR, 2009: 2.2bn EUR, 2010: 1.35bn EUR, 2011: 0.94bn EUR, 2012: 1.5bn EUR (DENA, 2012).

[41] For proposals on tax incentives for EE measures, see Klimaallianz, 2011.

the MAP saved up to 10.4 PJ of energy between 2008 and 2010. However, here it is not clear how much of these savings took place in the building sector, as according to BMWi (2011, 40) all funding has been provided to the building sector since 2010, but it remains unclear how much of the funding has been provided to the building sector before the year 2010.

Financial support for new buildings

KfW has a specific funding programme (no. 153) for the construction of new buildings or the initial purchase of an energy efficient building, if its EE standard fulfils one of the more ambitious KfW building standards, including the passive house standard (KfW, 2013e). Within this programme, low interest loans are provided to the new house owners, with a subsidised interest rate in the first ten years (KfW, 2013e). According to BMWi (2011, 39) 1.7PJ of energy were saved through this programme between 2008 and 2010.[42] In 2010, approximately 84,000 apartments have been constructed with the support of this programme, which according to Diefenbach et al. (2011, 19) constitutes approximately half of all the newly built apartments in this year. There was a slight decrease in 2011, with around 81,000 apartments, or 41% of all new built apartments, being constructed with the support of this programme (Diefenbach et al., 2012, 9).

The concept of a passive house

A passive house is a building which does not require an additional heating system. Rather, internal heating is provided, for instance by efficiently using solar irradiation, from the heat discharged by other technical appliances or from human bodies. Further, passive houses normally have triple glazing, thereby ensuring that the building is airtight. Through these measures passive houses use even less energy than the current KfW 55 standard (Photovoltaik-Förderung, no date).

Financial support for the retrofit of existing buildings

Low-interest loans are also provided for individual retrofitting measures or full retrofitting of existing buildings (programme no. 151/152). Furthermore, in the case of full retrofitting, repayment grants are also provided. It is worth noting that this programme is also applicable to initial buyers of a newly retrofitted energy efficient building (KfW, 2013c). As an alternative, one can apply for an investment grant (no. 430), which is available for the full or partial retrofitting of existing buildings (KfW, 2013d). Again, the level of the investment grant is dependent on the EE achieved. The BMWi (2011, 37) estimates, that between 2008 and 2010, 13PJ of energy were saved through these programmes.[43] In 2010, about 340,000 apartments were renovated using these KfW programmes (all related to EE renovation) (Diefenbach et al., 2011, 19et seq.). In 2011, there was a strong decrease in the amount of renovated apartments, with 180,000 apartments receiving support for EE renovation measures (Diefenbach et al., 2012, 9). This can be seen in connection with an overall decrease of available public funding from 2010 (1.35bn EUR) to 2011 (0.94bn EUR) (DENA, 2012).

With two other programmes (no. 218/219), KfW provides concessional loans or repayment grants to municipalities or municipal or local authorities or certain types of businesses if they

[42] However, here it must be noted that this programme only started in 2009 but constitutes the continuation of a previous programme. Hence, the authors take here the assumptions, that within the estimation of 1.7 PJ, also those energy savings from the previous programme between 2008 and 2009 have been included.

[43] Again it must be noted that although this programme only started in 2009, it constitutes the continuation of a previous programme. Hence, the authors take here the assumptions, that within the estimation of 13 PJ, the energy savings from the previous programme between 2008 and 2009 have also been included. Further, since according to Diefenbach et al. (2011) the programme 'energy efficient redevelopment' includes three different funding programmes, it is assumed that these are also included in the BMWi's report.

fully or partially retrofit buildings of their municipal or social infrastructure in line with EE standards for new buildings, including the passive house standard (KfW, 2013f, KfW, 2013i). Between 2007 and 2010, approximately 314 million EUR were provided in the form of loans for programme no. 218 and its predecessor, which led, according to Clausnitzer et al. (2011, 23, 33), to approximately 546 million EUR of investment and energy savings of about 1PJ.[44]

Financial support for solar thermal installations and CHP plants

There are other programmes, specifically focusing on the use of RE for heating in buildings, which are closely linked to the EEWärmeG. In order to support small scale RE heating systems, KfW provides low interest loans (no. 167) to home owners or home buyers for exchanging or enhancing their heating system (KfW, 2013g). BMWi (2011, 40) assumes that, between 2008 and 2010, 0.04 PJ of energy have been saved through this programme. For large scale RE heating systems, KfW provides low interest loans for instance for large scale solar panels (i.e. for heat generation), biomass installations, heat based CHP plants and large scale heating pumps (KfW, 2013h).

BAFA provides grants to private persons or municipalities for solar thermal installations on existing buildings, as well as for the financing of energy efficient heat pumps – with clear requirements on what constitutes an efficient heat pump. For new buildings, financing is only provided for innovative projects of solar thermal installations (BAFA, no date a; BAFA, no date b).

Further, BAFA provides small-scale CHP plants (up to 20 KW_{el}) with grants, which are dependent on the size of the power plant. Yet, there is a range of conditions (i.e. in regard to the plant location and level of efficiency) which must be fulfilled before such financing is available (BAFA, no date c).[45]

Finally, since the autumn of 2012, BAFA provides grants for companies who provide contracting services in which RE are used, with the scale of the grant depending on the type of RE used and the size of the installation (BAFA, no date f).

It is interesting to note, however, that according to a survey, despite the availability of the financing instruments of KfW and BAFA, the majority of investors (about 78%) did not make use of them, but rather financed measures directly themselves. This may however be due to the fact that most of the measures cost less that 20,000 EUR (Forsa, 2012). Of those who made use of the financial support, 71% used KfW programmes (Forsa, 2012).

As indicated before, economic instruments should always be accompanied by both regulatory and information policies in order to realise their full potential (Hilke/Ryan, 2012, 17). The economic instruments (funds provided) in Germany are set in relation to the building standards (regulatory policies). Further, according to Kuckshinrich et al. (2012, 6) the KfW standards have also helped to increase awareness of the issue of energy saving in buildings.

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[44] For programme no.219 no precise numbers were available, since it became not clear whether more programmes other than no. 157 were transferred to programme no. 219. According to Clausnitzer et al. (2011), within programme no. 157 (one of the predecessors of no. 219) 49.6 million EUR of public finance were provided between 2007 and 2010, triggering investment of 78.8 million EUR and leading to energy savings of about 0.19 PJ.

[45] In addition, owners of a CHP-plant can register their plant in order to receive financing for the electricity that they feed into the grid. This is valid for all scales of CHP-plants and the funding is dependent on the time when the plant first started its work and the overall amount of electricity being fed into the grid – with more funding for the first $50KW_{el}$ (see for instance BAFA, no date d).

Policies under discussion

For several years discussions have been ongoing regarding whether income tax reductions could be made available for those retrofitting their buildings. While the federal government wanted to introduce such a tax reduction, this has been blocked within the Bundesrat (Federal Council of Germany) since some federal states feared losing income tax revenues, of which federal states normally receive parts (Zeitonline, 2012a). Since these plans did not become reality, the German government decided to financially support renovations with an additional 300 million EUR per year over eight years (see above) (Zeitonline, 2012b). Only recently, tax reductions for retrofitting have again been proposed by the federal state of Hesse, and are therefore once again being dealt with in the Bundesrat. Within the proposal it is assumed that such tax reductions would lead to annual tax losses of 638 million EUR for the central government, 574 million EUR in total for federal state governments and 288 million EUR to municipalities, whilst on the other hand leading to available financial support for EE in buildings totalling 1.5bn EUR (Bundesrat, 2013). Tax reductions would be available for house owners as an alternative to KfW funding, but combinations would not be possible (Bundesrat, 2013).

Finally, WWF (2012) suggests implementing a system with clear energy reduction targets and tradable "white certificates", for instance, for electricity producers or grid operators, but potentially also on a voluntary basis for other actors.

3.2.3.2 Private financing

A fully detailed study on private investment in energy efficient buildings, both for retrofitting and construction, is beyond the scope of this paper. Therefore, this section touches only lightly on this topic. At first it is necessary to identify whether to look at triggered investment by public support programmes or overall private investment. The former appears more helpful if one wants to discuss the success of public support policies.

According to KfW (2012), its various funding programmes for energy efficient new buildings or renovations, which totalled 6.6bn EUR in 2011, initiated investment of up to 18.6bn EUR. Yet, Kuckshinrich et al. (2012, 6) differentiate between two different types of triggered investment: directly triggered investment, and an upper limit of potentially triggered investment with low occurrence probability.[46] According to Kuckshinrich et al. (2012, 6), in 2011 KfW funds of 6.6bn EUR (which includes, in addition to programmes 151/152, 167, 430 and 153 described above, the predecessor of no. 218 and one of the predecessors of 219) directly triggered investment of 8.9bn EUR, whilst the potential upper limit of triggered investment was 18.6bn EUR (as mentioned above). Figure 8 displays the amount of funding provided through BAFA within the MAP and the private investments triggered through these public funds.

[46] This differentiation is mainly necessary, because for new buildings, there is a cap for loans at 50,000 EUR. This would normally not be sufficient to cover the required investment in the house, leading Kuckshinrich et al. to take this differentiated approach (Kuckshinrich et al., 2012, 6).

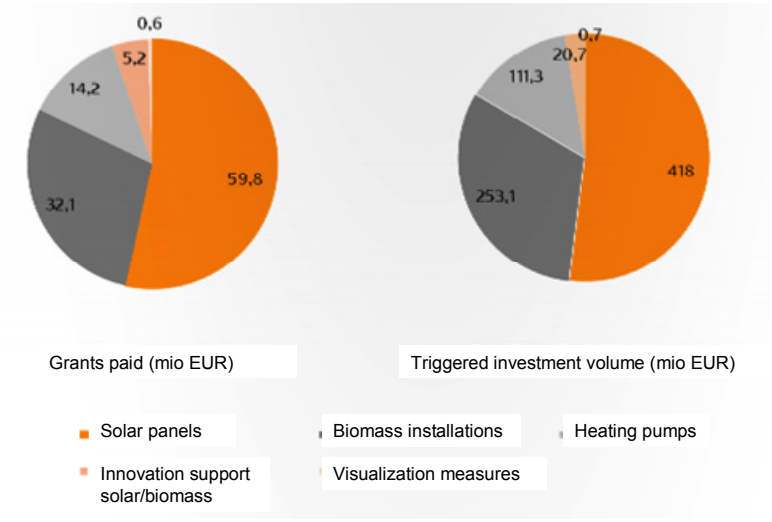

Figure 8 Grants provided through BAFA programmes in 2011 and triggered investment
Source: DENA, 2012, 120, translations made by the authors

Juergens et al. (2013) approached this question in a different way. They included in their estimations only incremental costs of EE but full costs for RE measures in relation to the building sector. As a result of this, they estimated the triggered investment of private households and companies by both KfW as well as BAFA programmes to be about 15bn EUR in 2010 (Juergens et al., 2013).

3.3 Interim summary

Both, China and Germany have EE codes laying out building standards and in addition specific labelling standards (star system in China and KfW house standard in Germany) for more EE buildings than required by the codes, which are set as a percentage of the codes' requirements. However, there are differences in implementation. According to Oberheitmann (2012), in China and Germany the same material is most commonly used for wall insulation. Yet, while in Germany the thickness of the material is 10-12cm or in some cases even up to 30cm, in China it is often only 5-8cm, even where the 50% or in other climate zones 65% standard of the building codes are being applied (Oberheitmann, 2012).

Approaches to retrofitting residential buildings differ between China and Germany. While in the latter, the building owner normally decides individually whether and when to conduct their retrofitting measures, in China it is normally the local municipal government which contacts the building owners (who might be acting as landlords) to discuss with them the potential of retrofitting their building (Richerzhagen et al., 2008, 32, see also Wollschläger, 2007a). The financial burden is then shared by a broad range of actors, including the national government, local municipal government and building owners (Richerzhagen et al., 2008, 32).

China's main tools used for providing financial support are direct grants to project developers, direct support for retrofitting projects in the Northern region, renewable energy pilot cities, and green building pilot cities via the local government as well as tax reductions for EE material producers. Germany puts a focus on low interest loans – and partially grants – provided to house owners to incentivize further investment. It is interesting to note that the low interest loans for house owners are under discussion in China, while tax reductions are under

discussion in Germany. However, the available tax reductions in China (i.e. VAT) differ from those discussed in Germany (income tax).

Private investment in China is partially triggered by the Green Credit Policy of MEP, PBC and CBRC which is targeted at commercial banks. In addition, residents of buildings, which undergo retrofitting measures, are sometimes also expected to contribute to share part of the costs, which are normally rather small amounts. In Germany, private finance is mainly triggered through the funding programmes of KfW.

4. Case studies: provincial and city level policies for the financial support of EE in buildings

In addition to national policies, there might be additional policies in place at either province/federal state level or the city level to provide financial support for EE in buildings. Therefore the following section describes case studies in China and Germany, in regard to whether or not the respective province/city has set itself a target for improving EE in buildings and if and then what kind of policies exist on province/federal state or city level to promote EE in buildings.

4.1 China – case study Guangdong/Guangzhou

According to Wang et al. (2012), due to "China's size, its national strategies and policies are typically interpreted and implemented at provincial and municipal levels. Key decisions regarding investment and consumption also take place at the local level." Thus, beside policies at the national level, city level policies also play a crucial role in promoting EE in buildings.

Facts on the region and climate targets

Guangdong province, located in the southern coast of China belongs to the Hot Summer Warm Winter (HSWW) climate zone. It has plenty of solar, heat and water resources with an average temperature of 19°C-24°C; a population of 105 million and an urbanization rate of 66.2% (Guangdong Provincial People's Government, 2013). It was the largest regional economy in China for two decades as a pioneer of China's reform and openness. However, it faces severe challenges such as low per-capita resources, high energy consumption and energy import rate (85% in 2005) and power shortages especially during summer, and hence has strived for energy saving and low carbon development (China Daily, 2005). In 2010, Guangdong was designated by the central government as one of the "Five Provinces Eight Cities" low carbon pilots.[47]

The Chinese central government has delegated the national energy and carbon intensity targets to the provincial level, considering therein the respective local situation and development stage. During the 12th FYP period, Guangdong's target is to reduce overall energy intensity and CO_2 intensity by 18% resp. 19.5% by 2015 (compared to 2010), which is the highest target among all provinces and provincial level cities (State Council of China, 2011a and 2011b, Guangdong Provincial People's Government, 2012c). Guangdong is already more advanced on energy intensity and the use of non-fossil energy than many

[47] The NDRC launched a national low carbon province and city experimental project in August 2010, covering five provinces: Guangdong, Liaoning, Hubei, Shaanxi and Yunnan, and eight cities: Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang and Baoding. These provinces and regions are required to include climate change related activities in their local 12th FYPs and to formulate low-carbon development plans. Their low carbon pilot work plans have been submitted by mid 2011. In addition, NDRC announced last December the second round of low carbon city/province pilots, including Hainan province, Beijing, Shanghai and 26 other cities, which adds to total of six provinces and 36 cities covering most provinces in China.

other regions[48] and therefore it will be a great challenge for it to meet the targets set above (Guangdong Provincial People's Government, 2012b). The regional climate change plan also sets longer-term targets, namely to reduce carbon intensity by 35% in 2015 and >45% by 2020 (in comparison to 2005) (Guangdong Provincial People's Government, 2011 and 2012b).

Guangzhou, which is the capital city of Guangdong province, with a population of 15 million, is among the most populous and economically advanced cities in China (Guangzhou Statistics Bureau, 2011). Guangzhou has received several national urban awards, including National Environmental Protection Model City, National Garden City and National Forest City (Guangzhou Daily, 2012). Following its concept of "low carbon, smart and happy Guangdong", it aims to reduce energy intensity to 0.54-0.56 tce/10000 RMB by 2015 and become a role model low carbon city for its province (Guangzhou Daily, 2011).

Policies and financial support by the Guangdong province

Guangdong had 6 bn m^2 of existing building stock in 2010, which is among the largest in China, and it was expected to add another 6bn m^2 during the period of the 12th FYP (2011-2015) (Nanfang Daily, 2011; Guangdong Province Association of Building Energy Efficiency, 2012). Accounting for around 30% of total energy consumption of the Guangdong province and with large abatement potentials, the building sector is essential to Guangdong meeting its energy and carbon targets (Nanfang Daily, 2013). Guangdong's building sector policies have several key foci, similar to the national level policy framework, such as codes for building EE, developing green and low energy consumption buildings, promoting renewables in buildings, retrofitting existing building, and enhancing the management of energy saving measures in public buildings (Guangdong Provincial People's Government, 2011). Table 2 summarizes the key policies and progress of Guangdong.

Table 2 Guangdong policies and progress of building EE

Source: own, based on Nanfang Daily, 2011; Guangdong Province Association of Building Energy Efficiency, 2012

Legislation	11th FYP (2005-2010)	12th FYP (2011-2015)
Regional legislation	None	Guangdong Province Building Energy Efficiency Regulations (2011)
Regional administrative regulations	The HSWW Residential Building Energy Efficiency Design Standard, the 12 supporting standard protocols (e.g. Guangdong Implementation Rules for HSWW Residential Buildings Energy Efficiency Design Standard) and the 11 standard atlas (e.g. Energy Efficient Building Curtain Wall Structure), together with the national standards, constitute the provincial technology standard system	Guangdong Province Green Building Evaluation Criteria (2011) Guangdong Green Building Evaluation and Labeling Management Approach – Trial (2011)
Energy code for new buildings	A series of design review and filing systems, and enhanced measures for construction and acceptance phases. The compliance rate	Targets: In 2011, compliance rate of 97% for 50% building

[48] It had an energy intensity of 0.664 tce/10000 RMB in 2010 (reduced by 16.4% from 2005) constituting 65% of national average, and a rate of non-fossil energy of 14% (much higher than national average of 8%) (Guangdong Provincial People's Government, 2012b).

	improved year-on-year: 2008, 2009 and 2010 respectively 96.85%, 99.27% and 100% for the design phase and 75.83%, 86.28% and 96% for the construction phase, thereby meeting national targets. In 2010 109-million m^2 new energy saving buildings were constructed.	EE code. In 2015, to follow the 60% code, with compliance rate of 100%.
EE retrofit for existing buildings	Various approaches to promote retrofitting, including EPC; reached 5.32 million m^2 of retrofit over the five years, which reduced >20% energy consumption, as compared to original ones before retrofit.	Targets: In 2011, 2.3 million m^2 areas of retrofit. By 2015, 7.5 million m^2 areas of retrofit.
Building Energy Efficiency Demonstration (RE installations, green buildings etc)	By end of 2010 there were 61 demonstration projects, including 14 national RE building projects, 14 solar PV building integration projects, 10 national green building demonstration projects, and 6 national low energy consumption demonstration projects; 10 projects received green building labels.	Targets: In 2015, 30% new buildings and residential buildings to achieve green building standard. By end of 2015, total of 40 million m^2 of green buildings, and >8 green ecologic park demonstration areas.
RE application in buildings	Newly built solar thermal installation area of 12.7 million m^2, installed solar PV capacity of 167.01 MW, and shallow ground energy construction applications area of 1.91 million m^2.	Target: In 2015, 30% of the new buildings apply RE technologies.

Since Guangdong belongs to the HSWW zone, its new buildings had to follow >95% compliance with the building code, which requires EE improvement by 50% in comparison 1980s average situation, during the 11th FYP (2005-2010). By 2015, it will implement the 60% EE building code with an intended 100% compliance rate, and aims to complete EE retrofitting for 7.5 million m^2 of existing buildings. It is expected that during the five years of the 12th FYP (2011-2015), Guangdong's building sector will save 7.7 million tce, thereby avoiding 20.48 million tons of CO_2 emissions (Nanfang Daily, 2011).

Green building is another core area for Guangdong to promote.[49] With the adoption of the Guangdong Province Green Building Evaluation Criteria (which includes a labeling system[50]) and its implementation regulation in 2011 (Guangdong Provincial Department of Housing and Urban-Rural Development, 2011a and 2011b), Guangdong has set a sound policy foundation, and ambitious targets. These targets are to reach a total of 40 million m^2 of green

[49] In the regional regulation, the definition of a green building is one which maximizes the conservation of resources throughout its life cycle (energy, land, water, materials, including use of LED green lighting products), through technological progress and scientific management, in order to protect the environment, reduce pollution, and to provide people with healthy, suitable and efficient use of space and architecture in harmony with nature (Guangdong Provincial Department of Housing and Urban-Rural Development, 2011a). It has not the exact same wording, but same meaning in substance, as the definition in the national-level policy (MOHURD and MoF, 2012).

[50] It set up six categories of evaluation criteria for green buildings, including land saving and outdoor environment, energy saving and energy use, water conservation and water resources utilization, materials saving and material resources, indoor environmental quality, and operational management. There are 44 criteria for rating residential buildings and 47 for public buildings, which will result in five levels of green buildings. Level II equals the one-star national green building standard, level IV equals two stars, and level V equals three stars (Guangdong Provincial Department of Housing and Urban-Rural Development, 2011a and 2011b).

buildings and >8 green ecologic park demonstration areas by 2015; to reach 40 million m^2 and >10 demonstration areas by 2017; and to reach 140 m^2 and >14 demonstration areas by 2020 (Nanfang Daily, 2011). Already by December 2012, Guangdong province had 123 projects with national, provincial or municipal level approved green building labels, with a construction area of 12.41 million m^2, in which 9.02 million m^2 were built in 2012 (Nanfang Daily, 2011). But the sub-regions differ in progress, with green buildings concentrated in cities like Guangzhou, Shenzhen, Dongguan and Foshan, while ten cities in the same province had no green buildings at all. To achieve the targets and expand the locations, Guangdong government has set specific green building targets for different cities of the province (see table 3).

Table 3 Examples for targets of green building construction in Guangdong province during 12th FYP

Source: own, based on Guangdong Provincial People's Government, 2012a

Region/city	Area of green building construction by 2015 (10000 m^2)	Area of green building construction by 2013 (10000 m^2)
Guangdong province total	**4000**	**1100**
Guangzhou	**950**	**250**
Shenzhen	950	250
Zhuhai	200	50
Shantou	80	25
Foshan	300	60
Shaoguan	80	24
Heyuan	60	20
Meizhou	50	16
Huizhou	200	50
Shanwei	50	16
Dongguan	220	50
Zhongshan	200	64
Jiangmen	120	36
Yangjiang	50	15
Zhanjiang	80	24
Maoming	60	20
Zhaoqing	120	40
Qingyuan	80	22
Chaozhou	50	16
Jieyang	50	16
Yunfu	50	16

The province plans to enhance investment in climate change actions, including in the building sector, to support demonstration projects on low carbon cities, communities, zones, and enterprises. It is encouraged to use innovative financial tools for leveraging and guiding private investment (Guangdong Provincial People's Government, 2011). In the regional law on building EE, it is expressly specified that all governments above the county level in Guangdong shall arrange funding for building EE, the preparation of building EE standards, scientific research, energy monitoring system construction, RE installation demonstration projects and subsidies for energy-saving renovation of existing buildings (Guangdong

Provincial People's Congress Standing Committee, 2011). In practice, besides the national government's financial support, Guangdong provincial government has spent public money to support building EE. In 2010 the provincial spending in this field was 10.6 million RMB, which was viewed by some as insufficient (Nanfang Daily, 2011). Besides the provincial government, municipal and lower level regional governments also contribute – reaching in 2010 a total of 20 million RMB. However this was with a big regional divergence, the funds came mainly from a few cities such as Shenzhen, Guangzhou and Dongguan, whilst other cities provided no financial support (Nanfang Daily, 2011).[51]

Recently in June 2013, there were new moves in Guangdong to promote green buildings and RE application in buildings. Green buildings which have won national green building certification and completed the acceptance procedure, will be subjected to third party evaluation arranged by Guangdong Provincial Department of Housing and Urban-Rural Development to select those with a major demonstration effect to receive an extra subsidy, on top of the national reward, of 25 RMB/m^2 for two stars (maximum 1.5 million RMB per project) and 35 RMB/m^2 for three stars (maximum 2 million RMB per project) (China Construction News, 2013). For RE building application demonstration projects, subsidies can be a maximum of 50% of the investment for public buildings, and 20% of investment for non-public buildings, with a maximum of 2 million RMB per project (China Construction News, 2013).

Besides grants, Guangdong has been exploring new methods of financial support. It will explore "building energy consumption quota, beyond which to fine, and below to award" management mechanisms for government office buildings and large public building from 2011 (Nanfang Daily, 2011). Guangdong is now actively formulating a building energy consumption quota and over-quota surcharge management approach (Nanfang Daily, 2013).

Policies and financial support by the city of Guangzhou

In 2009, Guangzhou's total area of buildings was 332.87 million m^2, 31.2% higher than in 2005, with 32.8% of this area being residential buildings and 26.1% public buildings (Guangzhou City Building Energy Efficiency Leading Group, 2011). In the same year, the total energy consumption of the city was 55.86 million tce, and the energy sector accounted for 30.84% (Guangzhou City Building Energy Efficiency Leading Group, 2011). Guangzhou has carried on building EE work since 2005 with some good results over the 11th FYP period (2005-2010). These include compliance rates of energy codes for new buildings (residential and public) of 100% and 96% respectively for the design and construction phases, the EE retrofit of 2.5 million m^2 of existing buildings, the installation of 3 million m^2 of RE in new buildings, 4 green building certificated projects, and 5 national green building demonstration projects (Guangzhou City Building Energy Efficiency Leading Group, 2011).

However, the city government has identified the lack of effective financial support and incentives for building EE as one of the key problems. For instance there was no specific fund for building EE, no tax constraint for building high energy consuming buildings, a lack of fiscal policy support for retrofitting, and very limited experience in EPC and energy saving labelling systems (Guangzhou City Building Energy Efficiency Leading Group, 2011). Some progress in

[51] These cities also performed better in their building EE and green building development.

this respect has been made. In March 2011[52] the Guangzhou government launched its Trial Measure for Guangzhou Civil Building Energy Efficiency, which provided some good ideas such as having the financial department working with the Building Commission to plan specific building EE funding, financial subsidies to city-awarded demonstration projects, a special fund for building EE set up by donations from enterprises and individuals, and government sharing in retrofitting cost (e.g. government budget to cover government office retrofitting, developers and government share the cost of retrofitting for public buildings of education, culture and sports, and a potential loan discount for owners of residential buildings) (Guangzhou Municipal People's Government Office, 2011). But since it was a trial measure with only two years of validation, the implementation of these ideas is subject to questions, and there is lack of information to accurately assess it.

It was further reported in 2012 that for green buildings with national certification (two stars and beyond) or Guangdong provincial certification (level IV and beyond, see footnote 50), the developers might apply for special financial awards from the city government; and those projects with 50% or more energy consumption from RE would be eligible for the Guangzhou Special Fund for Supporting Strategic Emerging Industries, as well as enjoying the corresponding tax benefits (Guangdong Construction News, 2012).

This year, Guangzhou also developed a local law to guide the development of green building and building EE. In this law there is a chapter dedicated to "incentives", that says governments at the city, district and county levels should arrange financial support for green building and building EE related work (Guangzhou Municipal People's Government Office, 2013). Green buildings with two stars or beyond will be rewarded at a rate based on their floor area (Guangzhou Municipal People's Government Office, 2013).

4.2 Germany – case study North-Rhine Westphalia/Bonn

In Germany, climate policies can be made at the national state level (see above), at federal state level or at the city level (municipality). While all national level programmes are also applicable at the city level, it is interesting to find out whether there are additional programmes at the city or federal state level. For the case study of a German city, the city of Bonn has been chosen, which is located in the federal state of North-Rhine Westphalia (NRW).

North Rhine Westphalia

NRW is the first federal state in Germany to have implemented a climate protection law (Ministry for Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection NRW (MCPEANCCP-NRW), 2013). According to this law, NRW will reduce its GHG emissions by at least 25% by 2020 (in comparison to 1990) and by at least 80% by 2050 (para 3 Climate protection law). This is especially remarkable if one considers that the emissions within NRW constitute 30% of Germany's overall emissions due to its expansive industrial production (MCPEANCCP-NRW, 2013).The first climate protection plan, which is part of the climate protection law, is being implemented in 2013 and will then be updated every five years (MCPEANCCP-NRW, 2013).

[52] Here it is interesting to note that it was launched a few months earlier than the Guangzhou provincial regulation on civil building EE.

Facts about the city of Bonn and its climate targets

Bonn belongs to the federal state of NRW and has about 320.000 citizens. The climate, which is an important aspect when analyzing building policies, in Bonn is relatively modest, with average temperatures between 0°C in winter and 23°C in summer (Klima.org, 2013).
The city of Bonn takes part in a range of city alliances, including Climate Alliance, Covenant of Mayors, Eurocities as well as the European Energy Award. Participation in such alliances in some cases includes the setting of specific city level targets. For instance, due to its membership within the Climate Alliance, the city of Bonn agreed to reduce by 2010 its CO_2 emissions by 50% in comparison to 1987 (City of Bonn, 2011). Another ambition is linked to the membership in the Covenant of Mayors, where all participants strive to achieve greater emission reductions than that of the current EU target of -20% in comparison to 1990, whereby Bonn has set itself the target of -20% (Covenant of Mayors, no date a, Covenant of Mayors, no date b). In its own "Masterplan for the Energy turnaround and Climate change" (Masterplan Energiewende und Klimaschutz) Bonn set the target of reducing its emissions by 90-95% by 2050 and by 40% by 2020 – both in comparison to 1990 levels (City of Bonn, 2011).

Currently, private households use about 32.4% of the final energy consumed in Bonn (Helbig, 2013). This presumably includes the energy use of buildings but also overall electricity consumption in private households, for instance through lightning, computer use etc.

Financial support by the federal state of North-Rhine Westphalia

In 2011, financial support of NRW for retrofitting totalled 133.046 million EUR and support for passive houses for low income families was 42.5million EUR (MCPEANCCP-NRW, no date).
With its programme "progres.nrw" the state of NRW financially supports a broad range of projects (Helbig, 2013). This includes for instance grants for the construction of a passive house, the instalment of solar thermal installations as well as for highly efficient small scale CHP-plants (Progres.nrw/Bezirksregierung Arndsberg, 2013). Overall, the project measure may not have started before the applicant applies for the support (Progres.nrw/ Bezirksregierung Arndsberg, 2013).
The bank of North-Rhine Westphalia ("NRW bank"), which is owned by the federal state of NRW, has various programmes for low interest loans – hence using the same approach as KfW at the national level. One is focusing on renovation measures in general, while others specifically intend to incentivise EE in buildings used by people with lower income. Since the question of socially compatible improvement of EE in buildings is currently often discussed, a more detailed analysis of the results of these specific NRW Bank programmes would be interesting, to find out what could be learned from them for the overall discussion.

Table 4 Exemplary measures funded by the province of NRW

Funding program	Examples for funded measures	Max. funding volume	Further information	Source
Progres.nrw via NRW Bank	Passive house	Up to 4.700 EUR per house / up to 3.400 EUR per housing unit in a multi-apartment building		Progres.nrw/ Bezirks-regierung Arndsberg, 2013, NRW Bank, 2013d
Wohn-raumför-derungspro gramm	Newly built passive house use for social housing	May increase the initial rent by 30cent/m^2		Klimaschutzst artprogramm, no date.
Progres.nrw via NRW Bank	Solar thermal installations	90 EUR/m^2	Grants are not available for installations which are used for fulfilling requirements of the EEWärmeG.	Progres.nrw/ Bezirks-regierung Arndsberg, 2013, NRW Bank, 2013d
Progres.nrw via NRW Bank	Highly efficient small scale CHP plans	Flat rate of funding for a certain amount of installed KW plus additional amount for each additional KW_{el}		Progres.nrw/ Bezirks-regierung Arndsberg, 2013, NRW Bank, 2013d
NRW Bank	Renovation measures, including EE improvement	Up to 100% of the fundable investment costs with amounts between 2500 and 75000 EUR	Available for private house owners who live in their house (hence no landlords)	NRW Bank, 2013a
NRW Bank	Measures include insulation of walls, new windows and heating or warm water installations based on for instance CHP-plants or on RE.	The loan covers up to 80% of the construction costs, but must be between 2500 and 40000 EUR per apartment	Available for home owners, who either live themselves in their apartment or whose relatives live in the apartment. The residents may not have an income beyond a specific amount, fixed in the social housing act of NRW.	NRW Bank, 2013b
NRW Bank	Measures include insulation of walls, new windows and heating or warm water installations which are based on RE or CHP-plants.	The loan covers up to 80% of the construction costs, and may not exceed 40000 EUR per apartment	Available for landlords. The landlord has to commit to not supersede the level of common rents and that potential new tenants must have a proof of the need for social housing.	NRW Bank, 2013c

Policies by the city of Bonn for (financial support for) energy efficient buildings

If the city of Bonn sells city-owned land for the construction of buildings, it requires the new residential buildings to be more energy efficient (KfW standard 55) than required by national law, unless more than 50% of the energy used for heating comes from RE – then the national standard is sufficient (Helbig, 2013; Mayor of the city of Bonn, 2012).[53] For non-residential buildings, the EE concepts are discussed between the city of Bonn and the owner of these buildings (Mayor of the city of Bonn, 2012).

The city of Bonn has established its own energy agency, which supports, via consultancy, the promotion of EE in buildings (City of Bonn, no date a). Closely linked to this consultancy work is the information tool of a solar cadastre whereby one can get information on whether one's roof is suitable for PV or solar thermal installations (City of Bonn, no date b).

For the installation of solar thermal installations for warm water for existing houses, which can but do not have to include also heating purposes, the city of Bonn provides grants of 100 EUR/m^2 of the gross device area (City of Bonn, no date c). Funding is only available if the measure has not yet been started and is provided once the measure has been finalized (City of Bonn, no date c).

4.3 Interim summary

The role of provincial or local governments seems to differ in China and Germany. While in China, the central government provides the overall framework, policies and targets, the local governments are expected to conduct the measures for fulfilling these targets and receive specific targets for this. With regards to financial support for building EE, there are great variations at regional level; which relates highly to the performance of different regions (provinces/cities). In Germany, the central government sets the overall targets and approaches, and the federal state or city government can set additional targets or policies, such as the financial support systems of the NRW Bank or the financial support of the city of Bonn for solar thermal installations. Yet also here the provinces and cities play an important role in meeting these targets.

[53] More detail also on previous measures can be found in City of Bonn, no date a.

5. Conclusions

For both China and Germany, the enhancement of EE in the building sector is of utmost importance, since this sector contributes to a large share of their overall energy consumption and GHG emissions, and moreover it creates additional crucial benefits to the real economy and society (including energy security, employment, and innovation). Therefore it is very important that both, China and Germany meet the targets identified in the 12th FYP and the Energy Concept respectively as minimum benchmarks, and in addition to this engage actively in the information and experience sharing initiative under the MEF.

After the unification of Germany, many measures were conducted for improving the energy efficiency of buildings made of prefabricated slabs in the former German Democratic Republic. Since there are also many similar buildings in China, the German experiences in this regard might be of special interest to China.

China, with four different climate zones, has a very fast growth rate of new buildings and a large existing building stock, whereas in Germany the growth of new buildings is quite moderate and building codes for new buildings are already very strict. However, in Germany there is a large building stock of old houses in need of retrofitting. Both countries have established policies to address building EE from central to local levels and have both implemented building codes which set the overall mandatory framework and ambition for energy efficient buildings. Further, both countries have introduced building standards for greener or more energy efficient buildings. For China this is the star system, and for Germany the standards described in EnEV as well as the KfW housing standards. While the star system in China applies only to new buildings, the EnEV addresses both new and existing buildings, and KfW standards are set as funding benchmarks for both new and existing buildings.

Financing is both a common challenge and a core factor for success for EE in buildings in China and Germany, to which attention should be given, and experiences be compared and shared between the two countries.
Based on our research, it becomes evident that both countries provide large amounts of funding for this purpose. Yet the approaches taken differ. In China, funding from the central government is provided to the local governments who then provide it further to project developers or conduct retrofitting measures directly. The financial instruments being used are mainly grants or tax reductions. In Germany, funding is provided to house owners or house buyers. The main funding instruments used are concessional loans and to some extent also grants. It is interesting to note that concessional loans are also under discussion in China and tax reductions (however of a different type than in China) are also under discussion in Germany. Further, the government of Guangdong is exploring options for a quota system, with a similar system also being suggested by stakeholders in Germany.

According to Hilke/Ryan (2012, 17) economic instruments should always be accompanied by regulatory policies as well as information policies in order for them to realise their full potential. Both in China and Germany, the economic instruments (funds provided) are set in relation to the above mentioned building standards/codes (regulatory policies). As has been indicated before, China also puts emphasis on information policies and according to Kuckshinrich et al. (2012, 6) the KfW standards have also helped to increase awareness of the issue of energy saving in buildings. Yet, the level of information provided and its effectiveness differ between

the two countries. Germany is more advanced in this respect, and hence so is also the awareness amongst the public (and thereby the motivation to install RE or to retrofit houses to be more energy efficient). Yet also in Germany, awareness could be increased.

It is also worth noting that KfW, as Germany's policy bank, plays a significant role in channelling public money for building EE, which may offer a good case for China's policy banks to learn from.

In regard to the problems slowing down process on EE in buildings, for both countries the inefficient level of financial means constitutes a core challenge. Another problem in Germany is the landlord-tenant problem, which can also be referred to as the investor-user dilemma. While in China the share of tenants is much smaller than in Germany, the diverse owner structure in large apartment buildings constitutes another hurdle.

At local level, it becomes evident that in the case study for Germany, financial support (additional to the money provided from the central government) is being provided at the province level (North-Rhine Westphalia), rather than at the city level. However, some financial support is also provided by cities such as Bonn, in addition to the national and provincial funding. In China, provincial governments are directly responsible for ensuring that the region contributes to the assigned share of national targets via the implementation of regional policies and programs, as shown by the case of Guangdong province. Such efforts and responsibilities are delegated further down to city level governments. But the level of ambition, speed and sophistication of policies, as well as financial support, vary greatly amongst regions and cities. Regional financial support is provided in the same manner as central government support (e.g. fiscal subsidy or specific funds), while more market-based approaches are under discussion[54]. Both Guangzhou and Bonn have their own targets for EE in buildings respectively emission reduction targets.

In order to improve the financial support to building EE, it would be valuable for China and Germany to share experience, and to explore individually and together, at both national and local levels, the questions proposed below.

- On financial resources: What are their experiences (good examples and hurdles) regarding:
  - ensuring that financial incentives reach the right actors, namely those who have the ability to act?
  - diversifying the financial resource channels and accelerating the amount of support?
  - encouraging local governments to play an important role in setting more ambitious local policies and support?
  - involving state development banks in providing support for EE measures?
  - encouraging commercial banks to apply more green crediting practices and to mainstream it in their business?
  - incentivizing house owners to conduct retrofitting measures?
- On the distribution of financial support: What are their experiences (good examples and hurdles) regarding:

[54] See for instance also BMU, 2013b.

  - improving effectiveness and accountability, especially for grants provided by the government or public banks?
  - ensuring transparency via information disclosure on the money spent and the results?
  - ensuring the "sustainability" and "quality" of the recipients' work, rather than just using a one-off award?
  - balancing social equity and safeguarding/ensuring that low-income families also get support for EE?
  - making the availability of financial support known clearly to potential recipients?
- On stakeholder engagement: What are their experiences (good examples and hurdles) regarding
  - informing and engaging with various stakeholders effectively, including the providers, recipients and intermediate bodies of the financial support, as well as civil society organizations, in order to consistently review the policies and exercises, to identify gaps to close, areas to improve and for sharing good practices?
  - raising awareness amongst the public of the energy saving potential of buildings, and of the potential in their own houses/buildings?
- On innovative finance: What are their experiences, (good examples and hurdles) regarding
  - possibilities to raise finance innovatively e.g. via carbon market revenue or other carbon pricing or taxation schemes?

As such, we hope this paper provides a starting point for valuable exchange and joint effort.

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Annex I – Policy framework of building EE in China

Source: own, based on Shui/Li, 2012

Area	Policy type	Examples of policies
EE policies for new buildings	Building energy codes	• Design Standards for Energy Efficiency of Residential Buildings in Severe Cold and Cold Zones (1986, 1995 24 and 2010) • Design Standards for Energy Efficiency of Residential Buildings in the Hot Summer and Cold Winter Zone (2001 and 2010) • Design Standards for Energy Efficiency of Residential Buildings in the Hot Summer and Warm Winter Zone (2003) • Design Standards for the Energy Efficiency of Public Buildings (2005) • Code for Acceptance of Energy Efficient Building Construction (2007)
	Building EE labelling and evaluation	• Notice on Disseminating A Comprehensive Working Scheme for Energy Saving and Emissions Reductions (2007) • Tentative Methods for Managing Civil Building Energy Performance Labels (2007) • Technical Guide for Labelling, Testing and Evaluating Civil Building Energy Performance (2007)
	Green buildings	• Management Measures for Innovative Green Building Award (2004) and Detailed Implementation Regulations for Innovative Green Building Award (2004) • Green Building Evaluation Standards (2006) • Management Measures for Green Building Evaluation Labelling (Trial) (2007) • Detailed Technical Guide for Green Building Evaluation (Trial) (2007) • Supplementary Explanations for the Detailed Technical Guide on Green Building Evaluation Labelling (Part of Plan and Design) (2008) and Supplementary Explanations for Detailed Technical Guide on Green Buildings Evaluation (Part of Operation and Use) (2008) • Detailed Implementation Guide for Innovative Green Buildings Awards (2010) and Assessment Standards for Innovative Green Buildings (2010) • Guide for Green Industry Building Evaluation (2010) and Evaluation Standards for Green Construction of Building Projects (2010), and one industry standard, namely Design Codes for Green Design of Civil Buildings (2010) • Detailed Technical Guide for Green Hospital Buildings, and began to update the Green Building Evaluation Standards (2011)
EE policies for existing buildings	EE retrofit	• Regulations on Civil Building Energy Efficiency (2008) • Technical Specifications for Energy Conservation Renovation of Existing Heating in Residential Buildings (2000, updated 2012) • Technical Guide for Energy-Saving Reconstruction and Heat Supply Measurement of Existing Residential

		Buildings in Northern Heating Areas (Trial) (2008) • Testing and Measurement of Building Energy Efficiency in Public Buildings (2009), and Testing and Measurement of Building Energy Efficiency in Residential Buildings (2009)
	Heat reform to metering and consumption based billing	• Opinions on the Guide for the Pilot Work of Heat Reform in Cities and Towns (2003) • Opinions on Promoting Heat Metering (2006) • Provisional Methods for Managing the Grants Employed for Promoting Metering and Retrofit of Existing Residential Buildings in Northern Heating Areas (2007) • Opinions on Implementation of Boosting Heat Supply Measurement Reform and Energy Efficiency Retrofitting of Existing Residential Buildings in Northern Heating Areas (2008) • Further Boosting Heat Supply Measurement Reform and the Notice on Making More Efforts to Ensure Heat Supply Measurement and Energy Efficiency Retrofitting of Existing Residential Buildings in Northern Heating Areas indicate (2011)
	National government and large-scale public buildings	• Implementation Guidelines of Improving Building Energy Efficiency in Governmental Office Buildings and Large-Scale Public Buildings (2007) • Regulations on Energy-Efficiency for Public Institutions (2008) • Guidance for Further Promoting Building Energy Efficiency in Public Buildings" (2011)
	Colleges and universities	• Technical Guidelines for Energy-saving Supervision Systems for Campus Buildings in Colleges and Universities (2009), • Technical Guidelines for Operation and Management of Energy-saving Supervision Systems for Campus Buildings in Colleges and Universities (2009), • Guidance for Energy Statistics, Energy Audits, and Public Information Disclosure of Building Energy Consumption for Campus Buildings in Colleges and Universities (2009), • Guidance for Energy-saving Operation and Management of Campus Facilities in Colleges and Universities, and • Guidance for Rating Systems and Evaluation for "Saving-oriented" Campuses in Colleges and Universities
Application of renewable energy in buildings		• Implementation Opinions on Promoting the Application of Renewable Energy in Buildings • Notification on Accelerating the Application and Scale-up of Solar Water Heating Systems • Notice on the Organization of the Annual Program of Integrated PV Buildings Demonstration Projects in 2012
Rural building energy consumption		• Methods for the Collection, Use and Management of Special Funds for New Wall Materials in 2007 • Notification on Implementation Scheme for Promoting and Accelerating the Application of Renewable Energy in Rural Buildings (2009) • Notification on Expanding the Building Materials Going to the Countryside Pilots Program 2011

Annex II – Funding programmes from the German national government

Funded by	Programme	Addressees	Funded measures	Instrument	Time of application and payment	Maximum amount	Source
KfW	New residential buildings (no. 153)	*Investor (acting as land lord or living there themselves) of to be constructed buildings *Initial buyers of a house	New houses which fulfil KfW building standards 40, 55 or 70.	*Low interest loans for the first ten years, followed by new conditions for the loan *Repayment grant, possible once energy standards 40 or 55 have been achieved	*Application before the start of the measure *Provision of the loan normally within 1 year after approval	*Loan: Up to 100% of construction costs (excluding land)[55] *Loan may not exceed 50 000 EUR per living unit *Repayment grant: 10% resp. 5% of committed amount for standard 40 resp. 55	KfW, 2013e
KfW	Retrofitting of existing residential buildings – part I and II (no. 151, 152)	*Investor (acting as land lord or living there themselves) *Initial buyers of newly renovated efficient buildings or apartments	*Buildings must have been built before 1995 *Retrofitting of the building to reach KfW building standards 55, 70, 85, 100, 115 and monument *Individual modernization measures (i.e. insulation of outer walls, new windows, new heating systems, new air conditioning) or full renovation	*Low interest loan for the first ten years, followed by new conditions for the loan *Repayment grants for full renovations with the level being dependent on the level of efficiency achieve	*Application before start of the measure *Provision of the loan normally within 1 year after approval *Repayment grant only once the measures is finalized	*Up to 100% of investment costs, which are directly linked to the measure (includes also scaffolding which is not directly climate relevant) *Individual measures: max. loan is 50 000 EUR/living unit *Full renovation: max. loan is 75 000EUR/living unit *Repayment grant: i.e. 17.5% of the agreed amount for standard 55; or 2.5% of the committed amount for standard 115	BMWi, 2011, 38, KfW, 2013c, Juergens et al., 2013

[55] However here it must be noted that Juergens et al. (2012) assume that funding provided for EE measures covers only incremental costs. While relevant KfW documents say that loans can be provided for the full construction costs (KfW, 2013e), this would, according to Kuckshinrich et al. (2012) in principle nevertheless constitute an incremental part, since the loan is capped at 50000EUR which by itself is not sufficient for the construction of a new building.

Funded by	Programme	Addressees	Funded measures	Instrument	Time	Maximum amount	Source
KfW	Retrofitting of existing residential buildings – part III (no. 430)	Amongst others *Home owners (acting as land lord or living there themselves) of 1- or 2 family houses (with max. 2 living units) or of apartments in apartment owners association *First buyers of newly renovated efficient 1- or 2 family houses or apartments	*Buildings from before 1995 *Individual measures (i.e. insulation of walls, new heating systems, new air conditioning, roofs) or full renovation which lead to KfW housing standard 55, 70, 85, 100, 115 or monument	*Investment grant with the level depending on the efficiency standard achieved	*Application before the measure, directly with KfW *Investment grant only once the measure is finalized	*Percentage of investment costs, which are directly linked to the measure (includes also scaffolding which is not directly climate relevant), is depending on EE standard achieved *I.e. standard 55: 25% of fundable investment costs, max. 18 750EUR/ unit; standard 115: 10% of fundable investment costs, max: 7500EUR/unit *Individual measures: 10% of fundable investment costs, max. 5000EUR/unit	KfW, 2013d, Juergens et al., 2013
KfW	Retrofitting of existing (not residential) buildings (no. 218/219)	*For instance municipal and local authorities and other institutions related to communities *Businesses which either provide measures for community buildings (i.e. contracting) or have the majority of the shareholders coming from the community *Charitable organisations (incl. churches)	*Buildings which have been finalized before 1995 *Individual measures (i.e. wall insulation, new heating systems, changes in lightning, sun protection) or full renovation which lead to KfW housing standard 55, 70, 85, 100 or monument	*Low interest loan for max. of ten years, followed by new conditions for the loan (218) and special regulations for 219 *Repayment grant with the level being dependent on the level of efficiency achieved	*Application directly with KfW (218) resp. via bank (219) *Provision of the loan normally within 1 year after approval *Repayment grant only once the measure is finalized	*Up to 100% of the investment costs *Max. loan for individual measures: 300EUR /m^2 of net ground floor *Max. loan for full renovation: 500EUR /m^2 of net ground floor *Repayment grant: i.e. standard 55: 12.5% of committed amount, standard 100: 5% of committed amount	KfW, 2013f, KfW, 2013i
KfW	Small scale RE heating systems (no. 167)	*Investor of houses or apartments (acting as land lord or living there themselves) *First buyers of newly renovated efficient buildings or apartments	Exchange or enhancement of heating systems (from before 2009) for small scale thermal solar panels, heat pumps or biomass installations.	Low interest loans	*Provision of the loan normally within 1 year after approval	*Up to 100% of the investment costs, which are directly linked to the measure (which may also include not directly climate relevant costs) *Max. loan: 50 000 EUR/living unit	KfW, 2013g
KfW	Large scale RE heating systems (no. 171/172, 181/182)	*Broad range of addressees, incl. private persons (not land lords), some type of companies and under certain conditions regional authorities	*I.e. large scale solar panels (for i.e. heat generation), biomass installations, heat based CHP biomass plants, large scale heating pumps.	*Low interest loans for the first ten years, followed by new conditions for the loan *Repayment grants with the level being dependent on the precise measure	*Application before start of the measure *Provision of the loan within 1 year after approval	*Up to 100% of the net investment costs (excluding VAT) *Max. loan 10 mio EUR *Repayment grant: depending on the measure	KfW, 2013h

Funded by	Programme	Addressees	Funded measures	Instrument	Time	Maximum amount	Source
BAFA	Solar thermal installations	Broad range of addressees, incl. private persons, municipalities and small and medium enterprises (SME)	*Solar thermal installations for various purposes on existing buildings *Solar thermal installations on new buildings only if the measure is very innovative * Additional funding can be provided for different reasons, including for heat pumps or if the installation is particularly innovative.	Grant	*Private persons or municipalities: application within six months after completion *SME: application before installation	*Level of grant depends on the installation (i.e. for warm water, heating or cooling) as well as size of the installation *I.e. for an installation < 16m^2 used for a combination of warm water and heating, the grant can be up to 1500EUR; for larger installations the support is measured per m^2 in addition to the flat rate	BAFA, no date a, BAFA, 2012a
BAFA	Efficient heat pumps	Broad range of addressees, incl. private persons, municipalities and SME	*Energy efficient heat pumps in existing buildings which have been built before 2009, with heat pumps for room heating in non-residential buildings and combination of heating and warm water heat pumps in residential buildings *Additional funding available, i.e. if the project is particularly efficient	Grant	*Private persons or municipalities: application within six month after completion *SME: application before installation	*Grant depends on the pump installed; for all of the pumps a specific flat amount is assigned (with the smallest amount being 1300 EUR), for some larger scale pumps one can get additional support to the flat amount per additional kWh installed	BAFA, no date b, BAFA, 2012b
BAFA	Small scale CHP-plants	No details available, presumably private persons (since it is available for 1- or 2 family houses) but potentially more addressees	Block CHP-plants (up to 20 KW_{el})	Grant	Application before start of the measure	Grants dependent on the size of the power plant; while for a plant with 1 KW_{el} one can receive 1500 EUR in grant, one can receive up to 3500EUR for a plant with 19 KW_{el}	BAFA, no date c
BAFA	Contracting with RE installations	Companies who provide contracting services	Contracting services with RE installations (incl. solar thermal, biomass, heat pumps)	Grants	Application before start of the measure	*Grant depending on RE used and installation size *Flat grant for smaller scale installation, the grant for larger scale installation is dependent on size	BAFA, no date f

G:HUB Climate and Finance Policy Center

G:HUB promotes the development and implementation of sound climate and financial policies, and encourages critical dialogue among stakeholders; the Center seeks positive changes in climate and sustainable finance via high-quality research and analysis.

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