EeMAP – Project Deliverable

D3.1 Initial Recommendations for Energy Performance Indicators and a Building Energy Passport

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EeMAP – Energy efficient Mortgages Action Plan - is an initiative by the European Mortgage Federation - European Covered Bond Council (EMF-ECBC); Europe Regional Network of the World Green Building Council; Royal Institution of Chartered Surveyors; Ca' Foscari University of Venice, E.ON and SAFE Goethe University Frankfurt. www.energyefficientmortgages.eu

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Initial Recommendations for Energy Performance Indicators and a Building Energy Passport

Contents

1. Introduction

This internal report fulfils the requirement under the grant agreement to deliver a '*Technical report on initial recommendations for energy performance indicators and a Building Energy Passport' (**D3.1**)* to underpin a European energy efficiency mortgage.

Section 2 provides some background and context relating to developments in the EeMAP project which have impacted on how these proposals have been developed. The proposals themselves are then set out in Section 3. Section 4 gives further explanation of the development process which underpins the proposals. The report annexes contain supporting material which had been used during the development of the proposals.

2. Background

The format and approach of this report reflects two major challenges for EeMAP, which the project has successfully overcome.

The first of these challenges was to compile detailed knowledge of the building performance assessment landscape relevant to energy efficiency mortgages at the Member State level, given EeMAP does not have technical national project partners like many Horizon 2020 building sector projects.

The Europe Regional Network have overcome this by negotiating an additional USD 90,000 grant with the World Green Building Council to enable the commissioning of x10 national building assessment briefings from key European markets involved in EeMAP. These national briefings have helped ensure the proposals in D3.1 are grounded in the existing building assessment infrastructure at national level. They also provide banks looking to develop energy efficiency mortgage pilots (see below) with a high-level technical understanding of the characteristics of each market. The briefings are available as an 'additional' set of deliverables on the EeMAP website. A further technical report on the roll-out of smart meters, and how these can support an energy efficiency mortgage product was produced by E.ON to provide the necessary background for integrating this technology into the proposed guidelines for the pilot phase. The briefings can be viewed in Annex III of this report, whilst the E.ON smart meter report can be found in Annex IV.

The second key challenge that the project team identified very early on was how to engage the regions' largest lending institutions[1]. Without their engagement and support, it would be impossible to get the necessary input and feedback to ensure the technical proposals developed under the project are fit for purpose.

In order to present banks with something 'concrete' to increase their engagement, the EeMAP Consortium has proposed to initiate a new 'pilot phase', to begin in the second year of the project (June 2018) with initial outcomes to be reported at the end of the project. This announcement, made at the Consortium meeting in

[1] EMF-ECBC, 2017, Energy Efficiency (EE) Financing: Emerging Analysis, available from: http://energyefficientmortgages.eu/wp-content/uploads/2017/07/Emerging-Analysis-1.pdf

September 2017 in Venice, has been very successful in gaining the attention of leading financial sector stakeholders.

To capitalise on this engagement, and lay the ground for this pilot phase, the EeMAP Consortium published a public consultation on a full set of draft guidelines for energy efficient mortgages[2] (EEMs) on 12 February 2018. This represents a significant acceleration of the original timelines set out in the project Grant Agreement, which foresaw proposals for energy performance indicators being made public in August 2018, with the first full framework of proposals for EEMs only released at the end of the first quarter of 2019. The Europe Regional Network has taken a lead role alongside EMF-ECBC in preparing the integrated set of proposals, public consultation document and questions. ERN has also designed national stakeholder workshops to further test and refine them and this is reporting in D3.2.

This accelerated rate of delivery is essential to maximise the engagement of banks and provide the opportunity for 'learning by doing' through an operational pilot.

Figure 1 shows how the draft framework of guidelines published in the consultation document is structured in three sections. The second part of the draft guidelines sets out the proposed building performance assessment criteria. This section is the core of D3.1, the '*Technical report on initial recommendations for energy performance indicators and a Building Energy Passport'.*

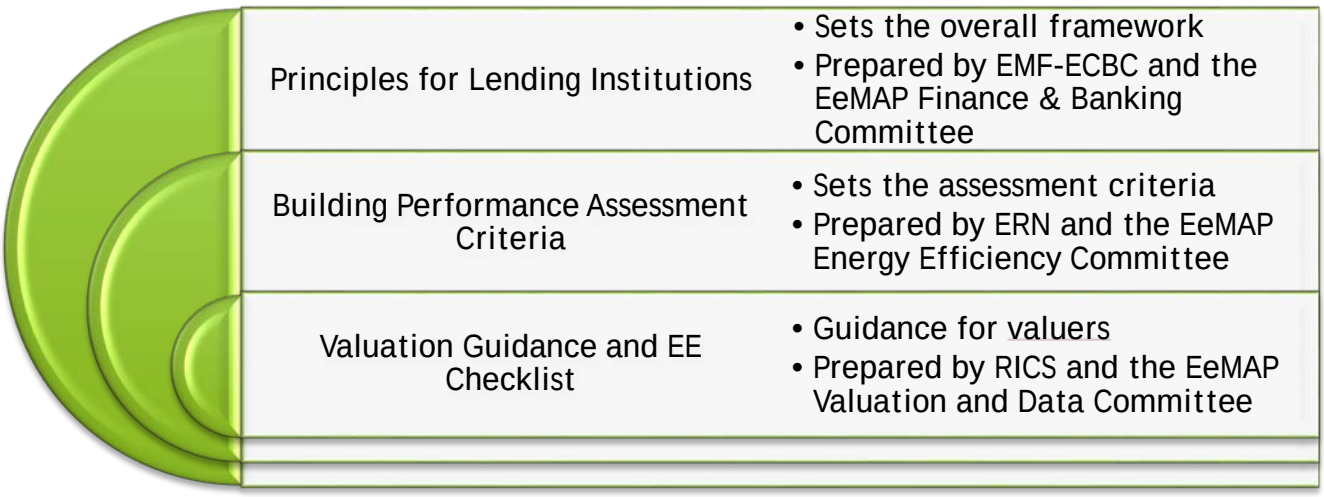


Figure 1: The structure of the proposed framework of guidelines for energy efficient mortgages

[2] EeMAP, 2018, Energy Efficiency Mortgage Pilot Scheme Implementation Guidelines: Draft for Consultation, available from: http://energyefficientmortgages.eu/wp-content/uploads/2018/02/EeMAP-Energy-Efficiency-Mortgage-Pilot-Scheme-Implementation-Guidelines-Draft-for-Consultation.pdf

3. EeMAP Building Performance Assessment Criteria

This section of the document sets out the proposed building performance assessment criteria which have been included in the draft framework of guidelines as part of the EeMAP market consultation. These are the criteria which, it is proposed, would determine eligibility for an EEM during the pilot phase of the EeMAP project.

The criteria set minimum requirements for piloting EEMs and should not preclude the application of more rigorous standards in those markets where lenders and other market actors deem this to be appropriate.

They are intended to be simple and flexible, so lending institutions testing the EEM framework may apply them in a way that is appropriate for a given market. The EeMAP consortium are establishing national partner networks who can advise on appropriate local interpretations of the criteria.

The criteria are listed in section 3.1 and Section 3.2 then provides definitions of some of the key terms used. Section 5 explains the future ambition for the EeMAP building performance assessment criteria, outlining aspects of energy and environmental performance assessment of buildings which will need to be reviewed and considered for incorporation into the EEM framework as the market matures. The EeMAP consortium will establish a governance structure to review and update the guidelines over time and as appropriate to respond to the market.

3.1. Pilot Scheme Energy Efficient Mortgage Criteria

The following three criteria shall be used by lending institutions during the EeMAP pilot scheme to determine eligibility for an EEM.

Text highlighted with ***bold, italic typeface*** indicates that a technical definition is provided in the Section 3.2 General Definitions, which follows.

Criterion 1 - Energy Performance:

A building will qualify for an EEM if its ***energy performance*** is either:

a. compliant with the relevant national definition of nearly zero energy buildings (NZEBs);

or

b. 20% better than required by current applicable national building regulations (for example, where NZEB definitions have not been finalized); or

or

c. improved by a minimum of 30% in the case of renovations. The lending institution may offer a scale of improved loan conditions for greater improvements, for example if a 40, 50 or 60% improvement is achieved.

Criterion 2: Ongoing performance monitoring:

The borrower, or the borrower's nominated third party, shall report the following to the lending institution or their nominated third party:

a. The building's ***measured energy consumption***, according to each energy carrier (e.g. electricity or fuel), at least once per year.

b. A revised Energy Performance Certificate after renovation, where applicable.

As indicated earlier, all lending institutions participating in the EeMAP pilot should also report this data, together with the average annual greenhouse gas emissions intensity of each energy carrier, to the EeMAP Coordinator in an anonymized format, complying with all relevant data protection laws. This data will be used by lending institutions and by the EeMAP Coordinator for the purpose of ongoing analysis of the risk profiles of these loans and to demonstrate their impact on energy efficiency and climate goals.

Criterion 3: Quality Assurance

All works that impact on the energy performance of the building shall be:

1. Planned by a competent person with an appropriate, ***nationally recognised*** qualification or accreditation; and
2. planned and implemented in such a way as to ensure that the cost or technical feasibility of future energy efficiency improvements needed to bring the building's performance up to the equivalent of the top national EPC band rating at the time are not adversely affected; and
3. undertaken by a competent contractor with the appropriate, ***nationally recognised*** qualifications or accreditations, and approved by the lender; and
4. evidence of all works undertaken, including product performance levels and manufacturer warranties, shall be collected and submitted to the lender or the lender's nominated third party.

3.2. General Definitions

This section sets out requirements for key elements in the building performance assessment criteria above. Throughout the criteria, bold, italic text indicates a reference to these general definitions.

Energy performance

For the EeMAP pilot scheme, the ***energy performance*** assessment shall be based on a calculation[3] of the delivered energy (kWh/m^2 per annum) for heating, domestic hot water, cooling and ventilation. For commercial buildings, lighting shall also be included and may be included for residential, wherever this is part of existing national calculation methodologies. Calculations should be based on either

a. National calculation methodology (such as an asset rating Energy Performance Certificate)
b. Other calculation tools that comply with relevant European standards, such as applicable parts of EN 52000.

Calculations, such as asset rating Energy Performance Certificates, will only be eligible where the inputs have been verified by site inspection and checking of documentary evidence. This shall be conducted by a competent person, accredited by a ***nationally recognised*** body.

[3] Energy calculations for a building are based on standard assumptions about the internal and external climate and as such are a predictor of the inherent performance of the building, independent of its occupants.

If calculations based on either option *a* or *b* above are not available, then ***measured energy consumption*** may be used as an alternative metric to demonstrate compliance with Criterion 1, provided that this is normalised for climatic conditions and based on at least 2 years' worth of data. This data could, for example, be taken from an operational rating Energy Performance Certificate.

Measured energy consumption

The measured energy consumption of a building refers to actual energy consumed, as recorded by a meter installed at the premises. It therefore reflects the actual internal and external climatic conditions and can differ significantly from the calculated energy requirement. In the EeMAP pilot scheme, measured energy shall be monitored using smart meters, wherever feasible. Manual meter readings will be accepted but must be recorded at least monthly. Meter data must be available for each energy carrier used in the property. The data must be made available to the lender, or the lender's nominated third party, to evaluate performance and must in turn be passed on to the EeMAP Coordinator in anonymized form, complying with all relevant data protection laws,

Nationally recognised

National recognition (of a method, approach or accreditation as being appropriate for fulfilling one of the criteria set out in this document) shall be defined by mutual agreement of the national organisations representing EeMAP (EeMAP national governance to be confirmed as part of the pilot phase). These national organisations shall consult and take advice from other relevant stakeholders in the mortgage finance value-chain. In some countries, these definitions may need to be set differently for different regions.

During the EeMAP pilot scheme, these definitions shall be overseen by the EeMAP Consortium.

4. Development of the EeMAP Building Performance Assessment Criteria

The criteria and general definitions set out in Section 3 were developed iteratively by ERN with the support and input of the EeMAP Energy Efficiency Working Group (EEWG) and the Energy Efficiency Committee (EECom) (a list of the members of these two groups can be found in Annex I). The development process consisted of three main stages.

1. Desktop study and expert consultations
2. EEWG and EECom feedback
3. EeMAP Finance and Banking Committee and Valuation and Data Committee feedback

4.1. Desktop Study and Expert Consultations

The main findings of the desktop study which preceded and informed the development of the building performance assessment criteria have been presented in a series of EeMAP reports published in October 2017:

i. White Paper: Creating an Energy Efficient Mortgage for Europe
ii. Review of the State of Play of Green Finance

iii. Review of the State of Play on Building Performance Indicators that Impact Mortgage Credit Risk
iv. Review of the State of Play on Mortgage Lending Valuation and the Impact of Energy Efficiency Value
v. Review of the Impact of Energy Efficiency on the Probability of Default

The most relevant of these for the development of the building performance assessment criteria is iii, the *Review of the State of Play on Building Performance Indicators that Impact Mortgage Credit Risk*. A list of the experts consulted during the desktop research phase can be found in the acknowledgements on page 2 of that report.
In addition to the above reports, which look at current practice across Europe, it was recognised that more specific information on individual markets was needed to help shape the proposals. To this end, the ERN negotiated a $90,000 grant from WorldGBC, to enable national market *Building Assessment Briefings* to be prepared by:

- Croatia GBC
- Finland GBC
- Alliance HQE-GBC (France)
- DGNB (Germany)
- IGBC (Ireland)
- GBC Italia
- Dutch GBC (The Netherlands)
- Polish GBC
- GBC España

UKGBC have separately prepared their briefing under the EeMAP grant. The *Building Assessment Briefings* that have been published to date can be found in the annexes to this report.

Further work was undertaken by E.ON to identify how the ongoing roll-out of smart meter technology across the EU could be used to support the EEM concept. A technical report was produced by E.ON, which outlines how smart meters work, some of the differences between national approaches to smart meters, and the types of data that are available including how these can be accessed. This material can be found in Annex IV of this report.

4.2. Energy Efficiency Working Group and Committee feedback

The first draft of the building performance assessment criteria was created in November 2017 and set out proposals which were intended to illustrate how EEMs could be defined once the market is reasonably well established. This draft, which can be found in Annex II, was circulated to the EeMAP Consortium, the EEWG and individual members of the EECom for feedback during December 2017.

Based on their feedback, it was clear that this approach was too advanced, since it presupposed the existence of some elements of building assessment 'infrastructure' which are still only in very early stages of development. In particular, the proposals required there to be a building energy (or building renovation) passport (BEP) for any property granted an EEM. Currently there are only three early pilots of BEPs in Europe[4] and so making these a prerequisite for EEMs would not be compatible with the ambitions to establish a pilot scheme during 2018. What

[4] In Germany, France and Belgium (Flanders), see here for more information: http://ibroad-project.eu/about/at-a-glance/

is needed are simple and flexible criteria that mortgage lenders could implement now, using currently available 'infrastructure'.

In January 2018, the ERN convened meetings of the EEWG and EECom where these issues were addressed. Based on these discussions, a revised and simplified set of criteria was defined which would meet this need. These simplified criteria (set out in Section 3 above) indicate how EEMs can be set up during the EeMAP pilot phase, building on existing national building performance assessment methods.

5. Future Ambition

It is important to recognise that these simplified criteria are not intended to be maintained over the long term. There are a number of areas which will necessarily need to be strengthened in the future and these are outlined below. The EeMAP consortium envisage the development of a governance structure for EEMs, consisting of one or more advisory groups. Their job will be to review the framework of guidelines and update them at appropriate regular intervals, ensuring that the EEM framework continues to be improved and reflects the state of the market. This governance structure could be modelled on the successful example of the governance of the Covered Bond Label[5] which was created by EMF-ECBC, the EeMAP project co-ordinator. The ultimate goal is that the framework becomes robust enough to ensure EEMs support the levels of improvement of Europe's building stocks and the increase of renovation rates, which are needed in order to develop a sustainable, competitive, secure and decarbonised energy system and meet the EU's climate and energy targets.

5.1. Energy Metrics

The key eligibility criteria for ensuring a building meets the necessary level of energy performance will need to be regularly reviewed. In particular, the use of calculated or measured energy data or a combination of these should be reviewed, as should the thresholds set for new builds and for renovations. Furthermore, in future, techniques to evaluate the real energy performance of a building using site measurements may become available. These techniques can be used to measure the intrinsic performance of the building envelope and the energy systems in the building, separate from the energy use pattern of any specific occupant(s). As these approaches mature, they could offer lenders a more accurate assessment of the actual thermal performance delivered by a renovation or of a new building. The suitability of these techniques will remain under review.

In reviewing the energy metrics and criteria, it will be necessary to observe and respond to the ongoing developments of national minimum energy performance requirements, NZEB definitions and other regulatory and voluntary standards in the market. In particular, the potential for regulatory developments to introduce the risk of obsolescence, such as the introduction of minimum energy efficiency standards at sale or rental, will need to be closely monitored.

[5] https://coveredbondlabel.com/governance

5.2. Ongoing Performance Monitoring and Performance Guarantees

A key element in the ongoing design of the EEM will be to develop suitable mechanisms to ensure that the predicted performance or performance improvement is realised in practice. At this early stage of development of the concept, requiring a full performance guarantee is considered to be too onerous for the pilot stage. The mechanisms for ensuring performance levels are met and maintained will be regularly reviewed. One important consideration will be whether, for the purposes of monitoring lending risk, the performance is monitored at the level of individual properties or across portfolios.

5.3. Building Energy/Renovation Passports

Building energy or renovation 'passports' can improve the availability of data for valuers and lenders and ensure that any renovation works are planned and implemented in a technically sound manner. Research undertaken by the EeMAP Consortium[6] indicates that borrowers see the value of having a building energy passport linked to the EEM. However, there are currently only three pilots of such passports in existence in Europe. Therefore, their incorporation into the EEM criteria cannot be a prerequisite for the pilot and will be subject to ongoing review. In particular the EeMAP project will be working with the iBRoad project to assess likely future requirements for building energy passports and how these instruments can be made most useful for lenders, valuers and other actors in the EEM value chain.

For the reasons set out above, the passport element is not being developed for the pilot phase, but key considerations for passports considered by EeMAP so far include:

- Consumer insight research shows that the passport is seen as a logical element of the EEM, and that it could improve the appeal of EEM products when offered simultaneously as a package.
- However, amongst some consumers, the prospect of being reminded about their energy use, or of the need to renovate their home on a regular basis is not welcome. Initial findings suggest that some elements of the passport may therefore be most useful as an industry and financial sector facing tool, rather than being aimed at the consumer.
- Evidence from the iBRoad project suggests that a key weakness of existing EPCs from the consumer's perspective is the perceived high cost for only limited benefits. This is something any planned passport scheme must seek to overcome.
- Early indications from EeMAP national stakeholder workshops suggest that as a tool for the financial sector, the passport could be very valuable for risk management teams in lending institutions. Passports could have a role as a key source of evidence for compliance with the EeMAP framework. For this purpose they would need to incorporate enough documentary evidence of which criteria have been achieved to allow risk departments to conduct due-diligence checks so that they can justify the 'tagging' of green loans. If the technical documentation is extensive, complex or difficult to access, this could be a major barrier. Given such documentary evidence is likely to vary from country to country, mapping this variation

[6] E.ON, 2018, Creating an Energy Efficient Mortgage for Europe: Consumer Research Insights, available from : http://energyefficientmortgages.eu/wp-content/uploads/2018/02/EeMAP_D2.7_E.ON_Final.pdf

and gathering further feedback from risk managers as to what level of detail is needed will be key in further developing recommendations for building energy/renovation passports.

5.4. Wider Sustainability

The evidence gathered by the EeMAP initiative shows that there is a strong case to be made for expanding the criteria for EEMs to incorporate wider sustainability performance aspects. These aspects are often much stronger drivers of property value and their incorporation could have a greater risk mitigation effect for lenders than energy performance alone. These aspects can be assessed using voluntary sustainability certification schemes, which are already increasingly common in the commercial property sector and are in early development in the residential sector in several European countries. The European Commission's new 'Level(s)' framework for sustainable building performance reporting is intended to further standardise the metrics and approaches used to evaluate these wider sustainability aspects. The suitability of Level(s) and other voluntary schemes to form the basis of criteria and assessment for a more comprehensive 'green mortgage' framework will be the subject of ongoing review within EeMAP's governance.

For markets where voluntary sustainability certifications for new commercial buildings have become standard practice, the pilot phase criteria set out above are not intended to preclude lenders applying a more rigorous standard. Additional criteria, based on an accepted voluntary sustainability certification scheme, may also be used provided the three basic criteria above are also complied with.

6. Next steps

As has been described above, the proposed building performance assessment criteria set out in Section 3 of this report are part of the EeMAP market consultation, which closes on 12 March 2018. The consultation will gather high-level, cross-sectoral feedback from stakeholders around Europe. The criteria are also being tested in more detail at national level in a series of workshops hosted by the ten Green Building Councils across the Europe Regional Network that form the EEWG (listed in Annex I).

The feedback received from the consultation and national workshops will be used to update the proposed framework, including the building performance assessment criteria, in advance of the pilot phase of the project. The final version of the framework of guidelines to be used during the pilot will be made public at the launch event on 14 June 2018 in Windsor, UK[7].

Additionally, in August 2018, Deliverable 3.4 will set out a full technical explanation of the final proposed framework, as well as future issues to be dealt with under the EEM governance structure being developed by EeMAP. That report will also go into further details regarding considerations relevant to the future development of Building Energy/Renovation Passports.

[7] http://energyefficientmortgages.eu/save-date-eemap-eedapp-stakeholder-event-windsor-14-june-2018/

Annex I: EeMAP Energy Efficiency Working Group and Committee

The Energy Efficiency Working Group (EEWG) consists of representatives from ten Green Building Councils within the Europe Regional Network of the World Green Building Council. These ten national Green Building Councils have formally committed to support the project and nine[8] of them have received a share of a $90,000 WorldGBC grant (entirely separate from and additional to the Horizon 2020 funding) towards their time and costs.

The members of the EEWG are as follows:

Alliance HQE-GBC (France)	Anne-Sophie Perressin, CEO
Croatia Green Building Council	Dean Smolar, CEO
Dutch Green Building Council	Martin Mooij, Head of Certification
Green Building Council Finland	Mikko Nousianen, CEO
German Sustainable Building Council (DGNB)	Samuel Koch, Product Manager – Existing Buildings
Green Building Council España	Emilio Miguel-Mitre, Director of International Affairs
Green Building Council Italia	Valentina Marino, International Activities and Relationships Manager
Irish Green Building Council	Marion Jammet, Business Development Manager
Polish Green Building Council	Alicja Kuczera, CEO
UK Green Building Council	Richard Twinn, Senior Policy Advisor

It should be noted that several of these national Green Building Councils have set up industry expert working groups at national level to feed into the EeMAP design process.

The Energy Efficiency Committee was set up to provide additional advice and guidance to the energy efficiency workstream and consists of experts from a range of companies and organisations that are active across Europe in supporting energy efficiency in the building sector. The group currently comprises the following individuals:

Andrew Sutton	BRE
Anna Creed	Climate Bonds Initiative
Barry Lynham	Knauf Insulation
Celine Carre	Saint-Gobain
Judit KImpian	Architects Council of Europe
Luis Castanheira	Investor Confidence Project Europe
Marco Marijewycz	E.ON
Mariangiola Fabbri	Building Performance Institute Europe
Quentin de Hults	BASF

[8] UKGBC has not received WorldGBC grant funding because they are a recipient of Horizon 2020 funding under the EeMAP Grant Agreement.

Annex II: Previous Draft Building Performance Assessment Criteria

This annex contains an earlier iteration of the Building Performance Assessment Criteria. As explained in Section 4.2 of the report, this previous version was conceived as a framework which could be appropriate once an energy efficient mortgage market has started to mature in a number of EU countries. It was deemed to be too complex for implementation during a pilot but is included here to give further insight into some of the work that has been done to develop the criteria set out in Section 3 of the report above. It also serves to indicate what a future set of criteria might look like as the proposed EeMAP governance structure begins to update and strengthen the pilot phase criteria.

Building Performance Assessment Criteria

The building assessment principles comprise three different routes for compliance, which are intended for use in different scenarios. These three routes; A, B and C, each have different but related criteria. The three sets of assessment principles are:

Route A: Mortgages for Green Buildings

This represents the highest standards of the three options and is the only option that incorporates sustainability performance assessment beyond energy. As such, mortgages aligned with the principles under this option are referred to as green mortgages in this document. It is suitable for new and existing buildings and may be applicable to commercial and residential properties. This will be dependent on the availability of appropriate and compliant voluntary certification schemes.

Route B: Mortgages for Energy Efficient Buildings

The second option only requires energy performance to be assessed and therefore represents a less stringent set of principles than Option A. Mortgages aligned with these principles are referred to as energy efficiency mortgages in this document. This option sets out principles aimed at buildings that are already highly energy efficient – i.e. either newly built or recently extensively renovated.

Route C: Mortgages for Energy Efficient Building Renovations

The final option also only requires energy performance to be evaluated. It sets out principles for energy efficiency mortgages which can be applied to existing buildings which require renovation to improve their energy performance. The principles are less stringent than for Options A and B.

In the following, text highlighted with ***bold, italic typeface*** indicates that a definition is provided in the subsequent section on General Definitions on page 6.

Route A: Mortgages for Green Buildings

A.1. A building will qualify for a 'Green Mortgage' if it has received a voluntary sustainability certification, provided that building performance in terms of

a. sustainability certification score,
b. ***calculated energy requirement*** and
c. ***operational greenhouse gas emissions***

are all within the top 15% of the national market for the relevant building type.

A.2. To be eligible, the building's certificate must be:
a. less than five years old,
b. third party verified,

and the certification scheme must:

c. have minimum mandatory performance criteria set for the ***calculated energy requirement*** of the building and
d. address at least the following three areas covered in the EU Level(s) framework
   i. greenhouse gas emissions,
   ii. resource efficiency,
   iii. water efficiency.

Additionally:

A.3. The lender or the lender's nominated third party shall carry out ***ongoing performance monitoring*** of the property for a period of at least 2 years.

A.4. A ***building energy passport*** shall be produced for the building. Where such a scheme is not yet available in a particular country, the lender will work with ***nationally recognised*** technical experts to determine how this principle can be met in the interim until a scheme is available.

Route B: Mortgages for Energy Efficient Buildings

II. A building will qualify for an 'Energy Efficiency Mortgage' if its ***calculated energy requirement*** is already either:
a. Compliant with the national definition of nearly zero energy buildings (NZEBs) [this will only apply to mortgages granted before 31st December 2020 – after this cut-off date, only B.1.b and B.1.c will apply]
b. Within the top *15%* of the national market for comparable building types
c. At least 30% below national building regulations

Additionally:

III. The lender or the lender's nominated third party shall carry out ***ongoing performance monitoring*** of the property for a period of at least 2 years.

IV. A ***building energy passport*** shall be produced for the building. Where such a scheme is not yet available, the lender will work with ***nationally recognised*** technical experts to determine how this principle can be met in the interim until a scheme is available.

Route C: Mortgages for Energy Efficient Building Renovations

C.1. An existing building will qualify for an 'Energy Efficiency Mortgage' if renovation works are undertaken which will reduce the ***calculated energy requirement*** by at least 30%.
The mortgage lender may offer a sliding scale of improved loan conditions if a reduction of 40% or more is achieved.

C.2. Renovation works shall be:

a. Planned by a competent person accredited by a ***nationally recognised*** body.
b. Planned and implemented in accordance with the renovation roadmap in the ***building energy passport***.
c. Undertaken by a competent contractor with the necessary qualifications or accreditations and approved by the mortgage lender.

Additionally:

C.3. The lender or the lender's nominated third party shall carry out ***ongoing performance monitoring*** of the property for a period of at least 2 years.

C.4. A ***building energy passport*** shall be produced for the building. Where such a scheme is not yet available, the lender will work with ***nationally recognised*** technical experts to determine how this principle can be met in the interim until a scheme is available.

General Definitions

This section sets out requirements for a number of key elements in the building performance assessment principles which apply to all three options listed above. Throughout the principles, italic text indicates a reference to these general definitions.

Calculated Energy Requirement

2. Calculations of the energy requirement for a building shall be based on delivered energy (kWh/m2 per annum) for heating, hot water, cooling, ventilation, and lighting (for all commercial buildings and for domestic, wherever this is included in national calculation methodologies) and shall be calculated using steady state calculations based on either:
    a. National Calculation Methodology (such as an asset rating EPC)
    b. Other calculation tools that comply with relevant European standards

    Alternatively, for commercial buildings, dynamic simulation may be used, provided this is in accordance with national or European standards.
3. Data used in the energy calculation shall be verified by site inspection and checking of documentary evidence. This shall be conducted by a competent person, accredited by a ***nationally recognised*** body.

Measured Energy Use

4. The measured energy use of a building refers to actual energy consumed, as recorded by a meter installed at the premises. Measured energy shall be monitored using smart meters, except where it can be demonstrated that the cost to install the smart meter would be prohibitively high. In such cases manual meter readings will be accepted. Meter data will be made available to the lender or the lender's nominated third party to evaluate performance.

Normalised Energy Use

5. Normalised energy use is based on the measured energy use and adjusted for climate and occupancy patterns. This shall be done according to either
    a. An internationally recognised standard such as ISO 50006
    b. Other ***nationally recognised*** method (e.g. national calculation tool for operational rating EPCs.)

Ongoing Performance Monitoring

6. During the monitoring period, a comparison shall be made of the ***normalised energy use*** and the ***calculated energy requirement***. This comparison shall be based on the same scope of end uses (i.e. the same end uses of energy shall be included in both the ***calculated energy requirement*** and the ***normalised energy use*** data).

5. Option 1
The ***normalised energy use*** must be within ±*X*% of the ***calculated energy requirement*** in order for the property to remain eligible for the preferential mortgage conditions. Where *X* is a value determined from a statistical analysis conducted by a ***nationally recognised*** body.
5. Option 2
The ***normalised energy use*** must be within ±*X*% of the ***calculated energy requirement*** in order for the property to remain eligible. Where *X* is a value determined by the lender, based on either existing published research, specially commissioned and published research, or their own internal assessment of building energy performance data.
5. Option 3
The lender will determine an appropriate margin of divergence for this comparison and will monitor this at a portfolio level. In other words, they shall ensure that *Y*% of their green or energy efficiency mortgages has a ***normalised energy use*** that is within ±*X*% of the ***calculated energy requirement***. *Where X* and *Y* are to be defined internally by the lender.

If new methods for evaluating in-use performance become available in the future, these shall be evaluated and incorporated in the ongoing performance monitoring of the lender's mortgage portfolio.

Energy Costs

7. Wherever possible, energy costs prior to the mortgage origination shall be evaluated using measured energy data from one of the following:
    a. Operational rating EPC
    b. Smart meter data
    c. Energy supply invoices
8. Where *measured energy use* data is not available, the energy costs for the building (including, where applicable, predicted costs and cost savings post renovation) should be estimated using a statistical model or another ***nationally recognised*** methodology.

Building Energy Passport

9. Building energy passports shall be produced by a competent person, accredited by a ***nationally recognised*** **body**. They shall include as a minimum:
    a. The current calculated energy requirement for the building (eg. an asset rating EPC).
    b. A building log book containing details of the building's construction and technical systems which affect energy performance, eg. insulation levels, glazing types, heating (space and water), cooling, ventilation and lighting systems and any renewable energy sources.
    c. A renovation roadmap detailing energy conservation measures to be undertaken and the order in which these should be carried out. The roadmap shall include a timeline which indicates how the energy performance needs to improve over time in order to meet either national or European targets for energy efficiency.
    d. A way of recording and monitoring the building's measured energy use.

Operational Greenhouse Gas Emissions

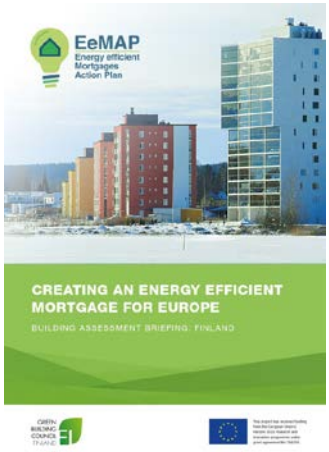
10. ***Calculated energy requirement*** and/or ***measured energy use*** may also be converted into greenhouse gas (GHG) emissions ($CO2e/m^2$ per annum) using nationally published emissions factors for fuels and/or electricity.
11. Wherever greenhouse gas emissions data are published or communicated, it must be clearly indicated whether these are based on ***calculated energy requirement*** or ***measured energy use***.
12. Claims of emissions reductions achieved must be based on ***measured energy use*** and must comply with accepted principles of additionality (see the notes on additionality in the section on greenhouse gas emissions under **Error! Reference source not found.**).

Nationally Recognised

13. National recognition (of a method, approach or accreditation as being appropriate for fulfilling one of the principles set out in this document) shall be defined by mutual agreement of the national associations representing mortgage lenders, the building valuation profession and the national green building council. In some countries, these may be defined differently for different regions.

Annex III: National Building Assessment Briefings

In developing a set of building performance assessment criteria that could be applied in a pan-EU framework, it was necessary to gain insight into the existing building performance assessment 'infrastructure' available at national level. WorldGBC provided a total of $90,000 in grant funding to nine Green Building Councils within the Europe Regional Network (Croatia, Finland, France, Germany, Ireland, Italy, Netherlands, Poland Spain) to produce detailed *Building Assessment Briefings* for their markets, with UKGBC producing a UK briefing. These have been published as standalone reports, in order to provide market intelligence to banks and other interested parties that may wish to explore setting up a pilot using the EeMAP framework of guidelines. They are included here as an annex to this report.



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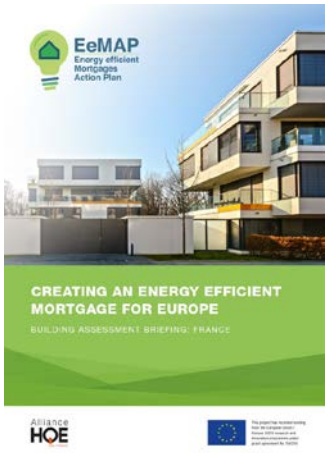

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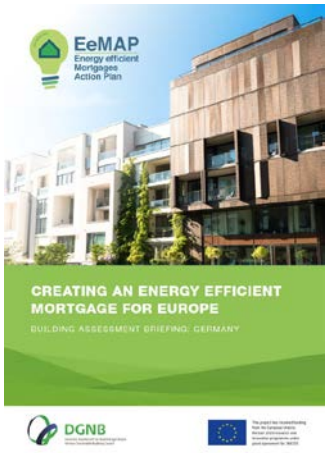
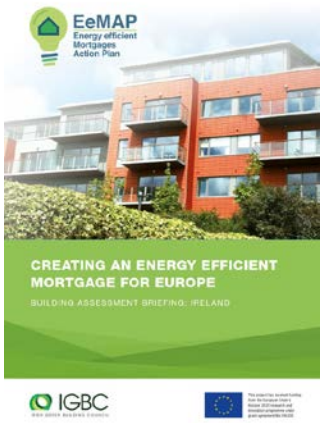


Germany



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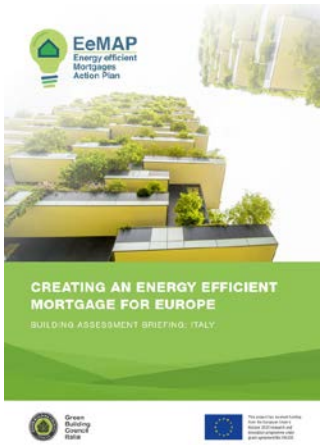

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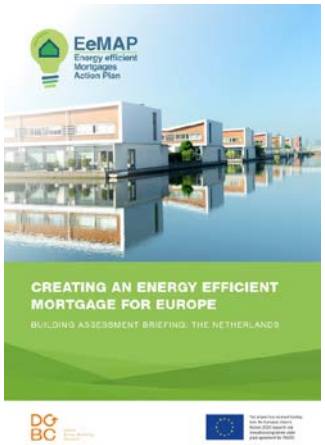

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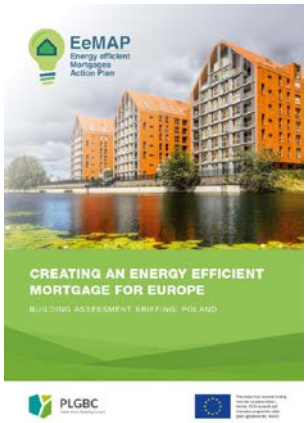

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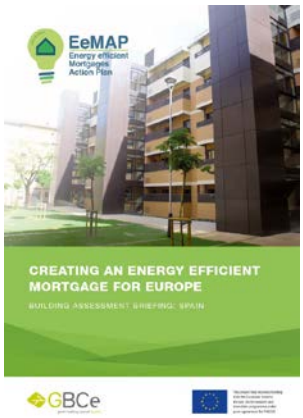

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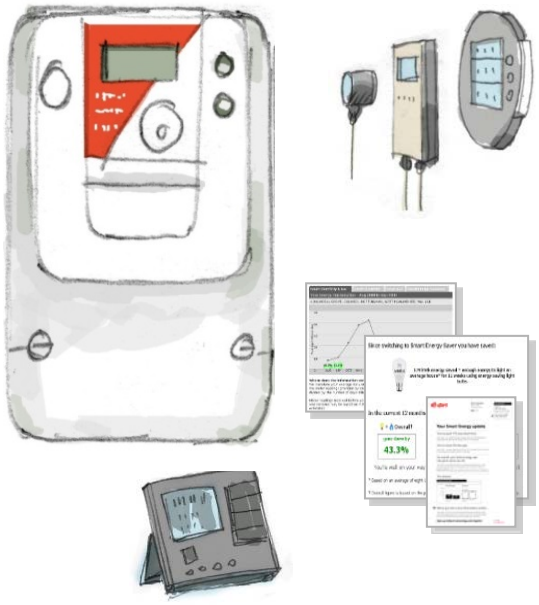
Annex IV: E.ON Technical Report on Smart Meters

Smart Meter Data as EE indicator

Introduction to Smart Meter Data Availability in four European countries



Contents

Glossary of Terms and Acronyms

DSO	**Distribution System Operator** Energy distribution companies responsible to deliver energy to customers and typically in charge of the last mile
EeMAP	**Energy efficient Mortgage Action Plan**
WAN	**Wide Area Network**
HAN	**Home Area Network**
EE	**Energy Efficiency**

1. Smart meters role in the EeMAP Initiative

The EeMAP Initiative aims to create a standardised "energy efficient mortgage", according to which building owners are incentivised to improve the energy efficiency of their buildings or acquire an already energy efficient property by way of preferential financing conditions linked to the mortgage.

The energy efficiency improvement process can be thought of as having three key stages (see figure 1) and the first and last could also apply to buildings that are already efficient.

1. **Energy Audit**: The current energy footprint of the dwelling is established, before any renovation work. This is also where energy renovation measures are planned, if applicable, in order to achieve the saving goals required by the home owner.
2. **Services Installation**: The measures established during the audit phase are implemented
3. **On-going Performance Measurement & Reporting**: The impact of the measures is evaluated to assess the quality of the measures and make sure that the results are in line with the expectations set forth in step 1.

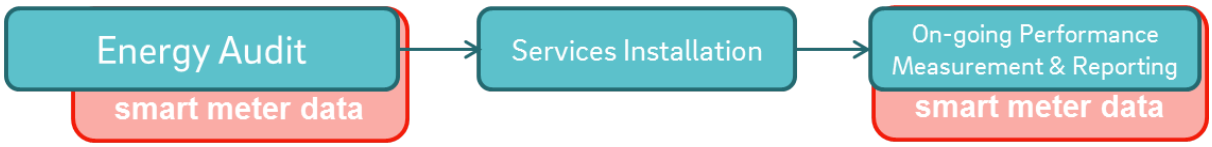


Figure 1 – The three stages of the energy efficiency improvement process

Smart meters play a crucial role in both step 1 and step 3. During the audit phase, smart meters can provide data regarding the past and present energy performance of the dwelling. In the performance evaluation after the installation of the energy saving measures, smart meters provide data to detect any deviations from the expected behaviour, allowing corrective steps to be taken if needed.

One key element of the initiative is the establishment, in the long term, of a **Building Energy or Renovation Passport (BEP)** framework, containing additional energy performance data necessary for an energy efficient mortgage product. The BEP should be capable of capturing the energy efficiency (EE) history of a property by recognising improvements made over time, as well as setting out a roadmap for the staged renovation of properties over their lifecycles. Such passports would aim to create an EE track record, given the access to validated information documenting the EE improvement and interventions carried out on the property (see Figure 2 for a conceptual model of how a building renovation passport could work).

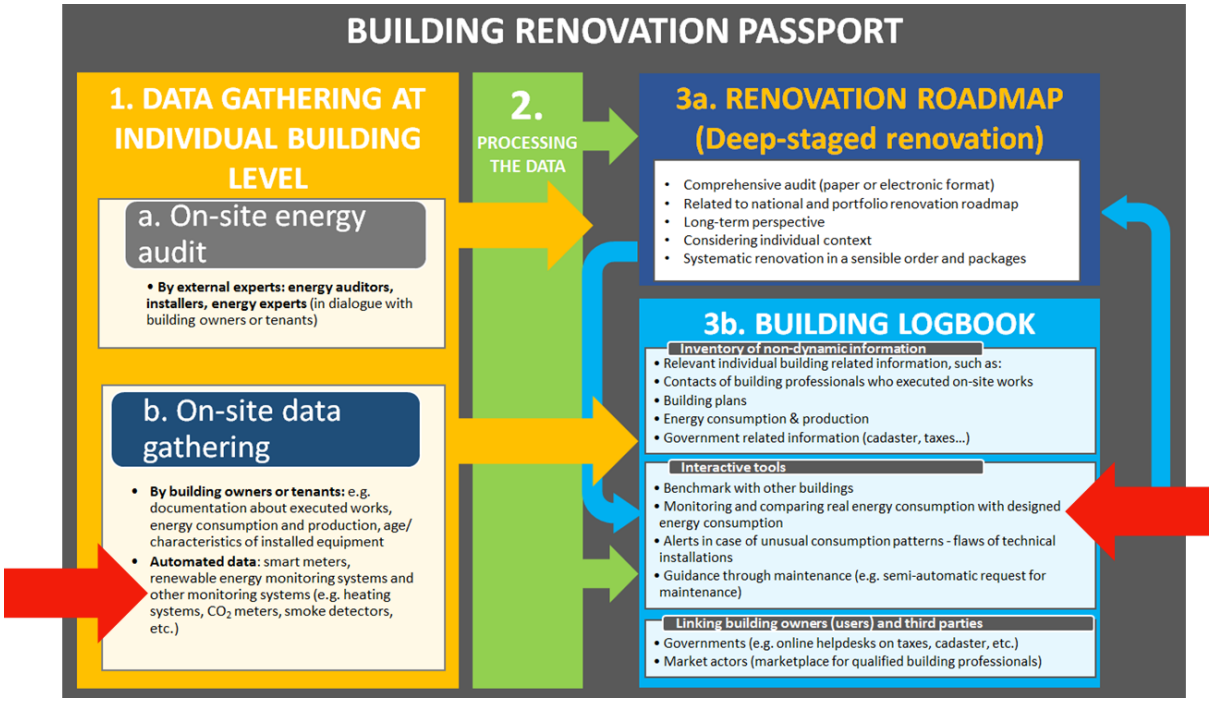


Figure 2: A conceptual model of how a building renovation passport or roadmap could work. The red arrows indicate the areas where smart meter contribution is expected [9]

Smart meters with their ability to capture near real-time energy data will lead to a step change in the amount of data that will be available regarding energy consumption. This will help the industry to operate more efficiently and to enhance competition in the energy services market.

In Figure 2 above, the red arrows indicate the areas of the Building Energy Passport where smart meters are expected to contribute most. These are the Automated data in the on-site data gathering section and the Interactive Tools in the Building Logbook section of the Building Energy Passport.

The following sections provide a short description of what a smart meter is, what type of data it generates, and how these types can be used in the three stages of the energy efficiency improvement process and the Building Energy Passport.

[9] BPIE, 'Building Renovation Passports', 2016, http://bpie.eu/wp-content/uploads/2017/01/Building-Passport-Report_2nd-edition.pdf.

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2. Overview of Smart Meter Data

A smart meter is an electronic device that records energy related data (including consumption) in intervals and communicates that information back to the authorised party (for example a utility company for monitoring and billing).

Smart meters enable two-way communication between the meter and the central system. This communication can be done via fixed wired connections (such as power line communications) or via wireless, also referred to Point-to-Point (P2P) (like cellular network, wireless mesh networks, etc.).

2.1. The Smart Meter Building Blocks

Regardless of the physical implementation, a smart meter is typically composed of four functional blocks:

Metrology

This is the part responsible for the measurement of the different values. A smart meter has a number of sensors that collect information from the energy grid. Typical values are the overall energy consumed or produced by the customer, the instantaneous power, the voltage, current and frequency, the duration and number of power outages, and any events where these values exceed a certain threshold.

Data Handling & Storage

Once the data have been measured by the sensors, they are usually sent to a processing and storage physical unit inside the smart meter. This is where the data are checked and organised either in single data points or assembled together in files with time stamps (load profiles). The processing unit is also responsible for allocating the consumption data against the correct tariff, if the customer has signed up for a Time of Use Tariff plan.

Once the processing part is completed, the data are stored in local memory while waiting for successful communication with the central system. The amount of memory in smart meters varies with local legislation. Typical values are anything between 6 and 18 months (as an example, smart meters in the UK must store local data up to 13 months for half-hourly data, and 2 years for daily consumption data).

Security

Smart meters come equipped with a communication module to send data to a central system. As such they are connected to the outside world and vulnerable to security breaches. Unauthorised parties could get access to smart meters and either collect customer's data or take control of the meter, remotely disconnecting the power in the customer's premises.

To prevent that from happening, smart meters are manufactured according to security policies. These policies vary across different countries but are typically aligned with international standards. These policies are implemented in a dedicated part of the meter and are responsible among other things for the management of security certificates, authentication mechanisms, and encryption of data.

Communication

The communication functionality allows the smart meter to send data and receive data or commands. There are two different channels the smart meter uses to establish a communication: a Wide Area Network (WAN) channel, and a Home Area Network (HAN) channel.

The WAN is used by the smart meter to communicate with a remote central system. The WAN is operated by an independent party (like an energy distribution company, or a data communication company), often operating in a regulated environment.

This communication channel is used to send billing data and network quality data and receive management data (like smart meter configuration or firmware updates), and commands (like on-demand reads, or switch on/off commands for the switch connected to the meter).

The HAN is used by the smart meter to communicate with other devices in the home (other meters, an in-home display, smart appliances, etc.). Typically, the HAN channel is more flexible than the WAN when it comes to data granularity, as the data is produced and consumed locally. Data sent via the HAN channel is usually related to local consumption or generation, price signals, and network congestion signals.

The physical implementation of these blocks changes from country to country in Europe (see Figure 3).

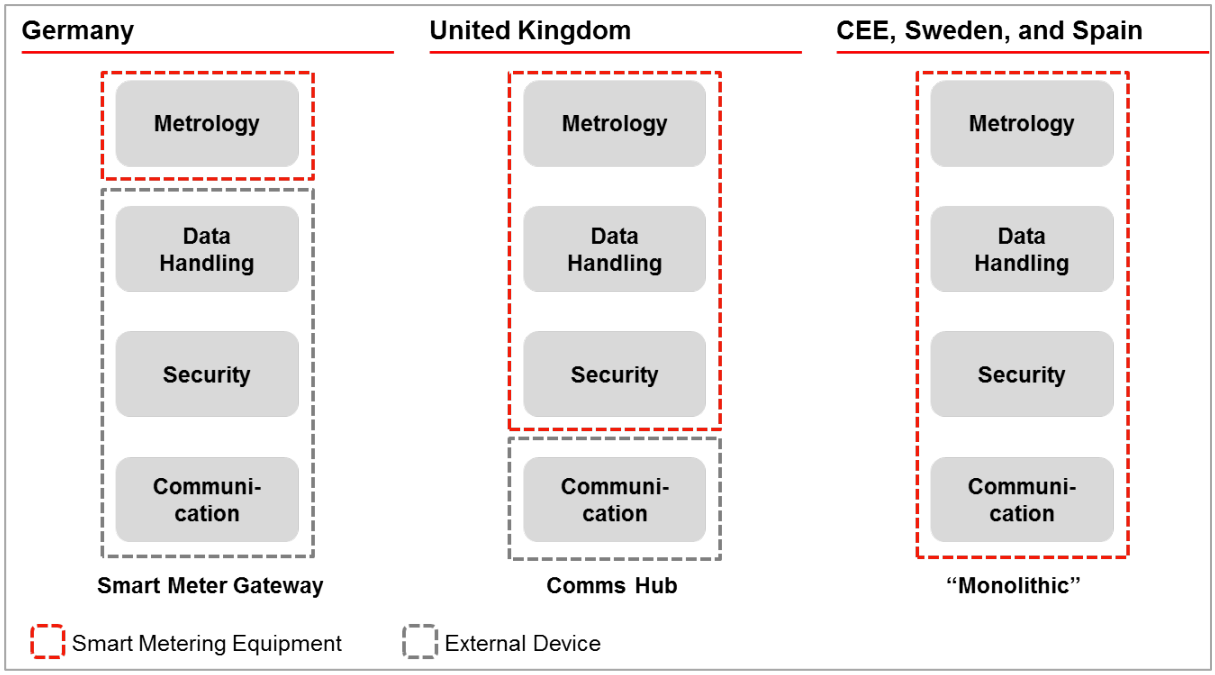

Figure 3: Physical implementation of the functional blocks of a smart meter in the EU

For example, in Germany, the meter is only responsible for the metrology part, while the data handling, security and communication are implemented in an external device called the Smart Meter Gateway. In the UK, the meter measures the energy, stores the data and is in charge of security, while the communication part is performed by an external device known as the Communication Hub. In other parts of Europe, like Sweden and Spain, all the

different functionalities are performed by the smart meter directly. This is sometimes referred to as the 'Monolithic' approach.

2.2. Smart Meter Data Types

A smart meter is capable of collecting a large number of data points. These values can be divided in the following categories:

Billing Data

These are values used by the utilities to prepare the bills for their customers. They measure the amount of energy consumed or produced (expressed in kWh) by customers during the billing period. If a customer has chosen a tariff plan, the smart meter is able to assign different values to the appropriate Time of Use tariff. The granularity of the data is aligned with the billing cycle (monthly or quarterly for the vast majority of the cases).

These data are usually transmitted by the meter across the WAN.

Network Quality Data

The Network Quality Data are used by the energy distribution company (DSO) to assess and monitor the quality of the distribution grid. Examples of Network Quality Data are: Voltage levels (measured in Volts), currents (measured in Ampere), frequency (measured in Hertz), maximum power over a specified interval (expressed in kW), instances and duration of configured events (over and under current, over and under voltage), instances and duration of brown-outs, black-outs, harmonic distortions, alarms, events, etc.

The granularity of the data is typically hourly but can be configured up to 15 minutes intervals. These data are stored into files with data stamps (load profiles) and transmitted daily to the DSO via the WAN.

Granular Data (real-time data)

These are data not covered in the previous two categories and are usually used by the energy supplier or third parties to offer additional services and products to the customers.

Examples of these data are: real time consumed power, real time produced power, power consumed and/or produced throughout the day at hourly intervals, price signals, network congestion signals, tariff in use, etc.

These data can be made available to the customer directly via the HAN in 'real time' (typically once per second or every 5 seconds). Alternatively, hourly data can be uploaded once a day via the WAN, and displayed to customers via a Web portal.

Figure 4 summarises the different types of data available from a smart meter, and shows the paths from where the data can be collected.

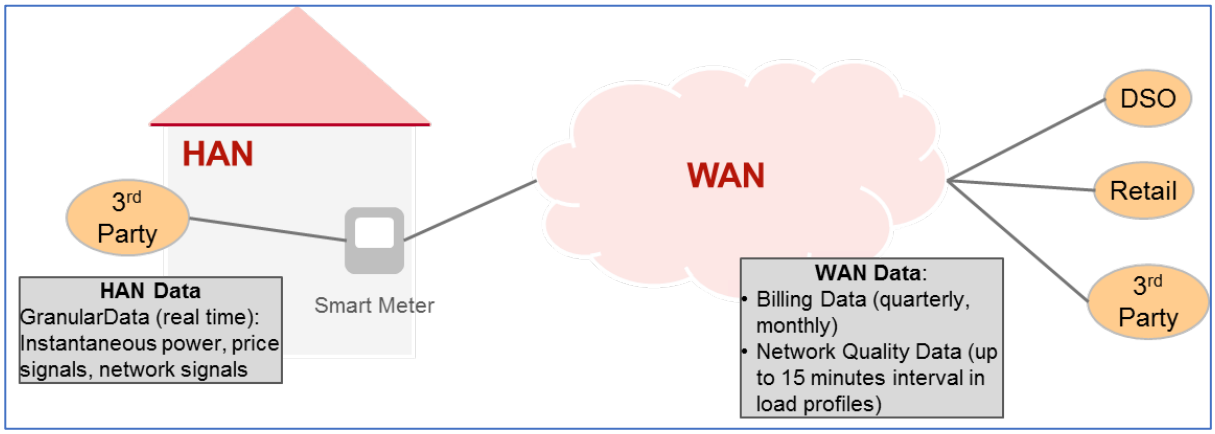

Figure 4 – Different types of data and availability

In summary, data generated by a smart meter is transmitted either via the WAN or the HAN. Data transmitted via the HAN has a greater granularity than the WAN data, as this is typically real-time. Also access to this data is easier as it is available directly from the customer's premises, while WAN data access is granted via an entity that is responsible to operate and maintain the WAN communication infrastructure in a regulated environment. This affects the type of data that is available and its granularity.

For the EeMAP initiative, Network Quality Data are not relevant, as they describe the quality of the distribution grid and provide limited visibility into the premises energy consumption. On the other hand, Billing Data and Real-Time Data are crucial to accurately describe the energy performance of the dwelling.

Table 1 specifies the recommended and minimum viable type of data related to the Three Stages in the EE Improvement Process and the Building Energy Passport.

EeMAP Scenarios		Recommended	Minimum Viable
Three Stages EE Improvement Process	Energy Audit	Billing Data	Billing Data
	Performance Monitoring	Granular Data	Billing Data
Building Energy Passport	Onsite Data Gathering	Billing Data	Billing Data
	Interactive Tools	Granular Data	Billing Data

Table 1 – Smart meter data relevance for the EeMAP

While smart meters are being widely rolled out in Europe, the availability of data varies from country to country, especially as far as granular data is concerned. The way 3rd parties[10] can get access to data also changes from country to country.

The following section provides a snapshot of data availability in four specific countries: Italy, UK, Germany and Sweden.

3. Current Status of Smart Meter Data availability

As smart meters are being rolled out across Europe, we see differences from country to country regarding smart meters and data availability.

This section provides a closer look at the current situation and possible developments in four European countries: Italy, UK, Germany and Sweden.

3.1. Italy

In Italy the smart metering data are owned by the customer, according to the "Customer Data Ownership Principle" set forward by the Italian decree 102/2014.

The energy distribution company (DSO) is responsible for the metering process, and the supplier has the customer's consent to receive the metering data from the DSO. The data is available as monthly readings for residential customers (with contractual power < 55KW) and at 15 minutes interval data for the remaining customers (typically delivered as curves, or load profiles). The data cover both consumption and generation and can also be accessed by customers via the DSO portal.

From August 2010 a new mechanism has been established by 'law 129', where data no longer flow from the DSO to the supplier directly, but get uploaded by the DSO onto a central database, called "Integral Information System (IIS)", managed by Acquirente Unico SpA (a public entity under the Ministry of Economics and Finances). This is to guarantee a level playing field in the competitive market and speed up processes and data availability.

Regulation about metering data exchange between the DSO and third parties is currently under discussion. The discussion focuses on mechanisms around customer's consent for the transmission of data to third parties other than the supplier, either via the IIS, or via the HAN (which is also used to send data to an in-home display, to smart appliances and to a Home Energy Management system).

[10] 3rd Parties indicates entities other than energy companies who use data to monitor the quality of the grid or to bill customers. This includes actors involved in the Green Mortgage product (like lenders, valuers, SMEs, etc.)

In this respect, the Italian Authority for electricity and gas has issued a resolution (87/2016) where a proposal is in place to allow IIS to provide data to different market players with customer's consent. This determines that the smart meter should allow transmission of data to the HAN via power line via an open protocol.

Currently in Italy, customer's consent management is defined only for the following two use cases:

1. **Delivery of metering data to the supplier by the DSO** (the legacy mechanism).
   In this case the DSO can link the customer's Point of Delivery (POD) information to the supplier that has an active supply contract with that customer. The supplier is only allowed to ask the DSO for the data of those customers with whom they have a supply contract in place.
2. **Access to metering data by the supplier via the IIS** (the new mechanism)

   In this instance the DSO uploads its customer data on the IIS database. A link is created between the customer's POD and the supplier who has a supply contract in place with that customer. The supplier can then access the data relative to its customers.

In either case, the customer gives their consent when they sign the supply contract. Currently the supplier is the only entity allowed to access customer's data. Third party access to customer data and relative consent management processes have not been defined yet. The Italian Authority is expected to issue regulation on the topic in upcoming resolutions.

The process for the authorisation of local communication between the smart meter and any third party's device installed in the HAN will be started by the customer that will request the DSO to enable this communication channel on their meter.

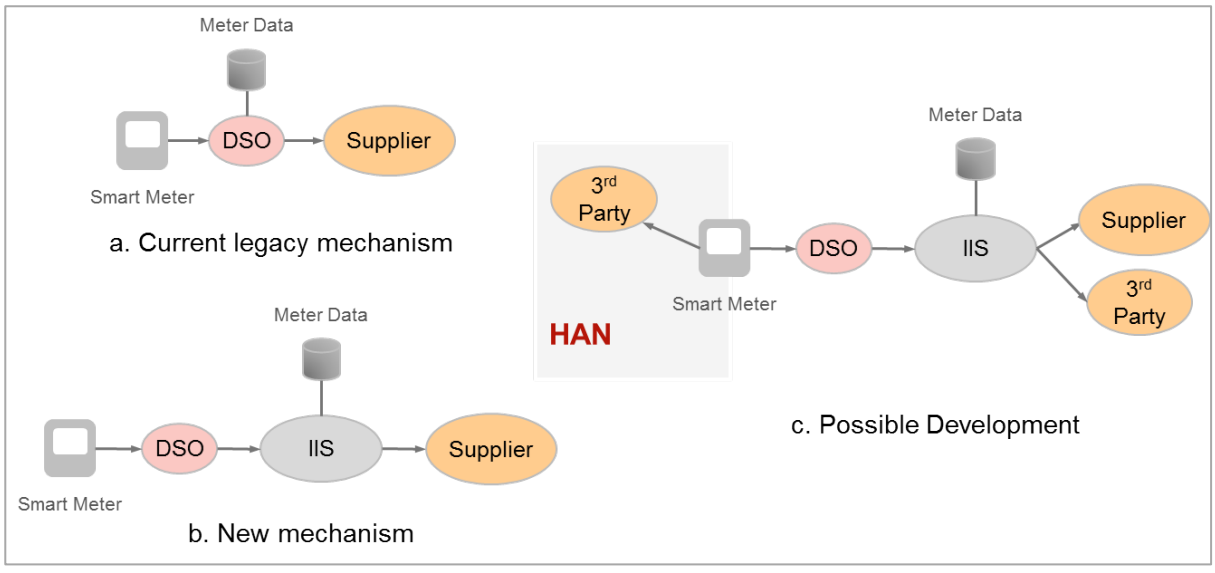

Figure 5: Data Access use cases in Italy

Enel Distribuzione, the biggest energy provider in Italy, started the second full country roll out of smart meters at the end of 2016. The meters and remote metering management infrastructure deployed by Enel are in line with the Authority's Resolution 87/2016. The remote metering management system can interface with the IIS, and the

smart meter is equipped with a power line communication channel that allows the transmission of data to the HAN.

Italy's data availability snapshot chart	
Smart Meter availability	100% - second roll out started
Data ownership	Customer
WAN Management	DSO (legacy)/IIS (new)
WAN Data Type	Network Quality; Billing
WAN Granularity	Monthly (<55KW); 15 mins with load profile (rest)
3rd Party Access to WAN	Planned
HAN & Granular Data	Planned
3rd Party Access to HAN	Planned

3.2. UK

As part of the Smart Metering Implementation Programme (with roll out of smart meters started in 2016 and due to finish in 2020), and in line with the UK Government's broader "midata"[11] initiative, arrangements have been put in place to enable domestic consumers to easily access their own energy consumption data.

Consumers will be able to access their own energy consumption data either through their In-Home Display (offered to all households free of charge) in near real time, or through the connection of additional devices to a Home Area Network (HAN) as part of their smart metering system, or by requesting information from their supplier. In addition, authorized third party organisations can access customer's consumption information directly from their smart meters via the Data Communications Company (DCC)[12], a central body responsible for managing the communication infrastructure.

In order to protect consumer interests whilst enabling proportionate access to data by energy suppliers and others, a **Data Access and Privacy Framework** has been established. The central principle of this framework is

[11] https://www.gov.uk/government/news/the-midata-vision-of-consumer-empowerment

[12] www.smartdcc.co.uk

that domestic consumers will have control over how their energy consumption data is used, except where this is required for billing or other regulated purposes.

The main features of this Framework are:

- Energy suppliers can access monthly consumption data for billing and other regulated purposes. Access to more granular data will depend on consumer consent; daily data can be collected if the customer has not opted out of providing it and half hourly data can be accessed if the customer has opted in to make it available.
- Network operators (DSO) will be able to access energy consumption data (including half-hourly) without consent, but only if they have implemented protocols for anonymising this data which have been approved by the Regulator.
- Third party users of the DCC will only be able to access consumption data with the explicit consent of consumers.

Smart metering equipment is capable of storing a minimum of 13 months of half-hourly and two years of daily consumption data for electricity and gas. In addition, real time readings (better than 10 second updates) are available for electricity across the HAN and are displayed, together with half-hourly information on gas consumption, to the consumer through their In-Home Display. The In-Home Display also provides the consumer with easy access to historical consumption information for the purposes of comparison.

Data can be accessed by authorised parties (subject to consumer consent) directly from the smart metering interface via a device called the **Consumer Access Device** (CAD) connected via the HAN, or through the Data and Communications Company (DCC). Third parties can request consumption data from these meters, in line with the requirements set out in the Data Access and Privacy Framework.

These third-party users (such as price comparison websites, home automation services and energy efficiency advice providers) must obtain the explicit consent of the consumer before accessing their consumption data through the DCC.

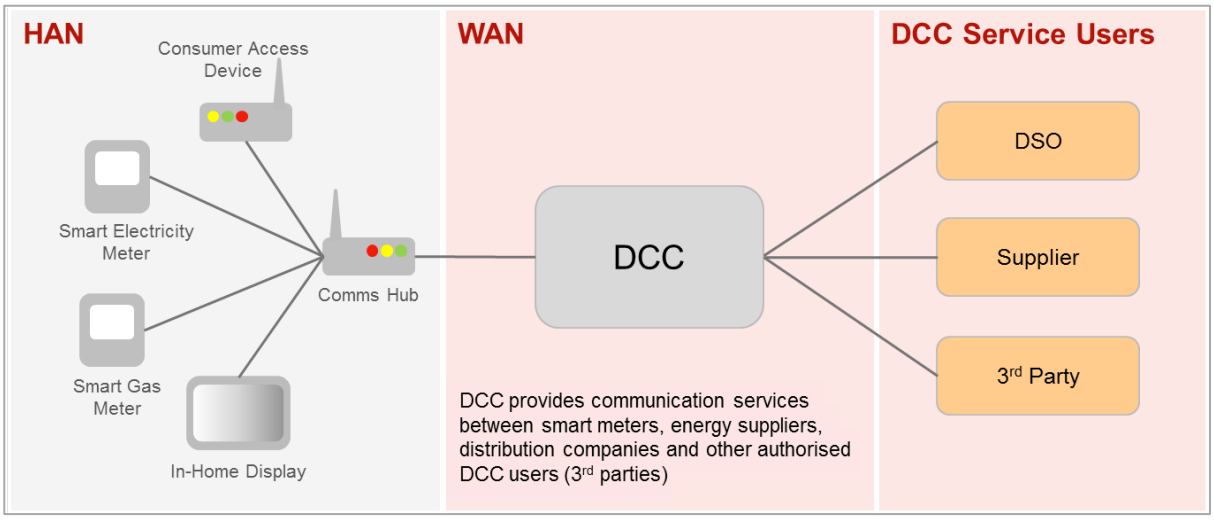

Figure 6: Data Access use cases in the UK

Information on the purpose for which data is collected by suppliers and third parties must be provided to the consumer. They must also contact the consumer at appropriate intervals, reminding them of their data access choices and providing information on how they can opt-out of data sharing (where relevant).

The local interface to the meter is standardized (ZigBee Smart Energy). Consumers can request up to 24 months of detailed energy consumption information directly from their energy supplier. Where such a request is made, the information must be provided to the consumer free of charge and in a readily understandable format.

Most energy suppliers rolling out smart meters also offer the ability to view the data on their website. Data at 30 minute frequency is available remotely (via the DCC), while 10 seconds (electricity only) is available via the smart meter (via the CAD connected to the HAN).

Information can be available in real time or updated every day, depending on the energy supplier, customer proposition, and whether the access is granted via an app or the webpage.

UK's data availability snapshot chart	
Smart Meter availability	Roll out in progress (2016-2020)
Data ownership	Customer
WAN Management	DCC
WAN Data Type	Network Quality; Billing
WAN Granularity	Monthly (all); daily (if customers don't opt out); half-hourly (with customers opt in)
3rd Party Access to WAN	Yes via DCC & Customer's consent
HAN & Granular Data	Yes
3rd Party Access to HAN	Yes via CAD & Customer's consent

3.3. Germany

In Germany, the "Law for the Digitalization of the Energy Transition" (GDEW) entered into force at the beginning of September 2016. The law sets the basis for a partial smart meter rollout establishing that:

1. Customers with a higher consumption (>6000 KWh/y) and/or bigger renewable energy feed-in system (>7.5KW peak) will be equipped with a so-called "intelligent metering system" (ca. 15% of the market). The intelligent metering system comprises an electronic meter and a Smart Meter Gateway (see Figure 1).
2. Customers with a consumption < 6000 kWh/y and/or feed-in systems < 7.5kW peak will be equipped with modern metering equipment (ca. 85 % of the market). This is a standalone, non-communicating electronic meter, which comes equipped with a serial port.

According to the law, the implementation of smart meters will start during the last quarter of 2017. The law also covers metering data, market communication, and contractual arrangements related to metering, for electricity, gas, heating and district heating.

Regarding metering data, this must be stored directly in the Smart Meter Gateway. Data up to 24 months can be downloaded by the customer at any time either directly from the smart meter or via a web portal, with the possibility of sharing them with third parties, with customer consent.

The supplier, who has the right to use the data, is obliged to delete all metering data after the completion of these tasks.

The GDEW also dictates that from 2020, meter data stored in the Smart Meter Gateway will be available to authorised parties, including third parties with customer's consent. The parties will gain access to data via the Meter System Operator (MSO) who controls and manages access to the Smart Meter Gateway (see Figure 4). At the moment the processes on how this will work are under consideration.

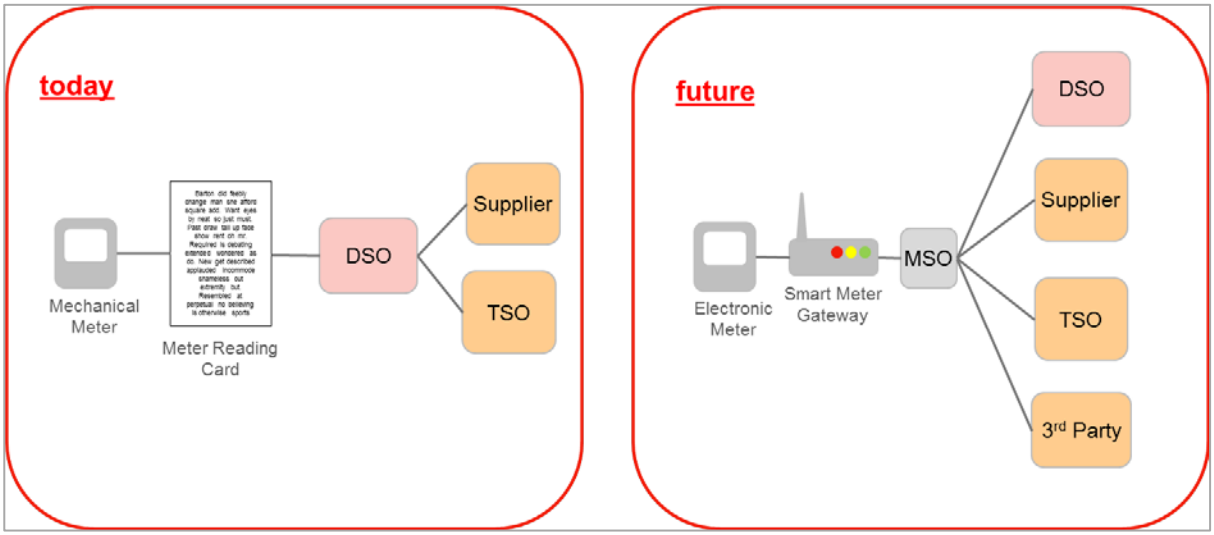

Figure 7: Smart Meter access in Germany, today and in 2020

3.3.1. Powerfox

To obviate these limitations, particularly related to the low penetration of smart meters, a number of products and services have appeared in the German market, mainly driven by the utility companies.

As an example, E.ON's Powerfox[13] allows customers without a Smart Meter Gateway to connect to the serial port of the electronic meter and get access to meter data, either directly via a mobile app solution or via a web portal.

Consumption and generation data with 1-minute resolution can be displayed in a customisable format in either hourly or 7 day form.

Information on quality data (i.e. voltage), provided with 15 minute resolution, is available as a data stream, and can be forwarded to third parties.

In addition, Powerfox also offers the possibility of benchmarking the energy consumption of the customer's home against the average consumption of similar dwellings in Germany.

[13] http://www.powerfox.energy/

Germany's data availability snapshot chart	
Smart Meter availability	Partial roll out in progress (2017-2024)
Data ownership	Customer
WAN Management	Meter System Operator
WAN Data Type	Network Quality; Billing
WAN Granularity	Monthly (all); daily
3rd Party Access to WAN	Planned via Meter System Operator & Customer's consent
HAN & Granular Data	Under discussion – possible with products like Powerfox
3rd Party Access to HAN	Under discussion – possible with products like Powerfox

3.4. Sweden

The first smart meter rollout in Sweden was completed in July 2009. The country is now preparing for the second-generation rollout which is due to start at the end of 2019.

In the current rollout, a smart meter operator, appointed by the DSO, is responsible for the collection of smart meter data (both billing data and grid quality data) via the WAN.

Billing data are relative to consumed and produced energy divided by tariffs. Billing is performed monthly using daily data[14].

Both billing and grid quality data are sent by the smart meter operator to the DSO. The DSO keeps the grid quality data and makes the billing data available to the relevant supplier or third-party, with the customer's consent.

The grid quality data has a granularity of 1 hour intervals, but can be increased to 15 minutes intervals, based on the needs of the DSO. These data are usually stored in load profiles and transmitted once a day.

The billing data has a granularity of daily intervals. Recently Sweden has introduced the possibility for customers to request hourly billing (with opt-in). In this case, hourly data are stored in load profiles which are transmitted via the WAN once a day.

[14] Since 2015 if customers want they can receive hourly billing

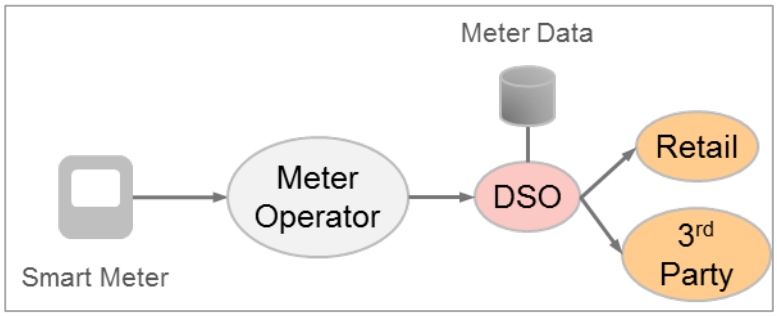

Figure 8: Smart Meter Data access in Sweden

As far as additional data is concerned, the current generation of smart meters do not support a connection to the HAN, which makes it challenging to have real time data available to customers. The next generation of smart meters planned to be deployed at the end of 2019 will have a connection to the HAN as part of their functional requirements.

Despite the lack of HAN connection, there have in recent years been many services and products based on real time data made available to customers by utilities.

An example is E.ON's **100Koll**, a product that allows customers to monitor their consumption via mobile apps, or web interface, and control loads in their homes using smart plugs. By connecting to the optical port on the meter which is normally used for calibration purposes, 100Koll is capable of collecting real time data (5 seconds intervals).

In the second rollout the meters will come equipped with a HAN interface. However the mechanisms for third party access to data is still under discussion.

Sweden's data availability snapshot chart	
Smart Meter availability	100%; second roll out planned (2019)
Data ownership	Customer
WAN Management	Meter System Operator via DSO mandate
WAN Data Type	Network Quality; Billing
WAN Granularity	Daily; hourly (with customer's request)
3rd Party Access to WAN	Yes with customer's consent
HAN & Granular Data	Planned in next roll out – possible today with products like 100Koll
3rd Party Access to HAN	Planned in next roll out – possible today with products like 100Koll