Assessment of Building Energy Policies in the IEA and the BRICS Countries

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Abstract

The International Energy Agency (IEA) Energy Efficiency Policy Recommendations for the building sector include mandatory building energy codes, minimum energy performance requirements with a long term objective of reaching net-zero energy consumption in building, a policy package for existing building such as an ambitious timeline and renovation rate for cost-effective reduction of the energy consumption in the existing building stock, the improvement of building components and systems that include minimum energy performance and labelling schemes to increase awareness about building energy performance.

The IEA Energy Efficiency Policy Recommendations, originally designed for the IEA member countries, are intended for worldwide implementation.

Although these recommendations are an important element of most national energy efficiency policy portfolios, less attention has been paid to the assessment of the whole implementation process, interactions between different policy instruments and their effectiveness from both an environmental and economic perspective.

The IEA Sustainable Building Centre has undertaken a research project to assess the overall implementation process of the building recommendations as well as their final effects in terms of energy savings and cost effectiveness.

This paper describes the assessment methodology developed by the IEA Sustainable Building Centre, the data required and the first findings for IEA member countries as well as Brazil, Russia, India and China, Tunisia and Saudi Arabia.

Data collected for the analysis have been assembled in an online database for Building Energy Efficiency Policies (BEEP), available on: www.sustainablebuildingcentre.org.

Initial analysis indicates that there is a lack of policy coordination in several countries and overall there is a need for better alignment of building energy efficiency policy instruments. Furthermore, increased efforts are needed in the area of enforcement, monitoring and evaluation. Improved data collection is also required to enable quantitative assessment of the impacts of policies. The methodology and indicators developed by the IEA Sustainable Building Centre could constitute a basis for analysis and enable the identification of success factors and constraints.

Introduction

The total global primary energy consumption in 2008 was 509 EJ. IEA member countries members consumed 209 EJ of this total amount, with 40% of their consumption attributed to the building sector

The IEA scenarios (World Energy Outlook (WEO) and Energy Technology Perspective (ETP)) show a rapid growth of the energy demand in the building sector by 2050 driven mainly by population growth and economic development, especially in emerging economies.

In 2008, the IEA developed the 25 Energy Efficiency Policy Recommendations (IEA, 2008). The recommendations aim to assist countries save large quantities of energy at low cost, address existing market imperfections, filling the gaps in existing policies such as their regular monitoring and encourage widespread implementation of policy measures. Of the 25

recommendations, 11 are related to the building sector with 5 addressing the building envelope, 4 for appliances and equipment, 2 for lighting products and 4 of the 5 cross-sectoral recommendations applying to the building sector as well.

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Although these recommendations are an important element of most national energy efficiency policy portfolios, less attention has been paid to the assessment of the whole implementation process, particularly in terms of enforcement of the implementation, the interactions between different policy instruments as well as their effectiveness from both an environmental and economic perspective.

The IEA Sustainable Building Centre has undertaken a research project that aims to gather information from governments about building energy efficiency policies that have been implemented or are planned to be implemented. The aim of this project is to assist countries develop effective implementation of energy efficiency policies for the building sector. It is intended that the results of these analyses will stimulate governments and policy makers to improve their capacity and practices in respect of developing and implementing holistic building energy efficiency policies.

Although the overall project includes policies for the building envelope, appliances, lighting and equipment, this paper focuses only on policies for the building envelope. This includes building energy codes and minimum energy performance requirements which aim to achieve zero energy building as well as labelling and incentive schemes.

Initially the project focused on IEA member countries as well as Brazil, Russia, India and China (BRICS countries). Due to lack of data, Brazil is not yet included; but Tunisia and Saudi Arabia have been added to the initial project.

Among the outcomes of this project is an online database for Building Energy Efficiency Policies (BEEP), the aim of which is to make complex technical information easily accessible for policy-makers, implementers, industry and researchers. The database can be accessed at www.sustainablebuildingcentre.org

In the database, the information on each policy instrument is organised in the same way for all countries. However, not all the information requested was provided by all countries, either because the information was not available, was unknown or not applicable. Where this is the case, the database records it as not identified or not applicable.

So far, the BEEP database includes information on both new and existing building for the countries included in the project. By September 2012, energy efficiency policies for appliances, lighting and equipment will also be included.

This paper describes the methodology developed by the IEA Sustainable Building Centre to assess the overall implementation process of building energy efficiency policies, interactions between different policy instruments and their impact in terms of energy savings and cost-effectiveness.

The methodology is inspired by the theory-based policy evaluation approach developed by the Californian Energy Commission to assess their market transformation programme (Blumstein et al. 2000). This evaluation approach requires the development of analysis criteria and indicators at each step of the policy cycle to assess the success or failure of the policy instrument.

The paper summarizes the main findings for the countries included in the project. The remaining IEA countries not included in this list were not able to provide responses in time for this paper.

The paper draws some early conclusions and presents the next steps that the IEA Sustainable Building Centre aims to take as part of its 2050 Roadmap for the building sector.

Methodology

The work is being carried out in several stages starting with a literature review of ex-post policy evaluation methods for policy instruments. Our aim was to evaluate the whole policy implementation process, interactions between different policy instruments and their effectiveness in terms of energy savings and cost. The objective is to provide policy-makers with insights on policy implementation, the main factors for the success and failure of each policy instrument or policy package. The ultimate goal is to make recommendations on how to adjust and redesign building energy efficiency policies in order to improve their implementation and effectiveness.

Therefore, we decided to adapt the theory-based policy evaluation approach developed by the Californian Energy Commission to assess their market transformation programme (Blumstein et al. 2000) to the purpose of our research. In short, in this approach, a theory is developed on how the policy, or package of policies is intended to lead to energy efficiency improvement. Each stage of the implementation process is then evaluated to identify how it led to the success or failure of the policy (see Table 2). The aim is to gain an understanding on where improvements to policies is needed and can be done.

An example of where the theory-based approach has been used for the evaluation of a policy cycle of planned or existing policies is in the EU project (AID-EE 2007) on the Active Implementation of the EU Directive on Energy End Use Efficiency and Energy Services (Directive 2006/32/EC)[1] where it was used to evaluate energy efficiency policies that could contribute to implementing the Directive. Under this project, the theory-based policy evaluation methodology was used to evaluate 20 existing energy efficiency instruments across Europe. For each policy instrument, the main characteristics were identified and based on this characterisation, quantitative and qualitative indicators were developed for the assessment of each instrument of the policy package.

Building energy efficiency policy instruments considered for the purpose of this paper are building energy codes[2] including minimum energy performance requirements with the aim of reaching zero energy building, energy labelling[3] and incentive schemes.

As suggested by the theory-based policy evaluation methodology for each instrument we identified for the purpose of our analysis the main characteristics at each step of the implementation process. We then developed indicators to assess the success and/or failure in implementation (Table 2). This work was based on a comprehensive literature review of building energy efficiency policies.

Then a comprehensive survey questionnaire consisting of seven Excel sheets was designed to collect the information and data needed for our analysis. The questionnaire was sent out to policy makers, policy implementers and policy analysts for feedback and amendment.

The questionnaire was made sufficiently generic so as to be applicable to different policies and terminologies used in both IEA and non-IEA countries. Although the survey uses generic language and provides guidance, many questions can be interpreted differently due to different practices, languages, and terminologies used in individual countries. Also, it should be noted that not all the questions included in the questionnaire were relevant to all countries.

The questionnaire was provided to governmental agencies in June 2011. Data collection ran from June 2011 to February 2012. To date, 20 IEA countries have responded to the questionnaire either with a completed survey questionnaire or with information from which we have been able to gather data. The level of detail within the responses varied and to avoid misunderstandings and misinterpretations of data received, telephone interviews were conducted with experts from different national agencies in charge of the design, the implementation and/or the enforcement of building energy efficiency policies. Data collection took relatively longer

[1] Detailed information on this project is available online on www.aid-ee.org.
[2] Usually called standards in the US.
[3] Called in the EU, Energy Performance Certificate.

than might have been expected because the information requested from countries is held in different agencies or ministries. This itself suggests that coherence in policy packages may be a problem. In addition to the responses and reports received from countries, we gathered information from experts and research institutes in some countries.

From the information gathered, we developed an online database for Building Energy Efficiency Policies, the BEEPs database. The aim of which is to provide useful information for the international building energy community and share the information collected. So far, entries in the BEEPs database have been completed only when the information collected has been validated by governmental representatives.

Development of Analysis Criteria and Indicators

For each policy instrument, we developed criteria for analysis and indicators in order to assess the factors for success or failure at each step of the implementation process when possible as well as assessing the interaction between different policy instruments and the impact of this interaction on the overall implementation of the policy package. Policy instruments can either reinforce or counteract the implementation of each other. The objective was to check the consistency and completeness of policy instruments considered in the building policy package in terms of the clarity of their aims, level of ambition in terms of energy requirements, and indicators used for monitoring.

We also developed quantitative indicators to assess the effectiveness of each policy instrument in terms of energy savings and cost. In some cases such as for building energy codes, we supplemented our qualitative analysis with quantitative data on end-use energy consumption collected on a regular basis by the IEA.

For the analysis of cost-effectiveness, the aim was to evaluate the implementation cost from government, consumers and industry's perspective. However, due to lack of data (at best we had the overall budget for two incentive schemes), we abandoned this analysis.

For each instrument, we analysed its legal status; whether it imposes mandatory energy performance requirements or not, how regularly it is updated, whether it is regularly aligned with new technologies and market development, the governance structure to check whether for each step of its implementation there is a clear and well defined structure, enforcement procedures in terms of penalty type, compliance rates and sanctions, the type of building (residential, non-residential, existing and new building) targeted by the instrument, energy requirements and the interaction of energy targets identified in each instrument. We also analysed the impact of labelling and incentive schemes in terms of any increase in the market share of low energy building and the number of incentive awards made.

Table 2 summarises the analysis criteria and indicators developed for each policy instrument.

Key findings

Legal status of energy codes and labels

The legal status of energy codes and labels for building varies from country to country. The codes are mandatory only in 19 of the 27 countries that responded to the survey. Although in some countries, such as the US, that developed its first building energy code just after the oil crisis in the seventies, the code is still voluntary at the federal level; in the US, it is implemented on a mandatory basis for the residential sector only in 22 states.

Energy labels or certificates for building are implemented on a mandatory basis only in the EU 27 and Tunisia. The energy labelling scheme became mandatory in the EU since the Energy Performance of Building Directive, EPBD (Directive 2002/91/EC). However, its

implementation varies among countries and in some countries only a few building types are targeted (BPIE 2010) by the labelling scheme. In addition to the mandatory energy label, voluntary labels exist in some European countries, and are becoming very popular such as Passive House[4] and Minergie[5] labels. Some non-European countries (with the exception of Tunisia) have implemented or plan to implement voluntary energy labels for building (e.g. the Energy Star[6] label in the US).

Our survey shows that in many countries building energy codes are revised on a regular basis and generally every four or five years. However, one country has never updated its code since its first implementation in 1997.

Voluntary energy labels such as Energy Star are also updated on a regular basis, however, sometimes the update lags behind the standards imposed by the energy codes. For example, in the most advanced States in the US, energy requirements in the building energy codes are more stringent than those in the Energy Star label. The implementation of mandatory labels is too recent in the EU and Tunisia therefore, not yet updated. Also, energy grades in the mandatory labels are based on best known practices; therefore, there is no need to update them now. The voluntary labels in the EU27 have been designed to target the lowest possible building energy consumption and they are still up to date and therefore they do not need to be updated.

Governance structure and compliance

Eighty per cent of the respondents to the survey were able to identify the governance structure for each step (development, implementation, enforcement, verification) for each policy instrument (Table 2). The development of building energy codes, building energy labels and incentive schemes is always carried out at national level, and then local authorities are responsible for the implementation, verification and enforcement. The only exception to that is China where compliance is double checked by both local and national authorities. Compliance checking at local level is carried out by an independent inspection company. National compliance checking is performed by inspectors reporting to the Ministry of Housing Urban and Rural Development, MOHURD. In fact, since 2005, MOHURD is annually conducting nationwide inspections of the implementation of the building energy code. The inspection campaign takes two to three weeks, and covers the urban areas where the energy code is implemented. The projects inspected are selected on a random basis. The inspection results are published on the MOHURD website. The compliance checking procedure in China seems to be well designed. However, the compliance rate published by MOHURD needs further investigation to better understand what is checked by both the local and national inspectors.

Sanctions in case of non-compliance are either unclear or not identified in 85% of the respondent countries. In other countries, the sanction consists of a denial of a building permit if the design does not meet the requisite energy requirements. In two cases, if the constructed building or work does not meet the energy requirements, the construction must be rebuilt to comply, or the local authority will instruct someone else to correct it, charging the owner. The onus is therefore on the capacity of the authority in terms of available resources to check the work, and the requisite skills and knowledge.

For building energy labels, the responsibility for enforcement hasn't been identified for the mandatory European label. Voluntary labels are issued after compliance has been checked by an independent third party. In Tunisia, local authorities are in charge of checking compliance. Penalties in case of non-compliance vary among countries, two countries impose fines, and two

[4] A Passive House is a very well-insulated, virtually air-tight building that is primarily heated by passive solar gain and by internal gains from people, electrical equipment, etc.
[5] For further information see http://www.minergie.fr/
[6] For further information see http://www.energystar.gov/

others do not, presumably leaving it to the buyer or new leaseholder to enforce the requirement when they buy or lease a property. Other countries have not provided information on this aspect.

Scope

Fifteen of the countries have implemented energy codes that cover new and existing building for both residential and non-residential building. The remainder have only developed codes for non-residential building. IEA data on building stock suggests that there is more existing residential floor space per country than non-residential. Therefore in these cases, codes will have a limited impact on improving the overall energy efficiency of a country's new building and building stock.

The building types included in the labelling schemes include both residential and non-residential building. However, they are not always implemented at the same time, for example in one country there was a two year gap between the implementation of the mandatory scheme for residential and that for non-residential building. The labelling schemes for existing building emphasise that the building need to be certified when they are rented or sold.

Also, from the information received on whether building energy codes apply to existing building, they do in ten countries, but their application is limited to specific interventions such as extensions or remodelling, and do not impose an obligation to upgrade the energy requirements of the whole existing building, unless the planned renovation reaches a particular threshold such as 25% surface area of the building renovated.

Requirement setting

Energy requirements in building energy codes are set based on the prescriptive approach or model based approach or mix of both[7] in all countries. Countries reported that their energy codes have a prescriptive component and six have included a performance component. In two cases, there were only prescriptive codes. In four cases there is an option to trade-off between performance and prescriptive requirements. Five countries reported that they use a model building. Tunisia, France and Denmark are the only countries included in the survey where energy requirements are set for the overall energy consumption and include the five end-uses (heating, cooling, ventilation, lighting[8] and hot water) specified in ISO 23045:2008

Energy requirements are difficult to compare across countries partly because of different climate zones but also because the end uses taken into account within the calculation vary and the way they are calculated is inconsistent. For example, the definition of floor area varies from one country to another even in the EU (Beillan, 2010).

Impacts

An analysis of the evolution of heating energy consumption in residential building in the IEA countries between 1990 and 2008 (Figure 1) suggests that there has been an improvement in

[7] Prescriptive approach is based on setting energy requirements for each building element and/or piece of equipment (i.e. U-value for windows and walls), which had to be met. However, some prescriptive codes offered more freedom to the designer by allowing a trade-off between energy requirements (i.e. between U-values of the building shell). Therefore it was possible to design one element to a lower standard so long as it was compensated by designing another to a higher standard.
Model based approach requires to compare the overall energy consumption of project to the model or a reference building (Laustsen, 2008).

[8] Some countries do not include lighting for the residnetial building

the overall building envelope. This improvement may well be partly due to the increase of the stringency of energy requirements in building energy codes.

The impact of energy labels is difficult to estimate at this stage as most countries have not yet developed energy label databases. We have found at least one example where the energy label is closely linked to an incentive scheme; in the city of Paris (Adil, 2012), preferential loans are based on the energy grade specified in the energy label. However, since the certification procedure in France is based on calculated rather than measured energy consumption, it is hard to accurately estimate the impact of this policy package on the building market.

Incentives

Countries use a range of incentive types, including grants, tax incentives or short term loans. These instruments are short-pay back tools and usually used for the replacement of Heating, ventilation and air conditioning and lighting products. In two countries they have been used also for windows replacement. Information gathered during the survey suggests that there is no link between the long term retrofit strategy developed by countries and the incentive schemes implemented. The only exception to that is the German KfW financing scheme. Also, when incentives are used, energy requirements are usually either unclear or not defined.

Incentives require that the energy efficiency work carried out improves on the requirements of the building energy code. However, the energy requirements are not always explicit as the code may be prescriptive, defining U-values rather than a performance requirement. It is therefore hard to estimate, at least at this stage, the energy savings or carbon emission reduction that have been achieved as a result of implementing incentive schemes on transforming the building market.

Incentive schemes cover both residential and non-residential building, but only a few focus specifically on deep renovation of existing building. Given that in the IEA countries new building form a small proportion of a country's building stock, for example, annual new building account for between 1 and 4% of total occupied building, those policy instruments that target, for example, new residential building will have little immediate effect.

From the information gathered so far, there is little evidence that these incentive programmes are being evaluated, or if they are, that this information is available. Countries have not been able to provide information on the cost of each instrument although detailed questions on costs were included in the questionnaire.

Zero Energy Building

Regarding the implementation of Zero Energy Building[9], ZEBs, eight countries reported on their strategy, five countries identified a deadline for when zero-energy building will be mandatory and only one country set out a definition of a ZEB.

The impact of ZEB policies in the market will be limited as this policy is targeting new building. This means that few building will be at zero by 2050. In non-IEA member countries, ZEBs policies are not yet included in their energy policy agenda.

Conclusions and next steps

Under this project we developed a uniform evaluation methodology to compare the overall implementation process of different building energy efficiency policy instruments. We also developed indicators to evaluate the effects of each instrument or the policy package in terms of energy savings and cost effectiveness.

[9] ZEB is defined as a very low energy demand building supplied by renewable energy.

The findings from this survey suggest at least five areas of concern. Overly complex documentation[10] to support the energy codes, misalignment between policy instruments particularly with incentive schemes, lack of clearly defined energy performance requirements, weak enforcement and a lack of monitoring and evaluation.

All of the instruments surveyed lack a comprehensive monitoring system. The availability and quality of monitoring data turned out to be much lower than expected at the start of the project. Quantitative data indicators that could explain success or failure of a policy instrument is rarely available and cost data were not identified by governments. A continuous, well-structured and rigorous monitoring system should be part of the policy cycle. This will allow countries to better understand factors of success and failure of energy policies to adjust them easily.

At this stage of the project, our main recommendations to reduce the energy consumption of building are about clarification of energy performance targets, the implementation of continuous monitoring systems to assess policy impact. Also, there must be rigorous enforcement, otherwise why will anyone bother? Enforcement and compliance procedures should be defined and included in building energy efficiency policies. Enforcement instutions need to be created and well funded using fees collected when the occupation permit is issued.

In addition, it's important that the different instruments, codes, labels and incentives are aligned otherwise at worst they will counteract each other and at best they will be merely confusing.

The IEA Sustainable Building Centre will continue its efforts on data gathering to cover all IEA and G20 countries and refine the above analysis. The objective is to define detailed policy recommendations pathways towards low energy building by 2050 based on best practices gathered.

Table 1. List of countries and policy instruments available on the BEEP database
Y: yes, N : no, NI : non identified.

	Building energy codes		**Energy label/Certificate**		**Incentive schemes**		
Country	Voluntary	Mandatory	Voluntary	Mandatory	Short term[11]	Long term	**ZEBs strategy**
Australia	Y	N	N	N	Y	NI	N
Belgium		Y		Y	Y	NI	Y
Canada	Y	N	NI	N	Y	NI	N
China		Y [12]	Y	N	NI	NI	N
Denmark		Y	Y	Y	NI	NI	Y
Finland		Y	Y	Y	Y	NI	Y
France		Y	Y	Y	Y	NI	Y
Germany		Y	Y	Y	Y	Y	Y
India	Y	N	NI	N	NI	NI	N
Italy		Y	Y	Y	Y	NI	Y
Japan	Y	N	Y	N	NI	NI	N
Korea		Y	Y	N	NI	NI	N
Luxemburg		Y	Y	Y	Y	NI	Y
Netherlands		Y	Y	Y	Y	NI	Y
Norway		Y	Y	Y	Y	NI	Y
Portugal		Y	N	Y	Y	NI	Y
Russia	Y	N	N	N	N	N	N
Saudi Arabia	Y	N	N	N	N	N	N

[10] For example, in France, the last building regulation code represents more than 1300 pages of documentation.
[11] By short term incentives, we mean incentives for less than 5 years
[12] In urban areas only

Slovak Republic		Y		Y	Y	NI	Y
South Africa	Y	N	Y	N	Y	NI	N
Spain		Y		Y	Y	NI	Y
Sweden		Y	Y	Y	Y	NI	Y
Tunisia		Y	N	Y	NI	NI	N
UK		Y	Y	Y	Y	NI	Y
US	Y	N	Y	N	Y	NI	N

Table 2. Policy instrument, analysis criteria and key indicators to assess success and/or failure of their implementation

Policy instrument	Analysis Criteria	Indicators
Building energy code	Legal status	Voluntary or Mandatory
	How often is the code revised?	Number of years between current and next version
	Governance Structure	Responsibility for each step (development, implementation, verification, enforcement)
	Enforcement	-Penalty type -Number of times enforced -Compliance rates since 2008
	Technical assistance	Is there compliance software or not? If yes, is the compliance software available for free or not?
	Scope	-Residential (new and existing) -Non-residential (new and existing)
	Energy and Carbon requirements	-Energy requirements for the overall primary energy consumption -End-uses included in the energy requirements, if any -Energy requirements for HVAC products -Energy requirements for insulation and building elements -Energy requirements for lighting -Thermal comfort requirements -Carbon requirements
Energy label/Certificate	Legal status	Voluntary or Mandatory
	How often is the label revised?	Number of years between current and next version
	Governance Structure	Responsibility for each step (development, implementation, verification, enforcement)
	Enforcement	-Penalty type -Number of times enforced -Compliance rates since 2008
	Technical assistance	Is there compliance software or not? If yes, is the compliance software available for free or not?
	Scope	-Residential (new and existing) -Non-residential (new and existing)
	Certification methodology	-Calculated rating -Measured rating
	Impact on the market	Number of certified building per category (new and existing)
	Transparency	Is there a database of certified building? If yes, is the database available for free?
	Energy requirements	-Energy rating -Carbon rating -End-uses included in the energy requirements if any

Incentive schemes	Instrument type	-Fiscal instruments: taxes, tax relief -Financial instruments: grants, loans
	How often is the scheme revised?	Number of years between current and next version
	Governance Structure	Responsibility for each step (development, implementation, verification, enforcement)
	Enforcement[13]	-Penalty type -Number of types enforced -Compliance rates since 2008
	Scope	-Residential (new and existing) -Non-residential (new and existing)
	Funding mechanism	-Public -Private -3rd party financing
	Interlinkage with other instruments	-Energy requirements
	Impact on the market	-Funding per award -Number of awards -Recipient/beneficiary
	Effectiveness	-Energy savings -Cost (total and administrative cost)
Zero Energy Building Strategy	Legal status	Voluntary or Mandatory
	Chronology	Define the targeted year for the implementation of ZEBs
	Scope	-Residential -Non-residential
	Energy requirements	-End-uses considered -Share of renewables -Energy balances (monthly, annually)
	Impact in the market	-Marginal cost -Share of ZEBs building in 2010 -Projected share of ZEBs building between 2011 and 2020

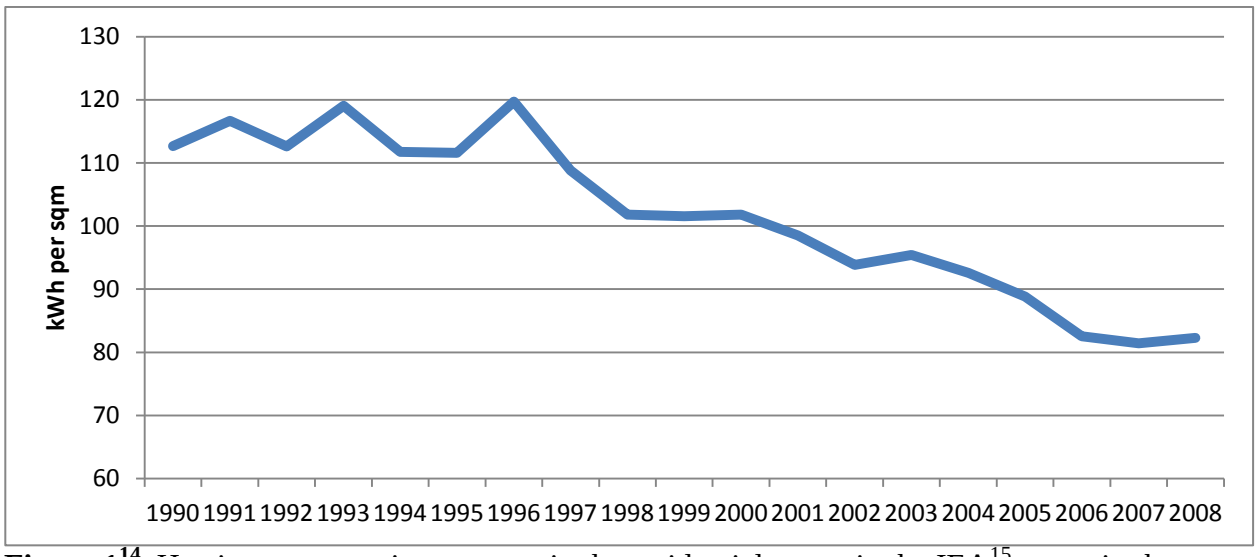

Figure 1[14]. Heating consumption per sqm in the residential sector in the IEA[15] countries between 1990 and 2008

[13] The enforcement for incentive scheme if related to the checking of how much savings are delivered by providing incentives.

[14] This figure is based on the IEA EE indicators database. Data are provided by IEA countries every year in terms of final energy consumption per end-use

References

ADIL 2012, Le prêt Paris logement 0%, http://www.adil75.org/pdf/av17.pdf

AID-EE project summary report, 2007: "*From theory based Policy Evaluation to SMART Policy Design".* http://www.aid-ee.org/documents/SummaryreportFinal.PDF

Blumstein, C., S. Goldstone, and L. Lutzenhiser. 2000. "*A Theory-Based Approach to Market Transformation*". Energy Policy 28:137-144

BPIE, 2010, "*Energy Performance Certificate: From design to implementation*". http://dl.dropbox.com/u/4399528/BPIE/BPIE_EPC_report_2010.pdf

Beillan, 2010, Socio-economic barriers and success factors in the development of low energy consumption housing. A comparative study in three European countries

Laustsen, J. 2008. *Energy Efficiency Requirements in Building Codes, Energy Efficiency Policies for New Building*. IEA Information Paper. Paris: OECD/IEA. http://www.iea.org/g8/2008/Building_Codes.pdf

IEA,2008."*25 Energy Efficiency Policy Recommendations update 2011*". http://www.iea.org/publications/free_new_Desc.asp?PUBS_ID=2042

[15] Luxemburg, Hungary and Turkey are not included in the Chart and data for New Zealand, Portugal, Korea and Belgium are based on interpolations.