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THE ENERGY EFFICIENT DIMENSION IN THE MORTGAGE MARKET: AN INTERNATIONAL COMPARATIVE REVIEW

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The energy efficient dimension in the mortgage market: an international comparative review

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Introduction

At the recently convened Paris Climate Summit (Conference of the Parties 21 – COP21), 196 countries agreed to strengthen the global response to climate change. The COP21 Agreement seeks to hold the increase in global average temperature to well below 2°C above pre-industrial levels, and down to 1.5°C above pre-industrial levels (1850-80) by 2050.

National governments have submitted comprehensive Intended Nationally Determined Contributions (INDC), which detail their national climate change efforts in a transparent and comparable way. However, the sum of current pledged INDCs is more in line with total warming of 3°C than one of less than 2°C, creating a need for the private sector to scale up their efforts and support large scale actions to reduce emissions.

The countries involved in COP21 send a strong message to capital markets, creating a degree of certainty about their future engagement in low carbon transformation. As a result, interest in climate friendly finance has increased in magnitude with the successful COP21. Financial institutions report increased demand for environmentally responsible investment products. 2015 represented the highest yearly issuance volume of green bonds, USD 41.3 billion. COP21 aims to increase capital flows for project financing to lower GHG emissions and pursue environmentally sustainable development.

The UN, World Bank, European Investment Fund, the European Commission, European Central Bank and numerous development financial institutions (DFIs) have long recognised a growing link between finance and environmental challenges. They have established green initiatives to bring about systemic change in finance to a support more sustainable world.

In August of 2016, the World Economic Forum, for the first time in its history, found that failure to mitigate and adapt to climate change constitutes the global risk with the greatest potential impact and likelihood over the next decade (Global Risks Report 2016). The Forum found that financial institutions "suffer from an alamring lack of standrised and comparable climate-risk information, which keeps investors and policy makers from accurately incorporating these risks into their decisions."

Housing is crucial to Energy Efficiency policy. In 2011, residential real estate accounted for 18% of global energy consumption (US Energy Information Agency (US EIA)). It is also responsible for an important part of GHG emissions. The US Environmental Protection Agency (US EPA) reports that residential and commercial real estate sectors account for 33% of total GHG emissions in the US Europe's buildings are responsible for 38% of total energy demand in the EU (BPIE, October 2014). In 2012, residential buildings contributed 26% of final energy consumption in the EU, nearly double that of non-residential buildings, 14% (Eurostat). By improving the EE of buildings alone, the EU's total energy consumption could be reduced by 5-6% and CO_2 emissions by 5%.

This article profiles nearly four decades of policy and practice in the United States, Japan, Canada and Europe, focused on improving the Energy Efficiency (EE) of buildings, particularly in the residential sector. Authors from each of these regions provide an overview of policy, industry practice, research, fiscal and financial market support for residential EE efforts.

In Japan, the government has established and developed EE standards and EE performance grades for houses since 1980. Utilising those standards and performance grades, the Government Housing Loan Corporation and its successor, the Japanese Housing Finance Agency, have provided financial incentives for those houses with a focus on increasing EE associated with their mortgage finance and securitisation business.

For nearly four decades, the United States has pursued EE building codes at the state level, and EE mortgage lending financial subsidies for residential retrofits, as well as robust experimentation through a wide range of mechanisms. Financial incentives, tax incentives, capital markets, technical assistance, utility company partnerships, subsidies have all been used to encourage home EE and and research has been conducted to prove the efficacy of EE mortgages on energy consumption, home values and mortgage risk. The US has also pursued the establishment of a variety of home energy rating systems (HERS) to predict a home's energy consumption.

In Canada, an EnerGuide rating system (ERS) was developed by Natural Resources Canada (NRCan) to evaluate and label the EE performance levels of new and existing homes. Currently, all mortgage insurers in Canada offer a program that includes partial mortgage loan insurance premium refunds to borrowers who qualify with more energy efficient homes.

In Europe, the European Commission (EC) has described EE as the EU's biggest energy resource and one of the most cost-effective ways to enhance the security of its energy supply and decrease greenhouse gas emissions. A number of policy and fiscal measures have been adopted by the EC to promote residential EE. Notably, the European Mortgage Federation-European Covered Bond Council (EMF-ECBC) has developed a green mortgage action plan to engage the mortgage industry, capital markets, valuers, banking regulators, utilities, and EE engineers in an effort to promote EE among home buyers and the mortgage industry at large.

It should be noted that this article focuses on owner-occupied home EE retrofits. The US, EU and Japan have pursued EE retrofit efforts for rental housing as well. In the US, a special emphasis has been placed on EE retrofits for affordable rental housing. That said, this article focuses its attention on the owner- occupied mortgage market and their EE retrofit programs.

Japan

Energy Efficient Houses in Japan

The Act on the Rational Use of Energy was enacted in 1979 as Japan experienced the oil crisis in 1970s, in which EE standards of factories, transportation and buildings were stipulated. The measures were enhanced when the act was amended, e.g. in 1998 substantially as the Kyoto Protocol was adopted in COP3 in 1997.

Responding to the Act, EE standards for houses were stipulated in 1980. Thereafter, EE performance grades were stipulated so that consumers could compare the standards more easily, which are now called thermal insulation performance grades. The higher the standard, the greater is the grade number. The standards and grades were both stipulated by the government. The relation of the standards and grades is indicated in Figure 1, the classifications of which are used for EE mortgages provided by Japan Housing Finance Agency.

EE Mortgages Provided By Japan Housing Finance Agency (JHF) (Former Government Housing Loan Corporation (GHLC)

JHF (Former GHLC)

The government has been providing incentives of tax reduction, subsidies and EE house points exchangeable for commodities and other incentives to promote EE of houses, including the subsidies to the EE mortgages provided by JHF.

FIGURE 1 ▶ EE Standards and Flat35, and Others

EE standards, etc.	Thermal insulation performance grades, etc.	Energy consumption for heating and cooling in houses per annum[2]	Share in the all existing houses[4]	Flat35 product types	Flat35 interest rates (As of August 2016)[6]
Prior to the year 1980 standard	Grade 1	56 GJ	61%	Non Flat35	–
The year 1980 standard	Grade 2	39 GJ	21%	Flat35	0.90%
The year 1992 standard	Grade 3	32 GJ	14%	Flat35	0.90%
The year 1999 standard	Grade 4	22 GJ	4%	Flat35S interest rate B type (For the first 5 years Δ0.3% per annum)[5]	For the first 5 years 0.60%, the remaining period 0.90%
Leading standard[1]	First energy consumption grade 5[1]	[3]	–	Flat35S interest rate A type (For the first 10 years Δ0.3% per annum)[5]	For the first 10 years 0.60%, the remaining period 0.90%

[1] *The leading standard that is stipulated in Act on the Improvement of Energy Consumption Performance of Buildings in 2015. The grades based on first energy consumption are stipulated, rather than the grades based on thermal insulation performance.*

[2] *Source : Ministry of Land, Infrastructure, Transport and Tourism*
Scale : Gigajoule

[3] *First energy consumption of the houses that satisfy "first energy consumption grade 5" is reduced by some 10% compared to that of the houses that satisfy "thermal insulation performance grade 4" with general equipment.*

[4] *Source : Ministry of the Environment, As of the year 2005*

[5] *There are additional EE standards for the houses to adopt Flat 35S interest rate B type or A type other than the standards that are indicated in this figure regarding specificities for detached houses or other types of buildings. These standards represent a marginal set with respect to those represented in the table.*

[6] *The lowest interest rates for Flat 35 of repayment term 21 to 35 years and maximum LTV 90%.*

GHLC was founded in 1950 and was fully owned by the government. GHLC had funded 19.41 million houses by the end of FY2006, which occupied 30% of the houses built after the World War II in Japan. GHLC mainly had provided long term fixed rate mortgages directly to the customers. The rights and obligations of GHLC were succeeded to by JHF in FY2007. JHF mainly provides long term fixed rate mortgages through their securitisation business.

Both GHLC and JHF have established proprietary technical standards of housing construction besides the general building standards applicable to all houses. Furthermore, they have promoted the quality of the houses by providing incentives of additional loan amounts and interest rate reduction to the higher quality houses that satisfy the EE and other standards important to the government policy. JHF has also conducted house inspections to supply mortgages. Some 10% of all JHF staff are architects and engineers, who establish proprietary technical standards and house inspection schemes. This is a significant commitment of staff resources by JHF, whose principal mission serves as a housing finance institution.

Flat35

Flat35 is the long term fixed rate mortgage (the interest rate is "flat" for 35 years) that is provided through the securitisation business, in which JHF purchases mortgages executed by private financial institutions and securitises them to MBS. There have been more than one million applications so far.

One of the basic technical standards for Flat35 is "thermal insulation performance grade 2" equivalent. The grade 2 could save some 30% of heating and cooling energy in houses per annum compared to the grade 1 that conducts no EE measures, which doesn't satisfy Flat35 technical standards.

Flat35S(Special)

- **Flat35S**
  The interest rate of Flat35S is reduced by a certain rate from that of Flat35 when the house satisfies one of the four high technical standards regarding EE, earthquake resilience, elderly accessibility, and durability and flexibility. This scheme was launched in 2005. The cost for the reduction has been subsidised by the government, as this measure is a policy mandate.

  There are two interest rate types of Flat35S. JHF reduces 0.3% per annum for the first 5 years with Flat35S interest rate B type that satisfies "thermal insulation performance grade 4". JHF reduces 0.3% per annum for the first 10 years with Flat35S interest rate A type that satisfies "first energy consumption grade 5". The EE standards are shown in the Figure No. (1). Flat35S interest rate B type houses could save some 60% of heating and cooling energy in houses per annum compared to non Flat35 houses. Resident health also improves, as bronchial asthma and atopic dermatitis decrease in the EE house, owing to reduction of the temperature difference in houses and indoor air quality.

- **Expansion In Economic Stimulus Measures**
  The interest rate reduction scale and term of Flat35S has been temporarily expanded several times by the government economic stimulus measures in the range of 0.3 - 1.0% and 5 - 10 years respectively. The government aimed at stimulating the economy and simultaneously promoting the enhancement of houses to address the policy issues.

- **Flat35S Eco (The Measure For Great East Japan Earthquake In 2011)**
  A great earthquake hit East Japan in 2011, with nearly 20,000 people dead or missing. A big tsunami hit the nuclear power plant in Fukushima and electric power fell short. To revive the economy and promote EE for houses, Flat35S Eco was launched. The interest rate reduction scale was expanded from 0.3 to 1.0% in the disaster area and to 0.7% in the other area for about one year. Flat35S is used for EE to cope with the natural disaster as described.

- **Measures For Existing Houses (Including Renovation)**
  It is critical to renovate the existing housing supply in Japan, with many vacant houses. In 2005, 61% of the total existing houses were without any EE measures. Therefore, special technical standards for existing houses to adopt Flat35S interest rate B type were stipulated, which simply require the use of double sashes or insulating glass in the doors and windows. Furthermore, a new program will be launched this October where the interest rate reduction scale will be expanded from 0.3% to 0.6% when the existing house after renovation satisfies Flat 35S regular technical standards. These are not temporary but permanent programs.

- **Rental Houses**
  JHF provides direct loans with long term fixed interest rates for EE rental houses for households with small children and those with nursing services for the elderly. This is another priority for government policy. EE requirement is "thermal insulation performance grade 4". JHF also promotes EE of rental houses whose qualities tend to be lower than the owner occupied houses.

- **House Inspection**
  JHF conducts proprietary house inspections to provide Flat35, including a check if the house meets technical standards for Flat35S. There are three stages for house inspections for newly built detached houses: (1) drawings inspection; (2) on-site inspection on completion of roof construction; and (3) on-site inspection on completion. For condominiums, there are two inspections: (1) drawings inspection; and (2) on-site inspection on completion. JHF also conducts house inspections for existing houses and rental houses. JHF contracts out house inspection operations to the private inspection institutions and local government units, e.g. to some 125 private inspection institutions for Flat35, so that JHF may conduct house inspections all over Japan.

EE Mortgages by Private Financial Institutions And Local Government

Some private financial institutions and local government units provide EE mortgages by reducing the interest rates or subsidising. Nevertheless, they are not popular products. The mortgage interest rates of private financial institutions are so low (0.625% for ARM, as of August 2016) that they could hardly reduce the interest rates or provide incentives. They don't seem to find the advantage of promoting EE houses with some costs to increase their mortgage portfolio. The local government units seem to focus more on the higher priority policies such as decreasing birth-rate and aging population than EE policy with their limited budgets.

Future Policy Direction for EE Houses

In 2020 when Tokyo Olympic and Paralympic Games will be held, the government will impose some EE standards to all the new houses for the first time in Japan. The government seeks to make the ZEH house (Net Zero Energy House, producing the same energy as consumed at the house) to be the standard house (more than the half of new houses) by 2020. JHF may be required to promote EE more by providing mortgages with interest rate reduction and other incentives responding these government policies.

Europe

Current Situation in Europe and Legal Framework

Buildings are responsible for the largest share of European final energy consumption (40%) and they represent the greatest potential to save energy - 80% of existing buildings in the EU were built before 1990 with very limited, energy-related building codes and the energy intensity of heating per floor area is two times higher than any other region of the world (Figure 2a and 2b).

Buildings are long-term assets expected to remain useful for 50 or more years and 75-90%[1] of the EU's existing building stock is expected to still be in use in 2050. The principal challenge for Europe's EE policies for buildings is to improve and upgrade the existing building stock, as demolition rates (0.1% per year) and renovation rates (1.2% per year) are very low and only 1% of new builds are highly energy efficient.

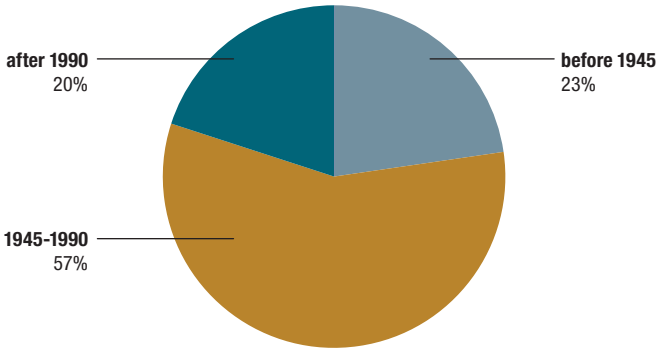
The European Commission describes EE as the EU's biggest energy resource, one of the most cost effective ways to enhance the security of its energy supply and decrease GHG emissions. By improving the EE of buildings, total EU energy consumption could be reduced by 5%-6% and CO_2 emissions by 5%[2]. The EU has set itself an overall 20% energy savings target by 2020 and is now considering increasing this to a 30% target by 2030. The Energy Efficiency Financial Institutions Group (EEFIG) calls for EE to be viewed as "the first fuel, because it is competitive, cost effective and widely available". The Group cites EE as the most cost effective approach to reducing the EU's reliance on energy imports, costing more than EUR 400 billion per year. Meeting this goal will require an estimated EUR 100 billion annually in investment up until 2030, with approximately EUR 65-70 billion per year in the residential EE sector[3].

The EEFIG calls for the direct support of EE retrofits to buildings, including housing, as a priority for the European Structural and Investment Funds, Horizon 2020, ETS Revenues (Emission Trading System). Each Member State decides on the use of its EU ETS revenues. However, the EU ETS Directive recommends that at least 50% of these revenues be used for climate action interventions including research and development in EE and clean technologies.

In 2014, DG Energy called for Member States to include Energy Performance Certificates (EPCs) as a requirement for the use of public funds for building retrofits. Member States have developed a wide range of EPCs throughout Europe, with some being much more capable of predicting a building's energy consumption. The Cohesion Policy Program 2014-2020 provides EUR 23 billion, which could be applied to large-scale EE retrofit programmes.

EE in the residential sector benefits from a wide range of policy actions, such as regulatory and financial/fiscal measures, as well as information- and awareness-raising measures, voluntary agreements, infrastructure investment (smart-metre roll outs), market based instruments, and others. Regulatory measures mostly relate to the implementation of the Energy Performance of Buildings Directive (EPBD), including minimum energy performance requirements and certificates for new and existing buildings and inspections of water boilers and air conditioning systems, and the Ecodesign Directive, including EE standards for appliances and equipment. Moreover, to help reach the 20% target, the Energy Efficiency Directive's (EED) Article 7 requires Member States to establish an "energy efficiency

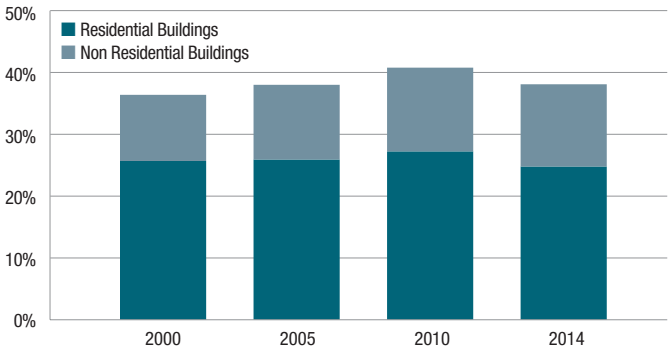
FIGURE 2a ▶ Housing Stock age structure in the EU*



Source: Eurostat

** The sample is of 27 EU Member States (Latvia has no data available)*

FIGURE 2b ▶ Energy Consumption of Buildings in the EU



Source: Eurostat

[1] Energy Efficiency Financial Institution Group (EEFIG). 2015. Energy Efficiency – the first fuel for the EU Economy How to drive new finance for energy efficiency investments. Available: https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report%20EEFIG%20v%209.1%2024022015%20clean%20FINAL%20sent.pdf

[2] European Commission. Available at: https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

[3] European Commission – Communication: Energy Efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy (COM(2014) 520 final)

obligation" scheme, which obliges EU energy companies to achieve yearly energy savings of 1.5% of annual sales to final consumers[4]. In order to reach this target, companies have to carry out measures which help final consumers improve EE. This may include improving the heating system in consumers' homes, installing double glazed windows, or better insulating roofs to reduce energy consumption.

Financial and fiscal measures that support EE improvements in the EU include grants and subsidies. A few Member States (France, Germany, Greece, the Netherlands and Portugal) offer loan programmes. Tax relief on EE upgrades for households is reported for Denmark, Finland, France, Germany, Greece, Italy, the Netherlands and Portugal. Six Member States (Austria, Denmark, Estonia, Germany, the Netherlands and Sweden) have put in place energy taxes that aim to change behavioural and investments in EE. Smart meters are expanding for to residential customers in Austria, Cyprus, Denmark, Finland, France, Greece, Ireland, Latvia, Malta and the United Kingdom.

At EU level, the European Commission has increased the amount of public funds available for EE. However, it has also suggested that there is a need to boost private EE investments. And this is where the EU Mortgage and Covered Bond Industries have a contribution to make.

The EMF-ECBC Green Mortgages Action Plan

With the EU's EE of buildings target and the necessary funds required to meet it in mind, the importance of which has been underlined by the COP21 Agreement, the EMF-ECBC believes there is a clear role for a private, bank financing initiative to support households in making EE improvements to their homes. The mortgage industry can play a leading role in developing a pan-European private financing initiative for the EE improvement of residential buildings, which is entirely independent from, but complementary to, public funds or tax incentives and utility rebates.

The EMF-ECBC initiative (the initiative) clearly supports three political priorities:

- **Financial Stability –** the initiative triggers market due diligence for consumers, mortgage lenders, bond issuers and investors, reduces borrowers' default, de-risks banks' balance sheets and management of non-performing loans and enhances transparency and pricing in the market by adding a green factor to real estate.
- **SME & Growth –** the initiative boosts the development of market and technological innovations, provides dedicated resources for specialised small and medium enterprises (SMEs) active in EE retrofit.
- **Energy Efficiency –** the initiative motivates borrowers to undertake EE investments, therefore reducing energy consumption and improving their financial resilience.

The EMF-ECBC initiative is based on two key assumptions:

- Firstly, that retrofitting has a positive impact on property value – studies in the EU and individual Member States have consistently proved this link to be true (between 5% and 12% depending on MS and location); and
- Secondly, that EE borrowers have a lower probability of default. This is because the consumer has more disposable income as a result of savings on the energy bill.

These assumptions drive the incentive chain which provides the business case for the initiative. The initiative provides a micro economic incentive for all of the actors in the chain:

Borrowers are incentivised to improve the EE of their homes for a preferential interest rate or for additional funds on the same terms as the mortgage loan. They benefit from lower operating costs for their home. Research[5] in the US shows that borrowers financing EE properties have a 32% lower probability of default on their loan, due to lower energy bills. This will prove beneficial for lenders if the EE mortgage loans on their balance sheet were recognised as a lower risk and therefore supporting better capital treatment by regulators. For investors, particularly in the current low yield landscape but likely beyond, the initiative will provide attractive interesting portfolio diversification opportunities for 'green' investments. The initiative also creates incentives to make existing green assets more visible, i.e. by segregating EE assets. Finally, this initiative, by encouraging EE improvements which increase the value of the property, protects homeowners and collateral holders against a 'brown discount', ensuring wealth conservation for borrowers and risk mitigation for lenders and investors.

The initiative aims to provide a preferential interest rate for mortgages for newly built dwellings or existing ones which undergo renovation. Regarding retrofit of existing dwellings, by factoring in the increased value of EE improvements, the lender, by maintaining the LTV ratio of the property unchanged, has freed capital which can be used to finance the EE retrofit. In this way SMEs active in EE will also benefit.

In order to quantify the amount of actual improvement, a robust set of indicators have to be developed. The EMF-ECBC proposes a three pillar approach combining in the short term (1) the Energy Performance Certificate (EPC) introduced by the EU's EPBD; (2) a consumption indicator, such as the household's energy bill taking into account the composition of the household and adjusting for different weather conditions; and (3) an alternative demand indicator in the longer term. The last indicator, still to be determined, will provide a real time measure between the energy used by the property before and after the retrofit. Until (3) is fully operational, it will be necessary to rely on (1) and (2).

Incidentally, the consumption and demand indicators will play other key roles as well by: (1) encouraging good consumer energy behaviour (energy bills) (see below) and (2) potentially supporting the EMF-ECBC's mechanism to provide additional funds.

Implementation of the Initiative

The EMF-ECBC roundtable events in October 2015 and February 2016, together with a series of bilateral discussions with relevant stakeholders have identified a set of criteria needed for the implementation of this initiative:

- A clear set of principles which enable flexibility at national level but ensure a minimum common denominator.
- A clear definition of an EE mortgage which needs to be aligned with the regulatory benchmarks in the European legal framework.
- The establishment of a 'data warehouse' in order (1) to understand the correlation between EE and the probability of default of the borrowers and (2) to clearly register the link between property, energy rating and loan performance so that these can be identified for 'green ' funding purposes.
- The establishment of an energy passport which records the EE history of a property.

This initiative will be managed by a governance structure comprising:

- Technical Committees to provide a definition and metrics on which to build the quantitative market analysis, with a focus on the financial, EE and valuation/data aspects of the initiative
- An Advisory Council with representatives from the World Bank and the EU Commission
- A Steering Committee with representatives from mortgage lenders, mortgage/banking associations, investment banks which will act as the decision body in charge of updating the initiative on an annual basis

On the 3rd of June 2016, the EMF-ECBC hosted a high level panel debate on "The Future Development of EU mortgage and Covered Bond Markets, and Implications of the Energy Efficiency Debate" at Ca' Foscari University in Venice. Panellists and participants, representing the interests of European mortgage lenders, covered bond issuers, investors, valuation experts, academics, the European Commission and the Basel Committee on Banking Supervision, exchanged views on the future role of banks in financing residential EE. Concluding more than a year-long effort, this event set the stage for the launching, in the coming months, of a pilot phase with a small number of relevant stakeholders to: (1) identify evidence of a positive impact of EE on property value and probability of default, and therefore bank risk by way of portfolio analysis, and (2) analyse the potential for and design of a concrete business case.

[4] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013SC0451&from=EN

[5] Bob Sahadi, Sarah Stellberg, Chao Yue, Nikhil Kaza, Roberto Quercia (2013); Home Energy Efficiency and Mortgage Risks; Institute for Market Transformation

United States

The US has engaged in very large scale residential building EE retrofit and finance efforts for more than three decades. Utilities, regulated by state governments in the US, face renewable energy portfolio standards (REPS), which establish quantified goals for the production of energy from renewable sources (e.g., solar, wind, geothermal). A growing number of state utility regulators are now adopting energy efficiency portfolio standards (EEPS) (New York, North Carolina), which require utilities to reduce energy consumption among their customers through EE retrofit programs. These efforts are supported by rebates and tariff reductions in support of EE and renewable energy home improvements. Mortgage lenders and mortgage insurers have specialised "green mortgage" programs, and the US tax code provides incentives for energy conservation and renewable projects. Federal cash subsidies (fiscal supports) for home EE retrofits, loan guaranties and related program total more than USD 10 billion over the last decade alone.

The Database of State Incentives for Renewables and Efficiency (DSIRE) website provides a comprehensive catalogue of state EE programs (rebate, grant, tax incentive, tariff reduction, finance, credit enhancement, secondary mortgage market) for home energy retrofit programs nationwide: http://www.dsireusa.org/.

In the United States, most states have substantially revised their building codes to require ever-greater EE. Led by California dating back to 1978 with its Title 24 building code standards, continuously strengthened by California through 2015, a variety of environmental certification systems have since emerged such as LEED, EnergyStar, Home Energy Rating System (HERS), GreenPoint rating and other systems. These building codes apply to new construction, and in some cases, to substantial renovation. They do not apply to stand-alone EE home retrofit projects.

Green Value

The "green value" of a building is defined by the impact on property value of EE and other environmentally friendly features, access to public transportation and other measures. Research on this topic usually focuses on the energy dimension of green value. The first attempts to assess green value in the US, and Europe (Germany and Switzerland) (Taffin, Rosen, 2015), estimated gains of around 5% for "green buildings," mostly commercial, characterised by regulator definitions or certifications.

A 2012 study in California assessed the effect of green labeling on the sale price of homes (Kok, Kahn). The study examined 1.6 million single-family home sales between 2007-2012 in California. However, of these homes only 4,321 were certified under the EnergyStar Version 2 format, GreenPoint rated, or LEED for Homes. The study controlled for a large number of variables that affect real estate pricing, and found a positive correlation between green labeling and price of 9% with an error of ± 4%. The authors calculate that with an average sale price of non-energy efficient/energy labeled homes in California of USD 400,000 during this period, a price premium for a certified green home equates to approximately USD 35,000 in value for a comparable nearby home. The authors note that the study's findings echo results from prior research in the commercial real estate sector.

A study published in the US Appraisal Journal documents that a home value increases USD 20 for every USD 1 decrease in annual energy costs. An analysis by the Pacific Northwest National Laboratory found that building a home that exceeds the Model Energy Code might result in annual energy savings of USD 170-425. Applying these findings to the analysis published in the Appraisal Journal would equate to an increased home market value of USD 4,250-10,625.

A 2015 study performed by the Lawrence Berkeley National Laboratory examined the effect of solar PV systems on home sale prices. The study examined 22,822 sales, 3,951 of which contained PV systems, during the period 2002-2013. PV sale price premiums averaged USD 4/W, or USD 15,000 for an average-sized 3.6-kW PV system. Statistically insignificant differences were found between new and existing home sales. This "PV Value" held consistently across states, housing and PV markets, and home types. The market appeared to depreciate PV systems in their first ten years, a rate which exceeds the rate of PV efficiency losses. The net cost of PV systems, taking into account government and utility subsidies, appeared to be the best proxy for market premiums. The authors note income-based estimates may perform equally well to estimate market premiums, if they can account for local utility tariff structures and subsidies. (Hoen, et al, 2015).

A small Colorado study was inconclusive in quantifying a value premium for EE of new and existing homes in a variety of Denver submarkets. On an individual case basis, the study did find positive values associated with measures of a home's EE. However, the authors conclude that "(s)tandardised documentation about EE appears to be in its infancy." (Desmarais, 2015, Colorado Energy Office).

In the United States, lenders and appraisers have been slow to recognise the value of EE homes. This is beginning to change. Both the US Appraisal Institute and the Appraisal Foundation have undertaken green value assessment programs for residential real estate. The Appraisal Foundation and the US Department of Energy have entered into a memorandum of understanding to help assure that the uniform standards of Professional Appraisal Practice (US PAP) are applicable for energy performance and green valuations, and that appraisers are trained in the application of these standards. The Appraisal Foundation issued an Evaluation of Green and High-Performance Property: Background and Core Competency in 2015, providing guidance on green valuations for residential, commercial, multifamily and institutional properties.

Energy Efficiency and Mortgage Risk

There is a paucity of research linking the EE rating of a home with the probability of default on the underlying mortgage for that home. However, those studies that have been conducted show promising correlations between mortgage and portfolio performance with green rating of the home (collateral). The Institute for Market Transformation conducted the only study in the US with researchers at the University of North Carolina Chapel Hill (Sahadi, et al, 2013). The UNC study examined actual loan performance data obtained from CoreLogic by assessing whether residential EE was associated with lower default and prepayment risks. The authors, accounting for loan, household and neighbourhood characteristics, constructed a study sample of 71,000 EnergyStar and non-EnergyStar rated single-family mortgages. About 35% of the total sample, or 21,000 homes, were EnergyStar rated. Nationally in the United States, the market penetration of the EnergyStar label in new housing construction is noteworthy, with approximately 25% of new US housing starts certified as EnergyStar in 2011. To earn an EnergyStar rating, a home must generally achieve a Home Energy Rating Score (HERS) of 85 or better, indicating at least a 15% improvement over homes built to the current market standard (2006 International Energy Conservation Code Standard), normalised to climate zone, size and type of house.

Controlling for other loan performance variables, the study found that owners of EnergyStar homes were, on average, 32% less likely to default on those homes rated EnergyStar, compared to comparable homes without such a rating. The authors note, "This finding is robust, significant, and consistent." Significantly, the study found that a borrower in an EnergyStar residence is 25% less likely to prepay the mortgage than a borrower in a home without such a designation. Furthermore, the study found that within EnergyStar rated homes, default risk continued to decline as the EE rating of the home improved. The authors conclude that the lower risk of default and prepayment associated with EE should be taken into consideration when underwriting home mortgages.

Energy Efficient Mortgages in the United States

Fannie Mae, Freddie Mac, FHA and the Veterans Administration (VA) have all adopted special underwriting guidelines to take into account EE of homes for mortgage underwriting. EE mortgages generally attribute more income to mortgage paying ability associated with lower projected energy costs of home ownership for the borrower. Some of these loans allowed for the financing of energy improvements at purchase, while others attributed alternative underwriting to homes with higher EE ratings. There is poor data availability on the origination of EE mortgages designed by these guarantee agencies.

In August of 2015, President Obama announced two home EE initiatives: (1) "stretched" underwriting by FHA for homes with better than average Home Energy Scores (Score); and (2) FHA approval of Property Assessed Clean Energy (PACE) financing on homes, in some cases.

FHA will expand its EE Homes (EEH) mortgage product to recognise the home's Score. Homes with scores of 6 or higher (on a ten point scale) will qualify for a 2% "stretch ratio" on a new or refinance mortgage. FHA housing debt-to-income ratio ("front end ratio") will be increased from 31% to 33%; the "back end" ratio, or total household debt to income, will increase from 43% to 45%.

FHA noted, in announcing the program, that a home's Score will be calculated by a home energy "Assessor", who inputs information about the home's characteristics into energy modelling software developed by the US Department of Energy and the Lawrence Berkeley National Laboratory. The Home Energy Scoring Tool software is designed to compare homes' performance, regardless of where they are located, or the number of occupants. FHA notes that the Score model is used primarily for existing homes. In contrast, the Home Energy Rating System (HERS) score is primarily used for new homes.

FHA's PACE program addresses a market acceptance challenge. PACE programs have been enacted in 30 states, and Washington, D.C. Under the PACE program, property owners receive financing for EE retrofits, which is repaid by property tax assessments on the homes. These assessments have a senior lien position the home's mortgage loan. FHA will make mortgage financing available on homes with subordinated PACE loans, under certain circumstances. FHA has issued guidance on the conditions it will approve financing for homes with PACE loans.

Energy Efficiency Retrofit Loan Performance in the United States

The most recent and largest demonstration of home energy retrofit performance, with regards to both energy savings and EE retrofit loan repayment performance, is associated with the Better Buildings Neighborhood Program (BBNP) conducted with Stimulus Act funding by the US Department of Energy (DOE). DOE awarded USD 500 million dollars to 41 grantees throughout the US to conduct a wide range of EE retrofit programs for residential and commercial buildings. Of 99,000 implemented projects, 74,184 were residential EE retrofits, comprising 75% of total BBNP project retrofits. Total energy source savings within the residential EE retrofit programs were 3.0 MMBtus. BBNP program participants estimated energy savings of 22% with average actual savings of 15% for a 71% realisation rate. That is, 71% of projected energy savings were realised when building performance was measured post retrofit.

Of the 41 BBNP grantees, 36 used their DOE grant funds to support financing of EE retrofits. 18% of residential retrofit projects received loans. The US State and Local Energy Efficiency Network reports that 10-20% of residential EE retrofits nationally participated in financing, rendering the BBNP 18% financing rate within expected production. Several independent evaluations of the program found that financing was not important for most residential participants, but some participants reported that financing was very important for them. Of those that did take out loans, 73% gave high ratings to the role of the loan in their EE upgrade decision. Aggregate default rates on BBNP EE retrofit loans were less than 1%. Despite the very low default rate, EE retrofit loan production was low and did not reach levels necessary to attract broad interest among financial institutions. Multifamily rental EE retrofit loan programs have found similarly low default rates, with very high loan repayment performance.

As part of its research correlating EE performance and financial performance of residential real estate, DOE conducted a literature review of the impact of EE on the financial performance of commercial buildings. More than 50 studies were reviewed. (See Energy Efficiency and Financial Performance: A Review of Studies in the Market, March 2014, US DOE, Waypoint, for the complete bibliography.) The study originally sought to review all research on EE and financial performance, but the final product focused on "green labelled" buildings, using either a LEED [Leadership in Energy and Environmental Design] designation or Energy Star certification of DOE. The studies found positive correlations with EE designation and rental rates, occupancy rates, utility expenses, sales prices and construction costs. Preliminary correlations were found with tenant quality, occupant health, comfort and productivity, and capitalisation (cap) rates. Mixed results were found correlating to total operating costs.

Canada

National Policy Context

In the summer of 2016, the Government of Canada launched a national campaign to solicit input for the future of housing in Canada. One of the core principles of this campaign is a focus on promoting environmentally sustainable and resilient homes that contribute to Canada's climate change goals. In 2015, the federal government committed to reducing greenhouse gas emissions (GHG) by 30% below 2005 levels by 2030. This signals the federal government's recognition that housing has a large impact on the environment and that there is growing interest for housing options that contribute to a cleaner environment and housing affordability. The residential sector is responsible for 15% of GHG emissions in Canada[6].

Over 70% of Canada's housing stock was built in 1990 or earlier[7]. According to the 2015 Canadian Home Builders' Association Home Buyer Preference Study, 64% of homebuyers rated an overall EE home as a 'must have' item, and an additional 25% considered it a 'really want' item. Given the government and housing industry emphasis on EE combined with an aging Canadian housing stock, as Canadians look to renovate their homes, many mortgage lenders may seek to capitalise on this demand. This will in turn influence the mortgage market offerings for financing home renovations.

Regulatory Requirements

As construction in Canada is regulated by the provinces and territories, there is no coordinated, national approach to EE standards in housing that currently exists. National building codes are model codes and have no legal status unless they are adopted by a province, territory or municipal government. Because of this, Canadian jurisdictions have taken a variety of approaches to regulating greater energy and water-use efficiency in buildings, by either using their individual building codes, or applying legislation specifically addressing EE, or both. Noteworthy jurisdictions include the provinces of British Columbia and Ontario. British Columbia has a broad and comprehensive Climate Change program which includes energy code amendments. In May 2016, Ontario announced climate change legislation aimed at stimulating a shift to a low-carbon economy.

Trend: Rise of Voluntary Labelling Standards for Housing

A particularly noteworthy trend in Canada is the rise in the development and deployment of a range of rating and labelling systems that characterise and communicate the environmental features and performance of housing and communities. These independent, third-party rating and labelling programs help consumers to make more informed choices about the environmental performance of the new homes they purchase, or the renovation of their existing homes. The programs range from single attribute (e.g. EE) type programs to multi-attribute programs that consider a wider range of performance indicators including indoor air quality, environmental impact, resource use and waste management.

The EnerGuide rating system (ERS) developed by Natural Resources Canada (NRCan) is widely used to evaluate and label the EE performance levels of new and existing homes. In 2016, NRCan released a new version of its EnerGuide Rating System (ERS) which evaluates a home based on the number of gigajoules it is expected to consume annually using standard operating conditions. This new scale is being gradually rolled out across the country replacing the existing system which scores EE of a house between 0 and 100; the more efficient the house, the higher the rating. As of July 2016, 1.037 million homes have been evaluated and received an ERS rating. Over 75% of those homes are located in Ontario (51%), Quebec (13%) and British Columbia (12%). The rating achieved by a home varies widely based on when the home was built and the degree to which it has received EE renovations. For example, homes built during the 1960s received on average a rating of 60, whereas those built in the 2010s received on average a 76.

The most prevalent labelling system in Canada is ENERGY STAR® (over 60,000 homes in Canada are labelled ENERGY STAR®). An ENERGY STAR® qualified new home is on average 20% more energy efficient than a home built to code. Various government and mortgage industry incentive programs are linked to the ENERGY STAR® standard.

Mortgage Industry Practice

In Canada, legislation requires federally-regulated and most provincially-regulated mortgage lenders to purchase mortgage loan insurance (MLI) when a borrower has

[6] Natural Resources Canada. *Energy Efficiency Trends in Canada, 1990 to 2009.*

[7] Canada Mortgage and Housing Corporation. *Dwelling Condition by Tenure and Period of Construction, Canada, 2011*

less than a 20% down payment. MLI is provided either by Canada Mortgage and Housing Corporation (CMHC) or a private insurer. Lenders are required to pay a premium which varies based on a number of factors related to the loan application including, but not limited to, the proposed use of the property (e.g. owner-occupied or rental), loan-to-value ratio and type of loan (e.g. purchase or refinance). Current industry practice is that this premium payment is passed on to the borrower.

At present, all mortgage insurers in Canada offer a program that offers partial MLI premium refunds to eligible borrowers if their home reaches a certain level of EE. In June 2016, CMHC enhanced its Green Home Program to offer a MLI premium refund of either 15% or 25% to borrowers who either buy, build or renovate for EE using CMHC-insured financing. Prior to this enhancement CMHC offered a 10% refund. CMHC's new premium refund structure recognises different levels of EE and provides a greater percentage of premium refund for homes achieving a higher level of EE. Therefore, the more energy efficient the home, the greater the potential premium refund for the homeowner.

Within the Green Home Program, standard underwriting procedure is followed and the pricing of the MLI is the same. The premium refund is given to eligible homeowners after the full premium amount has been paid and the mortgage loan has been advanced. In order to be eligible for a premium refund, a homeowner must prove that their home has achieved a certain level of EE. While CMHC requires a one-time assessment of the home's EE, the documentation provided by the homeowner must not be older than 5 years in order to ensure that the Program continues to encourage above standard levels of EE. For home purchases, this can be accomplished in one of two ways: the home can be built under a certain pre-qualified labelling standard (e.g. ENERGY STAR®, R-2000, etc.) or the home can be assessed using the NRCan ERS and achieving a prescribed minimum rating. For home renovations, the required improvements in EE depend on the initial ERS rating of the property in order to recognise that the more energy efficient a home is to begin with the more difficult it is to achieve EE gains.

Mortgage Lenders Practice

Around five years ago, some of Canada's big lenders offered green mortgages – e.g. rate discounts of posted interest rate or rebates off of the mortgage principal for ENERGY STAR® qualified purchases - but most of these products are no longer available. Today, some lending institutions offer cash backs to borrowers for the purchase of a home meeting a certain level of EE; however, these incentives are relatively limited both in number and in benefit to the borrower. For example, one credit union offers up to CAD 2,000 cash back for the purchase of a new home labelled as ENERGY STAR® or LEED® Canada. Standard underwriting applies including that the loan would have to meet legislative requirements (e.g. maximum 95% LTV).

Government and Private-sector Incentives

Various levels of government and utility providers offer green incentives to homeowners. These offerings fall primarily into three categories: rebates/financial incentives (e.g. cash back for EE renovations or cash back for the purchase of an ENERGY STAR® home); low-cost loans to make EE improvements to existing homes offered through either municipal governments or utility providers; and appliance replacement programs (rebates for the replacement of an older appliance with a new EE appliance). Similar to the mortgage insurer programs, the primary method of verifying energy performance for these programs is through either an NRCan rating or being enrolled in a labelling program.

Next Steps, Future Policy Direction and Mortgage Industry Trends

There is a variety of fragmented EE incentives, programs and policies underway in Canada from many different players. Any of these incentive programs will likely not, on their own, cause a large shift in the green mortgage market. However, as various levels of government continue to shift attention to policies and programs directed at reducing harmful impacts on the environment, it could potentially influence more mortgage lenders to enter or re-enter the "green" mortgage field or offer other financial incentives geared towards EE in homes.

Key Findings and Next Steps for the EU

COP 21 provides strong international agreement on the importance of EE toward the goal of reducing greenhouse gas emissions and global climate change. Building codes focused on EE standards for new construction alone will prove inadequate; all industry stakeholders and their government partners will need to develop verifiable, large-scale home EE programs.

The World Economic Forum found this year that failure to mitigate and adapt to climate change holds the greatest risk for the world's economy. The retrofit of existing housing is critically important to this goal. Lack of standardised and comparable climate-risk information hobbles financial markets and their stakeholders: banks, investors, regulators, consumers. The Forum calls upon the power of market forces to provide clear, uniform disclosures of climate-related economic risks.

Long-standing efforts dating back nearly 40 years throughout the EU, US and Japan have built up a rich industry and government track record of best practices, from which home EE retrofit policies may be developed. These efforts have largely been focused on northern countries and regions among developed economies. Despite this long-standing practice, residential EE programs are marked by many, diverse and somewhat disjointed efforts. This is a fragmented market in practice without clear, common standards. Home EE retrofit policy and practice are more strongly correlated in Japan, with GHLC and JHF operating as lead policy making and implementing agencies nationwide.

Perhaps as a result of these fragmented markets and public private practices, the home energy retrofit efforts of capital markets, issuers and lenders are immature, marked by skepticism in the financial world – including lenders, issuers, investors and regulators – about the predictive value of EE labels and associated loans. However, extensive and consistent research on Green Value demonstrates a strong correlation for positive effects on collateral (house value) associated with better EE performance and higher EE ratings. While research on EE mortgage portfolio performance is young, initial findings are promising. This is especially true of the UNC Chapel Hill study in the United States, which found material improvement in performance in default, loss and prepayment speed for homebuyers purchasing EE homes, compared to comparable homes that are less efficient. This research on mortgage portfolio performance needs to grow so that an empirical track record can be amassed for underwriting, credit, valuation and regulatory purposes. The EMF-ECBC green mortgage initiative importantly anticipates the growing significance of a "brown discount" on collateral with low EE performance ratings. This points to risk in portfolios that lenders, issuers, investors and regulators, not to mention homeowners, are wise to anticipate and avoid with a clear green mortgage program, as the EMF-ECBC proposes.

Moreover, Japan has found a promising indication of health benefits for residents of EE homes, offering another policy imperative for advancing residential EE.

The EMF-ECBC green mortgage initiative focus on measuring consumption, through data sharing and partnerships with major utilities, represents a critical advance. This will provide verifiable, quantified measures by which to reward EE performance with improved loan pricing, underwriting, credit policy and regulatory treatment – and market valuation. These data will prove critical in quantifying the effects of EE on mortgage portfolio performance, both at the originator (mortgage lender) and investor (mortgage security, covered bond and other instruments) level. The initiative promises to develop an industry standard whereby lenders, issuers, regulators, utilities and consumers alike can ready guage the effects of energy efficiency on their collateral and homes, and price their mortgage products, and portfolio values, accordingly.

Longstanding international practice across three continents also underscores the importance of integrating fiscal policy support with mortgage finance practice and regulation. This should also be coordinated with utility regulation and EE utility portfolio performance standards. Linking the entire supply chain of energy generation, energy regulation, mortgage policy and regulation, home energy performance measures, and the home retrofit industry will prove critical to achieving the scale necessary if we are to succeed in the goals articulated in the COP21 Agreement.

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