multEE
facilitating multi-level governance
for Energy Efficiency

Data Collection Process for Bottom-up Monitoring

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List of Abbreviations

AEA	Austrian Energy Agency
EE	Energy Efficiency
EED	Energy Efficiency Directive (2012/27/EU)
EU	European Union
IEA	International Energy Agency
M&V	Monitoring & Verification
MS	Member State
OECD	Organisation for Economic Co-operation and Development

Executive Summary

Current energy efficiency programmes, such as those of the Energy Efficiency Directive 2012/27/EU of the European Parliament, obligate all EU-Member States to report achieved energy savings on a regular basis. The requirements for Member States in reporting achieved energy savings therefore need to guarantee comparable results of their energy efficiency improvement efforts as well as a decent monitoring and verification process. These requirements can be met by having a sound data collection process which ensures the availability of significant data and enables decent monitoring and verification procedures.

This report provides guidance on how such an ideal data collection process could be structured. Based on best practice examples from preceding analysis, the ideal data collection process and its different stages will be described.

The main focus will be on how to collect the data needed in order to monitor and verify energy efficiency measures. The data collection process suggested in this document is to be considered as a guiding principle, not claiming that the suggested process is the universal method to collect data.

I Introduction

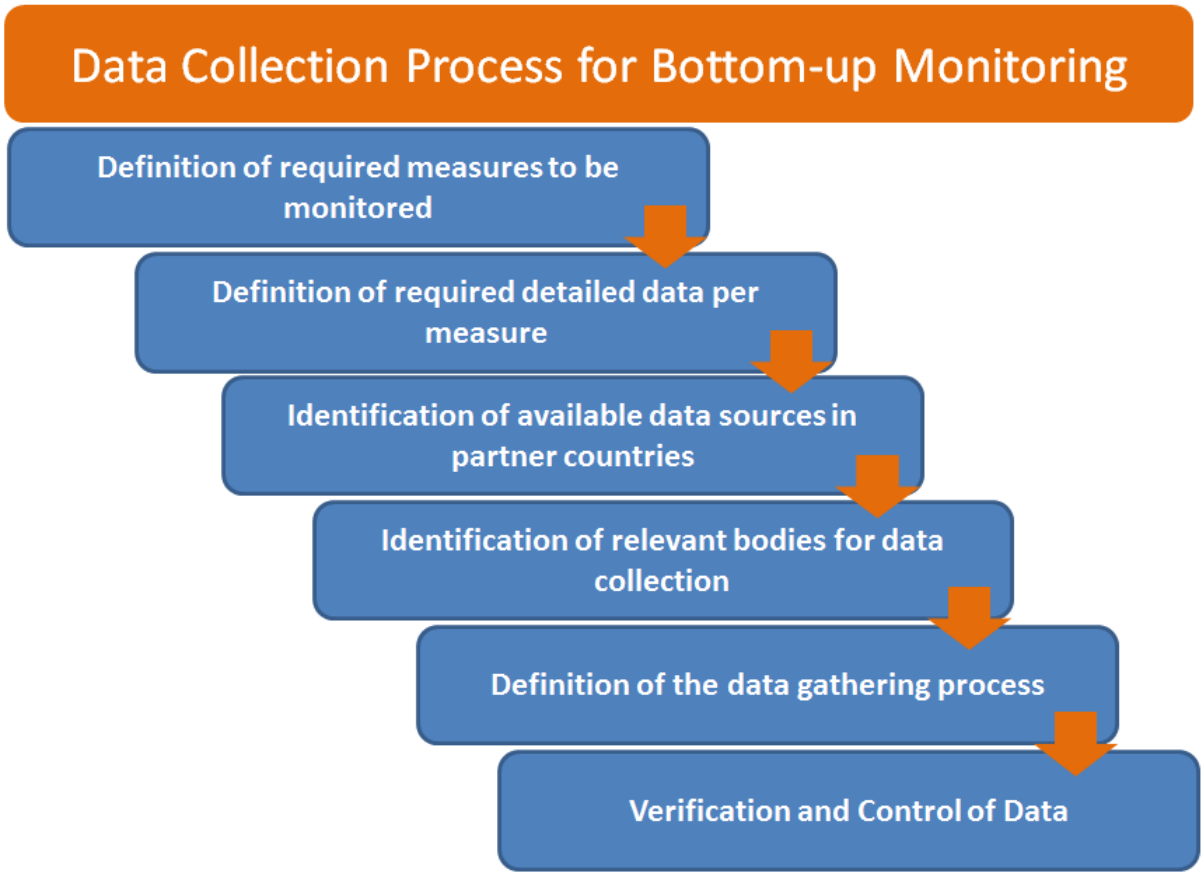
The project **multEE - Facilitating multi-level governance for Energy Efficiency,** financed by the Horizon 2020 programme, aims at enhancing the consistency and quality of energy efficiency policy planning and implementation on different administrative levels across the beneficiary countries. Specifically, the multEE project intends to introduce innovative monitoring and verification (M&V) schemes based on bottom-up data in order to ensure that the outcome of energy efficiency measures is correctly evaluated and useable for future energy efficiency planning. Furthermore, the vertical coordination between administrative levels shall be improved, exploiting the full potential of the integrated M&V schemes and enhancing the overall quality of energy efficiency planning and implementation (CRES, EIHP, 2015b).

The targets of large-scale energy efficiency programmes, such as those of the Energy Efficiency Directive 2012/27/EU of the European Parliament and Council, establishes a set of binding measures to help the EU reach its 20% energy efficiency targets by 2020. Under the Directive, all EU countries are required to use energy more efficiently across all stages of the energy value chain from production to final consumption. Member States have to report achieved energy savings on a regular basis.

The requirements for Member States in reporting achieved energy savings therefore need to guarantee comparable results of their energy efficiency improvement efforts as well as a decent monitoring and verification process. The monitoring of energy efficiency targets on local, regional or national level requires assessing the impacts of energy efficiency policies and measures in terms of energy savings and finally, their contribution towards the energy efficiency target. Assessing the impacts requires the collection of various data on implemented measures. By supporting consistency and high quality, energy policy decision-makers need to be equipped with the necessary data on implemented measures.

The aim of this report is to provide guidance on how such data collection processes can be structured. Based on best practice examples, the ideal data collection process including its different stages will be described.

Figure 1: Data Collection Process for Bottom-up Monitoring



Source: Austrian Energy Agency

The status quo of the partner countries will be taken into account at every stage of the data collection process, depending on the input of the provided country reports (CRES et al, 2015, p.18ff).

Important coordination mechanisms in the context of the data collection process will be displayed briefly in this report and analysed in further detail in the upcoming report: "*Synthesis report concerning areas of improvement of coordination mechanism*" which will soon be realised within the multEE project.

In most EU Member States, the national statistics office, national and international databases are used as data sources. The data collection process is realised by a governmental body, an agency, an energy regulator or a combination of the above (CRES et al, 2015, p.10).

The underlying report will neither be a reference manual on energy statistics nor on energy efficiency indicators. The main focus will be on how to collect the data needed in order to monitor and verify energy efficiency measures. The data collection process suggested in this document is to be considered as a guiding principle, not claiming that the suggested process is the universal method to collect data. There is no universal recipe to collect such data. This depends on the needs, situation, time and resources.

II Definition of required measures to be monitored

Large-scale energy efficiency programmes, such as those of the Energy Efficiency Directive 2012/27/EU of the European Parliament and Council require Member States to use energy more efficiently across all stages of the energy value chain from production to final consumption.

Energy savings can be achieved through a wide variety of energy efficiency measures, such as thermal renovation, improvement of heating systems or more efficient appliances across all segments, be it the residential, manufacturing, commercial or transportation sector. Energy savings therefore affect numerous economic players such as households, governments, utilities, manufacturers, etc.

Member States will not achieve their targets by solely implementing a small number of energy efficiency measures. These energy efficiency programmes can only succeed if energy efficiency measures covering all sectors are carried out repeatedly in order to reach a large percentage of energy uses (Reichl J., Kollmann A. 2008).

Essential for good monitoring of energy saving measures requires a clear definition of the measures that will be implemented to reach the saving targets. Only if this is clearly defined, Member States will be able to measure and evaluate final results and control the overall performance throughout the entire period between target setting and evaluation.

To measure national energy savings, both top-down (TD) and bottom-up (BU) methods can be used. Using bottom-up methods, the energy savings of individual measures are used and added to saving results from other specific energy efficiency improvement measures. A top-down calculation method is to understand that the national or larger -scale aggregated sectoral savings are used as a starting point for the calculation of the level of energy savings.

While the expected outcome of energy efficiency measures on the industrial, community or large buildings sector justifies the effort for metering and/or extensive data collection, the incentive for metering and data collection for an individual household may exceed a reasonable level compared to the expected savings. To ensure the cost/benefit balance, the use of standardised and individual measures is helpful. Standardised methods with predetermined savings targets (savings are estimated ex-ante through a standard methodology) will help to reduce costs. Default values may also be used in case energy efficiency

measures will lead to homogenous savings. In case no standard methodology exists, energy savings may also be calculated individually, yet this requires a lot more resources.

Whenever the measures that will be monitored have been determined, it is necessary to describe the required detailed data per measure. This will be discussed in the following chapter.

III The definition of the required detailed data per measure

This section provides a brief description of the methodology for specifying energy saving values for each measure.

As mentioned in the previous chapter, possible impacts of policies and measures can, on the one hand, be assessed top down, energy consumption in relation to the prevailing factors i.e. by means of specific indicators such as energy consumption in households for heating per m^2. On the other hand, bottom-up methods can be used to assess the impact of single energy efficiency measures.

Monitoring systems, based predominantly on energy statistics instead of bottom-up data from implemented projects, do not provide a clear overview of energy efficiency measures implemented across different administrative levels as well as on their effectiveness and cost efficiency. Furthermore, a good top-down evaluation strongly depends on trustworthy energy statistics. Meanwhile, bottom-up calculations offer a more detailed view of the impact of energy efficiency measures but are much more costly and time consuming than top-down calculations.

It is therefore recommended to use bottom-up methods in assessing the impact of single energy efficiency measures as they allow evaluating single measures not only in terms of energy savings but also for their cost-effectiveness expressed as cost in relation to energy saving impact (e.g. EUR/kWh). The energy savings obtained through the implementation of a single energy efficiency measure can be summed up to assess total energy savings in a specific area (e.g. heating).

Within the multEE project, a comprehensive report with a variety of methods to calculate energy savings from single energy efficiency measures has been compiled. This report provides guidance on assessing the impacts of energy efficiency measures using bottom-up methods. It comprises a multitude of energy efficiency measures for which bottom-up saving calculation methods, i.e. specific calculation formulae have been developed. The complete report can be downloaded from the multEE website

In order to apply these calculation methods, country-specific values (default values) have to be defined (e.g. as a baseline for calculating energy savings from the retrofit of existing buildings, the average space heating demand of the building stock in a particular country over a given period may be applied).

These bottom-up methods range from soft measures such as behavioural change and awareness raising up to more technological ones such as quantifying the energy saving impacts of retrofitted building shells, more efficient heating systems, appliances, industrial motors and cars, just to name a few (AEA et al, 2016).

The report comprises 48 measures; each is described in detail including the formula on how to calculate the energy savings from all these. Figure 2 shows the formula for the method "Introduction of building codes for new residential and tertiary buildings" giving an indication of values used in the formula and support in defining the baseline.

Figure 2: Bottom-up formula for the method "Introduction of building codes for new residential and tertiary buildings"

Bottom-up formula[14]	
Option 1: $TFES = A * (SHD_{inicode} * EF_{Ref} - SHD_{newcode} * EF_{Eff})$ **Option 2:** $TFES = A * \left(\frac{SHD_{inocode}}{\eta_{inicode}} - \frac{SHD_{newcode}}{\eta_{new}}\right)$	
Definition	
TFES:	Total Final Energy Savings [kWh/a]
A	Heated floor area of the newly constructed building [m^2]
$SHD_{inicode}$	Specific Space Heating Demand of building constructed according to the initial building code introduced after YYYY or of the building code in force in YYYY [$kWh/m^2/a$]
$SHD_{newcode}$	Specific Space Heating Demand of building constructed according to the new building code implemented in YYYY [$kWh/m^2/a$]
EF_{Ref}	Expenditure Factor of the heating system in the building constructed according to the old building code
EF_{Eff}	Expenditure Factor of the heating system in the building constructed according to the new building code
$\eta_{inicode}$	Annual use efficiency of the heating system in the building constructed according to the old (inicode) building code
η_{new}	Annual use efficiency of the heating system in the building constructed according to the new (newcode) building code
Baseline[15]	
Specific space heating demand of the initial building code in place in year YYYY or introduced after YYYY. In case, no building code was in place in YYYY, the baseline is the average space heating demand of buildings constructed in YYYY. In case where measures promote buildings that go beyond the building code, the yearly final energy savings are calculated based on the difference in the ratio between specific space heating demand and energy efficiency of the heating systems between the initial building code in place or introduced after YYYY and the ratio in the buildings promoted. If the building code also imposes efficiency requirements for heating systems, these should be included too. The specific space heating demand values should be corrected with the relevant heating degree days.	

Furthermore, the document provides extensive information on the data that needs to be collected in order to calculate the savings. Beside an indication whether these values could be default or project specific values, the report contains comprehensive guidance for identification of possible default values.

Figure 3: Data needed to calculate savings from "Introduction of building codes for new residential and tertiary buildings"

Values:

Lifetime of the measure in years (default or project specific)

Heated gross floor area (default or project specific)

Specific Space Heating Demand of building constructed according to the initial building code (default)

Specific Space Heating Demand of building constructed according to the new building code (default)

Expenditure Factor of the heating system in the building constructed according to the old building code (default or project specific)

Expenditure Factor of the heating system in the building constructed according to the new building code (default or project specific)

Annual use efficiency of the heating system in the building constructed according to the old building code (default or project specific)

Annual use efficiency of the heating system in the building constructed according to the new building code (default or project specific)

However, one has to note that savings calculated with bottom-up methods are foremost theoretical, especially when default instead of project specific values are used. In the example above, values referring to the specific building that has been retrofitted for the savings calculation are shown. Such calculated savings are called deemed savings in comparison to metered savings, where the savings from a particular measure are determined by recording the actual reduction in energy use, taking account of factors such as additionality, occupancy, production levels and weather which may affect consumption (European Commission 2012, p35). Other forms of calculating the impact of bottom-up energy efficiency measures are scaled and surveyed savings. Scaled savings are based on engineering estimates while surveyed savings are based on consumer responses.

Deemed and scaled savings are the most commonly used methodologies (ENSPOL 2016). It is recommended that Member States publish information on how deemed or scaled savings are determined, such as what quantity of savings are attributed to different individual measures and also ensuring that this information is publicly accessible. In particular, the scaled savings should be defined on the basis of nationally established methodologies and benchmarks by qualified or accredited experts. Other measures will have to have their energy savings

metered or surveyed to determine their values (ENSPOL 2016). A more detailed description on the different data collecting methodologies will follow in the next chapter.

The Austrian monitoring agency has developed a wide range of bottom-up methods to calculate energy savings from energy efficiency measures implemented by the different bodies affected under the EED. It is continuously developing additional bottom-up methods, updating existing methods and has also defined national default values in consultation with relevant stakeholders.

In Croatia, Bottom-up methodologies have been developed for 20 different energy efficiency measures and have been introduced to the IT-tool called SMIV (System for Monitoring, Measurement and Verification for Energy Savings). The bottom-up monitoring procedure and the methodology were developed in cooperation with many relevant institutions and were built upon the already existing rulebook.

III.I Identification of data collection methods

When defining the data collection process, attention needs to be given to the methods. This chapter provides an overview of possible methods to generate data.

In selecting the best method for data collection, it is necessary to consider the type of information needed; the method's validity and reliability; the resources that are available, such as staff, time, and money.

When collecting data, the following three major quality criteria need to be addressed:

- Validity: whether or not the collection method measures what it claims to measure
- Reliability: whether or not the resulting data is consistent and reproducible
- Fairness: whether or not the method is free from any kind of potential bias

The most frequently used methodologies can be grouped into four main categories:

- Surveys
- Metering and Measuring
- Modelling
- Administrative Sources

The most appropriate methodology in terms of needs, circumstances, costs, expenditure of time, etc. may be chosen for collecting specific data needed for a specific measure or project. The four methodologies listed above are described below, including opportunities and challenges which are also to be considered.

III.II Surveys

The main purposes of surveys include tracking energy use over time, evaluating the effectiveness of programmes and policies, complementing other data collection initiatives and setting energy efficiency benchmarks.

Surveys need to include a representative sample. Processing and quality assuring the data can be expensive and time-consuming. Further challenges which are to be considered include a possible bias from the interviewer, a large share of non-responses and lacking quality of responses (incomplete or inconsistent surveys).

Surveys can provide input to modelling exercises in order to estimate future years when the survey is not done. Surveys might also bear high costs for obtaining data.

III.III Metering and Measuring

Real-time activity can be monitored using appropriate equipment. This might also include billing and audits. Furthermore, measuring could be carried out for representative periods and extrapolated for the specific case of application.

Measuring and metering might be able to obtain patterns and trends over longer periods of time compared to a survey which is done at one point in time. It may also be less burdensome than a survey. However, auditors may sometimes not be allowed to take the measurement. In many cases, measuring and metering can complement existing surveys or modelling procedures.

III.IV Modelling

Modelling simulates activities based on given patterns and data. It can be used to estimate a wide variety of information, e.g. to estimate the energy consumption of buildings by service type or the diffusion and energy consumption of office equipment.

In general, there is a need to integrate data from other types of data collection methods into the modelling technique. In the following, modelling can also be used to interpolate or extrapolate information when specific data is not available.

Modelling can be expensive, depending on how comprehensive and sophisticated the model is, but it could potentially be less costly than collecting data.

Challenges associated with modelling include quality control issues, a lack of input data and the need to define assumptions. It is very important to validate the modelling results, for example against energy consumption in energy balances, the national greenhouse gas inventory or against available surveys.

III.V Administrative Sources

In most countries, there is relevant data collected by administrative sources. Data sources which are provided by the national statistical offices of virtually all European countries include energy balances, sectoral energy analysis (for industry, residential sector, transport and services), and specific statistics regarding renewable energy sources.

These may be easily accessible and less expensive than surveys that already exist for certain activities. However, it is difficult to create new or adapted data elements as they are already part of an existing data system.

Such administrative data sources include the following:

- Detailed vehicle information for new and used vehicles (registration date, engine capacity, type of fuel, gross weight, model)
- Gasoline tax information
- Fuel economy (such data may be used, among others, for the national oil demand/supply and demand statistics
- Utility bills
- Census
- Environmental agencies

Challenges with administrative sources include incomplete data, confidentiality issues and a required agreement from respondents.

Apart from national data, several international data sources are available from where the relevant data might be obtained.

III.VI IEA Energy Statistics

International databases include data generated and/or published by the International Energy Agency (IEA). There is an official commitment of IEA Member States to report data. There are various datasets and publications available at the website http://www.iea.org/statistics/.

The IEA datasets provide, among others, data and indicators for energy supply, consumption, energy efficiency, CO_2-emissions, policies and measures, etc.

Covered countries include over 30 OECD Member countries and over 100 non-OECD countries worldwide. In OECD Member Countries, the data is collected by official bodies (most often the national statistics office of each country) as well as companies, government agencies and industry organisations and are then reported to the IEA using questionnaires to ensure international comparability. In non-OECD countries, data is collected directly from government and industry contacts and from national publications.

III.VII ODYSSEE-MURE

ODYSSEE is a long standing project funded by the European Commission monitoring energy efficiency trends and measures in Europe. The general objective of the project is to provide a comprehensive monitoring of energy consumption and efficiency trends as well as an evaluation of sector-wide energy efficiency policy measures for EU countries & Norway. The project consortium is a network of 33 partners from all participating countries, usually national Efficiency Agencies.

ODYSSEE-MURE consists of two complementary internet databases: ODYSSEE, which focuses on energy efficiency and CO_2 indicators, including detailed data on energy consumption, activities and related CO_2-emissions (around 1,000 data series by country) and MURE, which highlights energy efficiency policy measures, including their impact evaluation whenever available (currently around 2,000 measures).

Both databases are available at the website http://www.odyssee-mure.eu/.

However, full free access to the ODYSSEE database is provided only for EU Ministries, Concerted Action EED, EED Committee Members, EU universities and research centres for non-commercial uses, while other users need to purchase a subscription. The MURE database is available for free for all users in form of an online tool.

The originality of the project is to cover all sectors and end-uses with a homogeneous and harmonised approach and offer an overall picture of the trends and measures by sector. Furthermore, the project has developed specific data facilities, displaying an overview of key indicators for different countries and time series. These indicators include, for instance, specific consumption of energy intensive branches, specific consumption per unit of traffic (e.g. car fleet average, new cars), consumption per dwelling and by m^2, energy consumption per employee, etc.

III.VIII Eurostat

Eurostat has also developed a coherent and harmonised system of energy statistics. Annual, half-yearly and monthly data collections cover the EU member states, the candidate countries of Albania, Montenegro, Serbia, the Former Yugoslav Republic of Macedonia, Turkey, Iceland and Norway.

Eurostat energy statistics include data on production and consumption by fuel type and sector.

The online database is available at http://ec.europa.eu/eurostat/web/energy/data/database.

In Austria, default values were often defined with the participation of the stakeholders for the respective energy efficiency measure. Stakeholders (i.e. industry representatives) are often able to provide sector specific values for certain energy efficiency methods. By means of a top-down-verification, the plausibility of the proposed savings can be examined.

Calculation methods which use project specific values (i.e. the actual effects of the measure in question) for quantifying energy efficiency gains are generally more preferred. However, in case of no available data related to the specific measure or if too costly to use project specific values, other data sources required to calculate the efficiency effects can be used.

IV Identification of relevant bodies for data collection

Due to the fact that energy efficiency policies are implemented across different end-use sectors, more than one ministry is involved in the formulation of energy policies. Nevertheless, the responsibilities for energy efficiency policy making and implementation are usually clearly defined between the different involved governmental layers in the majority of examined cases. This chapter outlines an overview of responsible bodies for collecting and processing data in context with the Energy Efficiency Directive 2012/27/EU within the partner countries of the multEE project. A detailed overview can be found in the "*Synthesis report on European best practices for M&V schemes and coordination mechanisms*" (CRES et al 2015).

IV.I.I Austria

The Austrian Energy Agency was selected by the Austrian Federal Ministry of Science, Research and Economy in May 2015 as the national monitoring agency (www.monitoringstelle.at). The national energy efficiency monitoring agency is responsible for setting up the data collection process and for informing all relevant stakeholders about the process.

The main actors affected by the data collection process are energy suppliers subject to the energy efficiency obligation scheme and federal bodies. They have to report energy efficiency measures to the national monitoring agency on a yearly basis. But also companies may suggest and design energy efficiency measures and report them.

IV.II Croatia

The organization responsible for monitoring and data collection is the National EE Authority, part of the Center for Monitoring Business Activities in the Energy Sector and Investments (www.cei.hr), founded by the Ministry of Economy. Croatia has an M&V scheme in the form of an IT-tool called SMIV (System for Monitoring, Measurement and Verification of Energy Savings).

The reporting is made on an annual basis from the interpretation of SMIV data. All parties participate in the Croatian M&V scheme at all levels (local, regional, national) – the public sector, the households sector, the industry sector and the transport sector. However, implementation of planned measures is obligatory only for about 200 parties as mentioned in the NEEAP through concrete measures.

IV.III Denmark

The Danish Energy Agency (www.ens.dk) defines a set of monitoring & documentation methods and at the same time is also responsible for controlling these. The objective is to secure the involvement of grid- and/or distribution companies (electricity natural gas, district heating and oil) in realising more energy savings.

Each body is responsible for the collection of data in respect of their energy savings. Energy savings data must be reported to the Danish Energy Agency each year once the energy saving is realized and documentation finished.

IV.IV Former Yugoslav Republic of Macedonia

The administrative authority for the M&V scheme is the Energy Agency of Macedonia (www.ea.gov.mk). The Energy Agency collects data through annual reports from local self-governments and processes these into national values.

The State Statistic Office is the responsible body for data collection. However, for energy related statistics, local self-governments are responsible to collect data and submit reports. The reporting period for the M&V scheme is on an annual basis.

IV.V Greece

The Ministry of Environment and Energy (www.ypeka.gr) is responsible for the implementation of the ESD and EED Directives at national level, for the design, facilitation and monitoring of the implemented energy efficiency measures and for the establishment, administration and coordination of the M&V schemes.

The Ministry Environment and Energy in collaboration with the Hellenic Statistical Authority is responsible for the coordination and the implementation of the data collection process.

IV.VI Latvia

Operation of the energy efficiency monitoring system is ensured by the Ministry of Economics. The Ministry is responsible for the accurate calculation of energy savings and is obliged to collect annual information on energy savings achieved in the previous year.

The main data source for the monitoring of implemented energy efficiency measures is reported data from subsidies - EU Funds as well as national funds (e.g. Green Investment Schemes). The majority of the data stems from the responsible institutions, administering the measures as well as entities

participating in the planning and implementation of energy efficiency measures. Furthermore the national statistics office Latvia Central Statistical Bureau provides data. For top-down monitoring data from the ODYSSEE database or data of the Road Traffic Safety Directorate (Transport sector) is being used.

IV.VII Lithuania

The Ministry of Energy is responsible for the creation and administration of M&V schemes, but it has delegated most of the administrative and coordination tasks to the State Enterprise Energy Agency (www.ena.lt).

The main data sources for the monitoring of the implemented energy efficiency measures are the National statistical office and other national databases. Most of the data is submitted by the institutions, which are administrators of the measures and entities participating in the planning and implementation of energy efficiency measures.

IV.VIII Slovakia

The responsible body for administration and coordination of energy efficiency monitoring is the Slovak Innovation and Energy Agency (SIEA, www.siea.sk). Data collection was done by the Ministry of Economy, yet since November 2015 this has been delegated to the SIEA.

The SIEA is obliged to check, process and analyse received data in relation to the energy efficiency targets. It also has to provide information for the annual energy efficiency report as well as national energy efficiency action plans.

As recommended in the "*Synthesis report on European best practices for M&V and coordination mechanisms*", it is important to clearly define the responsibilities between the responsible line Ministry, possible supporting institutions and data providers. These responsibilities should be defined by the adoption of primary and/or secondary legislation (CRES et al, 2015, p.2).

In Austria, the Austrian Energy Agency was designated by the Austrian Federal Ministry of Science, Research and Economy as national monitoring agency in May 2015 after a national competitive bidding process. The Austrian Energy Agency is the national monitoring agency as requested by the federal law on energy efficiency.

In Croatia, the Energy Efficiency Act has named the Croatian Institution Center for Monitoring Business Activities in the Energy Sector and Investments (CEI) as the National Energy Efficiency Authority establishing the obligation to develop, monitor and administer the M&V scheme

V Definition of the data gathering process

Having defined important steps such as which measures need to be monitored, what kind of data is needed per measure, how to identify suitable data sources and responsible bodies, the focus of this chapter is placed on the description of the optimal data collection process. This chapter highlights the data gathering process of energy efficiency measures and highlights aspects where attention should be paid to, ensuring the suitable collection of data concerning these measures.

To collect high-quality data material, utilisation of an appropriate IT-solution matching the definition of the varied requirements is necessary. Within the scope of the multEE project, one goal is to develop a database suitable for all partner countries, with the possibility to implement this for further interested countries. This database should serve as a centralized source with a clearly defined collection procedure.

To use an appropriate IT solution, the following questions need to be answered:

- Which and how many parties are obliged or allowed to insert data into the IT application?
- Which values based on the bottom-up calculation methodology for energy efficiency measures and contact information need to be entered?
- Is special training necessary to use the IT application?
- How will the data be used for reporting and evaluation?
- How is data privacy secured?
- How frequently should the data be reported?

To ensure that only authorised parties insert data into the IT application, it is necessary to determine these specific person groups. Depending on the specific commitment system in the particular country, various parties should gain access to the IT application. These parties might be enterprises such as energy suppliers or energy distributors obliged to perform energy efficiency measures according to Article 7 of the EED, as well as not obliged parties who potentially want to (provided that they are allowed to) report energy efficiency measures.

Furthermore, representative bodies across different administrational levels (national, regional, municipal) often need access to the IT application as well. These authorities might, for example, add energy efficiency measures related to state subsidies. In order to prevent double counting, it is important to set out clear provisions between public funding bodies and private funding bodies. Binding rules concerning the attribution and splitting of energy efficiency measures are also important in order to prevent double counting.

In Austria the only obligated party from the public sector is the federal government. Nevertheless absent legal regulations led to uncertainties concerning the reporting of energy efficiency measures between the regional and national administrative levels. The federal government has the responsibility to save 151 PJ by the end of 2020, yet the government itself is not able to provide this high amount of energy savings without energy savings from the federal states.

This shows the importance of a legal regulation in the respective state based on the EED which defines the obligated (private and public) parties, the obligations and the collection of data, etc.:

- Who in particular is obligated?
- What is the obligation in particular?
- What are the relevant time periods?
- Who has to report which kind of data concerning energy efficiency measures?
- What is the function of the monitoring body?

A detailed legal regulation ensures transparency in relation to the obligations for each obligated party and the data to be transmitted.

Austria has been using an online database to collect and calculate energy savings from energy efficiency measures bottom-up for the ESD and EED, but it is also possible to transmit proof of qualification by energy auditors, therefore energy auditors also need to gain access to the IT solution (AEA, 2016b)

Furthermore, data security is an essential topic. As the IT solution deals with confidential data, enterprises need to be sure that corporate data and data on

energy efficiency measures are safe and that IT-access to the solution is only granted to entitled individuals.

In Austria, the IT solution for the energy efficiency measures is hosted by the 'Unternehmensserviceportal (USP)', which is the Austrian Federal Government´s centralised web portal aiming to serve as a single entry point for businesses to fulfil their legal obligations online. The USP offers a high standard of data security as well as the possibility for companies to individually define access privileges (e.g. one employee is allowed to only view data concerning energy efficiency measures while another employee might have the permission to view and edit data in the IT application etc.) (Unternehmensserviceportal, 2016).

Another important issue is to provide support for all stakeholders to assure the adequate utilisation regarding the reporting of energy efficiency measures. To support the data collection process, various instruments can help to increase the acceptance of the IT data collection tool, such as a service hotline for obligated and potentially not obligated parties a manual and the reduction of access barriers for the IT-application. Information events and training courses for obliged parties, e.g. energy suppliers and representatives of public authorities, are also useful tools to increase the quality of the reported data.

Depending on the commitment system, it might be reasonable for some countries to utilise the IT solution not only for energy efficiency measures but also to report further data material (e.g. energy audits, diplomas and certificates from energy auditors).

The reporting cycles are mainly regulated through the legislation on EU level and on national levels in the respective EU member states. The EED requires each member state to submit a national energy efficiency action plan every three years, starting in 2017. At the national level, the review and the reporting relating to energy efficiency measures has been established mainly on an annual basis. These national reports serve obliged and not obliged parties as important decision-making tools and information sources concerning the achievement of energy saving goals and energy efficiency measures.

During the commitment period, obligated parties in Austria have to report energy efficiency measures for the previous year by the 14th of February of the following year.

VI Verification and control

To increase the effectiveness of the verification and the control process as well as the M&V schemes as a whole, the development of an integrated IT system is therefore essential (CRES, 2016).

In Austria, the necessary data on implemented energy efficiency measures is collected in a central online data base.

In order to verify the reported data based on the bottom-up calculation methodology, numerous components need to be enquired. The query is explained using the simple example of energy efficient lighting in Austrian industrial buildings, based on the report concerning the general formulae of bottom-up methods. The table below shows what kind of information is required when reporting such measure (AEA, 2016, p. 108).

Table 1: Example of a query of energy efficient lighting in industrial buildings in Austria

Reporting institution	Energy efficiency measure	Evidence
Contact data	Date of implementation	Invoice concerning the purchase of energy efficient lighting.
Address	Location of the measure (If the address of the party is not the place where the measure was carried out)	contract of transmission of ee-measures
Obligation status	Type of efficient lighting system	
	Number of lighting systems modernised	
	Power need of a single lighting device	
	Subsidy	

Source: Austrian Energy Agency

It should be noted that for different kinds of energy efficiency measures, various types of evidence is necessary. For efficient lighting, the evidence mentioned above might be sufficient whereas for behavioural measures, different evidence might be required, e.g. signed advice record, training certificate, and proof of qualification regarding the trainer.

When it comes to standardised energy efficiency measures, default values are determined through the relevant body or agency in the respective country. For default values, the obliged parties do not need to prove the amount of energy savings. In these cases, the obliged parties only need to provide proof of the actual implementation of the energy efficiency measure.

For some energy efficiency measures, project specific values can be used. Project specific values need to be proved through the obliged party, for instance higher yearly operating hours than the default values (AEA et al, 2016, p.109). In this case, obligated parties need to provide evidence concerning the actual implementation of the energy efficiency measures and the project specific values, e.g. extended operating hours.

Depending on the specific commitment system in the project country, the query might require an adaption concerning the requested values and data.

In Austria, energy suppliers are required to report energy efficiency measures on an annual basis, based on the previous' year amount of final energy sold to end consumers in Austria. Thus, the IT-application in Austria needs to query the amount of final energy sold to end consumers from energy suppliers as well.

VI.ISample size and representativeness

Article 7 of the EED requires that"…a control system is put in place that also includes independent verification of a statistically significant proportion of the energy efficiency improvement measures" (European Commission, 2012, p.17).

The amount of energy efficiency measures checked in detail is usually a single-digit percentage range of the total energy efficiency measures reported. It is advisable to estimate the sum of energy efficiency measures for the checking procedure in order to provide sufficient resources for this procedure.

It is also advisable to involve considerations concerning a statistically significant sample into the determination of the sample size although it has to be mentioned that in reality it is sometimes not possible to control a statistically significant sample of energy efficiency measures. Reasons for this might be limited structural or personnel resources or specified targets set by the contracting authority.

The following table shows the sample size for several levels of targeted populations, which is statistically important taking into consideration different scenarios for the confidence level and the confidence interval.

Table 2: Sample size of targeted population

Population Size (total amount of reported energy efficiency measures)	SIGNIFICANT SAMPLE					
	Confidence Level = 95% Confidence Interval			Confidence Level = 99% Confidence Interval		
	10%	5%	1%	10%	5%	1%
100	49	80	99	63	87	99
500	81	217	475	125	286	485
1,000	88	278	906	143	400	943
5,000	94	357	3,288	161	588	3,845
10,000	95	370	4,899	164	624	6,247
50,000	96	381	8,057	166	657	12,486
100,000	96	383	8,763	166	661	14,267
500,000	96	384	9,423	166	665	16,105
1,000,000	96	384	9,513	166	665	16,369

Source: Greek Centre of Renewable Energy Sources and Savings

The Confidence Interval implies the positive and negative deviation, which is allowed for the sample regarding the obtained results.

The Confidence Level indicates the percentage of the population that is identified within the boundaries of the Confidence Interval.

For example, if you want to control a significant sample of energy efficiency measures based on a total population of e.g. 10,000 reported measures with a confidence level of 95% and a confidence interval of 5%, the sample size is 370.

Plausibility check

An important issue is what measures are controlled and verified. As it makes a great difference in the amount of data that has to be controlled, the responsible body needs to determine at what point energy efficiency measures are controlled and verified.

In Austria, measures are only controlled after being reported by an obligated party, i.e. energy supplier.

The aim of a plausibility check in the context of reporting energy efficiency measures is a rough calculation and review of the total amount of all energy efficiency measures which are notified in the IT-solution. All data indicated by

obliged parties are checked by the plausibility check. This process is executed to a large extent automatically by desktop checks supported by the IT-solution.

Within the scope of the plausibility check, various reviews for measures based on default values are possible, e.g.:

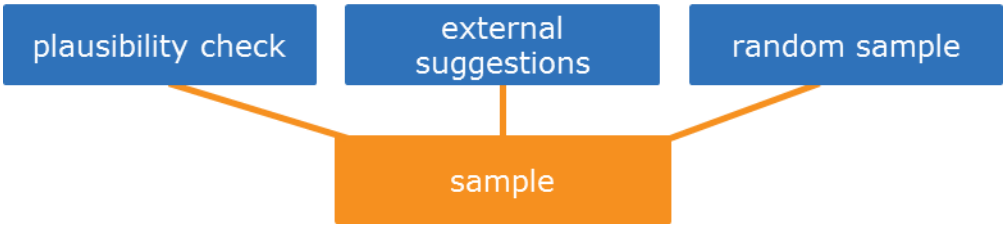
- Have all required fields been filled in correctly?
- Are there invalid combinations or deviations from default values?
- Was the energy saving goal per obliged party fulfilled?
- Have obliged parties reported energy efficiency measures at all?
- Has the same energy efficiency measure been reported twice?
- Is the amount of energy efficiency measures per category for one country possible at all?
- Are the values of the project specific measures realistic?

The plausibility check for measures based on project specific values is carried out by means of statistical outliers, e.g. extremely high energy savings compared to similar energy efficiency measures.

A sample of energy efficiency measures will be verified by the responsible body by means of depth checks (desktop checks) and occasionally by on-site visits.

The total sample should therefore contain conspicuous energy efficiency measures identified throughout the plausibility check, external suggestions (whistle-blower) and a random sample of energy efficiency measures as shown in Figure 4. Constant contact to the obligated parties, the contracting authority and all stakeholders lead to external suggestions concerning the control of certain energy efficiency measures. The randomly selected energy efficiency measures will be picked representatively in relation to the population.

Figure 4: Sample composition



Source: Austrian Energy Agency

To ensure the provision of an effective and efficient control process, various resources are required:

- IT-solution for the reporting of the energy efficiency measures
- Bottom-up methodologies which simplify the reporting of energy efficiency measures
- Personnel resources with the adequate educations (IT training, knowledge of statistical evaluation, etc.)
- Legal ordinance which defines the obligations of the obligated parties and the possibility to threat with punishment

In Croatia, the measured energy savings are verified through algorithms in SMIV – the M&V system. Targets for each measure in SMIV are related to those same measures planned through the Croatian NEEAP.

Detailed desktop check

Desktop check means the detailed check of reported data as well as the verification and validation of the reported energy efficiency measures by a research associate via a PC workstation. The calculation and documentation is evaluated based on paper files submitted through the IT solution (e.g. general information concerning the energy efficiency measure, invoice concerning the purchase of the energy efficient lighting as evidence, etc.). In order to clarify uncertainties regarding the report of energy efficiency measures, it is advisable to grant the obliged party the possibility to transmit missing paper files on demand to the responsible body.

Topics regarding the detailed desktop check are:

- General information: Is the general information concerning the company correct (e.g. address, energy sales, etc.)?
- Verification Process: Is the result of the calculation correct? Were the right default values from the bottom-up method catalogue used? Are the project specific values transparent?
- Validation Process: Was the right calculation method used for the energy efficiency measure? E.g. possibly the obliged party used the method *energy efficient lighting in residential buildings* instead of *efficient lighting in industrial buildings*.
- Evidence: Do the documents prove that the existence of the measure is sufficient and true? E.g. does an invoice confirm the amount of efficient lighting reported and is the confirmation reliable?

To guarantee a constant control process regarding the desktop checks, a defined checking routine is required. The following table shows a possible structure for a test protocol.

Table 3: Defined checking routine for desktop-checks

Check routine for energy efficiency measures			
General information: date, identification number, examiner, etc.?			
Reason for the review?			
Description of the review?			
Result of the review?			
Country specific reviews?			
yes	no	check information	comment
□	□	double counting	
□	□	verification document	
□	□	verification documents inquired	
□	□	country specific topics	

Source: Austrian Energy Agency

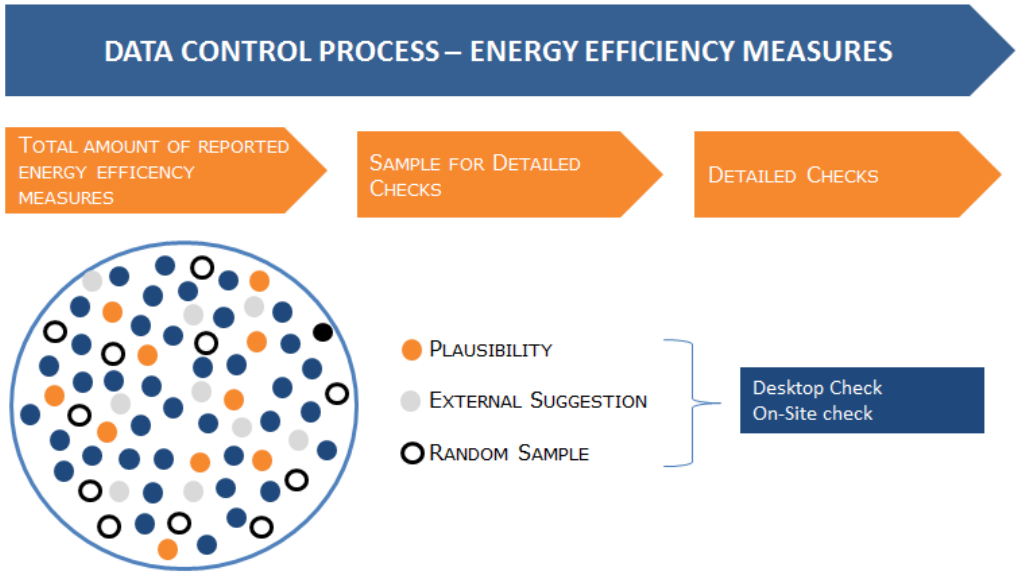
On-site checks

On the other hand, on-site checks are a useful tool to verify energy efficiency measures in detail on company premises and they also increase the presence of the authority in charge. However, it should be noted that this kind of review takes a lot of resources and sometimes it is not possible to review measures on-site, e.g. which measures were implemented by private households. Those measures can be controlled by detailed desktop checks.

VI.II The entire control procedure can be summarised as follows:

Each reported energy efficiency measure will go through a plausibility check which is largely carried out automatically; each suspicious measure will be included in the sample for a detailed check. In this way, all submitted energy efficiency measures can be checked roughly. Furthermore, the sample for the detailed checks contains externally suggested (e.g. whistle-blower) and representative randomly picked energy efficiency measures. Detailed checks are carried out by desktop checks and on-site checks. This procedure assures the efficient review of all data reported.

Figure 5: Data control process



Source: Austrian Energy Agency

VI.III Compensation Payments and administrative Fines

To ensure the implementation of energy efficiency measures, Member States should define compensation payments and administrative fines to take possible actions in case of non-compliance. This should be regulated by law so the administrative sanction can be enforced.

In Austria, compensation payments in the amount of EUR 20 cents per kWh become due if energy suppliers fail to provide proof of the required energy-efficiency measures by the specified deadline.

Furthermore, the Energy Efficiency Act entails administrative fines ranging from EUR 10.000 to EUR 100.000, depending on the nature of the offence committed by an energy supplier. In particular, fines of up to EUR 100.000 may be imposed on suppliers that fail to fulfil their individual energy-saving obligations or fail to make compensation payments on time. This administrative penalty for violation of regulations is imposed by the administrative authority concerned.

In Croatia, penalties exist in the Energy Efficiency Act, but they are only foreseen for the part of not planning the measures or not entering the implemented measures into SMIV. There is no penalty for failing to implement the measures within a specific time period.

VII Conclusions / Recommendations

A well-defined data collection process is a crucial step in the process of monitoring the impacts of energy efficiency policies and measures in terms of energy savings. When planning the data collection process, it is necessary to deal with a number of questions such as: Who needs to be involved? What are the legal aspects that need to be changed? Which legal bases have to be created? What resources will be needed? Etc.

Before starting with the definition of the data collection process, MS need to have a solid understanding of what exactly shall be monitored. Hence, the MS needs to define which measures should be monitored and verified. Only then can the relevant data needed to monitor and verify the EE-measures be specified.

When planning the data collection process, each MS needs to decide whether existing data sources can or will be used to obtain the relevant data or if they will collect data on an individual basis. After having defined this, the relevant bodies for the data collection process should be entitled and the data gathering process specified. Having structured a thorough data collection process will enable MS to monitor their energy efficiency policies and verify the achieved saving targets.

A MS should have a clear structure that identifies the desired results, the resources and activities necessary to accomplish these outcomes and a detailed list of the specific measures that will be taken. Once this is complete, the gathering of relevant data can start. This enables MS to monitor energy efficiency targets and report consistent and high quality data on a regular basis. Last but not least, MS have the possibility to recognize the effectiveness and value of their measures and pinpoint where changes or improvements need to be made.

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IX Annex: Guiding Questions for the Definition of the Data Collection Process

Measures to be monitored with the MVP Tool

- In which sectors will or can energy savings be achieved?
- Which measures shall be monitored?

Defining the required detailed data per measure to be monitored:

- Which bottom-up methods will be used to assess the impact of single energy efficiency measures?
- Definition of country-specific calculation values (default values) for bottom-up monitoring.
- What data needs to be collected?

Available Data Sources

- Are national data sources available? Quality of the data sources?
- What resources are available, such as staff, time, and money?
- Which method will be used for data collection?

Responsible bodies and specific contact persons for data collection

- Who needs to be involved?
- What are the legal aspects that need to be changed?
- Which legal bases have to be created? Etc.
- Who in particular is obligated?
- What is the obligation in particular?
- What are the relevant time periods?
- Who has to report which kind of data concerning energy efficiency measures?
- What is the function of the monitoring body?

Definition of data gathering process for using the MVP Tool

To use an appropriate IT solution, the following questions need to be answered:

- Which parties and how many are obliged or allowed to insert data into the IT application?
- Which values based on the bottom-up calculation methodology for energy efficiency measures and contact information need to be entered?
- Is special training necessary to use the IT application?
- How will the data be used for reporting and evaluation?
- How is data privacy secured?
- How frequently should the data be reported?

Verification and Control procedures

- Have all required fields been filled in correctly?
- Are there invalid combinations or deviations from default values?
- Was the energy saving goal per obliged party fulfilled?
- Have obliged parties reported energy efficiency measures at all?
- Has the same energy efficiency measure been reported twice?
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