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## D 2.3: List of most effective energy saving measures in office buildings

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## Abstract

In order to adapt the interactive Energy Savings Account (iESA) to the conditions of office buildings in participating countries it is important to update the list of possible short and medium term energy efficiency improvements in office buildings for each country. Users who undertake an energy efficiency improvement in an office (e.g. installing LED lights) can choose the respective improvement measure in the iESA (e.g. "Change of Lighting system to LED") from a dropdown list of all improvements measures. This measure will then be displayed (with a time stamp) in the energy consumption profile of the office. By this visualization, a user can see at a glance how this specific improvement measure influenced in the overall energy consumption (if the consumption after the implementation of the measure has de- in decreased).

This report will detail, how the country specific energy efficiency measures (that are not already implemented in the standard version of the iESA) were gathered, and detail the measure for every country separately.

## Procedure to gather country specific energy efficiency improvement measures

The country specific energy efficiency improvement measures can be split into two categories:

- a) Technical measures (e.g. replacing light bulbs by LED's)
- b) Non-technical measures (e.g. change habits for ventilation of the office)

The task of gathering country specific energy efficiency improvement measures (category a and b) was coordinated by SEnerCon and performed by all participating countries of EECC.

Steps of compiling country specific measure lists:

1. SEnerCon requested a list of most effective energy saving measures (5 weeks before the kick-off meeting) for companies in each country
2. The country specific lists were discussed in the kick-off meeting
3. SEnerCon sent around a shared online document<sup>1</sup> where the measures were listed for each country. This shared document let partners compare their list with the lists of other countries
4. Finalization of each list in accordance with partners

Consortium partners delivered all requested contributions on time.

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<sup>1</sup> [https://docs.google.com/spreadsheets/d/1udEopUHQ00fSZ49FD\\_0hT9o0pyW9JqjIT-X3dqIoYs/edit#gid=1050566453](https://docs.google.com/spreadsheets/d/1udEopUHQ00fSZ49FD_0hT9o0pyW9JqjIT-X3dqIoYs/edit#gid=1050566453)

## Lists of country specific energy efficiency improvement measures for each country:

### Austria

#### 1. Technical measures

|   |
|---|
| Technical measures  |
| <b>Circulating pump</b>   |
| Exchange of pump  |
| Regulation and adjustment of power of pump  |
| Exchange of pump motor  |
| Optimization of pipe system (pump)  |
| Maintenance and servicing pump  |
| Close leakages  |
| Improve net pressure  |
| <b>Air conditioning system</b>  |
| Adjustment of volume flow of air conditioning (AC)  |
| Exchange of parts of the site (AC)  |
| Heat recovery (AC)  |
| Humidity recovery (AC)  |
| Maintenance and servicing (AC)  |
| <b>Heating system</b>   |
| Reduce waste as losses (heating)  |
| Improve burner adjustment   |
| Reduce slurry losses (heating)  |
| Pipe insulation (heating)   |
| Reduce leakages in pipes and condensate diverters(heating)  |
| Use energy content in post-steaming through an intelligent cascade coupling (heating)                             |
| Monitor use of electricity of system components (pumps, ventilation, compressor)                                  |
| Energy assessment, evaluation of the system   |
| Identify and reduce cooling load  |
| Optimize system temperature   |
| regulation of single components and of whole system   |
| Check and install heat recovery   |
| Reduce leakages   |
| Installation of thermostat (temperature control device)   |
| Improvement of pipe insulation, bathroom fittings, storage tank access improvement of insulation of storage tanks |
| Hydraulic adjustment  |
| Installation of a time regulation for hot water circulation pump  |
| Installation of a pre-adjustable valve and regulation valve storage tank access with thermosiphon                 |

|  |
|--|
| Installation/ exchange of heating regulation   |
| Exchange of boiler - change to renewable energy installation of a solar-site                                 |
| <b>Lighting</b>  |
| Ligtbulbs replaced by LEDs   |
| Installation of Smart Meters to visualize and control of the own consumption in order to find energy wasting |
| Sensitizing of occupants through workshops   |
| <b>Buildings Insulation and ventilation</b>  |
| Controlled ventilation using heat recovery   |
| Insulation of story ceiling, basement ceiling, external wall   |
| Insulating glass (   |
| Exchange (replacement of) - efficiency improvement   |
| Windows - 3fold glass  |
| <b>Renewables</b>  |
| Solar collectors for water heating   |
| Solar collector for water heating and heating  |
| Solar collectors for water heating and heating   |
| Installation of solar collectors   |
| Installation of PV-system  |
| Installation of biomass, low condensing boiler, heating pump   |

## 2. Non-Technical (pure behavioural) measures

|   |
|---|
| Non-technical measures  |
| <b>Reduction of stand-by</b>  |
| Switch off parts and consumers beyond office hours  |
| Reduction of operation time of AC   |
| Limiting of the room temperature (The reduction of 1°C leads to 6% energy savings)  |
| Bleeding or rather venting of radiators in order to get rid of the oxygen in the heating water  |
| If old windows haven't been replaced, the use of insulation strip is convenient   |
| Ventilation - The "Rush" - Method: Close thermostatic valves and open widely a window for at least 5 minutes                              |
| Ventilation - The "Cross" - Method: Open opposite windows for 5 minutes to create an air exchange   |
| Radiators are free of cloth & furniture so that the heat exchange can work correctly  |
| A decrease of the room temperature during nights and longer periods of absence generate considerable energy savings                       |
| Reduce your Standby consumption by using Standby killers like: multiple sockets or even more comfortable remote controlled multiple plugs |
| Lights switched off when not needed   |

**Latvia**

## 1. Technical measures

|   |
|---|
| Technical measures  |
| Changing lighting to more energy efficient  |
| Buying energy efficient office appliances   |
| Instaling thermostatic valves on radiators  |
| Eliminating standby losses by using central electricity switch to turn of all electricity supply office building during night                 |
| Insulation of building envelope:<br>- external wall insulation<br>- basement insulation<br>- roof insulation<br>- change of windows and doors |
| New mechanical ventilation systems with heat recuperation   |

## 2. Non-Technical (pure behavioural) measures

|  |
|--|
| Non-technical measures                                   |
| Turning off monitors and lights during lunch             |
| Decreasing indoor air temperature during night at winter |
| Night ventilation for cooling building during summer     |
| Energy manager for the building                          |
| Rearranging the layout of employees                      |
| Thicker clothing during winter                           |

**Spain**

## 1. Technical measures

|                               |
|-------------------------------|
| Technical measures            |
|                               |
| Improve Lighting              |
| Installing fans instead of AC |
| Changing boilers              |
| Changing HVAC                 |
| Improved thermostat           |
| Installing smart meters       |
| Install Wall Insulation       |
| Upgrade Wall Insulation       |

|   |
|---|
| Install Roof Insulation                                       |
| Upgrade Roof Insulation                                       |
| Install Floor Insulation                                      |
| Upgrade Floor Insulation                                      |
| Replacement of Windows  |
| Replacement of Doors  |
| Install False Ceiling   |
| Improve Draught Proofing                                      |
| Improve Air Tightness   |
| Renovation or Installation of a ventilation system            |
| Installation of new Air Conditioning system                   |
| Install Water Conservation Features                           |
| Improve Domestic Hot Water Controls                           |
| Installation of water-saving fittings                         |
| Installation of water-saving cisterns                         |
| Installation of water-saving aerators                         |
| Improve Heating Controls                                      |
| Improve pipe and water storage insulation                     |
| Installing/Replacing of hot water circulation pump            |
| Replacement of heating system                                 |
| Installation of underfloor heating                            |
| Installing/Replacing of heating circulation pump              |
| New boiler commissioning                                      |
| Hydraulic balancing   |
| Installation of solar collectors for water heating            |
| Installation of a pellet or wood chip heating system          |
| Lighting Control Upgrade                                      |
| Enlargement of the radiator surface                           |
| Replacement of washing machine                                |
| Replacement of fridge/freezer                                 |
| Replacement of dishwasher                                     |
| Replacement of other electrical appliances                    |
| Purchase green electricity                                    |
| Install Variable Speed Drives                                 |
| Install Gas Heating System                                    |
| Install LPG heating System                                    |
| Replacement of solar collectors for water heating and heating |
| Installation/replacement of PV system                         |
| Change vehicle into a more energy efficient one               |
| Change of energy supplier                                     |
| Change energy source  |



|                           |
|---------------------------|
| Install monitoring system |
| Remote Controlled Plugs   |
| Time controlled Plugs     |
| Passive Shading           |

|  |
|--|
| Installation of Double glazing apertures                   |
| Application of reflective roof coating                     |
| Installation of external shading                           |
| Installation of Double windows                             |
| Upgrading of office electronics/computers                  |
| Replacement of electrical appliances                       |
| Renovation or installation of a passive ventilation system |
| Cleaning of PV panels                                      |
| Conversion of kitchen hobs from electricity to gas         |
| Installation of Building Management System (BMS)           |
| Installation of micro wind turbine                         |
| Installation of occupancy sensors                          |
| Installation of Solar reflection films                     |
| Installation of Room Energy Management systems             |
| Installation of Micro wind turbines                        |
| Installation of Waste heat recovery system                 |
| Installation of Solar air heating systems                  |
| Installation of Water cooled AC system via geothermal      |
| Installation of Boiler conversion from diesel to gas       |
| Installation of Geothermal heat exchange                   |
| Improved Landscape design + low-water plants               |
| Switching to night tariffs                                 |

## 2. Non-Technical (pure behavioural) measures

|  |
|--|
| Non-technical measures   |
| Switch off computers   |
| Suspend computers  |
| Correct thermostat values  |
| Use natural cooling instead of AC (Open windows)                   |
| Same Timetable for all employees                                   |
| Use of car sharing   |
| Buy of energy-efficient manufactured office materials or furniture |
| Building is vacant   |
| Reduction in the number of persons                                 |

|  |
|--|
| Reduced presence in office                       |
| More frequent use of office vehicle              |
| Less frequent use of office vehicle              |
| Increased presence in office                     |
| Increased number of persons                      |
| Completed energy-saving training                 |
| Completed fuel-saving training                   |
| Painting of walls in light colours               |
| Move heat sources away from A/C thermostats      |
| Planting of trees in front of office for shading |
| Energy audit and survey                          |
| Analysis of bills                                |
| Energy performance certificates                  |
| Undertaken ECO certification                     |
| Provision of Real-time energy display            |
| Standby Awareness                                |
| Switch to public transport                       |
| Other relevant trainings                         |

## Italy

### 1. Technical measures

|  |
|--|
| Technical measures                                     |
| Thermal insulation of walls                            |
| Roof insulation  |
| Basement ceiling insulation                            |
| External wall Insulation                               |
| installion of double windows                           |
| Replacement of thermostat valves                       |
| Installation of solar collectors for water heating     |
| PV plant installation                                  |
| Replacement of other electrical appliances             |
| Replacement of lighting bulbs with more efficient ones |
| Purchase green electricity                             |
| Installing a heat pump                                 |
| Installation of thermostat valves in each room         |
| Installation of water-saving fittings                  |
| Installation of underfloor heating                     |
| Installation of a pellet or wood chip heating system   |
| Installion of sensors for lighting control             |

|   |
|---|
| installation of smart meters                                |
| Solar shading systems                                       |
| central air conditioning systems (instead of single splits) |
| Energy consumption meters                                   |
| Replacement of light bulbs with LEDs                        |
| Electrical vehicles   |
| Changed vehicle   |
| Building automation   |

## 2. Non-Technical (pure behavioural) measures

|   |
|---|
| Non-technical measures  |
| Reduce heating schedule   |
| Reduce heating temperature  |
| Switch off pc and all the electronical applaiences                      |
| Stand by  |
| Car sharing and car pooling   |
| Use natural cooling instead of AC (open windows)                        |
| Planting of trees in front of the office                                |
| Audit   |
| Implementation of an Energy Management System                           |
| Energy saving training  |
| Allow employees to wear more informal and lighter clothes during summer |

## Malta

### 1. Technical measures

|  |
|--|
| <b>Technical measures</b>  |
| Installation of External/internal thermal insulation of walls/facade |
| Installation of Roof thermal insulation                              |
| Installation of Basement roof insulation                             |
| Installation of Double glazing apertures                             |
| Application of reflective roof coating                               |
| Installation of external shading                                     |
| Installation of Double windows                                       |
| Upgrading of office electronics/computers...                         |
| Replacement of electrical appliances                                 |
| Replacement of fridge/freezer  |

|  |
|--|
| Replacement of dishwasher                                  |
| Replacement of cooling systems                             |
| Replacement of heating systems                             |
| Replacement of boiler/geyser                               |
| Renovation or installation of a passive ventilation system |
| Installation of fans instead of AC                         |
| Installation of PV system (on or off site)                 |
| Switch to PV: Feed-in only                                 |
| Switch to PV: Feed-in and own consumption                  |
| Cleaning of PV panels                                      |
| Installation of Domestic Hot Water (DHW) collectors        |
| Servicing of Solar Water Heater                            |
| Installation of heat pumps                                 |
| Installation of Smart energy meters + sub-metering         |
| Installation of water-saving fittings                      |
| Installation/renovation of water-saving cisterns           |
| Installation of water-saving aerators                      |
| Installation of underfloor heating                         |
| Installation of ceiling fans                               |
| Installation of inverter based A/C                         |
| Installation of VRF type A/C                               |
| Servicing of heat pump or central air conditioner          |
| Installation of voltage optimisation system                |
| Upgrade to EE vehicles                                     |
| Change of lighting to T8 or LED                            |
| Conversion of kitchen hobs from electricity to gas         |
| Installation of Building Management System (BMS)           |
| Installation of micro wind turbine                         |
| Installation of occupancy sensors                          |
| Installation of Building Management Systems                |
| Installation of Room Energy Management systems             |
| Installation of Air of Handling Unit optimisation          |
| Installation of Intelligent lighting control               |
| Installation of Solar PV systems                           |
| Combined Heat and power systems                            |
| Installation of Geothermal heat exchange                   |
| Installation of Solar reflection films                     |
| Installation of Solar light tubes                          |
| Improved Landscape design + low-water plants               |
| Emphasis on Thermal zoning                                 |

|  |
|--|
| Installation of Thermal bridges in building envelope       |
| Installation of Passive Draught Evaporative Cooling (PDEC) |
| Installation of Solar assisted cooling                     |
| Installation of Night Time Convective Cooling              |
| Installation of Micro wind turbines                        |
| Installation of Waste heat recovery system                 |
| Installation of Solar air heating systems                  |
| Installation of Water cooled AC system via geothermal      |
| Installation of Boiler conversion from diesel to gas       |
| Installation of Solar lighting                             |
| Installation or renovation of water-saving cisterns        |
| Uptake of night tariffs                                    |

## 2. Non-Technical (pure behavioural) measures

|  |
|--|
| <b>Non-technical measures</b>                    |
| Building is vacant                               |
| Reduction in the number of persons               |
| Reduced presence in office                       |
| More frequent use of office vehicle              |
| Less frequent use of office vehicle              |
| Increased presence in office                     |
| Increased number of persons                      |
| Completed energy-saving training                 |
| Completed fuel-saving training                   |
| Switch off computers                             |
| Suspend computers                                |
| Change of thermostat values on A/Cs              |
| Use natural cooling instead of AC (Open windows) |
| Painting of walls in light colours               |
| Move heat sources away from A/C thermostats      |
| Planting of trees in front of office for shading |
| Car pooling policy                               |
| Energy audit and survey                          |
| Natural ventilation                              |
| Analysis of utility bills                        |
| Energy performance certificates                  |
| Undertaken ECO certification                     |
| Change of thermostat values on A/Cs              |

|   |
|---|
| Provision of Real-time energy display   |
| Completed energy-saving training        |
| Completed fuel-saving training          |
| Addressed stand-by electronic offenders |

## France

### 1. Technical measures

|  |
|--|
| Technical measures                                 |
| Install Wall Insulation                            |
| Upgrade Wall Insulation                            |
| Install Roof Insulation                            |
| Upgrade Roof Insulation                            |
| Install Floor Insulation                           |
| Upgrade Floor Insulation                           |
| Replacement of Windows                             |
| Replacement of Doors                               |
| Install False Ceiling                              |
| Improve Draught Proofing                           |
| Improve Air Tightness                              |
| Renovation or Installation of a ventilation system |
| Installation of new Air Conditioning system        |
| Install Water Conservation Features                |
| Improve Domestic Hot Water Controls                |
| Installation of water-saving fittings              |
| Installation of water-saving cisterns              |
| Installation of water-saving aerators              |
| Improve Heating Controls                           |
| Improve pipe and water storage insulation          |
| Replacement of hot water circulation pump          |
| Replacement of heating system                      |
| Installation of underfloor heating                 |
| Replacement of heating circulation pump            |
| New boiler commissioning                           |
| Hydraulic balancing                                |
| Install New boiler                                 |
| Lighting Upgrade                                   |
| Lighting Control Upgrade                           |
| Enlargement of the radiator surface                |

|   |
|---|
| Replacement of washing machine                                |
| Replacement of fridge/freezer                                 |
| Replacement of dishwasher                                     |
| Replacement of other electrical appliances                    |
| Purchase green electricity                                    |
| Install Variable Speed Drives                                 |
| Installation of solar collectors for water heating            |
| Installation of a pellet or wood chip heating system          |
| Install Gas Heating System                                    |
| Install LPG heating System                                    |
| Replacement of solar collectors for water heating and heating |
| Installing a heat pump  |
| Installation/replacement of PV system                         |
| Changed vehicle   |
| Change of energy supplier                                     |
| Change energy source  |
| Install monitoring system                                     |
| Install Smart meter   |
| Remote Controlled Plugs                                       |
| Time controlled Plugs   |
| Passive Shading   |

## 2. Non-Technical (pure behavioural) measures

|                                      |
|--------------------------------------|
| Non-technical measures               |
| Reduce Temperature Set Points        |
| Reduce heating schedule              |
| Reduce number of occupants           |
| Switched to public transport         |
| Car Sharing                          |
| Less frequent use of the vehicle     |
| Completed fuel-saving training       |
| Completed Energy Efficiency Training |
| Increased Use of Natural Ventilation |
| Sleep Function of equipment          |
| Standby Awareness                    |
| Painting of walls in light colours   |
| Bill Analysis                        |

## Bulgaria

### 1. Technical measures

|  |
|--|
| Technical measures   |
| Thermal insulation of walls/façade                             |
| Roof insulation  |
| Replacement of windows   |
| Replacement of elevators                                       |
| Installation of thermostat valves                              |
| Installation of solar collectors for water heating and heating |
| Replacement of other electrical appliances                     |
| hot water circulation pump control                             |
| Replacement of heating system                                  |
| Sensor control for lighting                                    |
| Replacement of fridge/freezer                                  |
| Passive heating/cooling  |
| new boiler commissioning                                       |
| Installing a heat pump   |
| Installation/replacement of PV system                          |
| Installation of water-saving fittings                          |
| Installation of water-saving cisterns                          |
| Installation of water-saving aerators                          |
| Installation of underfloor heating                             |
| Installation of electronic thermostat valves                   |
| Installation of a pellet or wood chip heating system           |
| Change energy source   |
| Basement ceiling insulation                                    |
| Changing Lighting  |
| Installing a smart meter                                       |

### 2. Non-Technical (pure behavioural) measures

|                                     |
|-------------------------------------|
| Non-technical measures              |
| Completed fuel-saving training      |
| Reduction in the number of persons  |
| Vaccant building                    |
| Less frequent use of office vehicle |
| Switch off computers                |
| Decreased presence in office        |



|  |
|--|
| Change of thermostat values on A/Cs              |
| Use natural cooling instead of AC (Open windows) |
| Energy audit and survey                          |
| Natural ventilation                              |
| Motivation campaigns for behavior changes        |
| Completed energy-saving training                 |

## Ireland

### 1. Technical measures

|  |
|--|
| Technical measures                                 |
| Install Wall Insulation                            |
| Upgrade Wall Insulation                            |
| Install Roof Insulation                            |
| Upgrade Roof Insulation                            |
| Install Floor Insulation                           |
| Upgrade Floor Insulation                           |
| Replacement of Windows                             |
| Replacement of Doors                               |
| Install False Ceiling                              |
| Improve Draught Proofing                           |
| Improve Air Tightness                              |
| Renovation or Installation of a ventilation system |
| Installation of new Air Conditioning system        |
| Install Water Conservation Features                |
| Improve Domestic Hot Water Controls                |
| Installation of water-saving fittings              |
| Installation of water-saving cisterns              |
| Installation of water-saving aerators              |
| Improve Heating Controls                           |
| Improve pipe and water storage insulation          |
| Replacement of hot water circulation pump          |
| Replacement of heating system                      |
| Installation of underfloor heating                 |
| Replacement of heating circulation pump            |
| New boiler commissioning                           |
| Hydraulic balancing                                |
| Install New boiler                                 |
| Lighting Upgrade                                   |

|   |
|---|
| Lighting Control Upgrade                                      |
| Enlargement of the radiator surface                           |
| Replacement of washing machine                                |
| Replacement of fridge/freezer                                 |
| Replacement of dishwasher                                     |
| Replacement of other electrical appliances                    |
| Purchase green electricity                                    |
| Install Variable Speed Drives                                 |
| Installation of solar collectors for water heating            |
| Installation of a pellet or wood chip heating system          |
| Install Gas Heating System                                    |
| Install LPG heating System                                    |
| Replacement of solar collectors for water heating and heating |
| Installing a heat pump  |
| Installation/replacement of PV system                         |
| Changed vehicle   |
| Change of energy supplier                                     |
| Change energy source  |
| Install monitoring system                                     |
| Install Smart meter   |
| Remote Controlled Plugs                                       |
| Time controlled Plugs   |
| Passive Shading   |

## 2. Non-Technical (pure behavioural) measures

|                                      |
|--------------------------------------|
| Non-technical measures               |
| Reduce Temperature Set Points        |
| Reduce heating schedule              |
| Reduce number of occupants           |
| Switched to public transport         |
| Car Sharing                          |
| Less frequent use of the vehicle     |
| Completed fuel-saving training       |
| Completed Energy Efficiency Training |
| Increased Use of Natural Ventilation |
| Sleep Function of equipment          |
| Standby Awareness                    |
| Painting of walls in light colours   |

## Bill Analysis

**Denmark**

## 1. Technical measures

|   |
|---|
| Technical measures  |
| <b>Insulation</b>   |
| Upgrade thermal insulation of building envelope (conventional external or internal by VIP, insulate to the crawl space/basement, etc.)                    |
| Replacement of windows to 3-layer   |
| Insulation of pipes   |
|   |
| <b>Water savings</b>  |
| Installation of watersaving toilets   |
| Installation of nonwater urinals  |
| sensor at the water taps  |
|   |
| <b>Solar energy</b>   |
| Solar collectors for heating and domestic hot water   |
| Installation of PV-system   |
|   |
| <b>Lighting modifications</b>   |
| Optimize access to daylight where possible  |
| Zone scheduling   |
| Change lighting to LED or more efficient lighting   |
| Night/Unoccupied setback  |
| After hour override   |
| Occupancy sensors   |
| Automatic solar shading devices (avoid cooling or keeps cooling demand at minimum)  |
| Lightlevel meters or follow sunrise and sunset (at parking lots, signs and outdoor spaces and acces lighting)   |
|   |
| <b>Ventilation</b>  |
| Optimum stop (Determines the earliest possible time to initiate setback temperatures before unoccupied periods while stille maintaining occupant comfort) |
| Ventilation on demand (calender/timer, CO2 indicated etc.)  |
| Heat recovery unit/change to better   |
| Hybrid ventilation (naturally+mech. ventilation)  |
| Natural ventilation   |
| Night cooling by natural ventilation  |
| Sceduled service maintainance or use of monitored components (ventilation)  |

|   |
|---|
|   |
| <b>Components</b>   |
| Replace circulation pumps etc. to energy efficient pumps.                   |
| Energy efficient office equipment (PC, printers etc.)                       |
| Energy efficient appliances (dishwasher, refrigerator etc.)                 |
| Replacement of thermostats  |
| Installing og PV-system   |
|   |
|   |
| <b>Additional changes</b>   |
| Minimize standby consumption  |
| Visualize consumption and increase awareness                                |
| Change energy source  |
| Purchase green energy   |
| Holiday scheduling (HVAC, lighting etc.)                                    |
| Minimize cooling need (solar shading, equipment choise, night cooling etc.) |

2. Non-Technical (pure behavioural) measures

|   |
|---|
| Non-technical measures  |
| Affect user behavior and inspire employees to energy awareness (though knowledge, dialogue, visualistion of consumption, activities etc.) |
| Use temperature control   |