DECEMBER 15, 2021 | 6TH AIEE ENERGY SYMPOSIUM - CURRENT AND FUTURE CHALLENGES TO ENERGY SECURITY

Energy efficiency as a key factor for the sustainability pathway of organizations. The case of the European Space Agency ESA-ESRIN in Rome

Francesco Castellani (presenter), Maria Carmen Falvo, Federico Santi, Maurizio Della Fornace

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EU achieves 20-20-20 climate targets

Next step: 55% emissions cut by 2030

European Environment Agency

20-20-20 goals:

- **20% emission reduction** of greenhouse gases compared to 1990 levels;
- **20% reduction of the primary energy consumption** compared to the 2020 levels originally forecasted in 2007 (so called business as usual scenario, BAU);
- **20% increment in the use of renewable energy** for the coverage of EU energy demands.


NEWS

EU achieves 20-20-20 climate targets, 55 % emissions cut by 2030 reachable with more efforts and policies

The European Union (EU) achieved its three main climate and energy targets by 2020, according to a new European Environment Agency (EEA) assessment, published today. The 2030 target of a 55 % reduction in net greenhouse gas emissions can be reached if additional efforts are made and new policies are adopted and implemented.

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Source: EEA (European Environment Agency), Trends and projections in Europe 2021

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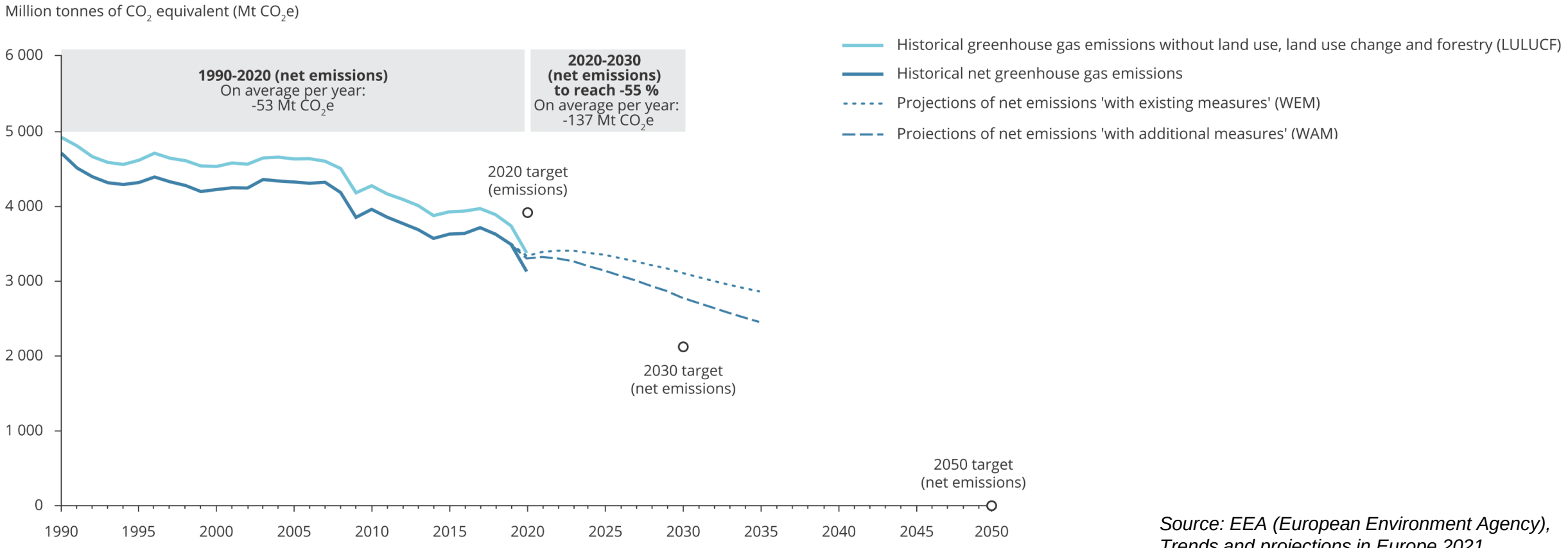
EU achieves 20-20-20 climate targets

Goal #1: Greenhouse gas emissions 1990-2020: Target 20%, Achieved 34%

Figure ES.1 Historical trends and projections of greenhouse gas emissions



Source: EEA (European Environment Agency), Trends and projections in Europe 2021

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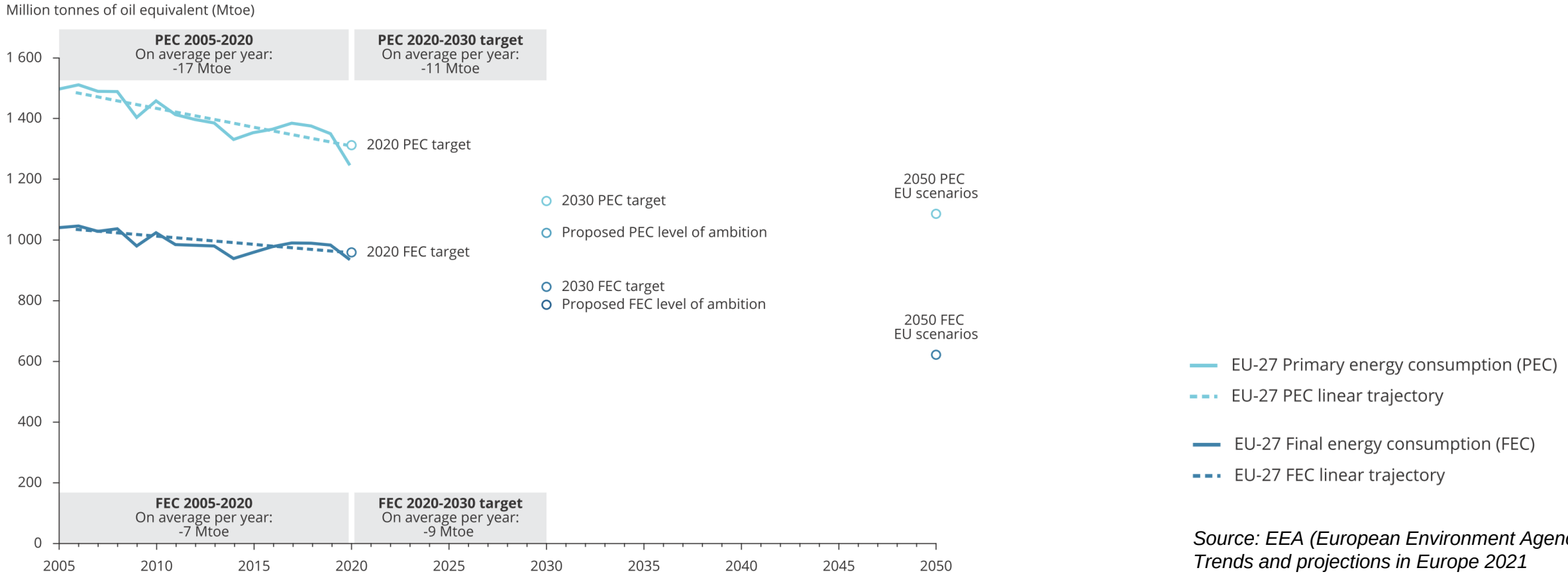
EU achieves 20-20-20 climate targets

Goal #2: Primary Energy Consumption reduction: target achieved only thanks to COVID-19…

Figure ES.3 Historical trends and outlooks on energy consumption



Source: EEA (European Environment Agency), Trends and projections in Europe 2021

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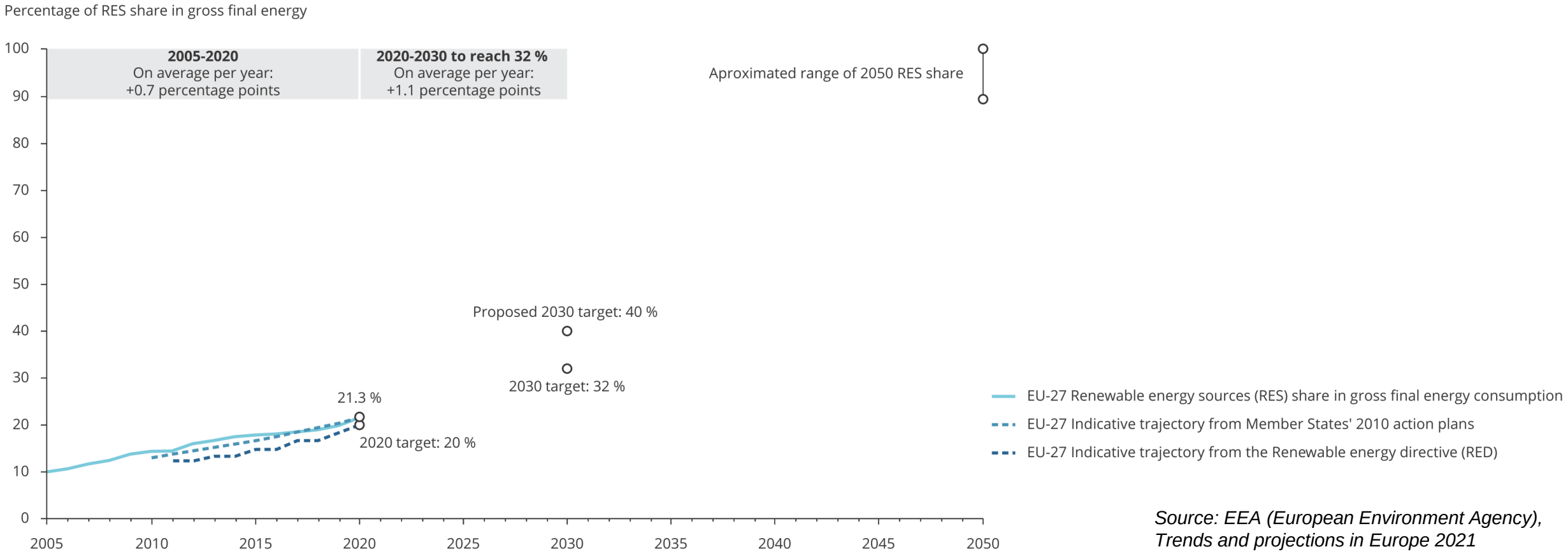
EU achieves 20-20-20 climate targets

Goal #3: Renewable Energy Sources share: Target 20%, Achieved 21,3%

Figure ES.2 Historical trends and outlook on renewable energy shares



Source: EEA (European Environment Agency), Trends and projections in Europe 2021

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The European policies towards the 20-20-20 goals

The pathway behind the achievement of these targets

- **The Kyoto Protocol (3rd UNFCCC Conference of Parties, Kyoto 1997):** after this agreement, the whole EU has been engaged in 8% greenhouse gases (GHG) emission reduction compared to 1990 levels (European Council Decision 2002/358/EC) in the period between 2008-2012.

- **The Copenhagen Summit (UNFCCC COP15, Copenhagen 2009)**: post-Kyoto phase. It was not possible to approve unanimously a binding commitment, despite the common aim of the participating states.

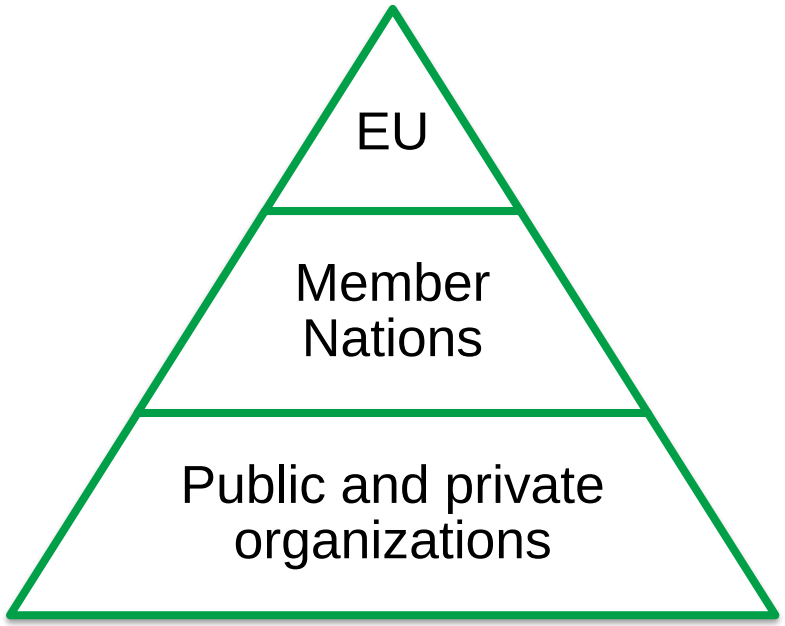
- **The Doha Amendment (UNFCCC COP18, Doha 2012)** represented the Kyoto Protocol extension up to 2020, including additional efforts of emission reduction. The minimum number of signatory countries, indeed, has not been reached.

EU took its own way to the 2020:

- **The 2020 Climate & Energy Package**, i.e. the legislative measures aimed at the implementation of the commitments made by the EU, approved by the European Parliament in December 2008. The policy is contained in the **European Directive 2009/29/CE**, it came into effect in June 2009 for the period between 2013 and 2020.

From EU to nations and to organizations

EU goals can be achieved only if member nations do their part, thanks to both private and public organizations



For Italy, the 20-20-20 Strategy were represented by the following targets:

- **13% of emission reduction in 2020 compared to the 2005 baseline** (Commission Decision 2013/162/EU and Decision 2013/634/EU);
- **24% of primary energy consumption reduction compared to the 2007 scenario** (European Directive 2012/27/EU, Article 7);
- **Renewable energy: increment up to 17% on the gross final energy consumption**. The national commitment, in turn, have been allocated among region and autonomous provinces, following the mechanism of “Burden Sharing” (Ministry of Development Decree, March 15, 2012).

Public and private organizations had to follow specific governative rules to participate to this process (energy efficiency in buildings, car fleet renewal, etc.) but they could also benefit from the incentives provided by the government (RES, etc.).

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Energy efficiency is a key factor for the sustainability pathway of organizations

Many UN Sustainable Development Goals are directly or indirectly related to energy efficiency

The sustainability path of organizations have to comprehend energy efficiency.

The 20-20-20 EU goals for:

- lower GHG emissions
- lower primary energy consumption
- higher RES share

are not only mandatory actions that come from governative rules, but they are also part of the voluntary choice of organizations to achieve many UN Sustainable Development Goals.

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The case of the European Space Agency ESA-ESRIN in Rome

The pathway of the italian ESA facility to its own reach of the 20-20-20 EU goals

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ESA ESRIN overview

The italian facility is the European centre of excellence for exploitation of Earth observation missions

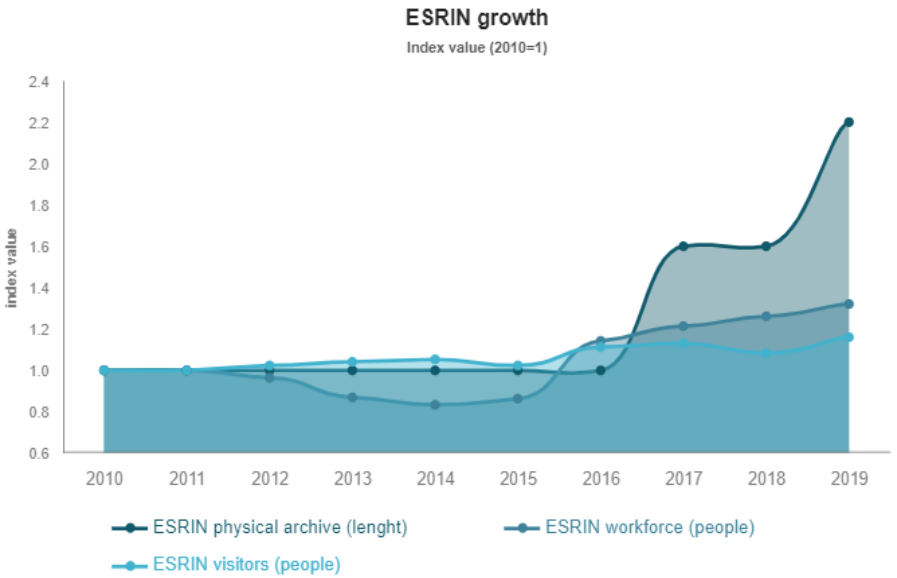
Located in Frascati, Rome (Italy).

- 20 buildings (35,000 sqm)
- 1,000 employees
- 2 main datacenters

ESRIN is the acronym of **European Space Research Institute**. The mission and payload operations of ESA's Earth observation satellites are managed here, and ESRIN is the primary source for the acquisition, distribution, and exploitation of data from these and other non-ESA satellites.

ESA ESRIN main activities and growth

Offices, data centre, conference hall and physical archive are the most important activities, and they are growing



The activities of the site are **constantly growing**.

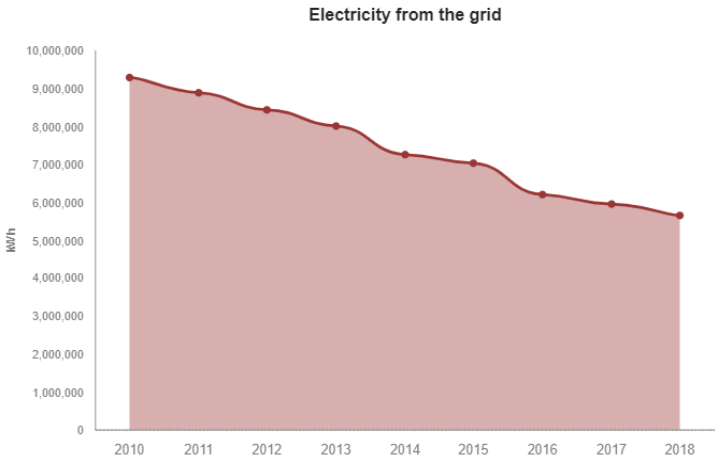
From 2010 to 2019:

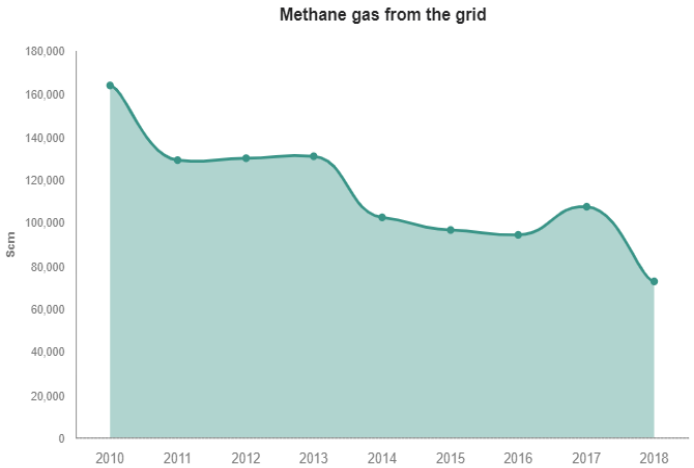
- Physical archive (length of the archives)
- Workforce (number of employees)
- Conferences (number of visitors)

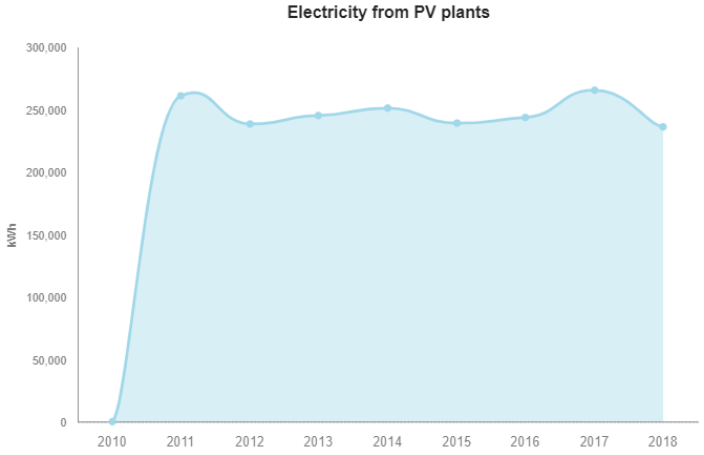
increased.

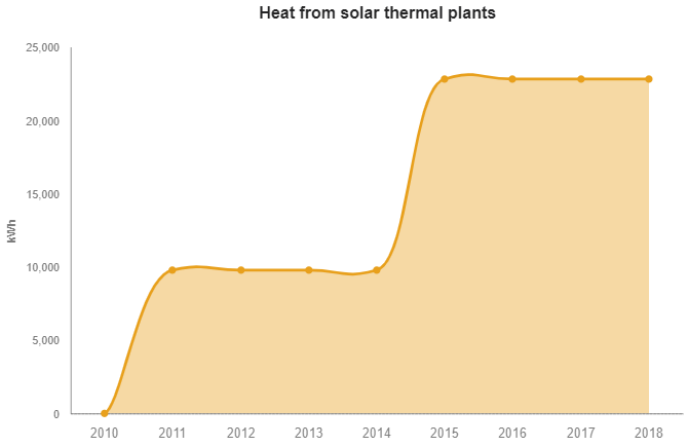
ESA ESRIN energy consumption

The energy vectors are electricity and natural gas from the grid, electricity and heat from solar plants









Despite the growth of the activities, thanks to:

- energy efficiency interventions
- increasing of RES (PV and solar plants)

from 2010 to 2018 **the energy withdrawn from the grid decreased significantly**.

Energy efficiency interventions and renewable energy sources

From 2010 to 2019 ESA ESRIN has been renovated step by step, following the sustainability roadmap

2010

185 kWp photovoltaic plant

30 kW solar plant

2011

Freecooling for datacenter

Thermal cut windows in B01, B02, B03, B04, B05

Heat management optimization

2012

Installation of motion detectors for bathrooms

Timing of HVAC in the offices, OFF during the nights and the weekends

Energy efficiency interventions and renewable energy sources

From 2010 to 2019 ESA ESRIN has been renovated step by step, following the sustainability roadmap

2013

New high efficiency chiller in B01

Full LED lighting for corridors in B01, B02, B03, B05, B09, B11, B14

Full high efficiency pumps in B05

2014

Full high efficiency pumps in B01, B02, B09

Solar thermal plant for the canteen

New UPS in B08

New condensing boilers for heating centers in B08, B20

ISO 50001 Energy management certification

2015

Full high efficiency pumps in B09

New high efficiency UPS in B10

New dishwashing machine with heat pump

New CRAC in B11

Smart metering for datacenters

Energy efficiency interventions and renewable energy sources

From 2010 to 2019 ESA ESRIN has been renovated step by step, following the sustainability roadmap

2016

New condensing boilers for heating centers in B16, B10

New chiller in B08 with heat recovery

2017

High efficiency pumps in B14

New chiller in B10 with heat recovery

Full LED external lighting

New CRAC in B04

Smart irrigation system

2018

New chiller in B16

4 more degrees in hot and cold isles in datacenters

ESA ESRIN energy efficiency interventions and renewable energy sources

From 2010 to 2019 the facility has been renovated step by step, following the sustainability roadmap

The process is still going on…

2019

New rooftop for the Sport Center

New thermal solar plant

High efficiency HVAC for B01

Transition to ISO 50001:2018 from ISO 50001:2011

Over the whole reference period 2010-2019:

New inverter and brushless AHU

DALI LED lighting in the datacenter B04, B11, B12, B05, B20

20% rack reduction due to virtualization

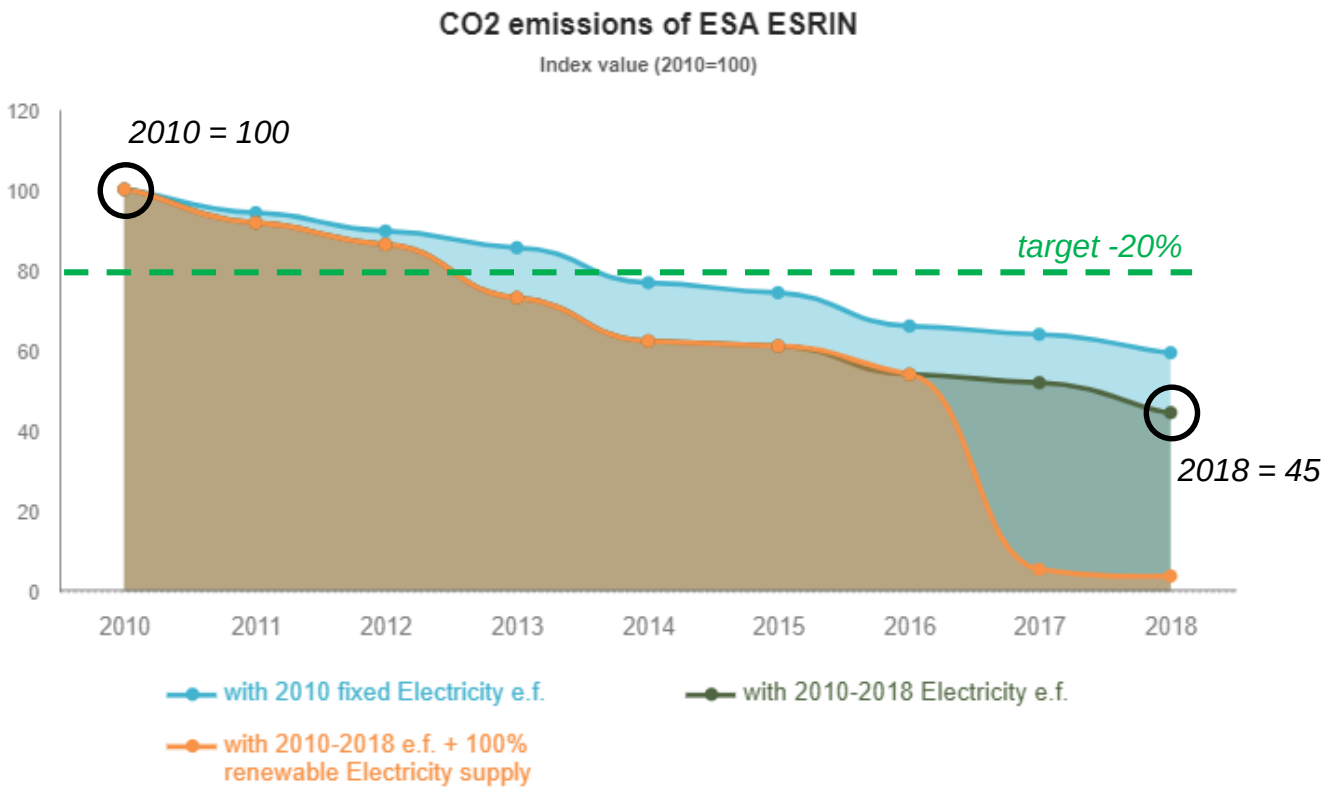
Improved IT equipment

Improved behavior of the workers

Improved operation time on the buildings

EU 20-20-20 goal #1: 20% reduction of GHG emission

ESA ESRIN achieved a 55% reduction compared to the 2010 data



Note: ESA ESRIN buys, from the Italian market, "Green Electricity" from the grid with a Guarantee of Origin Certificate. For the purpose of this calculation, this is not considered (orange value).

Considering:

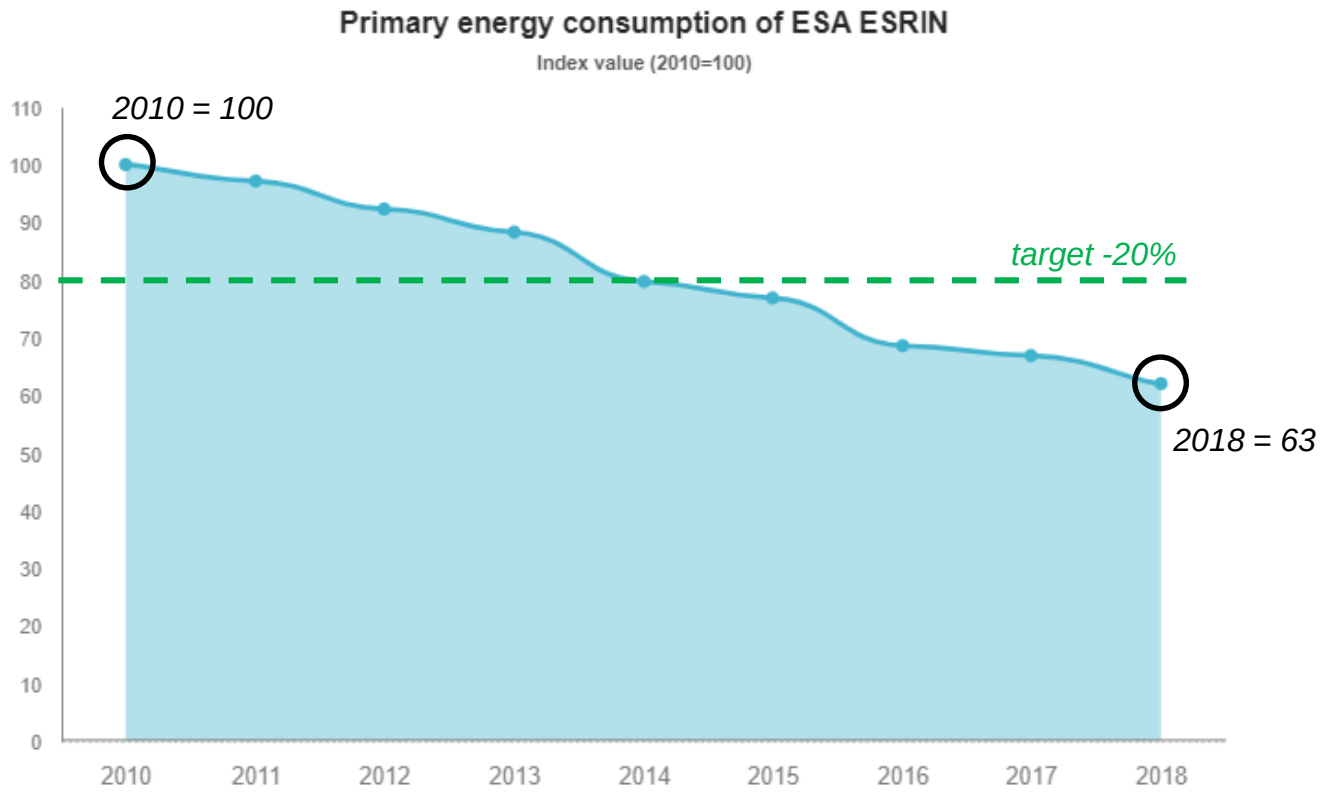
- energy efficiency and renewable energy sources in the facility during the years;
- the reduction of the gCO_2/kWh of the Italian electricity grid during the years (due to the increasing of RES);

ESA ESRIN achieved a **55% reduction** of GHG emission compared to the 2010 level.

The calculation methodology is very different from the original 20-20-20 goals calculation because it regards a facility and not a nation or an entire continent. One of these differences is on the baseline year: in the original goal it is 1990, for ESA ESRIN it is 2010.

EU 20-20-20 goal #2: 20% reduction of primary energy consumption

ESA ESRIN achieved a 37% reduction compared to the 2010 data



Note: for this calculations, the primary energy of electricity from PV plants is considered the same of electricity from the grid: RES do not influence the achievement of this goal.

Considering:

- energy efficiency interventions in the facility during the years;

ESA ESRIN achieved a **37% reduction** of the primary energy consumptions compared to the 2010 level.

The calculation methodology is very different from the original 20-20-20 goals calculation because it regards a facility and not a nation or an entire continent. One of these differences is on the refence value: in the original goal it was the 2020 value forecasted with the 2007 BAU, for ESA ESRIN is the 2010 real value, not considering the increasing of the activities during the years.

Electricity (from PV and grid)	*0,187 x 10^{-3} toe/kWh*
Natural gas	*0,807 x 10-3 toe/Scm*

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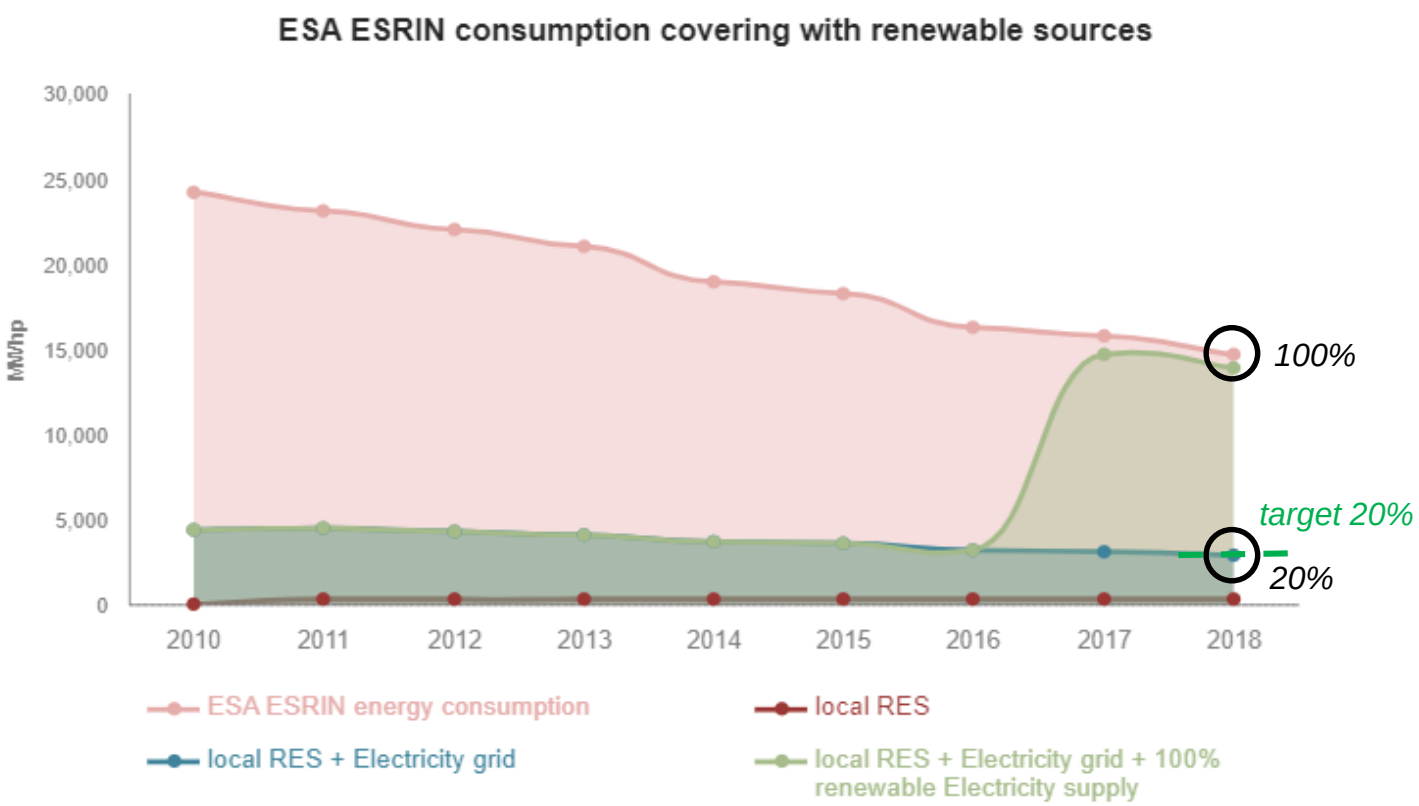
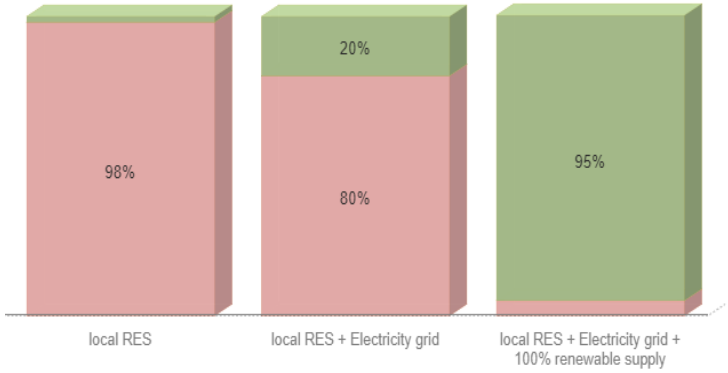
EU 20-20-20 goal #3: 20% share of renewable energy sources

ESA ESRIN achieved in 2018 a 20% coverage of the total energy consumption with RES



Note: ESA ESRIN buys, from the Italian market, "Green Electricity" from the grid with a Guarantee of Origin Certificate. For the purpose of this calculation, this is not considered.



Considering:

- local renewable energy sources (PV and thermal solar plants);
- the share of RES in the Italian electricity mix;

ESA ESRIN achieved a **20% coverage** of the total energy consumption with RES.

The calculation methodology is very different from the original 20-20-20 goals calculation because it regards a facility and not a nation or an entire continent.

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Conclusions

- **EU achieved the 20-20-20 goals of the 2020 Climate and Energy Package:**
  - 20% emission reduction of greenhouse gases compared to 1990 levels;
  - 20% increment in the use of renewable energy for the coverage of EU energy demands;
  - 20% reduction of the primary energy consumption compared to the 2020 levels originally forecasted in 2007.

- This EU achievement was possibile thanks to **the commitment of each nation and its public and private organizations**, led to this achivement by mandatory rules, incentives but also by **voluntary sustainability pathway** of which **energy efficiency is one of the most important component.**

- **The case study of ESA ESRIN**, the European Space Agency facility in Rome, **shows how an organization can plan a sustainability pathway, follow it and then achieve the 20-20-20 goals «within its walls», helping to achieve the general target.** ESA ESRIN achieved the 20-20-20 goals (specifically adapted for a single organization) in this way:

55%
reduction of GHG emissions

37%
reduction of primary energy consumption

20%
coverage of the total energy consumption with RES

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