On-Site Renewable Energy Requirements for Buildings

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the PEMBINA institute
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The Pembina Institute is a national non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance. For more information about the Pembina Institute, visit www.pembina.org or contact info@pembina.org. Our engaging monthly newsletter offers insights into the Pembina Institute's projects and activities, and highlights recent news and publications. Subscribe to Pembina eNews: http://www.pembina.org/enews/subscribe.

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On-Site Renewable Energy Requirements for Buildings

Contents

1. Summary

This report outlines policies that require on-site renewable energy generation for homes and buildings. These types of policies have been used to reduce greenhouse gas emissions, raise awareness about climate change solutions, alleviate energy poverty, spur the deployment of distributed renewable energy technologies, and support the businesses and jobs that accompany those technologies.

The research includes policies that take performance-based and prescriptive approaches. Performance-based approaches require a minimum percentage of a building's energy needs to be met using any renewable technology, leaving the choice to the developers. Prescriptive approaches require a specific technology be used, such as solar thermal.

Performance-based renewable energy requirement policies are now widespread in the U.K., and similar policies are catching on throughout Europe. The London Borough of Merton took the lead by introducing a 10% renewable requirement in 2003, known as the Merton Rule. London followed with a 10% requirement in 2004. Prescriptive on-site renewable requirement policies have mostly been used for solar energy; examples include Spain, Israel and Vellmar, Germany. The new Spanish building code requires 30 to 70% of hot water to be supplied by solar and solar photovoltaic equipment to be installed on buildings over 4,000 square metres (m^2). Barcelona and Madrid have developed more stringent solar requirements than the national ones.

The performance-based renewable requirement policies have mostly been applied to new developments larger than a set floor area (such as 1,000 m^2). The performance outcome required is typically a reduction in the building's greenhouse gas footprint that exceeds the building code requirements. Government staff determine the amount of renewable energy required based on a certified energy model. The renewable energy requirements can often be reduced if the developer is able to invest more in energy efficiency or combined heat and power solutions that may provide more cost effective ways to reduce greenhouse gas emissions.

These types of policies often directly support national goals to increase renewable energy and reduce greenhouse gas emissions. In the U.K., the Merton Rule and other on-site renewable energy requirements support the national government's target of 10% renewable energy by 2010 and net zero greenhouse gas buildings by 2016. The linkages have been used to gain acceptance from the national government. The primary concern expressed by stakeholders about this policy was the possible additional cost. This concern has been mitigated by the fact that implementation costs have been lower than anticipated and because many of the policies include flexibility mechanisms that limit overall costs.

Evaluations of these policies indicate that they have been successful. Significant growth in building-scale renewable energy technologies has been observed. A recent study found a 26% reduction in greenhouse gas emissions for new developments following the policy's introduction. The same evaluation also found that a significant percentage of those savings came from energy efficiency improvements that developers decided to pursue in lieu of more costly renewable energy opportunities.

2. Performance On-Site Renewable Energy Requirements

An on-site renewable energy requirement is a policy that requires buildings to meet a certain percentage of their energy demands (or reduce a certain percentage of their carbon footprint) with on-site renewable energy. There are numerous examples of local governments that have implemented such a policy. This report draws from three main examples: Merton, Croydon and Greater London, all in the United Kingdom.

2.1 History

General renewable energy requirements were first implemented in Merton Borough, London, U.K. in 2003.[1] Croydon implemented its renewable requirement in 2003 and Greater London followed in 2004. Similar policies have since been implemented by approximately 325 of 390 England councils as well as councils in Scotland and Wales.[2] All Local Planning Authorities in the U.K. are required to have a similar policy by 2010.[3] Similar policies have also been implemented in Ireland, Spain, Germany and France.

2.2 Objectives

Merton's objectives for its renewable requirement are to:

1. Reduce local greenhouse gas emissions to help the U.K. national targets.
2. Address fuel poverty.[4]

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[1]Adrian Hewitt, former Environmental Officer, London Borough of Merton, e-mail communication, June 3, 2009.

[2] London Borough of Merton, *Merton Rule Conference – Building a zero carbon future* (2008), http://www.merton.gov.uk/living/planning/planningpolicy/mertonrule/building_a_zero_carbon_future.htm (accessed June 2009).

[3] Hewitt, e-mail communication.

[4] Fuel poverty is defined by the U.K.'s Department for Environment, Food and Rural Affairs as the condition where a household must spend more than 10% of its income to maintain a warm living environment (21ºC for main living space). Source: DEFRA and BERR, *The U.K. Fuel Poverty Strategy,* 2008 available at http://www.berr.gov.uk/files/file48036.pdf. Merton's renewable requirement reduces energy poverty by encouraging

3. Make Merton businesses more competitive.
4. Expand the renewable energy economy.
5. Raise the profile of renewable energy and climate action locally and stimulate debate on sustainable energy.[5]

Greater London's renewable requirement is part of the London Energy Strategy, which has similar objectives to those of Merton, however there is a stronger focus on stimulating the economy.[6]

2.3 Application and Eligibility

Most renewable energy requirement policies apply to all new developments and major renovations over a certain minimum floor area (e.g. 1,000 square meters) or number of units (e.g. 10 in Croydon and Greater London). Merton has further restricted application of their policy to non-residential buildings.

Most policies have used a similar list of eligible technologies. Merton developed the following list of acceptable renewable energy technologies based on the London Renewables toolkit:[7]

- wind
- solar photovoltaics
- solar hot water systems
- biomass heating
- biomass combined heat and power
- ground sourced heating and cooling
- fuel cells using hydrogen from renewable sources
- gas from anaerobic digestion
- biogas from pyrolysis (added by Merton)
- geothermal electricity generation
- ground cooling air systems
- micro hydro

developers to build more efficient buildings. In addition, the developer pays for the installation costs of the renewable energy systems, reducing the energy costs of renewable energy generation for the owner or occupant.

[5] Adrian Hewitt, "The MertonRule Briefing February 2009."

[6] The goals of the London Energy Strategy (which Greater London's renewable requirement is a part of) are to reduce greenhouse gas emissions, eradicate fuel poverty and stimulate London's economy. Source: Day et al., "The use of planning systems to encourage low carbon energy technologies in buildings," *Renewable Energy 34* (February, 2009) www.elsevier.com/locate/renene (accessed June, 2009).

[7] Available at http://www.london.gov.uk/mayor/environment/energy/renew_resources.jsp (accessed June 2009).

- solar air collectors

The amount of renewable energy required to comply with the policy is first calculated relative to the energy performance that would be achieved in the building code. Developers can, and typically do, shrink this baseline by building a more energy efficient building. Once the baseline is revised to account for such improvements, developers need to plan for enough on-site renewable energy to meet the specified percentage of that baseline.[8]

Renewable energy requirement policies differ on the following two important issues:

- Whether the policy requires a certain percentage of renewable energy or an amount of renewable energy capable of reducing greenhouse gas emissions by a specified percentage. Merton and Croydon require a reduction in greenhouse gas emissions, whereas London requires a reduction in the energy demand. Most policies appear to have chosen greenhouse gas emissions as the focus to prevent technology decisions that could lead to increased greenhouse gas emissions (e.g. electric heat pumps in a greenhouse gas intensive electricity grid).
- Where the focus is on energy as opposed to greenhouse gas emissions; whether the reduction is relative to on-site energy consumption or primary energy consumption. London uses primary energy, whereas Waverly Borough uses the on-site energy used.[9]

In addition to being able to lower the renewable energy requirements by improving energy efficiency, most policies also give credit for the use of combined heat and power from fossil fuels and for district heating systems. For example, if a developer installs combined heat and power technology that reduces the building's carbon footprint, Merton will often relax the renewable energy requirement.[10] Greater London's policy is similar, but it requires that energy efficiency, combined heat and power and combined cooling heating and power be taken into consideration for new developments. If a building connects to a district energy system, London considers this an energy efficiency measure, which makes it easier for a developer to meet the renewable requirement.

2.4 Exemptions

Many policies have a viability clause which gives developers the opportunity to demonstrate that it is not technically or economically feasible for them to meet the renewable requirement. In all cases, the onus falls on the developers to provide evidence thereby minimizing additional workload for staff. In Merton, between 2 to 5% of incremental building costs is considered acceptable. If the developer can show that the costs will be significantly higher, then the council

[8] The exact wording of Merton's policy is: "All new non residential developments above a threshold of 1,000sqm will be expected to incorporate renewable energy production equipment to provide at least 10% of predicted energy requirements." Source: London Borough of Merton, *The Merton Rule*, http://www.merton.gov.uk/living/planning/planningpolicy/mertonrule (accessed June, 2009).

[9] See Sarah Wells, *Guide to the 10% Requirement of SE2*, http://www.waverley.gov.uk/downloads/policyse2guide.pdf (accessed July 7, 2009) for details.

[10] Adrian Hewitt, "The MertonRule Briefing February 2009."

may negotiate a lower renewable target with the developer.[11] Based on experience to date, it is very unlikely that it would not be economical to meet the renewable requirement.[12]

The British Property Federation recommended an exemption that would allow developers to purchase green power from off-site sources when on-site renewables are not cost effective or viable.[13] Some policies include this type of exemption (e.g. the Greater London Authority), while others (e.g. Merton and Croydon) do not allow off-site renewable energy. The decision to not allow off-site renewable energy is due to concerns over the legitimacy of "green power" sales; the administrative requirements of verifying the purchases and validity of off-site power; and the inability of off-site power to meet other policy objectives.[14] While Greater London does permit off-site green power, so far developers have chosen to install on-site energy systems.[15]

2.5 Implementation Process

Merton uses energy benchmark guidelines to calculate the baseline energy consumption on a per square meter basis.[16] Separate figures are worked out for electricity and gas, and then converted into greenhouse gas emissions using standard emissions intensities. The Development Officer then calculates the 10% reduction target and provides this to the developer.

The developer can count savings from energy efficiency measures to lower the benchmark energy consumption, provided that the savings have been modelled using approved software.[17] If the building exceeds the Building Code requirements for energy efficiency, then the amount of renewable energy required will be revised downwards accordingly. Greater London expects the developer to use combined heat and power or combined cooling heat and power, and to fully justify any decision not to use this technology.[18]

It is then the applicant's responsibility to reduce agreed upon baseline consumption or greenhouse gas emissions by the specified percentage with on-site renewable energy. Typically an engineering company would be hired to design the renewable energy system.

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[11] Adrian Hewitt, "The MertonRule Briefing February 2009."

[12] Ibid.

[13] British Property Federation, "BPF Statement on The Merton Rule," press release, August 22, 2002. Also available at http://www.bpf.org.uk/newsroom/pressreleases/document/23201/bpf-statement-on-merton-rule (accessed July 7, 2009).

[14] Adrian Hewitt, "The MertonRule Briefing February 2009."

[15] Public Liaison Unit, Greater London Authority, personal communication, July 3, 2009.

[16] London Borough of Merton, "How the Policy is Applied" (2008) http://www.merton.gov.uk/living/planning/planningpolicy/mertonrule/how_is_the_policy_applied.htm (accessed June 2009).

[17] Adrian Hewitt, former Environment Officer, London Borough of Merton, e-mail communication, July 3, 2009.

[18] Day et al.

2.6 Connections to Other Policies

The renewable energy requirement is complimentary to the U.K.'s building regulations, which require new buildings to achieve a greenhouse gas emissions target (Part L).[19] The greenhouse gas reductions required from on-site renewable must be in addition to the national building regulations. Renewable energy requirement policies also support the U.K.'s intention to require all new buildings to be carbon neutral by 2016 and parliament's goal to have 10% of the U.K.'s energy coming from renewable sources by 2010. [20,21]

2.7 Development and Consultation Process

The Merton Rule was proposed in 2000 as part of Merton's Development Plan. Initially the Government Office of London opposed the policy on the grounds that it did not fit within other government policy. Merton addressed this concern by explaining how the policy aligns with the U.K.'s overall climate action strategy, which includes a 10% renewable energy goal. The Government Office of London also voiced concerns that the proposed policy could increase costs of development and required Merton to undertake a financial feasibility study to ensure that developers would not face unrealistic financial demands.[22] The 10% target was determined based on this financial feasibility study.[23]

The House Builder's Federation also opposed the policy due to concerns that the policy would result in additional cost and effort.[24] This was a key factor in a 2007 movement to get Parliament to overturn Merton's renewable requirement. The eventual decision to keep Merton's policy has been attributed to a large publicity campaign by environmental groups, the Royal Institute of British Architects, universities and renewable energy companies. [25]

During the development of the Merton Rule, the Chartered Institute for Professional Development expressed opposition due to the additional costs that the policy might create. Partly in response to these concerns, the term "expect" was used instead of "require" so that a viability

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[19] NBS, *Target Carbon Dioxide Emission Ratio,* http://www.thenbs.com/BuildingRegs/knowledgeCentre/ShowContents.asp?Topic=b_0601_APPDOC_L2A_00320&Section=L2A.

[20] Sustainable Build, "Carbon Neutral Plans for the U.K.*",* http://www.sustainablebuild.co.uk/CarbonNeutralPlansForTheUK.html (accessed July 7, 2009).

[21] Adrian Hewitt, "The MertonRule Briefing February 2009"

[22] Adrian Hewitt, former Environment Officer for Merton Borough, e-mail communication, July 3, 2009.

[23] Financial Appraisals were conducted by Nick Smart, Merton's economic planner, who assessed the land values and construction costs against the retail or rental income and then factored in the cost of renewable technology (Hewitt, e-mail communication).

[31] Ashley Seager, "House Builders Win Battle Against Green Technologies," *The Guardian,* August 20, 2007, http://www.guardian.co.uk/environment/2007/aug/20/energy?gusrc=rss&feed=19 (accessed July 7, 2009).

[25] Adrian Hewitt, "The MertonRule Briefing February 2009."

clause could be included (see section 2.4). No formal consultation was carried out with Merton residents or interest groups prior to the policy's introduction.

In 2008, the U.K. parliament passed a bill giving Local Planning Authorities the unambiguous authority to pass similar policies, and in fact stating an expectation that they would implement similar policies. The Planning Policy Statement on Planning and Climate Change, issued by the U.K. Government's Department of Communities and Local Governance in 2008, states that local governments should "expect a proportion of the energy supply of new development to be secured from decentralized and renewable or low-carbon energy sources."[26] As a result, all 350 England councils will have on-site renewable energy requirement policies by 2011.[27]

2.8 Development Approval and Enforcement

Merton and Croydon do not approve a proposed development until they receive and are satisfied with a report submitted by the developer that outlines how the on-site renewable requirement will be met. Similarly, the Greater London Authority expects a report that includes how the greenhouse gas emission reductions will be achieved, which renewable technology will be used, and how the calculations were made.

Councils can send the proposals away for independent review, and larger councils may be able to employ staff with experience in energy systems.[28] However, according to Merton's past Environmental Officer,[29] it was typically deemed unnecessary for planning authorities to check the calculations in the developer's plan because the energy modelling is usually contracted to engineering companies that don't want to risk their reputations with non-compliant designs.

Merton is piloting a renewable energy monitoring and database system to monitor buildings with renewable energy systems, enforce the policy when required, and evaluate the policy. The system, which was designed by the Worcester Polytechnic Institute and Massachusetts Institute of Technology, uses wireless sensors to monitor energy savings and greenhouse gas emissions reductions.[30] This data system connects to the council's Geographical Information System (GIS) and compares each development to its "birth-certificate," which details the building's anticipated energy performance.[31] Natural Resources Canada's CanmetENERGY program is currently

[26] Communities and Local Governance, *Planning Policy Statement: Planning and Climate Change* (London, UK: Department of Communities and Local Governance, 2007),15. (paragraph 21).

[27] Adrian Hewitt, e-mail communication, July 5, 2008.

[28] Ibid.

[29] Ibid.

[30] This system is called the EnergyData-Gauge (copyright Energence.co.uk).

[31] Adrian Hewitt, "The MertonRule Briefing February 2009."

developing a new monitoring, targeting and verification software tool for use with their RETscreen software program, which may be relevant for similar efforts in Canada.[32]

It is the responsibility of the building owner to maintain the renewable energy equipment and ensure that the on-site renewable energy technologies continue to perform at anticipated levels. It is also expected that building owners monitor their renewable energy generation so that councils can easily check the performance. Through the U.K.'s Town and County Planning Act, councils have the power to enforce continued compliance through fines.[33] To date, Merton has not had to administer any fines because developers have so far been in compliance with their renewable energy requirements.[34]

2.9 Evaluation

Merton's evaluation of their renewable energy requirements has produced a number of positive conclusions:

- The pace and scale of development hasn't changed, contrary to what some critics claimed would happen.
- The administration's workload has remained relatively unchanged because the additional workload goes to developers, rather than to the planning office.
- Significant growth has been spurred in the renewable technology economy, and as a result technology is becoming more affordable and is seen as a less risky investment. Both of these outcomes are expected to help make it easier to apply the technologies in existing buildings and smaller developments.[35]
- Investment in higher levels of energy efficiency have received a boost because it is often more economical to meet the percentage renewable requirement if baseline energy usage and greenhouse gas emissions are lower. To date, all developers in Merton have invested in additional energy efficiency measures.[36]

An independent evaluation of London's renewable energy requirement completed for 113 development applications between May 2004 and July 2006 demonstrated a positive impact from

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[32] Source: RETscreen International email newsletter, June 23, 2009. See http://www.retscreen.net/ang/home.php for more details on RETscreen.

[33] Section 106 allows a planning authority to implement a planning obligation with a developer or land owner. This obligation is applicable to the person who enters the agreement (e.g. developer) and any person who gains title from that person (e.g. future owner). Source: Chris Skellern, AIE, *Section 106*, 2000, http://www.aie.org.uk/aie_data/aie_106.html, 6.

[34] Adrian Hewitt, "The MertonRule Briefing February 2009."

[35] Ibid.

[36] Hewitt, e-mail communication.

the policy.[37,38] Greenhouse gas emissions were reduced 26% from the baseline. Of these reductions, 10% were from combined heat and power (CHP) and combined cooling heating and power (CCHP) systems burning natural gas. A further 10% were from energy efficiency, and 6% were from renewable energy (Figure 1).[39] By the end of the period studied the 10% requirement was being met routinely by developers.

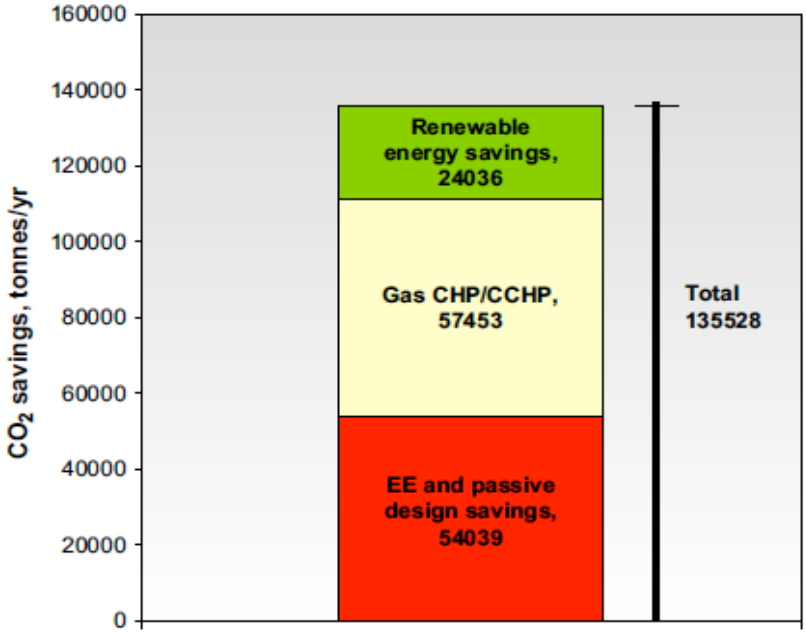

Figure 1: Overall Carbon Dioxide (CO_2) Reductions from Combined Heat and Power, Energy Efficiency and Renewable Energy for 113 Developments (Source: Day et al. 2009).

Figure 2 shows the distribution of renewable energy systems by technology type used to comply with London's policy in the 113 developments studied (i.e. the figure does not include natural gas CHP/CCHP or energy efficiency). Solar hot water was the most common renewable energy technology used, followed by biomass, ground source heating/cooling (heat pump) and solar photovoltaics. Combined heat and power and combined cooling heating and power from natural gas was used in 34 of the developments studied.

[37] Day et al. (2009).

[38] The sample of 113 was drawn from a total of 350 developments in the study period.

[39] Source: Day et al.

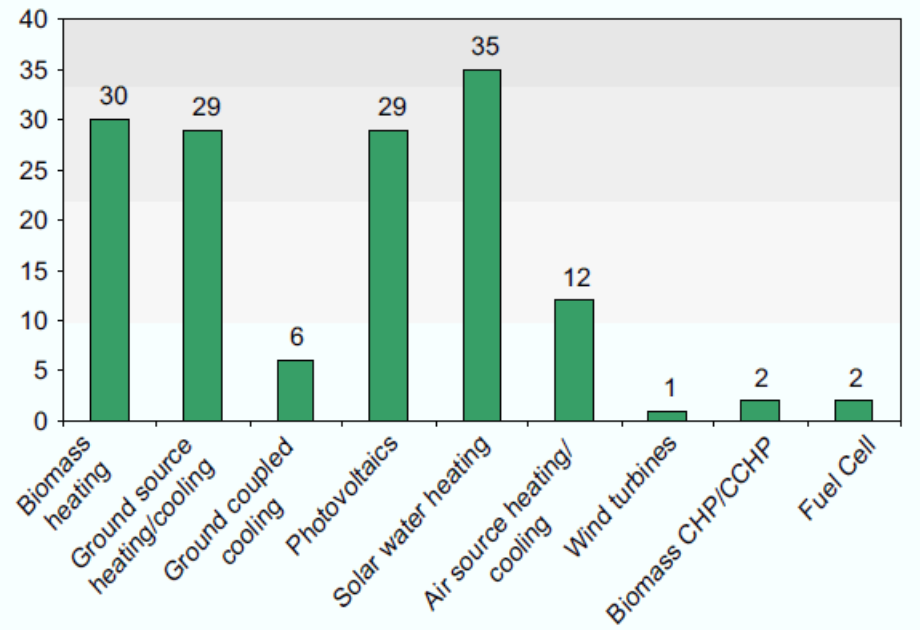

Figure 2: Number of Specified Systems by Renewable Energy Technology (Source: Day et al., 2009).

2.10 Additional Examples

2.10.1 Ireland

Since 2005 several Irish municipalities have introduced local regulations requiring higher energy efficiency and a renewable energy contribution to the thermal energy load of a building. Fingal County Council was the first council to challenge Ireland's central government exclusive authority over energy performance.[40] Fingal set a strong precedent, requiring that at least 30% of a building's thermal energy requirements (space and water heating) be supplied by renewable energy for a 29 hectare site that had been rezoned for housing development. For the same site, they also required annual heating demand to be lower than 50 kilowatt hour per square metre per year. Since then, this policy has been incorporated into the Local Area Plan for several other sites in Fingal. Although the policy received opposition from some in the construction industry, several companies were supportive.[41]

[40] See Xavier Dubuisson, XD consulting, *Local Building Energy Standards in Ireland*, http://www.estif.org/fileadmin/estif/content/policies/STAP/Ireland_local_solar_regulations.pdf (accessed July 3, 2009).

[41] European Solar Thermal Industry Federation, Best Practice Regulations for Solar Thermal, 2007, www.estif.org/fileadmin/estif/.../Best_practice_solar_regulations.pdf (accessed June 18, 2009).

2.10.2 Lyon, France

Lyon introduced renewable energy and energy efficiency targets into the tendering process for a 79,000 m^2 development area. This area will be a demonstration site for sustainable building, with 77% less energy usage than conventional development.[42]

2.10.3 Portugal

Portugal's new building code requires solar thermal systems for new developments, or other renewable energy systems that provide a similar energy savings. This requirement only applies to certain buildings, including those with a south-east to south-west roof orientation.

[42] Concerto, "Renaissance – City of Leon," http://concertoplus.eu/CMS/content/view/72/475/lang,en/ (accessed July 7, 2009).

3. Examples of Prescriptive On-Site Renewable Energy Requirements

The policies discussed in this section also require on-site renewable energy; however, these policies prescribe solar thermal and photovoltaic.

3.1 Spain

Spain's building code (2006) requires solar hot water to supply 30 to 70% of the domestic hot water demand for all new buildings or major renovations. It applies to all types of buildings, however some exceptions are made for buildings that use other renewable technologies for hot water or don't have access to adequate sunlight. The exact requirement is determined based on the volume of domestic hot water and geographical position. Large office buildings (greater than 4,000 m^2) are required to have solar panels to produce electricity in addition to the hot water requirements. Municipalities are able to develop more stringent requirements; two examples are Barcelona and Madrid.[43]

3.2 Barcelona, Spain

Barcelona pioneered solar thermal requirements by introducing a policy in 2000 that required a percentage of hot water to be supplied with solar hot water for all new and renovated buildings. Barcelona requires at least 60% of residential domestic hot water demand to be heated by solar energy. Solar must also heat 30% of the hot water needed for covered swimming pools, 100% for uncovered swimming pools, and 20% for industrial processes.

[43] European Solar Thermal Industry Federation (ESTIF), "Spain Approves National Solar Thermal Obligation" (2006), http://www.estif.org/no_cache/news/single-news-item/archive/2006/march/browse/3/article/spain-approves-national-solar-thermal-obligation-update-english-translation-available/?tx_ttnews%5BbackPid%5D=2&cHash=7be8de0176 (accessed June, 2009).

3.3 Israel

Israel has prescribed minimum sizes for solar hot water systems for residential buildings since 1980, with the policy currently applying to all new residential buildings. The policy is regarded as highly successfully and Israel claims that it has reduced electricity consumption by 8%. Increased manufacturing has made the technology more affordable, and the market has become large enough to sustain itself without subsidies. Reinforcing this statement is the fact that approximately 90% of solar thermal technology sales are in the voluntary market (e.g. installations on existing buildings and at greater scale than required by the policy).[44]

3.4 Vellmar, Germany

For the new development area of Osterberg, Vellmar required solar thermal installation as a prerequisite to development. A "buy out" clause was included, where applicants could simply pay a fine if they did not want to install solar thermal. Approximately 50% of the commercial developers choose to pay the fine, while nearly all of the people that were building their own homes chose to comply with the policy by installing solar systems.[45]

3.5 Toronto, Canada

While not a renewable energy requirement, Toronto's green-roof bylaw (adopted on May 26, 2009) has some similarities and provides a Canadian example. The policy is intended to be part of the City's overall climate change plan and to create green jobs.[46] It will come into affect in 2010 and will apply to all new construction with gross floor areas over 2,000 m^2. These developments will be required to have green-roofs covering from 20 to 60% of the total roof area. Industrial buildings will be treated separately with 10% coverage required starting in 2011.[47] The city-wide requirements build on existing green-roof requirements for municipal buildings and a $5 per square foot incentive to install green roofs on existing buildings.[48]

In 2004, the City of Toronto commissioned a group from Ryerson University to conduct a study on the environmental and economic costs and benefits of green roofs. It was found that widespread implementation of green roofs in Toronto would have significant environmental and economic benefits, including reduced storm water runoff and reduced energy consumption.[49]

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[44] European Solar Thermal Industry Federation, 2007.

[45] European Solar Thermal Industry Federation, 2007.

[46] Green Roofs for Healthy Cities, "Toronto City Council Adopts Mandatory Green Roof Requirements," press release, May 27, 2009. Available at http://greenroofs.org/resources/GRHC_Toronto_Makes_Green_Roofs_Mandatory.pdf.

[47] The City of Toronto, *Green Roofs*, http://www.toronto.ca/greenroofs/index.htm (accessed July 13, 2009).

[48] Green Roofs for Healthy Cities, "Toronto City Council Adopts Mandatory Green Roof Requirements," press release, May 27, 2009. Available at http://greenroofs.org/resources/GRHC_Toronto_Makes_Green_Roofs_Mandatory.pdf (accessed July 13, 2009).

[49] The City of Toronto, *Study Findings,* http://www.toronto.ca/greenroofs/findings.htm (accessed July 13, 2009).

4. Next Steps

To be in a good position to make informed decisions about the potential application of these types of policies in BC, the following next steps in research have been identified:

1. Include some research and discussion to compare prescriptive versus performance-based approaches to on-site renewable energy requirements.
2. Search for additional evaluations of on-site renewable energy requirements. For example, the Greater London Authority is working on an evaluation of the effectiveness of the London Energy Plan, including the renewable energy requirements.
3. Explore the details of Toronto's green roof requirement to understand how they have implemented the concept in a Canadian context.
4. Look into past experiences with BC's building code to understand how renewable energy requirements were assessed. For example, various stakeholders have proposed solar-ready requirements to be included in the code, but it isn't clear how the provincial government evaluated those proposals.