SPEEDIER

SME PROGRAM FOR ENERGY EFFICIENCY THROUGH DELIVERY AND IMPLEMENTATION OF ENERGY AUDITS

D3.4 - REPORT OUTLINING THE APPLICATION OF THE CHARACTERISATION PROCESS TO THE SELECTED PILOT SITES

Lead Contractor: ITeC

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This Deliverable, D3.4, outlines the application of the Characterisation process for the individual selected pilot sites. It details the methodology that will use for the SPEEDIER Tool (i.e. Energy management), as well as the principal data base for the characterisation of SME's as well as the categorization of the SMEs' pilot sites. This Deliverable also addresses the relevant energy saving measures and opportunities for each pilot, taking into account the findings of the survey performed in Task 2.3 and the criteria developed in Task 3.3.

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Document History

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14/02/2020	0.1	Diana Romeu	First document version.
03/03/2020	0.2	Ruchi Agrawal	Formatting update & content review.
11/03/2020	0.3	Jo Southernwood	Review and update all sections.
12/03/2020	0.4	Ion Dogeanu	Edits and revisions.
12/03/2020	0.5	Diana Rome	All changes from partners included.
12/03/2020	0.6	Tom Flynn	Reviewed and QA'd version.
13/03/2020	0.7	Diana Rome	Updates and final edits ready for closure.
13/03/2020	1.0	Jo Southernwood	Approved release and submission to EC.

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Abbreviations

ECM	Energy Conservation Measure.
HVAC	Heating, Ventilation and air conditioning.
SME	Small or Medium sized Enterprise.

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1 Introduction

1.1 Background

SPEEDIER is a highly innovative *one-stop-shop solution* that applies an integrated approach to energy management, providing information, advice, capacity building, energy auditing, financing, as well as implementation of energy efficiency solutions and the monitoring of impacts. As part of the project, the SPEEDIER team, led by partner, ITEC, will develop a SPEEDIER Tool for Experts that will assist them to quickly perform an assessment of the energy saving opportunities available to SMEs engaging in the SPEEDIER Service. The tool will use the characteristics of the SME to assist the SPEEDIER Expert to quickly identify the most relevant package for no-cost, low-cost, medium-cost and high-cost ECMs.

1.2 Purpose of the document

In this Deliverable, on a per country basis, each pilot site has been categorized by the country climate, the type of SME's and a package of relevant energy saving measures has been selected. This process also takes into account the findings of the survey carried out in Task 2.3 and the criteria developed and specified in this task.

The first part of this Deliverable describes the data that must be obtained from each SME for the purpose of characterization. Furthermore, this Deliverable describes the databases that will be used for the characterization of SMEs process based on the data obtained from each country. Finally, the Deliverable describes the range of appropriate ECMs for each pilot region based on the obtained data. The range of ECMs will then be refined further for each SME based on the acquired data during the energy audits in conjunction with the SPEEDIER Experts' knowledge and expertise.

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2 Proposed Methodology

In this section, a number of diagrams/illustrations are used to support the explanation of the applied methodology. It presents the design of the energy auditing tool methodology and it furthermore, it explains how the tool will work in practice.

As such, the SPEEDIER Experts will collect information about the building and its use and they will also use the SPEEDIER Tool for Experts to obtain all this information in a single location. The Tool (using ITeC database and others) will provide the SPEEDIER Experts with a list of possible ECMs that could be suitable for the building being audited/assessed. A SPEEDIER Expert can assess the proposed ECMs to help them to determine whether or not to advise the SME to implement these measures based on their own assessment and judgement. If the SME chooses to implement the recommended ECMs, the SPEEDIER Expert will then record the new energy consumption and cost in the tool so that the envisaged savings can be calculated.

Figure 2-1 shows the data flow process into and out of the SPEEDIER Tool. This includes the data flows to and from the SPEEDIER Experts. It also highlights, which data flows to and from the other relevant databases and it specifies the database associated with the SPEEDIER Tool itself.

Figure 2-2 describes the various data sources for information used by the tool. This includes building fabric, construction elements as well as climatic conditions. It also describes how the SPEEDIER Expert will use the data to define the building.

Figure 2-3 shows how the tool will select suitable measures for the building and calculate the likely energy and cost savings for the specific building.

Figure 2-4 shows how the tool will be improving the data base with all the real data that will be recollected from each specific building.

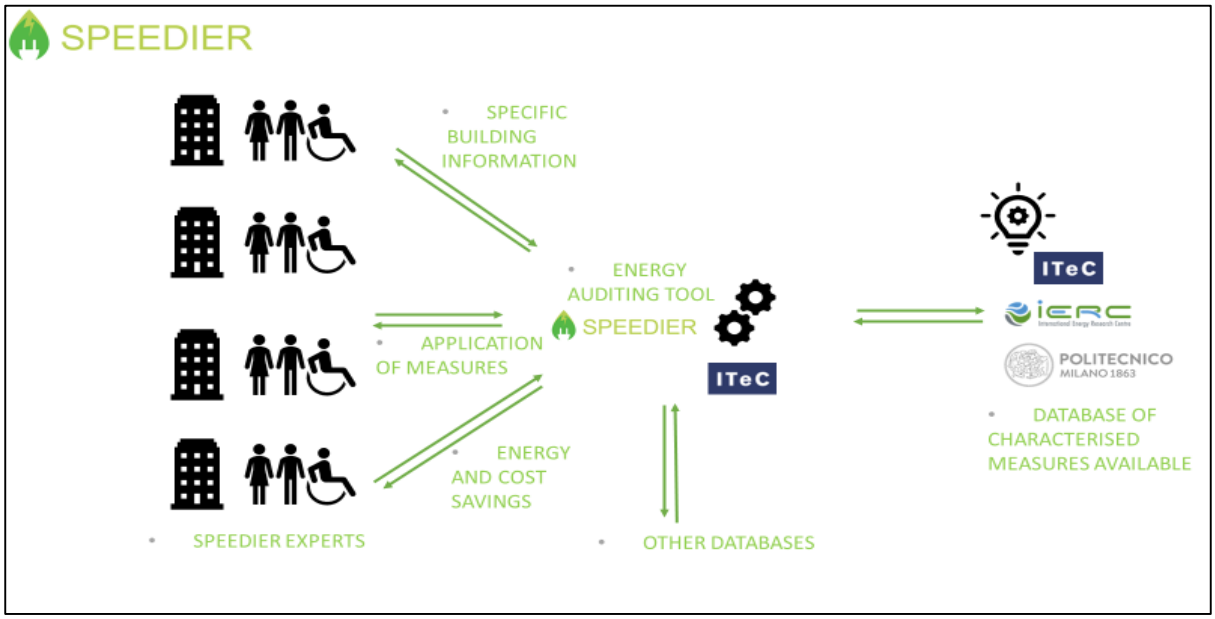

Figure 2-1: Data flows to and from the SPEEDIER Energy Auditing Tool for Experts

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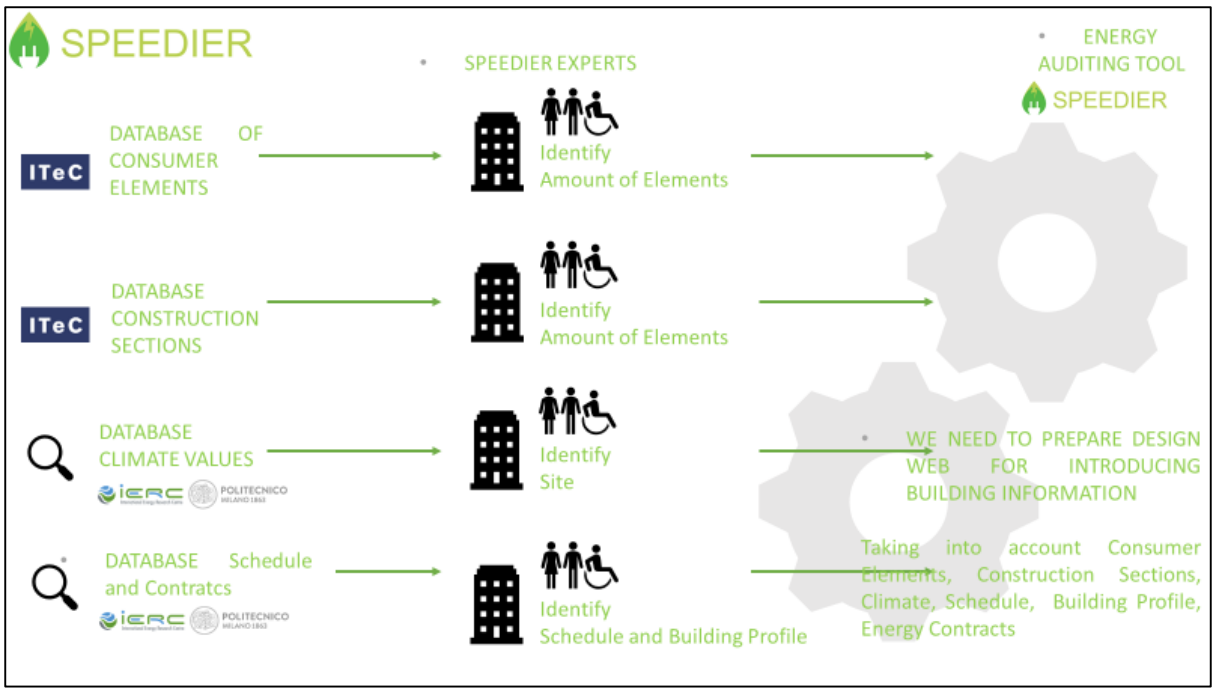

Figure 2-2: Databases that will be needed to define and build the tool.

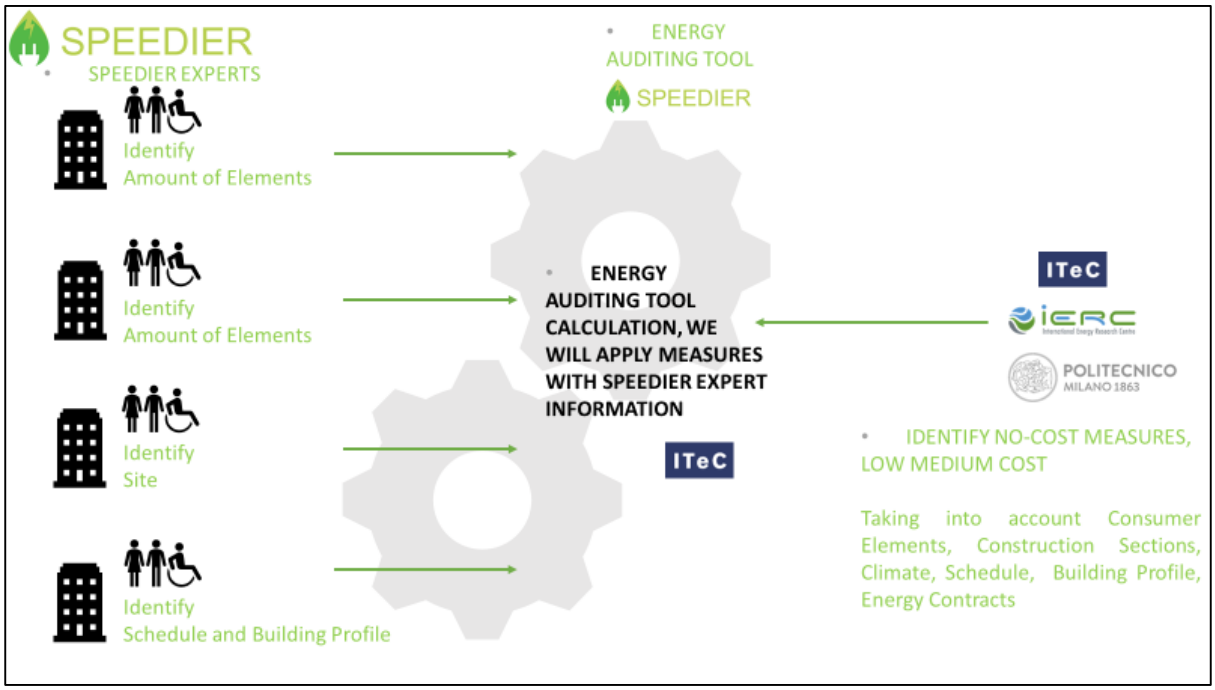

Figure 2-3: Proposed workflow of SPEEDIER Tool for Experts

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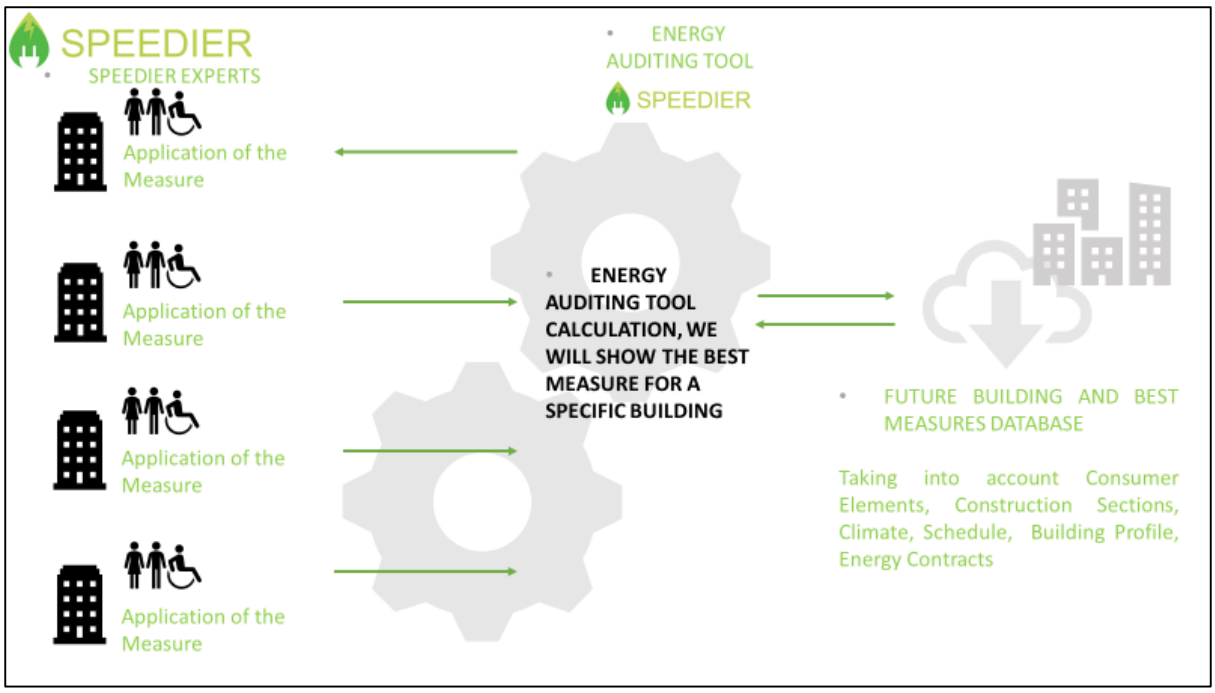

Figure 2-4: Proposed workflow of SPEEDIER Tool to improve solutions

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3 Database

The characterisation of SMEs and therefore the selection of appropriate ECMs is dependent on the selection of certain criteria from a number of databases that will be linked to the SPEEDIER Tool for Experts. In this section, the databases that will be used to determine the climatic conditions, the building and equipment operating schedules, the structure of the building envelope and the type of energy consuming equipment found on site will be described. These values will be used to allow the tool to define the site energy consumption and recommend appropriate ECMs.

3.1 Climate

3.1.1 Climate area

The Köppen-Geiger classification map has been selected as the method of defining the climatic conditions for all European countries. The most commonly used climate classification map is Wladimir Köppen, introduced in 1961 by Rudolf Geiger. A large number of climate studies and subsequent publications adopted this or an earlier publication of the Köppen-Geiger map. The concept of climate classification has been widely applied to a range of topics including climate and climate change research, physical geography, hydrology, agriculture, biology and educational aspects, and use of the global climate classification map is well documented.

Each climate zone is marked by a different colour on the map, and identified by three letters, according to:

1. General classification
2. Precipitation
3. Temperatures

By looking up the definitions associated with each of the letters, the description of each climate zone can be obtained directly. For example:

Climate Zone of Catalonia: Csa - Temperate, dry summer, hot summer.

The Köppen-Geiger classification map is shown in Figure 3-1. Numerical data can be obtained from each climate zone defined under this criterion. This quantified information is regularly updated in open access scientific publications.

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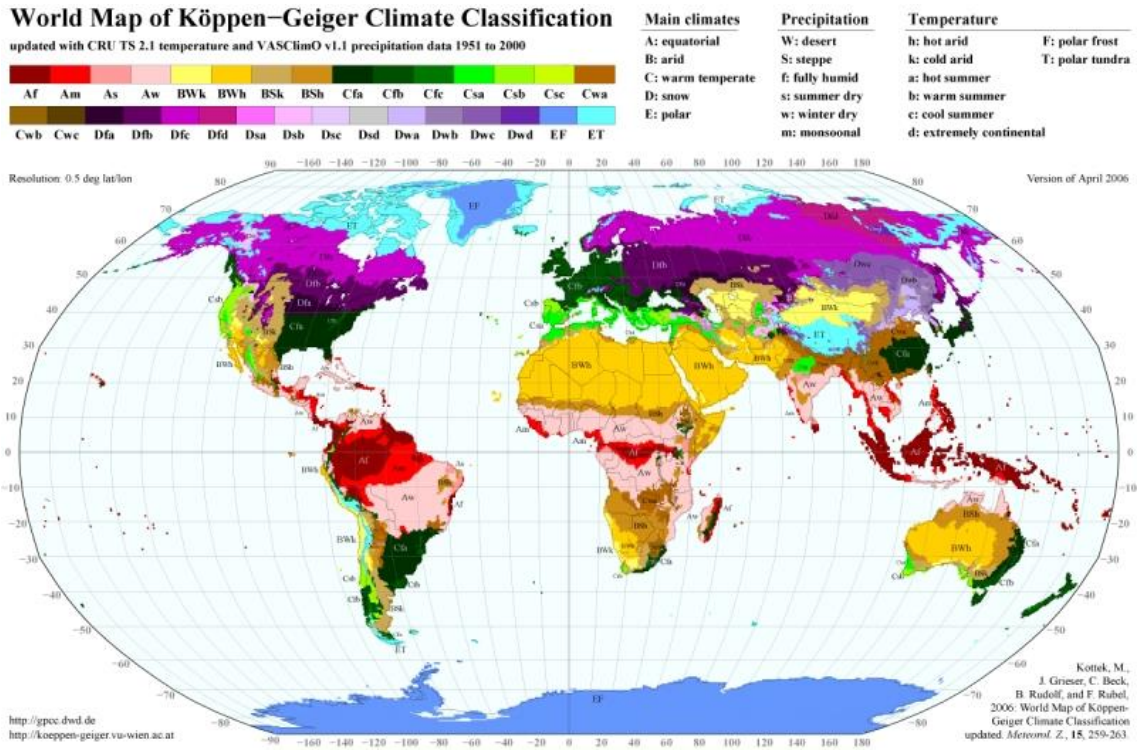

Figure 3-1: World map of Koppen-Geiger climate classification

3.1.2 Access to climate maps with vector information

On the Köppen-Geiger web site, maps in different formats can be accessed that allow vector information to be related to land coordinates. Table 3-1 provides links to the appropriate maps.

Table 3-1: Köppen Giger Climate Format

Format	Link
KMZ low resolution	http://koeppen-geiger.vu-wien.ac.at/kmz/Global_1986-2010_KG_30m.kmz.zip
KMZ Medium resolution	http://koeppen-geiger.vu-wien.ac.at/kmz/Global_1986-2010_KG_10m.kmz.zip
KMZ resolution high	http://koeppen-geiger.vu-wien.ac.at/kmz/Global_1986-2010_KG_5m.kmz.zip
TXT file with coordinates according to area	http://koeppen-geiger.vu-wien.ac.at/data/Koeppen-Geiger-ASCII.zip
GIF	http://koeppen-geiger.vu-wien.ac.at/pics/kottek_et_al_2006.gif
PDF	http://koeppen-geiger.vu-wien.ac.at/pdf/kottek_et_al_2006_A4.pdf

3.1.3 Climate zones of Europe and numerical parameters

Table 3-2 describes the climatic zones in relation to the 4 pilot countries of the SPEEDIER project (i.e. Ireland, Italy, Spain, Romania), which together covers a well rounded variety of climates across Europe.

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Table 3-2: Climate zones for SPEEDIER pilot countries

Countries	Ireland	Spain	Romania	Italy
Climate Zones	Cfb	Bsh Bsk Cfa Cfb Cfc Csa Csb Csc Dfc	Cfa Cfb Dfa Dfb	Csa Csb Csc Cfa Cfb Cfc

Figure 3-2: Numerical parameters and codes for each climate zones

and **Error! Reference source not found.** describes the numerical parameters of each

Type	Description	Criterion
A	**Equatorial climates**	$T_{min} \geq +18\ ^{\circ}C$
Af	Equatorial rainforest, fully humid	$P_{min} \geq 60$ mm
Am	Equatorial monsoon	$P_{ann} \geq 25\,(100 - P_{min})$
As	Equatorial savannah with dry summer	$P_{min} < 60$ mm in summer
Aw	Equatorial savannah with dry winter	$P_{min} < 60$ mm in winter
B	**Arid climates**	$P_{ann} < 10\,P_{th}$
BS	Steppe climate	$P_{ann} > 5\,P_{th}$
BW	Desert climate	$P_{ann} \leq 5\,P_{th}$
C	**Warm temperate climates**	$-3\ ^{\circ}C < T_{min} < +18\ ^{\circ}C$
Cs	Warm temperate climate with dry summer	$P_{smin} < P_{wmin}$, $P_{wmax} > 3\,P_{smin}$ and $P_{smin} < 40$ mm
Cw	Warm temperate climate with dry winter	$P_{wmin} < P_{smin}$ and $P_{smax} > 10\,P_{wmin}$
Cf	Warm temperate climate, fully humid	neither Cs nor Cw
D	**Snow climates**	$T_{min} \leq -3\ ^{\circ}C$
Ds	Snow climate with dry summer	$P_{smin} < P_{wmin}$, $P_{wmax} > 3\,P_{smin}$ and $P_{smin} < 40$ mm
Dw	Snow climate with dry winter	$P_{wmin} < P_{smin}$ and $P_{smax} > 10\,P_{wmin}$
Df	Snow climate, fully humid	neither Ds nor Dw
E	**Polar climates**	$T_{max} < +10\ ^{\circ}C$
ET	Tundra climate	$0\ ^{\circ}C \leq T_{max} < +10\ ^{\circ}C$
EF	Frost climate	$T_{max} < 0\ ^{\circ}C$

climate zone by code. A more detailed description of each zone is given in Table 3-3.

Figure 3-2: Numerical parameters and codes for each climate zones

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Type	Description	Criterion
h	Hot steppe / desert	$T_{ann} \geq +18\ ^{\circ}C$
k	Cold steppe /desert	$T_{ann} < +18\ ^{\circ}C$
a	Hot summer	$T_{max} \geq +22\ ^{\circ}C$
b	Warm summer	not (a) and at least 4 $T_{mon} \geq +10\ ^{\circ}C$
c	Cool summer and cold winter	not (b) and $T_{min} > -38\ ^{\circ}C$
d	extremely continental	like (c) but $T_{min} \leq -38\ ^{\circ}C$

Figure 3-3: Numerical parameters and codes for each climate zones

Table 3-3: Detailed description of Climate Zones

General classification	Precipitation	Temperature	Description
B			70% or more of annual precipitation falls in the summer half of the year and precipitation less than 20t + 280, or 70% or more of annual precipitation falls in the winter half of the year and precipitation less than 20t, or neither half of the year has 70% or more of annual precipitation and rainfall less than 20t + 140.
	W		Rainfall is less than one-half of the upper limit for classification as a B type (see above).
	S		Rainfall is less than the upper limit for classification as a B type but is more than one-half of that amount.
		h	Temperature equal to or greater than 18 °C.
		k	temperature less than 18 °C.
C			Temperature of warmest month greater than or equal to 10 °C, and temperature of coldest month less than 18 °C but greater than –3 °C.
	s		Precipitation in driest month of summer half of the year is less than 30 mm and less than one-third of the wettest month of the winter half.
	w		Precipitation in driest month of the winter half of the year less than one-tenth of the amount in the wettest month of the summer half.
	f		Precipitation more evenly distributed throughout year; criteria for neither s nor w satisfied.

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		a	Temperature of warmest month 22 °C or above.
		b	Temperature of each of four warmest months 10 °C or above but warmest month less than 22 °C.
		c	Temperature of one to three months 10 °C or above but warmest month less than 22 °C.
D			Temperature of warmest month greater than or equal to 10 °C, and temperature of coldest month –3 °C or lower.
	s		Same as for type C.
	w		Same as for type C.
	f		Same as for type C.
		a	Same as for type C.
		b	Same as for type C.
		c	Same as for type C.
		d	Temperature of coldest month less than –38 °C (d designation then used instead of a, b, or c).
E			Temperature of warmest month less than 10 °C.
	T		Temperature of warmest month greater than 0 °C but less than 10 °C.
	F		Temperature of warmest month 0 °C or below.

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3.2 Schedule

In order to define the usage condition for the heating or cooling installations, it is necessary to determine a normal operating schedule for each SME. For this, 14 types of predefined schedules have been defined that correspond to different types of buildings. Details of these time schedules and their application to different business sectors are presented in **Error! Reference source not found.** and in Figure 3-5: Detailed schedules for different sectors.

SCHEDULE PROFILE	DAYS PER YEAR	HOURS PER DAY	TOTAL HOURS
2h/7d	365	2	**730**
8h/7d	365	8	**2920**
12h/7d	365	12	**4380**
16h/7d	365	16	**5840**
24h/7d	365	24	**8760**
8h/6d	298	8	**2384**
12h/6d	298	12	**3576**
16h/6d	298	16	**4768**
24h/6d	298	24	**7152**
8h/5d	248	8	**1984**
8,5h/5d	176	8,5	**1496**
12h/5d	248	12	**2976**
16h/5d	248	16	**3968**
24h/5d	248	24	**5952**

Figure 3-4: Identified predefined schedules

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Administrations	**Schedule 12h/5d**
Corporate Building	Schedule 12h/5d
Social welfare	**Schedule 16h/7d**
Other social use centers	Schedule 8h/7d
Civic House	Schedule 8h/7d
Elderly center	Schedule 16h/7d
Multipurpose Civic Equipment	Schedule 8h/7d
Co-working center	Schedule 16h/7d
Playroom	Schedule 8h/5d
Warehouse	Schedule 8h/5d
Office of Social Welfare and Family	Schedule 12h/5d
Nursing home and Day care center	Schedule 16h/7d
Culture	**Schedule 12h/7d**
Film library	Schedule 12h/7d
Company and Employment	**Schedule 12h/5d**
Work Office	Schedule 12h/5d
Education	**Schedule 8,5h/5d**
Libraries	Schedule 12h/6d
Child and Primary Education Center	Schedule 8,5h/5d
Official Languages Schools	Schedule 8,5h/5d
Institute of Secondary Education	Schedule 8,5h/5d
Sports	**Schedule 16h/7d**
Pool, football pitch	Schedule 16h/7d
Sports facilities	Schedule 16h/7d
Sports center	Schedule 16h/7d

Interior	**Schedule 24h/6d**
Police Station	Schedule 24h/6d
Buildings other uses	Schedule 24h/6d
Fire station	Schedule 24h/6d
Justice	**Schedule 24h/6d**
Centers of imprisonment	Schedule 24h/6d
Penitentiary centers	Schedule 24h/6d
Courts	Schedule 12h/5d
Non-residential	**Schedule 12h/5d**
Other uses	Schedule 12h/5d
Industrial building	Schedule 12h/5d
Office building	Schedule 12h/5d
Hotel	Schedule 12h/7d
Logistic plant	Schedule 12h/5d
Industrial plant	Schedule 12h/5d
Residential	**Schedule 2h/7d**
Multi-family rental	Schedule 2h/7d
Multi-family homeowner community	Schedule 2h/7d
Single-family	Schedule 2h/7d
Health	**Schedule 16h/5d**
Primary Care Centers	Schedule 16h/5d
Specialized care centers	Schedule 16h/5d
Primary care emergency centers	Schedule 16h/5d
Hospital centers	Schedule 24h/6d
Local medical office	Schedule 16h/5d
Points of continued attention	Schedule 16h/5d
Diagnostic services for the image	Schedule 16h/5d

Figure 3-5: Detailed schedules for different sectors

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3.3 Structure

The main structure and the fabric of the building in which the SME is located, and the energy consuming equipment contained within it, must be defined in order to characterize the SME.

The following describes the options that define each of these parameters.

3.3.1 Envelope

The thermal envelope of a building is the skin that protects the occupants and building contents from outside weather conditions. Optimising the building envelope can reduce overall building energy consumption by reducing the level of heat losses from, or heat gains to, the building. The building's thermal envelope consists of all the enclosures that limit living or working spaces from the outside environment, and by the interior partitions that separate the floor area into useful spaces. The building envelope consists of walls, floors and roofs and are defined as follows:

Walls

Walls can be either exterior walls or party walls. The databases and selection criteria for the walls is described in more detail in Figure 3-6 and in Figure 3-7.

The exterior walls create the building enclosure and protects the interior spaces from the weather and other climatic conditions (i.e. rain, snow, heat, cold, winds), and are constructed from structural building materials and insulating elements. All exterior walls must comply with all the requirements of building regulations that apply in each country or region. In addition, the façade of the exterior wall is an architectural feature, which determines the identity of the building. For this reason, it is common to consider the aesthetic and expressive qualities of the façade as it can define and characterise the building in architectural terms.

A party wall is a partition that divides two adjacent buildings shared by the occupants of each residence or business. The key difference is that neither façade of a party wall is exposed to the outside environment. **Error! Reference source not found.** and **Error! Reference source not found.** describes the different envelope elements that could be selected for a wall.

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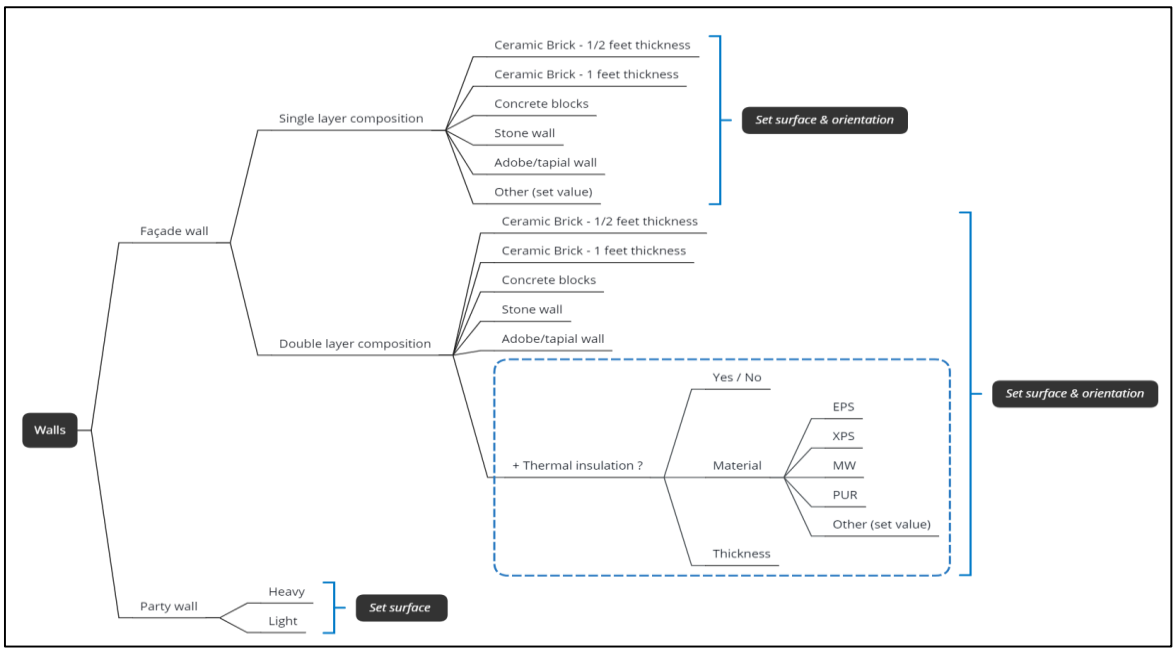

Figure 3-6: Envelope elements for a wall

Enveloping element	Position	Composition (1)	Composition (2)	Ventilation – Thermal insulation	Set surface	Set orientation
Wall	Façade wall	Single layer	Ceramic Brick – 1/2 feet thickness	a) → Thermal insulation? Yes / No (check) a. → Material 1. EPS 2. XPS 3. MW 4. PUR 5. Other – (set value) b. → Thickness c. → Ventillation 1. Non ventilated 2. Lightly ventilated 3. Ventilated	[m2]	N S E W NE NW SE SE
			Ceramic Brick – 1 feet thickness			
			Concrete blocks			
			Stone wall			
			Adobe/tapial wall			
			Other (set value)			
		Double layer	Ceramic Brick – 1/2 feet thickness			
			Ceramic Brick – 1 feet thickness			
			Concrete blocks			
			Stone wall			
			Adobe/tapial Wall			
	Party wall	Heavy ≥ 200 kg/m2	N/A	N/A	[m2]	N/A
		Light < 200 kg/m2				

Figure 3-7: Envelope elements for wall

Floors

The floor is a structural element in the horizontal plain that supports its own weight and that of any walls, roofs or other internal building elements. Loads are transmitted to the ground via other elements of the structure, such as beams, pillars, walls and foundations. **Error! Reference source not found.** and Figure 3-8: Envelope elements for floor

describes the different database elements for a floor.

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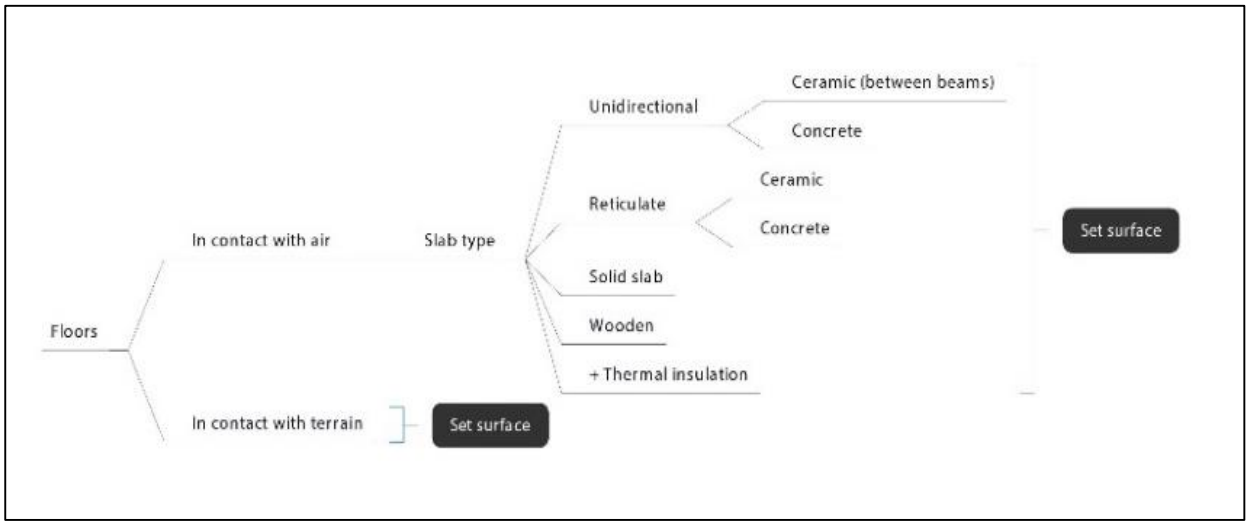

Figure 3-8: Envelope elements for floor

Floor¤	In·contact·with·air·outside¤	Unidirectional¤	Beamfill·material:↵ ¶ • → Ceramic¶ • → Concrete¶ ¶ Thermal·insulation¤	a)→ Thermal·insulation·(Yes·/·No—Check)¶ a.→ Material¶ i.→ EPS¶ ii.→ XPS¶ iii.→ MW¶ iv.→ PUR¶ v.→ Other..·(set·value)¶ b.→ Thickness¤	[m2]¤	N/A¤
		Reticulate¤				
		Solid·slab¤	N/A¤			
		Wooden¤	N/A¤			
	In·contact·with·terrain¤	N/A¤	N/A¤	N/A¤	[m2]¤	N/A¤

Figure 3-9: Envelope elements for floor

Roofs

The roof is the upper enclosing structures that sits above the walls and encloses the space underneath it, protecting the building from outside conditions and providing protection, privacy, acoustic and thermal insulation. **Error! Reference source not found.** and Figure 3-10: Envelope elements for roof

describes the different database elements for a roof.

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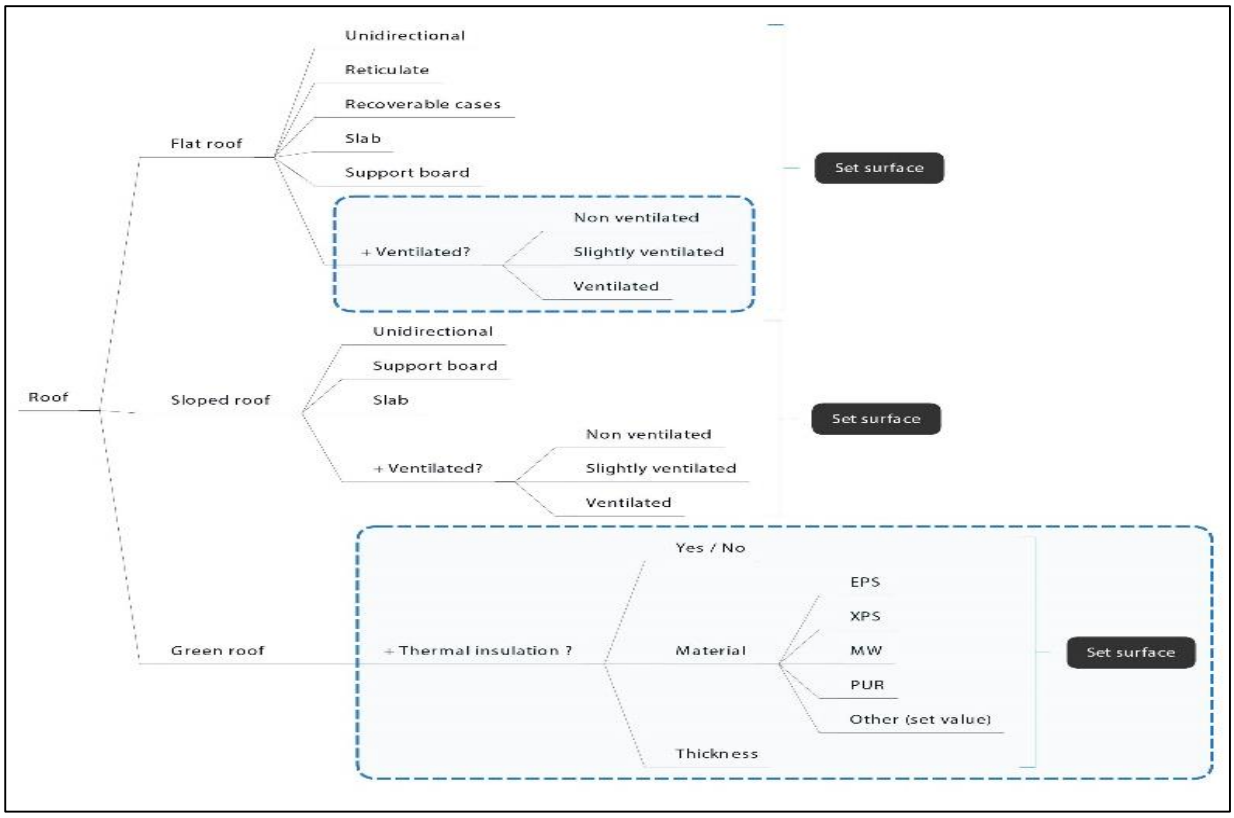

Figure 3-10: Envelope elements for roof

Roof¤	Flat·roof¤	Unidirectional¤	N/A↵ (a·coberta·no·es·defineix·material·entre·bigues,·ni·acabats)¤	a)→Ventillated¶ a.→Non·ventilated¶ b.→Lighly·ventilated¶ c.→Ventilated¶ b)→Thermal·insulation·(Yes·/·No—Check)¶ a.→Material¶ i.→EPS¶ ii.→XPS¶ iii.→MW¶ iv.→PUR¶ v.→Other··(set·value)¶ b.→Thickness¤	[m2]¤	N/A¤
		Reticulate¤				
		Recoverable·cases¤				
		Slab¤				
		Support·board¤				
	Sloped·roof¤	Unidirectional¤				
		Slab¤				
		Support·board¤				

Figure 3-11: Envelope elements for roof

3.3.2 Energy consuming equipment

Energy consuming equipment onsite consists of HVAC, Domestic Hot Water, lighting and other equipment such as computers. The databases and selection criteria for energy consuming equipment is described in more detail in Table 3-4Table 3-5 and Table 3-6.

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Table 3-4: Base table for Energy Consuming Equipment

Types	Generator	Fuels
DHW Heating only Heating and DHW	Standard boiler	Natural gas Diesel C Electricity Liquefied petroleum gas (LPG) Coal Biofuel Biomass Pelletised biomass
	Low temperature boiler	
	Heat pump	
	Variable refrigerant flow heat pump	
	Joule Effect	
	Constant performance equipment	
Cooling only Heating and cooling Heating, cooling and ACS	Heat pump	
	Variable refrigerant flow heat pump	
	Constant performance equipment	

Table 3-5: HVAC and domestic hot water fields and possible entries

DHW	Generator	see Table 3-4
	Fuel	see Table 3-4
	Demand Surface	m2
	Percentage	%
	Nominal Power	kWh
	Efficiency	%
Heating only	Generator	see Table 3-4
	Fuel	see Table 3-4
	Demand Surface	m2
	Percentage	%
	Nominal Power	kWh
	Efficiency	%
Cooling only	Generator	see Table 3-4
	Fuel	see Table 3-4
	Demand Surface	m2
	Percentage	%
	Nominal Power	kWh
	Efficiency	%
	Heat pump characteristics	Air -Air Air -water Air-Water Water-water

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Heating and cooling	Generator	see Table 3-4
	Fuel	see Table 3-4
	Heating demand surface area	m2
	Heating demand percentage	%
	Cooling demand surface	m2
	Refrigeration demand percentage	%
	Nominal Power	kWh
	Efficiency	%
Heating and DHW	Generator	see Table 3-4
	Fuel	see Table 3-4
	Heating demand surface area	m2
	Heating demand percentage	%
	Nominal Power	kWh
	Efficiency	%

Table 3-6: Other Equipment fields and possible entries

Heating, cooling, and DHW	Generator	see previous Table 3-4		
	Fuel	see previous Table 3-4		
	Heating demand surface area	m2		
	Heating demand percentage	%		
	Efficiency	%	Efficiency DHW	%
			Heating Efficiency	%
			Cooling Efficiency	%
			Installation age	
Energy contributions	Renewable energy sources	Yes/no	DHW percentage covered	%
			Covered heating percentage	%
			Covered refrigeration percentage	%
	Cogeneration Electricity generation through renewable	Yes/no	Electricity generated for self-consumption	kWh/year
			Heat recovered for DHW	kWh/year
			Heat recovered for heating	kWh/year
			Cold recovered	kWh/year
			Energy consumed	kWh/year
			Fuel type	see previous Table 3-4

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Lighting equipment	Surface area	m2		
	Lighting control?	Yes/no	Surface with lighting control	m2
	Representation Zone	Yes/no		
	Activity	-		
	Installed potency	W		
	Average horizontal illuminance	Lux		
Primary air equipment	Ventilation flow	m3/h		
	Heat recovery?	Yes/no		
	Seasonal Efficiency	%		
Pumping equipment	Pump type	a/b	a) Constant flow pump b) Multi-speed pump	
	Service	a/b/c	a) DHW b) Heating c) Cooling	
	Electric power	kW		
	Number of demand hours	h		
	Does the pump work when there is no thermal demand?	Yes/no		
Cooling towers	Tower type	a/b	a) Constant speed b) Variable speed	
	Electric power	kW		
	Number of demand hours	h		

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4 Characterisation of SMEs and ECMs

4.1 Hierarchy of applicable ECMs

Once the data described above has been collected, the SPEEDIER Expert should be able to make an estimate of the current building energy consumption and determine the most suitable ECMs to that relate to either (a) improving the building fabric to reduce the energy required to condition the indoor space or (b) reducing the amount of energy consumed by any equipment found onsite. In general, the data collected should begin with generic features relating to the SME activity and schedule, then include more detail regarding building location and orientation, followed by the internal layout and configuration, and finally the potential upgrades to apply in energy consumption equipment. If necessary, energy generating equipment could also be recommended.

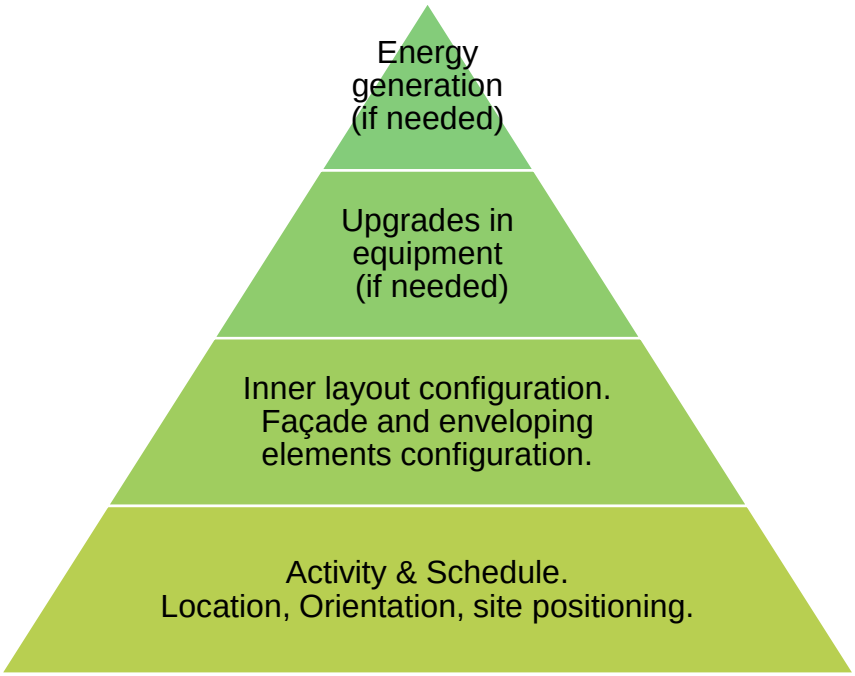

Figure 4-1: Hierarchy of applicable ECMs

The order in which recommended ECMs are applied is important, as more often than not, it allows the first interventions to be low cost measures, based on simple energy saving concepts (such as ensuring that the equipment time schedules for operation match the building's occupied hours) and the needs of the client, thus optimizing the economic impact with as little disruption or investment as possible. After this general approach, improving equipment installations (e.g. upgrading to more efficient equipment) can be considered. These measures typically involve a higher capital outlay and are more disruptive to the business.

In parallel to these actions, there are many best practice opportunities for energy saving that can be applied, regardless the activity or conditions of the SME. These measures have been listed as no cost ECMs in section 3.1 of Deliverable D3.3.

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4.2 ECMs predisposition from SMEs

The profiling and characterization of SMEs that was reported in Deliverable 3.1, section 3, allows certain ECMs to be recommended to SMEs based on the characterization according to location and sector. This allows a certain set of ECMs to be pre-selected (and others to be ruled out) from the overall list of ECMs based on those that are most likely to be applicable to the SME. For example, ECMs that focus on reducing heat gains will be most suitable for warm climates, while ECMs that encourage the use of heat gains as a form of passive heating will be recommended for SMEs located in colder climates.

A range of such measures is described in the following tables and organized according the several categories explained in section 2 of this document.

For each pilot region, the most common activity and climate has been described in the tables. That is, Table 4-1 describes the main ECMs that relate to the main activity of the SMEs, Table 4-2: Main describes the main climatic conditions in each pilot country and TablesTable 4-3 to Table 4-5 show ECMs that could be recommended based on those climatic conditions.

Table 4-1: Main activity and ECM recommendations

Country	SME sector	ECM Context
Ireland	Manufacturing	Energy consumption may relate mainly to specialist industrial equipment (compressed air, refrigeration, oven/kiln systems, dust/vapour extraction, etc.). It is important to review the specifications and maintenance requirements of every energy consuming device.
Italy		
Spain	Services	There are several fields of activity, but no prevailing sector profile dominates the portfolio of SMEs. Spain is the most unusual case as most of the SMEs do not own the building they occupy. This could mean most of the suitable ECMs will relate to onsite equipment and its energy consumption.
Romania	Hospitality	The main business-operating sector in Romania is Hospitality, and the average size of the SME's is slightly bigger than that of the other pilot regions. This may result in more ECMs that are specific to the needs of the hospitality sector. The larger average size of SMEs may make it possible to start from implementation of medium-cost measures although this depends on the availability of funds.

Table 4-2: Main climatic condition of pilot countries

Country	Main Climatic Area	Climate Characteristics
Ireland	Cfb	Temperate oceanic climate. Coldest month averaging above 0°C (or −3°C, all months with average temperatures below 22°C, and at least four

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		months averaging above 10 °C. No significant precipitation difference between seasons.
Italy	Csa	Hot-summer Mediterranean climate
Spain		Coldest month averaging above 0°C or −3°C, at least one month's average temperature above 22°C. At least three times as much precipitation in the wettest month of winter as in the driest month of summer, and driest month of summer receives less than 30 mm of rainfall.
Romania	Cfa, Dfb	Humid continental climate. Most regions have a **Cfa** Climate, a warm temperated humid Climate with the warmest month above 22°C over average and the coldest month between -18 and -3°C. The climate of the mountainous regions can be classified as **Dfb** Climate; a humid Snow climate with the warmest month between 10°C and 22°C, the coldest month below -3°C and at last four or more months above 10°C. Constant rainfall throughout the year, so there is not a dry period.

4.3 Suggested ECMs according to climate conditions

4.3.1 Climate related ECMs in Ireland

Table 4-3 lists various ECMs for businesses operating in Ireland, based on its specific climatic condition (Cfb – warm temperate climate, fully humid with warm summers).

Table 4-3: List of ECMs based on climatic condition for Ireland

Main climate condition	**Cfb Temperate oceanic climate.**
Building related ECMs	Install solar glazing in any windows oriented 15º from true south. Use a thermal store (e.g. thermal mass) to retain any excess heat gained during the day so that it can be released at night to preheat the building. Locate the occupied spaces along the south side of the building so that they benefit from heat gains in the winter. Lower the indoor temperature set points when the building is unoccupied at night to reduce heating energy consumption (night-time set back). Ensure that cold pitched roofs, (i.e. those that are vented outwards) are well insulated at ceiling level to avoid heating loss to unused loft space. If a basement is used, it must be at least 0.4 m below the ice line and insulated outside or inside to prevent heat loss to the ground.

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Equipment related ECMs	Ensure the building is as air tight and well insulated as possible, minimizing draughts in order to retain heat gain from lights, occupants, and equipment. This will reduce heating requirements. Very air tight buildings (e.g. those achieving passiv-haus standards) need a mechanical ventilation system with a heat recovery system to ensure indoor air quality is maintained while conserving energy. High efficiency heaters and condensing boilers should replace older, inefficient equipment and normally prove cost effective in this climate. **See deliverable 3.3 section 3 for further categorization of equipment related ECMs according to their cost.**

4.3.2 Climate related ECMs in Italy and Spain

Both Italy and Spain share similar climatic conditions (i.e. warm temperate climates with hot, dry summers). Table 4-4 lists various ECMs for businesses operating in Italy and Spain, based on these climatic condition.

Table 4-4: List of ECMs based on climatic condition for Italy and Spain

Main climate condition	**Csa Hot-summer Mediterranean climate.**
Building related ECMs	Use passive solar gain in winter to heat spaces with south facing glazing. Increase shading of south facing windows and facades to prevent overheating in summer. Encourage use of thermal mass such as masonry floors, walls and/or ceilings as the thermal mass absorbs and stores daytime solar heat in winter for release at night, thus reducing daytime heating requirements. Ensure window openings are used correctly to encourage passive cooling of spaces in summer. Window openings located perpendicular to prevailing winds, and coupled with openings on the opposite side of a space or building, will provide natural ventilation for fresh air and/or space cooling. Install window blinds, curtains or operable sunshades as these can reduce or eliminate solar gain in summer and reduce the need for air conditioning. On hot days use ceiling fans as indoor air motion can make it seem up to 5ºC cooler than the actual air temperature, thus reducing the need for air conditioning.

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Equipment related ECMs	Ensure the building is as air tight and well insulated as possible, minimizing draughts in order to retain heat gain from lights, occupants, and equipment. This will reduce heating requirements. Very air tight buildings (e.g. those achieving passiv-haus standards) need a mechanical ventilation system with a heat recovery system to ensure indoor air quality is maintained while conserving energy. **See deliverable D3.3 section 3 for further categorization of equipment related ECMS according to their cost**

4.3.3 Climate related ECMs in Romania

Table 4-5 lists various ECMs for businesses operating in Romania, based on the country's specific climatic condition (i.e. snow climate or warm temperate climate with high humidity).

Table 4-5: List of ECMs based on climatic condition for Romania

Main climate condition	Dfb. Humid continental climate
Building related ECMs	Use passive solar gain in winter to heat spaces with south facing glazing. Increase shading of south facing windows and facades to prevent overheating in summer. Locate storage areas or garages on the side of the building facing the coldest wind, to help insulate by reducing the area of the facades exposed directly to outdoor conditions. Install solar glazing in any windows oriented 15º from true south. Store a portion of the heat gained during the day for release at night by locating thermal mass in the space. Incorporate moveable insulation over the glazing at night. Extra insulation might proof cost effective, and will increase occupant comfort by keeping indoor temperatures more uniform and preventing night time heat loss. Carefully seal building to minimize air infiltration and eliminate drafts, especially in windy sites (wrap, weather stripping, tight windows).
Equipment related ECMs	Ensure the building is as air tight and well insulated as possible, minimizing draughts in order to retain heat gain from lights, occupants, and equipment. This will reduce heating requirements.

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	Install insulating blinds, heavy draperies or operable window shutters to reduce winter night time heat losses. If necessary, these can be automatically controlled. Very air tight buildings (e.g. those achieving passiv-haus standards) need a mechanical ventilation system with a heat recovery system to ensure indoor air quality is maintained while conserving energy. Lower the indoor comfort temperature at night to reduce heating energy consumption. **See deliverable D3.3 section 3 for further categorization of equipment related ECMS according to their cost**

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5 Conclusion

This Deliverable describes the ECMs that could be proposed as part of an energy audit/assessment of any SME based solely on their activity and location. This fits with the broader methodology defined for carrying out energy audits at any SMEs that anticipates using characterization techniques to quickly identify potentially suitable ECMs based on easily obtainable information.

This Deliverable should not be regarded as a “manual” for SPEEDIER Experts to follow to the letter, since every SME is different and their particular circumstances will lead to the selection of certain ECMs over others. Instead, this Deliverable is intended to be a guide to quickly narrow down the vast range of possible ECMs to a longlist of those ECMs that are most likely to be applicable based on simple, easily obtainable information.

Significantly, the SPEEDIER Expert must then use their expertise and judgement to refine this list and build a package of ECMs tailored to the specific needs of each individual SME.

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