Interreg Baltic Sea Region

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ENERGY TRANSITION
Easy Energy

Collection of Blueprints

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Building Insulation and Energy Saving

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Top floor ceiling insulation

Brief description
Uninsulated top floors account for up to 10-20% of a building's total heat loss. Even if the building walls are well insulated, a lot of heat can escape through the upper building envelope. In order to reduce this heat loss, if the attic is to remain unheated, the top floor ceiling can be relatively easily insulated using various measures. Floor insulation is usually achieved either by blowing or inserting insulating material between the joists or by applying insulating material to the floor surface. It is important to use protective barriers, to keep steam/water out of the insulation. Sustainable materials like wood wool or (less recyclable) mineral wool are preferred over plastic-based insulation. Insulation boards on the floor ceiling secure a certain stability. If the room should be used completely, the soil insulation must be covered by an additional layer such as wooden boards in order to ensure the capability and load capacity. *#insulation #buildingenvelope #coldprotection #heatprotection #thermalbridges*

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Water heating supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☐ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	up to10- 20% energy-savings
☐ Medium term (within 6 months)	☐ Other positive Effect	
☐ Long term (longer than 12 months)		

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☒ DIY / own work	☒ Not necessary
☐ Technical	☐ Medium	☒ Specialist company	☐ Advisable
☒ Construction	☒ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Simple construction: around 50€/m² Walkable construction: around 75€/m²	Return of investment within a few years.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany KfW program Nr. 152 for individual measures	The materials are generally available in hardware stores.
Special requirements, safety precautions, challenges or conditions	
It is advisable to use recycled materials or natural insulation, such as mineral / rock wool. Mineral wool is “relatively sustainable,” but usually has to be disposed of in construction waste landfills and is therefore only recyclable in exceptional cases. This insulation measure entails a reduction in room height. The ceiling construction should be adequately loadbearing depending on the use.	

Responsibilities / Actors

Mandatory actors and required competencies
construction company / craftsmen who can install the insulation in accordance with the technical requirements, if done by a company
Voluntary / helpful actors and competencies
Energy consultant or civil engineer / architect
Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Verification of funding eligibility (in some countries important before contracts are signed) 2. Consultation with energy consultants/planning offices on optimization approaches 3. Planning of insulation materials and methods according to the planned use after insulation.	Example for Germany https://redaktion.hessen-agentur.de/publication/2022/3950_2022-11-23_DIY-Anleitung-Oberste-Geschossdecke-Nicht-begehbar.pdf https://redaktion.hessen-agentur.de/publication/2023/4121_DIY-Anleitung-Oberste-Geschossdecke-begehbar.pdf
Realization of the main part	
1. Preparing floor for installation, cleaning and filling in gaps, depending on construction. Removing wooden floors to fill insulation in.	 *© PHI*
2. Laying out air and water-tight layer	 *© PHI*

3. Installing insulation and fixating.	 © PHI
4. Covering up insulation with protective foil or with wood planks if walkability is required.	
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Changed indoor climate and less permeable structure can incite mold infestations. If necessary, increasing ventilation can help 2. Monitoring consumption and evaluation of savings	Example for Germany https://www.schwaebisch-hall.de/ratgeber/sanieren-und-modernisieren/dach/dachboden-daemmen.html

Photos if available

Figure 1: Insulation example on top floor © ZEBAU GmbH

Insulation of basement ceiling

Brief description
An uninsulated basement ceiling is responsible for up to 10-20% of energy losses in residential buildings. Insulating these areas is a direct energy improvement and an increase in thermal comfort for the first-floor level. Insulating the basement ceiling begins with thoroughly cleaning the area to remove dust and dirt. Then the appropriate insulation, such as polystyrene or mineral wool, is cut into panels and laid precisely. The panels are then attached using glue or dowels to ensure stable and gap-free insulation. Finally, the insulated ceiling can be covered with a suitable surface, such as plasterboard or plaster. Only materials with high water resistance can be used for the insulation of the basement ceiling. *#Insulation #basementceiling #energyefficiency*

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☐ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	
☒ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Increased comfort in the upper floor	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☒ DIY / own work	☒ Not necessary
☐ Technical	☐ Medium	☒ Specialist company	☐ Advisable
☒ Construction	☒ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Depending on type: (incl. labour) - Insulation on first floor: 50€-100€/m² - Insulation at basement ceiling: 20€-50€/m² - Blown-in insulation in wood beam ceiling: 15€-30€/m²	Because of the low price of material and possible DIY, the return of investment of the insulation at the basement ceiling is 1-3 years.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany KfW 261, but only in relation to modernization to an energy-efficient building	Available in large quantities in many places, for example in DIY stores. Available in many variations with advantages and disadvantages in terms of ecology, price and workability available.
Special requirements, safety precautions, challenges or conditions	
Make sure that valves and other important installations can be reached after the insulation.	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Construction company for installation (advisable for large buildings) Energy consultant or civil engineer / architect
Possible implementation partners
Janitor, maintenance personnel

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Verification of funding eligibility (in some countries important before contracts are signed) 2. Cleaning up the basement ceiling and preparing installments if applicable like covering up valves 3. Deciding on material and method and procuring it	Example for Germany https://redaktion.hessen-agentur.de/publication/2023/4101_DIY-Anleitung-Kellerdeckendaemmung-mit-EPS_2023-07-02_WF_kk_HE_kk_jms_kk.pdf
Realization of the main part	
1. Roughly remove any unevenness.	 *© LEA Hessen / Rundel*
2. Cutting panels	 *© LEA Hessen / Rundel*

3. Cutouts for cables and heating pipes	 *© LEA Hessen / Rundel*
4. Mix and apply adhesive mortar	 *© LEA Hessen / Rundel*
5. Attaching the panels	 *© LEA Hessen / Rundel*

6. Over-insulating heating pipes	 *© LEA Hessen / Rundel*
7. Close gaps with assembly foam	 *© LEA Hessen / Rundel*
8. Covering or sealing insulation if necessary	
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Changed indoor climate and less permeable structure can incite mold infestations. If necessary, increasing ventilation can help 2. Monitoring consumption and evaluation of savings	Example for Germany https://www.energie-fachberater.de/daemmung/daemmung-keller/kellerdeckendaemmung/was-kostet-die-kellerdeckendaemmung.phpm

Photos if available

Figure 2: insulated basement ceiling © ZEBAU GmbH

Blown-In insulation roofs and wooden walls (Wool / Fibers)

Brief description

Uninsulated pitched roofs or uninsulated exterior walls made of timber frame can account for up to 40% of a building's annual heating energy consumption. Many buildings also have roof surfaces and walls with air gaps, which are a major contributor to heat loss. Filling these air gaps with insulation enables an energy improvement without changing the thickness of the roof or the wall thickness.

Blow-in insulation made of wood wool or cellulose is a quick and efficient way to fill these existing air layers in roofs or between wall layers in timber walls. For installation, the roof surface or the wall is prepared (usually from the inside) with holes spaced approximately 30 to 40 cm apart. The insulation materials are supplied loose. The material is blown into the cavities using compressed air.

This measure can be implemented in roofs or a double-skinned exterior wall made of timber with an external air and vapor barrier with an air layer at least 5 cm thick.

This material is not suitable for double-shell masonry, as this can lead to moisture penetration and the material sticking together. Moisture-resistant insulation materials such as perlite are an alternative.

#insulation #buildingenvelope #coldprotection #heatprotection #thermalbridges

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☒ Administrative	☒ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☒ Commercial	☒ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☐

Implementation time	Saving potential	
☐ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)		

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☐ DIY / own work	☒ Not necessary
☐ Technical	☐ Medium	☒ Specialist company	☐ Advisable
☒ Construction	☒ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Investment costs are 12-400€ / m^2 depending on the material and the required amount. Examples: Fiberglass wool: 28€/m^3 Wood fibre: 42€/m^3 Polyurethane granulate 80€/m^3 Aerogels: 300 – 400€/ m^3	The return of investment for the cheaper types is around 5 years.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany KfW261 efficient residential buildings – credit BAFA: BEG EM	The measure needs to be implemented by specialized company on building insulation. Example for Germany Good availability in Germany
Special requirements, safety precautions, challenges or conditions	
This measure can only be implemented in walls with at least 5 cm wide air spaces. The patency of the air layer should be checked beforehand by endoscopy if necessary.	

Responsibilities / Actors

Mandatory actors and required competencies
construction company / craftsmen who can install the insulation in accordance with the technical requirements Monument protection office, if necessary
Voluntary / helpful actors and competencies
Energy consultant, Architect
Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Verification of funding eligibility (in some countries important before contracts are signed) 2. Defining the amount needed for insulation by measuring the air layer 3. Defining the best material for the project in consultation with energy expert	
Realization of the main part	**Accompanying communication**
1. Procuring installation service from a specialist company. 2. Preparing roof/wall by drilling access holes 3. Installing thermal insulation with special equipment. 4. Closing holes 5. Checking for thermal bridges	
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Changed indoor climate and less permeable structure can incite mold infestations. If necessary, increasing ventilation can help 2. Monitoring consumption and evaluation of savings	Examples for Germany https://ekovilla.com/en/products/blownwool/ https://www.energie-experten.org/bauen-und-sanieren/daemmung/daemmstoffe https://www.daemmen-und-sanieren.de/daemmung/einblasdaemmung/

Photos if available

Figure 3: Blown In insulation installation © ZEBAU GmbH

Blown-In insulation masonry walls (Perlite Insulation)

Brief description

Uninsulated external walls can be responsible for up to 40% of a building's total heat loss. Many buildings have double-shell masonry walls with air gaps, which are a major contributor to heat loss. Filling these air gaps with insulation enables energy improvement without changing the wall thickness. In addition, insulating the walls from the exterior is only effective if these air gaps are filled with thermal insulation material to build a continuous, seamless layer of insulation that eliminates cracks and cold bridges.

Blow-in insulation made of perlite is a quick and efficient way to fill these existing air layers in double-shell masonry walls. For installation, the wall is prepared with holes spaced approximately 30 to 40 cm apart. The insulation materials are supplied loose. The material is blown into the cavities using compressed air. Perlite is fireproof, non-flammable and resistant to mold.

Self-expanding polyurethane foam can be used to fill smaller cavities, e.g. wall openings, roof extensions, roller shutter boxes, etc. This method can also be used to insulate air gaps in walls that contain other materials — such as polystyrene granules, cotton wool, sawdust, or peat — that are either unsuitable or improperly installed. The thermal insulation foam is injected into the air gap in liquid form and transforms into a porous, solid insulation layer within a few minutes.

The use of foams for entire walls is controversial because they can cause problems in terms of building physics, are not demountable and are also made of non-sustainable materials.

#insulation #buildingenvelope #coldprotection #heatprotection #thermalbridges #perlite #thermofoam #wallgaps

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Water heating supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	
☐ Medium term (within 6 months)	☐ Other positive Effect	
☐ Long term (longer than 12 months)		

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☐ DIY / own work	☒ Not necessary
☒ Technical	☒ Medium	☒ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Perlite granulate: 75€/m³ Expanding foams: 150/m³	Return of investment in 7-9 years.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany KfW261, Residential building loan Efficiency house Germany BAFA: BEG EM	Good availability

Special requirements, safety precautions, challenges or conditions
This measure can only be implemented in walls with at least 5 cm wide air spaces. The patency of the air layer should be checked beforehand by endoscopy if necessary. The much more expensive Aerogels are an option for insulation layers of less than 5 cm. Feasible insulation method for monument protection, if holes can be done from the inside or closed with the same plaster material of the façade. Safety training may be necessary before commercial or industrial use of self-expanding foams.

Responsibilities / Actors

Mandatory actors and required competencies
Specialized company for insulation with Perlite or thermal foam Monument protection office, if necessary
Voluntary / helpful actors and competencies

Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Verification of funding eligibility (in some countries important before contracts are signed) 2. Assessment by specialist to determine the area of the air gap, cubic capacity, calculating the approximate cost of heating and ventilation advise.	Example for Germany https://www.youtube.com/watch?v=07PdvcraeV8
Realization of the main part	**Accompanying communication**
1. Procuring service from specialist company. 2. Preparation for installation by drilling 16-18 mm holes in the outer walls of the house every meter. This can be done from inside for monument protection buildings. 3. Injection into the space with air compressor until completely filled. 4. Sealing up holes.	
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Changed indoor climate and less permeable structure can incite mold infestations. If necessary, increasing ventilation can help 2. Monitoring consumption and evaluation of savings	

Photos if available

Figure 4: Perlite material sample © ZEBAU GmbH

Brickwork in radiator niche

Brief description
Heating niches are weak points for buildings, as there is an increased risk of mold due to thinner walls. They were usually built in buildings earlier than 1970 to save space and should be walled up. If there are current plans to install a heat pump, it is advisable to replace small radiators with larger panel radiators or consider floor heating. Radiator niches can be bricked up to improve heating performance and increase energy efficiency. Bricking up prevents heat loss through the walls and allows for better heat distribution. The process begins with removing the radiator and thoroughly cleaning the niche. Suitable materials, such as bricks or insulation panels, are then fitted precisely into the niche and fixed in place with mortar or glue. Finally, the radiator is reinstalled on the same or in another place. *#brickwork #insulation #radiator niche #heating*

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☒ Administrative	☒ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☒ Commercial	☒ Residential housing
☐ Water heating supply	☐	☐ Industrial construction	☐

Implementation time	Saving potential	
☐ Quick to implement (within a few days)	☒ Energy	☒ Costs
☐ Short term (within 12 weeks)	☐ CO_2	
☒ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Increase in thermal comfort	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☐ DIY / own work	☒ Not necessary
☐ Technical	☒ Medium	☒ Specialist company	☐ Advisable
☒ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Aerated concrete for lining the heating niche: 20-40€/ m² Removing and reinstalling heaters: 150€ - 200€ (without materials needed)	3–7 Years (Depending on insulation of wall and heating behaviour)
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Currently no German funding programs for this measure available.	Material available in large quantities in many places, for example in DIY stores.
Special requirements, safety precautions, challenges or conditions	
When walling or insulating, it is important that the thermal conductivity is adapted to the neighbouring components to avoid mould.	

Responsibilities / Actors

Mandatory actors and required competencies
Plumber to dismantle the heating system.
Voluntary / helpful actors and competencies
Bricklayer or similar, to fill the niche.
Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Considerations for other efficiency measures like window replacement or wall insulation effect planning. 2. Checking whether a (partial) heating system replacement makes sense (radiator replacement, increasing radiator size or considering panel radiators) 3. Recording insulation status of windows and walls. 4. Removing radiators and covering valves. 5. Removing floors if applicable and covering up.	Example for Germany *https://www.hornbach.de/projekte/heizkoerpernische-zumauern/*
Realization of the main part	**Accompanying communication**
1. Cleaning the walls and wetting the surface in preparation. 2. Building up niche with the selected material. 3. Plastering the new surface and rebuilding the heating system if applicable.	
After installation of the measure: maintenance/operation routine	**Further comments / links**
1. After installing radiators, it is advisable to carry out hydronic balancing, especially in larger buildings	Example for Germany *https://www.heizung.de/ratgeber/heizkoerper/heizkoerpernische-daemmen-darauf-ist-zu-achten.html*

Photos if available

Figure 5: Radiator niche © Freepik (www.freepik.com)

Insulation or reflective mat behind radiator

Brief description
Radiators are usually installed along walls to keep the floor area clear for other purposes. This invites heat loss through the wall situated right behind the radiators, especially in buildings with insufficient wall insulation. A reflective film behind a radiator or insulating tiles for hanging on the back of the radiator are used to reflect heat back into the room and reduce heat loss through the wall making the radiator work more efficiently and reducing energy consumption by up to 5%. Installation begins with cleaning the wall surface, followed by cutting the insulation mat to the appropriate size. The mat is then attached to the wall with special adhesive or double-sided tape. This measure is most effective for old, open radiators in buildings that haven't gone through energetic renovation. *#insulation # effective insulation #heating #insulation mat*

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☒ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☐ Short term (within 12 weeks)	☐ CO_2	up to 5 %
☐ Medium term (within 6 months)	☐ Other positive Effect	
☐ Long term (longer than 12 months)		

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☒ DIY / own work	☒ Not necessary
☐ Technical	☒ Medium	☒ Specialist company	☐ Advisable
☒ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Reflective films cost 4€/ m² Reflective tiles for the back of the radiator cost around 100€/ m².	Because of the low price, the return of investment for the reflective film is under one year. Reflective tiles have a longer amortisation span but are easier to install.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Currently no German funding programs for this measure available.	Readily available in many variations and price span.
Special requirements, safety precautions, challenges or conditions	
Materials can be XPS, PIR or Vacuum insulation panels, due to the very good insulation characteristics, even if the space is thin, or reflective film for very thin spaces.	

Responsibilities / Actors

Mandatory actors and required competencies
This measure can be done in DIY.
Voluntary / helpful actors and competencies

Possible implementation partners
Janitor, maintenance personnel

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Measuring space between radiators and walls to decide on the appropriate insulation method 2. Purchasing of materials 3. Compilation of the tools and personnel required for implementation, if done as DIY	Example for Germany https://www.heizsparer.de/spartipps/warmedammung/heizkoerpernischen-daemmen https://redaktion.hessen-agentur.de/publication/2022/3856_DIY-Anleitung-Heizkoerpernische_Platte.pdf https://redaktion.hessen-agentur.de/publication/2022/3855_DIY-Anleitung-Heizkoerpernische_Daemmtapete.pdf https://redaktion.hessen-agentur.de/publication/2022/3854_DIY-Anleitung_Heizkoerpernische-mit-Luftpolsterfolie-daemmen.pdf
Realization of the main part	
1. Measure, make sketches and prepare materials	 *© LEA Hessen / Rundel*

2. Cutting the materials with recesses for the radiator mountings	 *© LEA Hessen / Rundel*
3. Applying the first adhesive strip	 *© LEA Hessen / Rundel*
4. Attaching the insulation	 *© LEA Hessen / Rundel*

5. Attaching the insulation and checking proper installation	 *© LEA Hessen / Rundel*
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Monitoring energy savings and adjusting heating behavior if necessary.	

Photos if available

Figure 6: Radiator © Freepik (www.freepik.com)

Insulation film for windows

Brief description
Depending on their condition, windows can account for up to 25% of a building's total heat loss. Where a window replacement is unattainable or too expensive in the short term, a special insulation film can be applied on old single-glazing windows for heat insulation. The thermo-insulation film can be of two types: convection film is designed to retain heat inside, while solar control film absorbs outside heat and the UV component of outside light reflects infrared light. Insulation films let in sunlight which can further warm a window. Any natural heat gain is beneficial as it reduces a heating system's work throughout the day. The energy savings are generated by reducing the amount of heat lost through the glass pane window and increasing the overall insulation of the premises. *#insulation #buildingenvelope #coldprotection #heatprotection #windows*

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☐ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	increased comfort in cold and hot seasons	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☒ DIY / own work	☒ Not necessary
☐ Technical	☒ Medium	☒ Specialist company	☐ Advisable
☒ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
40€ per m² including installation costs through company 20€ per m² if installed by DIY	Return of investment in around 3 years depending on the window and heating habits
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Currently no German funding programs for this measure available.	Available in large quantities in many places, for example in DIY stores and online shops. Available in many variations with advantages and disadvantages in terms of ecology, price and workability available.
Special requirements, safety precautions, challenges or conditions	
The film must be installed bubble free, which can be challenging if DIY.	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
construction company / craftsmen who can install the insulation in accordance with the technical requirements energy consultant
Possible implementation partners
Janitor, maintenance personnel

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Considering possible measures for thermal insulation. 2. Consulting energy consultants/planning offices on optimization approaches *3.* Planning insulation materials and methods.	Examples for Germany https://www.lea-hessen.de/buergerinnen-und-buerger/hessen-spart-energie/do-it-yourself-energiesparmassnahmen/diy-energiespartipp-fensterfolien-anbringen/
Realization of the main part	
1. Precuring materials	 *© PHI*
2. Preparing surface by cleaning	 *© PHI*

3. Apply adhesive tape	 © PHI
4. Cutting window film	 © PHI
5. Applying the film to the window (by blow-drying) without air pockets	 © PHI

6. Cutting off any excess	 © PHI
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Monitoring consumption and evaluation of savings	Example for Germany https://klimaschutz-wirtschaft.de/maßnahme/waermedaemmung-von-gebaeuden-2/

Photos if available

Figure 7: Preparation work for window film installation © Freepik (www.freepik.com)

Reglazing

Brief description
Depending on their condition, windows can account for up to 25% of a building's total heat loss. Instead of a window replacement, old windows can be updated through a reglazing process. This significantly increases the insulating effect and is cheaper and more sustainable, as the frames are still in use. Especially for monument preservation it can save old frames but modernize the insulation. However, to achieve high insulation with triple glazing, a complete window replacement is necessary, as triple glazing does not fit into smaller frames for double glazing. The process begins with the careful removal of the old window or glazing, followed by preparation of the frame. The new glass is then fitted and securely fixed, often using a special sealant to ensure air and water tightness. Restoring windows by repainting the frames is another measure that can be included in the process. *#insulation #buildingenvelope #coldprotection #heatprotection #thermalbridges #insulationcompositesystem #exteriorinsulation #finishingsystem #eifs #etics*

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☐ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	
☒ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Less draft in rooms	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☐ DIY / own work	☐ Not necessary
☐ Technical	☐ Medium	☒ Specialist company	☒ Advisable
☒ Construction	☒ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Double glazing costs 75–140€/m² Dependent on frame-material around 75€ for parts	Return of investment in around 5-10 Years
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany No subsidies: Only if windows reach criteria of W/m² 0,95, which is today not possible with double glazing.	Windows are available in large quantities.
Special requirements, safety precautions, challenges or conditions	
It is a very good method to use in monument preservation, by saving old frames with new glass, but to achieve state-of-the-art insulation, window replacement with triple glazing is necessary.	

Responsibilities / Actors

Mandatory actors and required competencies
Window manufactures
Voluntary / helpful actors and competencies
Energy consultant or civil engineer/architect
Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Deciding on the quality of the appropriate window glazing (compared to the frame and surrounding masonry) 2. Calculating the needed materials *3.* Find specialized company and get an offer	
Realization of the main part	**Accompanying communication**
1. Removing windows and reglazing. 2. Windows get reinstalled by window builders, according to guidelines. *3.* Readjusting window components	
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Monitoring energy consumption and evaluating savings	Example for Germany https://www.my-hammer.de/fenster-tueren/preisradar/was-kostet-fenster-verglasen

Photos if available

Figure 8: Window installation © Freepik (www.freepik.com)

Window replacement

Brief description
Depending on their condition, windows can account for up to 25% of a building's total heat loss. Especially when windows are in need of repair or are simply outdated, they are no longer energy efficient and need to be replaced. In case of modernization, it is recommended to upgrade old double glazing to new double or triple glazing. It must be ensured that the external wall after the renovation work does not have a lower insulation level than the new windows, as this would lead to mould growth. *#insulation #buildingenvelope #coldprotection #heatprotection #thermalbridges #insulationcompositesystem #exteriorinsulation #finishingsystem #eifs #etics*

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Water heating supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☐ Quick to implement (within a few days)	☒ Energy	☒ Costs
☐ Short term (within 12 weeks)	☒ CO_2	Up to 15% of energy saving
☒ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Better comfort because of ended draft	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☐ DIY / own work	☒ Not necessary
☐ Technical	☐ Medium	☒ Specialist company	☐ Advisable
☒ Construction	☒ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Depending on quality of windows: Double glazing: 400€ - 650€ triple glazing: 500€ - 850€	Return of investment in around 10 years
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany BAFA and KfW subsidies	Good availability of windows
Special requirements, safety precautions, challenges or conditions	
Special considerations for buildings with monument protection. Under certain circumstances, new glazing may be a sensible option to preserve the original frame.	

Responsibilities / Actors

Mandatory actors and required competencies
window-company, sometimes carpenters
Voluntary / helpful actors and competencies
Energy consultant
Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Verification of funding eligibility (in some countries important before contracts are signed) 2. Consultation with energy expert to assess the need for replacement, i.e. damaged windows or required energy modernization 3. Check the building envelope to install suitable windows, best done with an energy concept. 4. If more than 1/3 of windows are changed, there is a need ventilation concept (in Germany)	
Realization of the main part	**Accompanying communication**
1. Procure windows and installation service from specialist company 2. Replacing windows through company by removing old windows, fitting new windows and installation. 3. Paint or plaster jobs may be necessary. 4. Attention must also be paid to airtightness and protection against driving rain.	
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Regular checks on window seals and tightness of windows to maintain smooth function 2. Monitoring and evaluation of energy savings	Example for Germany https://wohnen-und-finanzieren.de/blog/fenster-austauschen-kosten

Photos if available

Figure 9: Triple glazing example © ZEBAU GmbH

Insulating blinds and shutters

Brief description
Outdated window glazing can cause up to 20-30% of a building's heat loss. Shutters and roller shutters offer protection from sun, noise, burglary and the impact of the environment. Roller shutters are placed outside and can be automated with sensors, timers or smart home integration. Blinds are installed indoors and are rarely automated. Thermal curtains are made of materials like polyester, aluminium, or foil and help maintain indoor temperature by blocking heat or cold. Blinds made of insulating materials, such as wood or special plastics, provide added insulation and reducing heat loss through windows. In hot summers, blinds shield against direct sunlight, helping to keep houses cooler and reduce the reliance on air conditioning. It is especially efficient to implement these during window replacement measures, to reduce costs for scaffolding/installation processes. *#insulation #buildingenvelope #coldprotection #heatprotection #exteriorinsulation*

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☒ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	Savings from 5 – 30%
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Increased privacy and protection against burglary	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☒ DIY / own work	☒ Not necessary
☐ Technical	☐ Medium	☒ Specialist company	☐ Advisable
☒ Construction	☒ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Shutters cost 200-300€ per piece. Additional 50€ or more for motor and automation. Blinds cost 30€ per piece or more depending on the design and insulating effect.	5-10 years depending on quality of windows and behaviour.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Funding available in connection with window replacements if roller shutters are automized and insulated.	Available in large quantities in many places, for example in DIY stores and online shops. Available in many variations with advantages and disadvantages in terms of ecology, price and workability available.
Special requirements, safety precautions, challenges or conditions	
When using curtains, it is important to uncover the radiators during heating periods. Materials can be recycled if they are not painted or heavily processed. In case of monument protection, monument protection office may need to be contacted.	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Window company for installation, especially for large buildings. In case of window replacement, window manufacturers for consulting and installation.
Possible implementation partners
Window manufacturers Janitor, maintenance personnel

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Verification of funding eligibility (in some countries important before contracts are signed) 2. Decision of required measures for each window, such as burglary protection. 3. Checking the building structure for durability to ensure they can carry the additional load. 4. Checking the possibility of combination with other measures.	Example for Germany https://www.t-online.de/heim-garten/wohnen/id_100077032/heizkosten-senken-mit-thermovorhaenge-und-rollos-geht-das-.html#das-ergab-unser-test https://www.energie-umwelt.ch/saison-tipps/848-am-abend-rolllaeden-herunterlassen-bzw-fensterlaeden-schliessen
Realization of the main part	**Accompanying communication**
1. Measuring windows to buy suitable products. 2. Scaffolding might be needed and used for additional measures. 3. Installation of blinds and/or shutters in DIY or through company. 4. If applicable, programming of automation according to timer or sunlight sensors. 5. Checking function.	
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Monitoring of energy consumption and evaluation of savings. 2. Regular inspection, especially of outdoor shutters.	

Photos if available

Figure 10: Shutter © Freepik (www.freepik.com)

Door closer

Brief description
Open doors can lead to heat loss and loss of comfort, especially in buildings with different temperature zones. Automatic opening/closing of doors prevent doors to be left open, so energy can be saved. This prevents warm air from escaping the room or, in the case of air conditioning in summer, the room from heating up. If doors between individual rooms in residential houses or flats are consistently closed, 5% of heating costs can be saved. Cambridge University estimated for shops, that closed doors could reduce energy consumption by up to 50%. *#energysaving #doorcloser*

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☒ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☐ Short term (within 12 weeks)	☐ CO_2	up to 10 %
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Increased comfort, less draft	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☒ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☐ Medium	☒ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
From 30€ per unit for simple function. Around 200€ per unit for fire doors, accessibility and other functions.	Small investment costs and a reduction in energy costs by up to 10% on average leads to a quick return of investment.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Funding available in connection with door replacements and conversion for accessibility	Automatic door opener/closer are readily available in stores.
Special requirements, safety precautions, challenges or conditions	
Fire doors are mandated to close automatically, and doors in escape routes are mandated to open easily in the direction of the escape route. Automatic door opener/closers must be placed in buildings other than residential, in such a way that they can be used by handicapped people as well.	

Responsibilities / Actors

Mandatory actors and required competencies

Voluntary / helpful actors and competencies
Carpenters, window and door manufacturer
Possible implementation partners
Janitor, maintenance personnel

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Verification of funding eligibility (in some countries important before contracts are signed) 2. Choosing and procuring fitting door closers according to the requirements (fire doors, exit doors, accessibility) 3. Preparation for the installation according to instructions or procuring installation service through company	Example for Germany *https://www.youtube.com/watch?v=fVyMSnmZ_VA* *https://www.youtube.com/watch?v=8SE09oKCmB8* *https://www.youtube.com/watch?v=Hrinz60svi0*
Realization of the main part	**Accompanying communication**
1. Installation in DIY or through company 2. Checking if the door opens and closes smoothly	
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Regular control and maintenance	

Photos if available

Figure 1:Electric door closer © Johanna Fink

Pipe insulation

Brief description
Uninsulated pipework and fittings can account for up to 25% of the total heating energy consumption of a building, because the pipes shed heat into unheated rooms or walls, before reaching the designated heated place. A useful measure is the thermal insulation of pipes, pipelines, fittings, fixtures and flanges (also hot water storage tanks and containers) with insulating materials and sealing strips to prevent heat escaping. It can be an easy and low-cost way to save energy and reduce costs. The most important place to insulate is the basement installation, because unheated cellars cause high energy losses right at the starting point of the heat system. A good place to start is the insulation of easily accessible pipes by wrapping foam tubes around the blank pipes and fittings. This measure can be done in DIY. Other heating appliances might be harder to reach and require a specialist company or maintenance personnel. *#insulation #insulationofpipes #fittings #flanges #pipes #hotwater #watertank #hotwatersupply #watersupply*

Thematic allocation		Building categories	
☒ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☒ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Improved heat distribution	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☐ Medium	☒ Specialist company	☐ Advisable
☒ Construction	☒ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Preparation and installation of thermal insulation • foam insulation (e.g. polyethylene): 5-7 €/m • rubber insulation: 1-5 €/m • mineral wool insulation: 4-9 €/m	Because of the low investments and the high energy saving potential, the return of the investment is under one year.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany BAFA: Heating optimization	Available in large quantities in many places, for example in DIY stores and online shops Available in many variations with advantages and disadvantages in terms of ecology, price and workability available.
Special requirements, safety precautions, challenges or conditions	
Possible resistance from tenants because of the larger space requirements in basements. High product carbon footprint of the insulation materials made of fossil fuels. Insulation made from sustainable materials (e.g. bio polyethylene, natural rubber, etc.) also available.	

Responsibilities / Actors

Mandatory actors and required competencies
Heating company for complex systems in large buildings
Voluntary / helpful actors and competencies
Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Verification of funding eligibility (in some countries important before contracts are signed) 2. Inventory of non-insulated pipes and fittings and subsequent calculation of material requirements 3. Purchase of materials and compilation of the tools and personnel required for implementation 4. If necessary, uncovering pipes and creating workspace	Example for Germany https://redaktion.hessen-agentur.de/publication/2022/3850_DIY-Anleitung-Leitungsdaemmung_final.pdf https://www.co2online.de/modernisieren-und-bauen/sanierung-modernisierung/heizungsrohre-isolieren-anleitung/
Realization of the main part	
1. Cutting and fitting the insulation shells with carpet cutters or similar	 *© LEA Hessen / Rundel*

2. Insulating straight pipes	 *© LEA Hessen / Rundel*
3. Insulate curves	 *© LEA Hessen / Rundel*
4. Insulate T-pieces	 *© LEA Hessen / Rundel*

5. Insulating valves and fittings, so that they are still useful afterwards	 *© LEA Hessen / Rundel*
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Monitoring and evaluating energy savings.	

Photos if available

Figure 11: Insulated heating pipes © ZEBAU GmbH

Heating, Electricity and Water

1. Hydronic Balancing
2. Heat load management/Smart temperature control
3. Smart thermostats
4. Temperature control by app
5. Visualization of energy consumption/ Energy monitoring
6. Lighting adaptation
7. Efficient lighting / LED lighting
8. Lighting Control
9. Socket timer/ digital socket plug
10. Aerator for water faucet
11. Sensor water faucet

Hydronic Balancing

Brief description
In old heating systems and after changes to the systems, rooms are often supplied with a different hot water flow rate, which is why radiators that are further away from the heating system often become less warm. This leads to increased fuel consumption. To heat every room in a building evenly and efficiently, the water flow in each radiator and heating circuit must be regulated. This is done by means of hydronic balancing. This not only achieves better heat distribution, but also saves energy, as the flow temperature can be lowered by improving the distribution of hot water. In this way, energy consumptions and costs can be reduced up to 15% and CO_2 emissions from fossil-fuel heating systems are lowered. At the same time, thermostats can be replaced and more efficient pumps installed if necessary. *#hydronic balancing #hydraulic balancing #equalisation #alignment #adjustment #heating #radiator #thermostativ valve #valve*

Thematic allocation		Building categories	
☐ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☒ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☐ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	Usually 5-7% up to 15%
☒ Medium term (within 6 months)	☒ Reduced load on the heating system	
☐ Long term (longer than 12 months)	Longer service life and lower repair costs	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☐ DIY / own work	☐ Not necessary
☒ Technical	☐ Medium	☒ Specialist company	☒ Advisable
☐ Construction	☒ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
500€ - 1500€ (depends on building size) Retrofitting to preset thermostatic valves cost 30€ / radiator. Replacing the heat circulation pump is around 300-400€.	return of investment within two years (with 15% energy and cost savings) between three and a half and six years with lower savings or expensive installation
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany The Federal Subsidy for Efficient Buildings (BEG) promotes investments in energy efficiency for all building types. The costs for hydronic balancing are eligible for funding as part of the heating optimization of individual measures (for non-residential buildings with a heated area of up to 1,000 m^2). In addition, hydronic balancing is even a minimum technical requirement for the eligibility of some other energy efficiency measures and is therefore also eligible for funding in these cases.	The measure is relatively uncomplicated, and materials are easy to procure, which makes it easy to convince decision-makers.
Special requirements, safety precautions, challenges or conditions	
Accessibility to all heating equipment and radiators and radiators need pre-settable valves. Lack of data can lead to a more time-consuming process.	

Responsibilities / Actors

Mandatory actors and required competencies
An energy consultant or architect who calculates the heating loads and a heating systems installer who installs the heating valves in the heating circuit.
Voluntary / helpful actors and competencies
Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Before hydronic balancing can be carried out the heating load must be calculated. The heat requirement is determined, the temperature difference to the minimum outside temperature and the operating conditions of the heating system and the system is checked for functionality. 2. The hydraulic data is then determined. This includes the flow rate, flow and return temperature, pressure losses and the pump pressure.	Example for Germany https://shk-info.de/hydraulischen-abgleich-im-bestandsgebaeude https://www.energiewechsel.de/KAENEF/Redaktion/DE/Downloads/Dialog-Energiewechsel/energiewechsel_faktenblatt-hydraulischer-abgleich.pdf?__blob=publicationFile&v=6raulischer Abgleich
Realization of the main part	**Accompanying communication**
1. Once this data has been collected, hydronic balancing can be carried out. 2. Each radiator is set to a specific flow rate. At a certain flow temperature at the operating point of the heating system, each room should be supplied with the amount of heat required to reach the desired room temperature. The return flow of each radiator must have almost the same temperature. 3. Before the work is completed, all settings and radiators should be checked so that adjustments can be made if necessary.	After installation, inform building users how the thermostatic valves should remain set to achieve optimum efficiency.
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Once the measure has been optimally implemented, no maintenance is required. 2. If structural changes are made later, like window replacement or installation of building insulation, the heat calculation could be updated, and the valves could be readjusted.	Example for Germany Since 2014, hydraulic balancing is mandatory for new or replaced hot water heating systems in Germany

Photos if available

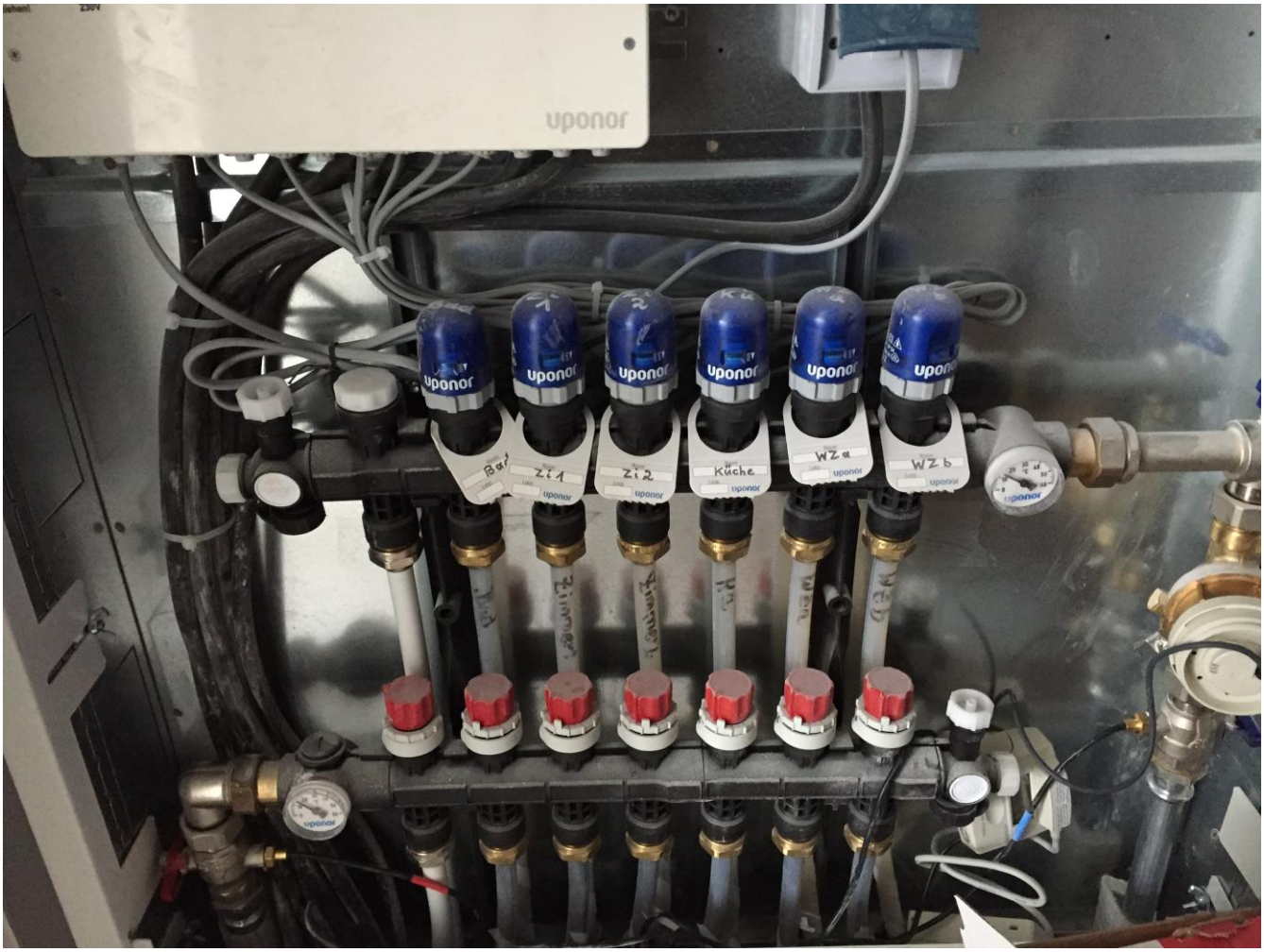

Figure 12: Pre adjustment of floor heating system © ZEBAU

Heat load management/Smart temperature control

Brief description
Heat load management includes the calculation of heat load, as well as the temperature control itself. Determining the heat load for a building at different times shows potential for energy reductions, for example overnight or in unused rooms. For periods with low heat load, smart temperature control is used to lower the room temperature. This can be done through automation of the heating system or timed shut-off valves at radiators and is especially efficient in older, less insulated buildings, where heat losses through the night/ unoccupied period would far outweigh the additional energy to reheat in the morning. Energy savings through night reduction lie between 5% and 15%. Additionally, heating systems can be connected to an outside temperature sensor, so that the heating system performs adequately based on the temperature difference between indoor and outdoor temperature. This reduces the risk of overheating on warmer days and reduces energy use by 30%. *#heatingload #heatloadcalculation #decisionaid #smarttemperaturecontrol #smarthome #smartbuildings #nightreduciton #summerreduction #roomtemperature*

Thematic allocation		Building categories	
☐ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☒ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	Up to 30% of energy reduction
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Precise temperature comfort, self-efficacy	

Orientation	Priority level	Qualification level	Special safety
☒ Behaviour	☒ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☐ Medium	☒ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Outdoor sensor and thermostat 50-100€ Complete automation systems with smart controller/ app and radiator thermostats up to 500€	Amortization period for smart temperature control 1.2 years Life Span 10 years
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Currently no German funding programs for this measure available.	The measure is uncomplicated, and materials / tools are easy to procure
Special requirements, safety precautions, challenges or conditions	
Useful criteria when selecting a technology provider is the available for visualizations and evaluations without the need for additional hardware purchases.	

Responsibilities / Actors

Mandatory actors and required competencies
Heating company who installs the heating valves
Voluntary / helpful actors and competencies
Supplier of appropriate system technology, energy consultant
Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Analysis of the heat load and the required temperature, building structure and heating system compatibility 2. Evaluation of the possible nighttime reduction or other reduction periods through experts is advisable	Example for Germany https://testing.verbraucherzentrale-energieberatung.de/heizen/heizung-optimieren/nachtabsenkung/
Realization of the main part	**Accompanying communication**
1. Procuring equipment or ordering service from a heating company 2. Installation of valves, sensors, automation equipment and timers. 3. Setting timers, programming scenarios for automation	Information for tenants, employees
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. training for proper use 2. monitoring of operation to ensure	

Photos if available

Figure 13: outdoor temperature control © ZEBAU GmbH

Smart thermostats

Brief description
From 30% in manufacturing industry up to 50% of energy demand for offices occur from heating systems. This offers a great energy saving potential by reducing the room temperature where possible. This can be done with smart thermostats. A smart thermostat automatically regulates the temperature of radiators to lower costs for heating in winter. When rooms or buildings are unoccupied, the temperature is reduced for example after operation hours or at night. It is important to keep the temperature above 16° on insulated walls, to reduce the possibility of mould infestation. The amount of reduction can vary for different building structure and building type. Smart Thermostats can be programmed to automatically operate, which is especially useful for buildings with fixed operation/occupancy hours like offices or schools. *#heatingcontrol #energysaving #thermostat #smartthermostats*

Thematic allocation		Building categories	
☐ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☒ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☐ Short term (within 12 weeks)	☒ CO_2	Saves 10- 20% of heating energy and costs
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Saves energy without causing discomfort	

Orientation	Priority level	Qualification level	Special safety
☒ Behaviour	☒ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☐ Medium	☒ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
50-100€ for automatic programmable thermostats	Depending on energy prices and heating behaviour, return of investment between 2 and 6 months
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Currently no German funding programs for this measure available.	Thermostats can usually be purchased at hardware or specialty stores, a wide selection of devices, available immediately.
Special requirements, safety precautions, challenges or conditions	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Specialist company for installation, especially for large commercial properties or offices
Possible implementation partners
Janitor, maintenance personnel

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Calculation of indoor temperatures and heat load 2. Decision on type of thermostat (remotely controlled or programmable). 3. Procure specialist company if needed	Example for Germany https://www.effizienznetzwerke.org/app/uploads/2023/12/Netzwerkinitiative_Factsheet_Bedarfsgerechte-Raumwaerme-durch-automatisierte-Thermostate.pdf https://www.youtube.com/watch?v=N4c1AF7oBa8es
Realization of the main part	**Accompanying communication**
1. Installation of thermostats to the radiator according to the included manufacturer's instructions or installation by specialist company.	Information about operation for office workers, tenants
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. If the thermostat is programmable, once programmed, no action is required. 2. Checking devices regularly for low battery	Reducing indoor temperature to less than 16 degrees in insulated rooms can incite mould infestations.

Photos if available

Figure 14: Smart thermostat © Raimond Spekking / CC BY-SA 4.0 (via Wikimedia Commons), CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=114998627

Temperature control by app

Brief description
The energy demand for heating rooms and buildings is very extensive and offers great saving potential, especially for buildings or rooms that are unoccupied at night but continue to be heated, or that are infrequently occupied, like hotel rooms or guesthouses. The greatest energy consumption for heating is caused by electric heaters, which can be equipped with controllable devices that switch the radiators to a lower temperature remotely via an appropriate app or switch them off when the rooms are not occupied. Instead of running these devices or a conventional heater permanently or turning them up daily after a night-time reduction, they can be turned up when needed via an app before the person using them is on site. *#electricityconsumptioncontrolling, #smartsolutions #smarthome*

Thematic allocation		Building categories	
☐ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☒ Energy/ heating system	☐ Lighting	☒ Commercial	☒ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ Accommodation

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☐ Short term (within 12 weeks)	☒ CO_2	10-15% electricity saving
☐ Medium term (within 6 months)	☐ Other positive Effect	
☐ Long term (longer than 12 months)		

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☒ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☒ Medium	☒ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
125€ per unit with installation.	Approximate payback within 10 months.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Currently no German funding programs for this measure available.	Many different solutions available on the market
Special requirements, safety precautions, challenges or conditions	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Measure can be done as DIY or with a specialist company.
Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Metering of consumption to assess potential savings 2. Deciding on a solution system	
Realization of the main part	**Accompanying communication**
1. Procuring equipment or ordering service from a specialist company 2. Installation of devices on radiators. 3. Activation of app 4. If possible, installation of a separate metering device	Training for employees if applicable to use the app appropriately
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Metering of consumption to control energy saving	Low priority for residential homes but higher priority for commercial properties with vacancies like guest houses or accommodation.

Photos if available
Picture

Visualization of energy consumption/ Energy monitoring

Brief description
To address energy consumption and change the behavior to reduce energy demand effectively, it is important to have a detailed overview over the consumption. This can be done through power meters that record energy use and technically supported monitoring and evaluation of consumption data, which can be shown on screen. The data ca be accessible to the employees / users of a building and directly influence energy consumption through optimized user behavior. This measure is especially useful for large buildings with very high energy consumption (office, commercial, industrial). *#energyvisualization #buildingmonitoring #energy #consumption #energyanalytics #buildingperformance #energymonitoring #datadrivenbuildings #sustainabletech #smartgrid #energyawareness #smartenergy*

Thematic allocation		Building categories	
☐ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☒ Monitoring	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☐ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☒ CO_2	
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Creates Awareness	

Orientation	Priority level	Qualification level	Special safety
☒ Behaviour	☐ Low	☐ DIY / own work	☒ Not necessary
☐ Technical	☒ Medium	☒ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Investment costs are around 2.000 €. Option of small power meters for single sockets from 10€ but no visualization or evaluation.	Depending on behaviour change or implementation of energy efficiency measures, cost savings can lead to return of investment.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Currently no German funding programs for this measure available.	Readily available
Special requirements, safety precautions, challenges or conditions	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Specialist company for installation in large buildings advisable
Possible implementation partners
Technical personnel, maintenance personnel

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Determining the extent and type of data that should be collected 2. Deciding on a spot for showing the data output, easily accessible, high visibility	
Realization of the main part	**Accompanying communication**
1. Procuring system or ordering a specialist company 2. Installing power meters for the entire building or determined appliances/ power points to collect information on used and produced (if applicable) power 3. Connecting to screen or system to visualize output and evaluation of energy consumption	Information for employees or tenants on how to read/ interpret the energy consumption
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Regular control to monitor changes and ensure energy savings	

Photos if available

Figure 15: energy consumption display © Freepik (www.freepik.com)

Lighting adaptation

Brief description
The energy demand for lighting can be up to 50% of the energy demand in offices and administration buildings. Apart from changing the rate of efficiency in the lighting fixtures, it can also be useful to reduce the lux, which means the illuminance of the room or workplace. By adapting a standard lux availability requirement, it is possible to reduce lighting, where it is not needed and therefore reduce energy. The standard requirements would be: • 500 lx handwriting, keyboard operation, conference rooms, computer workstations • 300 lx reception, filing documents, copying • 200 lx archives • 100 – 200 lx corridor To ensure minimum lighting, the lux should be measured in winter or with no daylight, however the use of daylight is recommended where possible. Lighting can be used to complement low daylight. *##easyenergy #wesaveenergy #efficientlighting #led #lighting*

Thematic allocation		Building categories	
☐ Insulation	☐ Electricity production	☒ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☒ Lighting	☒ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☐

Implementation time	Saving potential	
☐ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks)	☐ CO_2	
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Health benefits through adequate lighting	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☒ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☐ Medium	☐ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
2€ to 20€ per LED light bulb	Minimal investment, since not all lightbulbs have to be exchanged. Return of investment within a year.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Funding is possible for exchanging old lamps to new efficient LED lamps. In addition German funding program “Renovation of interior and hall lighting” (“Sanierung von Innen- und Hallenbeleuchtung“ im Rahmen der sog. Kommunalrichtlinie der Nationalen Klimaschutzinitiative)	New light bulbs are easily accessible.
Special requirements, safety precautions, challenges or conditions	
-	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Electric company for installation, especially in large buildings
Possible implementation partners
Janitor, maintenance personnel

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Measuring light intensity indoors with special measurement instruments or with smart phone apps like "Lux-O-Meter" which uses camera sensors to register light. 2. Determining the lighting requirements in different rooms or workstations in cooperation with employees 3. Purchase lighting fixtures with the desired amount of lux	
Realization of the main part	**Accompanying communication**
1. Removal of unnecessary or high lux light sources 2. Installation of adequate lighting	
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Verification of savings 2. Monitoring of changes in lighting requirements	Older light sources should be replaced with higher priority than new light sources. Light bulbs dismantled to reduce the number of lux will serve as emergency/backup.

Photos if available

Figure 16:Llight bulb Installation © Freepik (www.freepik.com

Efficient lighting / LED lighting

Brief description

The energy use for lighting varies heavily depending on the sector, it is up to 20% of electricity production in industry, up to 50% in the service sector, and up to 70% in retail. Residential buildings usually have a significantly lower lighting energy demand.

An easy way to reduce the energy demand is to replace inefficient lighting fixtures with new efficient ones like LED light bulbs. This can also provide better light quality and comfort at the workplace. LED lights don't shed heat energy like old lightbulbs do, which is a large part of the reduced energy demand. Furthermore, it reduces the excess internal heat during summer which can come from appliances and disrupt a comfortable interior climate.

This measure can be coupled with lighting adaptation, which reduces the energy by reducing illuminance where not necessary.

#electricitysaving #energysaving #lighting #led #ledlights #efficientlighting

Thematic allocation		Building categories	
☐ Insulation	☒ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☒ Short term (within 12 weeks for large building)	☒ CO_2	
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Improved lighting comfort. Less maintenance because of longer life span. Less heat from light bulbs.	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☐ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☒ Medium	☒ Specialist company	☐ Advisable
☐ Construction	☒ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
Between 2€ and 20€ per LED light bulb	Return of investment 6 months to 5 years (depending on scale of renovation and electricity price)
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany In Germany, the installation of energy efficient interior lighting systems can be subsidised by BAFA, as long it has a minimum cost of 300 Euros and is implemented in non-residential buildings like offices or public buildings. In addition German funding program “Renovation of interior and hall lighting” (“Sanierung von Innen- und Hallenbeleuchtung“ im Rahmen der sog. Kommunalrichtlinie der Nationalen Klimaschutzinitiative)	New light bulbs are easily accessible
Special requirements, safety precautions, challenges or conditions	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Lighting specialist, electric company for installation (especially for large buildings)
Possible implementation partners
Janitor, maintenance personnel

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Mapping existing light fixtures and lighting standards 2. Procuring lighting specialist if necessary 3. Calculating the new lighting fixtures to meet standards and needs	
Realization of the main part	**Accompanying communication**
1. Visit of a lighting specialist if necessary 2. Identification of places that need additional illumination 3. Purchase and installation of new LED lighting in DIY or with electric company	Possible inclusion of employees in the decision of light fixtures, lighting intensity and lighting needs.
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Ongoing tracking of changes in lighting technology	High priority for very old lighting, lower priority for newer installations Gradual exchange process possible

Photos if available

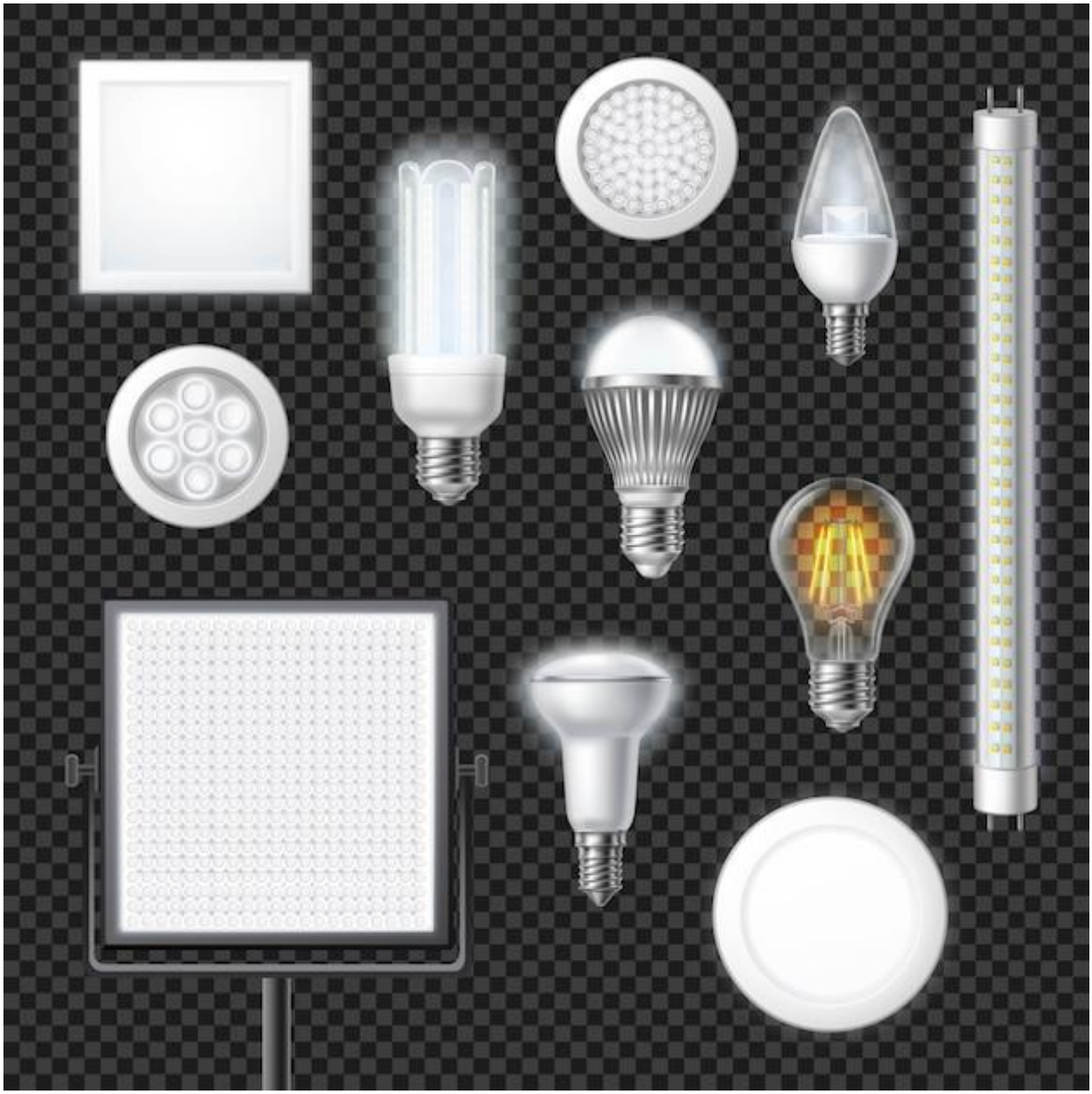

Figure 17:Various lightbulbs © Freepik (www.freepik.com)

Lighting Control

Brief description
Lighting control can be used to reduce the energy input for lighting. This can be done by automatically turning off appliances through: **Timer** (office, schools, commercial buildings) or daylight sensor, that automatically switch off lighting after a programmed time. This is most effective in buildings with fixed operating hours. Outdoor lighting can turn on through daylight sensor at dusk and automatically switch off at a designated time. **Occupancy sensors** through passive infrared (PIR) sensors, which detect the presence or absence of people and turn lights on and off accordingly. Triggering occurs when a change in infrared levels is detected (when a warm object moves in or out of view of one of the sensors). They are used most effectively in spaces that are often unoccupied. Passive infrared sensors can reduce lighting energy consumption by up to 50%-90%. **Motion sensors** are best used for passageways or rooms not generally occupied (toilets). The light appliances turn on when the sensor gets triggered and turn off after a programmed time. *##easyenergy #wesaveenergy #PIRsensor #occupancysensor #energysavingsensor #electricitysavings #smartlighting #automation #lightingautomation #smarthometech #automatization #smartbuilding*

Thematic allocation		Building categories	
☐ Insulation	☐ Electricity production	☒ Administrative	☒ Educational or social institution
☐ Energy/ heating system	☒ Lighting	☒ Commercial	☐ Residential housing
☐ Warm water supply	☐	☒ Industrial construction	☐ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☐ Short term (within 12 weeks)	☒ CO_2	
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Convenience	

Orientation	Priority level	Qualification level	Special safety
☒ Behaviour	☐ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☒ Medium	☐ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
The price of a programmable timer is 15€ -20€. Passive infrared sensors start at 20€ but can be up to 250€ for systems including lighting fixtures.	Investment is returned within 6 months or less for large spaces like storage halls/archives. For hallways, toilets and other frequently occupied rooms is between 1 and 2 years.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany German funding program “Renovation of interior and hall lighting” (“Sanierung von Innen- und Hallenbeleuchtung“ im Rahmen der sog. Kommunalrichtlinie der Nationalen Klimaschutzinitiative)	Different timers (dial, digital, smart) and sensors can be easily obtained.
Special requirements, safety precautions, challenges or conditions	
PIR sensors are temperature sensitive; they work optimally at ambient air temperatures of 15-20° C. The room/circuit wattage must be sufficient. Sensors must be positioned carefully so that they only detect in the intended area. They are best used within a 4-5 metre range, since the detection is less precise with larger distance.	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Lighting specialist
Possible implementation partners

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Identifying opportunities for sensor-controlled lighting 2. Selecting the appropriate sensor by taking the room size and the detection range of sensors into consideration. 3. Ensuring that installation requirements are compatible with the existing electric setup. 4. Planning sensor placement with building personnel/employees	https://www.energysavingsensors.com/General-Information.htm
Realization of the main part	**Accompanying communication**
1. Installation of the device on the wall or ceiling following instructions and considering installation height, angle, direction, and position. PIR Sensors should not aim to glass windows, HVAC ducts or heat flow sources like radiators. 2. Testing functionality of the sensor.	Train maintenance personnel and office occupants to keep sensors operational, rather than disconnecting them as problems occur
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Regular maintenance, troubleshooting promptly so that sensors can perform optimally and extend the life span of the light fittings or light bulbs that they're switching.	

Photos if available

Figure 18: Motion sensor © Freepik (www.freepik.com)

Socket timer/ digital socket plug

Brief description
The share of electricity consumption by office equipment and IT infrastructure in the total energy consumption in offices is usually between 30% and 50%. This range varies depending on the type and size of the office and the number and type of equipment used. To control energy consumption, sockets with timers can be used to automatically switch devices on or off. They are particularly useful for automating everyday tasks like lights, climate appliances or others at specific times. The timer is placed between the socket and the device. The program function allows users to set the desired times when the device should operate. This not only helps save energy, but also increases security, for example by simulating light when no one is at home. Newer models with screens are even able to monitor and show the energy consumption of its connected device. *#digitalsockettimer #smartsocket #sockettimer #smartsocketplug*

Thematic allocation		Building categories	
☐ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☒ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☐ Water heating supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☐ Short term (within 12 weeks)	☒ CO_2	
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	*Security through simulated lights or sound, monitoring of electricity consumption*	

Orientation	Priority level	Qualification level	Special safety
☒ Behaviour	☒ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☐ Medium	☐ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
5-25€ per socket timer	Minimal investment costs with quick return of investment depending on behaviour and electricity prices.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Currently no German funding programs for this measure available.	Sockets with timers, programmable timers are generally available in a wide range with different functions.
Special requirements, safety precautions, challenges or conditions	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Possible implementation partners
Janitor/ maintenance personnel in large buildings

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Determining of appliances that could benefit from a socket timer or digital socket plug 2. Procuring a suitable socket timer	
Realization of the main part	**Accompanying communication**
1. Installation of the socket timer 2. Programming of desired times, scenarios for appliances	Information for employees if applicable
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Monitoring of electricity consumption through device if possible 2. Verification of energy savings	

Photos if available

Figure 19: Smart Socket © ZEBAU GmbH

Aerator for water faucet

Brief description

Water consumption in offices is generally much lower than water consumption in households but can vary depending on the size of the office and the facilities there. The average water consumption in offices is usually between 2 and 5 litres per employee per day. Water consumption is higher in workplaces where people shower after work.

One of the simplest technical solutions for saving water is an aerator. This is a small, special device that is mounted on or inside the faucet. It distributes the water more widely, without reducing the water flow, so that water is used more efficiently, and less water is needed. Faucets with aerators can save up to 40% of the water without the discomfort of washing process. Water flow adjustment function allows to increase or decrease the water flow at any time in the range of 2-6 litres per minute.

This solution also exists for shower heads.

Reduced water pressure saves water as well as electricity, which is needed to pump and store the water. The energy savings are particularly high if hot water can be saved as a result.

#aerator #watersaving #waterfaucet #perlator

Thematic allocation		Building categories	
☐ Insulation	☐ Electricity production	☐ Administrative	☐ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☐ Commercial	☐ Residential housing
☒ Warm water supply	☐	☐ Industrial construction	☒ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☐ Short term (within 12 weeks)	☐ CO_2	up to 40% of water
☐ Medium term (within 6 months)	☒ Other positive Effect:	
☐ Long term (longer than 12 months)	Less leaks	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☒ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☐ Medium	☐ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
The price of one aerator is from 2€ to 12€.	Minimal investment with quick return in 2-4 months depending on the behaviour. The aerator saves around 40% of water per month, the cheapest aerators still save about 15% of water.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Currently no German funding programs for this measure available. Possible implementation within the framework of a funded measure of the program “Measures to Promote Climate-Friendly Drinking Water Supply” (“Maßnahmen zur Förderung klimafreundlicher Trinkwasserversorgung“ im Rahmen der sog. Kommunalrichtlinie der Nationalen Klimaschutzinitiative)	The aerator can be easily obtained, many options are available (including extra functions). Available in different sizes and dimensions. A rubber gasket is included.
Special requirements, safety precautions, challenges or conditions	
The aerator is not recyclable.	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Possible implementation partners
Janitor, maintenance personnel

Implementation process

First steps to initiate the measure: preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Selecting the type of Aerator needed and purchase	Example of installation process: https://www.energy.gov/sites/default/files/2023-10/24-2_Install-Low-Flow-Faucet-Aerator.pdf
Realization of the main part	**Accompanying communication**
1. Unscrewing the standard nut from the faucet. 2. Replacing it with a new device.	
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Clean regularly with a toothbrush and lime remover	Standard thread fits most taps on the market. Ideal for kitchen and bathroom taps.

Photos if available

Figure 20: Faucet Aerator © Freepik (www.freepik.com)

Sensor water faucet

Brief description

A sensor water faucet, also known as automatic or touchless faucet, uses sensors to detect the presence of hands or objects and automatically controls the flow of water. It typically features an infrared sensor located near the spout, which activates the water flow when it detects motion within its range. The water stops flowing once the motion is no longer detected, preventing water from running unnecessarily. Sensor water faucets are an efficient and practical solution for office environments, offering benefits in hygiene, water and energy conservation, and overall user convenience.

Preventing water from running saves water as a resource, as well as energy, which is needed to pump and store the water. The energy savings are particularly high if hot water can be saved as a result.

An additional water fitting option could be the installation of instantaneous water heaters on faucets. This could be especially useful in old buildings, where the whole retrofitting of pipes would be too costly or intrusive. This also reduces heat losses within the hot water system.

#sensor #automaticfaucet #watersaving #waterfaucet

Thematic allocation		Building categories	
☐ Insulation	☐ Electricity production	☒ Administrative	☒ Educational or social institution
☐ Energy/ heating system	☐ Lighting	☒ Commercial	☐ Residential housing
☒ Warm water supply	☐	☒ Industrial construction	☐ All building types

Implementation time	Saving potential	
☒ Quick to implement (within a few days)	☒ Energy	☒ Costs
☐ Short term (within 12 weeks)	☐ CO_2	
☐ Medium term (within 6 months)	☒ Other positive Effect	
☐ Long term (longer than 12 months)	Hygiene and convenience through hands free	

Orientation	Priority level	Qualification level	Special safety
☐ Behaviour	☒ Low	☒ DIY / own work	☒ Not necessary
☒ Technical	☐ Medium	☒ Specialist company	☐ Advisable
☐ Construction	☐ High	☐ Expert	☐ Mandatory

Implementation requirements

Investment costs	Return of investment
A sensor water faucet is around 250€. An instantaneous water heater on the faucet costs 50€.	The sensor faucets reduce water consumption by 40% annually. The results are noticeable within the first few months.
Possible subsidies and programs	**Availability of the material or technology**
Example for Germany Currently no German funding programs for this measure available. Possible implementation within the framework of a funded measure of the program “Measures to Promote Climate-Friendly Drinking Water Supply” (“Maßnahmen zur Förderung klimafreundlicher Trinkwasserversorgung“ im Rahmen der sog. Kommunalrichtlinie der Nationalen Klimaschutzinitiative)	Sensor water faucets and instantaneous water heaters are widely available. They come with various models and features accessible to suit different needs and budgets. The materials can be recycled.
Special requirements, safety precautions, challenges or conditions	
Sensors can malfunction due to power issues or sensor failure, leading to water wastage and user frustration. Better circuitry and alert systems could help mitigate these problems.	

Responsibilities / Actors

Mandatory actors and required competencies
Voluntary / helpful actors and competencies
Plumbing company for installation if necessary
Possible implementation partners
Janitor, maintenance personnel

Implementation process

First steps to initiate the measure: Preparatory actions	Installation instructions and guidelines, How to's, open source initiatives
1. Purchasing of sensor faucets and instantaneous water heaters if applicable 2. Turning off water supply	Example of installation process: https://www.youtube.com/watch?v=RSYvHsXV_XM
Realization of the main part	**Accompanying communication**
1. Removing the Old Faucet (if applicable): 2. Installation of the Sensor Faucet 3. Installation the Control Box and Sensor Components: 4. Testing and Calibration to check for leaks and adjusting the sensors sensivity and range if necessary. If the faucet has temperature control, test and adjust the water temperature and flow rate.	If installing in an office or shared environment, inform users about how the sensor faucet operates and any specific features it has.
After installation of the measure: maintenance/operation routine	**Further comments/ links**
1. Regular maintenance to ensure long operation	

Photos if available

Figure 21: Sensor water faucet © Freepik (www.freepik.com)