Energy Efficiency and Renewable Energy Sources in the Sustainable City

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Abstract

At national level, cities show a growing relevance in our energy system as they are an important nucleus of the economic activity and expansion, which entails some energy demands not negligible at all, equivalent to 50% of the whole of the end-energy demand. Hence the strategic role that cities play as they are the optimum scenario to the necessary transition towards a new paradigm in the urban model, which is to combine actions meant to improve energy efficiency and the boost of renewable energies. The Public Administration is aware of the need to undergo such steps to achieve it. At present, work is being done in this sense, with good results, thanks to the design and implementation of two important strategies within our energy policy: The Spanish Strategy for Energy Saving and Efficiency 2004-2012 (E4), and the Renewable Energies Plan, PER, 2005-2010.

Introduction

The urban scope accounts for a large part of the energy consumption in Spain, even exceeding 50% of the final energy consumption. This is due to the energy demand from activities linked basically to mobility at urban level, and the one from the building sector, which includes the demands of the Services and Residential sectors.

The prominence of cities within the current energy context is expected to grow, as it can be inferred, on one hand, from the inherent demand to the current urban and transport model, which so far, suffers from certain deficiencies, as for example, the lack of energy and sustainability criteria on the urban design and approach; and on another hand, of the growing trend of energy consumption in Spanish households due to larger equipment and in general, to an improvement in the standard of living.

As regards the above, it is crucial to evolve towards a new urban, more sustainable model where the integration of renewable energy sources and energy efficiency all along urban planning becomes essential. This will be translated into a greater presence of renewable energies in energy supply, and therefore in energy self-supply.

It is obvious that cities and the urban scope, given their relevance from the energy point of view, involve a strategic element to envisage transition towards a more sustainable

energy mode, and all in all, a change of paradigm. The latter becomes a pressing need within an energy context such as ours, whose main characteristic is the high energy dependence on fossil fuels, which entails a risk factor in competitiveness at national level, as it is well known, apart from being a curb to compliance with the national engagements signed at national level within the Kyoto Protocol framework.

Energy Policies in Spain

Consequently, it is necessary to intensify energy policies addressed to the urban scope that echo all the above and that should reinforce a more sustainable energy consumption all along the cycle integrating urban planning, i.e., from the very design to the end use of the energy demanded by the activities that take place in cities and towns.

With a view to it, work is already being done at present and thus, two important strategic tools are to be stood out in the areas of energy efficiency and renewable energies. These are, respectively, the Spanish Strategy for Energy Saving and Efficiency, 2004-2012, (E4), implemented through two action plans: the Action Plan 2005-2007, the Action Plan 2008-2012, and the Renewable Energies Plan, PER, 2005-2010. In both cases, the priority actions addressed to the urban scope are stated, meant on one hand, to try to encourage the improvement of efficiency in building energy and urban transport consumption; and on another hand, to boost the use of renewable energies both in buildings as in transport.

Spanish Strategy on Energy Efficiency 2004-2012 (E4) *Action Plan 2008-2012:*	*Renewable Energy Plan, 2005-2010:*
Targets, 2008-2012: • Annual improvement on energy intensity ≅ 1,9% (reference "business as usual" scenario) • Primary Energy saving: 87,9 Mtoe <>60% of energy consumption in 2006 • Mobility & Building priorities <> 64% of all energy savings ..... **Total investment: 22.190 M€** **Public Support: 2.367 M€**	**Targets, 2010:** • Primary Energy share: 12% • Electricity share: 30% • Biofuels: 5,83% (as percentage of transport oil) **Expected results, 2010:** • Wind: 20.349 MW (target: 20.155 MW) • Solar PV: 4.210 MW (target: 400 MW) • Solar thermal power: 730 MW (target: 500 MW) ..... **Total investment, 2005-2010: 23.598 M€** **Public support, 2008: 2.492 M€**

Figure 1: Summary of Energy Policies in Spain

It is expected that the global implementation of both the Strategy, through the Action Plans, and the PER, 2005-2010, will lead to favourable results, as it can be deduced from the good results achieved so far. Particularly, the Action Plan 2008-2012, which gives priority to diffuse sectors such as transport and buildings, will involve an improvement in primary energy intensity of about 2% by 2012, which will double the objective of the European Directive on Energy End-Use Efficiency and Energy Services. On another hand, the PER 2005-2010 will enable greater consumption of renewable energies at global level, and very specifically in the scope of cities by means of the solar energy and

biomass application in buildings, and of the promotion of biofuels in transport, expected to reach 5.83% of conventional fuels by 2010.

The tools used to carry out the above mentioned Plans are basically legal and regulatory actions, public support and investment placement in strategic and innovative projects in the area of energy efficiency and renewable energies.

Focussing on the actions of urban scope, and starting with the ones of a legal kind, the regulations recently approved on efficient public lighting and on building include the Technical Building Code (TBC), the new RITE and the Energy Certification for new buildings. Another certification will join the latter, regarding the already existing buildings. The approval and application of the said regulations involve a boost not only to improve buildings' energy efficiency at national level, but also a higher penetration of renewable energies, as it can be expected from the requirements introduced in the TBC in relation to the participation of solar PV and thermal energy to meet the household energy needs. In like manner, and with respect to the regulations of greater relevance in transport, another element of relevance is the obligatory labelling for new private cars, regarding energy consumption and CO_2 emissions, in force since 2002; the promotion of biofuels, with obligatory consumption percentages from 2009, states a higher global consumption objective by 2010 (5.83%) than the established one by Directive 2003/30/EC, on the promotion of the use of biofuels (5.75%); and a new car registration tax linked to CO_2 emissions over a 120g/km limit.

As regards public support actions, in general, these fall within the frame of the E4 Action Plan, either in the building sector or in the one linked to mobility in the urban scope, even if the said aids can be supplemented by the ones stated by the PER. These are devoted to using solar energy and biomass in buildings, on one hand, and biofuels in transport, on the other. Some of the most specific and remarkable aids in the Action Plan 2008-2012 of the E4, oriented to the building sector, are the ones seeking to improve efficiency in thermal and lighting installations, the promotion of new buildings and renewal of the existing ones with a high energy certification, to be supplemented with the aids to replace household equipment by some more efficient *(Renove Plan)*. This will also be reinforced by the role played by the Energy Service Companies (ESCOs) to maximise and manage buildings' energy facilities.

The content above is supplemented with public support to urban transport on the part of the Action Plan 2008-2012 by means of exemplary actions, such as the Transport Plans at both urban and company levels; the renewal of the private car fleet; efficient driving; and the promotion of electric cars linked to the MOVELE Project, which envisages a budgetary aid of 10 M€ to be managed by IDAE. It is also expected to introduce as many as 2,000 units into de national car fleet at the end of 2011. All this variety of public support actions to transport has been recently enlarged with aids related to the VIVE Plan 2008-2010, integrated within the Energy Saving and Efficiency Action Plan, 2008-2011, linked to the Action Plan. The aids of the VIVE Plan, amounting to nearly 1,200 M€, are meant to replace vehicles by more innovative and eco-friendly ones with emissions under 140g/km. The VIVE Plan will be continued through the Plan 2000, which envisages available aids amounting to 100 M€. Additionally, the PER involves an important support to the consumption of biofuels in urban means of transport.

Finally, a third axis to implement the energy policy is the support and participation in strategic and innovative projects, with a high replicability potential, to ease the introduction of clean energies as well as of efficient technologies in either the

production or use of energy. This kind of projects, in account of the stated features, show a high impact on the penetration of clean energies as well as of efficient technologies, both in the offer and in the end-use of energy. As regards these projects, the remarkable ones are those under the scope of renewable energies or energy efficiency which are taking place in the urban range, or else which can have an impact on it. IDAE has taken part in a large number of projects of this nature, either in the areas of renewable energies or energy efficiency.

A remarkable project among the ones stated above is the *Pilot plants for a building complex in Colmenar Viejo* (Madrid), based on micro generation with gas turbine of the CAPSTOE trade mark and 65kW, and gas engines of the Senertec trade mark, with 5.5 kW of unit electrical capacity. In both cases the thermal energy of the exhaust gases is used to supply SHW and heating to a 94-flat block; the *Districlima S.A. project* in Barcelona, based on a heating, SHW and cooling network of the buildings of the Universal Forum of Cultures 2004. The said supply is carried out from an energy plant that accounts for a high efficiency cogeneration amounting to 6.6 MW; the *Districlima S.L. project* in Saragossa, which consists in the generation and distribution of thermal energy within the scope of the International Exhibition in Saragossa 2008; a solar PV installation of 25 Kwp at the Polytechnic University of Madrid (UPM), which consists in a high concentration facility (250x) and two-axis tracking, equipped with GUASCOR Fotón technology.

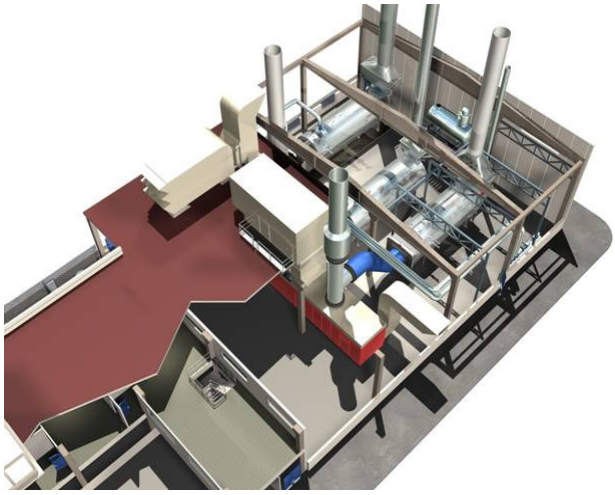

Figure 2: Micro CHP Pilots Plants in Colmenar Viejo (Madrid); 3 Gas micro motors of unit installed capacity of 5.5 kW and Gas micro Turbine of installed capacity of 65 Kw; Investment: €218,500; Coverage of Energy needs for a community of 191 households.

Figure 3: Solar Thermoelectric Plant in Puertollano (50 MW); Investment: M€28; Estimated Net Production: 41GWh/y

Other innovative projects of relevance are the ones based on the exploitation of solar thermo-electric energy, as the *solar thermoelectric technology plants in Almadén* (20 MW and solar tower technology), and the one in *Puertollano* (50 MW and parabolic cylinder technology). Their commissioning is due along 2009, with an annual electric production ranging between 40 and 10 GWh, which could supply municipalities with a population of up to 90,000.

The *Santoña wave energy plant* of 1.39 MW is in a more incipient state, as it had its first buoy installed in 2008. A favourable evolution of this technology is expected in the mid term, which could meet the energy needs of the cities on the shoreline in Spain in the future, from the Bay of Biscay, the Atlantic Ocean to the Mediterranean Sea.

Figure 4: Ocean Energy in Santoña (1.39 MW); Investment: 2.6 M€; Estimated Net Production: 2,956 GWh/y

Conclusions

From the contents above, it can be deduced the urgent need to integrate energy criteria on efficiency and sustainability within the national model on urban planning. This model shall translate into many benefits, such as immediate environmental ones since they foster cleaner and less congested cities; and into those with a larger scope, as greater energy self- supply and security supply, and competitiveness, both from an economic point of view – as the trade balance deficit decreases as a result of a reduction of dependence on imported fuels from geopolitically unstable regions, and at strategic level, as Spain is placed among the countries currently leading the world in the field of renewable energies and in the compliance with the international guidelines in climate change issues.

Some steps have already been given in the national energy policy, as accounted for by the Spanish Strategy for Energy Saving and Efficiency, 2008-2012, E4, for example, and the Renewable Energies Plan 2005-2010, PER, thus achieving favourable results since its setting into operation, especially in Spanish cities. Specifically, the E4 has meant a change in the energy efficiency trend, remarkable since 2005, with annual improvements of 3% in energy intensity. On the other hand, the PER has been translated into greater market dynamism for renewable energies, which have increased their weight in the energy mix, having covered 7.6% of the primary demand in 2008 and 20% of the electric power demand; being, after natural gas, the second source in relevance as regards electric power generation, even exceeding the production of nuclear power.

These Strategies involve thus a first step towards the necessary and sought transition towards a new urban model, to be reinforced by the development of an *Energy Efficiency and Renewable Energies Law*, as its draft bill is being developed under the responsibility of the Ministry of Industry, Commerce and Tourism (MICyT) with the support of the Institute for the Diversification and Energy Saving (IDAE). The draft of the said Law, which pays special attention to the urban scope, also relies on a large inter-ministerial participation and remains consistent with the prospective forecasts for 2030, as well as with the objectives set forth for the 2020 horizon within the framework of the EC legislative package on energy and climate change, recently approved by the European Council, to be further transposed to the Spanish legal system.

Cities are the ideal scenario for a transition towards a more sustainable energy and economic model, with the implementation of energy policies that may combine actions related to the improvement of energy efficiency and the boosting of renewable energies. What is more, in compliance with European guidelines as the UE Action Plan for Energy Efficiency, in a near future, the 2020 horizon should lead towards a new concept of cities labelled as "low consumption" or "passive", where cities should stop being "consuming" or "wasteful" to become "self-producing" based on an optimum integration of the urban and transport model relying on a greater presence of energy issues, from the very planning to final use.

References

[1] Energy Saving and Efficiency Strategy in Spain (2004-2012) E4. Ministry of Economy. November 2003.

[2] Action Plan 2008-2012. Ministry of Industry, Tourism and Trade-IDAE. (July, 2007).

[3] Action Plan 2005-2007. Ministry of Industry, Tourism and Trade-IDAE. (July, 2005).

[4] Plan for Renewable Energies, 2005-2010. Ministry of Industry, Tourism and Trade-IDAE. (August, 2005).

[5] Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002, on the energy performance of buildings

[6] www.idae.es