T3.1: Report on the data used, their sources and on the methodology used for the tool development

Ole Michael Jensen / AAU

September 2017

Task 3.1 coordinator: Alexandros G. Charalambides

This project has received funding from the European Union's Horizon 2020 programme under Grant Agreement No 695873

Table of Content

1. Introduction

This report documents the work done in Task 3.1: Definition of key data from EPC and open data to cover the needs identified in WP2.

Based on the outcomes of WP2, and the information gathered, the aim of this task is to analyse which data would be needed for the methodology for the development of the ENERFUND tool. Hence, within this task, all possible parameters needed for development of the tool have been identified.

2. Data and key drivers identification

In order to identify the most important data and parameters for the development of the ENERFUND tool several key drivers and criteria were examined according to previous studies, expert's opinion and surveys conducted in the framework of the ENERFUND project.

Nevertheless, the most important key drivers affecting the demand for energy renovation depended on who the decision maker is. One parameter can affect significantly the decision making for a user type A, but could have the minimum impact on the decision of a user type B. Thus, the most important parameters have been identified and listed for: owners of commercial buildings, owners of public buildings, financial institutions and ESCOs. These tables are presented in the **Appendix 2** of the current document, including comments or suggestions on how these drivers could be used from the ENERFUND tool or whether there is any related open data source.

Based on WP2 inputs three kind of data have been identified:

1. Mandatory data,
2. Additional data and
3. Predetermined data (default values).

Whereas the Mandatory values are crucial for the initial ENERFUND tool working, the additional values are necessary data to be delivered by the users for qualifying the ENERFUND output. Mandatory data will by necessity be the basis for the screening of possible deep energy-renovation potentials for instance by rating public buildings according to their year of erection and actual energy performance.

The mandatory data are EPC data. These data are collected by the national energy agencies or parallel institutions responsible for the Energy Performance Certificate scheme. Also data from databases holding energy and fuel prices might be used as mandatory data for the initial tool working.

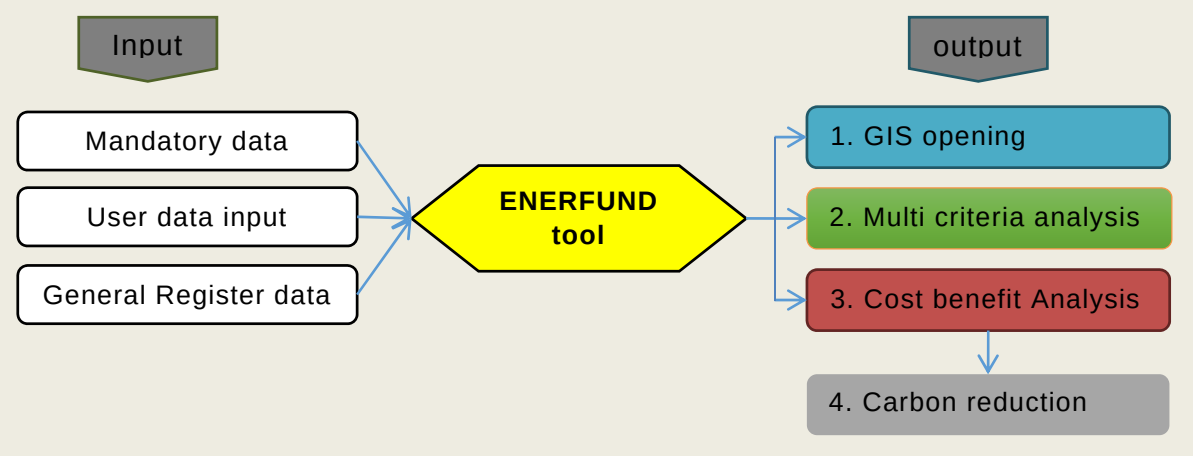

Figure 1 -Input and output data illustrating how the ENERFUND tool will be able to transform.

The mandatory data will mainly be used for the Enerfund creating of a GIS opening which at the same time will generate the initial screening, i.e. the first identification of buildings that might be object for a deep energy renovation. Additional data are needed in preparation for a multi criteria analysis that seriously will be able to identify candidates for energy renovation. Moreover, a cost-benefit analysis will contribute to the final identification of possible business cases. Also this analysis will need input in the form of national register data. Finally, as a consequence of a business case and the associated carbon emission reduction, data necessary for this task might also be found in national register data bases.

3. Mandatory data input

Mandatory data for the development of the ENERFUND tool are data found in the national EPC registers. Next to that important data bases are found in the national building registers containing information about time of erection, ownership, application and for some Member States measured energy consumption. In case of no access to building register data, information of the individual buildings may be found in the EPC data base as well. Finally, important data are energy data concerning electricity prices, district heating prices etc. Energy data includes national CO_2 emission factors and climate data. These data must be updated regularly according to the price movement in the individual member states.

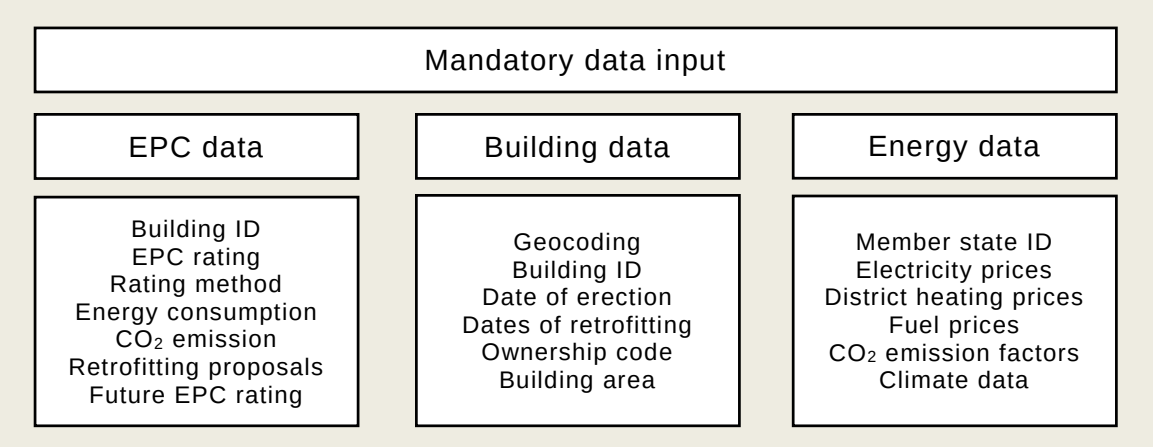

Figure 2 -Mandatory data bases are national databases more or less open to the public and more or less available for data capture.

Since EPC data among EU member states are always based on the Energy Performance Building Directive, most data gathered in the individual member state registers are relatively comparable. Thus, all national EPC data bases encompass an EPC rating reflecting an estimate of energy consumption, based on either asset or operational rating. Most national energy performance schemes require a list of retrofitting proposals as well and consequently a “future” EPC rating.

Building data are usually found in national building and dwelling registers. In this data collection the date of erection of the individual buildings and type of building are found. Also dates of retrofitting, ownership code, building area (heated and total area) etc. are usually represented in these databases.

Energy data means on one hand energy prices and energy taxes and on the other CO_2-emission factors and appliance-efficiency factors for instance concerning gas boilers and heat pumps. Energy prices are subject to daily change and concerning district heating prices subject to local price setting. Annual averages can serve as relevant input for the rating tool.

4. User data inputs

The mandatory data input from EPC databases, Building databases and Energy data are crucial for the first benchmarking and identification of potential buildings for deep renovation. However, for further qualification of the individual building, user data will be necessary for the ENERFUND tool working. Thus, it is expected, that these data are uploaded by the users when they are entering the ENERFUND. Put otherwise, this feature will be part of the tool, so that users when availing themselves of the tool, the necessary information will be requested and immediately integrated the benchmarking and in the final end make rating still more precise.

The interested in the field of energy saving in buildings and thereby interested users of Enerfund are:

1. Energy service companies (ESCO) and retrofitting companies,
2. Financial institutions and
3. Building owners.

The first user type includes companies specialized in either delivery of energy services (ESCOs) or in delivering building upgrade in the form of energy retrofitting or less exhaustive: energy refurbishment.

Financial institutions are typically banks concerned with real estate loans and other mortgage providers.

Building owners can be private house owners, landlords, housing associations, institutional owners, public authorities and company owners.

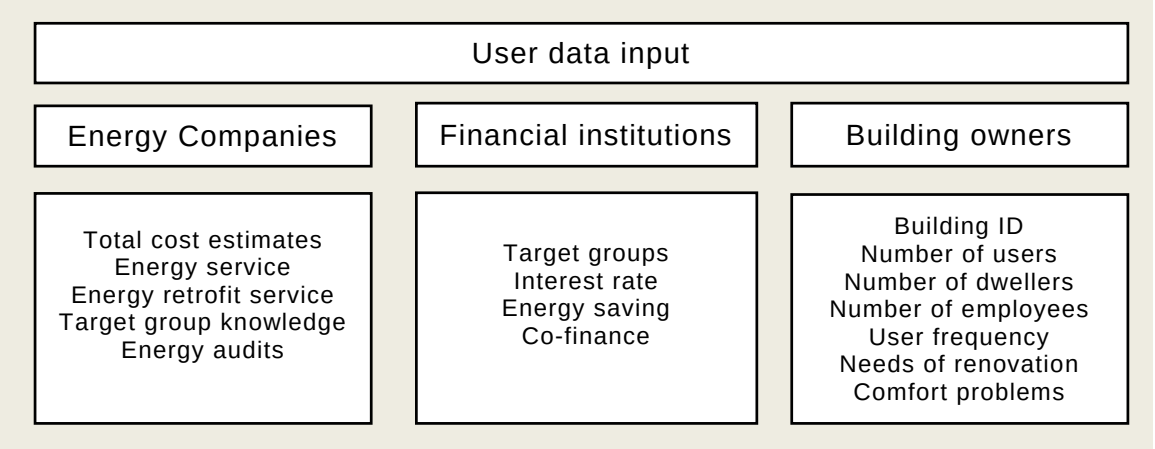

Figure 3 -Additional data inputs are data generated by the users: Building owners, financial institutes and energy companies respectively.

5. General register data

First general register data are economic data, energy data and climate data. The data are fixed data obtained from national building regulations (building code), EU building standards (EPBD requirements) and different default values like boiler and heat pump performance. Second, general register data can be economic data like national bank interest rates, national subsidy schemes for energy retrofitting and different default values like, minimum co-finance, transaction costs and exchange rates. Third, general register data are energy data like estimates of future oil, natural gas and electricity prices, national CO_2 values of electricity and district heating production and default values like energy content of fuels and CO_2 emission by exchange of fuels. Finally, general register data are data for climate correction in the form of national heating and cooling degree days.

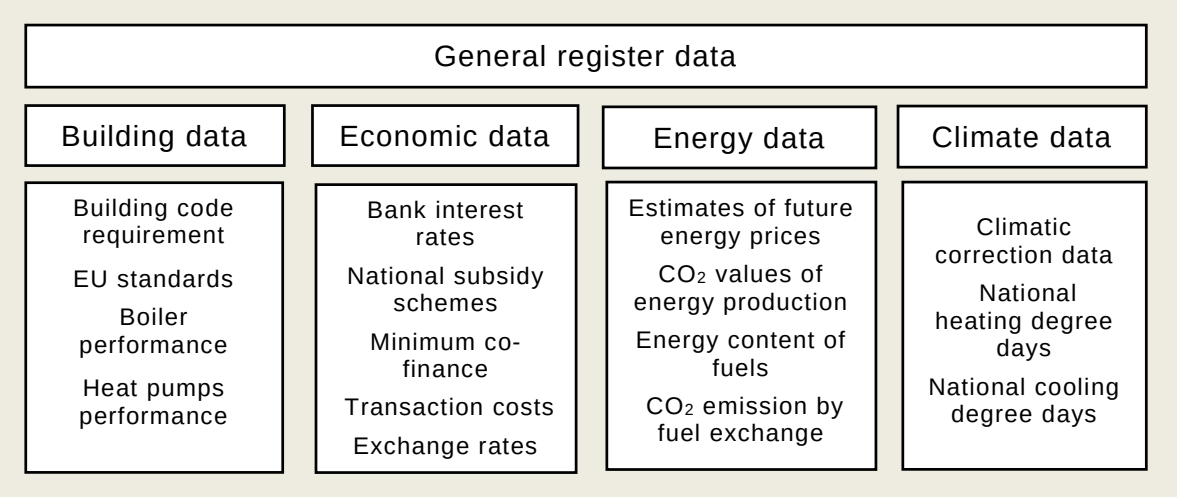

Figure 4 -Different kinds of general register data are necessary for benchmarking of buildings ready for deep energy renovation.

6. Data sources

Crucial for the tool development is access to national databases with EPC data and general register data as well. To get knowledge about the access for each individual country, a comprehensive questionnaire was filled in by ENERFUND participants. A total outcome of the request is found in the

Appendix 1: Key drivers for energy renovation

Key Drivers affecting the Demand for Energy Renovation for owners of commercial buildings

1	Awareness at Key Decision Maker Level & Leadership	If all decision makers are aware of the potential renovation and they are positive. Precondition for the decision making. If the decision makers are negative to changes/new investments and conservative this will reduce significantly the decision perspective.
2	Clear Business Case (tool evaluation)	Annual energy savings potential leads to a clear business case (IRR, payback period). The tool will calculate the (simple) payback period and the IRR and provide a score according to the results.
3	Standardization	- Uptake and use of standards at Member State level for Energy Performance Contracts developed, working with ESCOs and for MRV and legal documentation (CEN-CENELEC EN/HD implementation rates per country). - Specialized insurance coverage for reduction of financial risk
4	Buildings Regulation, Certification and Energy Performance Certificates	- Building specific: Availability of EPC - Country specific: EPC information detailed, useful for investors?
5	Effective enforcement of regulation (also see 14: Doing Business Report)	
5.1	Enforcing contracts	Open source data per country Doing Business ranking
5.2	EU standards adaptation	Open source data per country CEN-CENELEC EN/HD Implementation Rates per Country
6	Regulatory Stability	EU & Country specific
7	Regulation which impacts on timing and scope of renovation	EU & Country Specific: The Energy Efficiency Directive places energy savings requirements on EU countries' buildings. This includes making central government buildings more energy efficient and requiring EU countries to establish national plans for renovating overall building stock. EU countries have drawn up strategies to show how they plan to foster investment into the renovation of residential and commercial buildings. These strategies are part of their National Energy Efficiency Action Plans.
8	Measurement,Reporting and Verification (MRV) and Quality Assurance	MRV and quality assurance ensure the sustainability of the energy retrofitting Depending on each project (If no MRV application, maintenance plan is foreseen?)
9	Transaction costs/ simplicity	
9.1	Single or multi ownership	Single ownership facilitates the renovation decision making
9.2	Single or multi users (not persons, bodies)	Single building-user facilitates the renovation decision making
9.3	100% own resources	Independency of external financial resources makes the project more simple and feasible.
10	Price of energy	Electricity and natural gas prices available at EUROSTAT energy prices,http://ec.europa.eu/eurostat Electricity_and_gas_prices,_second_half_of_year,_2013–15_(EUR_per_kWh)_YB16 High energy price will receive high score (motivation) e.g. country with low energy prices -> no motivation to renovate. Taken into account for the IRR and payback period calculation.
11	"Green Premium"/ Brown Discount	
12	Green policy/ opportunity to promote more the Institution	
13	Facilitation/Technical Assistance	Proper project's technical team available (internal or external)
13.1	Energy Audit	Yes -> More mature project

14	Key Parameters from Doing Business Report	
14.1	Ease of dealing with construction permits (DTF)	Open source data per country Doing Business ranking
14.2	Ease of Construction RANK	Open source data per country Doing Business ranking
14.3	Getting credit	Open source data per country Doing Business ranking
15	Availability of a special European or national or district or local granting scheme for energy renovations	Open source data (y/n as motivation parameter) Related with other financial indicators. However its contribution lies on the motivation of the market because of this parameter.
16	Availability of loan programs specialized for energy renovations	Open source data (y/n as motivation parameter) Related with other financial indicators. However its contribution lies on the motivation of the market because of a specialized loan program availability.
17	Current Building thermal comfort	The higher the thermal comfort is, the lowest the score. An energy retrofitting is expected to improve the indoor's thermal comfort for the users of the building.
18	Current noise level comfort	The higher the noise level comfort is, the lowest the score.
19	Does the building will be renovated anyway (y/n)	Favorable parameter for the implementation of the project.
20	Evaluation of the condition of the electrical and mechanical systems (after the renovation)	The user will evaluate the condition of the building's equipment in order to ensure the sustainability of the project. Equipment in bad condition (which will not be replaced) increases uncertainties and the financial risk and thus makes the energy retrofitting less attractive.
21	Requested loan in accordance with the market value after renovation (y/n)	Starting point/precondition No -> not feasible project
22	Availability of actual energy data	The use of actual energy data reduces the financial risk (higher level of accuracy)
23	VAT exception (lower VAT rates for renovation)	Motivation for energy renovation (y/n)
24	Structural Condition	Self evaluation if the building is suitable for renovation Too old building might not be selected to be renovated

Key Drivers for Energy Renovation Decision Making for Owners of Public Buildings

1	Rules on public authority accounting, procurement and reporting	National public procurement procedures adapted in light of the need to renovate Public Buildings at scale, in particular regarding the procurement of energy performance contracts.
2	Awareness at Key Decision Maker Level & Leadership	If all decision makers are aware of the potential renovation and they are positive. Precondition for the decision making. If the decision makers are negative to changes/new investments and conservative this will reduce significantly the decision perspective.
2.1	(Political Commitment: in case of public sector)	If political commitment exists (e.g. Covenant of Mayor (open source data could be used), Green Procurement Action Plan)
3	Clear Business Case	Annual energy savings potential leads to a clear business case (IRR, payback period). The tool will calculate the (simple) payback period and the IRR and provide a score according to the results.
4	Standardization	- Standard tender documents for energy renovations - Mandatory training for procurement officers on energy efficiency - Uptake and use of standards at Member State level for Energy Performance Contracts developed, working with ESCOs and for MRV and legal documentation (CEN-CENELEC EN/HD implementation rates per country). - Specialized insurance coverage for reduction of financial risk
5	Buildings Regulation, Certification and Energy Performance Certificates	- Building specific: Availability of EPC - Country specific: EPC information detailed, useful for investors
6	Effective enforcement of regulation (see also 15: Doing Business Report Rankings)	
6.1	Enforcing contracts	Open source data per country Doing Business ranking
6.2	EU standards adaptation	Open source data per country CEN-CENELEC EN/HD Implementation Rates per Country
7	Regulatory Stability	Country specific
8	Regulation which impacts on timing and scope of renovation	EU & Country Specific: The Energy Efficiency Directive places energy savings requirements on EU countries' buildings. This includes making central government buildings more energy efficient and requiring EU countries to establish national plans for renovating overall building stock. EU countries have drawn up strategies to show how they plan to foster investment into the renovation of residential and commercial buildings. These strategies are part of their National Energy Efficiency Action Plans.
9	Measurement, Reporting and Verification (MRV) and Quality Assurance	MRV and quality assurance ensure the sustainability of the energy retrofitting Depending on each project
10	Transaction costs/ simplicity	
10.1	Single or multi ownership	Single ownership facilitates the renovation decision making.
10.2	Single or multi users (not persons, bodies)	Single building-user facilitates the renovation decision making.
10.3	100% own resources	Independency of external financial resources makes the project more simple and feasible.
11	Price of energy	Electricity and natural gas prices available at EUROSTAT energy prices,http://ec.europa.eu/eurostatElectricity_and_gas_prices,_second_half_of_year,_2013–15_(EUR_per_kWh)_YB16

		High energy price will receive high score (motivation) Taken into account for the IRR and payback period calculation.
12	Tailored Financial Product Availability	
13	Green policy/ opportunity to promote more the Institution	Level of Importance of green publicity
14	Facilitation/ Technical Assistance	If a proper project's technical team has formulated (internal or external)
15	Key Parameters from Doing Business Report	
15.1	Ease of dealing with construction permits (DTF)	Open source data per country Doing Business ranking
15.2	Ease of Construction RANK	Open source data per country Doing Business ranking
15.3	Getting credit	Open source data per country Doing Business ranking
16	Availability of a special European or national or district or local granting scheme for energy renovations	Open source data (y/n as motivation parameter) Related with other financial indicators. However its contribution lies on the motivation of the market because of this parameter.
17	Availability of a loan program specialized for energy renovations	Open source data (y/n as motivation parameter) Related with other financial indicators. However its contribution lies on the motivation of the market because of specialized loan program availability.
18	Current Building thermal comfort	The higher the thermal comfort is, the lowest the score. An energy retrofitting is expected to improve the indoor's thermal comfort for the users of the building.
19	Current noise level comfort	The higher the noise level comfort is, the lowest the score.
20	Does the building will be renovated anyway (y/n)	Favorable parameter for the implementation of the project.
21	Evaluation of the condition of the electrical and mechanical systems	The user will evaluate the condition of the building's equipment in order to ensure the sustainability of the project. Equipment in bad condition (which will not be replaced) increases uncertainties and the financial risk and thus makes the energy retrofitting less attractive.
22	Requested loan in accordance with the market value after renovation (y/n)	Starting point/precondition No -> not feasible project
23	Availability of actual energy data	The use of actual energy data reduces the financial risk (higher level of accuracy)
24	Structural Condition	Self evaluation if the building is suitable for renovation Too old building might not be selected to be renovated

Key Drivers affecting the supply of Energy Renovation Investments (Financial Institutions)

1	Standardization	

2	Regulatory Stability	
3	Measurement, Reporting and Verification (MRV) and Quality Assurance	MRV and quality assurance ensure the sustainability of the energy retrofitting Depending on each project
4	Increased Investor Confidence & Change in Risk Perception	
5	Lender's approach to risk assessment (non-recourse project financing vs. Borrower-based credit recourse)	
6	Availability of Data	The use of actual energy data reduces the financial risk (higher level of accuracy)
7	Transaction costs/ simplicity	
7.1	Single or multi ownership	Single ownership facilitates the renovation decision making
7.2	Single or multi users (not persons, bodies)	Single building-user facilitates the renovation decision making
8	Risk-return targets	
9	Definition and common understanding of the value of energy cost savings	Clear understanding on the energy saving sources which lead to energy cost reduction
10	Price of Energy	Electricity and natural gas prices available at EUROSTAT energy prices,http://ec.europa.eu/eurostatElectricity_and_gas_prices,_second_half_of_year,_2013–15_(EUR_per_kWh)_YB16 High energy price will receive high score (motivation) Taken into account for the IRR and payback period calculation.
11	Use of European Structural & Investment Funds (y/n)	If yes it Reduces the financial risk
12	Buildings Regulation, Certification and Energy Performance Certificates	
13	Body of Evidence (including Social Benefits and Costs)	
14	Sustainable Real Estate Funds	
15	Key Parameters from Doing Business Report	
15.1	Ease of dealing with construction permits (DTF)	Open source data per country Doing Business ranking
15.2	Ease of Construction RANK	Open source data per country Doing Business ranking
15.3	Getting credit	Open source data per country Doing Business ranking
16	Financial Indicators (according to calculations of the tool)	
16.1	IRR	The higher the IRR is, the more feasible is the investment
16.2	Payback Period	The lower the period, the more attractive is the investment
17	Availability of a loan program specialized for energy renovations (launched by the financial institution)	Open source data Related with other financial indicators. However the contribution lies on the sensitivity of the financial institution on energy renovations
18	Requested loan in accordance with the market value after renovation (y/n/ don't know)	Precondition
19	Owner's payment capacity	Healthy payment capacity is required (precondition)
20	Energy Audit (yes/no/ under preparation)	If an energy audit was carried out, it reduces the risk
21	Maintenance plan after the renovation	Reduces the risk
22	Green policy/ opportunity to promote more the Institution	If it is important or not for the financial institution

Key Drivers for the supply of Energy Efficiency Investment (ESCOs)

1	Standardization	
2	Regulatory Stability	
3	Measurement, Reporting and Verification (MRV) and Quality Assurance (User Input)	MRV and quality assurance ensure the sustainability of the energy retrofitting Depending on each project Important key driver for ESCOs
4	Increased Investor Confidence & Change in Risk Perception	
5	Lender's approach to risk assessment (non-recourse project financing vs. Borrower-based credit recourse)	
6	Availability of Data	Reliable energy data (3 year-period) reduce the risk of the ESCOs as the related calculations include less uncertainties
7	Transaction costs/ simplicity	
7.1	Single or multi ownership	Single ownership facilitates the renovation decision making
7.2	Single or multi users (not persons, bodies)	Single building-user facilitates the renovation decision making
8	Risk-return targets	
9	Definition and common understanding of the value of energy cost savings	Reduces the risk of the investment (related with MRV)
10	Price of Energy	Electricity and natural gas prices available at EUROSTAT energy prices,http://ec.europa.eu/eurostatElectricity_and_gas_prices,_second_half_of_year,_2013–15_(EUR_per_kWh)_YB16 High energy price will receive high score (motivation) Taken into account for the IRR and payback period calculation. Moreover for ESCO projects: - If the project is not affected by future energy prices changes, it reduces the financial risk. (max score) - If the ESCO company receives all the risk of the energy price fluctuations this means increased financial risk (no score) - Another option could be to balance the risk between the owner and the ESCO
11	Use of European Structural & Investment Funds	
12	Buildings Regulation, Certification and Energy Performance Certificates	
13	Body of Evidence (including Social Benefits and Costs)	
14	Sustainable Real Estate Funds	
15	Key Parameters from Doing Business Report	
15.1	Ease of dealing with construction permits (DTF)	Open source data per country Doing Business ranking
15.2	Ease of Construction RANK	Open source data per country Doing Business ranking
15.3	Getting credit	Open source data per country Doing Business ranking
16	Financial Indicators (according to calculations of the tool)	
16.1	IRR	The higher the IRR is, the more feasible is the investment
16.2	Payback Period	The lower the period, the more attractive is the investment
17	Availability of a loan program specialized for energy renovations	Open source data Related with other financial indicators.
18	Investment in accordance with the ESCO's annual cash flow (y/n/ don't know)	precondition

19	Owner's payment capacity	precondition
20	Maintenance plan foreseen after the renovation	Reduces the risk Moreover, the investment is less risky for the ESCO, if the maintenance will be carried out by the ESCO
21	Guarantees foreseen	Ensures ESCO payments
22	Evaluation of the condition of the electrical and mechanical systems (after the renovation)	The user will evaluate the condition of the building's equipment in order to ensure the sustainability of the project. Equipment in bad condition (which will not be replaced) increases uncertainties and the financial risk and thus makes the energy retrofitting less attractive.
23	Contract Duration	Long period contract increases the risk for ESCO

Sources for key drivers identification

- Energy Efficiency Financial Institutions Group: Final Report, covering buildings, industry and SMEs (February 2015)
- European Commission, DG Energy: Market study for a voluntary common European Union certification scheme for the energy performance of non-residential buildings (2012)
- Doing Business Report: Measuring Regulatory Quality and Efficiency (2016)
- Investor Confident Project: Enabling Markets for Energy Efficiency Investment (2014)

Appendix.

7. National access to EPC data

In the inquiry form however, the request for EPC data access was of highest priority. EPC data are mandatory data for the tool development and EPC data sources therefore crucial. **Error! Reference source not found.**gives an overview of the national data access concerning EPC building data and their sources. The extended table for the EPC and open data is provided in Appendix 2: Table of Open Data.

Table 1. EPC open data information

	EPC data	
	Indicate the link)	**notes**
AUSTRIA	N/A	EPC data are not public data in Austria. (for Province level see Appendix 1)
BULGARIA	N/A	Data export might be given in the form of files.
CYPRUS	N/A	N/A
DENMARK	http://sparenergi.dk/forbruger/vaerktoejer/find-dit-energimaerke	EPC data are public data in Denmark. They are available by use of anInternet link of Spar Energy. Raw data, geodata included, is required by Netcompany.
FRANCE	https://www.data.gouv.fr/fr/datasets/base-des-diagnostics-de-performance-energetique-dpe/	The dataset includes per EPC and for the domestic sector only.For full database http://www.observatoire-dpe.fr/index.php/statistique with statistics easily accessible but aggregated to the departments levels. EPC database is available for Paris municipal buildings.
GREECE	http://www.ypeka.gr/Default.aspx?tabid=907&language=el-GR	Aggregated data for EPCs for geographical areas, decade of construction, use, energy category, energy consumption, etc.
IRELAND	https://ndber.seai.ie/BERResearchTool/Register/Register.aspx	Residential data only at local level - not at building level
ROMANIA	N/A	Legal responsibility of the central EPC database is under MDRAPFE, while the EPC in electronic format are received and stored by NIRD URBAN-INCERC. The data could be mapped if each EPC is geocoded semi-automatically using the address.
SLOVAKIA	http://www.inforeg.sk/ec/SearchEC.aspx	Only in Slovak language.Geo-Data are contained in field “Adresa budovy”, where text after last comma represent name of municipality.
SLOVENIA	http://www.energetika-portal.si/podrocja/energetika/energetske-izkaznice-stavb/register-energetskih-izkaznic/	Complete register of EPCs is publicly available in pdf only. Single EPCs can be found on http://prostor3.gov.si/javni

SPAIN	http://icaen.gencat.cat/es/energia/usos_energia/edificis/certificacio/registre_certificats/ https://www.iderioja.larioja.org/vct/index.php?c=506a6a7670454c724c4772527a366c6c62666d3130673d3d&t=5&e1=A	Only 2 regions have Maps of georeferenced EPC
UNITED KINGDOM	https://epc.opendatacommunities.org/ https://www.ndepcregister.com/	Access to EPC data for buildings in England and Wales. Non Domestic EPC register.

Some conclusions which can be extracted from this table are listed below:

- The table shows that only in six countries there is an open access to EPC data for buildings (among partner's countries). These are United Kingdom, Bulgaria, Denmark, Slovakia, Slovenia and Spain.
- In United Kingdom there is a detailed open source EPC database, for domestic and non domestic buildings, including a great amount of EPC information.
- In Slovenia a complete register of EPCs is publically available only in the form of files, for instance in pdf format.
- In Spain maps with EPC data are available only for 2 Regions.
- In France, there is an EPC database for the Paris Municipal buildings (excel format).
- In Bulgaria, there is an EPC database for 6.785 of all type buildings (excel format).

In addition, an EPC database is available online for Italy too and can be integrated with the ENERFUND tool.

Therefore, as EPC open source data are significant for the tool concept, the first version of the ENERFUND tool (under development) will include UK (see figure below) and Italy where the open source EPC databases are currently (Geo-coded and in suitable format). However, ENERFUND tool will be able to embed more EPC databases, in the next versions, from other EU countries (when available).

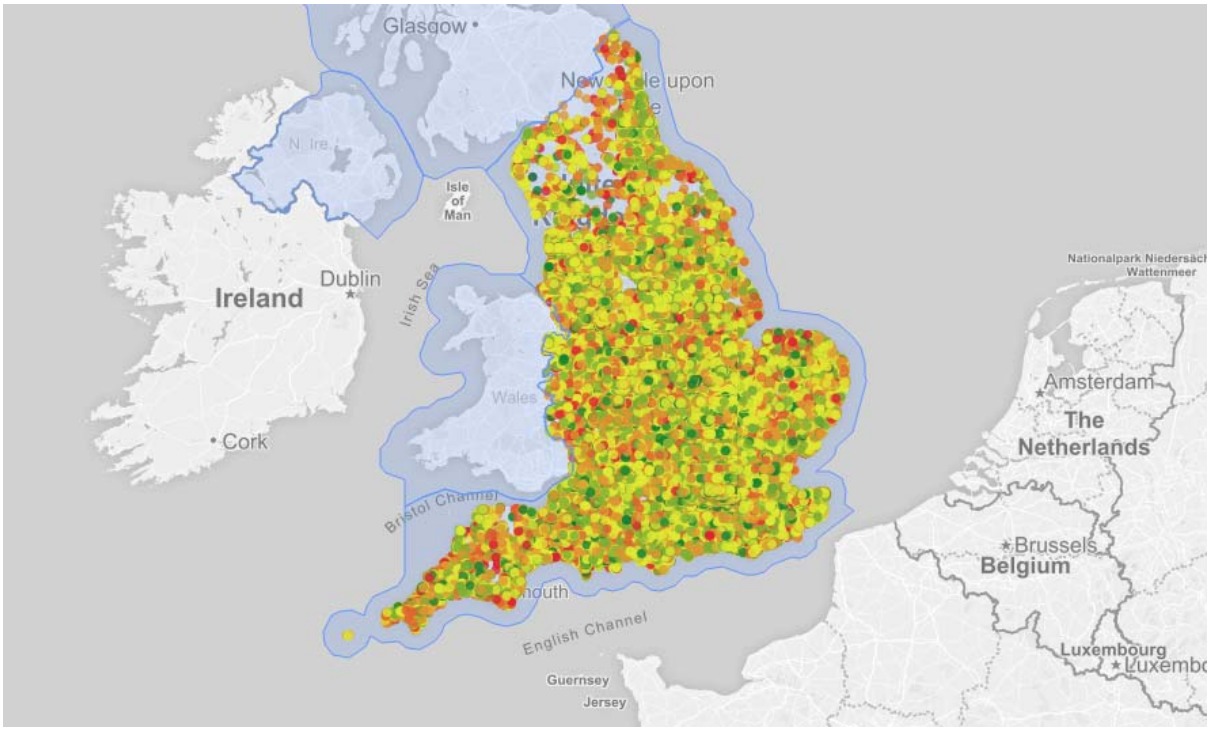

Figure 1. ENERFUND map with EPC data

8. National access to general register data

Besides EPC data, the questionnaire asked for building ownership, building type and use, property and rent prices, construction cost, economic activities, average household income, energy Company databases and other databases available. These are general register data, useful and necessary for the further benchmarking of buildings for their "readiness" for energy renovation. Access to such data will be integrated in the tool development at well.

9. Methodology

The structure of the algorithms that constitutes the Enerfund tool is based on four modules which are presented in the following paragraphs. The modules are:

1. A GIS opening and first screening(i.e. the first identification of buildings that might be object for energy renovation).

2. A multi criteria analysis, that will be able to decrease the number of buildings relevant for energy renovation.

3. A cost benefits analysis that will be able to identify relevant business cases and finally

4. A carbon emission calculator that will be able to estimate the carbon emission reduction as a consequence of the energy reduction associated with energy saving.

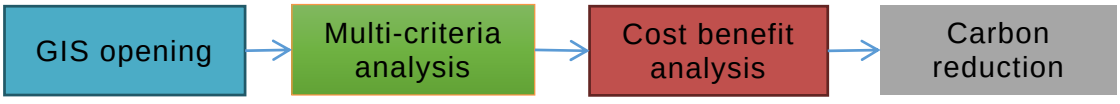

Figure 6. Four modules integrated in the Enerfund tool.

10. GIS opening

By nature, the data needed for the initial step of a GIS opening and first screening must be available beforehand for instance by access to national EPC data, national housing and building data and national energy prices. Decisive for this first step is availability to geo-coordinates for each individual building included the tool database. Still, different default values might be necessary for a well-functioning first screening step.

By adding a rating system, the screening will be able to expose which buildings are the most likely candidates for deep energy renovation, and hence which ones are the less obvious and thus doubtful candidates. The rating system can easily be based on the already existing EPC classification of A to G.

The GIS opening must be carried out of a map application so that classic functions like zooming and moving the map by use of the curser. Moreover, different ways of entering the map must be obtainable, like use of scroll bars with country names, municipality names, zip codes etc. Other useful features in the searching of candidates are scrollbars of building and ownership categories and scrollbar for the time of erection for instance divided into decades. Finally, information on maximum EPC rating or minimum energy saving it must be considered. See the outline for an opening screen, Figure 7.

The map used in the illustration (Figure 6) comes from the Danish web application: http://sparenergi.dk/forbruger/vaerktoejer/find-dit-energimaerke, i.e. a web site with an open database translated into English called “Find your energy label”. This map concept, showing all buildings with a certificate issued within the area and the zoom selected, is similar to the Enerfund map concept (see Figure 7).

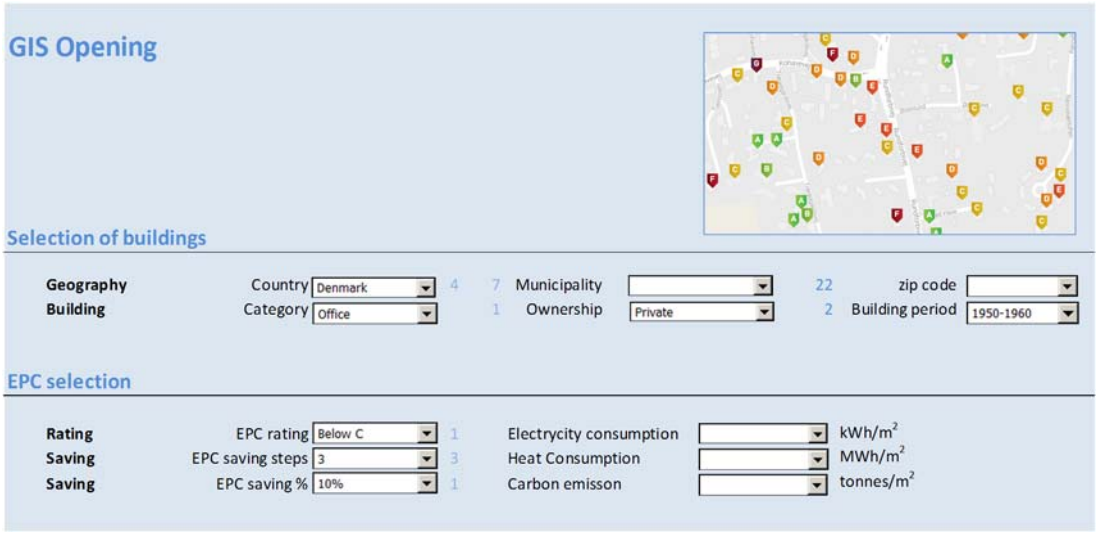

Figure 7. Possible features concerning the GIS opening of the tool.

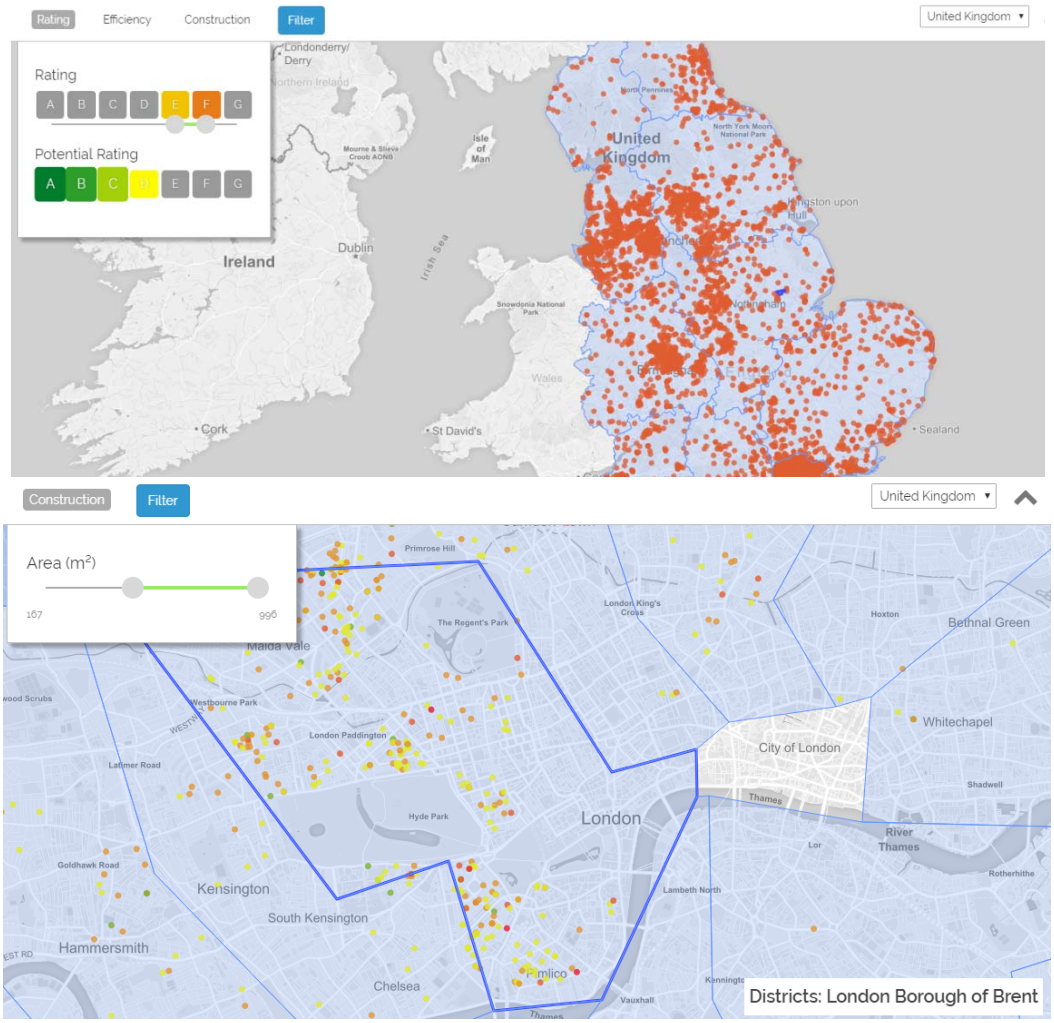

Figure 8. Current features of the under development ENERFUND tool

11. Multi criteria analysis (MCA)

Next to GIS opening it has been decided that a Multi Criteria Analysis (MCA) must follow. 3Hence, the immediate objective is to create a tool that will rate and score building-energy renovation opportunities. To do this, relevant options in the form of selection of a building must be identified (see GIS opening features). Then, relevant criteria for the rating and the scoring must be determined.

On an early stage, it was decided that five main criteria might be suitable. Five criteria can be overviewed (see Figure). At the same time five criteria cover the all relevant aspects of a building candidate for future deep energy renovation. The five criteria are:

1. Energy saving and carbon reduction potential,
2. Quality of auditing or monitoring been carried out,
3. Actual ownership and use,
4. Access to energy data and
5. Building characteristics.

Subsequently, each main criterion can be subdivided into a number of secondary criteria. For instance is has been put forward to subdivide Energy saving and carbon reduction potential into EPC class improvements and growth of renewable share.

In a MCA both main and secondary criteria must be assigned weightings. In the example presented, the main criteria are assigned a weighting between 15% and 25%, so that the total score will always correspond by 100% (seeFigure).

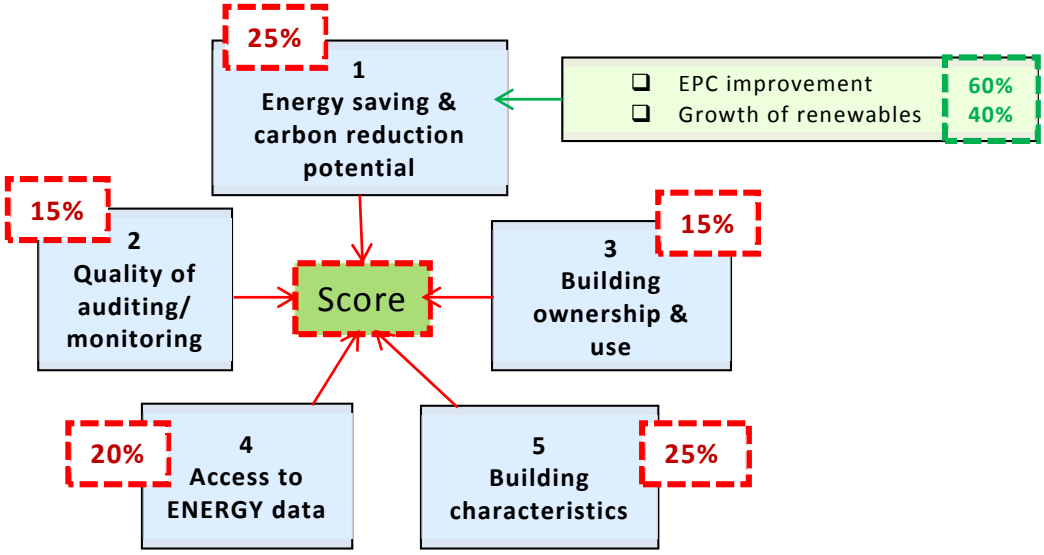

Figure 9. In the point of departure, five main criteria have been singled out in order to cover all relevant aspect of a future deep energy renovation.

In the same way each of the secondary criteria must be assigned with weighting. In the example the main criteria: Energy saving and carbon reduction is made tangible by a second criteria of number of EPC class improvement and growth of renewable share. If the weighting of the main criteria is set to 25% and the weighting of the

secondary criterion are set to 60% and 40% respectively the total score of possible energy saving and carbon reduction can be charged a score of 13. See Figure .

In the example presented 4 steps of EPC improvement and 40% growth of renewables result in a total share of 13 points. The number of points contributed by 4 steps of EPC improvement is: 3 out of 4 points multiplied with 60% and 25% respectively; that is 3/5*0.60*0.25 = 9.0. Corresponding to that a 40% growth of renewables is 2 out of 4 points multiplied with 40% and 25%; that is 2/5*0.4*0.25 = 4.0; in total a score of 13.

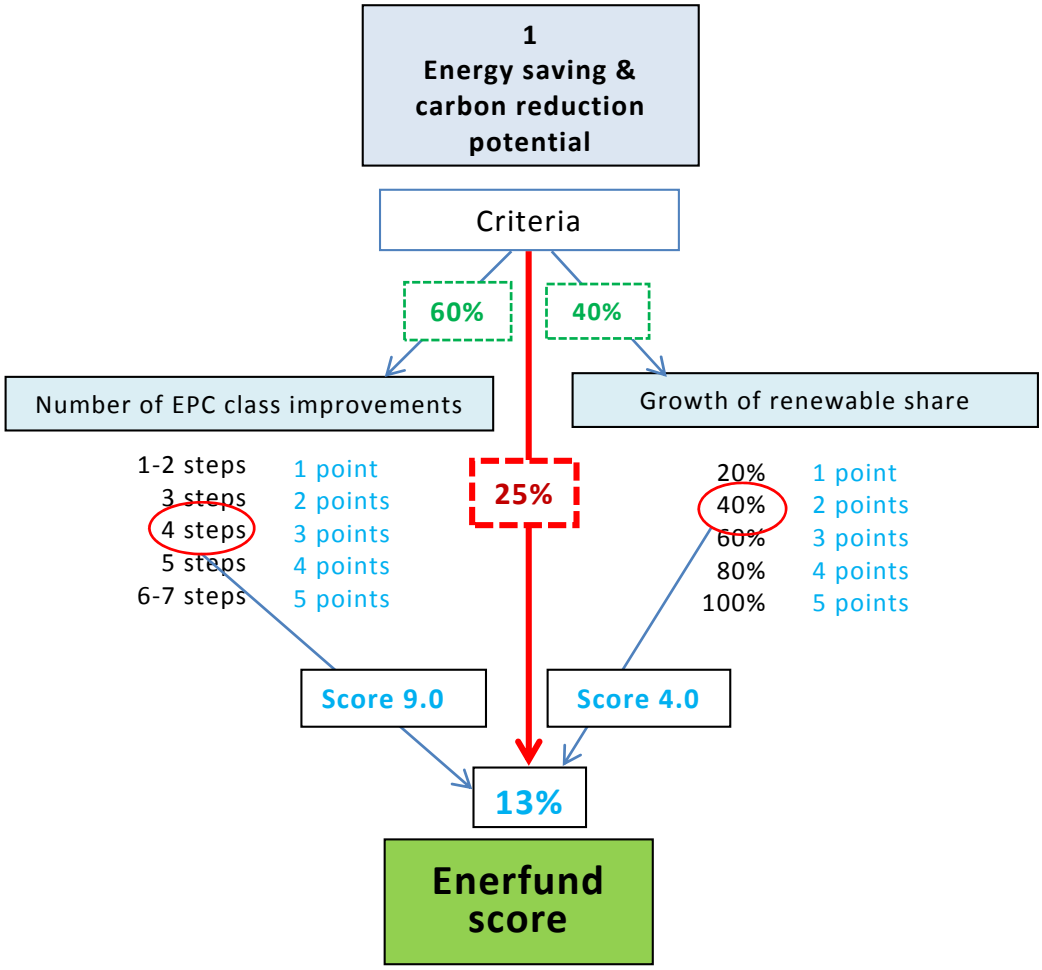

Figure 10. The total score obtained within the main criterion of Energy saving and carbon reduction potential in a case where 4 EPC steps of improvement is achievable and 40% of renewable share growth can be achieved.

At the same way the weighting principles of other main criteria and their secondary criteria might be carried out. Beside the energy saving and carbon reduction potential, an important criterion is building characteristics. Included the number of building characteristics is the criteria of erection period, aesthetics improvements, thermal condition improvement, sustainability improvements and building limitations.

The score and weighting system is constructed in such a way that the score always will be in between 0 and 100.

12. Cost Benefit Analysis

Concerning the tool methodology, the multi-criteria Analysis will for users interested in the overall economy be followed by a Cost Benefit Analysis (CBA). However, this offer requires a number of user data input for all buildings in consideration for an energy renovation. This is about the character and size energy retrofits and the cost linked to these retrofits

In short the tool in an easy way makes it possible to compare cost and benefit for each building and to compare CBA for a number of buildings. See Figure 2. Thus costs relate to retrofit investments whereas and benefits relate to electricity and heat savings. As a special feature it is proposed that also none energy benefits (NEBs) like better indoor climate, Increase of property value and carbon saving can be include the benefit calculation. This however, requires that the user is able to price these benefits.

Costs

Denmark

Retrofit investments	m^2	€/m^2	€
Roof insulation	1500	100	150.000
Wall insulation	3500	90	315.000
Change om windows	900	150	135.000
Change of air conditioning system			35.000
Change of heating system			
Change of inefficient appliances			15.000
Other regular costs			5.600
Unexpected costs			2.000
None energy costs			6.000
Costs total			663.600

Energy prices	€/kWh
Electricity	0,295
District Heating	0,074
Natural gas	0,037
Heating oil	0,121
Woodlogs	
Other fuels	
Heaating average	0,08

Benefits

Electricity saving	kWh/year	€
Better insulation of envelope		-
Adjustment of air conditioning system	1500	442
Change of air conditioning system	125000	36.863
Change of inefficient appliances	21000	6.193
Change of user behaviour	1800	531
Total	**149300**	**44.029**

Heat saving	MWh/year	€
Better insulation of envelope	780	60.200
Adjustment of heating system	120	9.262
Change of heating system		-
Change of user behaviour	130	10.033
Total	**1030**	**79.495**
Benefits total		**123.524**

Figure 2 An example of a cost and benefit calculation, where costs relate to retrofit investments and benefits are electricity and heat savings.

The aim of the CBA is to make an estimate of the payback time. This can be simple, i.e. the number of years necessary to for the payback of the investment. Nonetheless, grants are very often part of the overall decision making when it comes the deep

energy renovation. Grants can be tax reduction, national subsidies for installing of renewables or regional unemployment subsidies. Such benefits must definitely be included. Less obvious is an including of NEBs. However, this feature is offered as well so that the user can decide for this and get an access to a total overview of financial situation.

13. Carbon emission link

Finally, at carbon emission link will be offered. By use of three links to the former features of the tool, an estimate of the carbon reduction as a consequence of a planned energy renovation will show up. Knowledge about a possible carbon emission reduction very often is an important element of the decision making. Therefore a link corresponding to the former features make each an estimate.

The first carbon calculation is related to the actual EPC, i.e. the actual emission before renovation. Consequently, the calculation can show up as soon as a building has been selected at the GIS opening map. In the example presented, using Danish key figures of carbon emission, an electricity consumption of 650 000 kWh/y and a heat consumption of 1 500 000 kWh/y have an carbon emission of 493 metric tons annually.

The second calculation is based on the proposal for EPC improvement in the form of better ratings on the energy band. In addition also proposal concerning growth of renewable share can be included this first estimate. In the example a total reduction of 225 metric tons seems obtainable.

The third and most precise calculation I based on the cost benefit calculation. By use of this calculation a carbon emission reduction of 249 tons annually will be the result.

EPC link		kWh/y	metric tons/y
	Electrycity consumption	650000	**195**
	Heat Consumption	1500000	**298**
	Total carbon emisson		**493**

			Carbon reduction
MCA link		Estimation	metric tons/y
	EPC improvement	3 steps	**160**
	Groweh of renewables	40%	**65**
	Carbon emission reduction		**225**

			Carbon emission	**Carbon reduction**
CBA link		kWh/y	metric tons/y	metric tons/y
	Electrycity saving	149300	*150*	**45**
	Heat Saving	1030000	*93*	**204**
	Carbon emission reduction		*493*	**249**

Figure 3. Carbon emission and carbon emission reduction calculations based on EPC input, MCA and CBA.

14. Conclusion

Based on studies of GIS representation, multi criteria analysis, cost benefit analysis and carbon emission calculation, the features of the ENERFUND tool have been imposed. Thus the entrance of the tool for all users is a GIS Map of Europe. By zooming and delimitation of specific areas, buildings and their EPCs(where available) are appeared.

Next to that a decision making feature in the form of at multi criteria analysis will appear. In this at selection of building can be weighed against each other on at number of parameters. To that extent the user want to include more than one parameter, so-called criteria, and the tool will offer a weighting system consisting of a primary and secondary weighting system. For instance within the primary criteria of Energy saving an carbon reduction potential the secondary criteria can be specified as EPC class improvement and growth of renewable share. Other primary and secondary criteria can show up in the test phase of the project.

For those users that want to go further on in the decision making are then offered the feature of a cost benefit analysis. By use of this it will be possible to balance costs and benefit and further on be presented of a pay-back time diagram. In this analysis it will be free for the user to include available grants but also none energy benefits (NEBs).

Finally for those users that have special interest in the consequences of the energy renovation concerning carbon emission they will be offered a carbon calculator.

In total the Enerfund tool will have a flexible architecture, so that different users with different aim and perspective will get value of the tool.

Appendix 1: Key drivers for energy renovation

Key Drivers affecting the Demand for Energy Renovation for owners of commercial buildings

1	Awareness at Key Decision Maker Level & Leadership	If all decision makers are aware of the potential renovation and they are positive. Precondition for the decision making. If the decision makers are negative to changes/new investments and conservative this will reduce significantly the decision perspective.
2	Clear Business Case (tool evaluation)	Annual energy savings potential leads to a clear business case (IRR, payback period). The tool will calculate the (simple) payback period and the IRR and provide a score according to the results.
3	Standardization	- Uptake and use of standards at Member State level for Energy Performance Contracts developed, working with ESCOs and for MRV and legal documentation (CEN-CENELEC EN/HD implementation rates per country). - Specialized insurance coverage for reduction of financial risk
4	Buildings Regulation, Certification and Energy Performance Certificates	- Building specific: Availability of EPC - Country specific: EPC information detailed, useful for investors?
5	Effective enforcement of regulation (also see 14: Doing Business Report)	
5.1	Enforcing contracts	Open source data per country Doing Business ranking
5.2	EU standards adaptation	Open source data per country CEN-CENELEC EN/HD Implementation Rates per Country
6	Regulatory Stability	EU & Country specific
7	Regulation which impacts on timing and scope of renovation	EU & Country Specific: The Energy Efficiency Directive places energy savings requirements on EU countries' buildings. This includes making central government buildings more energy efficient and requiring EU countries to establish national plans for renovating overall building stock. EU countries have drawn up strategies to show how they plan to foster investment into the renovation of residential and commercial buildings. These strategies are part of their National Energy Efficiency Action Plans.
8	Measurement,Reporting and Verification (MRV) and Quality Assurance	MRV and quality assurance ensure the sustainability of the energy retrofitting Depending on each project (If no MRV application, maintenance plan is foreseen?)
9	Transaction costs/ simplicity	
9.1	Single or multi ownership	Single ownership facilitates the renovation decision making
9.2	Single or multi users (not persons, bodies)	Single building-user facilitates the renovation decision making
9.3	100% own resources	Independency of external financial resources makes the project more simple and feasible.
10	Price of energy	Electricity and natural gas prices available at EUROSTAT energy prices,http://ec.europa.eu/eurostat Electricity_and_gas_prices,_second_half_of_year,_2013–15_(EUR_per_kWh)_YB16 High energy price will receive high score (motivation) e.g. country with low energy prices -> no motivation to renovate. Taken into account for the IRR and payback period calculation.
11	"Green Premium"/ Brown Discount	
12	Green policy/ opportunity to promote more the Institution	
13	Facilitation/Technical Assistance	Proper project's technical team available (internal or external)
13.1	Energy Audit	Yes -> More mature project

14	Key Parameters from Doing Business Report	
14.1	Ease of dealing with construction permits (DTF)	Open source data per country Doing Business ranking
14.2	Ease of Construction RANK	Open source data per country Doing Business ranking
14.3	Getting credit	Open source data per country Doing Business ranking
15	Availability of a special European or national or district or local granting scheme for energy renovations	Open source data (y/n as motivation parameter) Related with other financial indicators. However its contribution lies on the motivation of the market because of this parameter.
16	Availability of loan programs specialized for energy renovations	Open source data (y/n as motivation parameter) Related with other financial indicators. However its contribution lies on the motivation of the market because of a specialized loan program availability.
17	Current Building thermal comfort	The higher the thermal comfort is, the lowest the score. An energy retrofitting is expected to improve the indoor's thermal comfort for the users of the building.
18	Current noise level comfort	The higher the noise level comfort is, the lowest the score.
19	Does the building will be renovated anyway (y/n)	Favorable parameter for the implementation of the project.
20	Evaluation of the condition of the electrical and mechanical systems (after the renovation)	The user will evaluate the condition of the building's equipment in order to ensure the sustainability of the project. Equipment in bad condition (which will not be replaced) increases uncertainties and the financial risk and thus makes the energy retrofitting less attractive.
21	Requested loan in accordance with the market value after renovation (y/n)	Starting point/precondition No -> not feasible project
22	Availability of actual energy data	The use of actual energy data reduces the financial risk (higher level of accuracy)
23	VAT exception (lower VAT rates for renovation)	Motivation for energy renovation (y/n)
24	Structural Condition	Self evaluation if the building is suitable for renovation Too old building might not be selected to be renovated

Key Drivers for Energy Renovation Decision Making for Owners of Public Buildings

1	Rules on public authority accounting, procurement and reporting	National public procurement procedures adapted in light of the need to renovate Public Buildings at scale, in particular regarding the procurement of energy performance contracts.
2	Awareness at Key Decision Maker Level & Leadership	If all decision makers are aware of the potential renovation and they are positive. Precondition for the decision making. If the decision makers are negative to changes/new investments and conservative this will reduce significantly the decision perspective.
2.1	(Political Commitment: in case of public sector)	If political commitment exists (e.g. Covenant of Mayor (open source data could be used), Green Procurement Action Plan)
3	Clear Business Case	Annual energy savings potential leads to a clear business case (IRR, payback period). The tool will calculate the (simple) payback period and the IRR and provide a score according to the results.
4	Standardization	- Standard tender documents for energy renovations - Mandatory training for procurement officers on energy efficiency - Uptake and use of standards at Member State level for Energy Performance Contracts developed, working with ESCOs and for MRV and legal documentation (CEN-CENELEC EN/HD implementation rates per country). - Specialized insurance coverage for reduction of financial risk
5	Buildings Regulation, Certification and Energy Performance Certificates	- Building specific: Availability of EPC - Country specific: EPC information detailed, useful for investors
6	Effective enforcement of regulation (see also 15: Doing Business Report Rankings)	
6.1	Enforcing contracts	Open source data per country Doing Business ranking
6.2	EU standards adaptation	Open source data per country CEN-CENELEC EN/HD Implementation Rates per Country
7	Regulatory Stability	Country specific
8	Regulation which impacts on timing and scope of renovation	EU & Country Specific: The Energy Efficiency Directive places energy savings requirements on EU countries' buildings. This includes making central government buildings more energy efficient and requiring EU countries to establish national plans for renovating overall building stock. EU countries have drawn up strategies to show how they plan to foster investment into the renovation of residential and commercial buildings. These strategies are part of their National Energy Efficiency Action Plans.
9	Measurement, Reporting and Verification (MRV) and Quality Assurance	MRV and quality assurance ensure the sustainability of the energy retrofitting Depending on each project
10	Transaction costs/ simplicity	
10.1	Single or multi ownership	Single ownership facilitates the renovation decision making.
10.2	Single or multi users (not persons, bodies)	Single building-user facilitates the renovation decision making.
10.3	100% own resources	Independency of external financial resources makes the project more simple and feasible.
11	Price of energy	Electricity and natural gas prices available at EUROSTAT energy prices,http://ec.europa.eu/eurostatElectricity_and_gas_prices,_second_half_of_year,_2013–15_(EUR_per_kWh)_YB16

		High energy price will receive high score (motivation) Taken into account for the IRR and payback period calculation.
12	Tailored Financial Product Availability	
13	Green policy/ opportunity to promote more the Institution	Level of Importance of green publicity
14	Facilitation/ Technical Assistance	If a proper project's technical team has formulated (internal or external)
15	Key Parameters from Doing Business Report	
15.1	Ease of dealing with construction permits (DTF)	Open source data per country Doing Business ranking
15.2	Ease of Construction RANK	Open source data per country Doing Business ranking
15.3	Getting credit	Open source data per country Doing Business ranking
16	Availability of a special European or national or district or local granting scheme for energy renovations	Open source data (y/n as motivation parameter) Related with other financial indicators. However its contribution lies on the motivation of the market because of this parameter.
17	Availability of a loan program specialized for energy renovations	Open source data (y/n as motivation parameter) Related with other financial indicators. However its contribution lies on the motivation of the market because of specialized loan program availability.
18	Current Building thermal comfort	The higher the thermal comfort is, the lowest the score. An energy retrofitting is expected to improve the indoor's thermal comfort for the users of the building.
19	Current noise level comfort	The higher the noise level comfort is, the lowest the score.
20	Does the building will be renovated anyway (y/n)	Favorable parameter for the implementation of the project.
21	Evaluation of the condition of the electrical and mechanical systems	The user will evaluate the condition of the building's equipment in order to ensure the sustainability of the project. Equipment in bad condition (which will not be replaced) increases uncertainties and the financial risk and thus makes the energy retrofitting less attractive.
22	Requested loan in accordance with the market value after renovation (y/n)	Starting point/precondition No -> not feasible project
23	Availability of actual energy data	The use of actual energy data reduces the financial risk (higher level of accuracy)
24	Structural Condition	Self evaluation if the building is suitable for renovation Too old building might not be selected to be renovated

Key Drivers affecting the supply of Energy Renovation Investments (Financial Institutions)

1	Standardization	

2	Regulatory Stability	
3	Measurement, Reporting and Verification (MRV) and Quality Assurance	MRV and quality assurance ensure the sustainability of the energy retrofitting Depending on each project
4	Increased Investor Confidence & Change in Risk Perception	
5	Lender's approach to risk assessment (non-recourse project financing vs. Borrower-based credit recourse)	
6	Availability of Data	The use of actual energy data reduces the financial risk (higher level of accuracy)
7	Transaction costs/ simplicity	
7.1	Single or multi ownership	Single ownership facilitates the renovation decision making
7.2	Single or multi users (not persons, bodies)	Single building-user facilitates the renovation decision making
8	Risk-return targets	
9	Definition and common understanding of the value of energy cost savings	Clear understanding on the energy saving sources which lead to energy cost reduction
10	Price of Energy	Electricity and natural gas prices available at EUROSTAT energy prices,http://ec.europa.eu/eurostatElectricity_and_gas_prices,_second_half_of_year,_2013–15_(EUR_per_kWh)_YB16 High energy price will receive high score (motivation) Taken into account for the IRR and payback period calculation.
11	Use of European Structural & Investment Funds (y/n)	If yes it Reduces the financial risk
12	Buildings Regulation, Certification and Energy Performance Certificates	
13	Body of Evidence (including Social Benefits and Costs)	
14	Sustainable Real Estate Funds	
15	Key Parameters from Doing Business Report	
15.1	Ease of dealing with construction permits (DTF)	Open source data per country Doing Business ranking
15.2	Ease of Construction RANK	Open source data per country Doing Business ranking
15.3	Getting credit	Open source data per country Doing Business ranking
16	Financial Indicators (according to calculations of the tool)	
16.1	IRR	The higher the IRR is, the more feasible is the investment
16.2	Payback Period	The lower the period, the more attractive is the investment
17	Availability of a loan program specialized for energy renovations (launched by the financial institution)	Open source data Related with other financial indicators. However the contribution lies on the sensitivity of the financial institution on energy renovations
18	Requested loan in accordance with the market value after renovation (y/n/ don't know)	Precondition
19	Owner's payment capacity	Healthy payment capacity is required (precondition)
20	Energy Audit (yes/no/ under preparation)	If an energy audit was carried out, it reduces the risk
21	Maintenance plan after the renovation	Reduces the risk
22	Green policy/ opportunity to promote more the Institution	If it is important or not for the financial institution

Key Drivers for the supply of Energy Efficiency Investment (ESCOs)

1	Standardization	
2	Regulatory Stability	
3	Measurement, Reporting and Verification (MRV) and Quality Assurance (User Input)	MRV and quality assurance ensure the sustainability of the energy retrofitting Depending on each project Important key driver for ESCOs
4	Increased Investor Confidence & Change in Risk Perception	
5	Lender's approach to risk assessment (non-recourse project financing vs. Borrower-based credit recourse)	
6	Availability of Data	Reliable energy data (3 year-period) reduce the risk of the ESCOs as the related calculations include less uncertainties
7	Transaction costs/ simplicity	
7.1	Single or multi ownership	Single ownership facilitates the renovation decision making
7.2	Single or multi users (not persons, bodies)	Single building-user facilitates the renovation decision making
8	Risk-return targets	
9	Definition and common understanding of the value of energy cost savings	Reduces the risk of the investment (related with MRV)
10	Price of Energy	Electricity and natural gas prices available at EUROSTAT energy prices,http://ec.europa.eu/eurostatElectricity_and_gas_prices,_second_half_of_year,_2013–15_(EUR_per_kWh)_YB16 High energy price will receive high score (motivation) Taken into account for the IRR and payback period calculation. Moreover for ESCO projects: - If the project is not affected by future energy prices changes, it reduces the financial risk. (max score) - If the ESCO company receives all the risk of the energy price fluctuations this means increased financial risk (no score) - Another option could be to balance the risk between the owner and the ESCO
11	Use of European Structural & Investment Funds	
12	Buildings Regulation, Certification and Energy Performance Certificates	
13	Body of Evidence (including Social Benefits and Costs)	
14	Sustainable Real Estate Funds	
15	Key Parameters from Doing Business Report	
15.1	Ease of dealing with construction permits (DTF)	Open source data per country Doing Business ranking
15.2	Ease of Construction RANK	Open source data per country Doing Business ranking
15.3	Getting credit	Open source data per country Doing Business ranking
16	Financial Indicators (according to calculations of the tool)	
16.1	IRR	The higher the IRR is, the more feasible is the investment
16.2	Payback Period	The lower the period, the more attractive is the investment
17	Availability of a loan program specialized for energy renovations	Open source data Related with other financial indicators.
18	Investment in accordance with the ESCO's annual cash flow (y/n/ don't know)	precondition

19	Owner's payment capacity	precondition
20	Maintenance plan foreseen after the renovation	Reduces the risk Moreover, the investment is less risky for the ESCO, if the maintenance will be carried out by the ESCO
21	Guarantees foreseen	Ensures ESCO payments
22	Evaluation of the condition of the electrical and mechanical systems (after the renovation)	The user will evaluate the condition of the building's equipment in order to ensure the sustainability of the project. Equipment in bad condition (which will not be replaced) increases uncertainties and the financial risk and thus makes the energy retrofitting less attractive.
23	Contract Duration	Long period contract increases the risk for ESCO

Sources for key drivers identification

- Energy Efficiency Financial Institutions Group: Final Report, covering buildings, industry and SMEs (February 2015)
- European Commission, DG Energy: Market study for a voluntary common European Union certification scheme for the energy performance of non-residential buildings (2012)
- Doing Business Report: Measuring Regulatory Quality and Efficiency (2016)
- Investor Confident Project: Enabling Markets for Energy Efficiency Investment (2014)

Appendix2: Table of open data

	EPC data		Building ownership		Building type / use	
	Indicate the link)	**notes**	**(Indicate the link)**	**notes**	**(Indicate the link)**	**notes**
AUSTRIA (see below for province level)	N/A	EPC data are not public data in Austria, they have to be aggregated like in Ireland. We could do a pilot in ENERFUND with the Government of Province of Salzburg, or rely on EPC data filled by individuals	N/A	Partly available on Province level, see below	N/A	Partly available on Province level, see below
BULGARIA	N/A	Data export is given in attached file. There is an opportunity to update the file on a regular basis.	N/A	Data export is given in attached file. There is an opportunity to update the file on a regular basis.	N/A	Data export is given in attached file. There is an opportunity to update the file on a regular basis.
CYPRUS	N/A	N/A	N/A	N/A	N/A	N/A
DENMARK	N/A	EPC data are public data in Denmark. However, they are only available by use of the Internet link: http://sparenergi.dk/forbruger/vaerktoejer/find-dit-energimaerke Raw data is required by Netcompany, for the attention of Brian Pedersen bpe@netcompany.com	EPC data base	Available by individual look-ups or by access to EPC-data base	EPC data base	Available by individual look-ups or by access to EPC-data base
FRANCE	https://www.data.gouv.fr/fr/datasets/base-des-diagnostics-de-performance-energetique-dpe/	The dataset includes per EPC and for the domestic sector only: (Also EPC database available for Paris in excel file) - Postcode - Type of building: 1 for houses and 2 for appartments - Year of construction - Surface - Energy consumption - Year of EPC - Method of EPC used - Modele of EPC (for a selling; a location, a new building…) - Type of use (mostly heating)	http://www.observatoire-dpe.fr/index.php/statistique/statDpeParTypeBatiment	Statistics available at aggregated/ department level	http://www.observatoire-dpe.fr/index.php/statistique/statDpeParTypeBatiment	Statistics available at aggregated/department level

		- Type of energy - Final energy consumption for heating For full database http://www.observatoire-dpe.fr/index.php/statistique with statistics easily accessible but aggregated to the departments levels. All EPC accessible provided you have the reference number. For statistics aggregated at department level: http://www.observatoire-dpe.fr/index.php/statistique/statDpeParTypeBatiment				
GREECE	http://www.ypeka.gr/Default.aspx?tabid=907&language=el-GR	Aggregated data for EPCs for geographical areas, decade of construction, use, energy category, energy consumption, etc.	N/A	N/A	N/A	
IRELAND	https://ndber.seai.ie/BERResearchTool/Register/Register.aspx	Residential data only at local level - not at building level	N/A	N/A	http://www.seai.ie/Publications/Energy_Policy_Publications/Energy_Modelling_Group_Publications/Extensive-Survey-of-Commercial-Buildings-Stock-in-the-Republic-of-Ireland.pdf	N/A
ROMANIA	N/A	Legal responsibility of the central EPC database is under MDRAPFE, while the EPC in electronic format are received and stored by NIRD URBAN-INCERC. Until now there is no information publicly available regarding the content of issued EPCs, however cca. 45000 EPCs (mostly apartments in collective buildings) have been introduced in a structured database developed by NIRD URBAN-	N/A	No information is publicly available at this time	N/A	No information is publicly available at this time

		INCERC based on the criteria defined for MDRAPFE in 2010. The data could be mapped if each EPC is geocoded semi-automatically using the address (but this should be additionally checked manually).				
SLOVAKIA	http://www.inforeg.sk/ec/SearchEC.aspx	Only in Slovak. Geo-Data are contained in field “Adresa budovy”, where text after last comma represent name of municipality Only in Slovak. Geo-Data are contained in field “Adresa budovy”, where text after last comma represent name of municipality	N/A		N/A	
SLOVENIA	http://www.energetika-portal.si/podrocja/energetika/energetske-izkaznice-stavb/register-energetskih-izkaznic/	Complete register of EPCs is publically available in pdf only. Single EPCs can be found on http://prostor3.gov.si/javni	N/A		http://prostor3.gov.si/javni	Possible search of buildings by various criteria.
SPAIN	http://icaen.gencat.cat/es/energia/usos_energia/edificis/certificacio/registre_certificats/ https://www.iderioja.larioja.org/vct/index.php?c=506a6a7670454c724c4772527a366c6c62666d3130673d3d&t=5&e1=A	Only 2 regions have Maps of georeferenced EPC	N/A	N/A	https://es.goolzoom.com/	you must click "Mapas" .You can go to "catastro transparente", You can select a building and access the simplified cadastre information: square meters and uses

UNITED KINGDOM	https://www.ndepcregister.com/	Non Domestic EPC register.	https://www.gov.uk/search-property-information-land-registry	post coed based	http://www.geoinformationgroup.co.uk/ukbuildings	Commercial mapping of UK buildings may be of use here but at cost?
	https://www.epcregister.com/	Domestic EPC register				
AUSTRIA SALZBURG PROVINCE	N/A	see above	N/A	N/A	http://service.salzburg.gv.at/ogd/client/showDetail/645dbdfe-857f-4485-b111-b88d5b2f32d0	Location of school buildings
					http://service.salzburg.gv.at/ogd/client/showDetail/3d6227d2-fdd5-47c0-ba9b-ccd104b9ad51	Location of municipal offices
					http://service.salzburg.gv.at/ogd/client/showDetail/a928ef06-a47e-49ee-bdf3-f138bdb64a66	Office buildings of regional Government Salzburg (Province of Salzburg)
AUSTRIA LINZProvince	N/A	see above	https://www.data.gv.at/katalog/dataset/50e92493-ee3a-407b-b791-ceb9bdfdd891	Ownership of flats	https://www.data.gv.at/katalog/dataset/739c5d91-5260-42ac-b1f8-ddb5271eed82	Building period / year of completion of construction

PROJECT DETAILS:

Website: www.enerfund.eu

Twitter: @enerfund

Facebook: /enerfund