Energy Efficiency and the use of Renewable Energy Sources in Public Buildings in Brazil

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Abstract

The focus here is on Energy Efficient (EE) measures in Public Buildings in Brazil, the current barriers to these, the main drivers for EE, and some of the ways to overcome the identified barriers. From the analysis made, it is clear that Public Buildings not only hold an enormous potential for EE actions, but also have at their disposal a powerful tool to implement such actions, in the shape of the 11079 PPP Federal Law, that allows the public administrator to overcome the barriers to EE imposed by the general 8666 procurement law, and at the same time offering the necessary guarantees for both parties (private and public). The way forward would encompass: establishing priority buildings (sectors or profile), better dissemination of the PPP procedure, and coordination with the private sector, with EE understood as a tool to change the Building Sector performance in Brazil.

Keywords: Buildings, energy efficiency, renewable energy, governance

1. Introduction

Buildings are meant to last, and this is particularly true when related to public buildings in Brazil, where many buildings are often used beyond their forecast lifetime, often with no retrofit or update. Sometimes these buildings even come to form part of a city's heritage and may also change their use over time (without the necessary re-engineering of the building).

Many Energy Efficiency (EE) technology and innovative management procedures that have been developed around the globe could be divided between the design phase and the operational phase.

Although in the design phase the possibilities are wider, many times only after the building awareness on efficiency is raised and better use of resources targeted. As these are the majority of cases in Brazil, it is important to be able to incorporate energy efficiency measures and better use of the renewable resources in buildings while they are under operating use (and not only during the design phase).

The application of EE measures in the public sector, besides promoting the modernization of segments managed by governments, such as public lighting, sanitation and buildings, generates positive externalities such employment and income generation, and forms the bases of a beacon effect that could serve as an example to take with it the rest of society.

The main potential and the main barriers that make it difficult for public administrators to tap significant gains from better energy use can be found mainly in the areas of the proper selection of technologies and in the modernization of the contractual procedures available to public entities in the procurement of energy efficiency services outside the criteria imposed by the public law.

Due to the specific nature of the public administration and its procedures (which are

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focused on protecting the public interests), it is often difficult to develop innovative energy actions. This paper analyses some issues to be observed in the design of energy efficiency increase action in public buildings in Brazil.

2. Energy Efficiency and Renewables in Buildings

Energy Efficiency (EE) is to be understood as a way to provide the same set of services or products, but using fewer resources. In this vision, part of the goal is to decrease energy use, and also to seek for innovative ways to achieve this.

EE means not only replacing old equipment with new (like changing old wall mounted air conditioning by modern units). In order to achieve this, it is necessary to understand the real desired service – like thermal comfort instead of air conditioning – and to evaluate all the different options available to provide this service within the building and its surroundings.

In this case, this could encompass: changing the building envelope to decrease the thermal load; redesign the use of internal space and increase the air circulation; incorporation of thermal mass materials; use of a central air conditioning system based on solar thermal collectors (chillers). Normally, the diversification and combination of more then one solution is the best way to achieve a given target and to encompass more requirements towards the optimal situation.

2.1. International Scenario

One thing is for sure: "Green" is good for business. At an international level the main trend now is to decrease the environmental impact of buildings, incorporating the use of renewable resources, passive housing design, innovative technology incorporation, etc.

This is not only due to the willingness of the market to pay more for eco-friendly spaces (or to avoid bigger operating costs even facing bigger upfront costs), but also due to a dynamic and step-by-step increase of the requirements imposed by law and regulations (i.e. UK and DE).

But legal enforcement by itself should not be seen as the single major force in this move, as the market itself is capable of self regulating, as with the LEED green building rating system, or the BREEAM, that started as optional but has now gained mandatory status (DCLG, 2008).

Legislation is a key aspect, but a suitable financial framework (allowing longer pay-back times), proper contract modalities and the development of research and development programs (including demonstration pilot cases), are all also crucial.

The main challenges faced are in the already built structures, as new projects already consider how to achieve as low a foot-print as possible. In general, the key aspect is to have a holistic approach, starting from evaluating passive house actions, local energy generation, use of solar energy (for light, heating and cooling), etc, without the need to make too deep interventions on the already built structure.

2.2. Brazilian Context

The public sector in Brazil is responsible for 1.7% of total energy consumption, and 9% of electricity (BEN, 2008). Despite not being the biggest consumer, the public sector represents a very high potential for EE. According to ABESCO[†], it is in the public sector that one can find the biggest energy waste, accounting for 45% of the estimated losses. In second

[†] *ABESCO* - Associação Brasileira das Empresas de Conservação de Energia. National association of EE related companies, more information at: www.abesco.com.br.

place is the commercial sector, with 30% of losses, and lastly the industrial sector with 15% of losses, but the biggest energy consumer in the Country: 40.6% of the entire energy matrix (BEN, 2008).

The main areas of the public sector with potential for energy efficiency measures and energy performance contracts are public lighting, sanitation and buildings. Within these areas there are many comprehensive measures which may be applied, depending on the need and desire of the public customer.

Technically speaking, the actions are focused on: lighting; heating; air conditioning and ventilation control systems; building envelope improvements (insulation, roofs, windows); cogeneration; demand response; renewables and biomass, etc.

The public buildings with retrofit potentials range from airports, libraries and stadiums to universities, hospitals schools and presidiums, as well as water utilities (in Brazil the majority of these buildings are state owned enterprises).

In Brazil, there are more that 56 different kinds of public buildings at the federal, estate and municipal levels, representing more than 14,743 units which can receive EE measures. (Nexant, 2001) The choice for one or another facility should consider, besides the energy reduction potential, the possible social tangible benefits for the society as a whole.

In terms of energy final use in public buildings where possible EE actions may be applied, the percentages are indicated in Fig. 1. The percentage of Public Buildings that could undergo EE procedures are shown in Fig. 2 (Nexant, 2001).

Although it is difficult to determine energy consumption in public buildings nationally, based on data taken from utilities and a data bank from PROCEL (National Program for Electric Energy Conservation), when considering saving potentials and social representativeness, the areas which represent biggest relevance for energy efficiency measures, are as follows:

1. Office buildings (administrative);
2. Quarters and military bases;
3. Hospitals;
4. Schools;
5. Storage houses;
6. Airports; and
7. Universities.

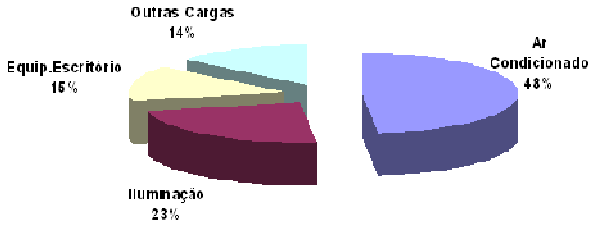

Figure 1: Energy final use in public buildings (Lamberts, 2008). Caption: Ar Condicionado – air conditioning; Iluminação – lighting; Equip. Escritório – Office equipment and Outras Cargas – Other loads.

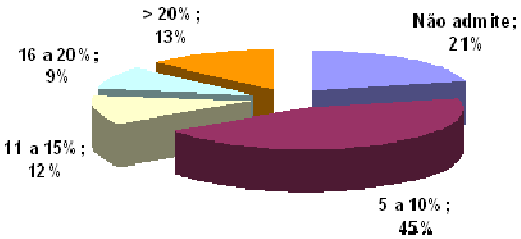

Figure 2: Percentage of public buildings where EE measures could be developed (Nexant, 2001).

3. The Way Forward

The main question in applying EE measures is generally not the question of whether the technology will work, or if it pays itself, but rather the issue is whether the present management system could implement new procedures and new forms of thinking. On the purchase of goods in the public sector, life-cycle-cost analysis instead of purchasing at the lowest bid, represent one of these shifts in behave that considers the better use of resources in a medium to long term scenario. On the same perspective one can consider also the change

from purchasing goods to paying for services like the ones developed by Energy Service Companies.

It is clearly necessary to push for new instruments and technologies in the EE market in Brazil. And although the public sector is in some aspects not best placed for EE, due to certain administrative regulations, it offers the best conditions to support practices with a longer payback period, in contrast to the private sector.

3.1. Energy Performance Contract in Brazil

According to the Brazilian National Energy Efficiency Institute, a performance contract is a "contract in which the service provider has the commitment to project and install– and in specific cases to operate and maintain – a mix of measures that guarantee savings in energy and water resources, by improving energy efficiency in an industry unit, as well as in commercial and residential buildings" (INEE, 2001).

Basically, this procedure uses the costs saved from reduced energy consumption to repay the costs of installing the energy conservation measures, which allows contractors to achieve savings without incurring upfront capital expenses. The Energy Service Companies assume the costs of all efficiency measures, including: assessment, design, project finance, implementation and sometimes even the maintenance costs (NAESCO, 2008).

Contracting by performance could directly target the inefficient use of energy by the public sector, but due to a series of factors and market failures this instrument is not yet a reality in Brazil.

Regarding legislative issues, the biggest barrier for Energy Performance Contracts (EPCs) is Federal law 8666[‡] which regulates public procurement. Due to the high risk for parties involved in the process of contracting EPCs, there are four key aspects hindering their implementation: the project description/ basic project (in the tender document), the budget items for funding and savings, the term of the contract, and the criteria for evaluating the different proposals.

However in reality, there already exists a juridical model more suitable than the EPCs contract and which already addresses the most controversial issues of law 8666. This is the PPPs[§] law 11.079 from 2004[**], which establishes general norms and regulation for procurement and contracts in models of public-private partnerships in the public administration sphere (Federal Law 11.079). Nevertheless, this mechanism is not being widely used for energy efficiency.

The main concept of a PPP is that the private sector provides its capacity to invest and finance, and supplies its flexibility and management competence, while the public sector satisfies the public interest. Depending on the operation, the remuneration of the private partner may include a complement of public funding, which is backed up by guarantees that avoid future governments failing to comply with the agreed contract.

The Brazilian PPP law was for economical and juridical convenience defined as a model for concessions. The contract involves the realization, construction, financing, operation costs and transference of the assets to the public power at the end of the execution of the contract. The contracts have long-term periods and public payment is conditioned to effective service execution and to the performance of the private partner. Hence, public payment is guaranteed by insurance or guarantees emitted by a guarantee fund (Ribeiro, 2005).

Because of these features, PPPs have theoretically the possibility to be more flexible

[‡] More information at: http://www.planalto.gov.br/ccivil_03/LEIS/L8666cons.htm.
[§] In Portuguese: Parceria Público Privadas (public-private partnerships).
[**] More information at: http://www.planalto.gov.br/ccivil_03/_Ato2004-2006/2004/Lei/L11079.htm.

than the traditional formalities of the procurement law for EPCs. In this sense, the PPP law solves the problem of the basic project (that in the case of EE corresponds to the preliminary audit) since it allows the successful bidder which will execute the project also to be responsible for the previous elaboration of the basic project.

In regards to budgetary credit, the clear recognition of payments based on performance minimises the largest barrier imposed by the 8666 procurement law to EPCs. The creation of guarantee funds ensures the payment of the project even if other entities come into power (in case of political instability).

In contrast to the problems of the term of the contract and the evaluation criteria issues of the 8666 law, PPP contract terms can last up to 30 years (and not less than 5 years) and the evaluation of proposals can be based on best price and tariff; best technique; and best counterparty of the public administration (Nexant, 2004).

It is however important to note that the law of PPPs does not have a significant tradition in Brazil and that the states which have the most administrative resources for applying it are Minas Gerais and São Paulo. To date, the field of application of PPP contracts has been more focused on federal highways, the construction of prisons and management of landfills. However, public sector sanitation presents a huge potential for these partnerships, and SABESP (São Paulo Sanitation Company), has approved in 2008 the first PPP project, which also includes EE measures.

The adaptation of public tender documents, PPPs, EE projects as concessions, and the use of performance contracts, are issues that could be used to overcome many of the legal difficulties. However, in order to do so, some structural changes will have to take place in the governance of energy efficiency in Brazil, specially to enable a more interactive environment between the Public Sector and the other EE stakeholders.

In this sense, governance arrangements in the public sector could generate greater awareness of the benefits of energy efficiency, which are not only an opportunity to save energy and generate savings for their administrations, but also an opportunity for innovation and to apply state of the art management strategies in this sector.

EPCs in the whole context of interactivity and application of EE measures should not be considered as a panacea for all the difficulties and failures in implementing energy efficiency in the public sector. EPCs have a role as a mechanism that enhances the capacity of the governance system to learn and adapt. Nonetheless, EPCs in the public sector also bring a greater focus on accomplishing EE targets, and provide public managers with an opportunity to move towards a more efficient public administration.

EPCs will not become a widely used practice in the public sector just as a result on changing or adapting the procurement law 8666. A whole context of increased involvement of EE institutions and related stakeholders with the public sector is necessary. This involvement is necessary in order to create the structural framework and awareness needed. These conditions can be only achieved by leveraging more synergistic relationships in the governance of Energy Efficiency in Brazil.

3.2. New Technologies – Solar Cooling

There are many technologies that could be applied to public buildings in Brazil, but the authors consider that one technology – that is not yet present in Brazil – might present a major breakthrough in the current trend. This technology is the use of solar based absorption cooling systems (Torí, et al., 2008).

Nowadays it is economically viable to run cooling systems using only solar thermal energy, by means of vacuum tube collectors (used with parabolic mirrors), thermal oil and dual stage absorption Chillers (running either with ammonia or with lithium bromide) (Baptista, 2006), Placios, 2007) (Zanki & Galaso, 2003).

A brief illustration of the solar based air conditioning system can be seen in Fig. 4, where the solar array provide the primary energy for the Chillers to generate the cooling effect for the Air conditioning and at the same time providing hot water for the facilities (Lokutrlu, 2006).

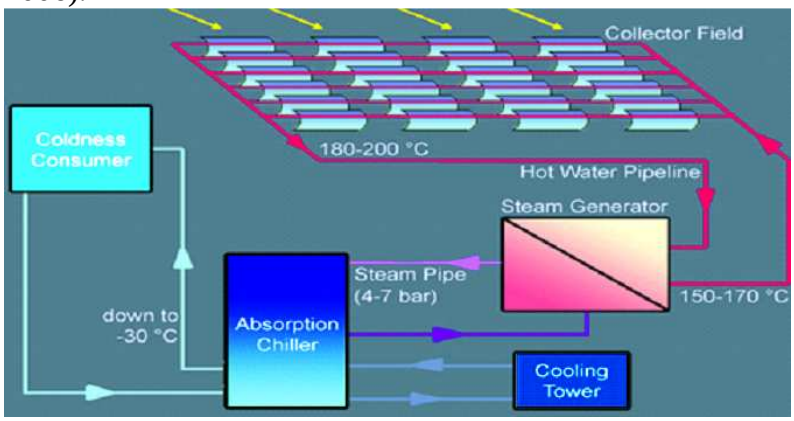

Figure 4: Schematic of the solar tri-generation system (Lokurlu, 2006).

Another aspect is how to insert this new technology in the country, as the private sector must also play its role, as other economic sectors could also profit from the use of this new technology, like the Hotel sector. Using the private sector to grow the market to support the technology transfer could be a way to support the incorporation of such new systems in PPP schemes in the public sector.

6. Final Words

It is essential to analyze more deeply the applicability of the PPP law (Law 11.079) to support energy efficiency activities in the public sector based on performance contracts. This is indispensable in order to figure out if this law could really be widely used as a lower risk model to implement EPCs in the public sector than is currently possible with the options given by the 8666 law. An important consideration is also if ESCOs would have the resources to accomplish such large scale projects, as minimal values for PPPs are quite high in relation to budgets even of medium size ESCOs. A feasible alternative to this could be creating a pool of public buildings which could be categorized by their potential for savings, field of activity (hospitals, schools, administrations) or even by their relevance for society as a whole.

When EPCs are widely implemented in the Brazilian public sector, EPCs could help serve as an instrument for achievement of bigger and more ambitious national EE goals. This need for better energy use is already resulting in the development of an EE market in Brazil, and EPCs are a proven market mechanism for reaching these targets, in both the public and private sectors worldwide.

Further actions are needed to remove legislative, financial, and institutional barriers to implement EPCs in the public sector in Brazil, and to encourage governance arrangements which can stimulate the use of EPCs in the public sector in practice. Due the current high priority given to EE in all policy levels (National and International), it is expected that these actions will result in much wider use of EPCs by the public sector in Brazil, and hence in significant energy savings across the country.

Finally, another issue to be addressed is the need for the coordination of such EE actions in parallel with the private sector, as the sectors could encourage each other in terms of setting new standards and providing better support for the introduction of technologies which are not yet present in Brazil (such as solar cooling).

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8. References

Bannister, Pau, 2008. Business Hotel Utility Consumption and Saving Opportunities. In: Proceedings of the IEECB Focus 2008 – Improving Energy Efficiency in Commercial Buildings Conference, 10 - 11 April 2008, Congress Center Messe Frankfurt (CMF), Frankfurt am Main, Germany.

Baptista, Alessandra Sleman Cardoso, 2006. Análise da Viabilidade Econômica da Utilização de Aquecedores Solares de Água em *Resorts* no Nordeste do Brasil. Tese Mestrado: COPPE/UFRJ: Rio de Janeiro.

BEN (Balanço Energético Nacional), 2008. Balanço Energético Nacional, Ministério das Minas e Energias.

INEE, 2001; Adaptação dos contratos de performance energético às condições brasileiras: modelos genéricos de contrato. Procel/Eletrobrás & US Agency for International Development.

Lamberts, R. Energy Efficiency in Buildings in Brazil: Towards a Standard. Report presented to the International Energy Initiative. Florianópolis: Núcleo de Pesquisa em Construção - Universidade Federal de Santa Catarina, march/1999.

Naesco, 2008. Energy Star Performance Contracting Best Practices. Prepared for U.S. Environmental Protection Agency / Energy Star Buildings by ICF International (May 2008)

Nexant, 2001. Programa de Eficientização Energética de Prédios Públicos Através de ESCO's. - Balizadores para a Implementação. Rio de Janeiro: Vibhava Cons. Emp. & RSC Tec. e Serv. em Energia LTDA

Nexant, 2004. Contratos de Desempenho para Serviços de Eficiência Energética no Setor Público do Brasil: Questões Jurídicas e Possíveis Soluções. Published by U.S. Agency for International Development.

Palacios, Reynaldo Bereche, 2007. Avaliacao de sistemas de refrigeracao por absorção H2O/LiBr e sua possibilidade de insercao no setor terciario utilizando gas natural, Dissertacao Mestrado, FEM – UNICAMP: Campinas.

Ribeiro, 2005. Distinções entre concessões administrativas, concessões patrocinadas, concessões comuns e privatizações. Seminário O Contrato PPP/MG (23/09/2005).

Torío, Herena; Angelotti,Adriana & Schmidt,Dietrich, 2008. Exergy analysis of renewable energy-based climatisation systems for buildings: A critical view. Energy Buildings (Article in Press), doi:10.1016/j.enbuild.2008.10.006.

Zanki,Vlasta & Galaso, Ivan, 2003. Possibilities for High Temperature Cooling in Tourism Accommodation Facilities. In: Proceedings of the Worldwide CIBSE/ASHRAE Conference, Building Sustainability, Value and Profit, September 24-26, 2003, Edinburgh, United Kingdom.