CERTIFICATION OF ZEROCO$_2$ BUILDINGS - IS IT FEASIBLE ?

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Shaping the Buildings Low Carbon Future

ZeroCO$_2$ Final Conference

PROMOTION OF ENERGY SUSTAINABILITY IN BUILDINGS

- Mitigation of climate change requires the promotion of energy sustainability in various sectors of the economy including the building stock. EU buildings currently consume more than 30% of all energy consumption and contribute significantly in anthropogenic carbon emissions. Current EU policies aim at
- 1. Increasing energy efficiency in buildings,
- 2. Reducing their fossil fuels consumption, and
- 3. Reducing their carbon emissions.

EU DIRECTIVES FOR SUSTAINABLE BUILDINGS

- European legislation for the promotion of environmental and energy sustainability in buildings include the directives
- 1. Directive 2010/31/EU, and
- 2. Directive 2018/844/EU (revision of the previous directive)
- These two directives have been included in the National legislation of member states.

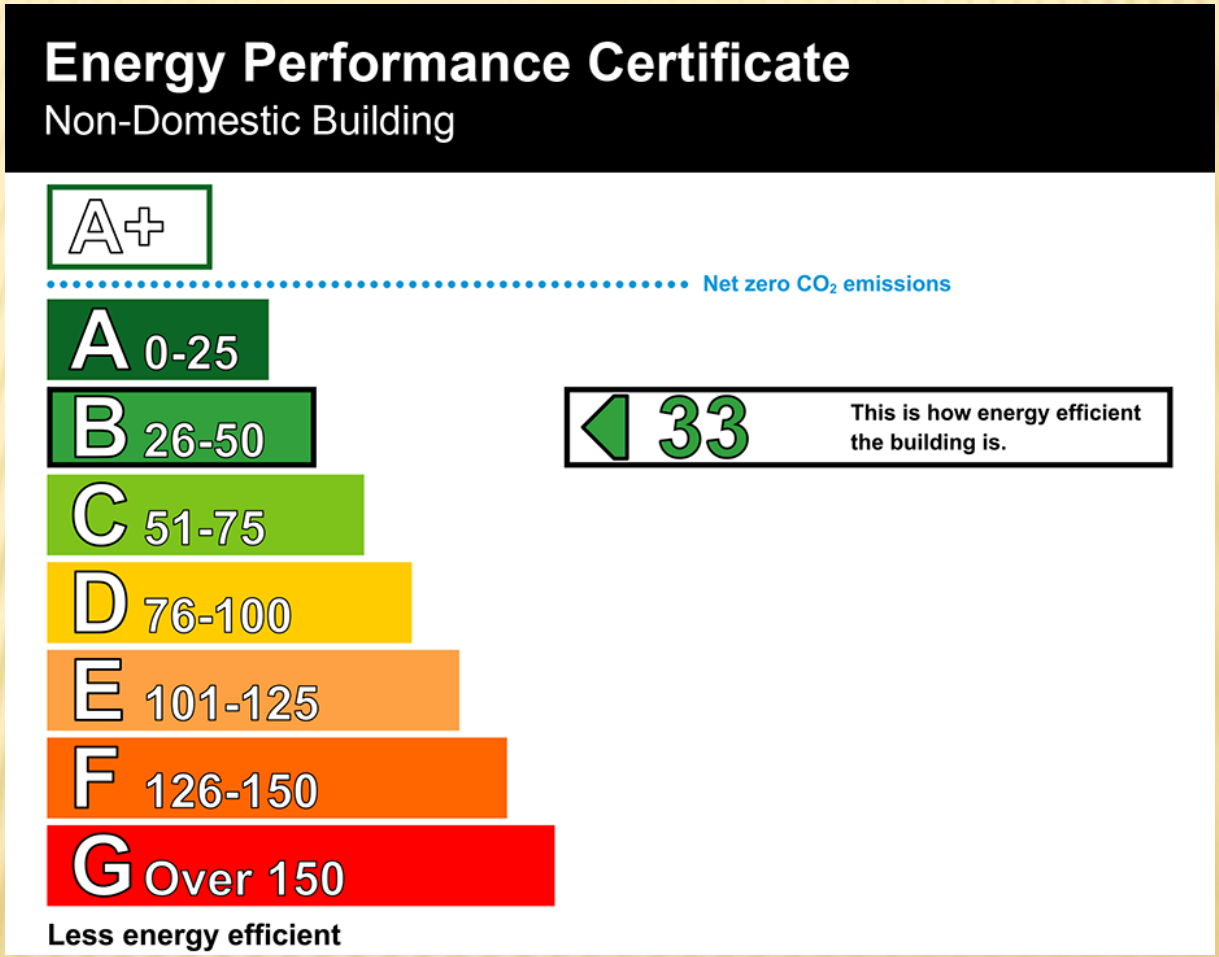
PROMOTION OF ENERGY SUSTAINABILITY IN BUILDINGS

- According to those two directives the member states should
- A)Establish long term renovation strategies aiming at de-carbonization of the building stock until 2050,
- B) Promote the nearly zero energy buildings (NZEBs),
- C) All new buildings must be nearly zero-energy buildings (NZEB) from 31 December 2020. (Since 31 December 2018, all new public buildings already need to be NZEB)

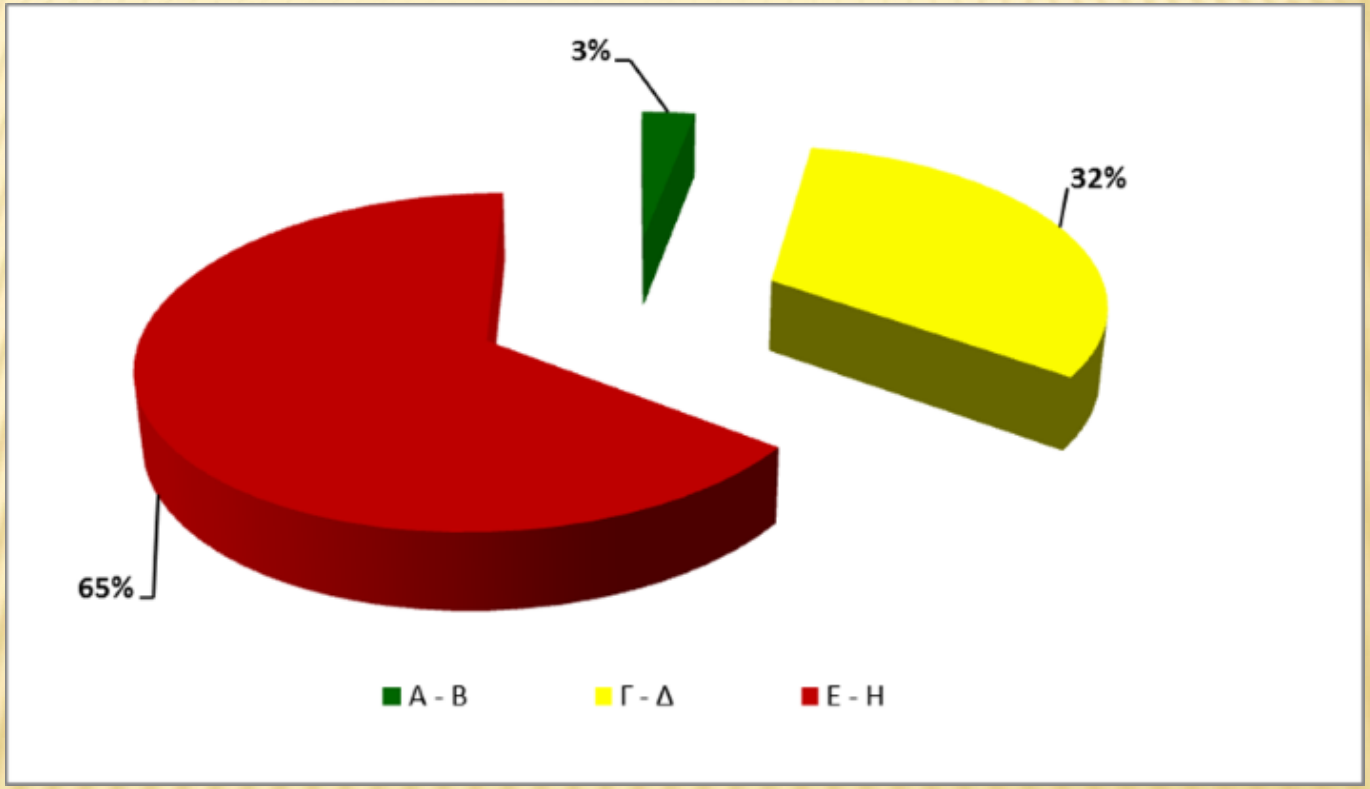
PROMOTION OF ENERGY SUSTAINABILITY IN BUILDINGS

- D) Promote energy certification of buildings,
- E) Promote the use of smart technologies to improve energy performance in buildings,
- F) Set cost-optimal minimum energy performance requirements for new buildings, and
- G) Provide financial support for energy renovation of various buildings creating the appropriate financial tools and mechanisms

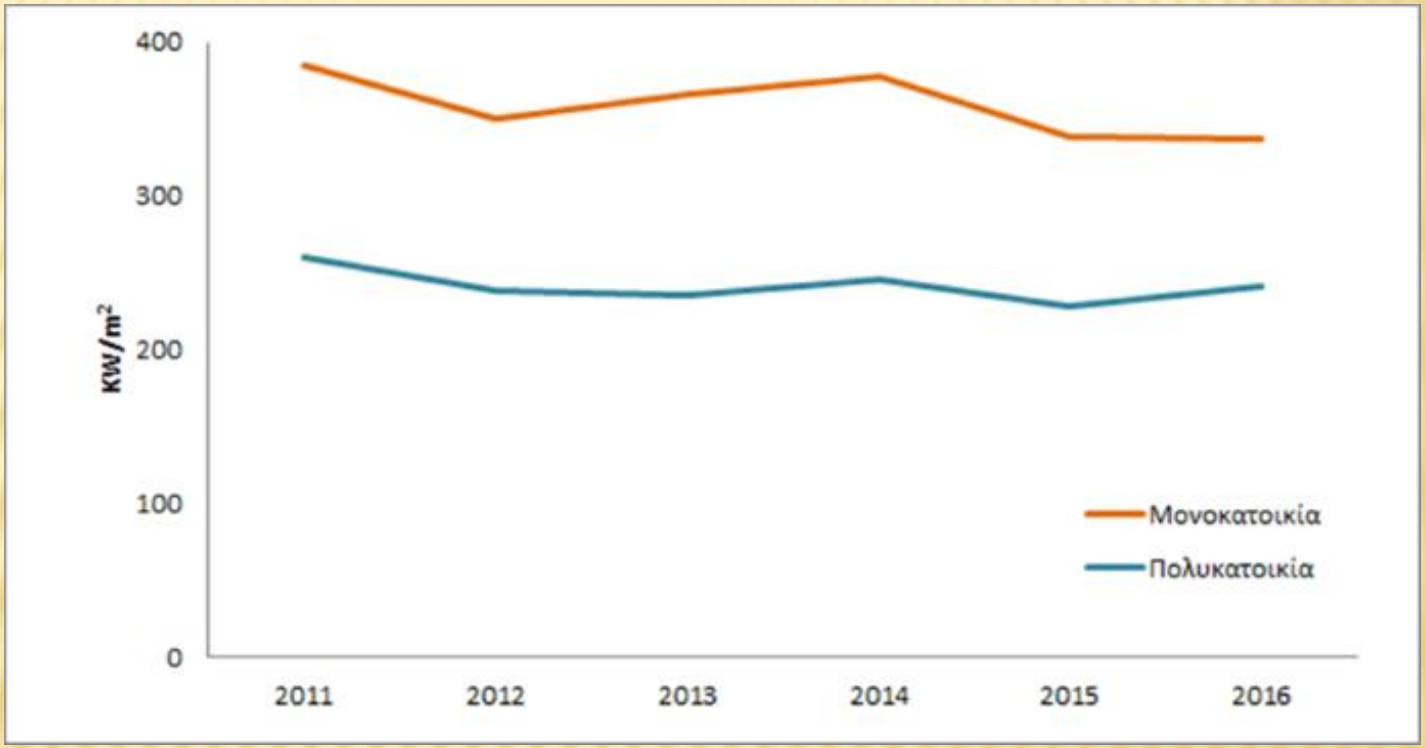
ENERGY CERTIFICATION OF BUILDINGS



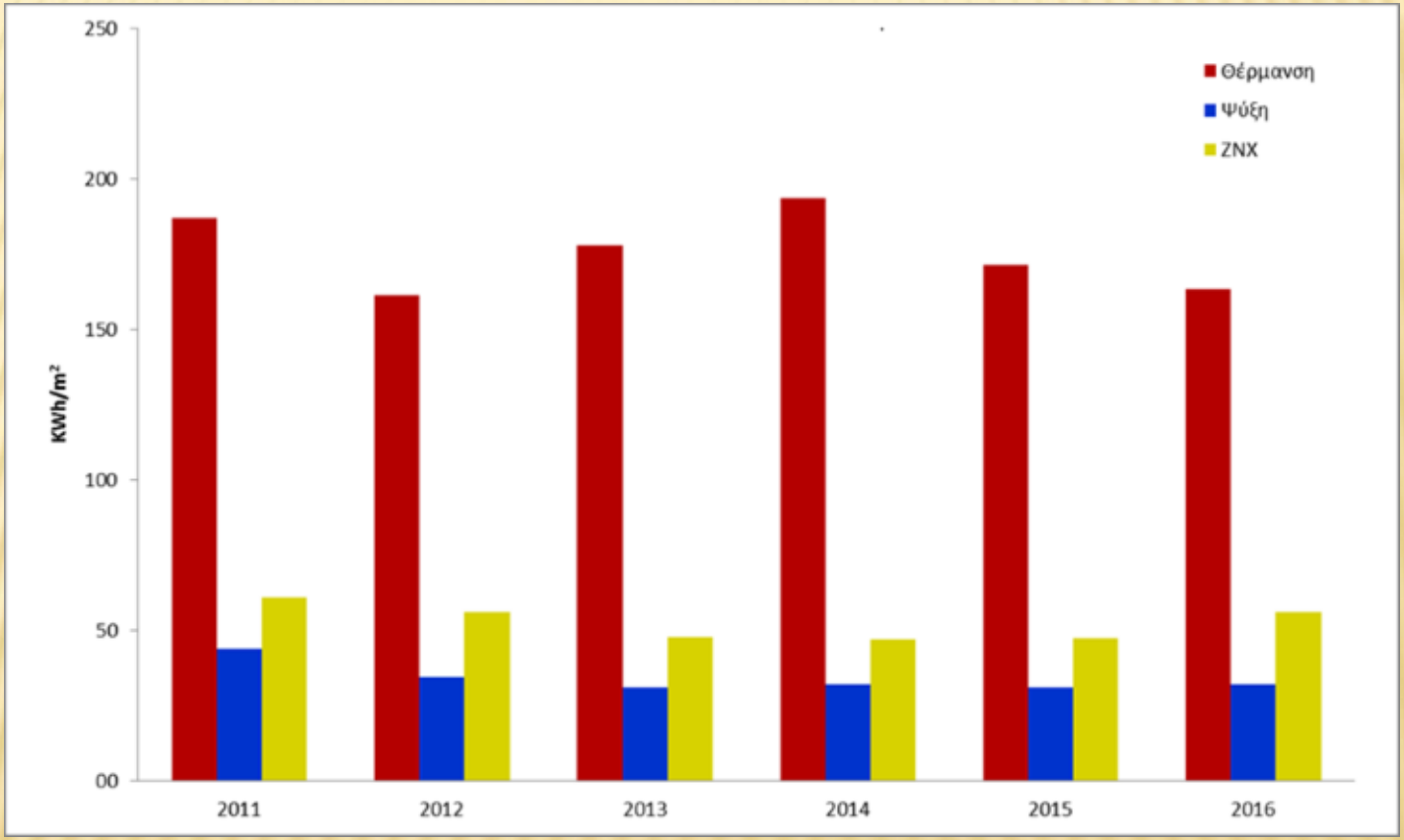
ENERGY CERTIFICATION OF RESIDENTIAL BUILDINGS IN GREECE (2011-2016)



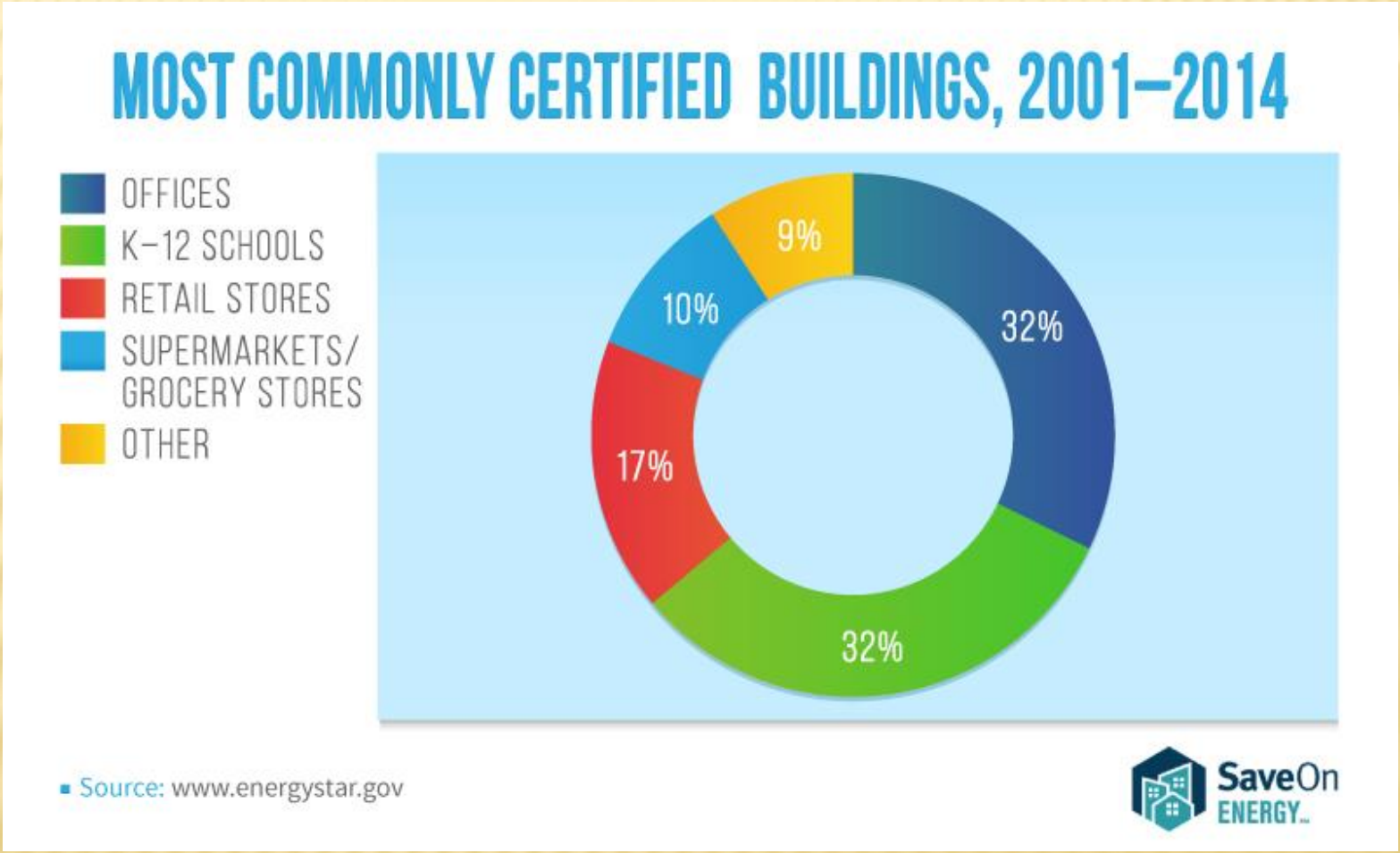
ANNUAL PRIMARY ENERGY CONSUMPTION IN GREEK SINGLE-FLAT AND MULTI-FLAT RESIDENTIAL BUILDINGS (2011-2016)



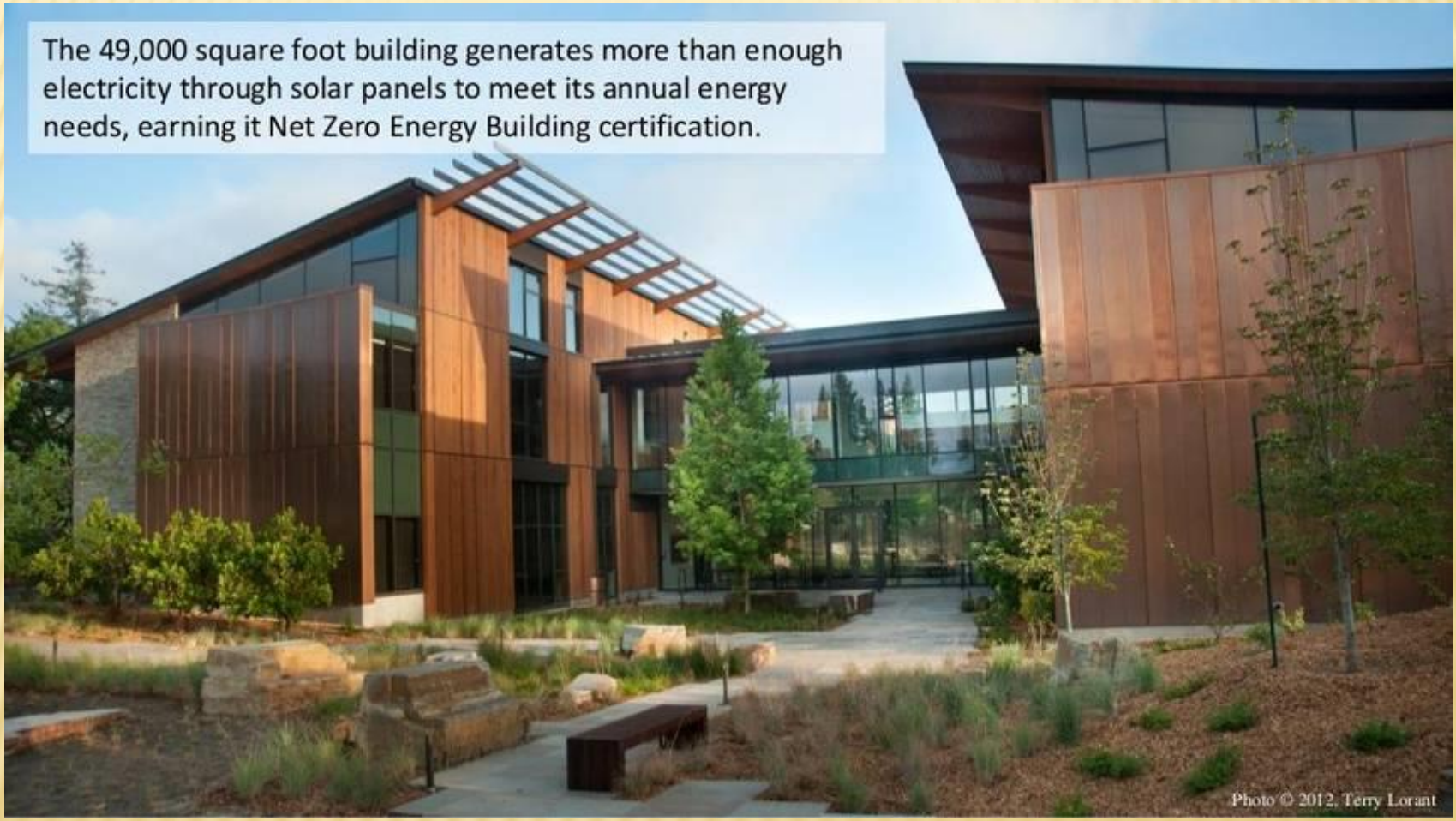
ANNUAL ENERGY CONSUMPTION IN GREEK RESIDENTIAL BUILDINGS FOR HEAT, COOLING AND DHW (2011-2016)



ENERGY CERTIFIED BUILDINGS



AN EXAMPLE OF A ZEROCO_2 BUILDING



AN EXAMPLE OF A ZEROCO_2 BUILDING

- This building does not utilize annually fossil fuels while it does not result in net CO_2 emissions into the atmosphere. However it does not necessarily reduces its overall energy consumption. It is categorized as a ZEROCO_2 building.

NREL RESEARCH SUPPORT FACILITIES BUILDING. THE LARGEST NZEB IN USA, 2010

OBERLIN COLLEGE LEWIS CENTER, OBERLIN, OHIO, USA
THE BUILDING IS CONNECTED INTO THE GRID AND IT USES PV

COMPLETED NREL/HABITAT ZERO ENERGY HOME, USA
THE BUILDING IS CONNECTED INTO THE GRID AND IT USES PV

A ZEROCO$_2$ SMALL BUILDING LOCATED IN CRETE, GREECE

A ZEROCO$_2$ SMALL BUILDING LOCATED IN CRETE, GREECE

- This small building is not interconnected with the grid. It is autonomous and it covers its annual electricity requirements using solar-PV energy and wind energy. It uses solid biomass for heating and heat-pumps for cooling in the summer. Electricity generated with solar and wind energy is stored in electric batteries.

DEFINITION OF A ZEROCO_2 BUILDING

- ***Net zero CO_2 building – operational energy is defined as:***
- "When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset.
-

DEFINITION OF A ZEROCO_2 BUILDING

- *Net zero CO_2 building – whole life is defined as*:
- "When the amount of carbon emissions associated with a building's embodied and operational impacts over the life of the building, including its disposal, are zero or negative.

ZEROCO_2 BUILDINGS

- **A ZEROCO_2 building** can be conceived as a building in which
- *1. All the fossil fuels used have been replaced with renewable energies,*
- *2. All its annual grid electricity consumption is offset with electricity generated by renewable energy technologies (either on-site or off-site) using the net-metering initiative.*
- *The net annual CO_2 emissions due to energy use in the building would be zero.*

DEFINITION OF WORLD GREEN BUILDING COUNCIL FOR ZEROCO$_2$ BUILDINGS

- The ***World Green Building Council*** definition of a **net zero carbon building:**
- A building that is **highly energy efficient** and **fully powered from on-site and/or off-site renewable energy sources.**
- However a **net ZEROCO$_2$ building** could have **low energy efficiency** and be **powered from on-site and/or off-site renewable energy sources** resulting in net zero carbon emissions.

DIFFERENCE BETWEEN A ZERO ENERGY BUILDING AND A ZEROCO2 BUILDING

- A **ZERO ENERGY BUILDING** **combines energy efficiency** and **renewable energy generation** to consume only as much energy as can be produced onsite through renewable resources over a specified time period.
- **A ZEROCO2 BUILDING** **uses renewable energy resources** to produce as much energy as it consumes through on-site (or off-site) renewable energy installations over a specified time period. However **it does not necessarily has high energy efficiency.**

SUSTAINABLE ENERGY TECHNOLOGIES FOR ZEROCO$_2$ BUILDINGS

- Various renewable energy technologies can be used for the creation of **ZEROCO$_2$ buildings** including :
- 1. Use of **solar thermal energy** for heat generation including DHW production,
- 2. Use of **solar photovoltaic technology** for electricity generation,
- 3. Use of **solid biomass** for heat generation including DHW production,

SUSTAINABLE ENERGY TECHNOLOGIES FOR ZEROCO_2 BUILDINGS

- 4. Use of **high efficiency heat pumps** including **geo-thermal heat pumps for heating and cooling** ,
- 5. Use of **district heating systems** where the hot water has been produced from RES or rejected heat,
- 6. Use of **small size wind turbines**, and
- 7. Use of **systems co-generating heat and power** fuelled with biomass.

SUSTAINABLE ENERGY TECHNOLOGIES FOR ZEROCO_2 BUILDINGS

Technology used	Electricity generation	Heat	Cooling
Solar thermal		Yes	
Solar photovoltaic	Yes		
Solid biomass		Yes	
Heat pumps		Yes	Yes
District heating systems		Yes	
Small size wind turbines	Yes		
Co-generation systems	Yes	Yes	

SUSTAINABLE ENERGY TECHNOLOGIES FOR ZEROCO_2 BUILDINGS

- Use of sustainable energy technologies depend on the local availability of the renewable energy sources,
- Technologies used must be reliable, mature and cost-effective,
- The sustainable energy systems used can be installed either on-site or off-site of the building.

ZEROCO$_2$ BUILDINGS AND EU POLICIES

- A **ZEROCO$_2$ building** can achieve at least **two out of the three targets** of the EU policy:
- 1. Zeroing the fossil fuels used, and
- 2. Zeroing its carbon emissions due to its operational energy use,
- However this type of building **is not necessarily energy efficient** which is an additional requirement of EU policy.

FINANCING ZEROCO$_2$ BUILDINGS

- Creation of ZEROCO$_2$ buildings needs **financial support** and various financial mechanisms have been developed for facilitating these energy investments including:
- 1. Bank loans,
- 2. Tax reliefs,
- 3. Capital subsidies, and
- 4. Third party financing through ESCOs

DIFFICULTIES IN CALCULATING A **ZEROCO$_2$ BUILDING**

- A **ZEROCO$_2$ building** produces at least as much carbon emissions-free renewable energy as it uses from carbon emissions-producing energy sources.
- Success in achieving a **ZEROCO$_2$ building** depends **on the generation source of the grid electricity used.** Emissions vary greatly depending on the source of grid electricity generation.

DIFFICULTIES IN CALCULATING A ZEROCO$_2$ BUILDING

- One could argue that any building that is constructed in an area with a large hydro or nuclear contribution to the regional electricity generation mix would have fewer emissions than a similar building in a region with a predominantly coal-fired generation mix. Therefore, a **ZEROCO$_2$ building** would need a smaller PV system in areas with a large hydro or nuclear contribution compared to a similar building supplied by a utility with a large coal-fired generation contribution.
- Another point is that the electricity generation mix could change over time in an area as gradually more RES plants are replacing old coal-firing plants.

CERTIFICATION OF ZEROCO$_2$ BUILDINGS - IS IT FEASIBLE ?

- The concept of ZEROCO$_2$ buildings has not been taken into account in the existing two EU directives regarding sustainable energy buildings. However these buildings have neutral impacts on the climate change and they utilize only benign energy sources which are locally available. Therefore they deserve a high rating among sustainable energy buildings.

CERTIFICATION OF ZEROCO$_2$ BUILDINGS - IS IT FEASIBLE ?

- A **ZEROCO$_2$ building** can be certified according to the existing rating procedure compared with a notional building. If the building is categorized as equal or higher than B it will remain so. If though its categorization is less than B then it should get a B rating. It should be agreed and accepted that since a **ZEROCO$_2$ building** does not consume fossil fuels neither it emits greenhouse gases its achieves some (but not necessarily all) of the EU requirements regarding sustainable buildings and its rating should not be less than B.

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THANK YOU FOR YOUR KIND ATTENTION!!!

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