

# A Comparative Study on the Role of Energy Efficiency in Urban Planning Instruments of Iran and Germany

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## Abstract

In recent years energy efficiency in different levels become of prime importance. Studies have been shown that urban planning can play a critical role in this area. At the same time in oil-producing countries like Iran, energy efficiency has not been considered as a national priority. However, in recent years with increase in the population growth, rapid urbanization and acceleration of environmental degradation, the issue is gaining more importance. Iran has adopted its first national building code on energy efficiency in 90's. However, as the country lacks a hierarchical energy planning system, its achievements were below the expectations. To improve the situation, it is important to study the experiences of other countries. Germany with a solid and successful energy planning in different scales can be considered as one of the pioneering countries, and its programs could be used as a guideline to achieve similar goals in other countries. Recently the German government has adopted a highly ambitious energy program, called "Energy transition" (Energiewende). The program will affect all planning instruments and ordinances in the country. As a comprehensive and upper level plan, "Energy transition" can be studied from different viewpoints. In the current study, its influence on urban planning instruments will be the main focus. The main objective is to compare the role of energy in urban planning instruments of Iran and Germany, and to develop some solutions and strategies to be considered in Iran. The first step in this study is the introduction of urban planning systems and instruments in the two countries, then the role of energy in each country will be introduced and with an analytical review, some suggestion for Iranian planning instruments will be made. Using comparative study as the research methodology, the study will focus on "comprehensive plan" and "detailed plan" as two main urban planning instruments in Iran, and "binding land use plan" and "preparatory land use plan" as formal planning instruments in Germany together with informal and other supporting instruments. The study will show how urban planning in Germany achieves the federal goals on energy efficiency and how it can work as a model for other countries.

**Keywords:** Urban Planning, Germany, Iran, Energy Efficiency, Planning Instruments

## 1. Introduction

A review on Iran's energy facts and figures shows its critical situation: according to the data published by "Iran's energy balance sheet" in 2012, per capita usage of natural gas and crude oil is respectively 6 and 1.6 times more than global average. Energy end use in agriculture, residential and commercial, industry and transportation sectors are also respectively 3.3, 1.9, 1.5 and 1.5 times higher than global average. Energy intensity in Iran is also 1.5 times higher than global average and energy efficiency has been 5.7% reduced compared to the last year (VPPE, 2013). The same set of data shows a considerable share of fossil fuels (specially natural gas and oil products) in energy end use of the country, which is the main cause of green gas emissions. The fact that residential and commercial sectors together with transportation have the first and second position for energy end uses shows the great share of urban related activities in this area.

Demographic changes have also an important role in future trends of energy demand. During the 20th century, Iran has encountered vast population growth with a considerable immigration from rural to urban areas.

Although the population growth rate has been slow down in the recent years, urban areas are still in the phase of rapid expansion. According to the last national census in 2011, about 70% of Iran's 75 million inhabitants are living in urban areas (SCI, 2011). Another demographic change is aging population and reduction of household size together with increasing household numbers, which would introduce fundamental changes in housing needs and expectations, and may also affect housing market and energy use in the country.

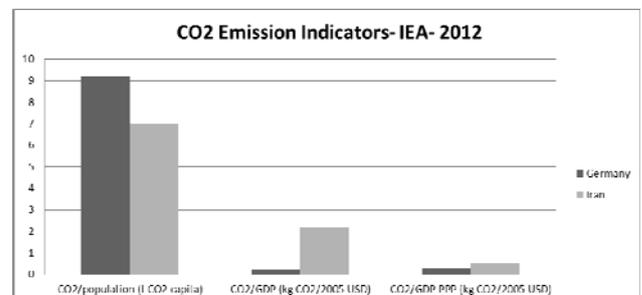


Fig. 1. Comparison of CO2 emission indicators in Germany and Iran (IEA, 2012)

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The focus of present paper is to do a comparative study on energy efficiency in Germany as an industrialized county and Iran. Here we will start with a brief comparison of some environmental factors. IEA (International Energy Agency) data shows that although Germany produces more CO<sub>2</sub>, its emission per GDP is less than Iran. From

the following charts, it is also obvious that energy supply in Germany shows more share of renewables with a total decreasing trend, while in Iran the usage of fossil fuels (namely natural gas) is still increasing (figures 1 and 2).

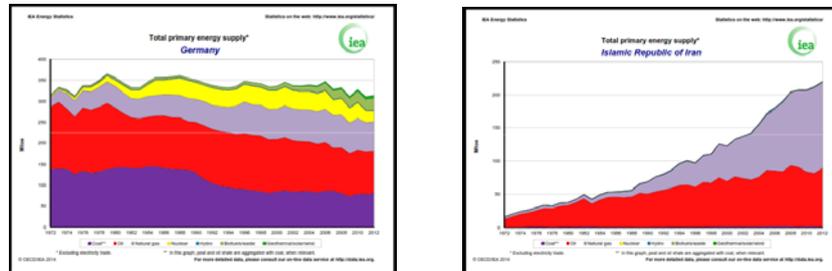


Fig. 2. Comparison of total primary energy supply Germany and Iran (IEA, 2013)

The short introduction and data comparison illustrates Iran’s urgent need to develop energy efficiency in different sectors. The facts prove the need for restructuring energy planning in different sectors. To do so, one approach would be the study of world’s best practices. Germany is a leading country in the fields of environmental protection and energy efficiency. Its experiences could work as an example to other countries. With the focus on the role of urban planning in energy efficiency, this paper will compare urban planning instruments in Iran and Germany with the general goal of finding solutions to improve Iranian planning system.

**2. National energy master plan**

**2.1 German energy transition**

Germany has developed its ambitious and unique energy master plan, which is called “Energiewende” or “Energy Transition” in 2010. However, the endeavor to save

environmental qualities has a quiet long history in this country, which at least dated back to 1970s and rooted in the anti-nuclear movements of that period (Morris and Pehnt, 2015). This nation-wide program organizes and interconnects all the activities related to energy usage in the country. Six main issues have been discussed as the main reasons to switch to renewable energy and increase energy conservation in this program (ibid):

- a) Fighting climate change.
- b) Reducing energy imports.
- c) Stimulating technology innovations and the green economy.
- d) Reducing and eliminating the risks of nuclear power
- e) Energy security.
- f) Strengthening local economics and providing social justice.

The overall approach for restructuring the energy system has been introduced in table 1(BMWi, 2012a):

Table. 1.

Restructuring the energy system- overall approach

<b>General principle</b>	<b>Energy policy is the foundation for growth and prosperity:</b> The restructuring of the energy system will not just happen by itself - it needs the backing of consumers and businesses. At the same time, Germany is to be remaining as a competitive location for industry. To deliver this goal, we must place the restructuring on a solid economic footing.
<b>Objectives</b>	<b>What do we want to achieve?</b> We want a secure and affordable supply of energy in Germany. We have mapped out the development path through to 2050 in energy concept. Greenhouse gas emissions must be reduced, the share of renewable should be increased and energy efficiency has to be improved.
<b>Action areas and measures</b>	<b>How will we manage to restructure the energy system?</b> The Federal Government took the first important step toward the restructuring in summer 2011 by the introduction of Energy Package (six laws and one ordinance). The Energy Concept contains over 120 individual measures that must now be implemented gradually.
<b>Finance</b>	<b>How will we financially support this project?</b> Essential investments and associated new business fields are closely linked to costs charged to consumers and taxpayers. Financed through systems such as renewable surcharge and grid utilisation fees, they are also supported by the Energy and Climate Fund (Energy Efficiency Fund, Building Modernisation Programme, etc.)
<b>Implementation/ monitoring</b>	<b>How do we track implementation?</b> Annual implementation monitoring (grids, power stations, renewable energy and energy efficiency). An independent commission of expert will oversee this process. We will engage in dialog with key stakeholders (Grid Platform, Power Plant Forum)

(Source: BMWi, 2012a)

The Federal Government has developed several goals, which pursue quantitative objectives in the target year of

2050. The goals have been identified in the following fact-sheet and table 2:

“The Energy Concept plans to cut greenhouse gas emissions by 40% until 2020, and at least 80% by 2050 as it was agreed by the industrialised nations.”

Renewable energies have to be expanded to become the mainstay of energy supply. The goal is to increase their share in final gross energy consumption from roughly 10% in 2010 to 60% in 2050. The share of renewable energy in electricity supply is to grow to a high amount of as 80% by 2050.

Simultaneously, the government seeks to reduce energy consumption over the long term. Compared to 2008 levels, there is to be a 50% reduction in primary energy consumption by 2050. On average, this demands a 2.1%

annual increase in energy productivity relative to final energy consumption.

By year 2050, electricity consumption is to undergo a 25% drop rate compared to year 2008, and should already have a 10% increase by 2020. Final energy consumption in the transportation sector is to be reduced by a 40% approximation in year 2050 - compared to 2005 levels.

Furthermore, the annual rate of energy retrofits for buildings is to be doubled from current levels from to two percent of existing buildings per year” (BMWi, 2012 a).

Table. 2.  
Targets of the Energiewende

	2011	2020	2050		
<b>Greenhouse gas emissions</b>					
Greenhouse gas emissions (compared with 1990)	-26.4%	-40%	2030 -55%	2040 -70%	2050 -80% to -95%
<b>Efficiency</b>					
Primary energy consumption (compared with 2008)	-60%	-20%	-50%		
Energy productivity (final energy consumption)	2.0% per annum (2008-2011)	2.1% per annum (2008-2050)			
Gross electricity consumption (compared with 2008)	-2.1%	-10%	-25%		
Share of electricity generation from combined heat and power plants	15.4% (2010)	25%	-		
<b>Buildings</b>					
Heat requirement	no data	-20%	-		
Primary energy requirement	no data	-	around -80%		
Rated of modernisation	approx. 1% per annum	Doubling of levels to 2% per annum			
<b>Transport</b>					
Final energy consumption (compared with 2005)	approx. -0.5%	-10%	-40%		
Number of electric vehicles	approx. 6600	1 million	2030 6 million	-	
<b>Renewable energies</b>					
Share in gross electricity consumption	20.3 %	At least 35%	2030 At least 50%	2040 At least 65%	2050 At least 80%
Share in gross final energy consumption	12.1%	18%	2030 30%	2040 45%	2050 60%

(Source: BMWi, 2012 b)

The ambitious and very strict energy concept has been already launched and it is carefully monitored to check its progress according to what have been fixed as the target goals. To be successful, it should affect all active sectors which their functions are somehow related to energy or climate issues. Cities as one of the important sources of energy consumption should include the energy concept in their future plans and development goals. Thus, the planning system should have been adopted accordingly by including environmental concerns in any future development.

### 3. Planning system and instruments

#### 3.1 Germany

Germany has a decentralized planning system in which municipalities (local authorities) have the most active role and power to handle the local community. Among their responsibilities, an important task is to prepare the planning documents.

The comprehensive planning system in Germany is composed of formal and informal plans: The building code (Baugesetzbuch- BauGB) is designated to create legally binding (formal) instruments” (Bialk and Kurth, 2013). Two important formal planning instruments for controlling urban development (in local level) in Germany are "binding land use plan"<sup>1</sup> and "preparatory land use plan"<sup>2</sup> (Table 3). Binding land use plan has been defines as a document that “lays down legally binding rules for the development and organization of sections of the municipal territory. It is developed on the basis of the preparatory land use plan, but unlike the latter, it creates direct rights and duties with regard to the utilization of the sites within its purview. It can determine the category of use and the degree of building coverage, type of development (open or closed), and lot coverage, etc. The binding land use plan can categorize land use areas. The degree of building coverage can be determined by setting the plot ratio, floor-space index, cubing ratio, height of structure, and number of full storeys. Permissible lot coverage can be set by means of building lines, set-back lines, or coverage depth” (Pahl-Weber and Henckel, 2008). Accordingly, preparatory land use plans have been defined as documents to “represent in basic form the types of land uses envisaged for the entire municipal territory in accordance with the intended urban development which is proposed to correspond to the anticipated needs of the municipality. Thus, [it] sets out the municipality’s proposal for future land use and makes preliminary representations on the use of plots within the municipal territory for built development or for other uses” (ibid). Apart from formal planning tools, which are legally binding documents, German planning system has also supplementary, informal documents that are used to prepare alternative planning and are to be taken into account in preparation of formal plans.

### 3.2 Iran

Iran is a country with centralized planning system, in which different institutions are responsible for preparation and execution of planning documents. The planning system has been considered to be a “sector- centralized model, where organizations and agencies in different planning levels are vertically linked” (Pahl-Weber and Wolpert, 2014).

While building formulation rules and regulation together with planning processes (policy-making, supervision, preparation of development plans and budgeting) is the responsibility of the “Ministry of road and urban development” and its “Supreme council of architecture and urban development”, municipalities have the role of applying the formal documents provided by the ministry with limited legal power to influence planning process of cities. Most important planning instruments in local level

are “detailed plans” and “comprehensive plans”. According to the definitions, “The comprehensive (master) plan which is prepared for the cities with a population of more than 25000 people is a long-term physical plan. This plan depicts the land use map; sectors such as residential, commercial, administrative and industrial zoning; the road networks; facilities and public services; rules and regulation for construction of private and public buildings; as well as the criteria for protecting historical sites and monuments. Upon approval of the comprehensive plan, a detailed plan must be prepared for medium and large-scale cities based on the comprehensive plan. The detailed plan determines the detailed land use allocations and requirements, exact physical condition of street networks and detailed population density in city parcels” (Rasoolimanesh et al., 2013).

There are ongoing discussions on the weak role of local authorities in Iranian planning system and separation of preparation and realization of planning documents. However it should be mentioned that in metropolitan areas like Tehran, municipality has a considerable power, and through some legal instruments, such as “Article No.5 Commission<sup>3</sup>” would enforce changes in land use allocation and building densities (Donya-e-eqtesad, 2013). This authority arise another wave of objections, as the municipality has been blamed to use its legal power for making profit through changing green spaces to residential and commercial land uses and to increase building densities by just asking for more money (as fines) from the developers.

## 4. Role of energy in planning instruments

### 4.1 Germany

It is not exaggerating to claim that environmental concerns are the core of all decision-makings in Germany. However, by enactment of the country’s new energy concept, the role of energy and climate in planning system has gained more priority. As a part of “Energiewende” in Germany, development planning needs a strategic energy concept at the urban level. Due to its decentralized nature of planning system and semi-independency of local authorities, different cities have developed different energy or climatic strategies: “For example, it is called Integrated Energy and Climate Action Plan in Leipzig, and in Munich Ecology Guideline-part: Climate Change and Protection” (Bialk and Kurth, 2013). Informal tools in Germany’s planning system could be used as the main instruments to include energy or climatic issues in planning documents. Climate Zoning Plans are informal and sectorial which bundles all sustainability actions to

<sup>1</sup> - Bebauungsplan

<sup>2</sup> - Flächennutzungsplan

<sup>3</sup> - Article No.5 Commission has the responsibility to study and enact the detailed plan in accordance to the comprehensive plan and to permit any modification in it, provided that no basic conflicts with the comprehensive plan arise.

improve city livability and resilience to climate change. Decentralized planning system in Germany, enables the municipalities to play a key role in energy governance. They have “the right to regulate all local affairs on their own responsibility, within the limits prescribed by the laws” (Schö nberger, 2013). This self-government

provides the ability to plan according to local situation, and since climate and energy should be handled locally, this fact one of the main reasons for their relative success. The key characteristics of the Climate Zoning Plans can be summarized as follows (Bialk and Kurth, 2013):

Table. 3.  
Local level planning system in Germany

	Planning instruments	Content of plan	Legal basis	Policy maker	Legal impact	scale
Local authority	Binding land use plan	Arrangement for urban development and order in the form of legally binding designations for specific parts of the municipal territory.	Federal Building Code in connection with Land Utilization Ordinance and Plan Notation Ordinance.	Municipal council	Legal by binding for everyone, legal basis for building projects and issuing building permits	Ca 1:500 1:1000
	Preparatory land use plan	Represents the type of land uses envisaged for the entire municipal territory in accordance with the intended urban development in a basic form.	Federal Building Code in connection with Land Utilization Ordinance and Plan Notation Ordinance.	Municipal council	Binding effects for all planning authorities.	Ca 1:10000

(Source: Pahl-Weber and Henckel, 2008)

- All energy sources and energy-related activities should be considered as a whole system.
- Energy demand is the basis for sustainable energy planning.
- Energy conservation, energy efficiency and demand side management should be considered the basis for planning.
- The plan should be flexible and can anticipate and respond to changes.

The methodological approach of *Climate Zoning Planning* consists of four levels (ibid):

1. Urban Development Plans and energy concepts at the city-level will be used to formulate the overall urban development strategy.
2. Urban District Development Plans at the district-level will be used to identify quarters that have potential for future energetic rehabilitation.
3. Following the development of refurbishment concepts on the neighbourhood level, an Energetic Neighbourhood Development Plan will be devised to implement these concepts.
4. Implementation Strategy with recommendations for building refurbishment and a strategy for owner mobilization

Examples of Climate Zoning plan can be found in the guidelines prepared by municipalities such as Munich (Oberste Baubehö rde, 2011) and Ludwigsburg (Eicker and Kurth, 2011).

#### 4.2 Iran

Iran is a country with centralized and sectorial planning system in which local government has a major responsibility in execution of urban development plans

and has low rights in: decision-making, preparing plans, supervision on plan preparation, approval, review and amendment (Jasbi, 2012). At the same time, it should be mentioned that there is no national energy master plan to harmonize different energy related activities in the whole country (Mobini, Dehkordi and Hourri Jafari, 2009). The case study of Germany indicated two important factors, which affect relative success of energy planning in the country<sup>4</sup>. One is development of a national energy master plan, which harmonizes all activities throughout the country, and the other is the power and willingness of local authorities to prepare and realize energy efficient programs. In Iran, urban planning documents on the local level have been developed according to standard instructions, which are valid for the whole country. This uniform content neither has any room for various geographical and climatic zones of the country and nor any capacity to include energy and climatic considerations (Barakpour and Mosannenzadeh, 2012). At the same time, informal planning tools, which work like supporting documents to include new themes (like energy and climate), do not exist in Iranian planning system.

#### 5. Conclusions

The results of this paper demonstrate that local governments can make important role in energy efficient planning. Investigation in urban planning in two countries exhibits that, factors such as: 1. Comprehensive national strategies and policies 2. Role of the local government,

<sup>4</sup> - It should be emphasized that other factors such as high price of energy, high level of industrialization, public awareness, etc. are also crucial issues, which are beyond the scope of present paper.

3. Urban-planning instruments (specially informal tools), could affect energy planning in different levels.

Setting the German experiences as an example, Iran should first develop a national energy master plan to coordinate and harmonize all energy related activities in the country. The second step, which is professionally the main focus of this paper, is the necessity to introduce energy related topics in Iranian urban planning documents and instruments. Autonomy and authority of local government to provide planning documents is a controversial topic here. The place and role of local government in each country bounds to its political system: in a decentralized, federative administration system like Germany, it is obvious that local authorities could have more power and independency. This system cannot be repeated or copied in a centralized organization, which Table. 4.

Main differences of Iran and Germany considering local level energy planning

Country	National energy master plan	Local government	Informal planning tools
Germany	Comprehensive national energy concept with explicit, quantitative goals	With the authority to prepare and execute formal and informal planning documents	Act like supporting planning tools to include new themes/ goals in planning system
Iran	No national energy master plan	With the authority to execute and realize planning documents- no right to develop local level planning documents	Not existing

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