

# Improvements of building efficiency

*Didactic materials*

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# HOUSING COMMISSIONS IN EU

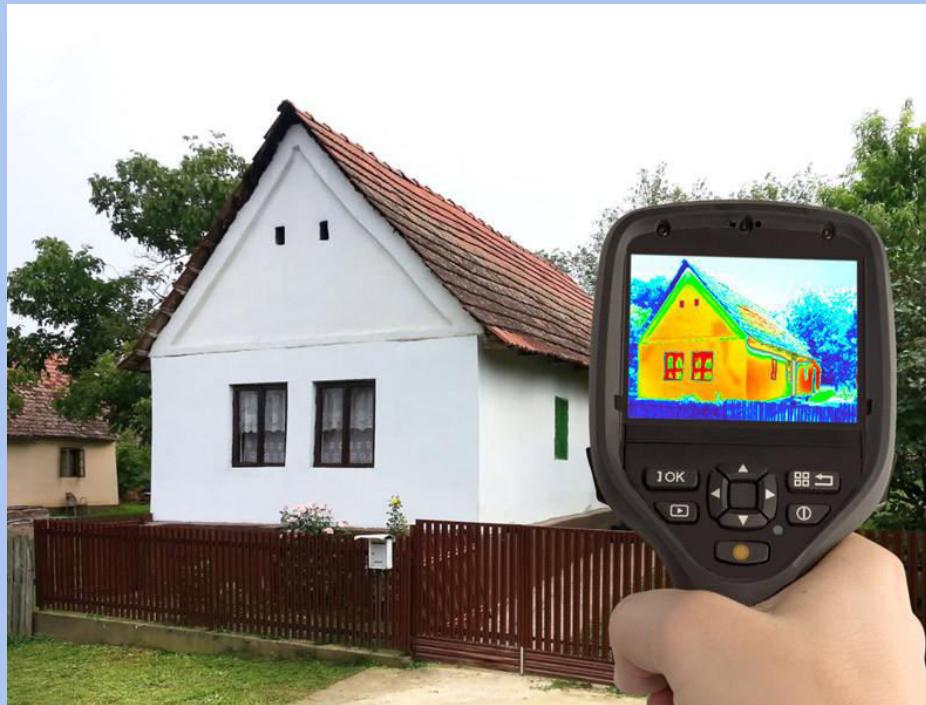
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# HOUSING COMMISIONS IN EU

Housing organizations are doing a lot to make energy use effective, but this is also based on the behavior of the people living in the buildings.

Energy use and efficiency in buildings is generally characterized along end-use categories such as space heating, cooling, and lighting. In these categories is generally determined by the design and construction (**which includes the materials and components used**) of a building and by the technical efficiency and operational management of a building's energy-consuming devices.



Associated picture

Energy consumption is further influenced by variations in building function, climate, energy prices, billing methods, and human behavior.

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# HUMAN BEHAVIOR VERSUS EFFICIENCY

Understanding human behavior is critical for achieving the goals of energy efficiency. Whether we are purchasing goods, using energy to service our homes and workplaces, or responding to the constraints placed upon us by technology and systems that surround us, **human behavior is the key.**



Associated picture

<https://www.wsj.com/articles/big-data-cuts-buildings-energy-use-1411937794>



Associated picture

Studies shows, that most people make rational economic choices if they have the wherewithal to do so. But the overwhelming majority of consumers do not have this wherewithal.

<https://www.forbes.com/sites/williampentland/2012/08/31/human-behavior-the-hot-spot-in-energy-efficiency/#38456c112df4>

<https://www.wsj.com/articles/SB10001424052970203897404578078510673121172>

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**Buildings are significant contributor to greenhouse-gas emissions and need to go green has never been more important.**

You → Must → Go → Green



# Trouble spots. Common sources of energy waste in commercial buildings

- 1 Worn or missing weather stripping.** Analytics tools can match weather patterns with each side of a building and see where energy seems to be leaking more than it should.
- 2 Lighting unused conference and store rooms.** The tools can develop a sense of where people are in buildings, and pinpoint parts of a building that aren't used much but draw power like they are.
- 3 Heating or air conditioning unused conference and store rooms.** The tools develop a baseline for building usage patterns and pinpoint anomalies.

**4 Lights left on when not in use, especially overnight.** Analytics can show if electricity draw doesn't drop sharply after business hours.

**5 Inefficient heating, ventilation, air-conditioning systems.** These show up through things like finding heating or air conditioning systems being used at times of year when they shouldn't be.

**6 Lack of central management for lighting and heating/cooling systems.** Analytics tools can help provide a total picture of buildings that don't have a central management system.

**7 Inefficient fans, like exhaust fans in building garages.** Analytics software will detect spikes in usage patterns caused by inefficiently set exhaust fans and the like.

<https://www.wsj.com/articles/big-data-cuts-buildings-energy-use-1411937794>

# What is ZERO energy in the house?



Lets look:

<https://www.youtube.com/watch?v=qFEvK7qf7ik>

[https://www.youtube.com/watch?feature=player\\_embedded&v=qFEvK7qf7ik](https://www.youtube.com/watch?feature=player_embedded&v=qFEvK7qf7ik)

<http://inhabitat.com/lush-green-walls-sandwich-pioneering-net-zero-energy-building-in-spain/>

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Associated picture

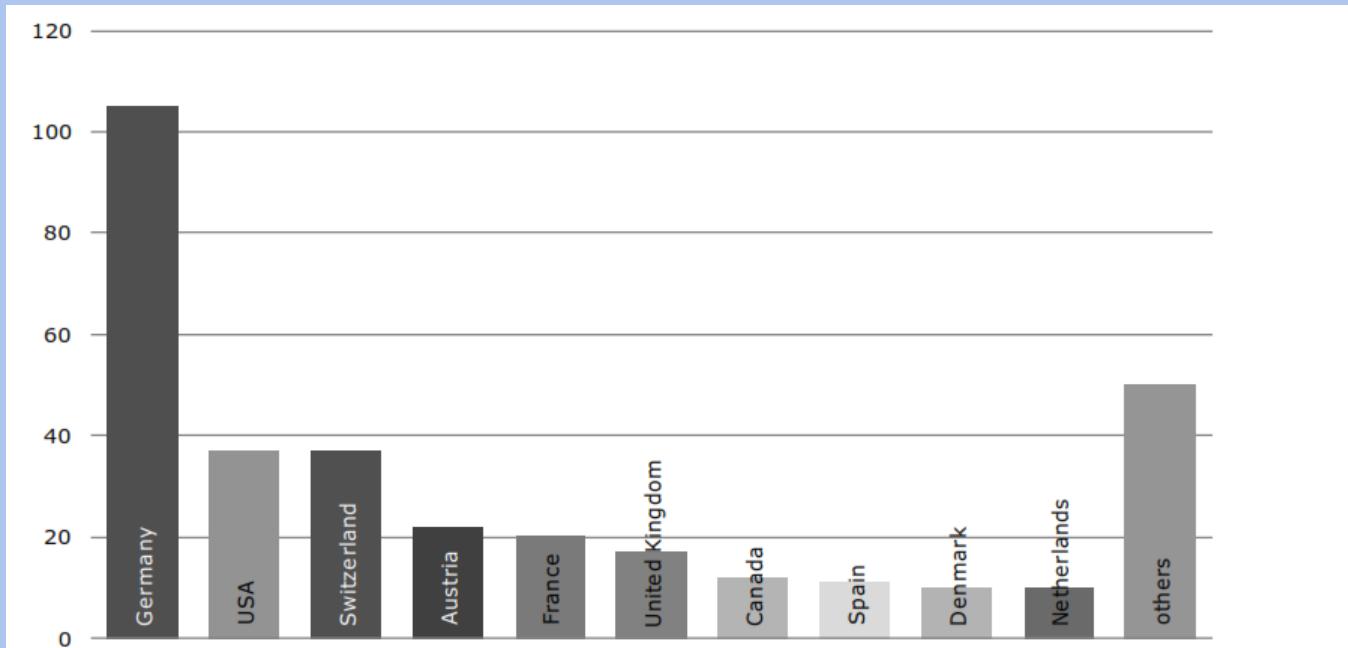
Nearly zero-energy buildings have very high energy performance. The low amount of energy that these buildings require comes mostly from renewable sources.

<http://mymodernmet.com/vincent-callebaut-paris-smart-city/>

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# Frequency of known Zero Energy Buildings per country



[https://ec.europa.eu/energy/sites/ener/files/documents/nzeb\\_full\\_report.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/nzeb_full_report.pdf)

# What does it mean “Clean Energy for all Europeans”?

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- Putting energy efficiency first.
- Achieving global leadership in renewable energy.
- Providing a fair deal for consumers.

# Why is so important improve efficiency in the buildings?

[https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/ESMAP\\_Energy\\_Efficient\\_MayoralNote\\_2014.pdf](https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/ESMAP_Energy_Efficient_MayoralNote_2014.pdf)

# Why is so important improve efficiency in the buildings?

About **one-third of global energy is consumed** in residential, public, and commercial **buildings** (collectively referred to as buildings), where it is used for space heating, cooling, ventilating, lighting, cooking, water heating, refrigerating, and operating electric and mechanical devices.

[https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/ESMAP\\_Energy\\_Efficient\\_MayoralNote\\_2014.pdf](https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/ESMAP_Energy_Efficient_MayoralNote_2014.pdf)

Studies shows, that global energy use in buildings is expected to grow as cities in developing countries continue to modernize and per capita income levels continue to increase.



Associated picture

<http://www.goodnewsfinland.com/city-opt-project-curbs-energy-consumption/>

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## More using means more opportunities to save

Buildings account for some 41 % of global energy savings potential by 2035, compared with the industrial sector (24%) and the transport sector (21%).



Associated picture

[https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/ESMAP\\_Energy\\_Efficient\\_MayoralNote\\_2014.pdf](https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/ESMAP_Energy_Efficient_MayoralNote_2014.pdf)

## Ways in which energy efficiency can be improved in residential, public, and commercial buildings

Through improved design and construction techniques that reduce heating, cooling, ventilating, and lighting loads

Through building upgrades and the replacement of energy-using equipment

By actively managing energy use

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# Where energy efficiency interventions can be launched?

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By retrofitting existing buildings

By establishing and maintaining energy management systems

When designing and constructing new buildings

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# Designing and constructi ng new buildings

New buildings represent the best opportunity for reducing heating, cooling, ventilating, and lighting loads. The most effective way is by introducing and enforcing **Building Energy Efficiency Codes**. It sets out the minimum energy efficiency requirements of a building, including the thermal performance of a building's "envelope" and the energy efficiency standards of its internal equipment and devices.



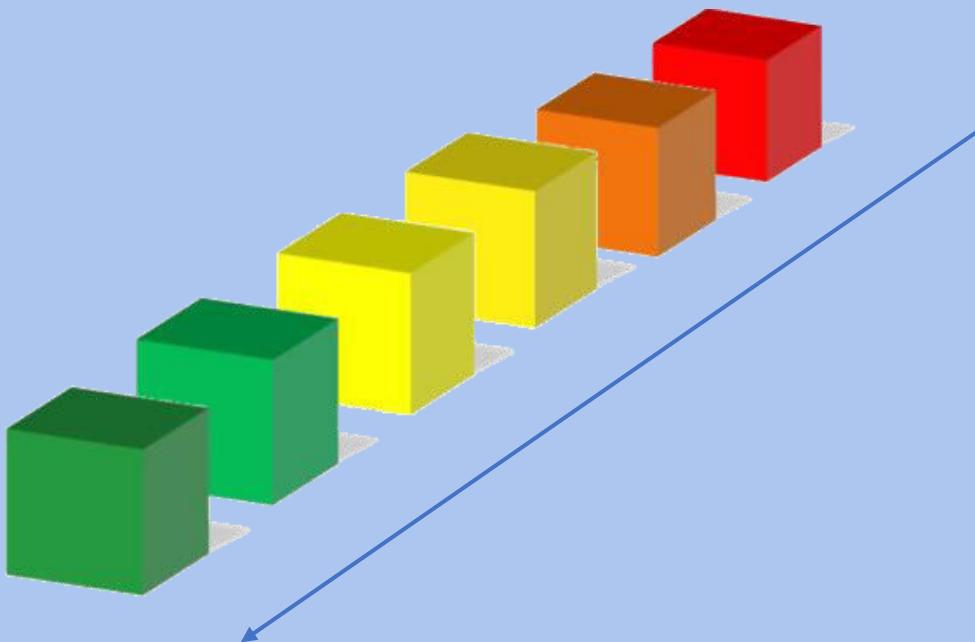
# Establishing and maintaining energy management systems



Establishing and maintaining effective energy management systems for monitoring and controlling energy use in large public and commercial buildings is a low-cost means with which to improve energy efficiency and reduce energy demand.

<https://www.indiamart.com/v-san-electricals-sensors/aboutus.html>

# Retrofitting existing buildings



Associated picture

It's critical for improving energy efficiency in cities where building stock turnover is low.

Cities need to be opportunistic in order to capture this potential by incentivizing and/or requiring energy efficiency upgrades as part of all significant renovations and equipment-replacement activities.

## Building components for improving

Roofs



Walls



Windows



Foundation



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The EU has set itself the target of reaching at least 27% energy savings by 2030.



Associated picture

([http://www.powerhouseeurope.eu/index.php?eID=tx\\_nawsecuredl&u=0&file=fileadmin/users/phe/PH\\_NZC\\_Project\\_Partners\\_Zone/WP1\\_Coordination\\_and\\_Management/POWER\\_HOUSE\\_nZEC\\_Final\\_Publishable\\_Report.pdf&t=1493898365&hash=4a80700d0f5038e4686f184db2765585](http://www.powerhouseeurope.eu/index.php?eID=tx_nawsecuredl&u=0&file=fileadmin/users/phe/PH_NZC_Project_Partners_Zone/WP1_Coordination_and_Management/POWER_HOUSE_nZEC_Final_Publishable_Report.pdf&t=1493898365&hash=4a80700d0f5038e4686f184db2765585) )

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Energy-efficient home improvements can make your home more comfortable while saving you energy and money. It may also increase the value of your home.

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# Improving home's energy efficiency could take many forms

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## 1. Weatherizing your home by insulating or by installing new windows or doors



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## 2. Replacing a water heater or a heating or cooling system



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### 3. Changing the type of light bulbs you use



Associated picture

# If you are thinking about ways to improve your home's energy efficiency, what should you do first?

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## GREEN YOUR HOUSE

- Tune up your heating system regularly
- Insulate your attic
- Get some indoor plants to clean your air
- Use natural air fresheners like coffee or potpourri
- Trade-in cleaning products for baking powder
- Get your water heater a blanket
- Invest in some good drapes
- Use the rake instead of a blower
- Wash clothes in warm instead of hot
- Plant a tree
- Use an electric mower
- Go latex paint not oil based
- Donate spare paint to a school
- Go broom over hose
- Use a toaster oven for small meals

So many  
rules, so  
little desire

<https://www.pinterest.com/pin/61994932351182001/>

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- Use air dry setting on dishwasher
- Clean dishwasher filter regularly
- Install motion sensor light switches
- Switch out bulbs to CFLs
- Unplug things not used a lot
- Buy chlorine-free products
- Squash your trash
- Buy stainless steel pots rather than non-stick
- Opt for a gas stove over an electric
- Buy timers for your lights
- Buy crank or solar powered chargers
- Don't hide heating vents behind things
- Get a recycle bin
- Install low flow fittings to faucets

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rules, so  
little  
desire

<https://www.pinterest.com/pin/61994932351182001/>

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Do a home energy audit that allows you to assess how much energy your home uses and compares your home with similar homes across the country.



Associated picture

Energy audits are a useful tool to provide the information needed to implement energy efficiency measures in a specific environment. You could save 5 to 30 % on your energy bill by making efficiency upgrades identified in your home energy audit

<http://www.moonworkshome.com/energy-audit/mass-energy-audit/>  
<https://energy.gov/public-services/homes/home-weatherization>

Depending on the project, you may choose to do it yourself or find a contractor.

Before you select someone to do the work, read these tips for hiring a contractor.



Associated picture

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Don't forget about the outside. You can use landscaping to boost your home's energy efficiency.



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<http://www.keepingenergyaffordable.com/taxonomy/term/453#.WR76dtu1u1M>

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Associated picture

Find out what federal or state tax credits and incentives and financing you may be able to get for improving your home's energy efficiency.

## What's more?

- Good building design, including passive systems and landscaping.
- Improved building envelope, including roofs, walls, and windows.
- Improved equipment for heating and cooling air and removing humidity.

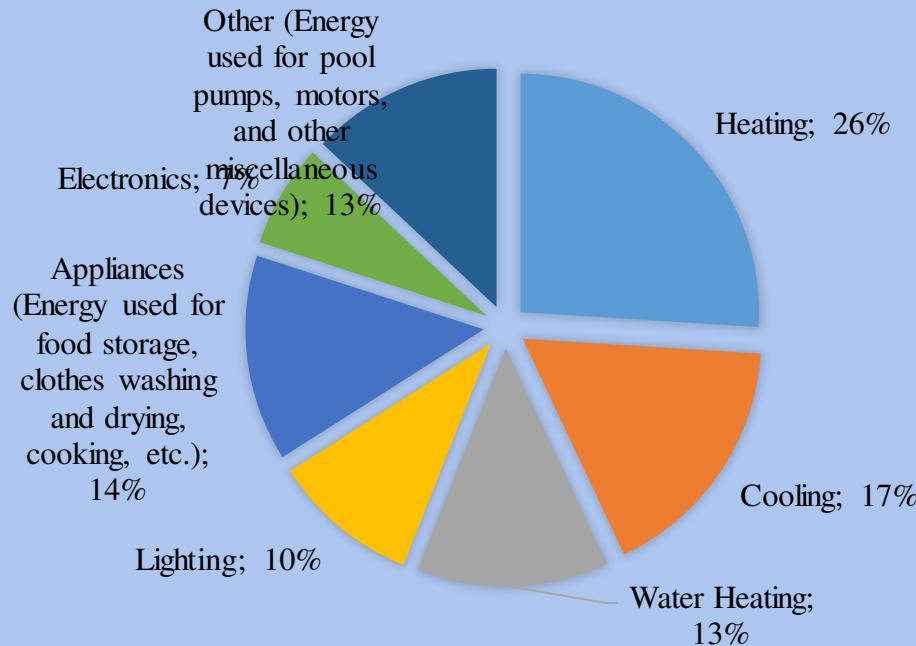
<https://energy.gov/sites/prod/files/2015/09/f26/QTR2015-05-Buildings.pdf>

## What's more?

- Thermal energy storage that can be a part of the building structure or separate equipment
- Improved sensors, control systems, and control algorithms for optimizing system performance

<https://energy.gov/sites/prod/files/2015/09/f26/QTR2015-05-Buildings.pdf>

# Home energy breakdown



<http://smarterhouse.org/>

Made by ahor

## Step by step. Cooking

The key to efficient cooking is understanding your cooking habits. If you are purchasing new cooking appliances, it is worth using efficiency as a guide because they tend to have long lives



Associated picture



# Dishwashing

More than half of the energy used by a dishwasher goes towards heating the water. The energy and water consumed by new dishwashers has dropped dramatically, while making great strides in cleaning performance.



Associated picture

# Food Storage



Associated picture

If current refrigerator or freezer is more than 15 years old, it may be so inefficient that a new one would pay for itself in energy savings in just a few years.

## Appliances and Electronics



### TOP ENERGY WASTERS

#### \$100 - \$200 / year - Old appliances

Old Refrigerator

**\$200**

Old Freezers

**\$150**

**Most standard**

Old Clothes Dryers

**\$150**

**units are**

Old Electric Ovens

**\$150**

**in-between**

Old Dishwasher

**\$100**

Newer and energy  
efficient units:  
**\$25 - \$50/year**



### SECOND RANK ENERGY WASTERS

#### \$50 - \$80 / year

Inefficient Plasma TV

**\$80**

**Most standard**  
**units are**  
**in-between**

Old Clothes Washer

**\$80**

Newer and energy  
efficient units:  
**\$15 - \$30/year**

Old Cooking Range

**\$60**

Inefficient LCD TV

**\$50**

Old Dehumidifiers

**\$40**

Aquarium

**\$40**

Inefficient Standard TV

**\$35**

Inefficient Computer Monitor

**\$35**

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## THIRD RANK

**\$10 - \$30 / year**

Video Game Player	<b>\$25</b>
Coffee machine	<b>\$20</b>
Microwave	<b>\$20</b>
Toaster oven	<b>\$20</b>
Air dryer	<b>\$15</b>
Clock radio	<b>\$15</b>
Vacuum cleaner	<b>\$10</b>
Humidifier	<b>\$10</b>
Laptop	<b>\$10</b>
DVR	<b>\$10</b>
Wireless router	<b>\$10</b>



## FOURTH RANK

**\$2 - \$8 / year**

Popcorn popper	<b>\$8</b>
Toaster	<b>\$8</b>
Cable box	<b>\$5</b>
DVD player	<b>\$5</b>
Satellite dish	<b>\$5</b>
Cordless telephone	<b>\$5</b>
Espresso machine	<b>\$4</b>
Electric blanket	<b>\$4</b>
Stereo	<b>\$4</b>
Cell phone charger	<b>\$2</b>
Answering machine	<b>\$2</b>



## FIFTH RANK

**\$1 - \$2 / year**

**Dozens of small electronics**

**Examples:**

Blender	<b>\$1</b>
Stand mixer	<b>\$1</b>
Electric can opener	<b>\$1</b>
Curling iron	<b>\$1</b>
Printer	<b>\$1</b>
VCR	<b>\$1</b>
Portable stereo	<b>\$1</b>



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# Home Electronics

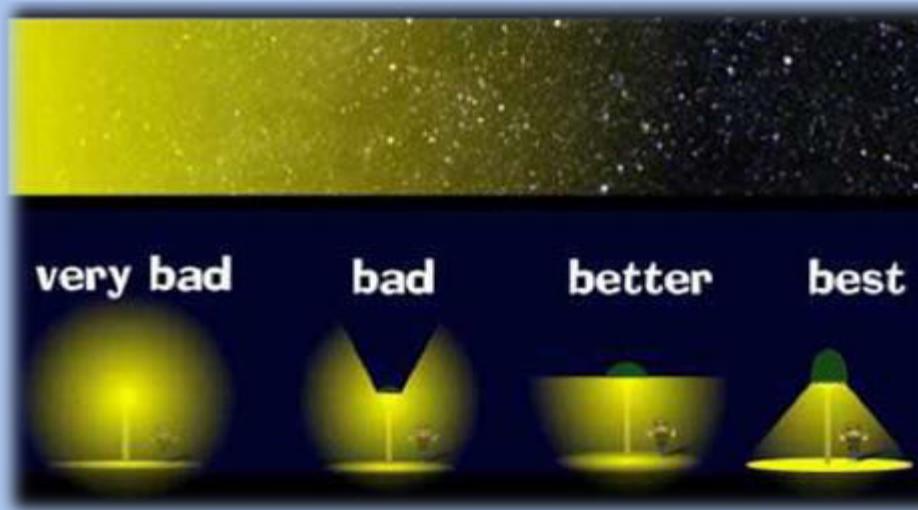


Associated picture

An estimated 10% to 15% of all electricity used in homes can be attributed to the buzz of electronic devices, not because they use a lot of energy, but because of their sheer numbers.

# Lighting

Lighting costs the typical household 75 – 200 Eur per year in electricity. Making the switch to energy-efficient lighting is one of the quickest, easiest, and least expensive ways to cut home's energy use.



Associated picture

# Laundry



Associated picture

Most of the energy used to wash clothes is for heating the water. New resource-efficient washers provide excellent wash performance while cutting energy and water use by half or more.

## Average per year

	Gas heater	Gas heater	Electric heater	Electric heater
How you typically wash?	Top-loader	Front-loader	Top-loader	Front-loader
100% hot	168 Eur	87 Eur	252 Eur	138 Eur
50% hot/cold 50% cold/cold	134 Eur	67 Eur	176 Eur	92 Eur
50% warm/cold 50% cold/cold	122 Eur	59 Eur	148 Eur	76 Eur
25% hot/cold 75% cold/cold	117 Eur	57 Eur	138 Eur	70 Eur
100% cold/cold	101 Eur	47 Eur	101 Eur	47 Eur

<http://blog.constellation.com/2016/07/26/laundry-energy-saving-tips-flowchart/>

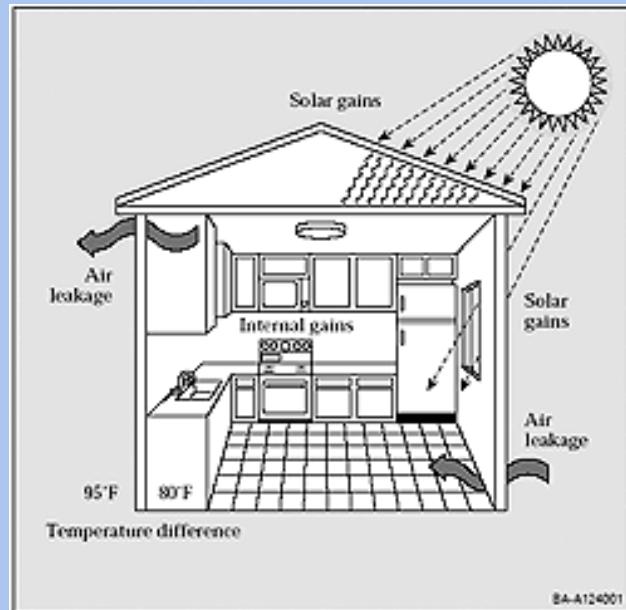
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# Use your windows to gain cool air and keep out heat

Four factors affect heat accumulation in a home: solar heat gain, internal heat gain, air leakage, and temperature difference.



Associated picture

<https://publications.usa.gov/epublications/coolyourhome/cooling.htm>



Associated picture

If you live in a climate where it cools off at night, turn off your cooling system and open your windows while sleeping. When you wake in the morning, shut the windows and blinds to capture the cool air.

Dull, dark-colored home exteriors absorb 70% to 90% of the radiant energy from the sun that strikes the home's surfaces ☺

Install  
window  
coverings to  
prevent heat  
gain through  
your  
windows.



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Operate  
your  
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efficiently

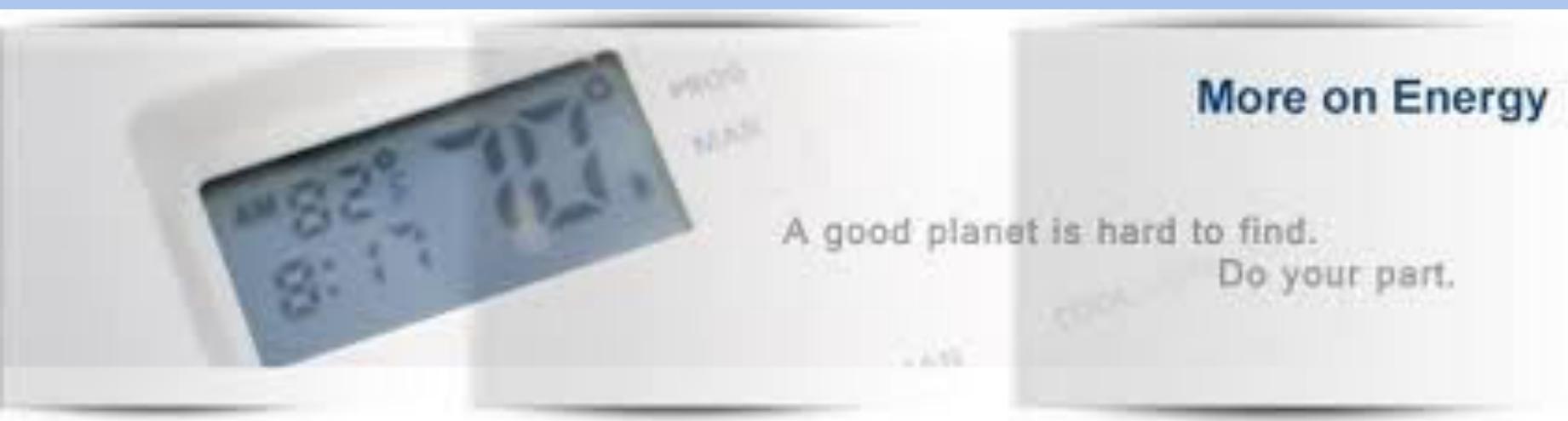


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Set your thermostat as high as comfortably possible in the summer.  
The smaller the difference between the indoor and outdoor  
temperatures, the lower cooling bill will be



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Associated picture

Keep your house warmer than normal when you are away, and lower the thermostat setting to 26°C only when you are at home and need cooling (in summer of course ☺)

Avoid setting your thermostat at a colder setting than normal when you turn on your air conditioner. It will not cool your home any faster and could result in excessive cooling and unnecessary expense.



Associated picture

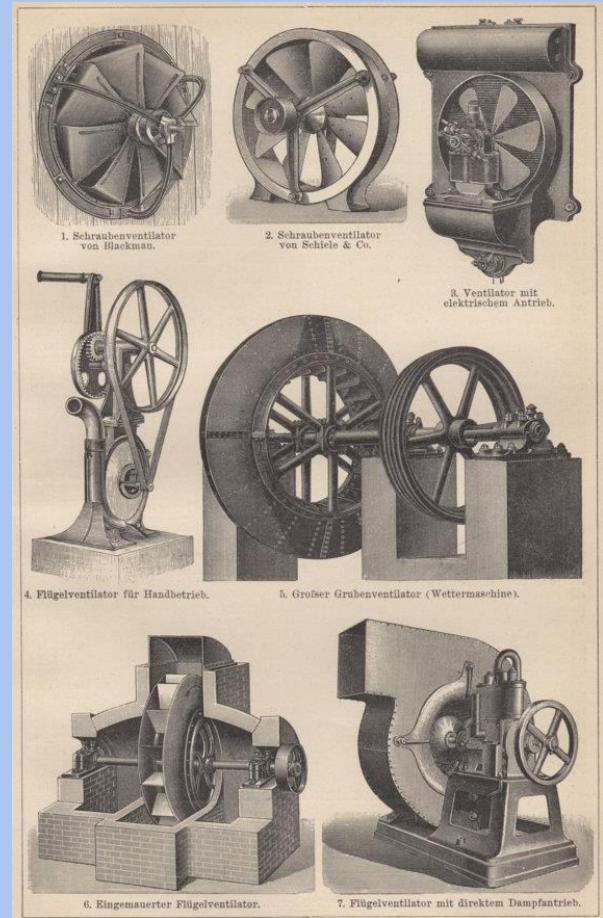
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# Use fans and ventilation strategies to cool home



Associated pictures



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If you use air conditioning, a ceiling fan will allow you to raise the thermostat setting about  $-15^{\circ}\text{C}$  with no reduction in comfort.



Associated picture

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Turn off ceiling fans when you leave the room. Remember that fans cool people, not rooms, by creating a wind chill effect.



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When you shower or take a bath, use the bathroom fan to remove the heat and humidity from your home. Your laundry room might also benefit from spot ventilation. Make sure bathroom and kitchen fans are vented to the outside (not just to the attic).



Associated picture

# Keep your cooling system running efficiently



Associated picture

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Schedule regular maintenance for your cooling equipment.



Associated picture

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Avoid placing lamps or TV sets near your room air-conditioning thermostat. The thermostat senses heat from these appliances, which can cause the air conditioner to run longer than necessary.

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Vacuum registers regularly to remove any dust buildup. Ensure that furniture and other objects are not blocking the airflow through your registers.



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# Don't heat home with appliances and lighting



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On hot days, avoid using the oven; cook on the stove, use a microwave oven or grill outside.



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Install efficient lighting that runs cooler. Only about 10% to 15% of the electricity that incandescent lights consume results in light—the rest is turned into heat.



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Take advantage of daylight instead of artificial lighting, but avoid direct sunlight.



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Wash only full loads of dishes and clothes. Consider air drying both dishes and clothing.

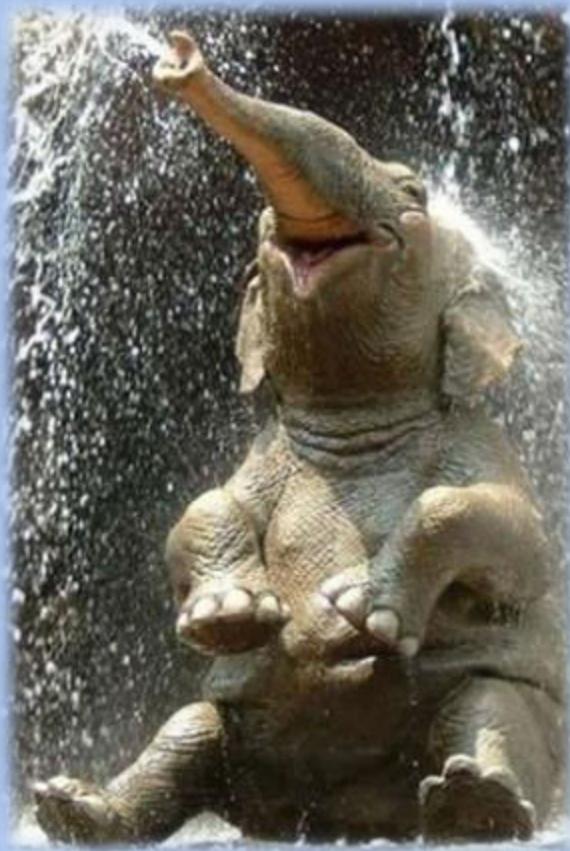


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Take short showers instead of baths.



VS



Associated pictures

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Minimize activities that generate a lot of heat, such as running a computer, burning open flames, running a dishwasher, and using hot devices such as curling irons or hair dryers. Even stereos and televisions will add some heat to your home.



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# Keep hot air from leaking into home

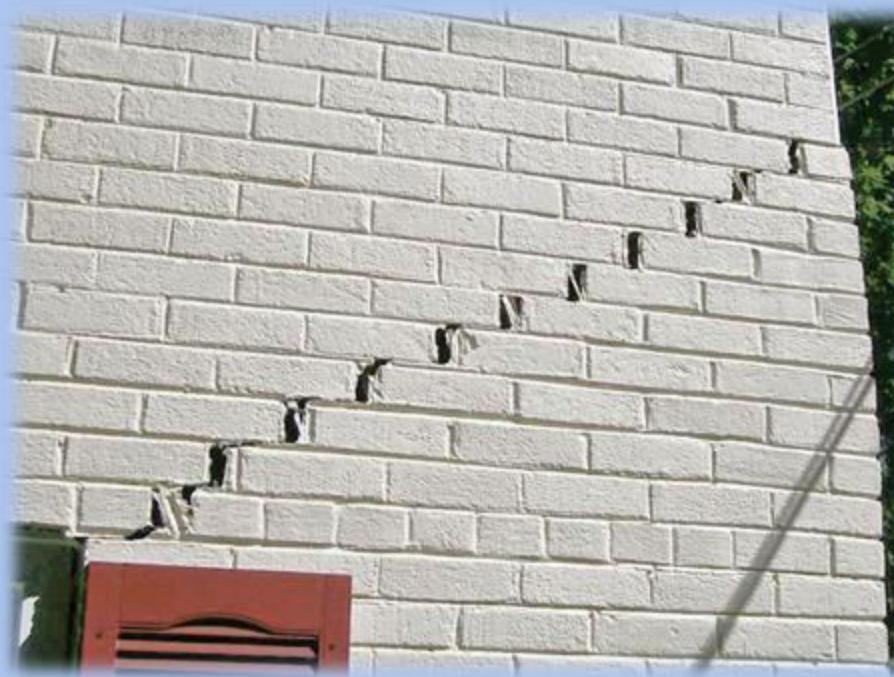


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Seal cracks and openings to prevent warm air from leaking into your home.



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# Lower water heating costs



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Turn down the temperature of your water heater to the warm setting 49°C. You'll not only save energy, you'll avoid scalding your hands.



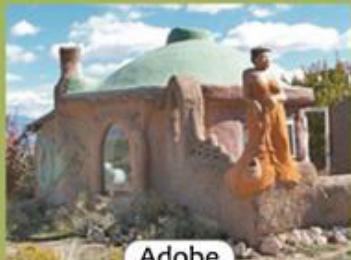
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<https://www.energy.gov/energy saver/water-heating>

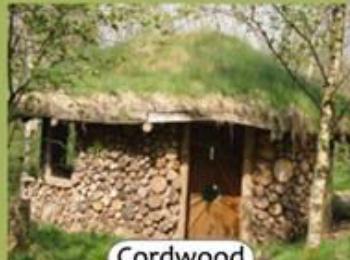
#### Contact

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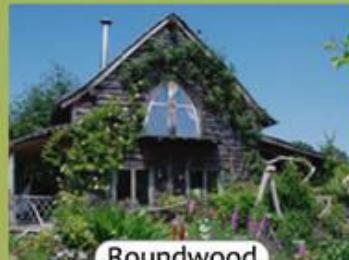
## Natural Homes around the World



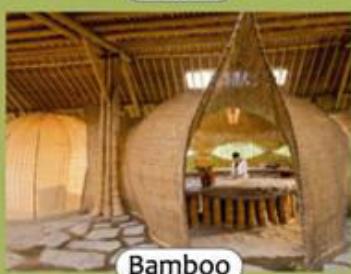
Adobe



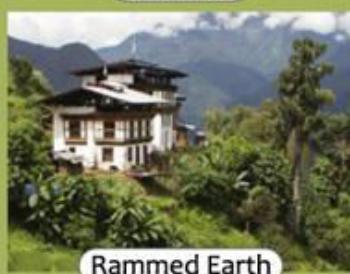
Cordwood



Roundwood



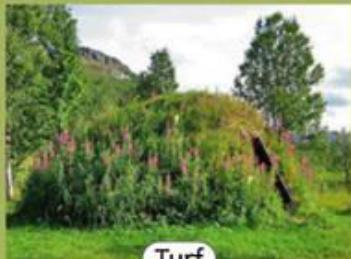
Bamboo



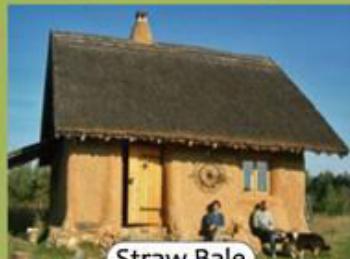
Rammed Earth



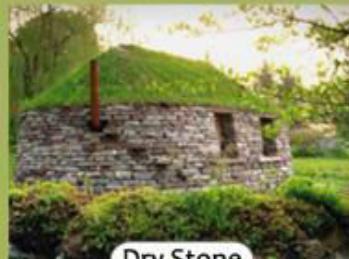
Cob



Turf



Straw Bale



Dry Stone

**Building designs  
and the selection of  
equipment depend  
on the climate  
where the building  
operates.**

<https://www.pinterest.com/pin/124974958382143678/>

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# The climate of Europe is very mild



Associated picture

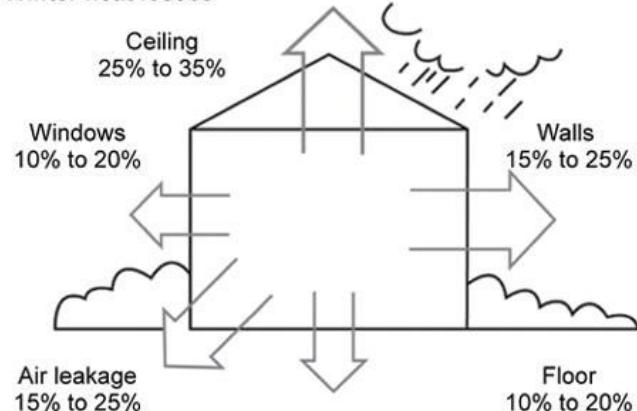
Contact

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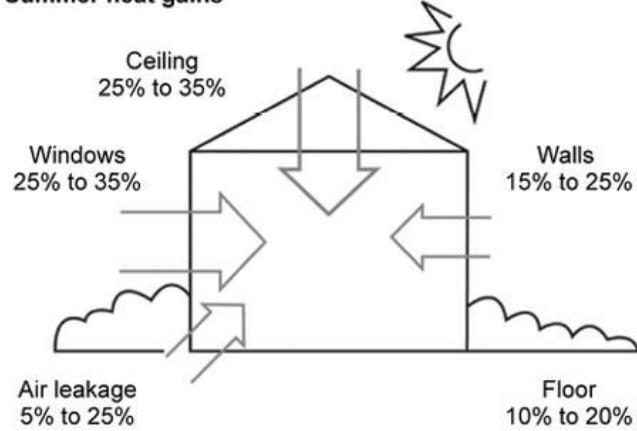
# Typical heat losses and gains without insulation in a temperate climate

<http://www.yourhome.gov.au/passive-design/insulation>

## Winter heat losses



## Summer heat gains



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# National plan for increasing the number of nearly zero energy buildings in Lithuania.

Contact

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from 2018 – new buildings or their parts shall comply with the requirements for class A+ buildings;

- from 2021 – new buildings or their parts shall comply with the requirements for class A++ buildings.

- Law on Construction provides that after 31 December 2018, new state and local authorities, institutions and companies built buildings must be nearly zero-energy buildings.

# References

1. [https://ec.europa.eu/energy/sites/ener/files/documents/nzeb\\_full\\_report.pdf](https://ec.europa.eu/energy/sites/ener/files/documents/nzeb_full_report.pdf)
2. <https://publications.usa.gov/epublications/coolyourhome/cooling.htm>
3. <https://www.energy.gov/energysaver/water-heating>
4. <https://energy.gov/sites/prod/files/2015/09/f26/QTR2015-05-Buildings.pdf>
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6. <https://www.forbes.com/sites/williampentland/2012/08/31/human-behavior-the-hot-spot-in-energy-efficiency/#38456c112df4>
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8. <https://energy.gov/public-services/homes/home-weatherization>
9. [http://www.powerhouseeurope.eu/index.php?eID=tx\\_nawsecuredl&u=0&file=fileadmin/users/phe/PH\\_NZC\\_Project\\_Partners\\_Zone/WP1\\_Coordination\\_and\\_Management/POWER\\_HOUSE\\_nZEC\\_Final\\_Publishable\\_Report.pdf&t=1493898365&hash=4a80700d0f5038e4686f184db2765585](http://www.powerhouseeurope.eu/index.php?eID=tx_nawsecuredl&u=0&file=fileadmin/users/phe/PH_NZC_Project_Partners_Zone/WP1_Coordination_and_Management/POWER_HOUSE_nZEC_Final_Publishable_Report.pdf&t=1493898365&hash=4a80700d0f5038e4686f184db2765585)

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This project has been funded with support from the European Commission.  
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