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POLICY RESPONSES TO CLIMATE CHANGE:
SUSTAINABLE DEVELOPMENT AND ENERGY TRANSITION
Supporting Ethiopia in implementing and monitoring INDCs

1 - Introduction to Climate Change issues

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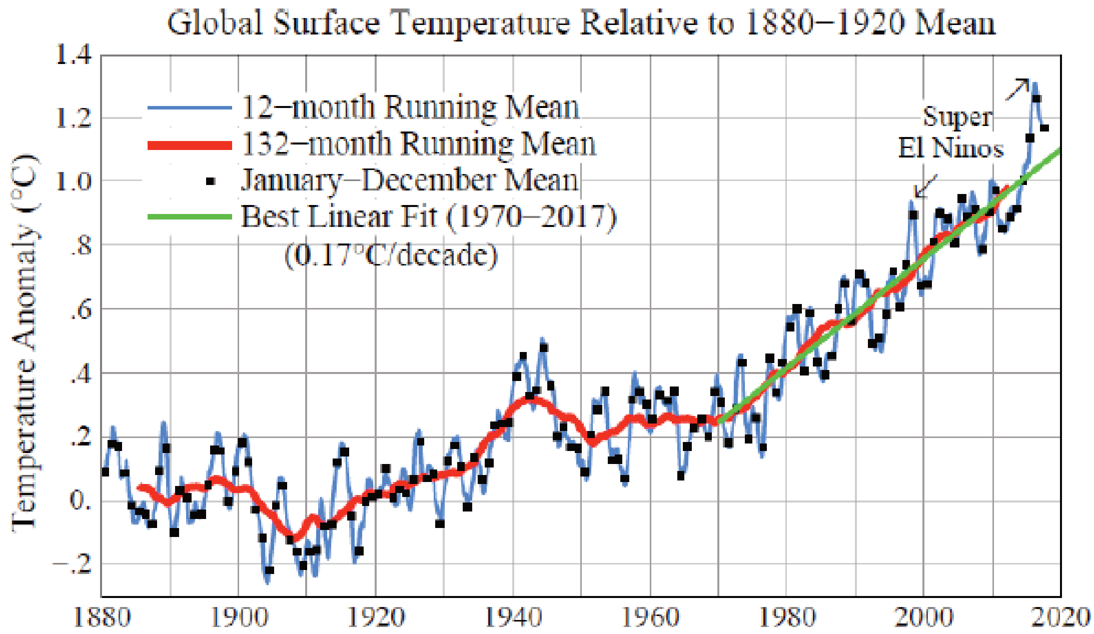
1 - Introduction to Climate Change issues

Outline

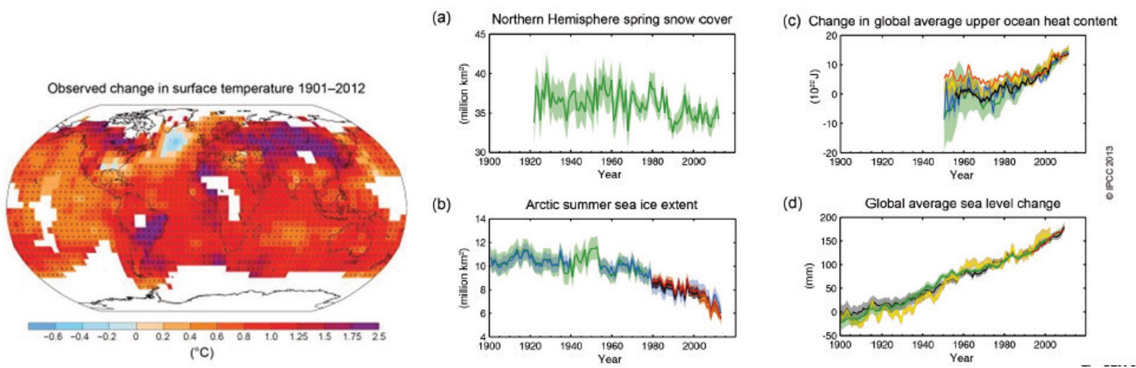
- Introduction to the science basis of climate change
- Phenomenology of the greenhouse effect
- Impacts of climate change
- Climate models and climate projections.
- Mitigation of climate change: definition and main strategies
- Adaptation to climate change: definition and main strategies
- The UN Framework Convention on climate change and the Paris Agreement
- Challenges and opportunities



Source: Hansen et al., 2018, Global Temperature in 2017

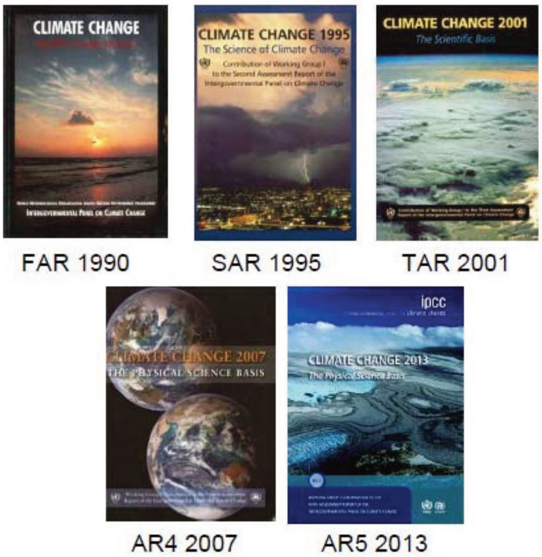
Warming of the climate system is unequivocal

- Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.
- Since the 1950s, many of the observed changes are unprecedented over decades to millennia.
- The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased.



IPCC - Intergovernmental Panel on Climate Change
www.ipcc.ch

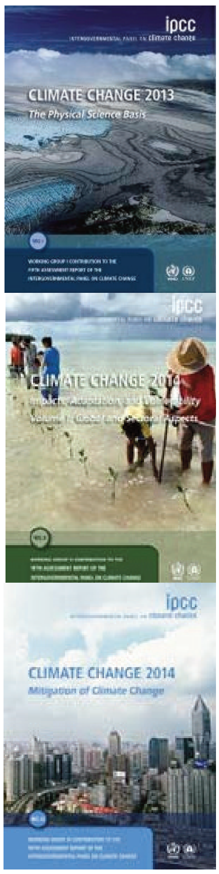
Assessment reports



Special reports

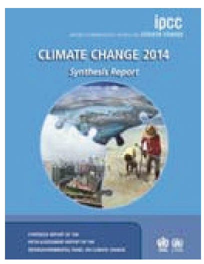
Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)

IPCC - Fifth Assessment Report (AR5)



- ***WG1: Climate Change 2013: The Physical Science Basis*** (*September 2013*)
- **WG2: Impacts, adaptation and vulnerability)** (*March 2014)*
- **WG3:Mitigation of climate change** (*April 2014*)

Every reports has a *Summary for Policymakers (SPM)* and a *Technical Summary (TS)*



- **Synthesis report** (*November 2014*)

All the report (test, figures, annexes) can be downloaded from the IPCC website: **www.ipcc.ch**

How the work of the IPCC is organized

- Thousands of **scientists** all over the world contribute to the work of the IPCC on a voluntary basis as authors, contributors and reviewers. None of them is paid by the IPCC. Their work is supported by a central **IPCC Secretariat**, whose role is to plan, coordinate and oversee all IPCC activities and by the Technical Support Units of the Working Groups and Task Force. The Secretariat and the TSUs employ 5-10 people each.
- The IPCC is currently organized in **3 Working Groups. Working Group I** deals with "The Physical Science Basis of Climate Change", **Working Group II** with "Climate Change Impacts, Adaptation and Vulnerability" and **Working Group III** with "Mitigation of Climate Change". They are assisted by a Technical Support Unit, which is hosted and financially supported by the government of the country who offered to do so.
- The IPCC has also a **Task Force on National Greenhouse Gas Inventories**. The main objective of the Task Force is to develop and refine a methodology for the calculation and reporting of national GHG emissions and removals.

Example from AR5-WG1 - SPM

In the Northern Hemisphere, 1983–2012 was likely the warmest 30-year period of the last 1400 years (medium confidence).

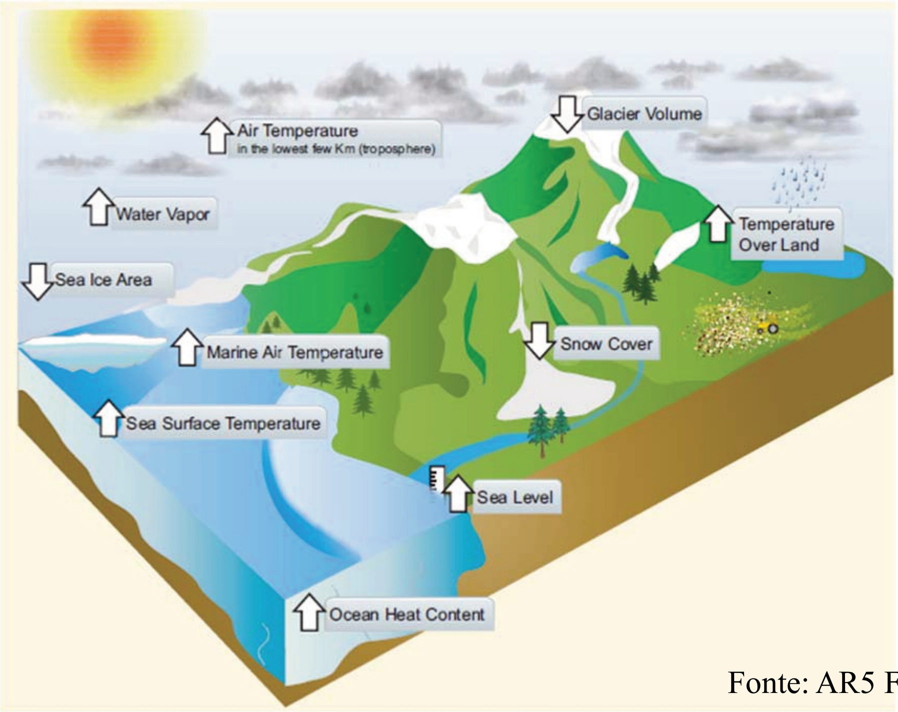
…

Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90% of the energy accumulated between 1971 and 2010 (high confidence). It is virtually certain that the upper ocean (0– 700 m) warmed from 1971 to 2010 (see Figure SPM.3), and it likely warmed between the 1870s and 1971. {3.2, Box 3.1}

…

Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent (high confidence) (see Figure SPM.3). {4.2–4.7}

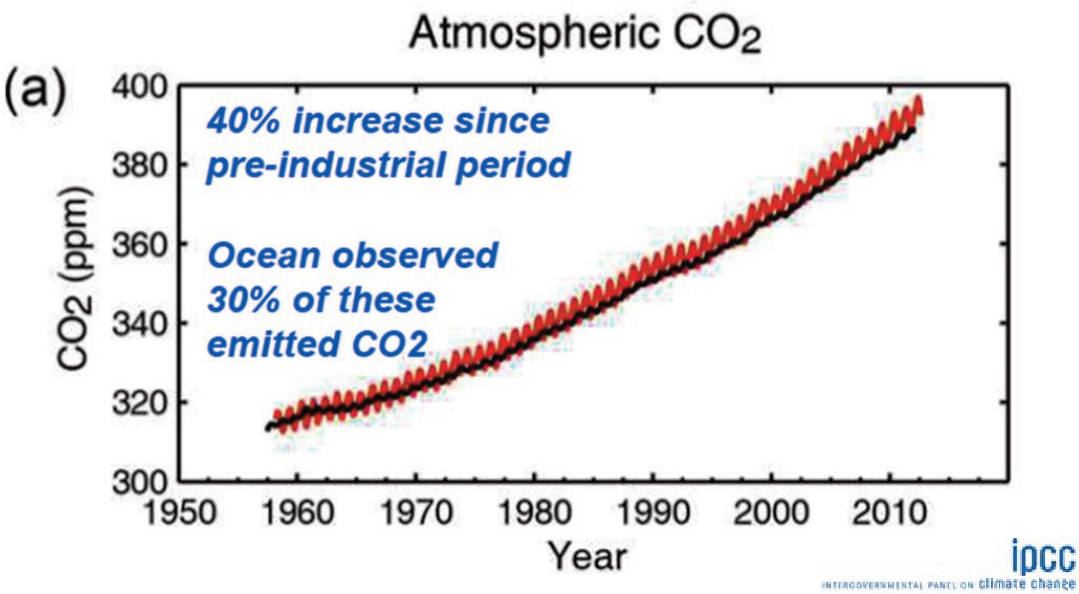
Independent analyses of many components of the climate system that would be expected to change in a warming world exhibit trends consistent with warming (arrow direction denotes the sign of the change)

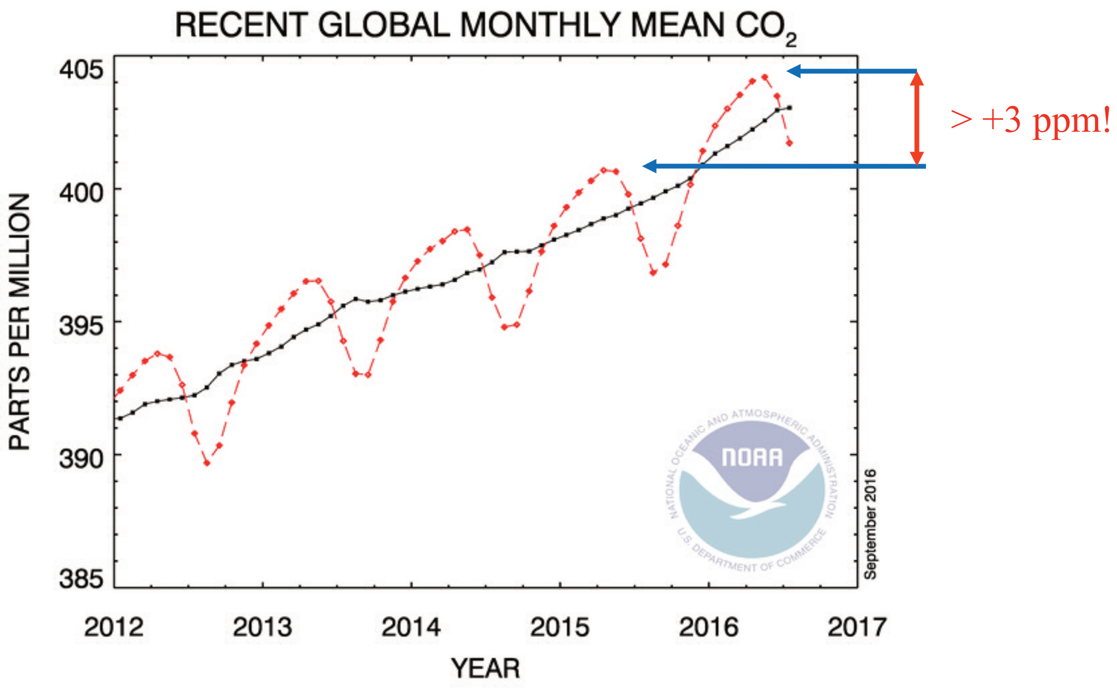


Fonte: AR5 FAQ 2.1, Figure 1

Understanding the causes

The atmospheric concentrations of CO_2, CH_4 and N_2O have increased to levels unprecedented in at least the last 800.000 years





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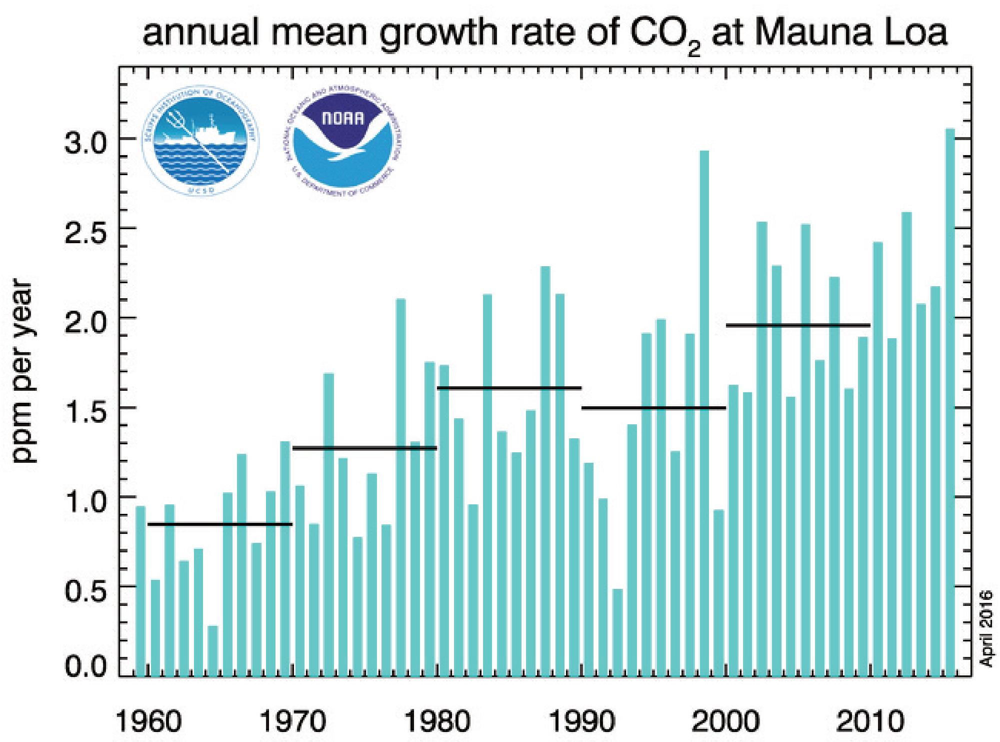
Source: NOAA, www.esrl.noaa.gov/gmd/ccgg/trends/



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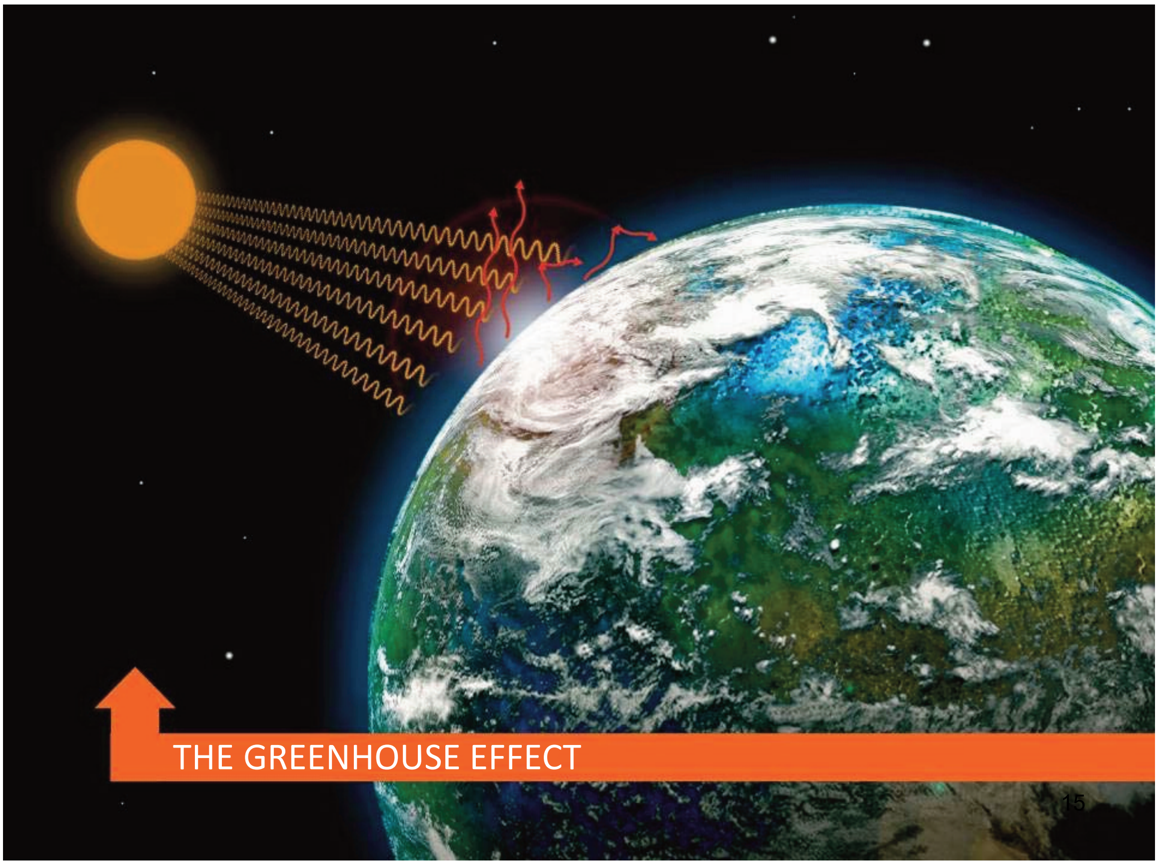
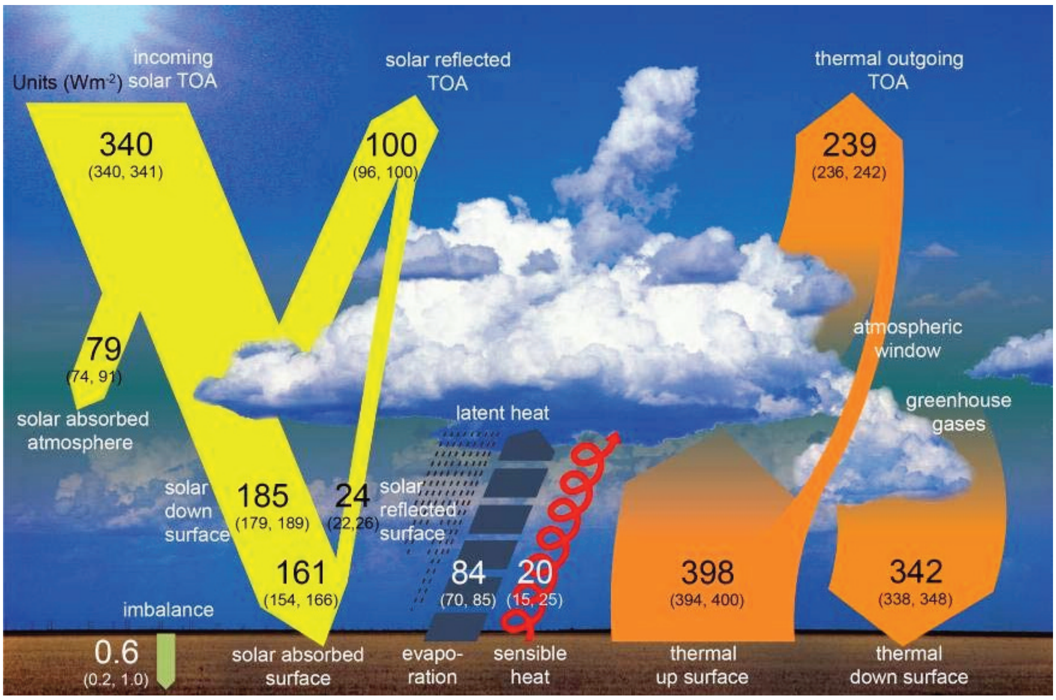
http://www.esrl.noaa.gov/gmd/ccgg/trends/gr.html

Main cause of CO_2 increase: combustion of fossil fuels

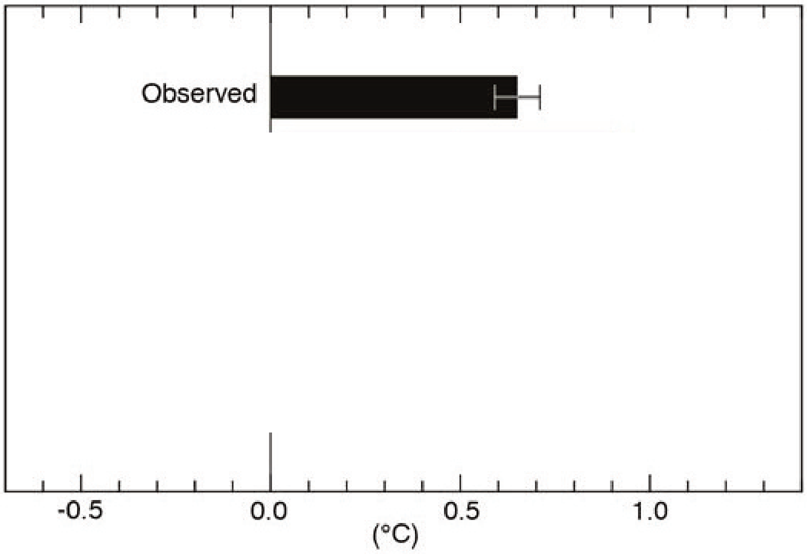
Another cause of CO_2 increase: deforestation and land use change



Global mean energy budget under present-day climate conditions
Fonte: IPCC, 2013. AR5-WG1-Fig.2.11



The observed warming 1951−2010 is approximately 0.6°C to 0.7°C.



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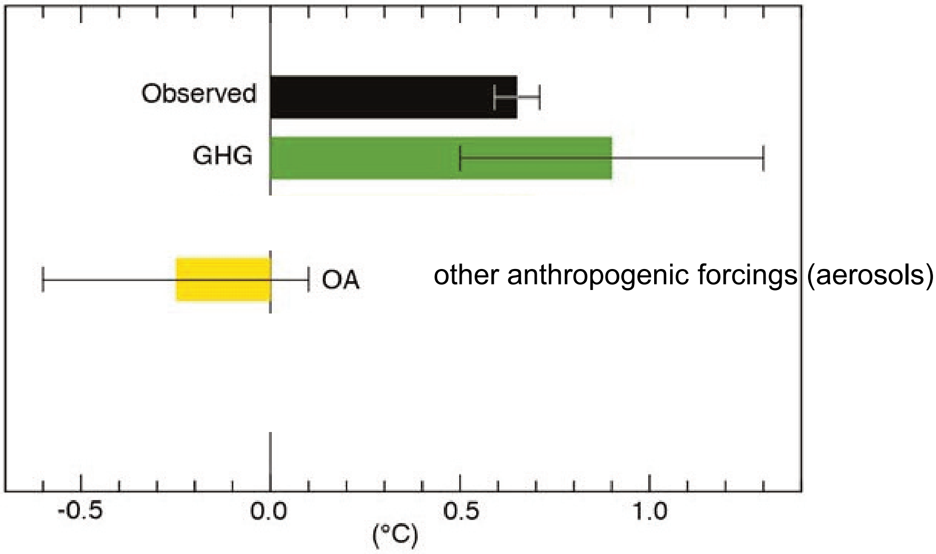
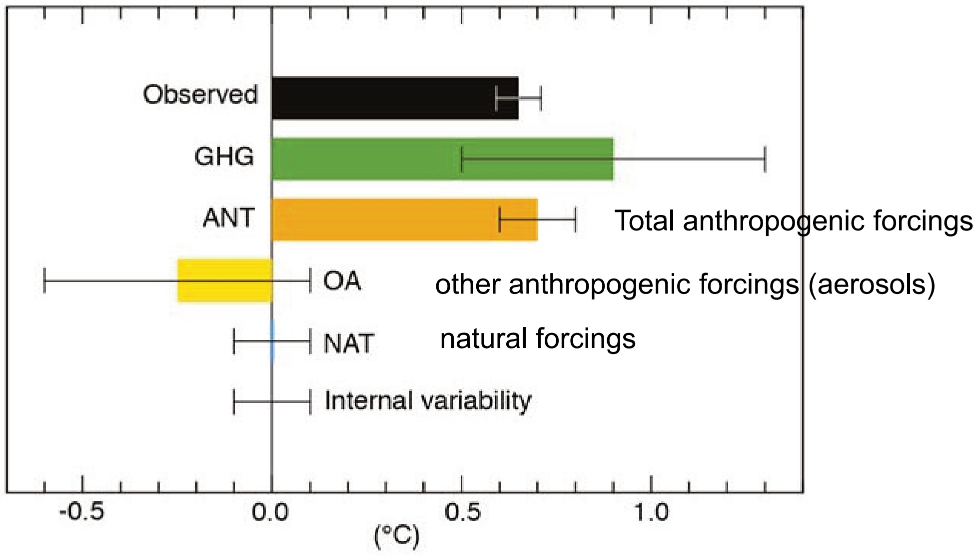


It is *extremely likely* that *human influence* has been the dominant cause of observed warming since the mid-20th century

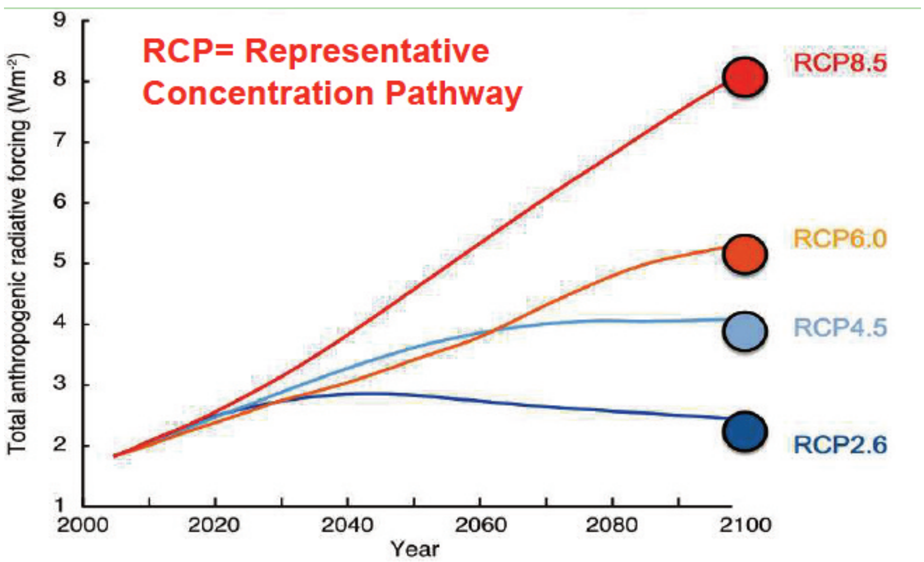
The observed warming 1951–2010 is approximately 0.6°C to 0.7°C.



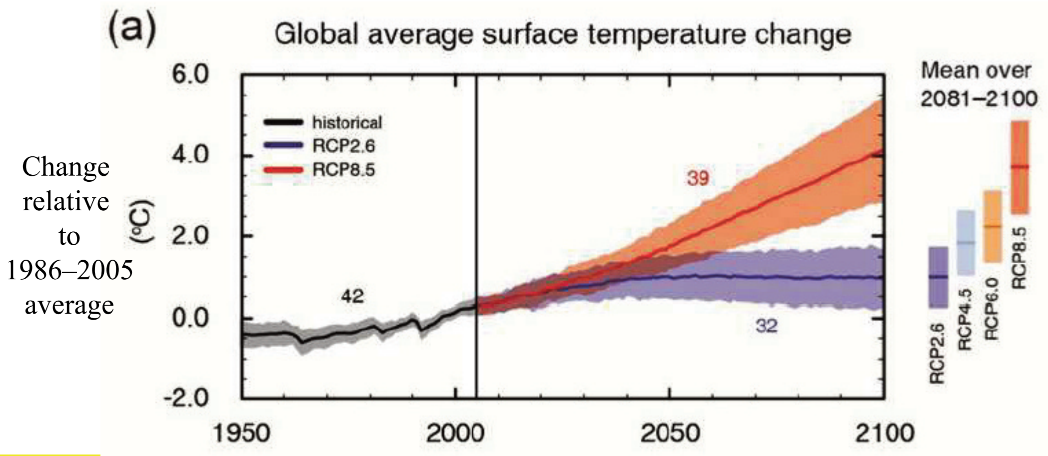
Human influence on the climate system is clear

Future Climate Projections

For future climate projections, climate models requires **Emission Scenarios**. Models in AR5 use ***Representative Concentration Pathway (RCP)***



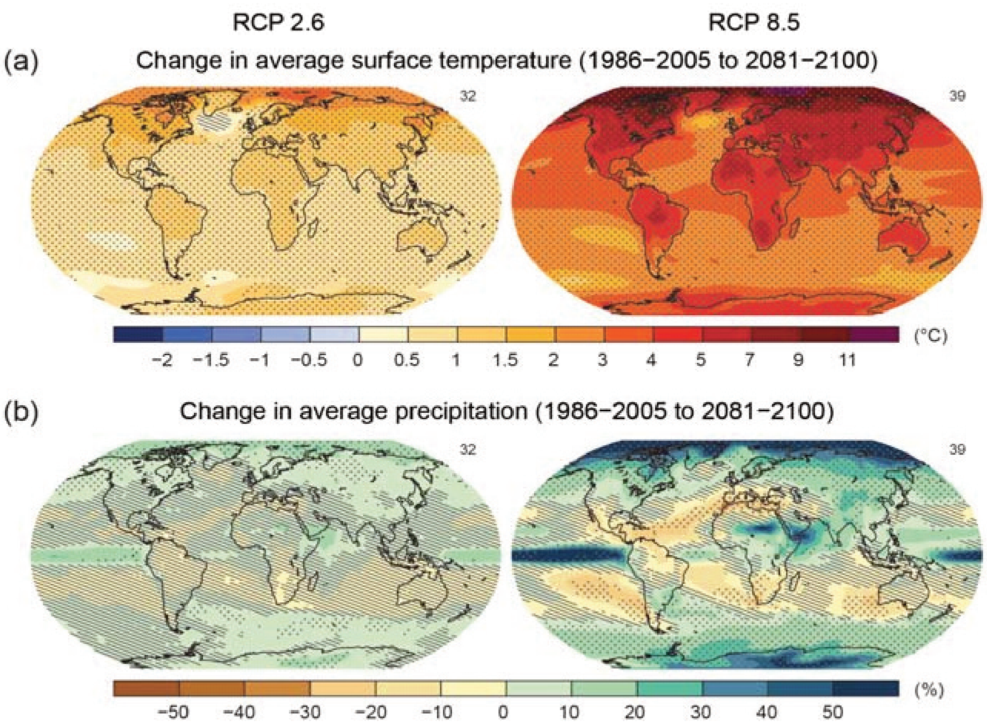
Projected Global Average Temperature Change
by end of 21st Century



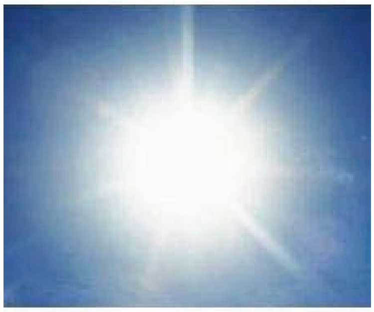
The temperature increase during the last 100 years: about **1°C**.

Global surface temperature change for the end of the 21st century
is *likely to exceed* 1.5°C relative to 1850−1900
for all scenarios except RCP2.6.

Maps of CMIP5 multi-model mean results



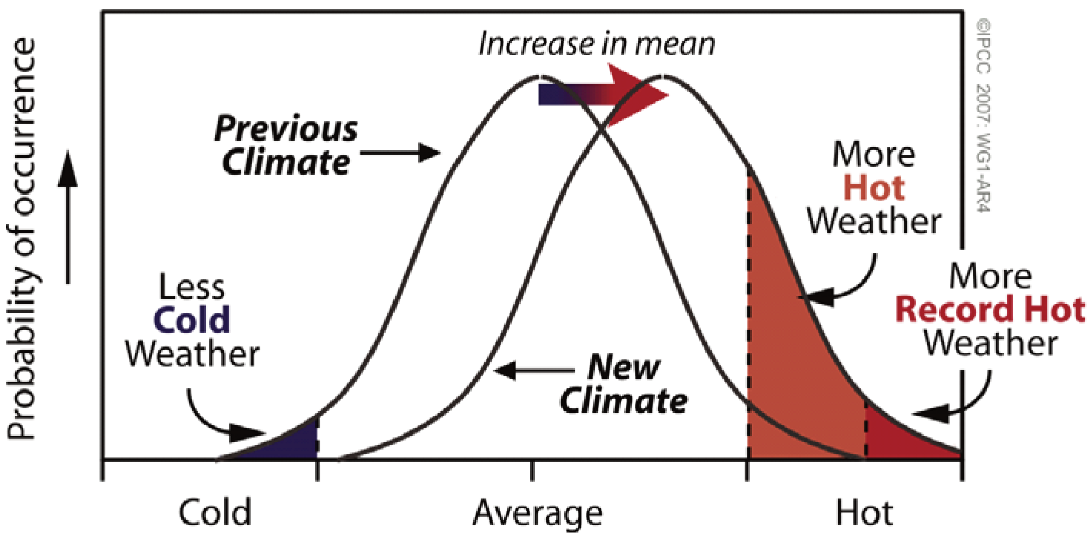
Source: IPCC AR5-WG1, Figure SPM.8a,b



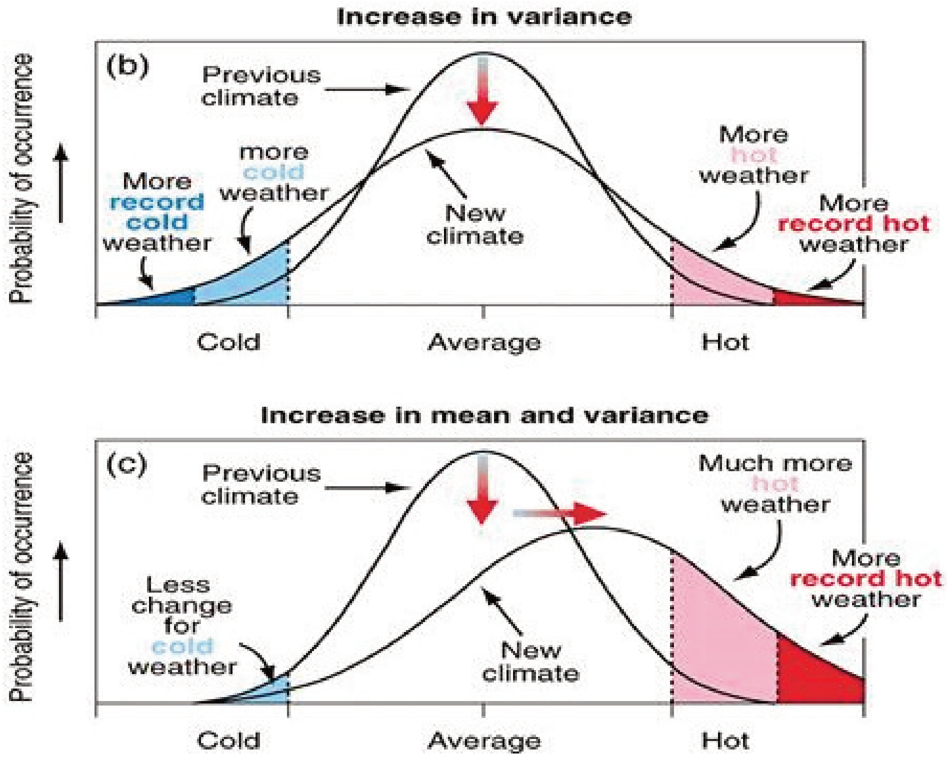
Heat wave

A heatwave is an extended period of hot weather relative to the expected conditions of the area at that time of year. Is often accompanied by high humidity.

Meteorological Organization definition:
"when the daily maximum temperature of more than five consecutive days exceeds the average maximum temperature by 5 °C, the normal period being 1961-1990".



The change of the mean implies a higher probability of occurrence of extreme values.



Source: AR3, WG1, Fig. 2.32

AR5 WG1 - Tabella SPM.1 *Extreme weather and climate events: Global-scale assessment of recent observed changes, human contribution to the changes, and projected further changes for the early (2016–2035) and late (2081–2100) 21st century. Bold indicates where the AR5 (black) provides a revised* global-scale assessment from the SREX (blue) or AR4 (red).*

Phenomenon and direction of trend	Assessment that changes occurred (typically since 1950 unless otherwise indicated)	Assessment of a human contribution to observed changes	Likelihood of further changes	
			Early 21st century	Late 21st century
Warmer and/or fewer cold days and nights over most land areas	*Very likely* [2.6] *Very likely* *Very likely*	***Very likely*** [10.6] *Likely* *Likely*	*Likely* [11.3]	*Virtually certain* [12.4] *Virtually certain* *Virtually certain*
Warmer and/or more frequent hot days and nights over most land areas	*Very likely* [2.6] *Very likely* *Very likely*	***Very likely*** [10.6] *Likely* *Likely* (nights only)	*Likely* [11.3]	*Virtually certain* [12.4] *Virtually certain* *Virtually certain*
Warm spells/heat waves. Frequency and/or duration increases over most land areas	***Medium confidence*** on a global scale *Likely* in large parts of Europe, Asia and Australia [2.6] *Medium confidence* in many (but not all) regions *Likely*	***Likely***[a] [10.6] Not formally assessed *More likely than not*	Not formally assessed[b] [11.3]	*Very likely* [12.4] *Very likely* *Very likely*
Heavy precipitation events. Increase in the frequency, intensity, and/or amount of heavy precipitation	*Likely* more land areas with increases than decreases[c] [2.6] *Likely* more land areas with increases than decreases *Likely* over most land areas	***Medium confidence*** [7.6, 10.6] *Medium confidence* *More likely than not*	*Likely* over many land areas [11.3]	***Very likely*** over most of the mid-latitude land masses and over wet tropical regions [12.4] *Likely* over many areas *Very likely* over most land areas
Increases in intensity and/or duration of drought	***Low confidence*** on a global scale *Likely* changes in some regions[d] [2.6] *Medium confidence* in some regions *Likely* in many regions, since 1970[e]	***Low confidence*** [10.6] *Medium confidence*[f] *More likely than not*	*Low confidence*[g] [11.3]	***Likely*** *(medium confidence)* on a regional to global scale[h] [12.4] *Medium confidence* in some regions *Likely*[e]
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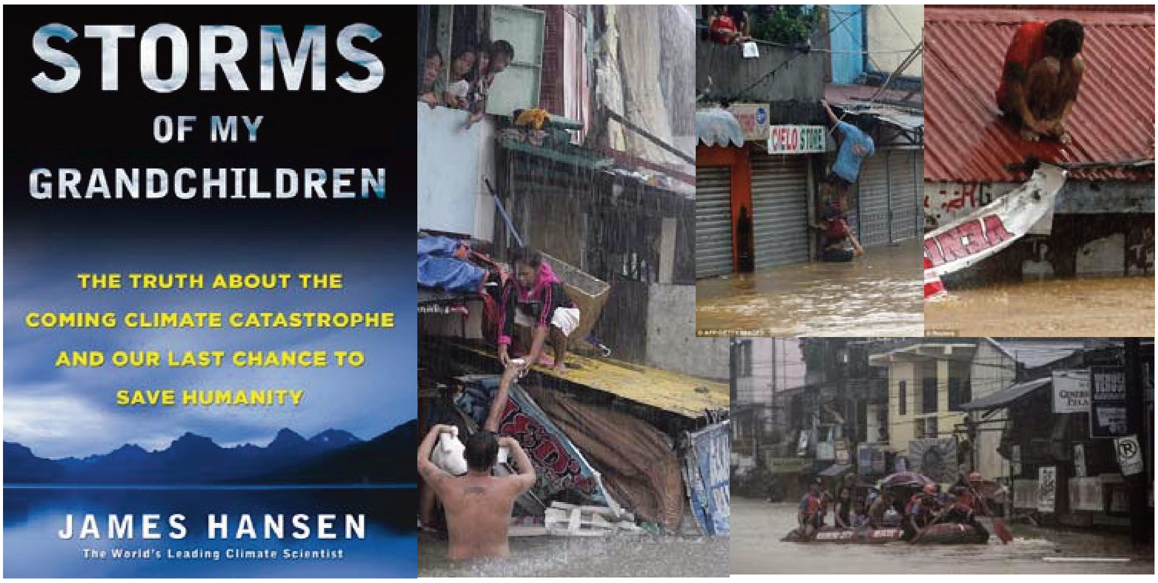
Increased incidence and/or magnitude of extreme high sea level	*Likely* (since 1970) [3.7] *Likely* (late 20th century) *Likely*	***Likely***[k] [3.7] *Likely*[k] *More likely than not*[k]	*Likely*[l] [13.7]	***Very likely***[l] [13.7] *Very likely*[m] *Likely*

* The direct comparison of assessment findings between reports is difficult. For some climate variables, different aspects have been assessed, and the revised guidance note on uncertainties has been used for the SREX and AR5. The availability of new information, improved scientific understanding, continued analyses of data and models, and specific differences in methodologies applied in the assessed studies, all contribute to revised assessment findings.

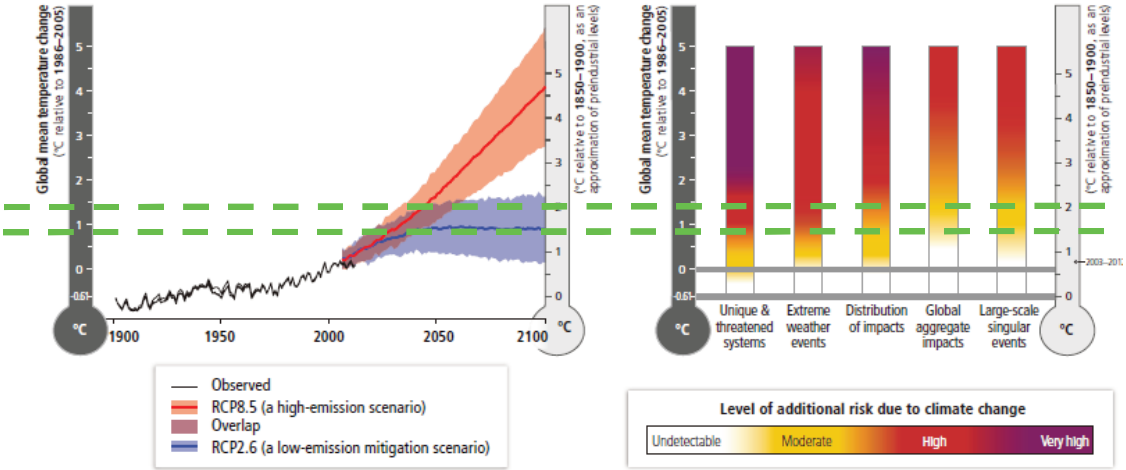


"Storms. That is the one word that will best characterize twenty- first century climate, as policy makers continue along their well- trodden path of much talk without a fundamental change of direction"

Source: © 2005 Getty Images/AFP/Sebastian D'Souza

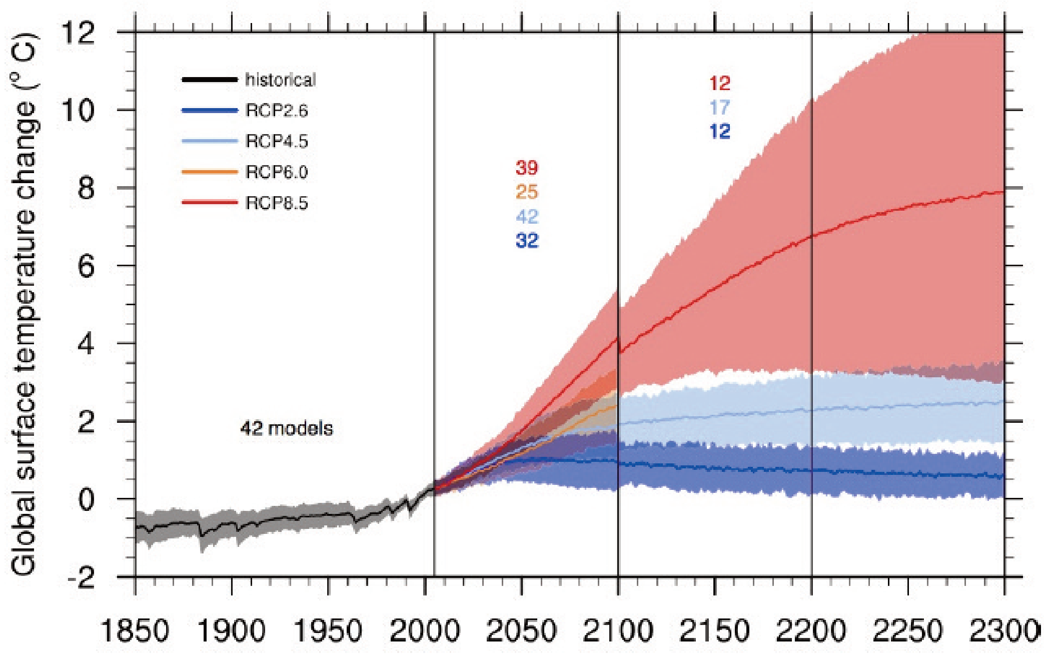
Many impacts projected for a global warming level of 2 °C or more relative to pre-industrial levels may exceed the coping capacities of particularly vulnerable countries. Therefore, many countries advocate limiting warming to below 1.5 °C.

Global perspective on climate-related risks. Risks associated with reasons for concern are shown at right for increasing levels of climate change



Fonte: IPCC-AR5 WG2, Box TS.5 Figure 1

Increase of global temperatures (compared to the average from 1986 to 2005) in CMIP5 models



Source: IPCC, 2013 – WG1

Impacts on Global South

AR5 WG1 - Table SPM.1 *Extreme weather and climate events: Global-scale assessment of recent observed changes, human contribution to the changes, and projected further changes for the early (2016–2035) and late (2081–2100) 21st century. Bold indicates where the AR5 (black) provides a revised* global-scale assessment from the SREX (blue) or AR4 (red). Projections for early 21st century were not provided in previous assessment reports. Projections in the AR5 are relative to the reference period of 1986–2005, and use the new Representative Concentration Pathway (RCP) scenarios (see Box SPM.1) unless otherwise specified. See the Glossary for definitions of extreme weather and climate events.*

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Phenomenon and direction of trend	Likelihood of further changes: Early 21st century	Likelihood of further changes: Late 21st century
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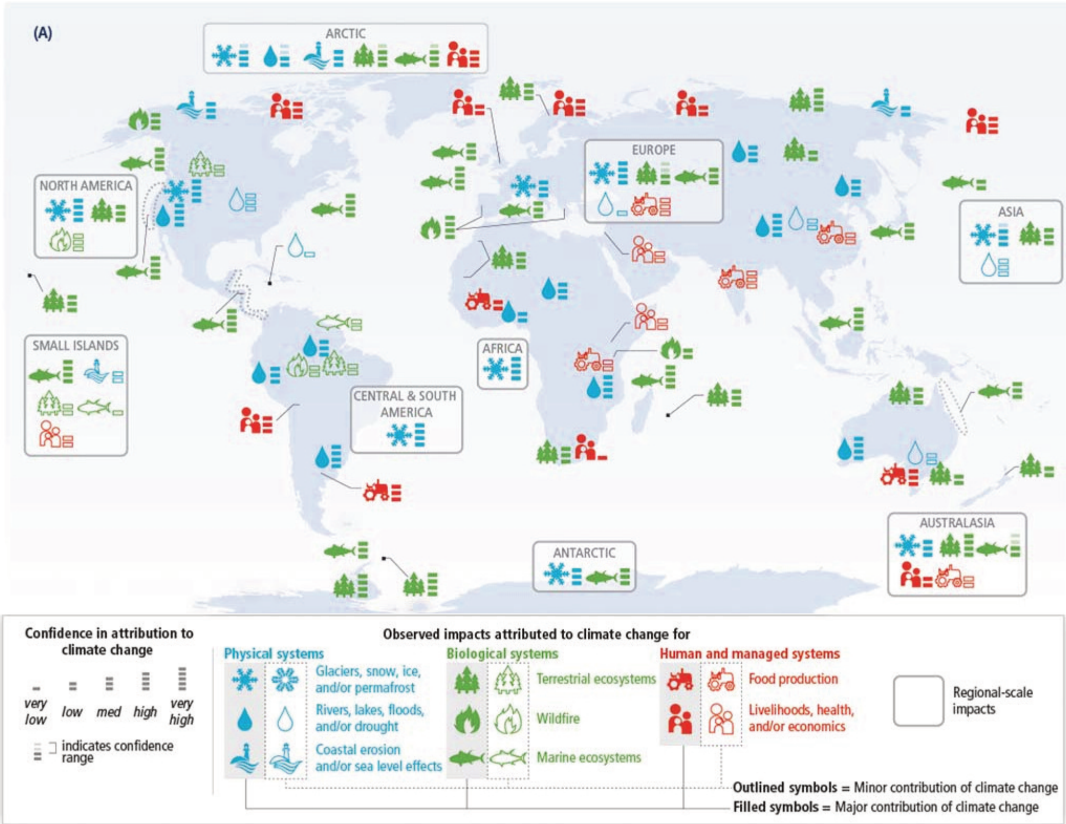
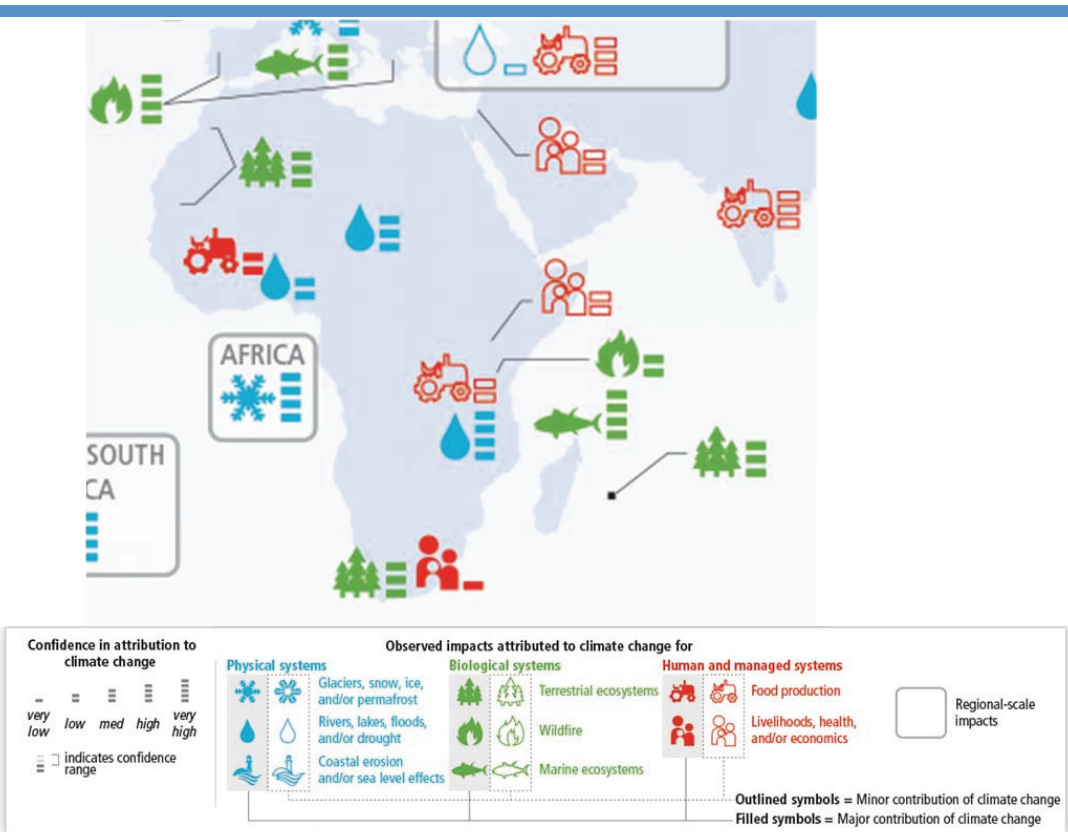

(A)
ARCTIC
NORTH AMERICA
EUROPE
ASIA
SMALL ISLANDS
AFRICA
CENTRAL & SOUTH AMERICA
ANTARCTIC
AUSTRALASIA
Confidence in attribution to climate change
very low
low
med
high
very high
indicates confidence range
Observed impacts attributed to climate change for
Physical systems
Glaciers, snow, ice, and/or permafrost
Rivers, lakes, floods, and/or drought
Coastal erosion and/or sea level effects
Biological systems
Terrestrial ecosystems
Wildfire
Marine ecosystems
Human and managed systems
Food production
Livelihoods, health, and/or economics
Regional-scale impacts
Outlined symbols = Minor contribution of climate change
Filled symbols = Major contribution of climate change


AFRICA
SOUTH
CA
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Outlined symbols = Minor contribution of climate change
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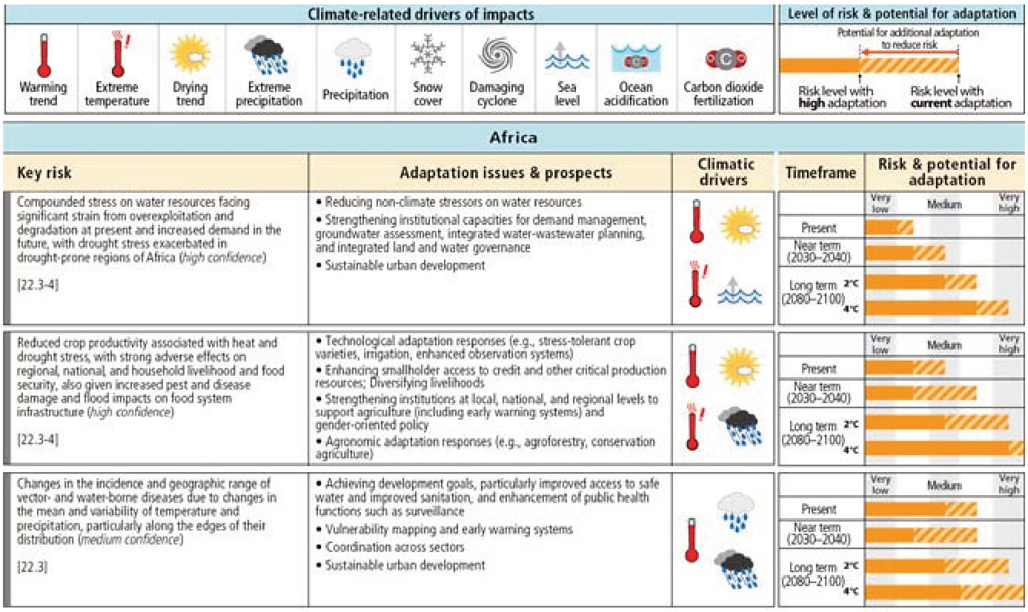
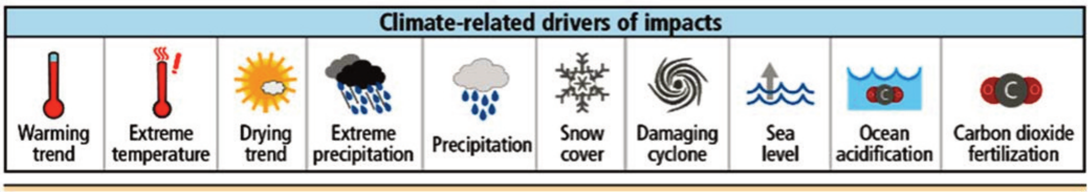
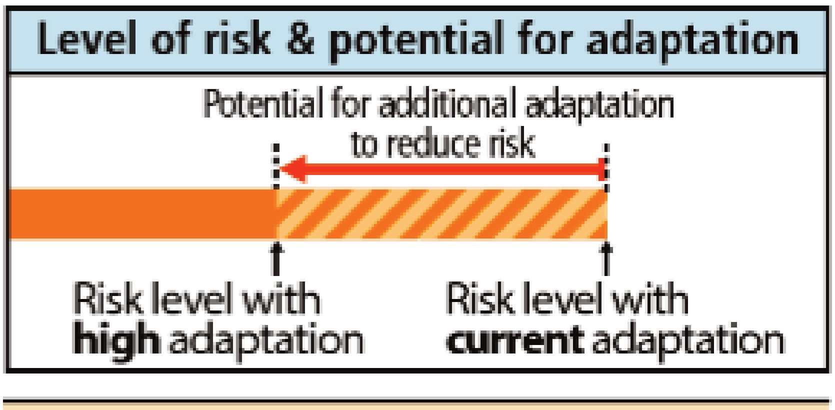
Key regional risks from climate change and the potential for reducing risks through adaptation and mitigation. /1

Each key risk is characterized as very low to very high for three timeframes. In the near term, projected levels of global mean temperature increase do not diverge substantially for different emission scenarios. For the longer term, risk levels are presented for two scenarios of global mean temperature increase (2°C and 4°C above preindustrial levels).



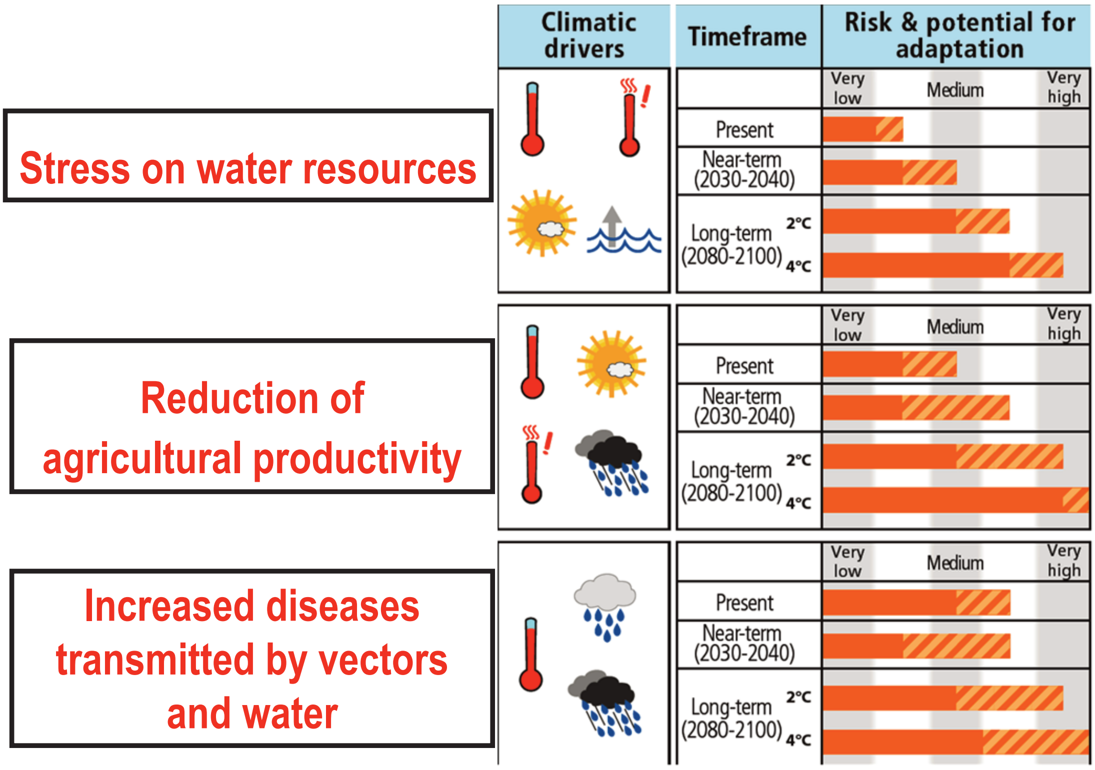
The level of risk and the potential for adaptation

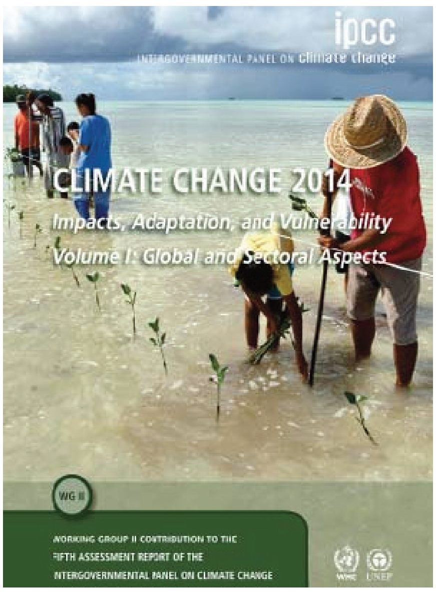




Source: Figure SPM.2 - SPM WGII AR5 IPCC (2014)

AFRICA:





IPCC WGII AR5
Chapter 7. Food Security and
Food Production Systems

The double challenge

CHALLENGE 1: ADAPTATION

Even if policies and efforts to reduce emissions prove effective, **some climate change is inevitable**; therefore, **strategies and actions to adapt** to its impacts are also **needed.**

CHALLENGE 2: MITIGATION

In order to stabilize GHGs concentrations in the atmosphere, **emissions would need to peak and decline thereafter.** Mitigation efforts over the **next decade** will have a large impact on opportunities to achieve lower stabilization levels.

CHALLENGE 1: ADAPTATION

- Adaptation means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise.
- It has been shown that well planned, early adaptation action saves money and lives later.

Examples of adaptation measures

- using scarce water resources more efficiently
- developing drought-tolerant crops
- building flood defences and raising the levels of dykes
- choosing tree species and forestry practices less vulnerable to storms and fires
- adapting building codes to future climate conditions and extreme weather events

Risk: the potential for consequences: probability of occurrence of hazardous events multiplied by the impacts if these events or trends occur.
Risk results from the interaction of vulnerability, exposure, and hazard.

Vulnerability: the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Exposure: the presence of people, livelihoods, species or ecosystems, resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected

Hazard: the potential occurrence of a natural or human-induced physical event or trend or physical impact

Vulnerability
The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Criteria to identify key vulnerabilities:
- magnitude of impacts
- timing of impacts
- persistence and reversibility of impacts
- likelihood (estimates of uncertainty) of impacts and vulnerabilities and confidence in those estimates
- potential for adaptation
- distributional aspects of impacts and vulnerabilities
- importance of the system(s) at risk.

VULNERABILITY AND EXPOSURE ARE DIFFERENT

AROUND THE WORLD

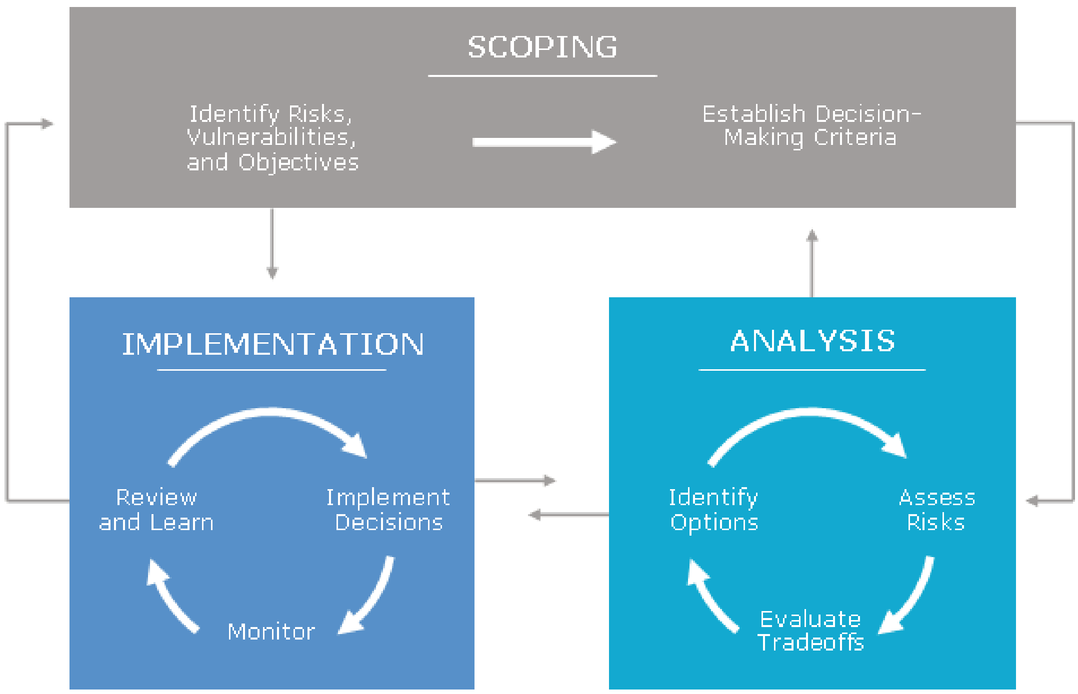
ipcc
INTERGOVERNMENTAL PANEL ON climate change

VULNERABILITY
function [exposure (+); sensitivity (+); adaptive capacity (-)]

VULNERABILITY
potential impact (sensitivity x exposure) – adaptive capacity

REDUCING AND MANAGING RISKS IS VITAL

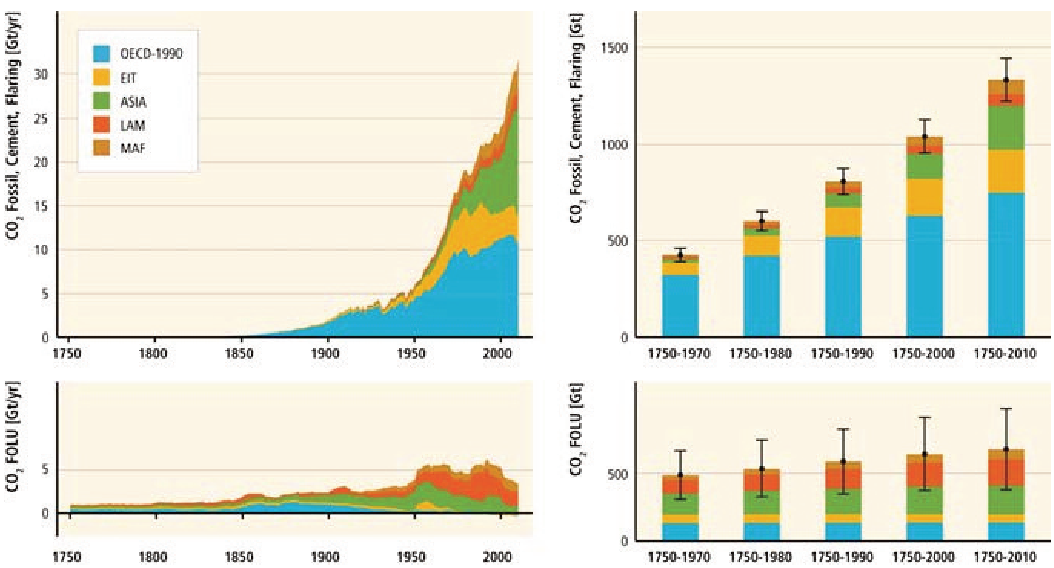
ipcc
INTERGOVERNMENTAL PANEL ON climate change



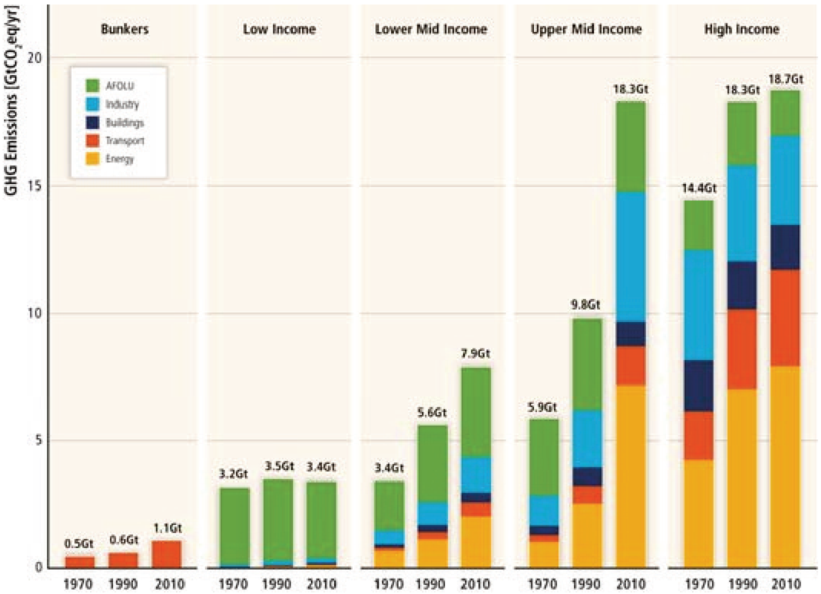
CHALLENGE 2: MITIGATION

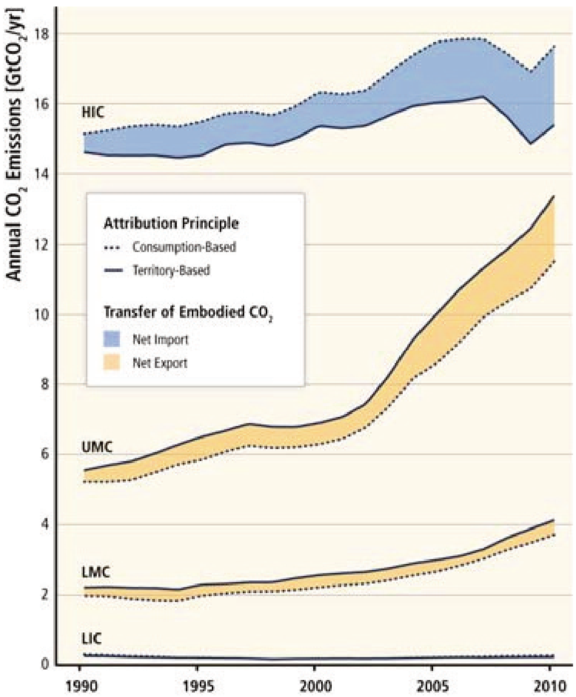
- Mitigation is needed to stabilise rising temperatures to avoid irreversible and catastrophic changes
- To reach these goals, we need a big transformation of our energy-system, a fast scale-up of mitigation action in all the sectors, leading to emission reductions as soon as possible
- We need a transition to net zero carbon emissions worldwide, to be achieved between by the middle of the century
- We need many different type of technologies, but also a changes in the lifestyles
- Mitigation can result in large co-benefits for human health and other societal goals.

Cumulative CO_2 emissions have more than doubled since 1970.



Regional patterns of GHG emissions are shifting along with changes in the world economy.





A growing share of CO_2 emissions from fossil fuel combustion and industrial processes in low and middle income countries has been released in the production of goods and services exported, notably from upper-middle income countries to high income countries.

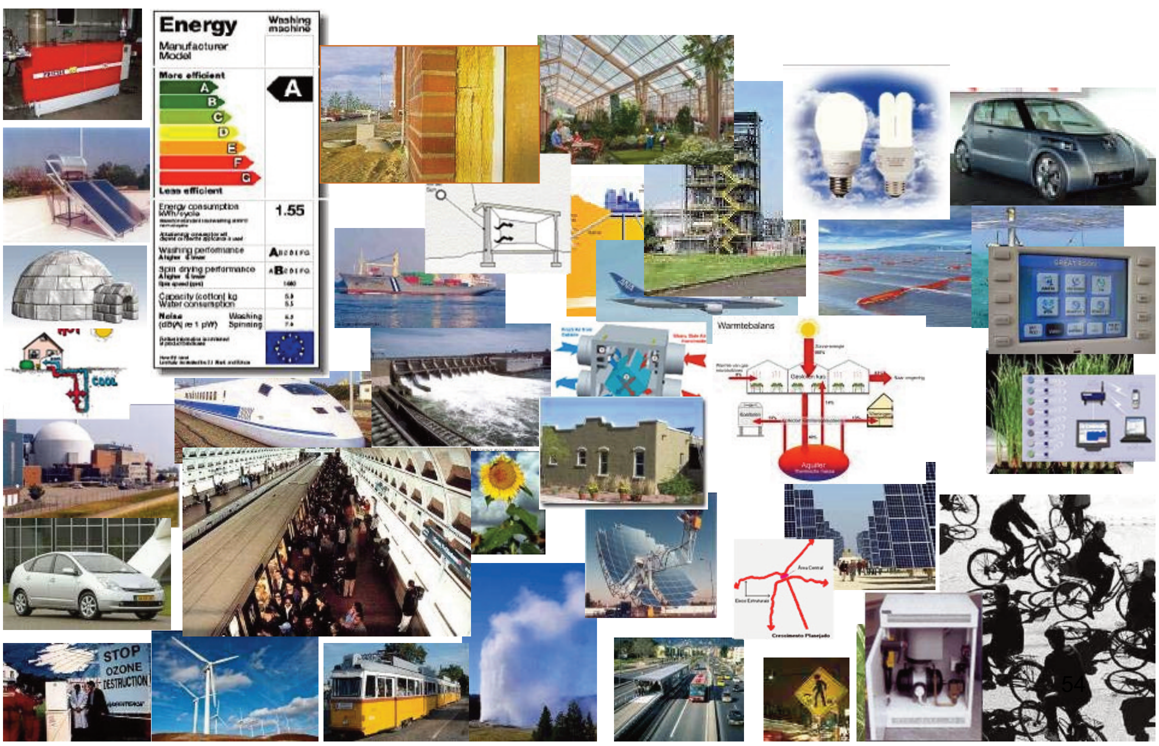
Mitigation strategies

- Bring big cuts to CO_2 emissions and switch to low carbon technologies
- Make dramatic changes to energy use and production
- Use energy more efficiently
- Promote renewable energies and innovative technologies
- Stop deforestation

Mitigation requires major technological and institutional changes including the upscaling of low- and zero carbon energy.

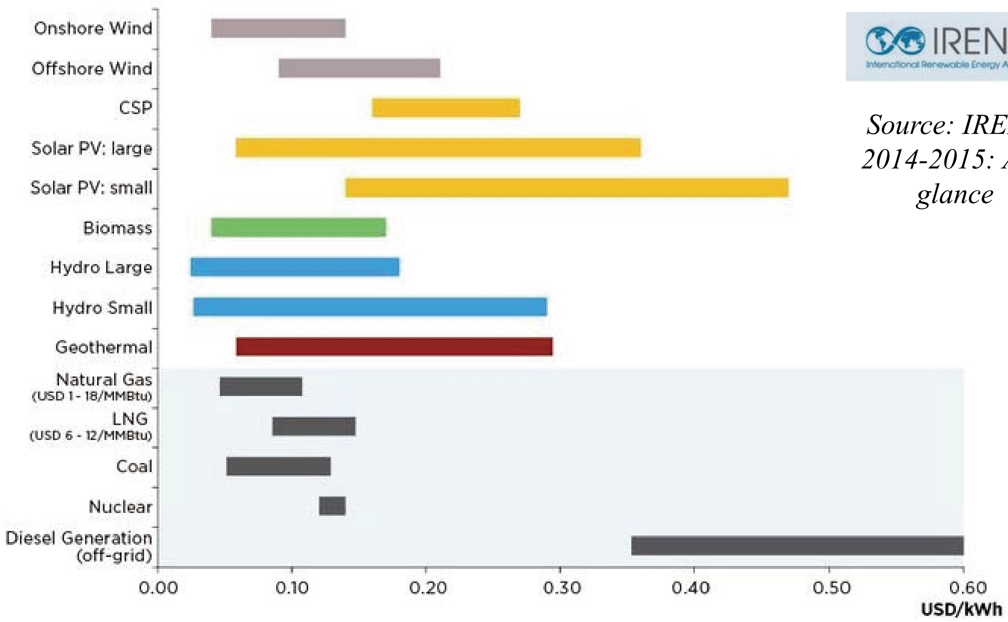
Delaying mitigation is estimated to increase the difficulty and narrow the options for limiting warming to 2°C.

Many technologies and practices are available



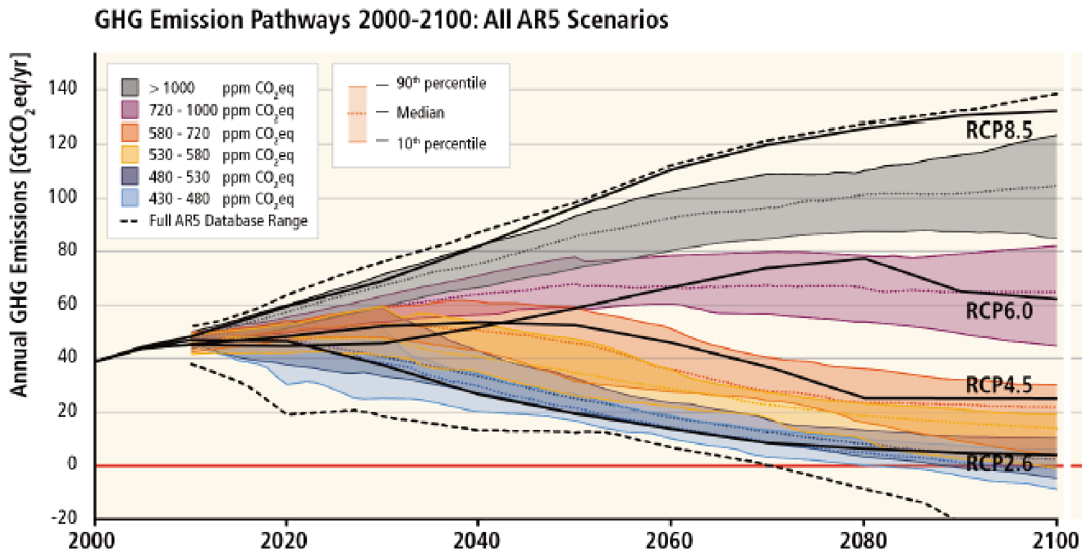
We receive from the Sun far more energy we need

Costs of renewable energies are falling



IRENA
International Renewable Energy Agency

Source: IRENA 2014-2015: At a glance



Scenarios reaching atmospheric concentration levels of about 450 ppm CO_2eq by 2100 (consistent with a likely chance to keep temperature change below 2 °C relative to pre-industrial levels) include substantial cuts in anthropogenic GHG emissions by mid-century through large-scale changes in energy systems and potentially land use (high confidence). (IPCC-AR5, WG3, SPM)

Estimates for mitigation costs vary widely.

- Reaching 450ppm CO_2eq entails consumption losses of 1.7% (1%-4%) by 2030, 3.4% (2% to 6%) by 2050 and 4.8% (3%-11%) by 2100 relative to baseline (which grows between 300% to 900% over the course of the century).
- This is equivalent to a reduction in consumption growth over the 21st century by about 0.06 (0.04-0.14) percentage points a year (relative to annualized consumption growth that is between 1.6% and 3% per year).
- Cost estimates exlude benefits of mitigation (reduced impacts from climate change). They also exclude other benefits (e.g. improvements for local air quality).
- **Mitigation can result in large co-benefits for human health and other societal goals.**

- **Mitigation can result in large co-benefits for human health and other societal goals.**

- In some countries, tax-based policies specifically aimed at reducing GHG emissions–alongside technology and other policies–have helped to weaken the link between GHG emissions and GDP.
- The reduction of subsidies for GHG-related activities in various sectors can achieve emission reductions, depending on the social and economic context.
- **Substantial reductions in emissions would require large changes in investment patterns.**

Effective mitigation will not be achieved if individual agents advance their own interests independently.

- Existing and proposed international climate change cooperation arrangements vary in their focus and degree of centralization and coordination.
- Issues of equity, justice, and fairness arise with respect to mitigation and adaptation.
- Climate policy may be informed by a consideration of a diverse array of risks and uncertainties, some of which are difficult to measure, notably events that are of low probability but which would have a significant impact if they occur.

Least-cost mitigation scenarios rely on strong institutions

Key institutional requirements:

1. All countries cooperate and begin to mitigate immediately.
2. They all introduce a globally uniform price on all GHG emissions.
3. They all allow the use of all key mitigation technologies.

- **1992 - Rio de Janeiro (Earth Summit)**

UNFCCC (www.unfccc.int)

United Nation Framework Convention on Climate Change

The Convention has been ratified by 197 countries («parties»)

The ultimate objective of the Convention (art. 2):

To achieve stabilization of greenhouse gas concentrations at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system.
Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.

How do we know what is "dangerous anthropogenic interference"?

⇩

IPCC reports…

Principles of the Convention (art. 3):

The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof

The specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change, and of those Parties, especially developing country Parties, that would have to bear a disproportionate or abnormal burden under the Convention, should be given full consideration

Commitments (art.4): *many!*

General committment:

- Develop and periodically update national inventories of emissions and removals
- Formulate, implement, publish and regularly update national communications containing measures to mitigate climate change and and measures to facilitate adequate adaptation to climate change;
- Communicate to the Conference of the Parties information related to implementation
- … cooperation… technology transfer… finance… etc.

The Paris Agreement

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

The Paris Agreement

The outcome of UNFCCC COP 21 exceeded expectations, producing an agreement that while perhaps not a revolution, is an important step in the evolution of climate governance and a reaffirmation of environmental multilateralism.

The Paris meeting created a pathway for success, but the Agreement itself cannot ensure it.

174 Parties have ratified of 197 Parties to the Convention

Recent news

- quick ratification of the Paris Accord
- first deal to curb aviation emissions agreed in the ICAO meting
- Kigali agreement to use Montreal Protocol to cut HFCs

THE PARIS AGREEMENT and the NDCs

According to Article 4 paragraph 2 of the Paris Agreement, each Party shall prepare, communicate and maintain successive nationally determined contributions (NDCs) that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions.

162 NDCs have been submitted, representing 190 countries

There is a gap between ambitions ("*well below 2°C…*") and actions proposed by countries (INDCs).
At the center of the Paris Agreement are five-year cycles: each nationally determined contribution (NDC) cycle is to be more ambitious than the last and a global "stocktake" will inform collective efforts on mitigation, adaptation and support, and occur midway through the contribution cycle, every five years after 2023.

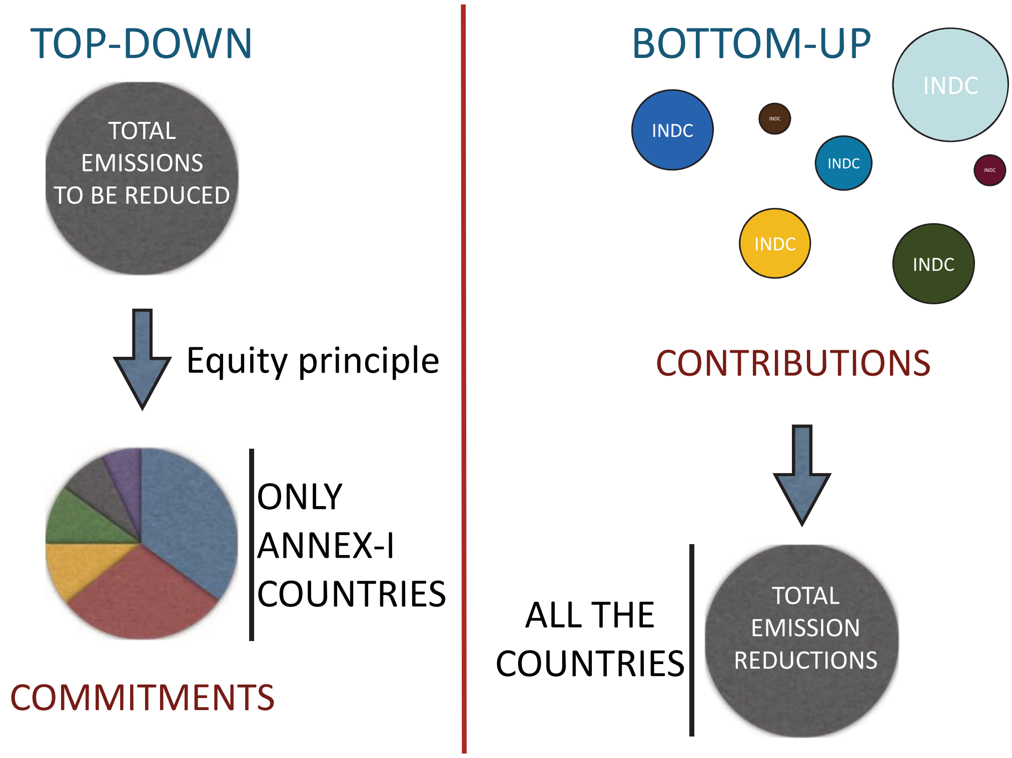
Legally binding or not?

In short, the procedural aspects of the Paris Agreement are legally-binding.
Nevertheless, most substantive elements, including the specific goals of the NDCs that will be housed in a public registry maintained by the Secretariat, are not legally binding.

The Paris Agreement can be described as a **hybrid between a top-down, rules-based system and a bottom-up system of pledge and review**. The NDCs "codify" the bottom-up approach that emerged from the COP15 in Copenhagen.
Yet, many pointed to "vestiges" of a Kyoto Protocol-type, top-down system, in the form of the common rules for transparency and the compliance mechanism, although some noted that the compliance mechanism is "merely" facilitative in nature as it lacks an enforcement branch

(IISD-ENB)

From TOP-DOWN to BOTTOM-UP

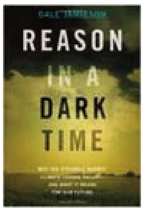


THE PARIS ACCORD

COP Decision + Accord

Mitigation
Adaptation
Loss and damage
Finance
Capacity Building
Trasparency
Implementation

Some ideas on the road ahead



Dale Jamieson, *Reason in a Dark Time: Why the Struggle Against Climate Change Failed -- and What It Means for Our Future. 2014*

- In this fragmented and decentralized world no comprehensive doctrine or policy has a chance;
- There will be a «portfolio of policies without a portfolio manager»;
- A lot could happen, although it may seem rather disorderly;
- Given such uncertainty and decentralization it is fatuous to try to sketch an optimal portfolio for addressing climate change over the next half century;
- Stop arguing about what is optimal and instead focus on what is good.

POLICY RESPONSES TO CLIMATE CHANGE:
SUSTAINABLE DEVELOPMENT AND ENERGY TRANSITION
Supporting Ethiopia in implementing and monitoring INDCs

2 - Tools for effective climate change projects design and development

Stefano Caserini

Politecnico di Milano, D.I.C.A. sez. Ambientale

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2 - Outline

Tools for effective climate change projects design and development – Rationale, sensitivities analysis and risks assessment

- Source of data of temperature and assessment of the warming trend, with a focus on Africa and Ethiopia
- Source of information on adaptation methodologies and projects
- Source of data for energy balances and greenhouse gas emissions assessment.
- Tools for MRV
- The Ethiopia's INDC (Intended Nationally Determined Contribution)
- Tools for emission assessment: methodologies and practical exercise
- Methodologies for estimating the potential for emission reduction of different technological options (practical exercises)

Global temperature data

GISS - Goddard Institute for Space Studies
http://data.giss.nasa.gov/gistemp/

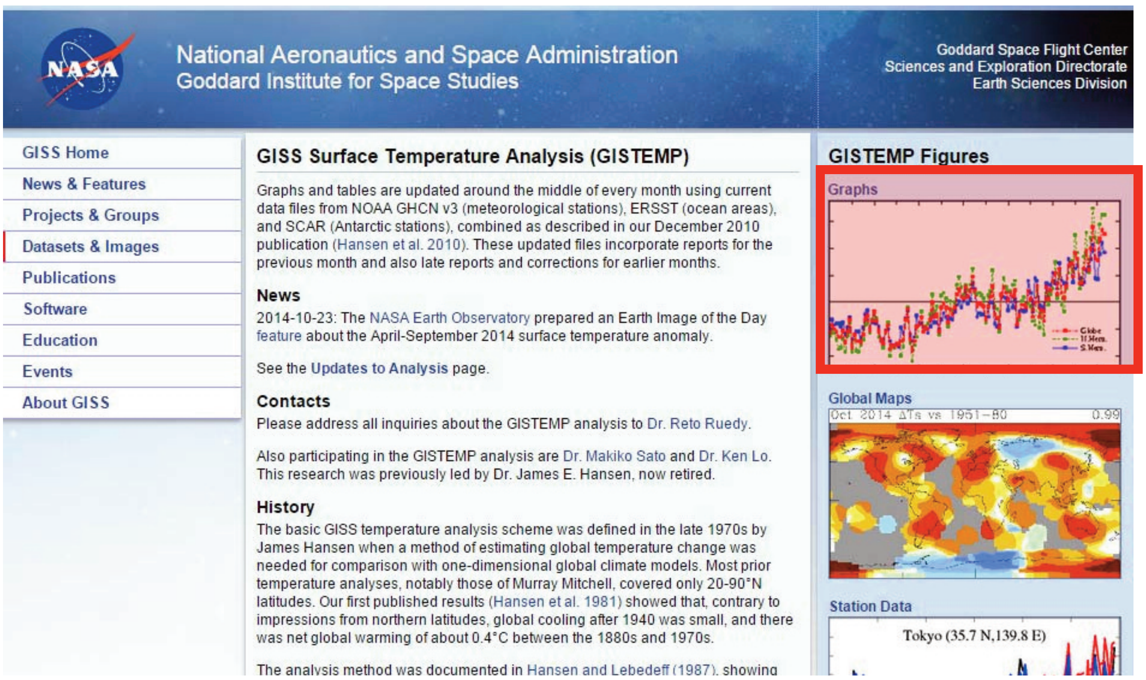
METOFFICE - Climatic Research Unit (University of East Anglia)
http://www.cru.uea.ac.uk/cru/data/temperature/#datdow

NOAA–NCDC - National Oceanic and Atmospheric Administration – National Climatic Data Center
http://www.ncdc.noaa.gov/monitoring-references/faq/anomalies.php

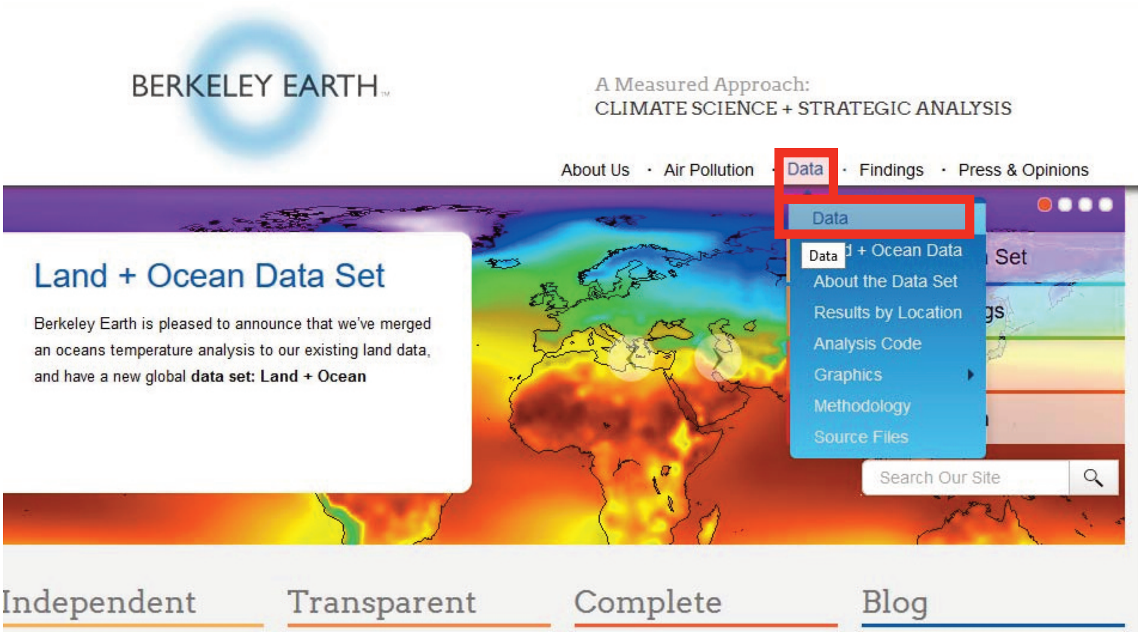
Berkeley Earth
http://berkeleyearth.org/ Data at country level

Global temperature data

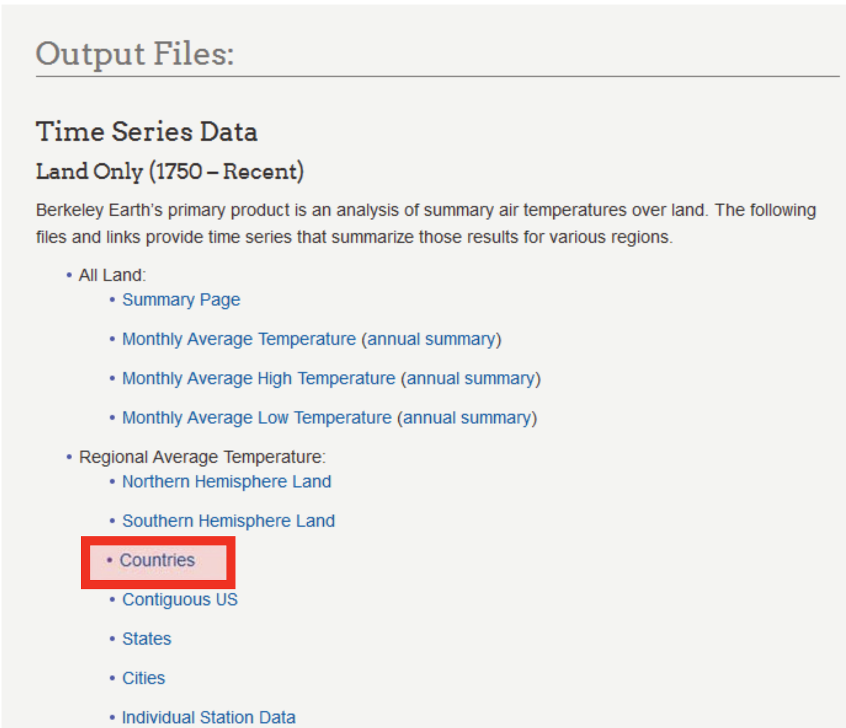
GISS - Goddard Institute for Space Studies
http://data.giss.nasa.gov/gistemp/



Temperature medie annue
Berkeley Earth - http://berkeleyearth.org



Air temperature over land – available also as country average



Output Files:

Time Series Data

Land Only (1750 – Recent)

Berkeley Earth's primary product is an analysis of summary air temperatures over land. The following files and links provide time series that summarize those results for various regions.

- All Land:
  - Summary Page
  - Monthly Average Temperature (annual summary)
  - Monthly Average High Temperature (annual summary)
  - Monthly Average Low Temperature (annual summary)
- Regional Average Temperature:
  - Northern Hemisphere Land
  - Southern Hemisphere Land
  - Countries
  - Contiguous US
  - States
  - Cities
  - Individual Station Data

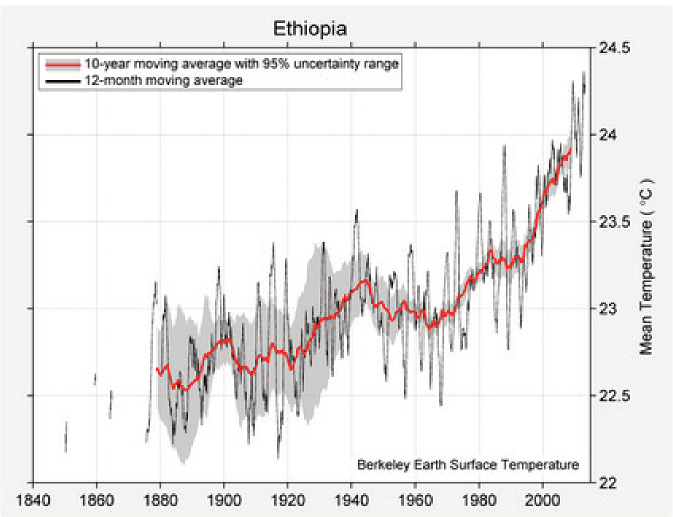
Temperature medie annue

Tuti i gruppi – dati per entità geografica

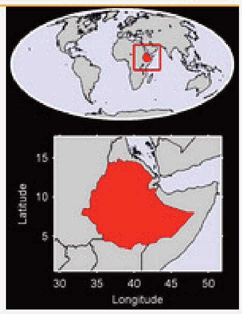
Dominican Republic	1.67 ± 0.33	North America
Ecuador	1.31 ± 0.36	South America
Egypt	2.03 ± 0.33	Africa
El Salvador	1.41 ± 0.30	North America
Equatorial Guinea	1.48 ± 0.39	Africa
Eritrea	2.29 ± 0.39	Africa
Estonia	3.01 ± 0.27	Europe
Ethiopia	2.19 ± 0.25	Africa
Falkland Islands (Islas Malvinas)	1.37 ± 0.38	South America
Faroe Islands	1.74 ± 0.63	
Federated States of Micronesia	1.79 ± 0.51	
Fiji	1.30 ± 0.44	Oceania
Finland	3.03 ± 0.27	Europe
France	2.60 ± 0.21	
France (Europe)	2.77 ± 0.22	Europe
French Guiana	1.85 ± 0.22	South America
French Polynesia	1.58 ± 0.46	
French Southern and Antarctic Lands	1.67 ± 0.67	

Regional Climate Change: Ethiopia

Search Our Site



High Resolution Version | Data Table



Ethiopia Region Statistics

Land Area:	1,123,000 km²
Percent of Global Land Area:	0.76%

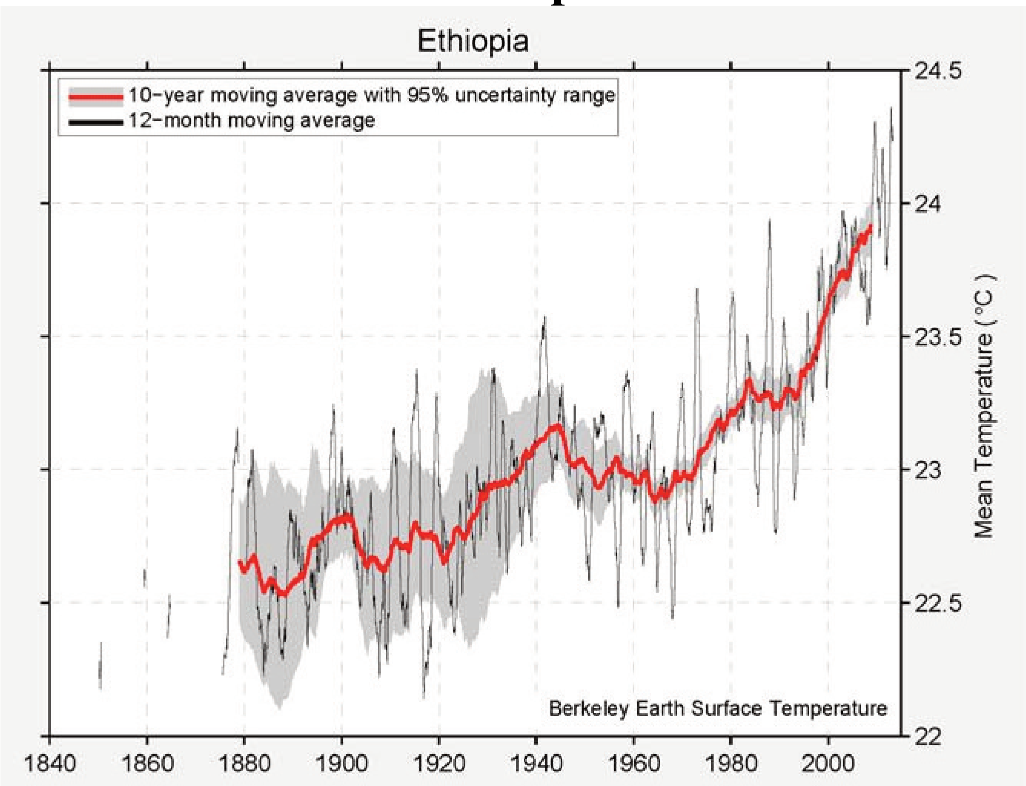
Temperature Stations in Region

Active Stations:	6
Former Stations:	23
Monthly Mean Observations:	9,710
Earliest Observation:	January 1898

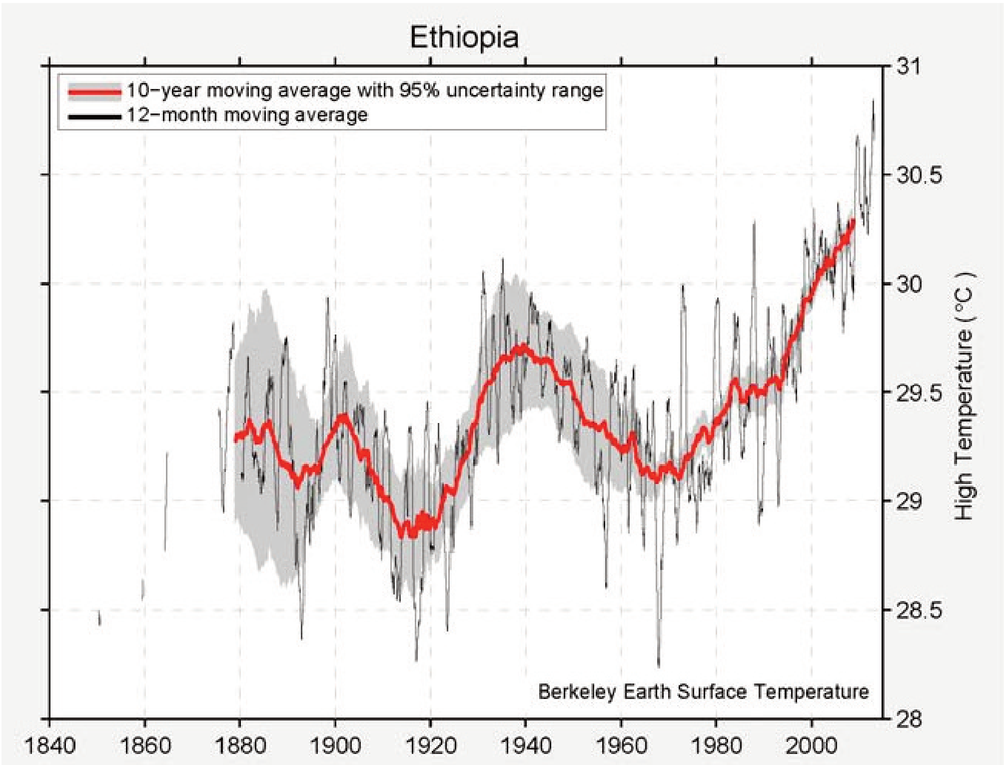
Mean Rate of Change (°C / Century)

Since:	1760	1810	1860	1910	1960	1990
Ethiopia	-	-	-	0.98 ± 0.30	2.19 ± 0.25	4.00 ± 0.97

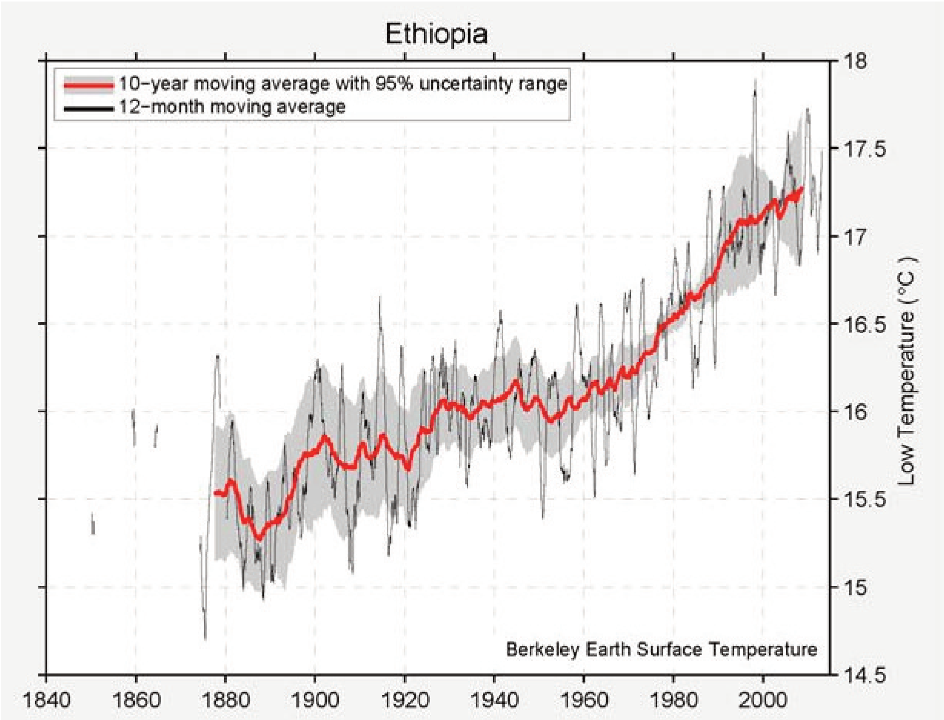
Mean temperature



Highest temperature

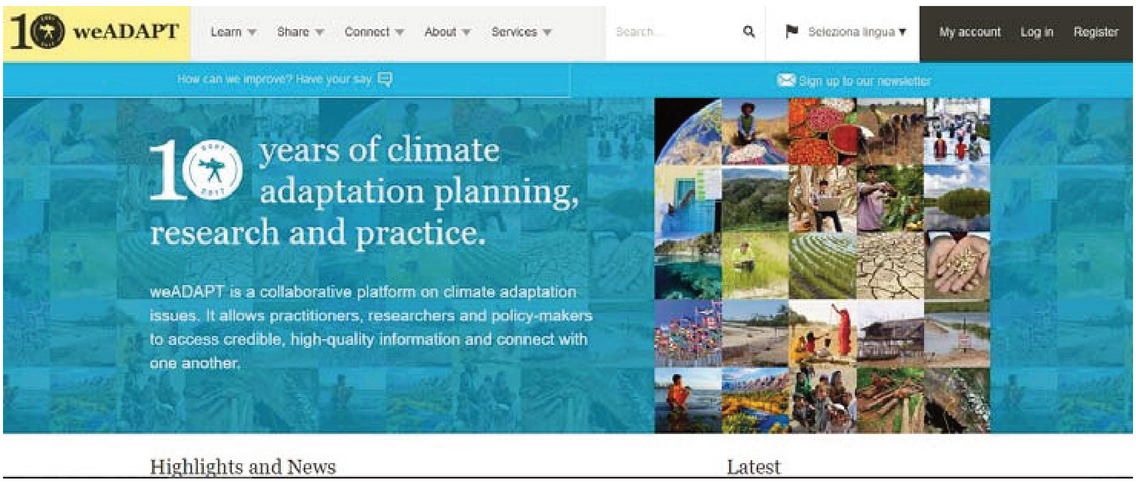


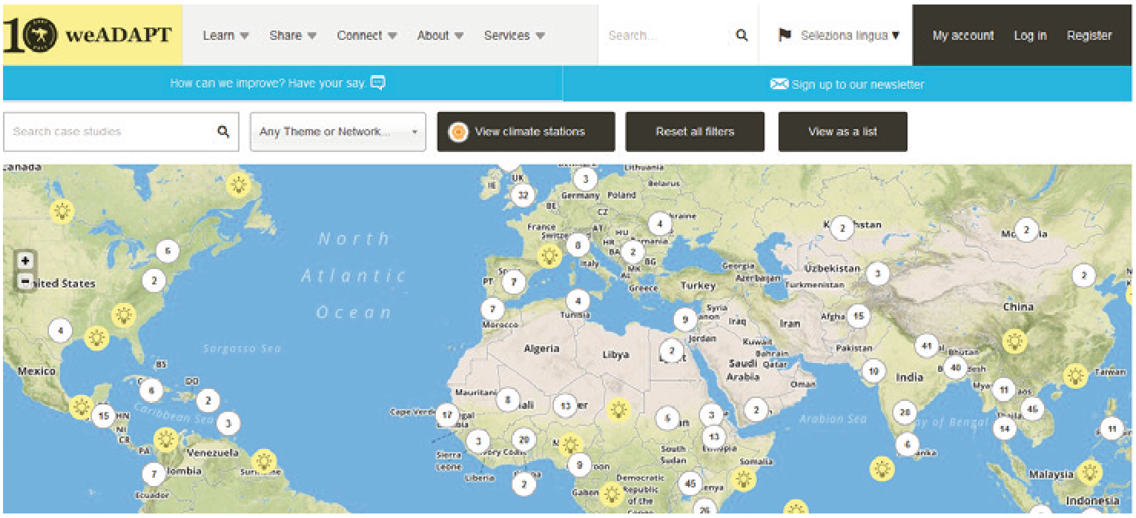
Lowest temperature



www.weadapt.org/

weADAPT® is a collaborative platform on climate adaptation issues, supported by the Stockholm Environment Institute.
It allows practitioners, researchers and policy-makers to access high-quality information and connect with one another

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Learn
Share
Connect
About
Services
Search...
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My account
Log in
Register
How can we improve? Have your say.
Sign up to our newsletter
Search case studies
Any Theme or Network...
View climate stations
Reset all filters
View as a list
North
Atlantic
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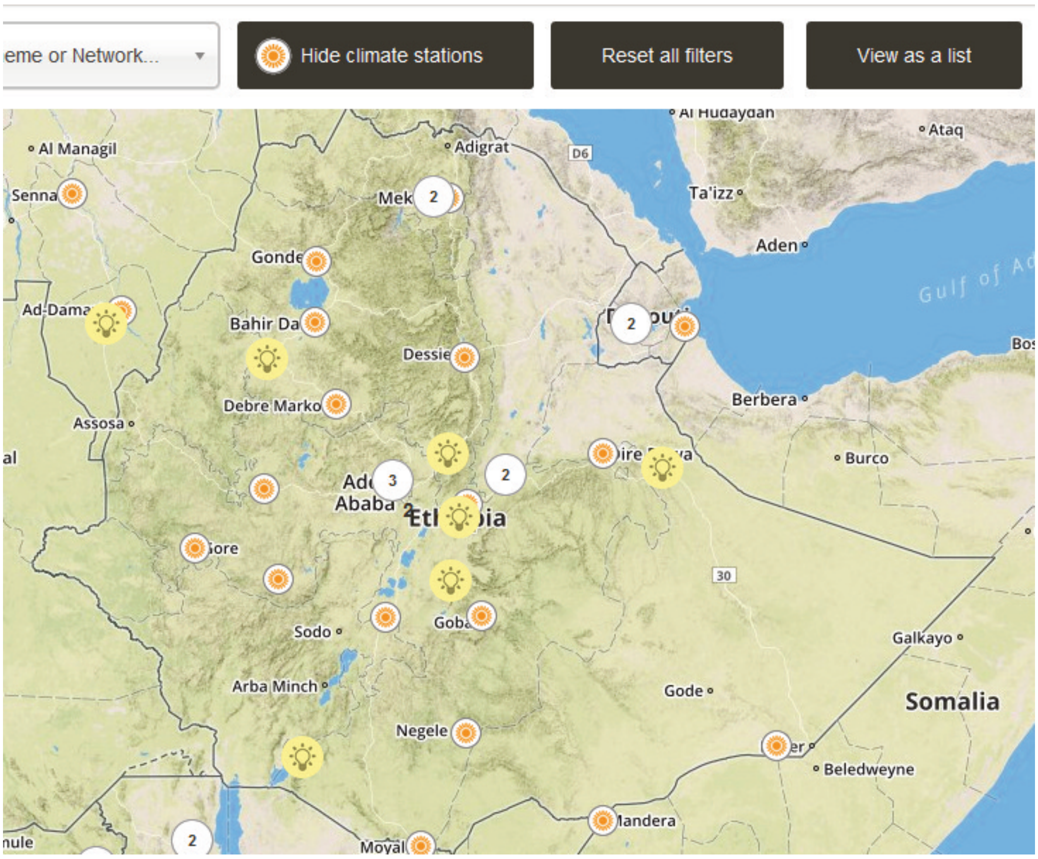
Turkey
China
India
Venezuela
Malaysia
Indonesia


eme or Network...
Hide climate stations
Reset all filters
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Al Managil
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Adigrat
Ta'izz
Aden
Gulf of Ad
Ad-Dama
Bahir Da
Dessie
Debre Marko
Berbera
Assosa
Burco
Ababa
Sodo
Galkayo
Arba Minch
Gode
Somalia
Negele
Beledweyne
Moyal

The role of community-based natural resource management in climate change adaptation in Ethiopia

Published: 14th October 2015 17:59 **Last Updated:** 14th October 2015 17:59

Introduction

This paper describes the methodology developed by the International Institute for Environment and Development (IIED) to assess what role selected community-based/ participatory natural resource management (CB/PNRM) initiatives undertaken by Save the Children with pastoral communities in the lowland Borana

The role of community-based natural resource management in climate change adaptation in Ethiopia

Ask the community

Discuss this Network with the experts on the Forum ▶

▶ **Network**

Global Initiative on Community Based Adaptation (GICBA) ▸

Collective learning on Community Based Adaptation

Explore Network

▶ **Featured Download**

Good practice guide: Local disaster risk reduction planning in Ethiopia

Published: 28th July 2014 11:04 **Last Updated:** 4th August 2014 16:05

Ask the community

Discuss this Network with the experts on the Forum ▶

▶ **Network**

Africa Climate Change Resilience Alliance (ACCRA) ▸

The Africa Climate Change Resilience Alliance programme is made up of Oxfam GB, ODI, Save the Children International, Care International and World Vision International

Explore Network

Community Based Coping Mechanisms and Adaptations to Droughts in the Borana Pastoral Area of Southern Ethiopia

Published: 4th April 2012 16:23 **Last Updated:** 4th April 2012 17:23

Ethiopia: The Economics of Adaptation to Climate Change Study (EACC)

Published: 7th June 2010 14:21 **Last Updated:** 27th May 2014 16:14

Planning for the future and adapting to climate change in Ethiopia - Lessons from ACCRA

Published: 1st August 2014 13:23 **Last Updated:** 1st August 2014 12:30

How can Ethiopia do better at mitigating disaster risk and adapting to climate change?

Published: 20th November 2014 12:59 **Last Updated:** 20th November 2014 13:00

Source od energy data: www.iea.org/statistics

1- www.iea.org/statistics/

2 – Search statistics by country
www.iea.org/statistics/statisticssearch/

"Balances"

Ethiopia: Indicators for 2015

2015 | Indicators | Balances | Coal | Electricity and Heat | Natural Gas | Oil | Renewables and Waste

Key Indicators:	
Population (millions)	99.39
GDP (billion 2010 USD)	48.33
GDP PPP (billion 2010 USD)	148.98
Energy production (Mtoe)	46.71
Net imports (Mtoe)	3.71
TPES (Mtoe)	49.99
Electricity consumption* (TWh)	8.50
CO2 emissions** (Mt of CO2)	10.20

Key Indicators:	
TPES/population (toe/capita)	0.5
TPES/GDP (toe/thousand 2010 USD)	1.03
TPES/GDP PPP (toe/thousand 2010 USD)	0.34
Electricity consumption / population (MWh/capita)	0.09
CO2/TPES (t CO2/toe)	0.2
CO2/population (t CO2/capita)	0.1
CO2/GDP (kg CO2/2010 USD)	0.21
CO2/GDP PPP (kg CO2/2010 USD)	0.07

Advanced search
Country/region: Ethiopia
Topic: Indicators
Year: 2015
Search
Or:
Country/region: Ethiopia
Graph: Select
Search

Ethiopia: Balances for 2015

in thousand tonnes of oil equivalent (ktoe) on a net calorific value basis

2015 | Indicators | Balances | Coal | Electricity and Heat | Natural Gas | Oil | Renewables and Waste

	Coal*	Crude oil*	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total**
Production	0	0	0	0	0	832	65	45813	0	0	46710
Imports	253	0	3472	0	0	0	0	0	0	0	3726
Exports	0	0	0	0	0	0	0	0	-14	0	-14
International marine bunkers***	0	0	0	0	0	0	0	0	0	0	0
International aviation bunkers***	0	0	-438	0	0	0	0	0	0	0	-438
Stock changes	0	0	6	0	0	0	0	0	0	0	6
TPES	**253**	**0**	**3041**	**0**	**0**	**832**	**65**	**45813**	**-14**	**0**	**49990**

Attention to the units of measurement!

1 toe (ton of oil equivalent) = 41868 MJ (megajoule) = 41,868 GJ (gigajoule)

1ktoe = 41,868 TJ (terajoule)

MRV: **M**easure **R**eport **V**erify

all activities for collecting data on emissions, mitigation actions and support

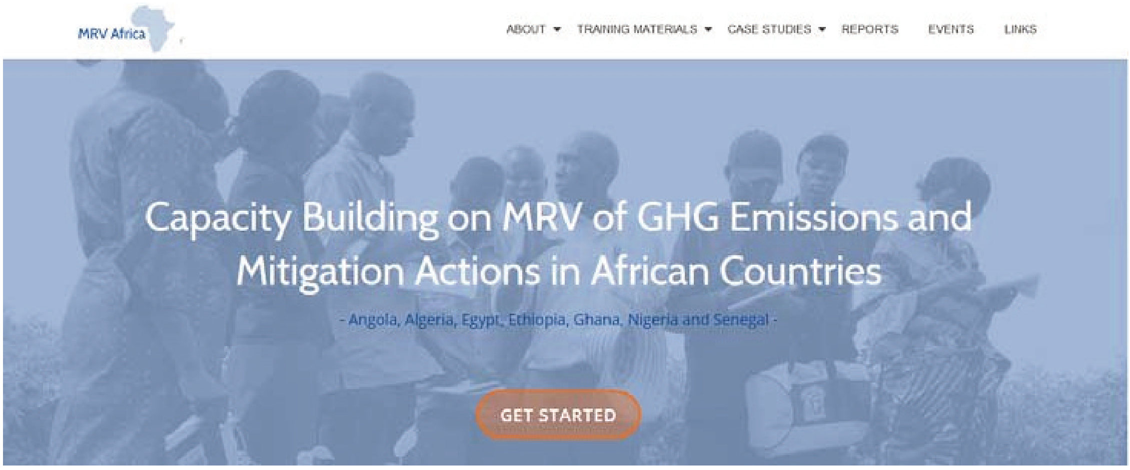
Measure: direct measurement using devices OR estimation using simple methods or complex models. Calculations following strict guidance and protocols.

Report: documentation intended to inform all interested parties – including methodologies, assumptions and data.

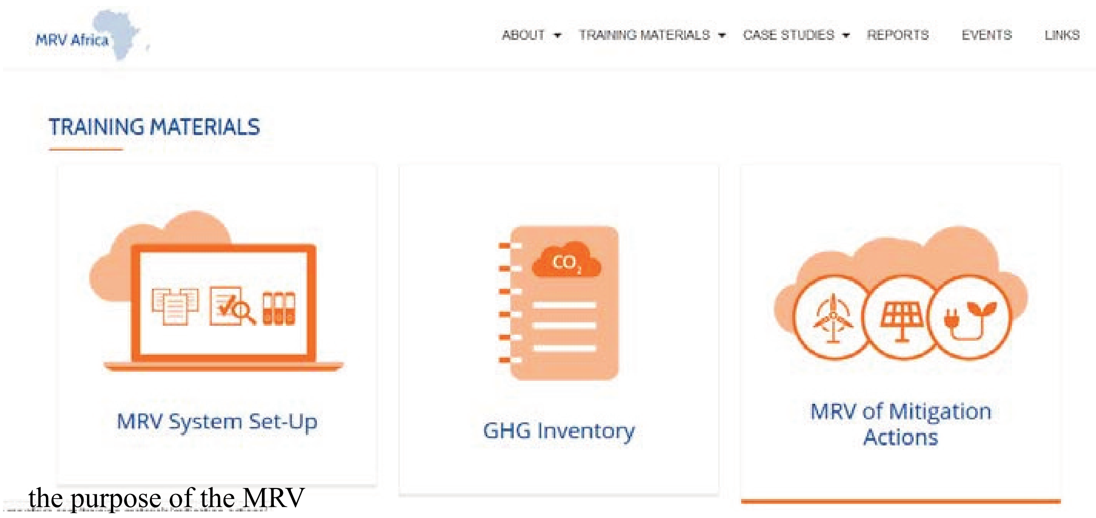
Verify: specific procedures or expert review used to verify the quality of the data. Internal or External verification

A robust Monitoring, Reporting and Verification (MRV) system is fundamental to meet the reporting requirements of the United Nations Framework Convention on Climate Change (UNFCCC).

The European Commission launched a project in 2015 to support a group of seven African countries to meet the UNFCCC reporting requirements



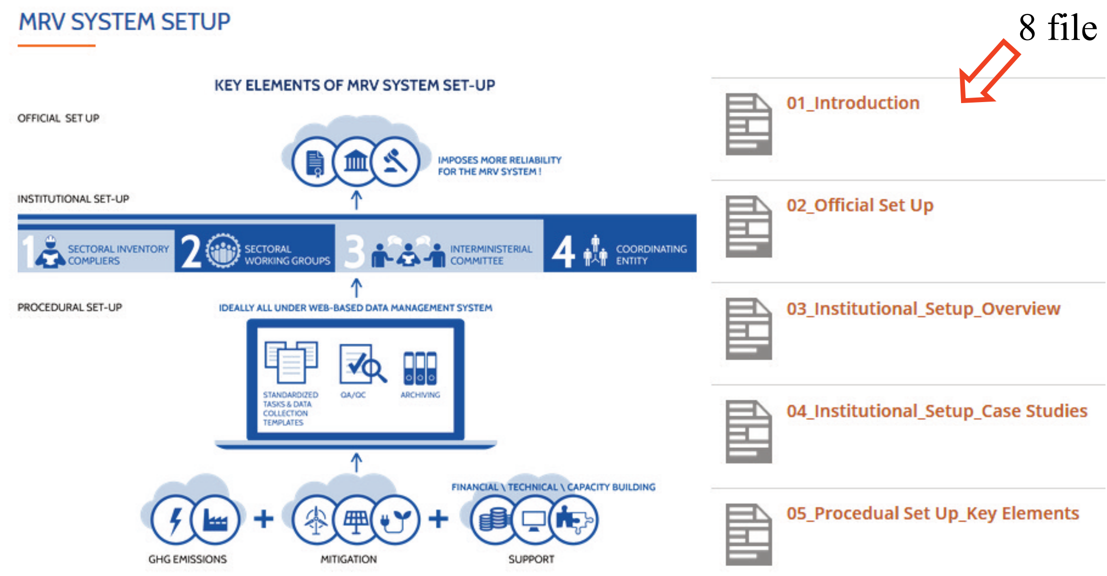
www.mrvafrica.com/training-materials/



the purpose of the MRV System is to monitor report and verify,

- GHG Emissions,
- Mitigation Actions and Policies, and their effects
- Support received (financial, technical, capacity building) and their effects

www.mrvafrica.com/training-materials/**mrv-system-setup/**



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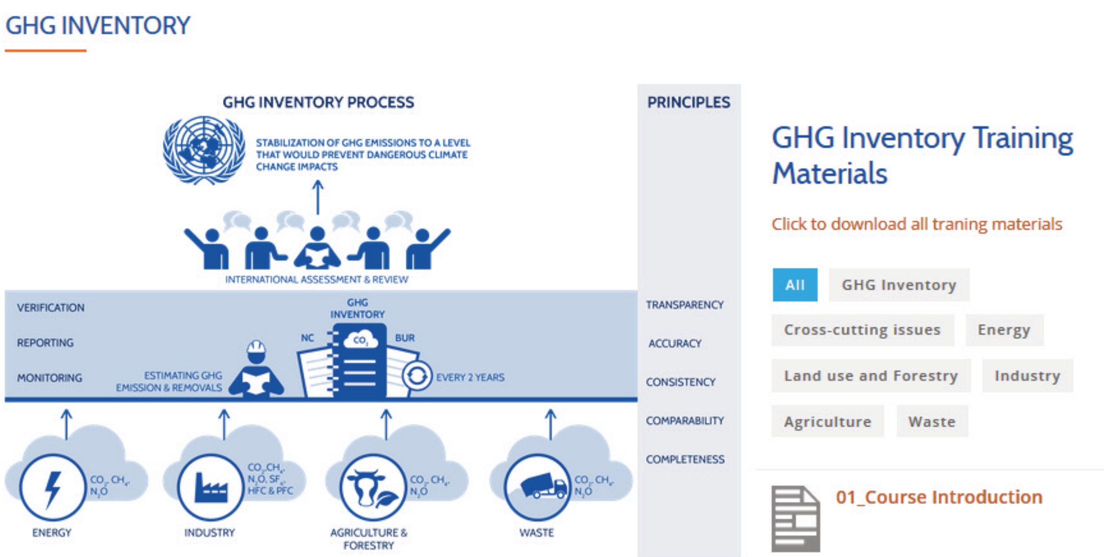
The purpose of the MRV System is to monitor report and verify,
- GHG Emissions,
- Mitigation Actions and Policies, and their effects, as well as
- Support received (financial, technical, capacity building) and their effects

www.mrvafrica.com/training-materials/**ghg-inventory/**



Aim: to develop capacity in government institutions, industry and the private sector to realize comprehensive GHG inventories, estimating emissions (and removals) from all source categories.

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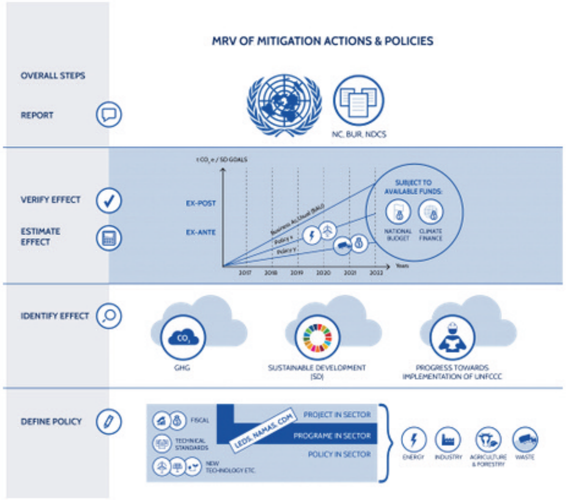
www.mrvafrica.com/training-materials/**mitigation-actions/**

MRV OF MITIGATION ACTIONS



Aim: to develop capacity to acquire understanding of the available approaches and methodologies for MRV of mitigation actions and to specific sector-wide policies.

Training Materials for MRV of Mitigation Actions

Download all training materials (zip file)

All | Cross-cutting | Energy | Transport | Waste

01_Cross Cuting_Intro

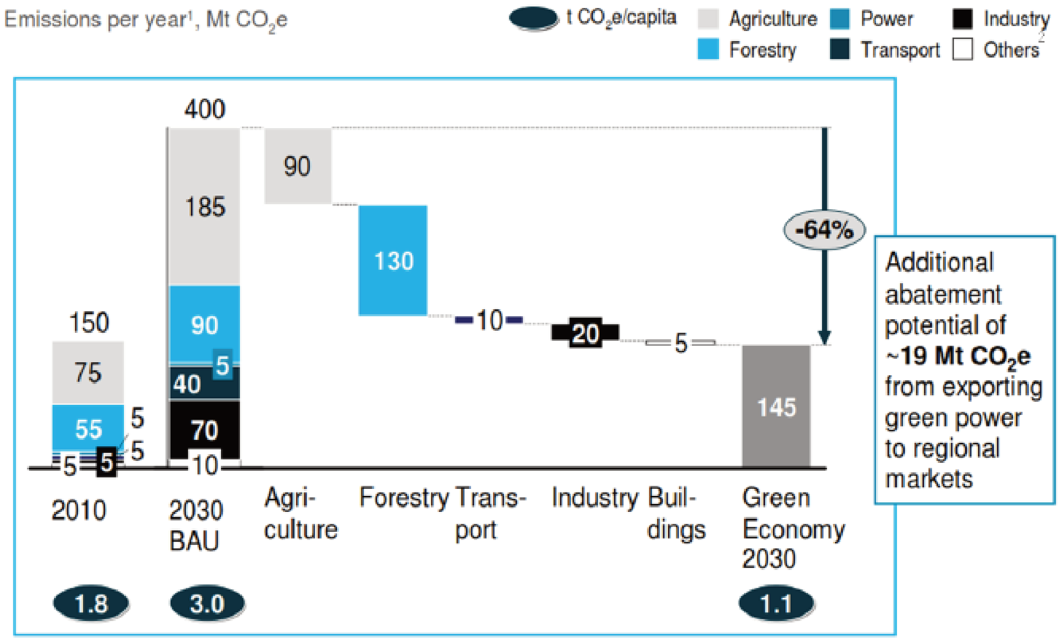
02_Cross Cuting_MRV Frameworks_CDM vs. NAMA

16 file

FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

Intended Nationally Determined Contribution (INDC) of the Federal Democratic Republic of Ethiopia

Ethiopia intends to limit its net greenhouse gas (GHG) emissions in 2030 to 145 Mt CO_2e or lower. This would constitute a 255 MtCO_2e reduction from the projected 'business-as-usual' (BAU) emissions in 2030 or a 64% reduction from the BAU scenario in 2030. Ethiopia also intends to undertake adaptation initiatives to reduce the vulnerability of its population, environment and economy to the adverse effects of climate change, based on its Climate Resilient Green Economy Strategy (CRGE). The CRGE is Ethiopia's strategy for addressing both climate change adaptation and mitigation objectives. The implementation of the CRGE would ensure a resilient economic development pathway while decreasing per capita emissions by 64% or more. The CRGE is also integrated into the Second Growth and Transformation Plan (the national development plan). In the long term, Ethiopia intends to achieve its vision of becoming carbon-neutral, with the mid-term goal of attaining middle-income status.


Emissions per year[1], Mt CO_2e
t CO_2e/capita
Agriculture
Power
Industry
Forestry
Transport
Others[2]
400
90
185
130
150
90
10
20
5
75
5
-64%
40
55
5
70
145
5
5
5
10
2010
2030 BAU
Agri-culture
Forestry
Trans-port
Industry
Buil-dings
Green Economy 2030
1.8
3.0
1.1
Additional abatement potential of **~19 Mt CO_2e** from exporting green power to regional markets

POLICY RESPONSES TO CLIMATE CHANGE:
SUSTAINABLE DEVELOPMENT AND ENERGY TRANSITION
Supporting Ethiopia in implementing and monitoring INDCs

3 - Options for accessing international climate finance to support activities

Stefano Caserini

Politecnico di Milano, D.I.C.A. sez. Ambientale

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3 - Options for accessing international climate finance to support activities

Outline

- The main instruments of climate change financing
- Cap and trade Systems: emission trading
- Project-based system: Clean Development Mechanism
- Credits of the voluntary market
- The concepts of additionality and double counting
- State of carbon markets
- The Green Climate Fund (GCF)

- Substantial reductions in emissions would require large changes in investment patterns.
- Increased investment in energy efficiency
- Increased investment in renewable energy
- Decrease in investment for the extraction of fossil fuels
- In some countries, tax-based policies specifically aimed at reducing GHG emissions – alongside technology and other policies – have helped to weaken the link between GHG emissions and GDP.
- The reduction of subsidies for GHG-related activities in various sectors can achieve emission reductions, depending on the social and economic context.

Principles behind the carbon markets

- The effect of greenhouse gases emissions is global (not location specific)
- The rights to a unit of GHG emissions can be tracked and transferred
- The market is the best mechanism for determining how to reduce GHG emissions at the lowest possible cost
- Many instrument are available

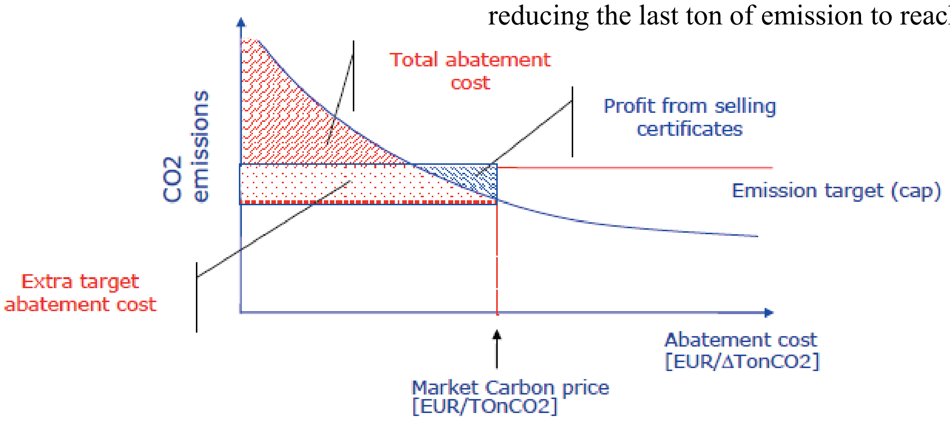
A carbon credit (often called a carbon offset) is a financial instrument that represents a ton of CO_2 or CO_2e (carbon dioxide equivalent gases) removed or reduced from the atmosphere.

The systems to create carbon credits /1

CAP AND TRADE (Emission Trading)

At the end of each period, if a facility emits less than the amount of allowances it holds, it may sell its surplus allowances to other emitters.

First case: CO_2 market price higher than the cost of reducing the last ton of emission to reach the target

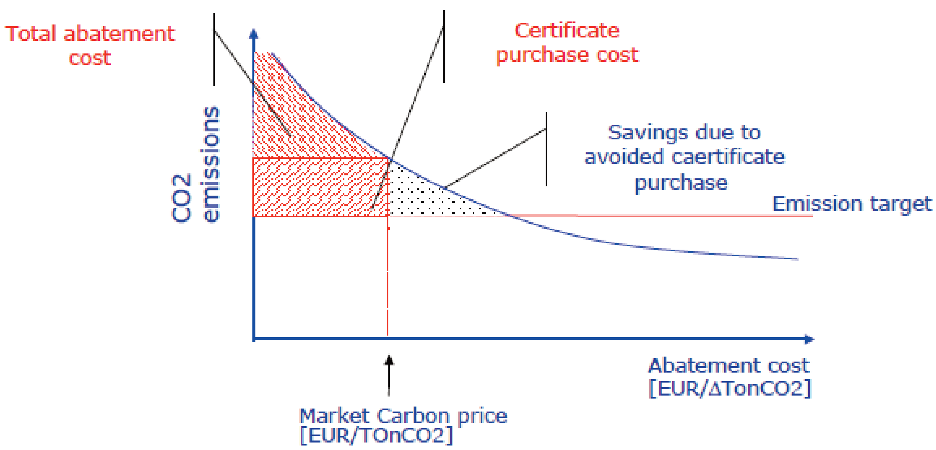


Winning strategy: reduce emissions more than your target and sell extra certificates

The systems to create carbon credits /1

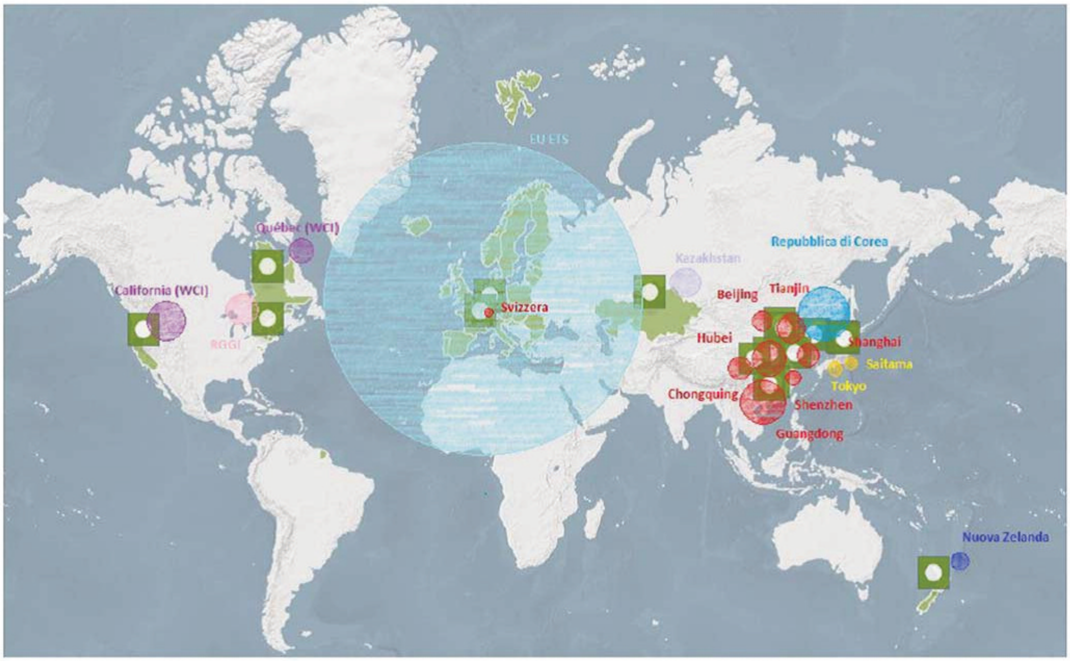
CAP AND TRADE i.e. Emission Trading

Second case: CO_2 market price lower than the cost of reducing the last ton of emission to reach the target



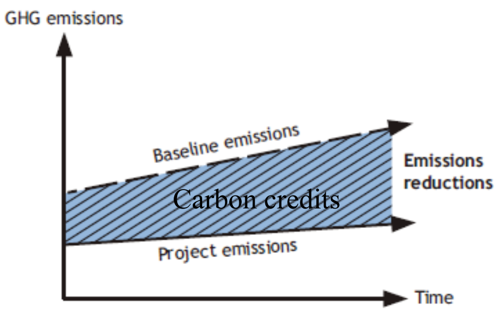
Winning strategy: buy certificates to reduce total cost to meet your reduction target

Size of Emission Trading systems - existing in 2015



The systems to create carbon credits /2

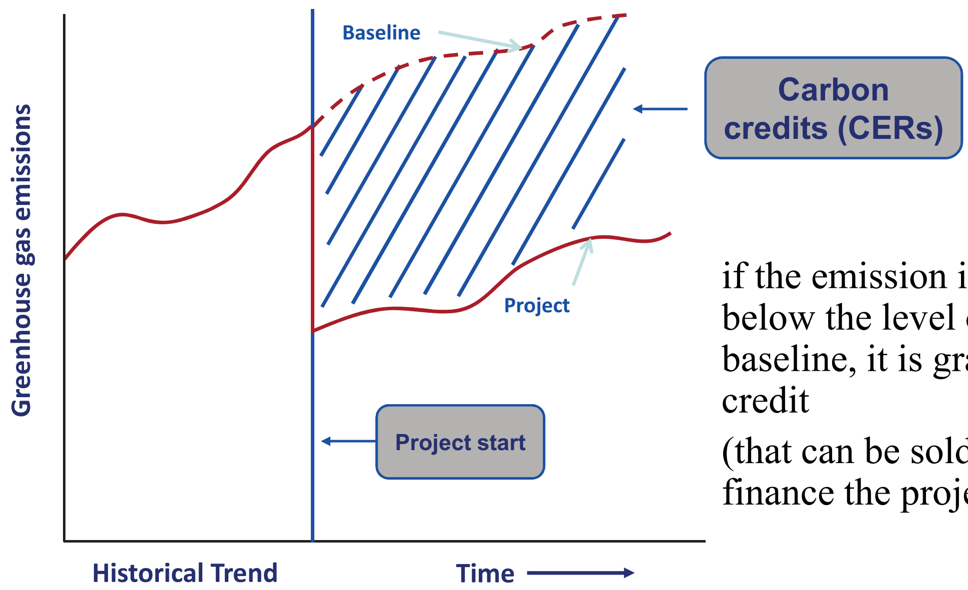
<u>BASELINE AND CREDIT</u> <u>(Project based)</u>



Baseline and credit

No maximum limit is set for total emissions

A comparison is made between a reference level (baseline) and the actual level of emissions with the project



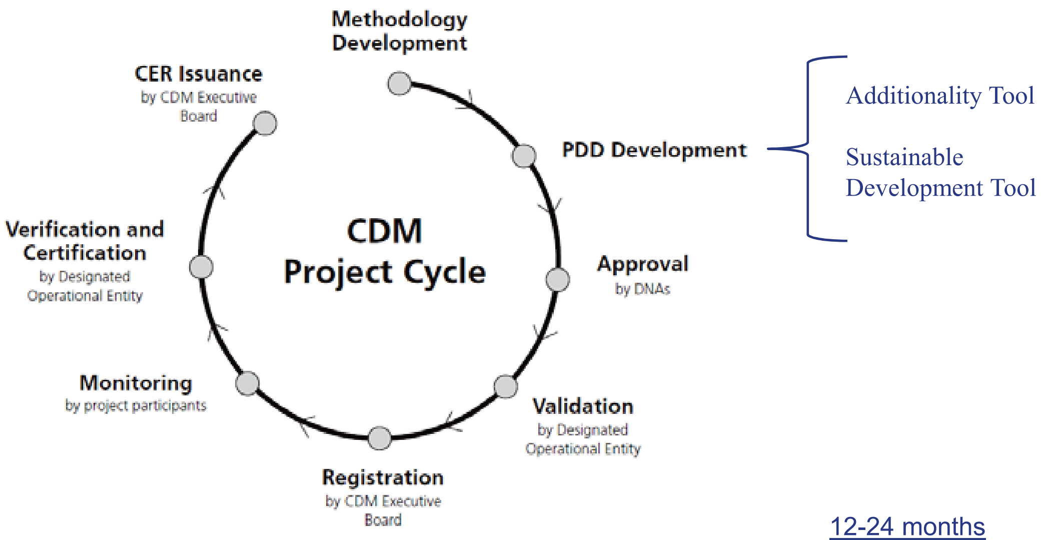
if the emission is reduced below the level of the baseline, it is granted a credit

(that can be sold to finance the project)

Examples of CDM projects

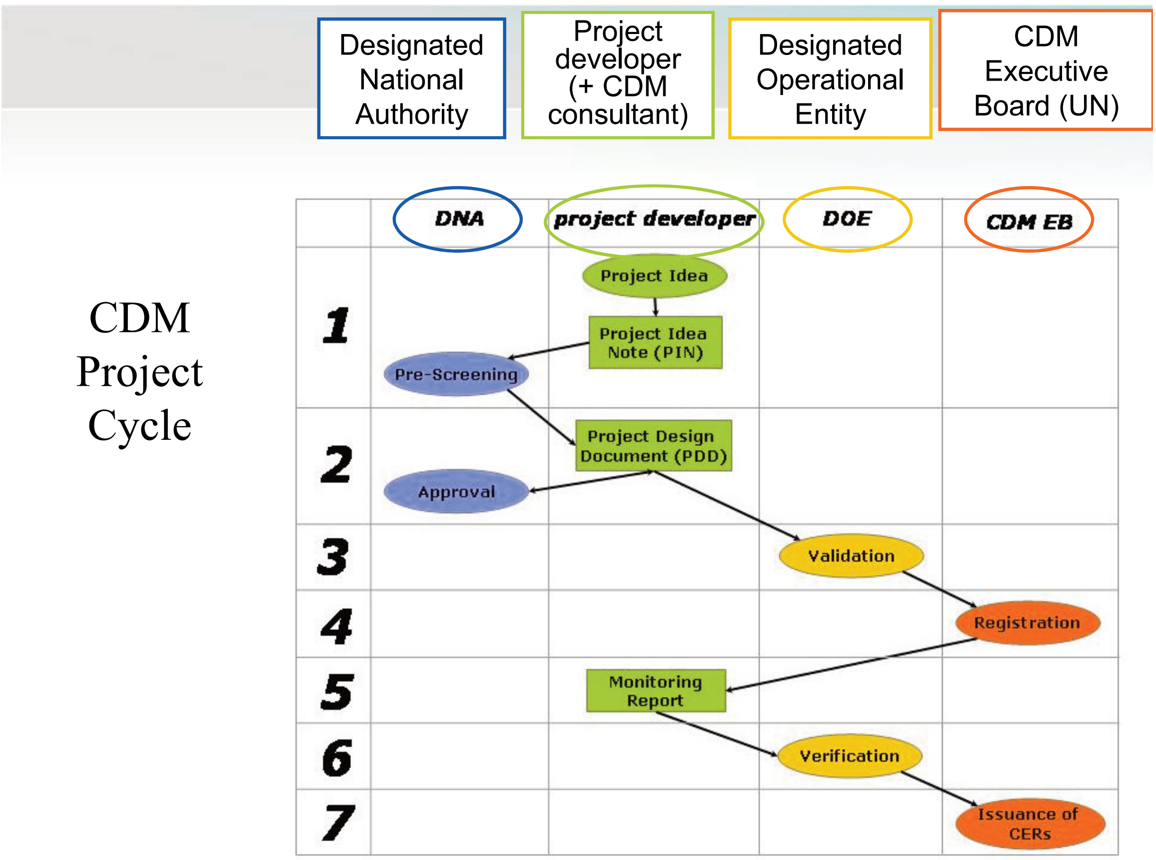
Vale do Rosario Bagasse Cogeneration (VRBC) Project	renewable energy supply side grid connected project activity
Salvador da Bahia Landfill Gas Project	Landfill gas reduction project
NovaGerar landfill Gas to Energy Project	Fugitive gas capture and alternative/renewable energy
HFC Decomposition Project in Ulsan	Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride
Durban Landfill-gas-to-electricity project	Fugitive gas capture and renewable energy
Graneros Plant Fuel Switching Project	Switching fossil fuels
A.T. Biopower rice husk power project	Renewable energy project: grid-connected electricity generation
CERUPT methodology for landfill gas recovery	Landfill gas recovery
El Gallo Hydroelctric Project	Renewable electricity generation in grid connected applications

CDM project cycle



12-24 months

Methodologies describe how to measure baseline and project manure management change and fuel substitution, how to monitor and verify baseline and project situation, how to calculate emission reductions.



How do CDM Projects work? 1/4

Detailed guide on the CDM from CDM Watch: www.cdmwatch.org

- Someone decides to present an application
- Project documents have to be produced
  - Explanation how the project will reduce emissions of greenhouse gases (e.g. without this project electricity would have been generated using a coal power plant or a diesel generator)
  - Calculation / estimation of how much greenhouse gas would have been released without the project
  - Based on that, calculate how much emissions the project will save
- Many of these documents are very technical and are produced with the help of Northern-based consultancies
- The documentation is also supposed to include a description of how 'stakeholders' have been consulted
- The project also should explain how it contributes to 'sustainable development'

How do CDM Projects work? 2/4

- The project also needs a letter of approval from the hosting country that the project contributes to sustainable development

- There are then two more approvals before the project is accepted as a CDM Project and can sell its carbon credits:
- The methodology that is used to explain why the project reduces emissions and that calculates how much CO2 would have been released without the project
- This approval is meant to ensure that projects were not already planned anyways but that they are new projects that will create additional emission reductions ('additionality")
- Additionality is the process of determining whether a proposed activity is better than a specified baseline, will produce some "extra good" in the future relative to a reference scenario, which we refer to as a baseline.

The key questions are: how do we define what is "extra" and to what is this "extra" measured against?

Legislative additionality

Technological additionality

Financial additionality

Uncertainty in the baseline

Uncertainty in the monitoring

Uncertainty in the implementation

Double counting: The same emission reduction or financial flow could be counted more than once

The environmental integrity of project-based mechanisms has been subject to controversial debate and extensive research

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- Brown S. (2002) Measuring, monitoring, and verification of carbon benefits for forest-based projects. Philosophical Transactions: Mathematical, Physical and Engineering Sciences,. 360, 1797.
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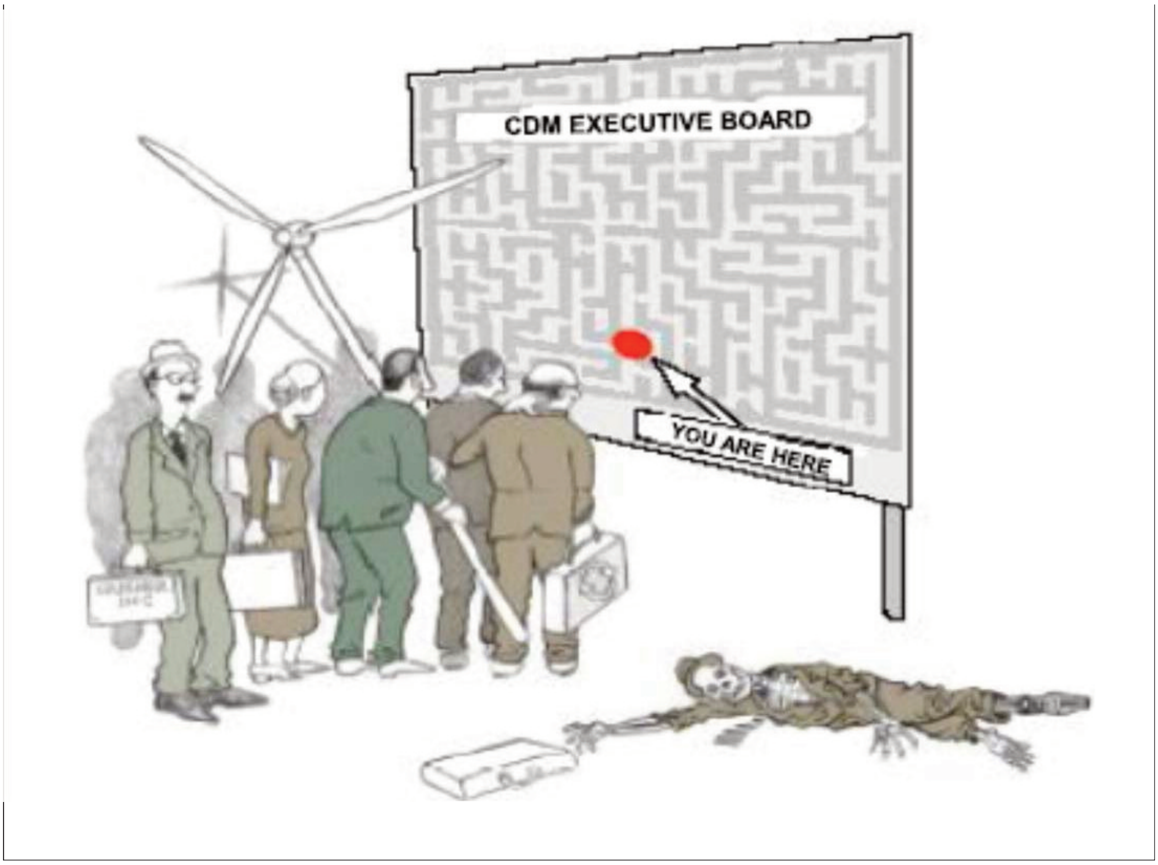
- Gillenwater M. (2012a) What is additionality? Part 1: a long standing problem. Part 2: a framework for more precise definitions and standardized approaches. GHG Management Institute, Discussion Papers.
- Greiner S., Michaelowa A. (2003) Defining investment additionality for CDM projects--practical approaches. Energy Policy 31(10): 1007-1015.
- Kollmuss A., Schneider L., Zhezherin V. (2015) Has Joint Implementation reduced GHG emissions? Lessons learned for the design of carbon market mechanisms. S.E.I. Working Paper 2015-07
- Mason CF, Plantinga A.J. (2013) The additionality problem with offsets: Optimal contracts for carbon sequestration in forests. Journal of Environmental Economics and Management, 66, 1-14.
- Millard-Ball A., Ortolano L. (2010) Constructing carbon offsets: the obstacles to quantifying emission reductions. Energy Policy 38: 533-546
- Moosa V. et al. (2012) Climate change, carbon markets and the CDM: a call to action, Report of the High-Level Panel on the CDM Policy Dialogue.
- Schneider L. (2009) Assessing the additionality of CDM projects: Practical experiences and lessons learned. Clim. Policy 9, 242–254
- Sutter C., Parreño J.C. (2007) Does the current CDM deliver its sustainable development claim? An analysis of officially registered CDM projects. Climatic Change, 84.
- VCS (2012) Double counting: clarification of rules. Voluntary Carbon Standard Policy Brief, 1 Feb.2012.

How do CDM Projects work? 3/4

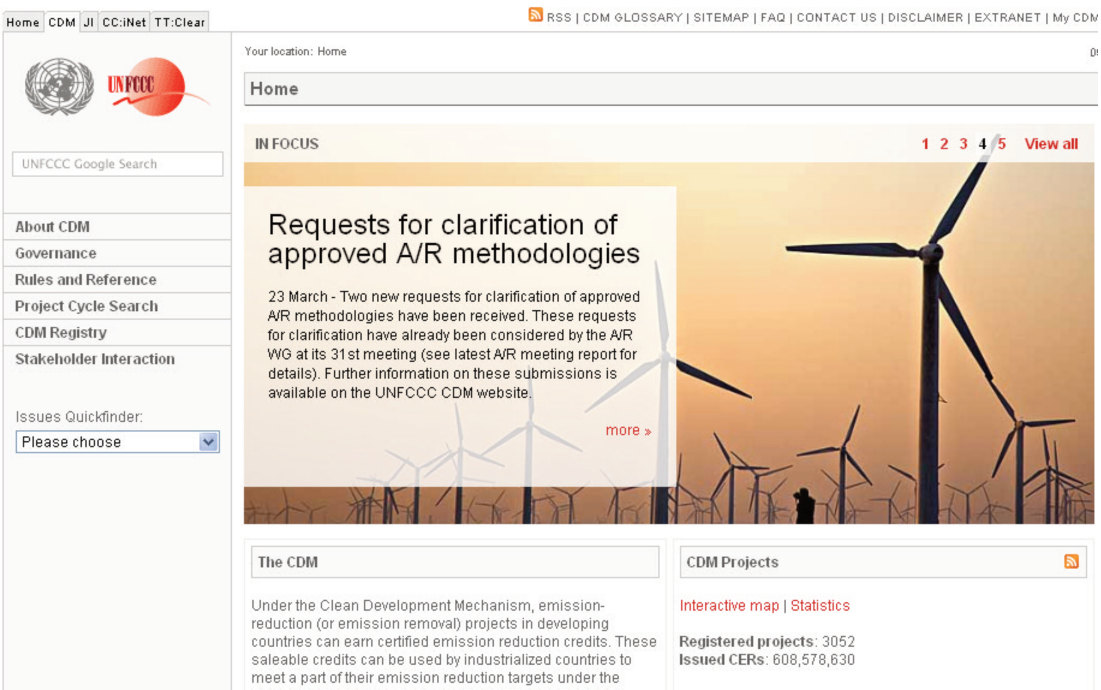
- The public can comment during 30 days of when a note is placed on the web that a project has submitted these documents for approval
- If this approval is given, the project moves to the next step: It submits all its documents for ‘validation’. There is again a 30 day public comment period from the day the validator sends out note
- Environmental and social concerns alone are not enough for a validator to reject a project
- If a project also receives this approval, then it will now only need to get a certificate that testifies that no more greenhouse gas has been released than stated in the documents and that compared to what would have happened without the project, x tonnes of CO_2 have been ‘saved’ from release.
- These ‘saved’ tonnes are called carbon credit
- They are then sold to a company or government in an industrialised country

How do CDM Projects work? 4/4

- And the company in the industrialised country can ‘cash’ in the credits – or pollution rights - by using fossil fuel it would otherwise not have been able to use because it has to reduce its emissions by 5% until 2012.
- In the case of a plantation, the company in the industrialised country then has bought the rights to this tree (the carbon that makes up its wood and roots) for the time for which the carbon credit is valid.
- If the tree burns or is cut, the project might have to re-pay the carbon debt it now owes to the company in the industrialised country, which had bought the credit for that carbon that was supposed to be saved in the tree.
- Some contracts say that the lost credits have to be replaced at the price of the credits at the time when the tree burns. This is likely to be more than the company paid when it bought the credit.

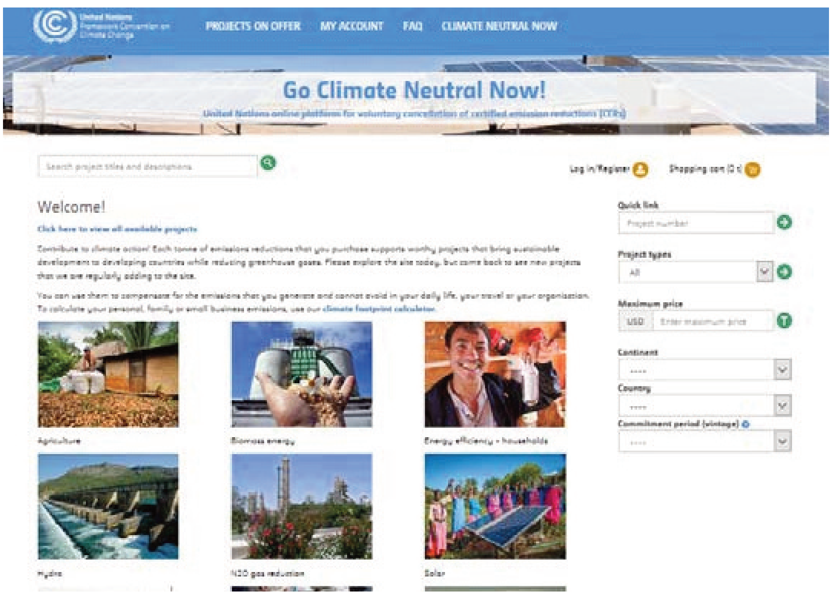


http://cdm.unfccc.int



- **CERs (UNFCCC- CDM, Clean development mechanism)**
- Largest, most widely recognized offset mechanism in the world
- Almost 8000 registered projects in 93 countries
- 300 programmes of activities in 64 countries
- Total 1.4 billion credits issued to date; further 1.4 to 6.2 billion emission reductions by 2020
- Estimated USD 315 billion in capital investment in climate change mitigation and sustainable development
- Saved countries USD 3.6 billion in compliance costs
- Contributed to development of 110 gigawatts of new renewable energy capacity

UNFCCC created a portal to offer the public the credits of the CDM projects
https://offset.climateneutralnow.org/



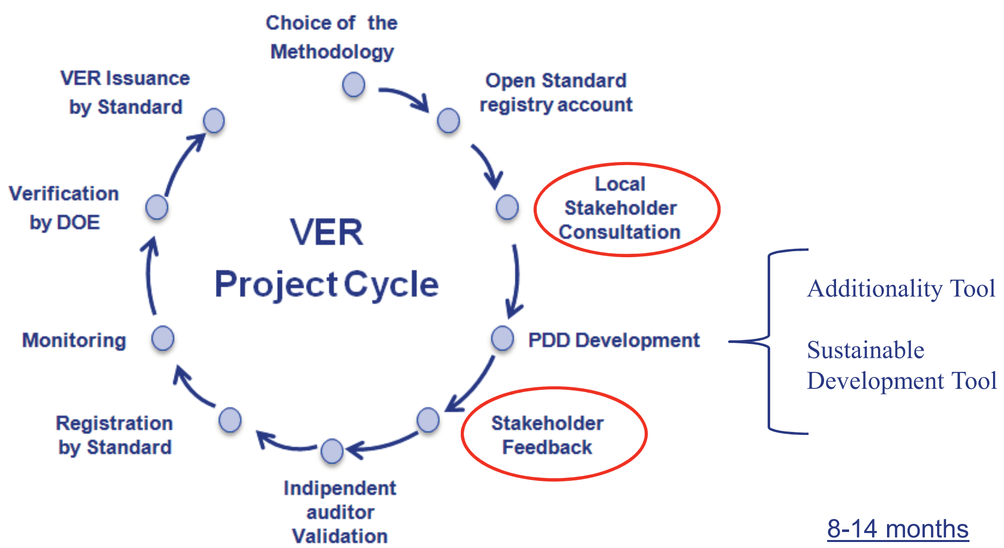
Voluntary markets: the motivations

The most common type of voluntary carbon trading is when individuals, organizations or companies buy GHG emission offsets to reduce their “carbon footprint” .

- the credits of the voluntary market are called VER (verified emission reductions)
- purely voluntary offset buyers are driven by a variety of considerations related to Corporate Social Responsibility (CSR), Public Relation (PR), ethics, and reputational or supply chain risk
- even if standards and voluntary certification systems were born, the rules are not clear and shared rules as in the regulated market, there is less transparency, more stability
- there is a problem of "double counting" with the interventions of the official market or with other incentive systems to reduce the emissions from States

VER project cycle

24

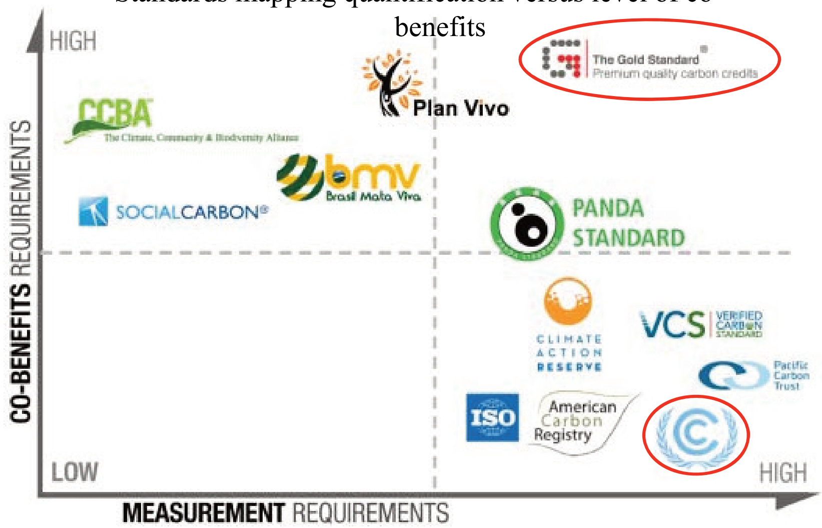


- Host Country approval not required

Certification Standards

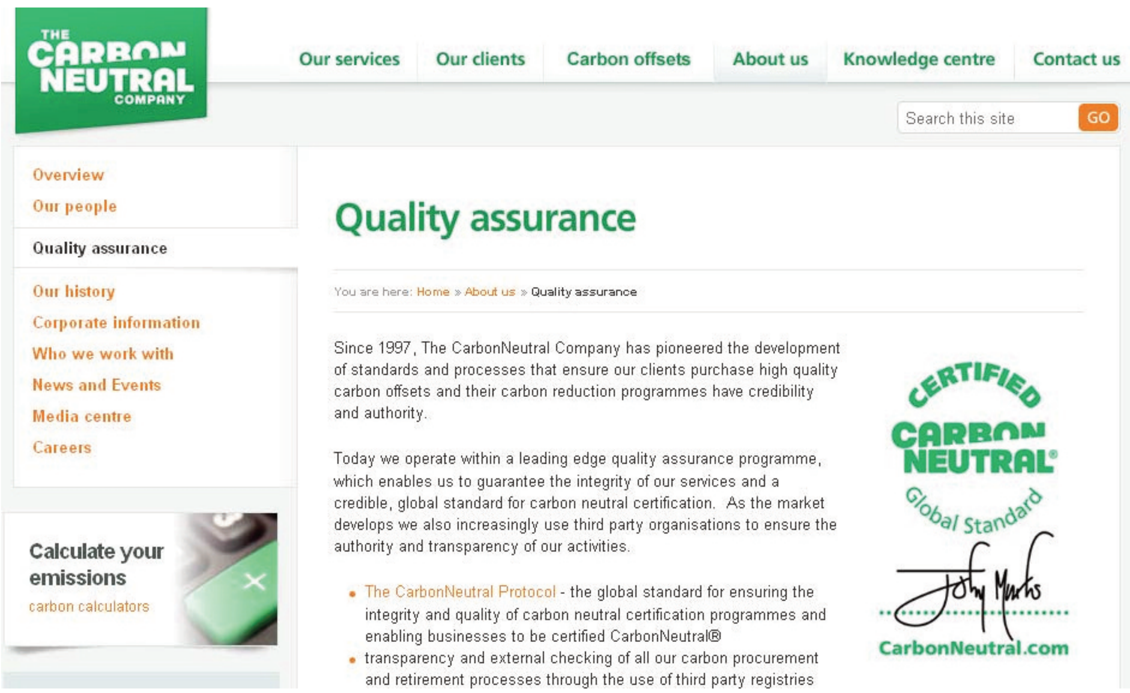
Certification Standards give assurance to purchasers that credits are valid, are not double counted and contribute to sustainable development.

Standards mapping quantification versus level of co-benefits

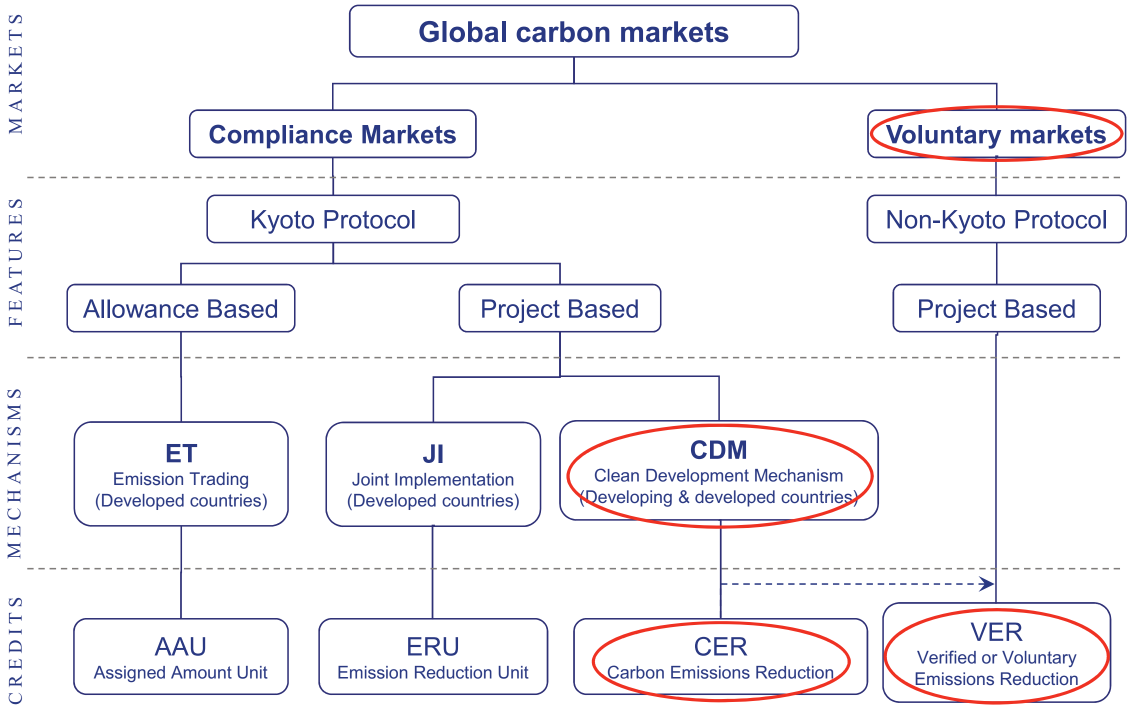


Source: NetBalance Foundation

A number of quality systems have arisen which should guarantee checks and verify the effective realization of the compensations

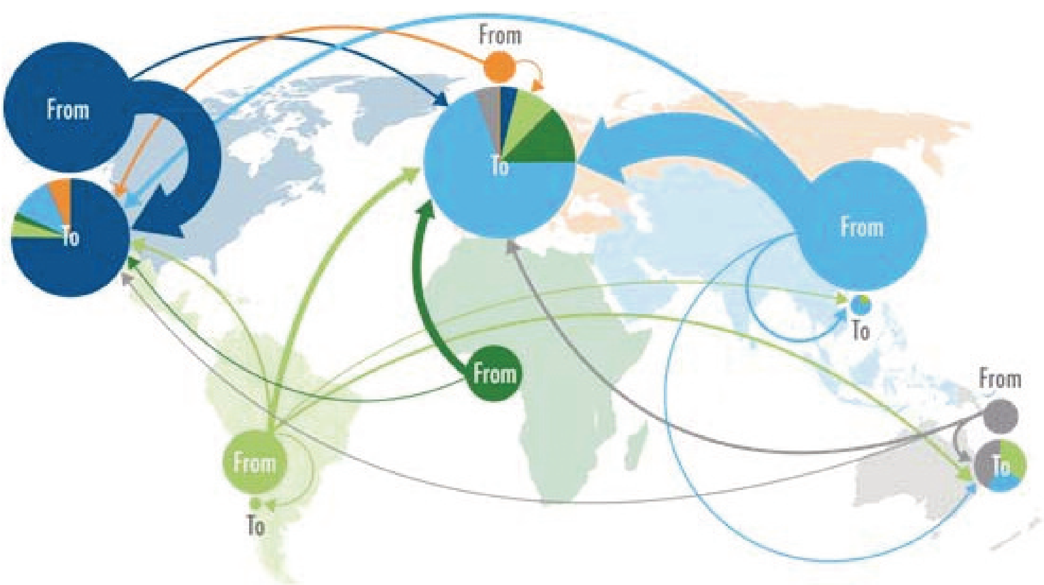


Carbon markets structure



Voluntary markets in the world

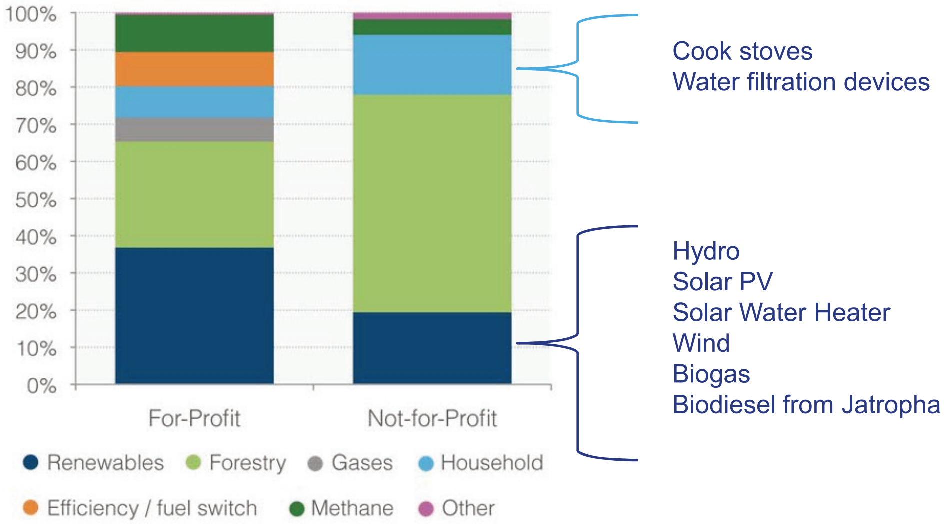
Flow of Transacted Volumes



Source: Ecosystem Marketplace-Bloomberg

Typical NGOs' projects

Market share by project category and supplier profit status



Source: Ecosystem Marketplace-Bloomberg

Method of analysis

- Choice of the certification standard: GOLD STANDARD
- Choice of the methodologies under CDM and GS VER
- Choice of crediting period: 7 YEARS

- Estimation of emission reductions:

$$ER_y = BE_y – PE_y - LE_y$$

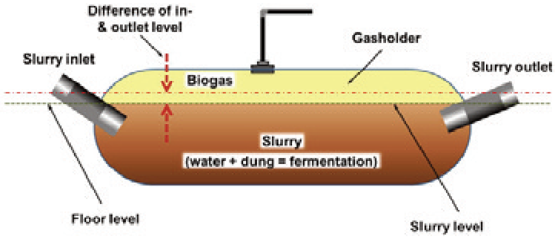
ER_y	Emission Reductions in the year y (tCO_2e/y)
BE_y	Baseline emissions in the year y (tCO_2e/y)
PE_y	Project emissions in the year y (tCO_2e/y)
LE_y	Leakage emissions in the year y (tCO2e/y)

$PE_y = 0$ for most renewable energy project. (Ex-ante evaluation)
$LE_y = 0$ because project devices are transferred from a site near the project location

- Price scenarios
- Transaction costs
- Potential impact of economic revenue

Case study: Biogas plant

Biogas
NGO Promoter: LVIA
Beneficiaries: 8400
Distribution of 1400 plastic biogas digester



Input data
- Biogas plant volume: 4 m^3
- Biogas per HH per day: 1 m^3/HH/day
- Biogas composition: 56% CH_4
- Energy output: 6 kWh/day/plant
- Number of cattle per household: 3 cattle/HH
- Fuel substitution: fire wood and kerosene
- Budget (LVIA data): 430000 EUR

Hypothesis
- Biogas life time: 7 years
- HH percentage of usage: 100%

CDM Methodology for biogas plant

Methodology: CDM AMS I-E Switch from non-renewable biomass for thermal applications by the user

$$B_y = HG_{p,y} / (NCV_{biomass} * \eta_{old})$$

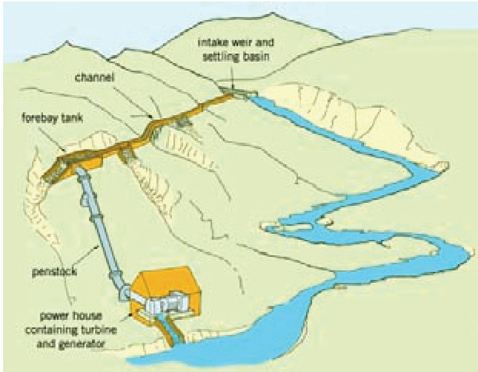
B_y	Quantity of woody biomass that is substituted or displaced (t_{wood}/y)
$HG_{p,y}$	Quantity of thermal energy generated by the new renewable energy technology in the project (TJ)
$NCV_{biomass}$	Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.015 TJ/t)
η_{old}	Efficiency of the system being replaced

$$ER_y = B_y * f_{NRB,y} * NCV_{biomass} * EF_{projected\_fossilfuel}$$

ER_y	Emission Reductions during the year y in tCO_2e
$f_{NRB,y}$	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non-renewable biomass (default value for Ethiopia 0,88)
$EF_{fossilfuel}$	Emission factor for the substitution of non-renewable woody biomass by similar consumers. (Default value 81.6 tCO_2/TJ)

Case study: Hydro - Ethiopia

Hydro run-of-river - Ethiopia
NGO Promoter: LVIA
Beneficiaries: 18500
Installation of 5 Pico and 5 Micro-Hydro power plants



Input data

- Installed Power: 5 kW Pico, 15 kW Micro
- Working hours per day: 16 h/day
- Working days per year: 280 day/y
- Fuel substitution: kerosene
- Budget (LVIA data): 570000 EUR

Hypothesis

- Installation of hydro plants
  1st year: 2 Pico,1 Micro; 2nd y:10 plants

Hydro and PV – CDM methodology

Methodology: CDM AMS I-A Electricity generation by the user

$$E_{BL,y} = \sum_i EG_{i,y} / (1 - l)$$

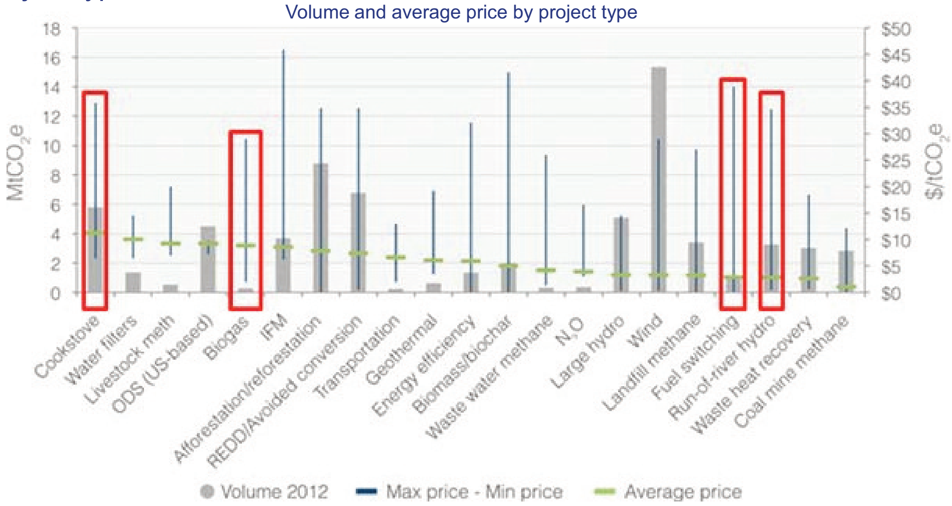
$E_{BL,y}$ Annual energy baseline (kWh/y)
$EG_{L,y}$ Annual output of the renewable energy technologies installed (kWh/y)
l Average technical distribution losses that would have been observed in diesel powered mini-grids installed in isolated areas (10%)

$$BE_{CO2,y} = E_{BL,y} * EF_{CO2}$$

$BE_{CO2,y}$ Emissions in the baseline in year y (tCO_2/y)
EF_{CO2} CO_2 emission factor; tCO_2/kWh

Price scenarios

- By project type:



- By project scale: Micro scale (<5000 tCO_2) 9 EUR/tCO_2e for VER
- By certification: Price of Gold Standard CDM is 30% more than Gold Standard VER

Source: Ecosystem Marketplace-Bloomberg

- Which is the right carbon market for NGOs ?
  - ✓ The voluntary market continues to grow. Forecast 2020: 1,67 billion EUR
  - ✓ GS for small scale energy projects allows smallest transaction costs and ensures to meet sustainable development requirements.
  - ✓ CDM is more credible than VER projects.

- Can carbon finance support NGOs’ energy projects in developing countries ?
  - ✓ Different methodologies result in a different number of carbon credits because of the date and version of the methods. Methodologies could be improved.
  - ✓ Analysis of carbon revenue highlights the advantage for NGOs of accessing carbon finance through the dissemination of improved cook stoves or biogas digesters. Only PV is disadvantaged for high project costs.
  - ✓ Carbon markets promote access to modern fuel, instead of electricity.

Initiative "4 x 1000 Soils for Food Security and Climate".

First global objective of soil management linked to climate change

Launched during the COP21 in Paris by the French Minister of Agriculture

Offset in climate change policies: many advantages

- Reduction of the overall mitigation costs.
- Facilitating the transition toward a low-GHG economy.
- Lower-cost reduction opportunities in uncapped sectors.
- GHG reduction by emission sources not addressed by traditional command-and-control regulation.
- Significant driver of new, innovative technologies.
- Promotion of technology and knowledge transfer between the developed and developing worlds.
- Other environmental, social, and economic co-benefits.
- Deep decarbonization in the Post –Kyoto era needs new tools and strategies

Offset in climate change policies: some problems

- Critical point have been documented in many offset projects, even in those apparently more reliable.
- Many existing offset projects does not really reach the goal of reducing emissions as expected.
- Problems of additionality, double counting, leakages, transparency and lack of independent controls.
- If individual projects are not linked to a serious long-term policy, they can not really achieve their results.

The Great Carbon Offset Swindle

How Carbon Credits are Gutting the Kyoto Protocol,
and Why They Must Be Scrapped

It is a global shell game, a cheats' charter that is increasing greenhouse gas emissions while transferring billions of dollars from consumers and taxpayers to undeserving project developers and a growing army of carbon brokers and consultants.

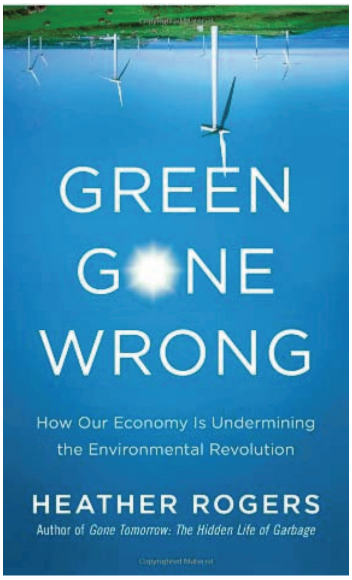
International Rivers, 2008

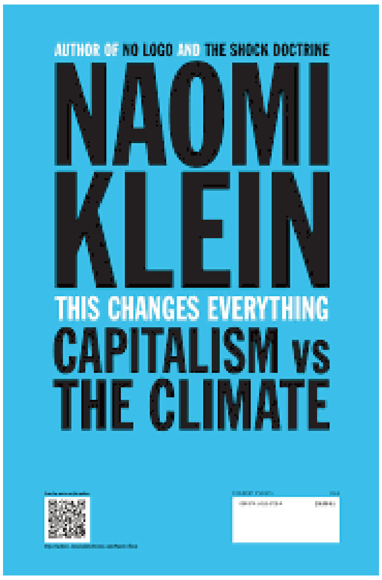
A DANGEROUS DISTRACTION

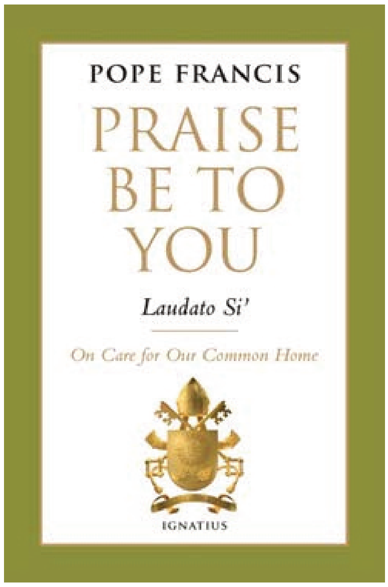
WHY OFFSETS ARE A MISTAKE THE U.S. CANNOT AFFORD TO MAKE

"offsetting does not work, will not work and must be scrapped."

Friends of the Earth, September 2009







"The environment is one of those goods that the market mechanisms are not able to defend or promote adequately"

Selling Indulgences
The trade in carbon offsets is an excuse for business as usual
George Monbiot, 2006

And while the carbon we release by flying or driving is certain and verifiable, the carbon absorbed by offset projects is less attestable... To claim a carbon saving, you also need to demonstrate that these projects would not have happened without you…
In other words, you must look into a counterfactual future. I have yet to meet someone from a carbon offset company who possesses supernatural powers.

Ron Barrett

To move forward

- More consultation and partecipation from stakeholders (prior to and during the implementation), i.e. in developing countries
- Effective and transparent communications and surveys
- Certification cheaper and easier
- Increase collaboration between standard bodies
- Additionality important if the aim is to generate additional emission reductions, but less important than in compliance market
- Government endorsement
- Policy frameworks to ensure long term mitigation
- Positive lists for technologies with an high up scaling and innovation potential, or highest likelihood of additionality
- Negative lists for technology with risk of carbon lock-in
- Ex-post monitoring and verification by third party
- Cancelation of emission credits - registries

REDD mechanism

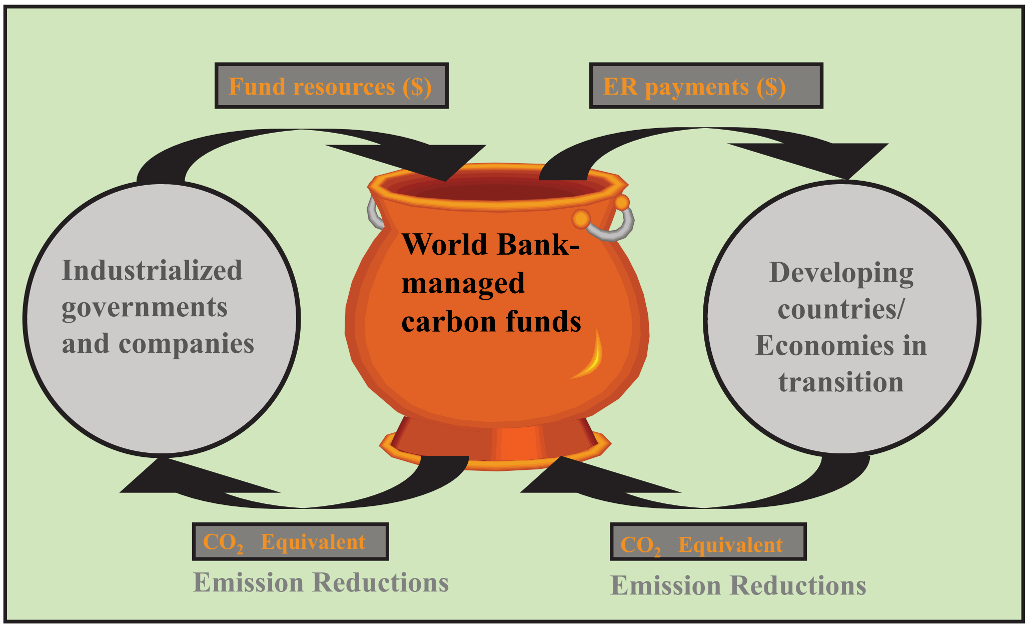
(*Reducing Emisssions from Deforestation and Degradation of Forest)*

Objective: mitigating climate change through reducing net emissions of greenhouse gases through enhanced forest management in developing countries.

REDD+ (or REDD-plus) refers to "reducing emissions from deforestation and forest degradation in developing countries, and the role of **conservation, sustainable management of forests, and enhancement of forest carbon stocks** in developing countries"

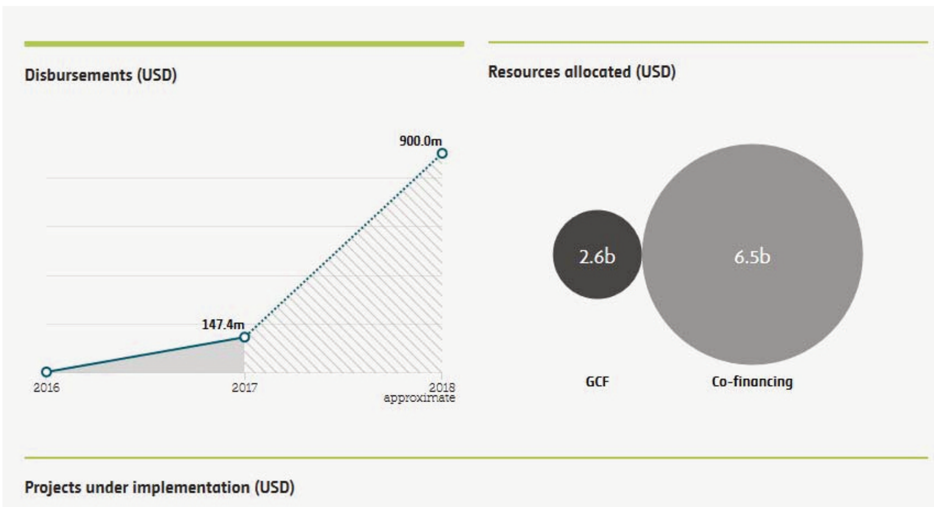
All developing countries aiming to undertake REDD+ should:
(a) Develop a national strategy or action plan;
(b) Develop a national forest reference emission level and/or forest reference level
(c) A robust and transparent national forest monitoring system for the monitoring and reporting on REDD+ activities
(d) A system for providing information on how the social and environmental safeguards (included in an appendix to the decision) are being addressed and respected throughout the implementation of REDD+

How carbon funds work



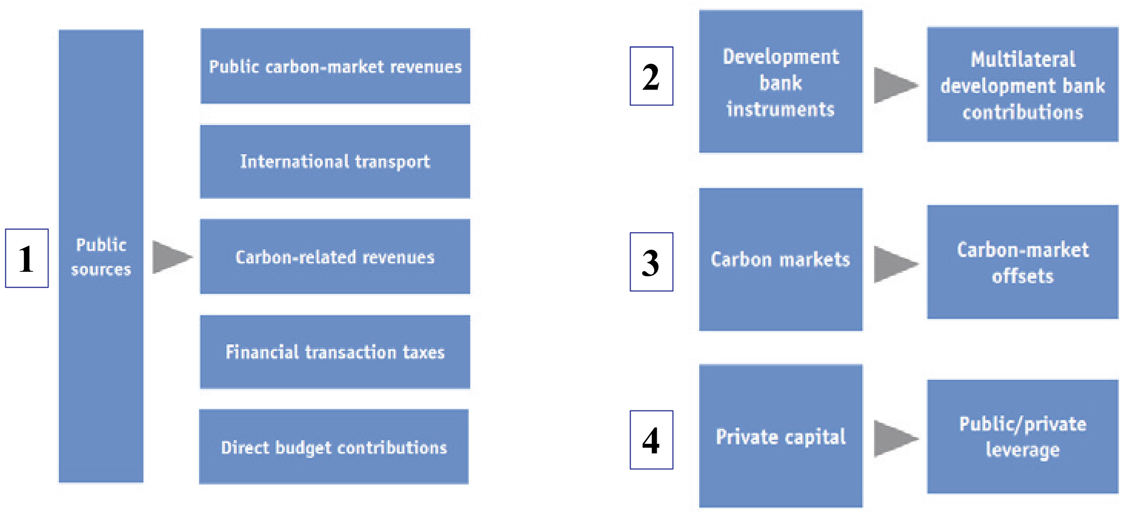
The Green Climate Fund (GCF) is a financial mechanism under the UNFCCC, created to support the efforts of developing countries to respond to the challenge of climate change

When the Paris Agreement was reached in 2015, the Green Climate Fund was given an important role in serving the agreement and supporting the goal of keeping climate change well below 2 degrees Celsius



- The GCF created an extensive support programme which has the main purpose of facilitating the building and strengthening of national institutions in developing countries, in order to enable those countries to implement projects on their own.
- More than 50 national, international and regional institutions have been accredited to submit project proposals.
- Some challenges remain: direct access for developing countries so far remains restricted
- One reason for the slow progress concerning the direct access can be found in the insufficient capacity of the GCF-secretariat.
- The secretariat does not only consider project and accreditation proposals and answers questions regarding the complex GCF procedures and forms; is also involved in the follow-up process to further assistance and supervision of the institutions.
- To fulfil its duties the secretary lacks the necessary resources.

Four type of potential sources of finance



Source: Report of the Secretary-General's High-level Advisory Group on Climate change Financing. United Nation,

Addis Ababa, Ethiopia

February 27th - March 2nd, 2018

RES4AFRICA
RENEWABLE ENERGY SOLUTIONS FOR AFRICA

Bocconi

Prof. Miriam Allena

United Nations
Framework Convention on
Climate Change

- The "**Earth Summit" in Rio de Janeiro, 1992:**

The ultimate objective of the Convention is to stabilize greenhouse gas concentrations in the atmosphere «*at a level that would prevent dangerous anthropogenic interference with the climate system* …»

«*Such a level should be achieved within a time-frame sufficient to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner*»

United Nations
Framework Convention on
Climate Change

- The Parties to the Convention have met annually from 1995 in **Conferences of the Parties (COP)** to assess progresses in dealing with climate change (Berlin, 1995; Geneva, 1996; Kyoto 1997; Buenos Aires, 1998, Bonn, 1999, the Ague, 2000, Marrakech 2001, New Delhi, 2002, Milan, 2003, Buenos Aires, 2004, Montreal, 2005, Nairobi, 2006, Bali, 2007, Copenhagen, 2009, Cancun, 2010, Durban, 2011, Doha, 2012, Warsaw, 2013, Lima, 2014, Paris, 2015, Marrakech, 2016, Bonn, 2017

United Nations
Framework Convention on
Climate Change

- Art. 3.1 UNFCCC: «*The parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differenciated responsibilities and respective capabilities. Accordingly, the developed countries should take the lead in combating climate change and the adverse effects thereof*»

- Art. 3.3 UNFCCC: Parties «*should take measures to anticipate, prevent or minimize the causes of climate change and mitigate its advers effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as an excuse for postponing action*» (the PRECAUTIONARY PRINCIPLE)

- **All parties** (both developed and developing) **agreed to share information** on their emissions and removal of GHGs, to prepare annual GHGs inventories (according to **international IPCC guidelines**), **to formulate national programmes containing mitigation measures and to cooperate** in the development and transfer of technology

The Kyoto Protocol to the UNFCCC, 1997

- Structured around two fundamental premises:

1. A prescriptive, quantitative, time-bound approach to addressing climate problems

- **Legally binding obligations** for developed countries to cut their GHG emissions — up to 5% below 1990 levels — in the period 2008-2012

2. The **principle of common but differentiated responsibilities**

- More than 100 developing countries, including China and India, were exempted from the Treaty

- The US has not ratified the Treaty. Canada withdrew in 2012

The Kyoto Compliance System

- One of the strongest and most sophisticated system of compliance ever adopted by any Multilateral Environmental Agreement (**MEA**)

- It combines two complementary approaches to compliance:

a) A **facilitative approach** (which aims to provide advice, assistance and facilitation to Parties in order to promote compliance)
b) A **sanction-based approach** (the 'hard' compliance approach)

A LEGALLY BINDING, TOP-DOWN and RESULT-BASED APPROACH

The Protocol sets an *ex-ante* basis environmental objective which can be effectively enforced through a compliance mechanism

The Kyoto Compliance System

- Facilitative compliance: through financial and technical assistance (seek to promote compliance *ex ante*), technology transfer, capacity building, persuasion, cooperation (ex. by providing 'early warning' of potential non compliance)

- **Enforcing compliance**: through coercion, sanctions

What non being compliant means?
-specific emission targets for some Parties
-timetables for their achievements

Multilateral Environmental Agreement

- Can we rely on States to implement their international environmental commitments?

- Environmental agreements are build on reciprocity (if Canada can violate its commitments under the Kyoto Protocol and get away with it, what assurance is there that others will comply?)

- **How to enforce a MEA?**

- Domestic legal systems can enforce rules through sanctions. In international law who can impose sanctions?
- The injured State reaction is not working with global environmental issues such as climate change

The reaction of the injured country

The Trail Smelter dispute

«No State has the right to use or permit to use of its territory in a manner as to cause injury by fumes in or to the territory of another …»

Sources: UNEP/GRID-Arendal, European Environment Agency; AMAP Assessment Report : Arctic Pollution Issues, Arctic Monitoring and Assessment Programme (AMAP), 1998, Oslo; European Monitoring and Evaluation Programme (EMEP); Co-operative programme for monitoring and evaluation of the long range transmission of air pollutants in Europe, 1999. Adapted from *Le Monde Diplomatique, July 2000.*

How to effectively implement MEAs?

- **Huge discrepancy between commitments and action**

The weakness of compliance Mechanisms in climate change MEAs: the <u>'Achilles' heel</u>' of International environmental Law?

How to effectively implement MEAs?

- A different track from enforcement: the attempt to **encourage and facilitate compliance**
- By helping countries to draft implementing legislation
- By setting guidelines for the implementation of the MEA
- By providing financial or technical assistance
- By identifying the cause of non-compliance (Why do States fail to comply with their international obligations? Why do they make commitments and then fail to do what they promised?)

Climate compliance mechanisms: new trends

- **From hard to soft law**
- Promote future compliance rather than remedy past non-compliance (sanctions can have an important deterrent or preventive function rather than a retributive purpose)
- Focus on procedural commitments, self-reporting

<u>**A poor means of evaluating compliance?**</u>

- Are developing countries capable to comply with methodological and reporting requirements?
- What role for non-State actors?

- Community pressure, international accountability
- Enforcement efforts shift to the domestic level (legal character of domestic rules, role of domestic institutions)

The path towards the Paris Agreement

The negotiations towards a 2015 climate agreement focused on two key questions:

- **How to secure the participation of all major emitters?**

- **How to ensure that the commitments adopted by countries will be respected?**

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The Paris Agreement

- The Paris Agreement relies on a **pledge and review architecture**

-Countries VOLUNTARY COMMIT themselves to limit carbon emissions
-Countries have to REPORT PERIODICALLY and their efforts and results are periodically reviewed and assessed

- A **bottom-up** approach which leaves **a very wide margin of discretion to States** on how to contribute to tackle climate change

UNDER THE PARIS AGREEMENT, **EMISSION REDUCTION** TARGETS ARE **POLITICALLY BINDING, BUT NOT LEGALLY BINDING**

ON THE CONTRARY, **REPORTING AND VERIFICATION MECHANISMS ARE LEGALLY BINDING**!!

The Paris Agreement

- **States agreed to limit the global temperature increase to 'well below' 2° C** (compared to pre-industrial levels), **and to pursue efforts to limit global warming to 1.5° C**

- Since the beginning of the industrial revolution, atmospheric concentrations of carbon dioxide (CO2) - the principal GHG - have risen from about 280 parts per million (PPM) to more than 400 pm

- Achievement of the 2° C would likely require to stabilize GHG concentrations at no more than 450 ppm and global emissions to peak and then fall by 40-70% by 2050

- The aim is «*to achieve a balance between anthropogenic GHG emissions and removals by sinks of GHG in the second half of this century*»

Capacity-building

According to art. 11 of the Paris Agreement, it is **the capacity** and ability **of developing countries to take effective climate change action** (i.e., the capacity to implement adaptation and mitigation actions, to facilitate technology development and access to climate finance, to improve climate education and public awareness, to ensure timely and accurate communication of information.

Developed countries should support CAPACITY BUILDING ACTIONS in developing countries

Capacity-building is essential to enable developing countries to participate fully and to implement the UNFCCC

MRV of GHG mitigation

- The UNFCCC laid the foundation for the current system of reporting of information

Art. 12.4 of the Convention obliges all Parties to report information relevant to the implementation of the Convention (including on their GHG emissions and removals by sinks). **This is done through National Communications (NCs)**

- Over the decades, **a more structured approach to measurement and reporting was elaborated**

Parties adopted a number of decisions detailing guidance on reporting (on the content and frequency of NCs and on the content of BURs), as well as on the **financial and technical support to be provided to help non-Annex I Parties to meet their reporting obligations**

MRV of GHG mitigation

- In 1996, Parties adopted detailed guidelines for the preparation of NCs from both developed and developing countries (for the first time, the scope, structure and content of the information to be reported were defined)
- COP 8 (Delhi, 2002) adopted revised guidelines for the preparation of NCs
- Until **COP 13 (Bali, 2007),** NCs of developing countries were not subject to VERIFICATION: **MRV was extended to developing countries**
- **COP 16 (Cancun, 2010) established that:**

- Developed countries have to submit **GHG inventory annually** + NC (every 4 years) and BUR (every 2 years)
- Developing countries should submit **NCs every 4 years** and **BUR every 2 years**

Measurement

- **Measurement** entails direct physical measurement of GHG emissions (as well as measurement of estimating emissions or emissions reductions) and collecting information about support needed and received for climate change

- Guidelines for NCs for developing countries stress the need «*to encourage the presentation of information in a **consistent, transparent and comparable, as well as flexible, manner**, taking into account **specific national circumstances***»

- BURs are intended as an update to NCs, providing more recent information. Guidelines for BURs allow flexibility so as to appropriately reflect the «*capacities, time constraints, data availabilities and the level of support provided*»

Reporting

- **Reporting** means focusing on the steps States have taken to implement their commitments (information on implementing legislation as well as on national measures taken to enforce this legislation)

It is implemented through GHG inventories (developed countries only), NCs and BURs (both developed and developing countries)

Reporting on mitigation actions (NCs guidelines)
«*Based on national circumstances, non-Annex I Parties are encouraged to provide, to the extent their capacities allow, information on programmes and measures implemented or planned which contribute to mitigating climate change … Including, as appropriate, relevant information by key sectors on methodologies, scenarios, results …*»

Verification

- **Verification of information** (contained both in NCs and BURs) may be conducted at national level before submission to the UNFCCC (voluntary)

- NCs are not subject to international verification. At national level verification is implemented through domestic MRV mechanisms to be established by non-Annex I Parties (General guidelines adopted at COP 19, Warsaw 2013)

- **BURs are subject to verification through International Consultation and Analysis (ICA)**

To increase the transparency of information reported in BURs

Evolving MRV under the Paris Agreement

- Both developed and developing countries have agreed to undertake and communicate their efforts to limit the global temperature increase to well below 2° C and to pursue efforts to limit the temperature increase to 1.5 ° C

- Two main instruments:
- **National Determined Contributions (NDCs)**
- the **Enhanced Transparency Framework (ETF)**

The Paris Agreement and the NDCs

- (**Intended) Nationally determined Contributions (INDCs)** are at the earth of Paris Agreement

All parties have outlined their climate action plans to be implemented starting from 2020

- The **NDC are not legally binding**
- According to art. 4 of the Paris Agreement, countries are mandated to submit updated NDCs **every five years**
- Countries have agreed that the level of ambition to reduce emissions will increase over time (no back-tracking in climate plans)

• Ethiopia submitted its new climate action plan in 2015, well in advance of the UN climate conference in Paris (COP 21)

The Paris Agreement and the NDCs

Art. 4, parr. 13-14, Paris Agreement

«*Parties shall account for their nationally determined contributions. In accounting for anthropogenic emissions and removals corresponding to their nationally determined contributions, Parties shall promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting, in accordance with guidance adopted by the Conference of the Parties (…).*
In the context of their nationally determined contributions, when recognizing and implementing mitigation actions with respect to anthropogenic emissions and removals, Parties should take into account, as appropriate, existing methods and guidance under the Convention»

The Enhanced Transparency Framework (ETF)

Art. 13 Paris Agreement: «*In order to built mutual trust and confidence and to promote effective implementation*, ***an enhanced transparency framework*** *for action and support, with built-in* ***flexibility*** *which takes into account Parties' different capacities and builds upon collective experience is established*»

- The ETF: a significant step in the further evolution of the MRV framework under the UNFCCC. **The ETF will eventually supersede the existing modalities, procedures and guidelines for MRV**

- The purpose of ETF is **to provide a clear understanding of mitigation actions**, **to track progresses** towards NDCs, **to assess collective progresses every 5 years**

Transparency is the backbone of the Paris Agreement!!

The Enhanced Transparency Framework (ETF)

Both developed and developing countries shall:

- **Regularly submit national inventory reports and information on implementation and achievements of NDCs**
- Regularly communicate progresses in implementing capacity building plans, policies, actions, measures

- **Information** on GHG inventories and on implementation and achievement of NDCs **are subject to technical expert review** (in particular, they are be subject to '*facilitative, multilateral consideration*')

Art. 4.2 Paris Agreement: «*Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions*»

The Enhanced Transparency Framework (ETF)

- **The ETF will build on and enhance existing transparency arrangements** under the UNFCCC (**NCs, BURs and related verification processes**)

- There is some flexibility in the stringency of requirements for developing countries

- MRV should be «*voluntary, pragmatic, non-prescriptive, non-intrusive and country-driven, take into account national circumstances and national priorities, respect the diversity of nationally appropriate mitigation actions, build on existing domestic systems and capacities, recognize existing domestic measurement, reporting and verification system and promote a cost-effective approach*» (Guidance on GHG quantification for domestic MRV: the Paris Agreement refers to existing guidance adopted under the UNFCCC)

MRV of livestock GHG emissions

- Livestock GHG emissions account for a significant portion of total GHG emissions in many developing countries (in Ethiopia, 42% of the total GHG emissions)

- In developed countries, GHG emissions from livestock production have declined in the last decades. On the contrary, they have increased significantly in developing countries

- Developing countries' GHG emissions from livestock production is expected to increase in the coming decades (as a consequence of further growth in production and consumption of livestock products)

The impact of CC agriculture

Both drought and floods are already endemic in Ethiopia

-**droughts** destroy farmland and pastures; it can severely affect hydropower generation (Ethiopia's main source of electricity)

-- Agriculture in Ethiopia is heavily dependent on rain: CC is expected to result in 30% less average income in the country in the next 50 years

-**flooding** causes significant damage to settlement and infrastructure; it compromises the quality of crops, especially if the rain occur around harvest time

Climate change increases the natural climate variability, has effects on cropland area and soil erosion-

However, changes in the severity and frequency of drought and flood events are difficult to project (uncertainty and precautionary principle)

How farmers will adapt?

The impact of CC on livestock and crops

- Direct effect (from temperature, humidity and other climate factors that influence animal performance in terms of growth, milk production, wool production)

- Indirect effects: the influence of climate on the quantity and quality of feed (such as pasture, forage, grain) and the incidence of livestock disease and parasites

How famers will adapt to climate change?

The impact of CC on food security

The impact on all 4 dimensions of food security: AVAILABILITY, ACCESS, UTILISATION and STABILITY and over the whole food system

The 2014 IPCC report on food security

Does CC brings opportunities for Ethiopia?

- Benefits for agricultural and livestock production?

- The impact of financial support from industrialized countries on the well-being of the population and the economy

- The importance of preparing, planning, cooperation

- **A climate resilient economy** (the ability to cope with the change brought by climate stresses and shocks: minimize the potential damage and maximize potential benefits)

Ethiopia and its leading role in the response to CC

- At the UNFCCC of 2009, in Copenhagen, he insisted on and obtained the promise of $100 billion per annum from developed to developing countries

- UNFCCC of 2011, in Durban: «*It is not justice to foul the planet because others have fouled it in the past. Africa (…) should take its future development and its environment in its own hands*»

Thank you for your attention!

Canada Announces Exit From Kyoto Climate Treaty
By IAN AUSTEN - DEC. 12, 2011

OTTAWA — Canada said on Monday that it would withdraw from the Kyoto Protocol, the 1997 treaty to reduce greenhouse gas emissions.

Under that accord, major industrialized nations agreed to meet targets for reducing emissions, but mandates were not imposed on developing countries like Brazil, China, India and South Africa. The United States never ratified the treaty.

Canada did commit to the treaty, but the agreement has been fraying. Participants at a United Nations conference in Durban, South Africa, renewed it on Sunday but could not agree on a new accord to replace it.

Instead, the 200 nations represented at the conference agreed to begin a long-term process of negotiating a new treaty, but without resolving a core issue: whether its requirements will apply equally to all countries.

The decision by Canada's Conservative Party government had long been expected. A Liberal Party government negotiated Canada's entry into the agreement, but the Conservative government has never disguised its disdain for the treaty.

In announcing the decision, government officials indicated that the possibility of huge fines for Canada's failure to meet emissions targets had also played a role.

"*Kyoto, for Canada, is in the past*," the environment minister, Peter Kent, told reporters shortly after returning from South Africa. He added that Canada would work toward developing an agreement that includes targets for developing nations, particularly China and India.

"*What we have to look at is all major emitters*," Mr. Kent said.

Under the Kyoto Protocol's rules, Canada must formally give notice of its intention to withdraw by the end of this year or else face penalties after 2012.

The extent of those penalties, as well as Canada's ability to redress its inability to meet the treaty's emission reduction targets, is a matter of some debate.

Mr. Kent said Canada could meet its commitment only through extreme measures, like pulling all motor vehicles from its roads and shutting heat off to every building in the country. He said the Liberal Party had agreed to the treaty "without any regard as to how it would be fulfilled."

He also said the failure to meet the targets would have cost Canada $14 billion in penalties.

Other estimates, however, put the figure at $6 billion to $9 billion. Matt Horne, the director of climate change at the Pembina Institute, a Canadian environmental group, said the financial penalties might have been further reduced by agreeing to additional reductions. He also dismissed Mr. Kent's assertions about the steps that Canada would have had to have taken to meet its commitments as extreme misrepresentations.

"*It's not a surprise that it happened*," Mr. Horne said of the government's decision to withdraw from the treaty. "*But it is a bit of surprise that it happened pretty much as they got off the plane from Durban*."

Stay In or Leave the Paris Climate Deal? Lessons From Kyoto

The *New York Times*, May 9, 2017
By BRAD PLUMER

WASHINGTON — The architects of the Paris climate accord deliberately designed it to be supple, adaptable to the differing political and economic environments of the nearly 200 countries that signed it. The authors were mindful of its predecessor, the Kyoto Protocol, which was roundly rejected by the United States because it set binding emissions targets for wealthy countries while letting most developing nations, including China, off the hook.

But now, as forces within the Trump administration continue to debate whether to leave the Paris agreement, they face a far different calculus. The accord, agreed to in 2015, is largely nonbinding, imposing no serious legal restraints on the United States or any other nation. While that makes the treaty a less rigorous plan to fight global warming, it also means there are few compelling reasons to exit.

That flexible structure has given ammunition to those urging the Trump administration to stick with Paris, a group that includes Ivanka Trump, diplomats like Secretary of State Rex W. Tillerson, and hundreds of corporations. The United States, they argue, can stay within the Paris deal and adjust its domestic plans for cutting greenhouse gas emissions however it sees fit. Staying has little cost. Leaving, by contrast, could result in immense diplomatic blowback, send confusing signals to industry and deprive American diplomats of the ability to influence future talks.

Within the White House, Trump advisers like the chief strategist Stephen K. Bannon have urged the president to follow through on his promise to exit the deal. They have tried to argue that staying in the Paris accord could entangle the United States in a series of legal obligations, much as Kyoto did. But this argument has been rejected by both outside legal scholars and those who fashioned the original deal. Even fossil-fuel companies that sharply opposed Kyoto, like Exxon Mobil, have urged the United States to stick with Paris. In a letter to the White House, Exxon argued that the flexible accord was “an effective framework for addressing the risks of climate change.”

For the negotiators of the Paris agreement, this was all by design. The accord includes more safety valves than the Kyoto deal, so that countries like China and India, which are trying to balance emissions against economic growth, would not be scared off.

“*Paris was designed to be less brittle than Kyoto, so that it could bend without breaking*,” says David G. Victor, professor of international relations at the University of California, San Diego, who had long argued for a Paris-like agreement. “*Whether the Trump administration decides to leave or not will be a big test of that approach*.”

Under the Paris deal, every country submitted a voluntary pledge for how it planned to address climate change, with no penalties for failing to meet those goals. Todd D. Stern, the lead climate negotiator in the Obama administration, said that the voluntary nature of the pledges was intentional. Unlike with Kyoto, nations would not have to submit to emission cuts dictated from above by United Nations negotiators. They could submit plans tailored to their domestic circumstances and would not have to fear being stuck with them if circumstances changed, as happened to Japan in 2011 after a reactor meltdown at Fukushima forced the closing of the country's nuclear fleet.

As part of that deal, the Obama administration pledged to cut domestic greenhouse gas emissions 26 to 28 percent below 2005 levels by 2025 as well as commit up to $3 billion in aid for poorer countries by 2020. China vowed that its emissions would peak around 2030 and that it would get about 20 percent of its electricity from carbon-free sources by then. India would continue to reduce its carbon intensity, or CO_2 output per unit of economic activity, in line with historic levels.

Countries would then meet regularly to assess their progress and increase their ambitions as feasible. While the current pledges would not keep global warming well below 2 degrees Celsius, the agreed-upon goal, there is some evidence that this "soft diplomacy" is nudging countries toward greater action. A recent study from the Grantham Research Institute found that the mere existence of Paris had prodded dozens of countries to enact new clean-energy laws.

With the Trump administration aiming to dismantle a variety of Obama-era climate policies, including the Clean Power Plan, it is unlikely that the United States will be able to meet its earlier goal. Opponents of the Paris deal, including the administrator of the Environmental Protection Agency, Scott Pruitt, have warned that the United States could be on the hook for Mr. Obama's pledge. But legal experts and architects of the treaty say this is not how Paris was designed.

There is no legal obstacle to simply staying in the treaty and submitting a weaker pledge, and even reneging on aid goals.

"*We dealt with this specific question when designing the deal*," Mr. Stern said. "*We didn't want a situation where if something came up and a country couldn't meet its target, they'd have no choice but to leave*."

The Paris deal does still impose a few smaller legal requirements on countries for reporting their progress and submitting fresh plans over time. But, Mr. Stern said, the administration has ample reason to stay in the talks and shape future rules that govern those requirements.

During both the Bush and Obama administrations, for instance, the United States pushed for all countries to adhere to a single set of transparency rules for reporting emissions, while China has long argued for a weaker set for developing countries. If the United States were to leave, it would lose its ability to shape these discussions.

"*If you're interested in pushing China to do more*," Mr. Stern said, "*then the best way to do that is to have us at the table*."

***

In June 2017 President Donald Trump announced his decision to take the U.S. out of the accord: the official process of withdrawal will take more than three years. The U.S. cannot formally leave the accord until 2020: in the interim, the U.S. will continue to participate in UN climate discussions aimed at fleshing out the Paris Agreement.

Climate variability and change implication on Ethiopia's economic development

25 August 2017

The low-level of economic development, combined with a heavy dependence on rain-fed agriculture and high population growth, make Ethiopia particularly vulnerable to the adverse impacts of climate change, writes ***Hadush Kidane Meresa (PhD).***

There is overwhelming evidence that the global climate is changing and projections suggest that the rate of change will likely increase. Warming has occurred across much of Ethiopia and both the frequency and intensity of droughts have increased, inflicting severe damage to the livelihoods of millions of people. At the same time, increases in flooding have stressed social institutions and intensified the vulnerability of households.

Ethiopia is highly vulnerable to climate variability and change as a result of its geographic location, topography, high levels of poverty and heavy dependence on rain-fed agriculture for subsistence and income generation. Many researchers have been addressed that Ethiopia is vulnerable to the effects of climate variability and climate change. This high climate variability and changes are highly exposed to hydro-climate extremes, such as droughts and floods. Such extreme weather and hydrological events hinder economic and social development and cause high numbers of casualties. According to WDI in 2010, 77.5 percent of Ethiopians were estimated to live on less than two dollars a day and 46 percent of the total population was undernourished. Ethiopia's capacity to address poverty, food insecurity and various other socioeconomic problems is highly dependent on the performance of the agriculture sector (UNDP, 2014), as over 80 percent of the population depends on agriculture to make a living.

Meresa et al., 2016, stated that climate change is likely to cause increased variability in rainfall and lead to more frequent and severe flooding and drought events. Mean annual temperature is also projected to increase by 0.8-2.1°C by the 2030s. Small-scale farmers and pastoralists are likely to be significantly affected by these changes in climate, through increased poverty, water scarcity, and food insecurity. Furthermore, Ethiopia, like many developing countries, is exporting primary products (e.g. coffee), which again is highly prone to the effects of climate change and climate extremes. As such, climate impacts on the agriculture sector have the potential to influence Ethiopia's GDP. Similarly, Meresa, et al, 2010, addressed that Ethiopia has been prone to extreme weather variability**.**

Rainfall is highly erratic, most rain falls with high intensity and there is a high degree of variability, temporally and spatially. Since the early 1980s, the country has suffered seven major droughts-five of which have led to a famines-in addition to dozens of local droughts. Currently, a slow-onset natural disaster is evolving, resulting from the failure of the spring *belg* rains, compounded by the arrival of El Niño weather conditions that have weakened the summer *kiremt* rains that feed 80-85 percent of the country. This has greatly expanded food insecurity and malnutrition and devastated livelihoods across the country.

The low-level of economic development, combined with a heavy dependence on rain-fed agriculture and high population growth, make Ethiopia particularly vulnerable to the adverse impacts of climate change. Intense pressure on the country's soil, water and biodiversity resources add to the national challenge of responding to climate variability and change. Climate variability and change, therefore, has the potential to hold back economic progress, or reverse the gains made in Ethiopia's development and could exacerbate social and economic problems.

However, following Ethiopia's bold policy to accelerate development while reducing its vulnerability to climate change, internal and external projects played a leading role in coordinating the preparation and launch of the Climate Resilient Green Economy (CRGE) Facility, the first in Africa, to support this policy/strategy. With the launch of the Facility, Ethiopia is now in a better position to initiate programs, finance mechanism and an institutional setup to pursue a low carbon/emission climate development strategy. Through these funds (national and international) support in the establishment of the National Climate Resilient Green Economy Facility Ethiopia has taken the first step in climate finance readiness.

Having such consensus**, Ethiopia is already committing significant resources to reduce its greenhouse gases and build resilience to the impacts of climate change**, in line with its national development priorities, notably through:

· Intensified natural resource management and afforestation/ reforestation of several million hectares of degraded land, with active voluntary contributions of local communities;

· Investments in a low-emission transport sector, namely the construction of a 5,000 kilometers railway network that will utilize clean energy;

· Increased energy access and power generation from the hydro, wind and solar energy sectors, including the construction and operationalization of the Grand Ethiopian Renaissance Dam amounting to USD four billion generated from domestic sources.

However, despite this investment, Ethiopia still needs to attract and mobilize finance to support its climate compatible development agenda. The country has responded by establishing a national fund, the Climate Resilient Green Economy Facility (CRGE Facility), as a mechanism to mobilize finance from various sources, including domestic and international, and drive investments to build resilience and support green growth.

Ed.'s Note: Hadush Kidane Meresa (PhD) is particularly interested in water resource and climate change. He received his PhD from institutes in Norway and Poland and a Master's Degree in Water Science and Engineering from the Netherlands. The views expressed in this article do not necessarily reflect the views of The Reporter. He can be reached at kidane.hadush@gmail.com.

Global warming brews big trouble in coffee birthplace Ethiopia

Rising temperatures are set to wipe out half of Ethiopia's coffee-growing areas, with loss of certain locations likened to France losing a great wine region

Damian Carrington *Environment editor*
@dpcarrington
The Guardian, Mon 19 Jun 2017

Global warming is likely to wipe out half of the coffee growing area in Ethiopia, the birthplace of the bean, according to a groundbreaking new study. Rising temperatures have already damaged some special areas of origin, with these losses being likened to France losing one of its great wine regions.

Ethiopia's highlands also host a unique treasure trove of wild coffee varieties, meaning new flavour profiles and growing traits could be lost before having been discovered. However, the new research also reveals that if a massive programme of moving plantations up hillsides to cooler altitudes were feasible, coffee production could actually increase.

Coffee vies with tea as the world's favourite beverage and employs 100 million people worldwide in farming the beans alone. But climate change is coffee's greatest long-term threat, killing plantations or reducing bean quality and allowing the deadly coffee leaf rust fungus to thrive. Without major action both in the coffee industry and in slashing greenhouse gas emissions, coffee is predicted to become more expensive and worse-tasting.

The research combined climate-change computer modelling with detailed measurements of current ground conditions, gathered in fieldwork that covered a total distance of 30,000km within Ethiopia. It found that 40-60% of today's coffee growing areas in Ethiopia would be unsuitable by the end of the century under a range of likely warming scenarios.

But the study, published in the journal Nature Plants, also shows that major relocation programmes could preserve or even expand the country's coffee-growing areas. "There is a pathway to resilience, even under climate change," said Aaron Davis, at the Royal Botanic Gardens Kew in the UK, who conducted the work with Ethiopian scientists. "But it is a hugely daunting task. Millions of farmers would have to change."

However, by 2040, such moves uphill will have reached the top of Ethiopia's mountains. "It literally reaches the ceiling, because you don't have any higher place to go," Davis said.

The impacts of global warming are already being seen as temperatures have been rising steadily in Ethiopia for decades. Farmers report a longer, more extreme dry season and more intense rain in the wet season, with good harvests much less frequent than in their parents and grandparents' time.

One famous coffee location likely to be lost is Harar. "In one area, there are hundreds if not thousands of hectares of dead trees," said Davis. "It is a world renowned name and has been grown in that area for many centuries. But under all [climate change] scenarios, it's going to get worse.

"Some of the origins, what you would call terroir in the wine industry, will disappear, unless serious intervention is undertaken," he said. "It would be like losing the Burgundy wine region. Those areas are found nowhere else but Ethiopia, and because of the genetic diversity, the diversity of flavour profiles is globally unique."

Both arabica and robusta coffee originated in Ethiopia and wild arabica plants are virtually unknown outside the country. The wild arabica varieties may well harbour traits for disease and drought

resistance that could prove vital for the future health of coffee crops.
Prof Sebsebe Demissew, from the University of Addis Ababa and one of the research team, said: “Coffee originates from the highland forests of Ethiopia, and it is our gift to the world. As Ethiopia is the main natural storehouse of arabica genetic diversity, what happens in Ethiopia could have long-term impacts for coffee farming globally.”
The new research is a “brilliant piece of work”, according to Tim Schilling, chief executive of the World Coffee Research programme: “This is the only comprehensive, country-specific study I have seen that uses some of the best methods in climate modelling coupled to very rigorous ground-truthing – extremely useful for governments and industry and a model to be repeated.”
Schilling led an expedition into South Sudan in 2013 to confirm wild arabica coffee was also present in the Boma forest: “What we found was major degradation caused by climate change on the forest and the wild coffee under its canopy. That is pretty much what I think we can expect if nothing is done to preserve the arabica genetic treasure chest in Ethiopia.”
Schilling said new varieties and growing methods must be developed and that plantation “migration will have to be part of a plan B”. He added: “Plan C might be moving up in latitude and growing coffee in Southern France and Texas!” But he said funding all this is difficult when coffee producers are not making much money at present.
The Intergovernmental Panel on Climate Change concluded in 2014: “The overall predictions are for a reduction in area suitable for coffee production by 2050 in all countries studied. In many cases, the area suitable for production would decrease considerably with increases of temperature of only 2-2.5C.” It said that in Brazil, the world’s biggest coffee producer, a temperature rise of 3C would slash the area suitable for coffee by two-thirds in the principal growing states. In 2016, other researchers predicted climate change will halve the world’s coffee-growing area.
“People should also be thinking about the millions of smallholder farmers who put their coffee on the table,” said Davis. “The coffee farmers of Ethiopia are really on the frontline [of climate change] – they are the people who will pay the price first. In the longer term, the only truly sustainable solution is to combat the root causes of climate change.”

Ethiopia has commendable role in climate diplomacy, green development
07 Dec 2017, The Ethiopian Herald

Despite being a developing country, Ethiopia has been playing a leading role in climate change negotiations. It has become a country that is engaged in successful climate diplomacy so that the voice of developing countries is heard in various international arenas. Ethiopia is also a model country in implementing a green economy development strategy.

One of the key factors that enabled the country to play a key role in climate negotiations is the fact that it has integrated climate into its domestic development and foreign policies and strategies. This strong commitment has earned the country a voice in international climate negotiations.

Many agree that Ethiopia has been among the proactive countries in the process of ratifying the Paris Climate Change Agreement. Though the adoption of the agreement is historic by itself, it does not mean that the mission is accomplished as the continuing climate change is posing threat on the lives of billions across the world. That is why the country has shifted its diplomatic engagement to keeping the momentum of the agreements so that they are swiftly implemented.

In the recent global Cope 23 climate change negotiation which was held in Bonn Germany, Ethiopia successfully led as a Chair, some 47 climate change vulnerable developing countries that are suffering from the severe consequences despite their insignificant contribution to global warming.

Ethiopia is also a member of the group that represented the African continent in global climate change negotiations. The group holds a firm position that the compensation financial support and other technical support to cope with the impacts of climate change should be improved.

One of the success stories of the climate change negotiations is the fact that developed countries agreed to pay 90 million USD as compensation payment for climate change. They also pledged additional 100 million to developing countries that are severely harmed by the impacts of climate change.

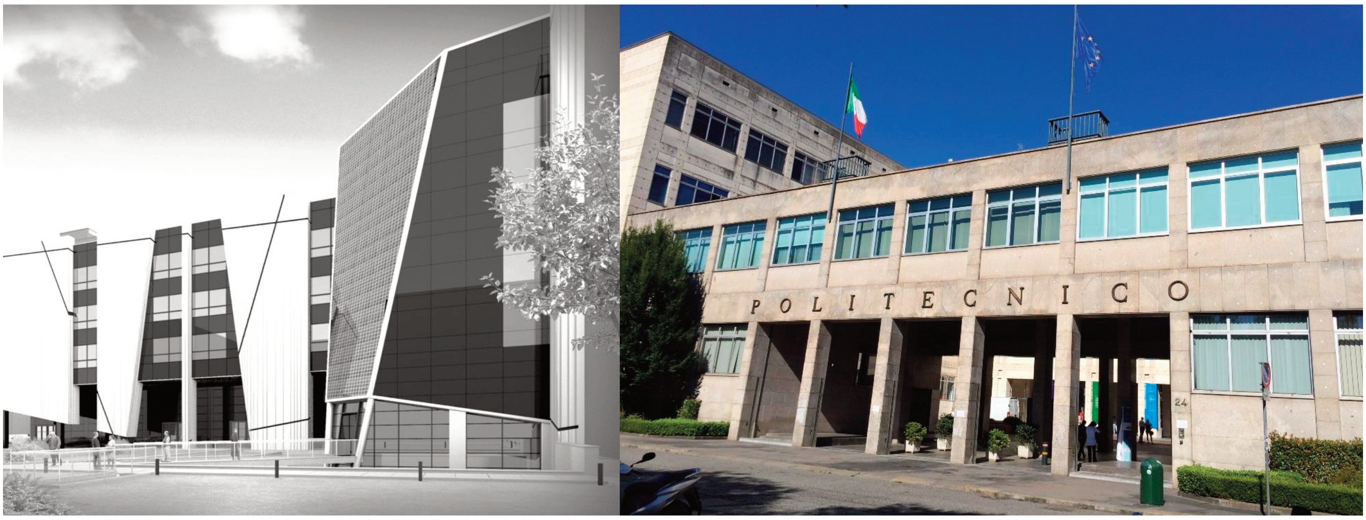
Locally, the government has prepared a National Adaptation Programme of Action (NAPA) and Climate Resilient Green Economy Strategy to avert the impact of climate change on the country's economy.

The government has also demonstrated its commitment to the green economic development through its environment friendly projects such as the expansion of renewable energy for industry and transportation (railways operation). This commitment has also been demonstrated by the extensive rural environmental rehabilitation works.

Various awareness creation programs regarding desertification and environmental rehabilitation works such as reforestation and afforestation have been taking place country wide. As a result, the country's forest coverage has reached 15 percent, which was at an all time low of less than 4 percent almost two decades ago.

Having such strong commitment, developing countries like Ethiopia still need better economic and technological capacity to upgrade their coping mechanisms. Hence, developed nations need to step up their support as per their promises in the Sendai Framework on Disaster Risk Reduction, the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change.

But Ethiopia should exert maximum effort to mobilize local resources, both the public and private sectors and above all its huge human resource potential to further pursuit its ambition to become an advocate of green economic development.



State of the art of clean energy solutions – Technology assessment and strategy development

Policy responses to climate change: sustainable development and energy transition

Prof. Pierluigi LEONE

Outline

- Tracking clean energy progress
- Renewable energy in power, transport, heating sectors
- Challenges of high renewable sources penetration
- Renewables in Ethiopia
- Renewable energy cost trends

Two terrifying messages for the future in our hands

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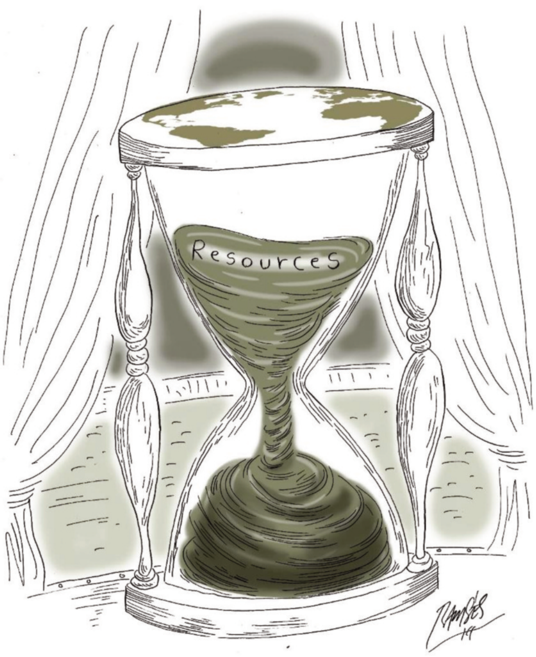
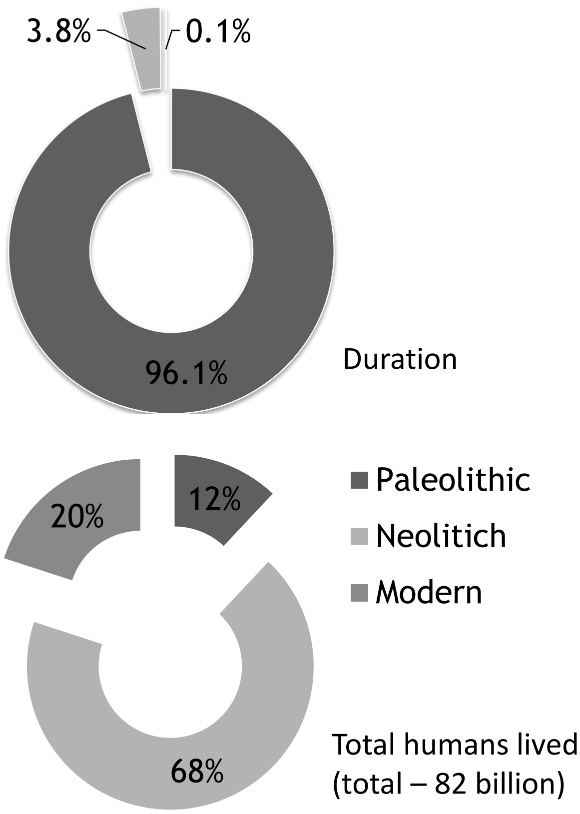
Ecosystem pressure





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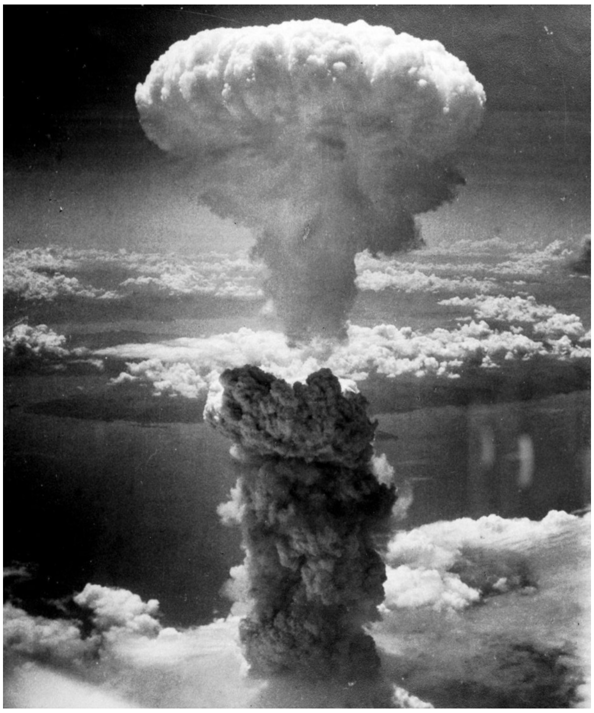
Climate change threats



Radiative forcing

↓

1,000,000

Hiroshima bombs in a day for 365 days

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Humankind at the center of the energy transition

Dr. Strangelove or: How I Learned to Stop Worrying and Love the Bomb (1964), From https://www.flickr.com/photos/tom-margie/4050083521

2001 Space Odyssey - the dawn of man (1968),

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Tracking clean energy progress

POLITECNICO
DI TORINO

Key numbers - Reference technology scenario

+50%	Global final energy demand at 2060 compared to 2014
+16%	CO_2 emissions at 2060 compared to 2014
2.7 °C	Average temperature increase by 2100

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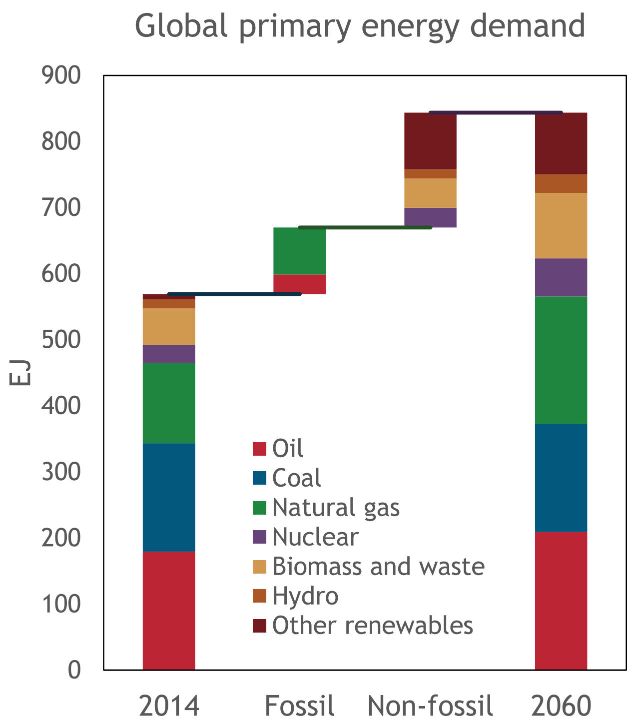
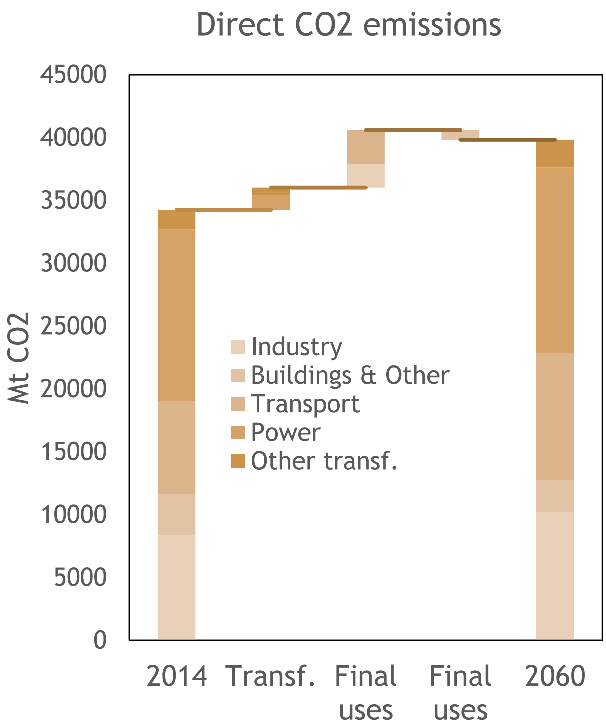
DI TORINO

'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Global primary energy demand and CO_2 emissions - RTS





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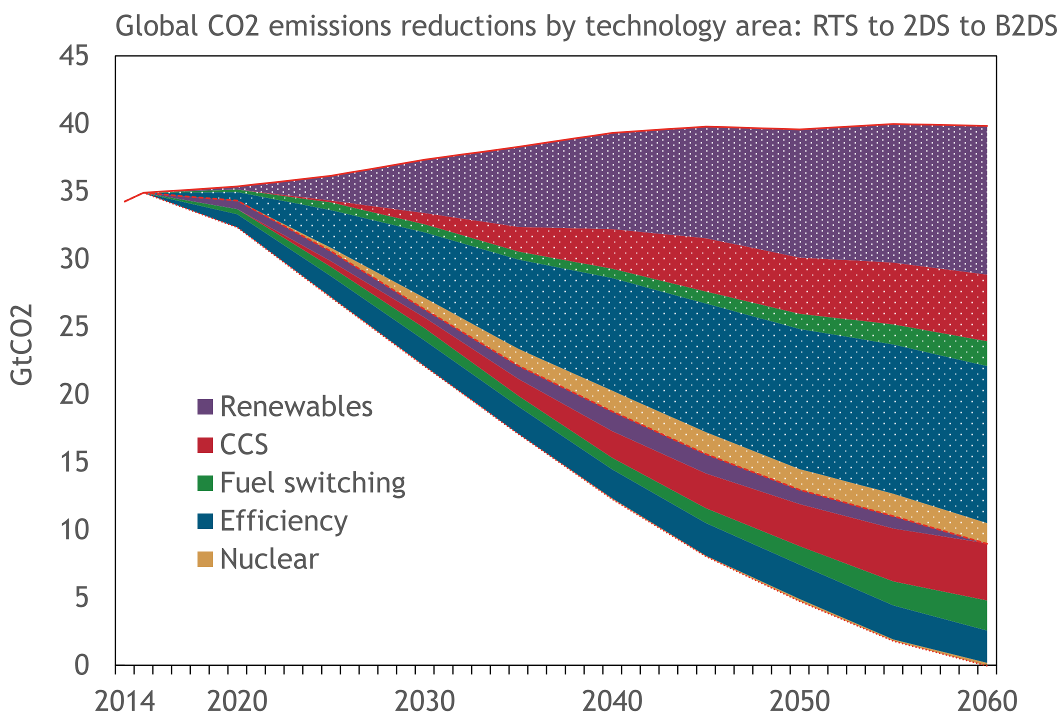
'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Global CO2 emission reductions



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'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Tracking clean energy progress: energy supply

POLITECNICO DI TORINO

ENERGY CENTER

Key numbers - Energy supply

Renewable power	24% - Share of renewables in global power generation in 2016 165 GW - World renewables new capacity in 2016 4.4 GW - SSA renewables new capacity in 2016
Nuclear power	11% - Share of nuclear in global power generation in 2016 10 GW - World nuclear new capacity in 2016 10 - Countries with nuclear programs in INDCs
Natural gas-fired power	3° - Global electricity generation source 4 – Typical reduction of capacity factors
Coal-fired power	41% - Global electricity generation 84 GW – new coal-fired capacity in 2015
Carbon capture and storage	30 $MtCO_2$ – Potential annual capture rate 9.3 $MtCO_2$ – Proven capture

POLITECNICO DI TORINO

ENERGY CENTER

Elaboration from 'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Key policies - Energy supply

Renewable power	Stable, predictable and sustainable policy frameoworks Infrastructure challenges and market design to improve grid integration Reduce cost of finacing and off-taker risk
Nuclear power	Energy incentive schemes Reduce investments risks due to uncertainties
Natural gas-fired power	Carbon pricing Maximum emission caps Capacity markets
Coal-fired power	Carbon price Pollution control
Carbon capture and storage	Public and private investments Infrastructure

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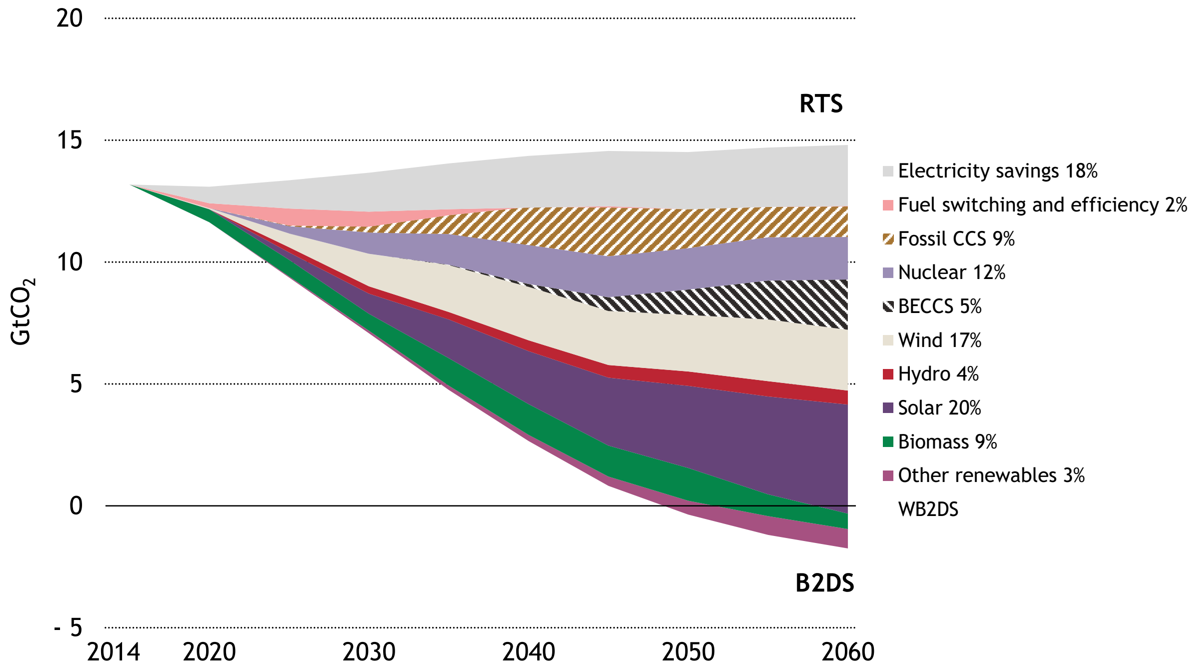
Elaboration from 'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Electricity generation



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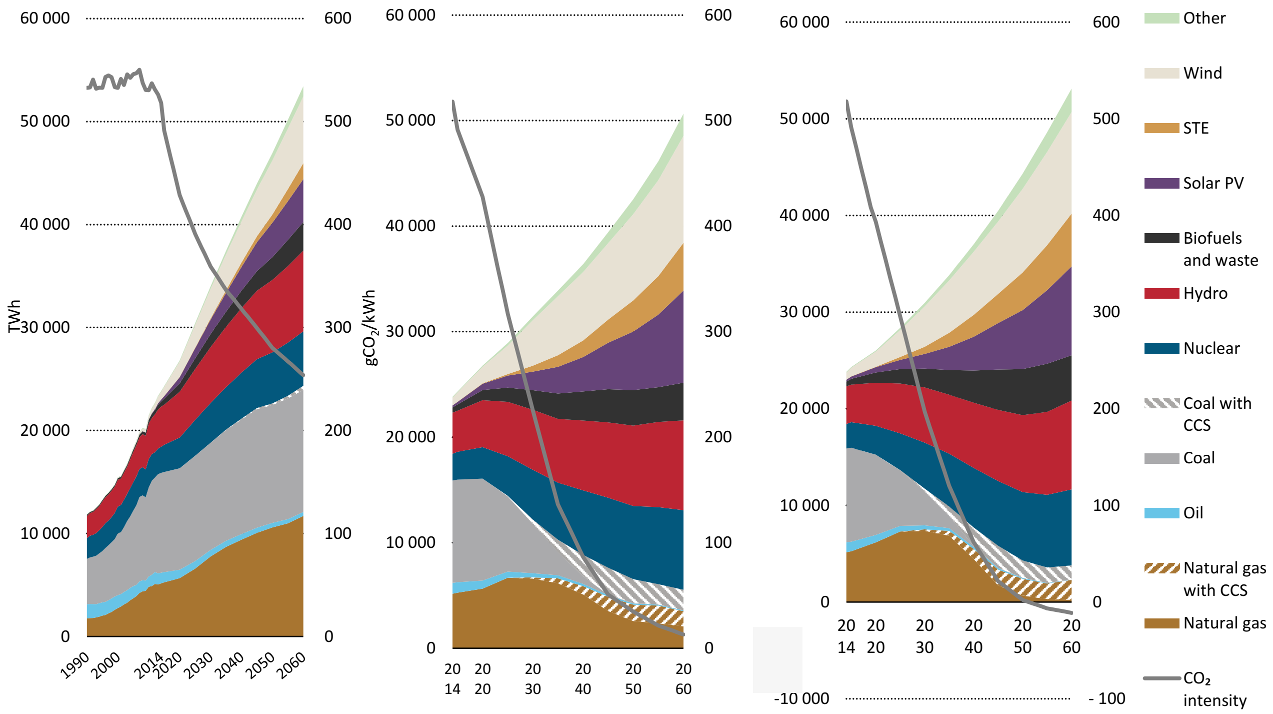
'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Electricity generation



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'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Tracking clean energy progress: energy demand

ENERGY CENTER POLITECNICO DI TORINO

Key numbers - Energy demand

Industry	38% - Share of global industry sector in final energy consumption 42% - Share of global industry sector in final electricity demand 24% - Share of global industry sector in global energy-related CO_2 emissions
Building	30% - Share of global building sector in final energy consumption 53% - Share of global building sector in final electricity demand 26% - Share of global building sector in global energy-related CO_2 emissions
Transport	28% - Share of global transport sector in final energy consumption 1.6% - Share of global transport sector in final electricity demand 23% - Share of global transport sector in global energy-related CO_2 emissions

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Elaboration from 'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Key policies - Energy demand

Industry	Energy efficiency and BAT Material efficiency Fuel and feedstock switching Low-carbon innovation Transition to low carbon energy systems
Building	Building energy codes MEPS Policy and markets incentives Prevent carbon lock-in
Transport	Fuel and vehicle taxes ZEV mandates Regulatory limits Fuel economy/GHG emissions Access restrictions. Differentiated road pricing and parking fees Suitable infrastructure Promoting ITS

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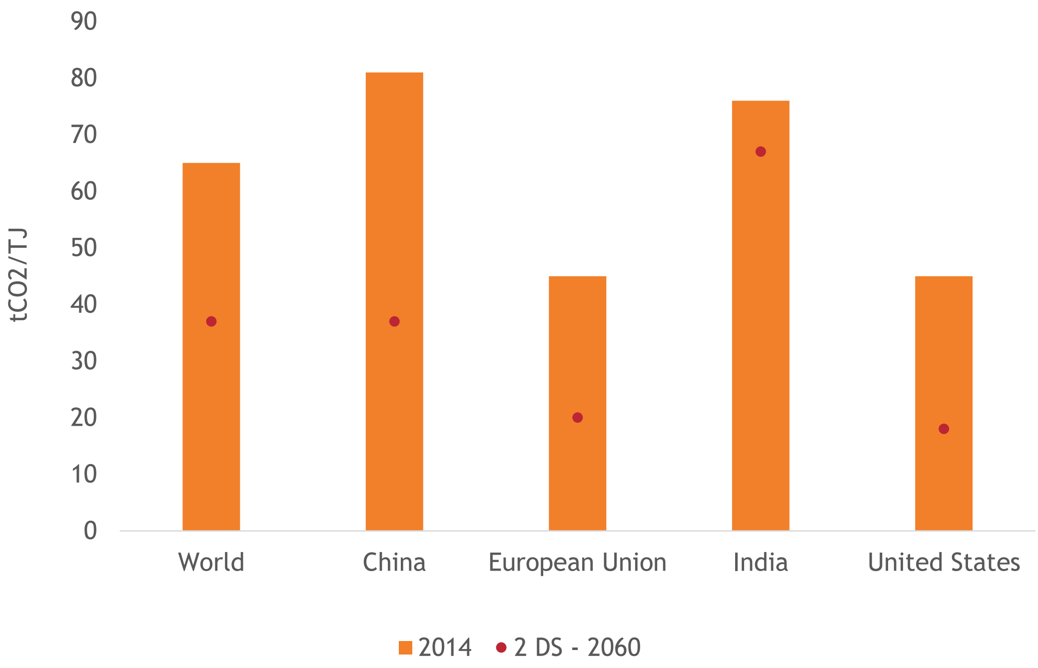
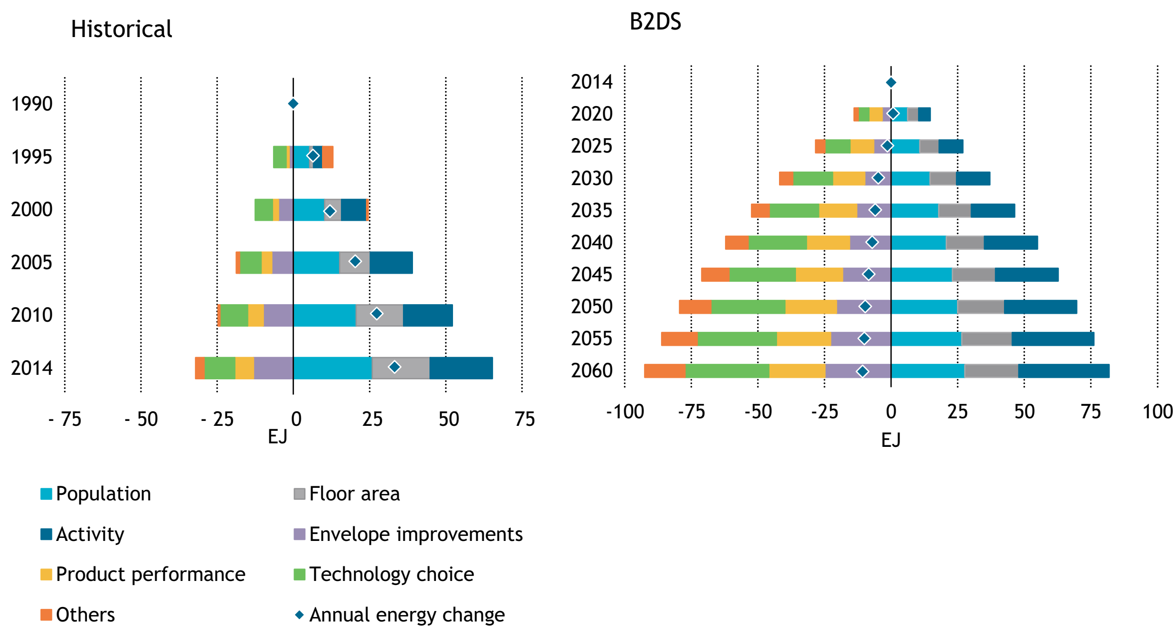
Elaboration from 'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Energy demand - industry



'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Energy demand - building



'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Tracking clean energy progress: energy integration

POLITECNICO DI TORINO

Key numbers - Energy integration

Renewable heat	9% - renewable energy in heat consumption 15% - EU Largest consumer of renewables for heat production 436 GWth – Solar thermal capacity
Energy storage	159 GW- installed storage capacity 3.4 GW – installed non-pumped hydro storage capacity in 2016 Li-ion (41%), Flywheel (28%), CAES (19%), NaS (19%), Lead acid (6%)
Transmission infrastructure	38 million km - New high-voltage transmission infrastructure adds up to existing 50 million km 1100 kV – frontiers of UHV technologies 2.4 TW - transmission links and interconnectiosn against 250 GW today
Demand side management	11 GW – demand side management capacity at 2015

POLITECNICO DI TORINO

Elaboration from 'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Key policies - Energy integration

Renewable heat	Targets Heat planning Carbon taxes, building codes, financial support
Energy storage	Clarify market rules Lack of markets for flexibility and ancillary services Business models
Transmission infrastructure	Governance Market assets
Demand side management	Policy Market mechanisms Field trials

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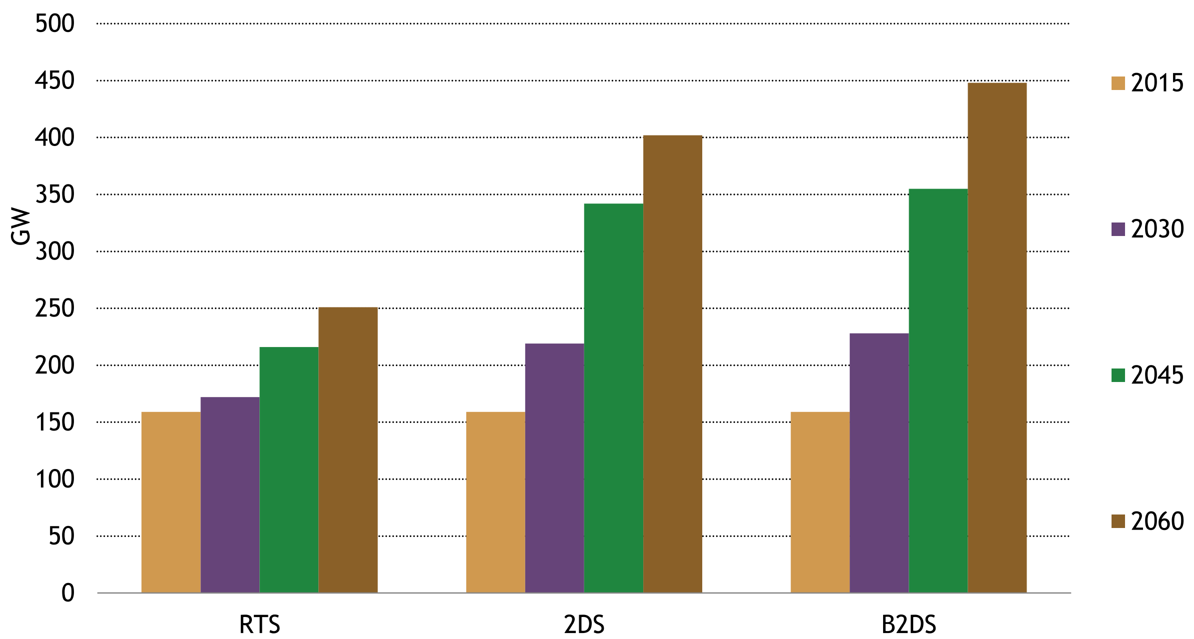
Elaboration from 'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Energy integration - storage capacity



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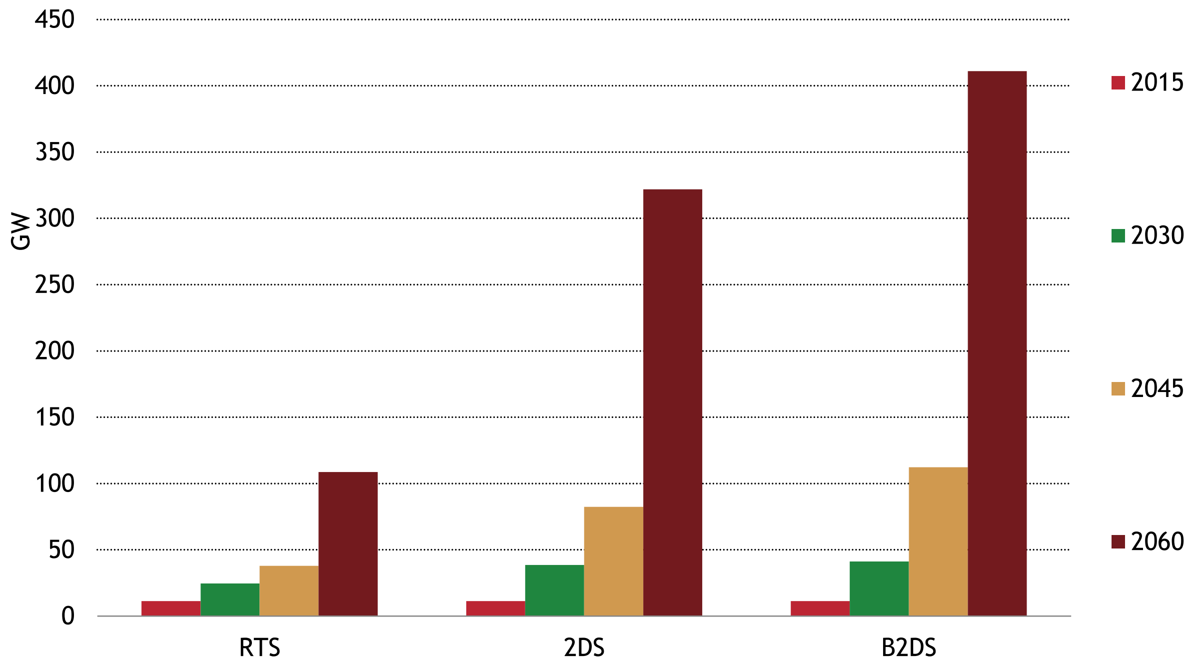
'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Energy integration - demand side management



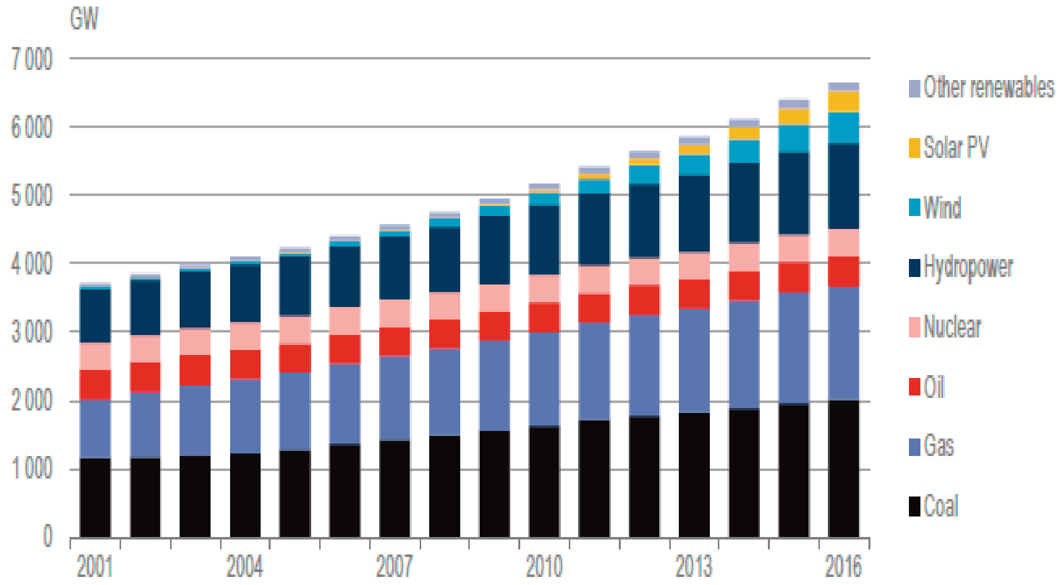
POLITECNICO DI TORINO

'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Focus - energy supply Renewable energy in power, transport, heating sectors

POLITECNICO DI TORINO

Renewable power



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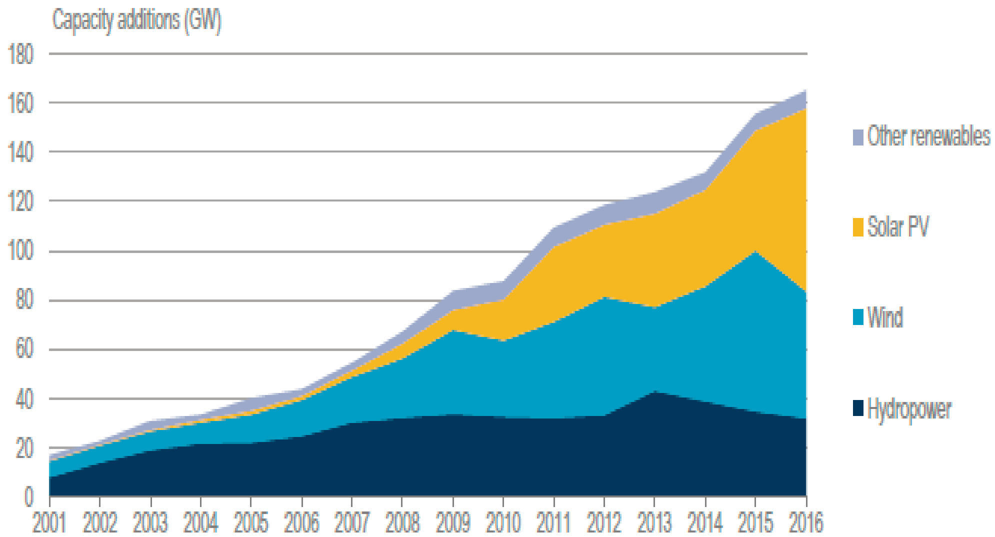
Renewable power



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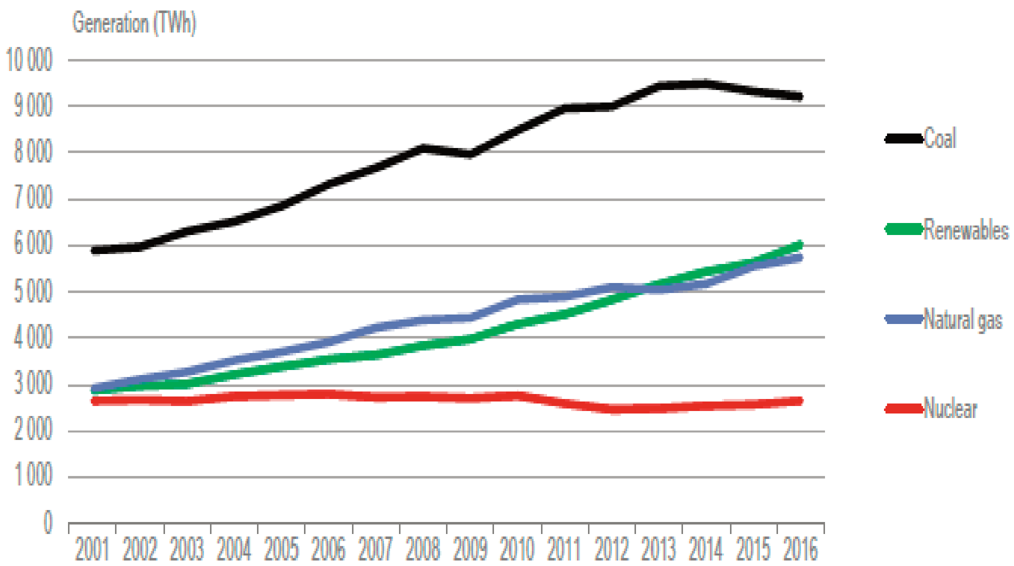
Renewable power



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'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Renewable power capacity in 2016

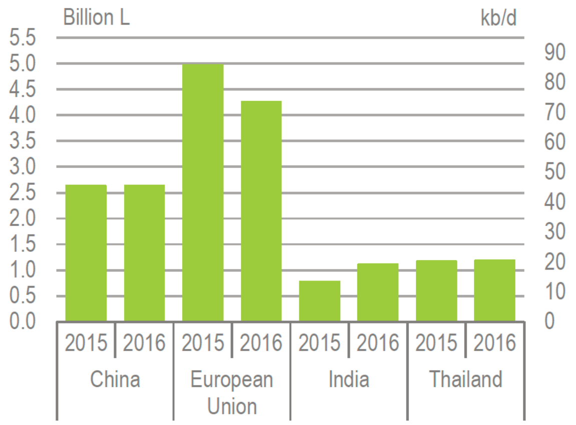
Solar PV	GW	Onshore wind	GW	Hydropower	GW	Bioenergy	GW
China	34.2	China	18.7	China	12.6	China	1.8
US	14.8	US	8.2	Brazil	5.3	Brazil	0.9
Japan	7.9	Germany	4.3	Ecuador	1.8	Denmark	0.6
India	4.0	India	3.6	Ethiopia	1.7	India	0.4
UK	2.4	Brazil	2.5	Peru	1.1	Japan	0.3

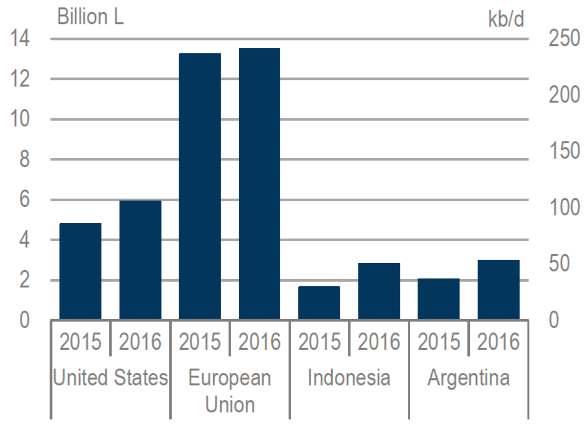
Offshore wind	MW	Geothermal	MW	CSP	GW	Ocean	GW
Germany	813	Turkey	197	Morocco	160	Canada	1.6
Netherlands	691	Indonesia	99	South Africal	100	France	1
China	592	Guatemala	15	Australia	3	Norway	0.3
Viet Nam	83	Kenya	10	US	2	Korea	0.2
UK	56	Nicaragua	10	France	2	China	0.2

POLITECNICO DI TORINO

'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

Renewable transport





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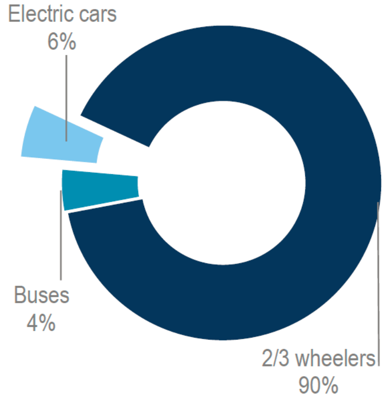
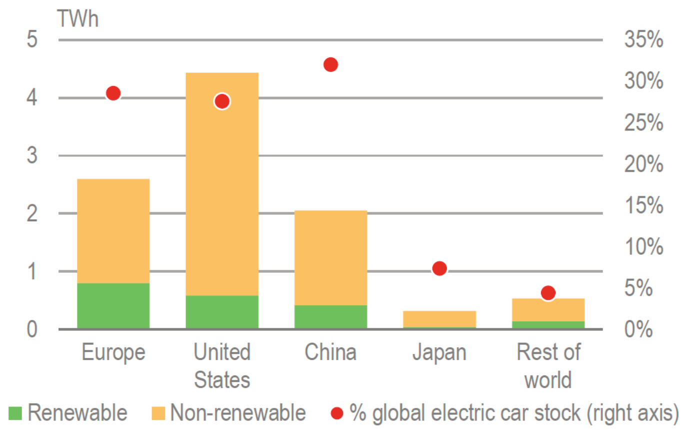
Renewable transport





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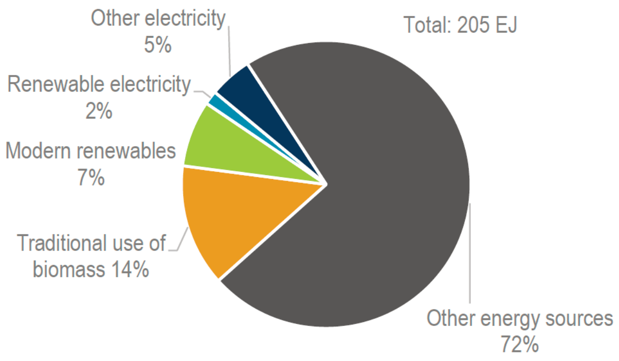
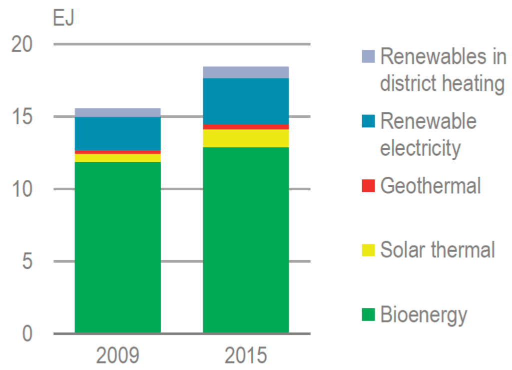
'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

Renewable heat

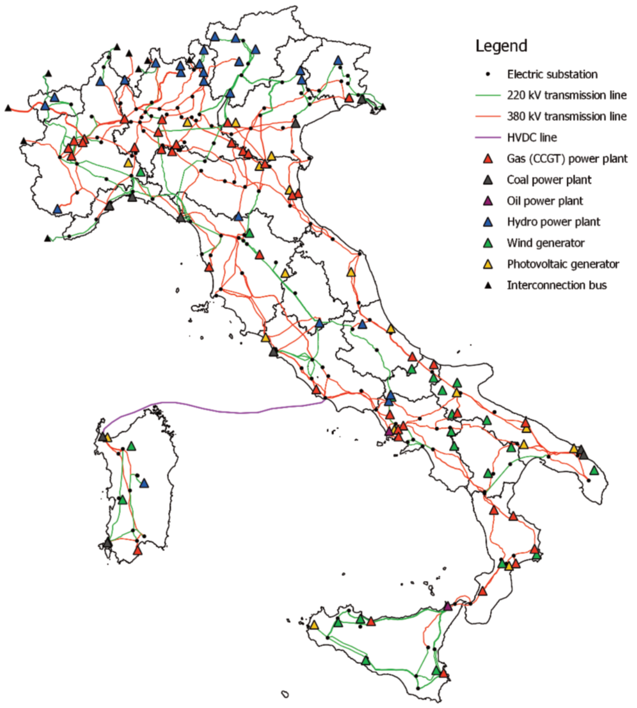




'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

Focus - energy integration Challenges of high renewable sources penetration

Energy integration - the 2050 italian case

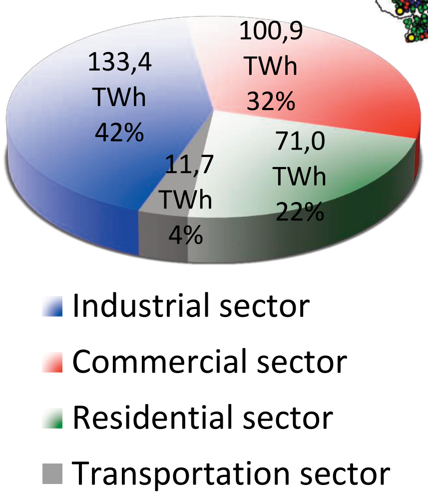


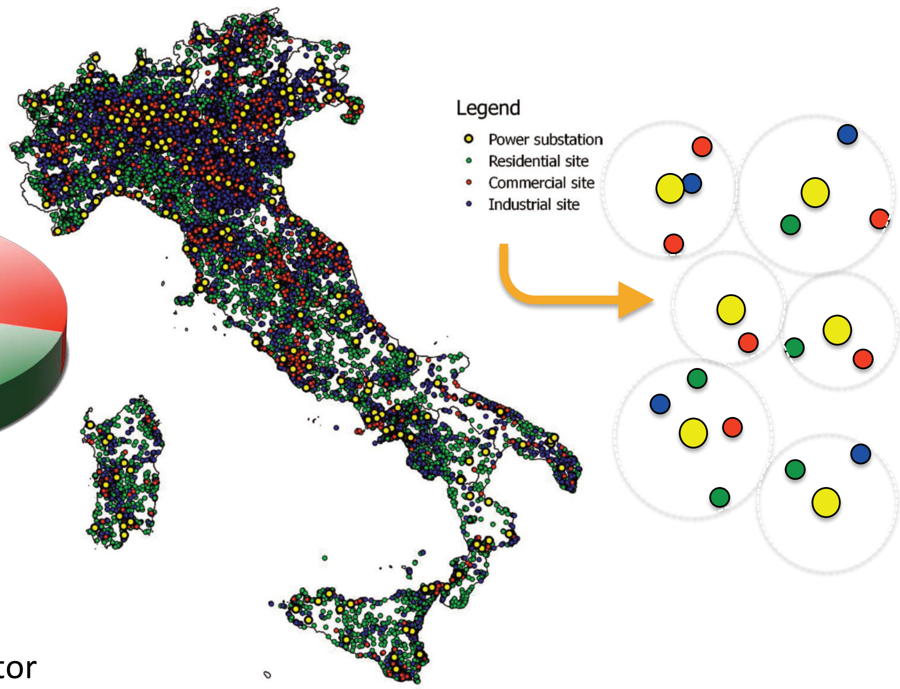
- 214 Electrical Substations
- 475 Transmission Lines
- 121 Generators
- 12 Interconnections

POLITECNICO DI TORINO

'E. Vaccariello, M. Cavana, P. Leone, Impact of Renewable Power Generation Penetration on Back-Up Thermal Power Plants and Storage Capacity, submitted to Energy, 2018'

Energy integration - the 2050 italian case





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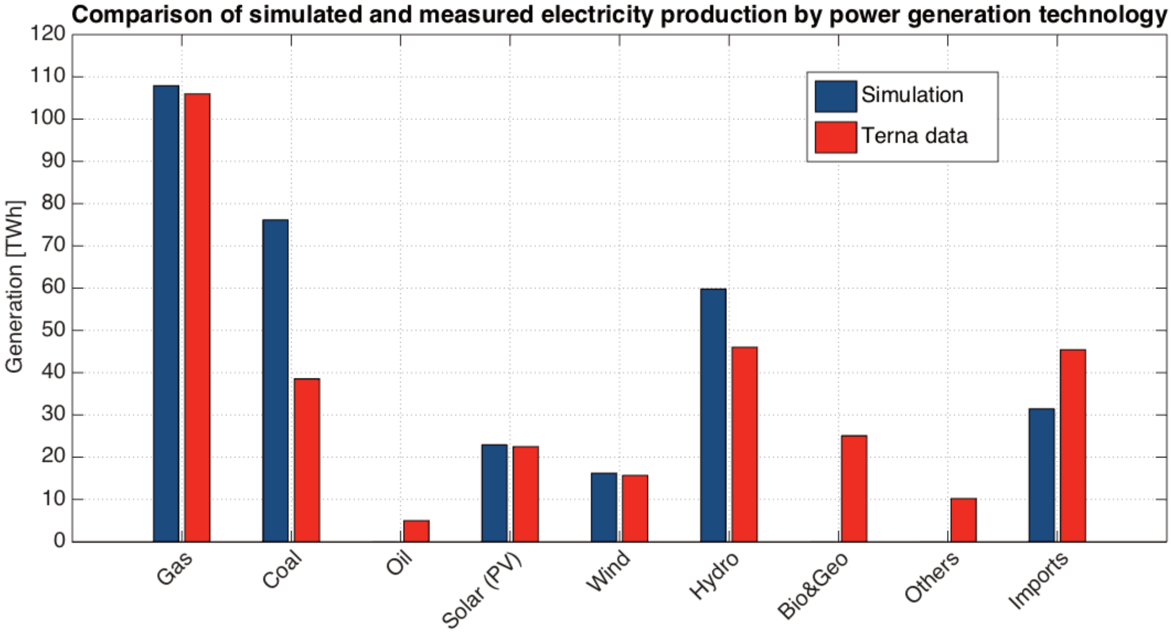

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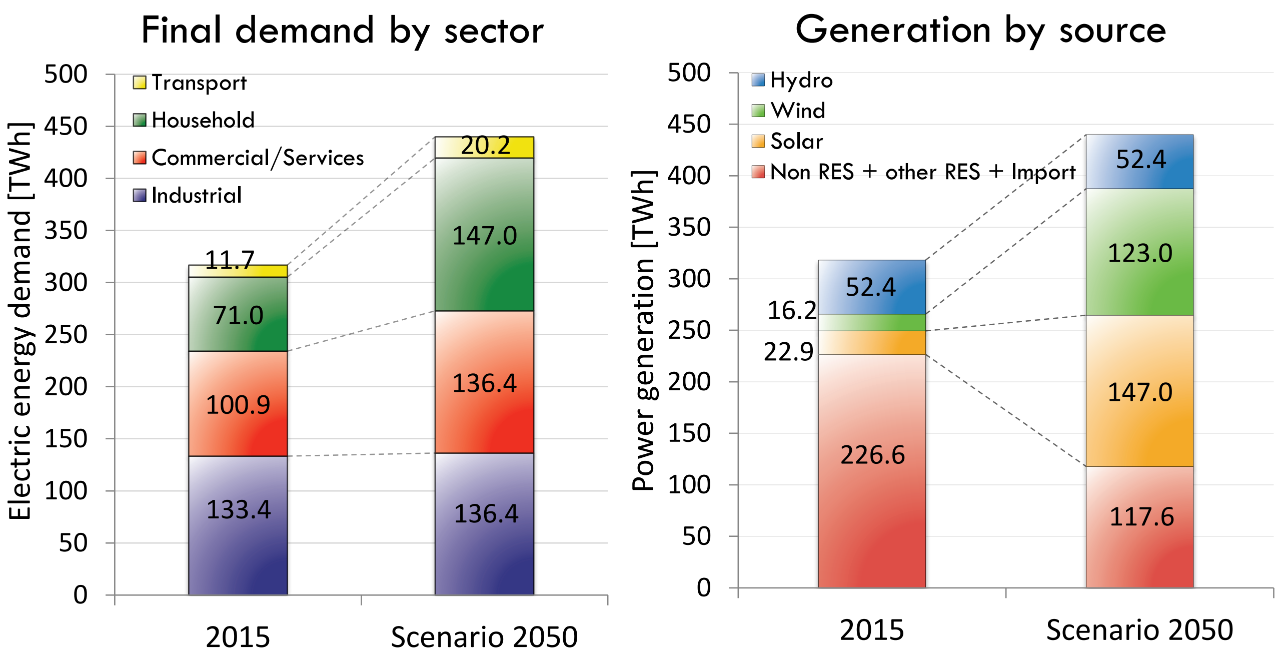
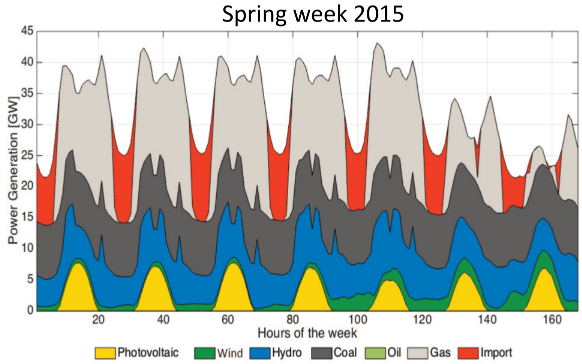


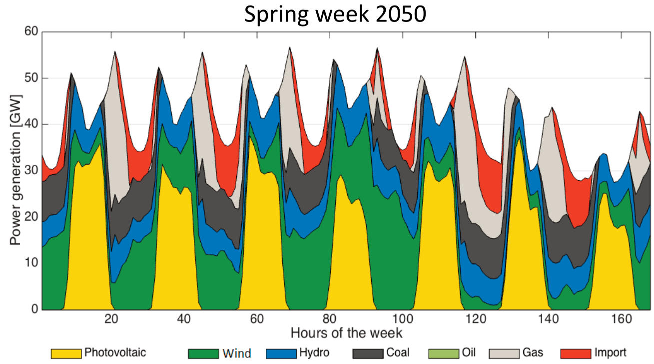
Elaboration from: *Virdis, M.R. et al. (2015). Pathways to deep decarbonization in Italy, SDSN - IDDRI*

Energy integration - the 2050 italian case

Hourly breakdown of power generation by source
Spring week 2015



Hourly breakdown of power generation by source
Spring week 2050



	All thermal units		CCGT units	
	2050	%VAR wrt. 2015	2050	%VAR wrt. 2015
Equivalent Operating Hours	2099	**- 36%**	1750	**- 20%**
STARTS	470	**+14%**	572	**+16%**
RAMPS	735	**+17%**	879	**+18%**
Av. Load Factor	65,3%	**+7%**	59,2%	**+11%**

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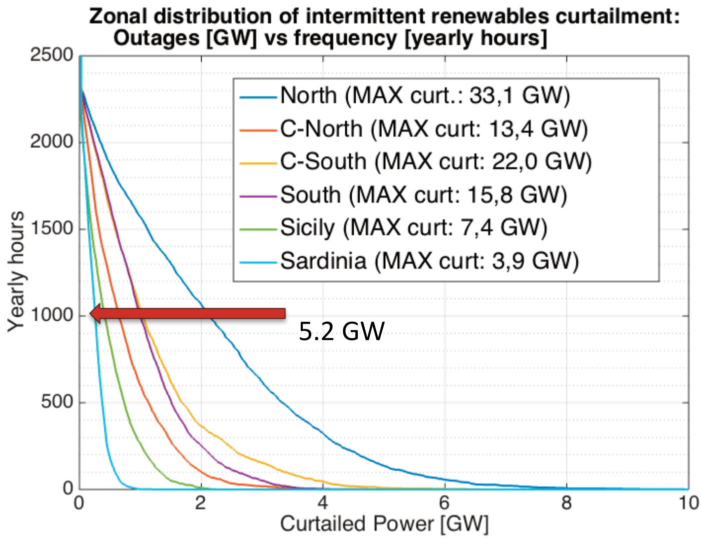
'E. Vaccariello, M. Cavana, P. Leone, Impact of Renewable Power Generation Penetration on Back-Up Thermal Power Plants and Storage Capacity, submitted to Energy, 2018'

Energy integration - the 2050 italian case

SIMULATED ENERGY MIX FOR 2050

	Generation [TWh]	Share of total	
Gas	71,3	16,2%	**27,6%**
Coal	49,8	11,4%	
Oil	0,0	0,0%	
Solar (PV)	117,0	26,7%	**66,7%**
Wind	115,8	26,4%	
Hydro	59,8	13,6%	
Import	25,0	5,7%	**5,7%**



- **Curtailment of variable RES**: **43.9 TWh** (17.7% of utility-scale RES generation)
- **Storage capacity required** (input power): **95,6 GW**

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'E. Vaccariello, M. Cavana, P. Leone, Impact of Renewable Power Generation Penetration on Back-Up Thermal Power Plants and Storage Capacity, submitted to Energy, 2018'

Energy integration - the 2050 italian case

- As penetration of RES increases, thermal power plants will face:
  - More cycling
  - Less operating hours
  - Threats to financial performance
- Additional storage facilities will be essential for meeting EU targets, but their full integration might be limited due to little equivalent operating hours.
- Need of OEMs, utility owners and market regulators for accounting for lower operating hours and increased cycling

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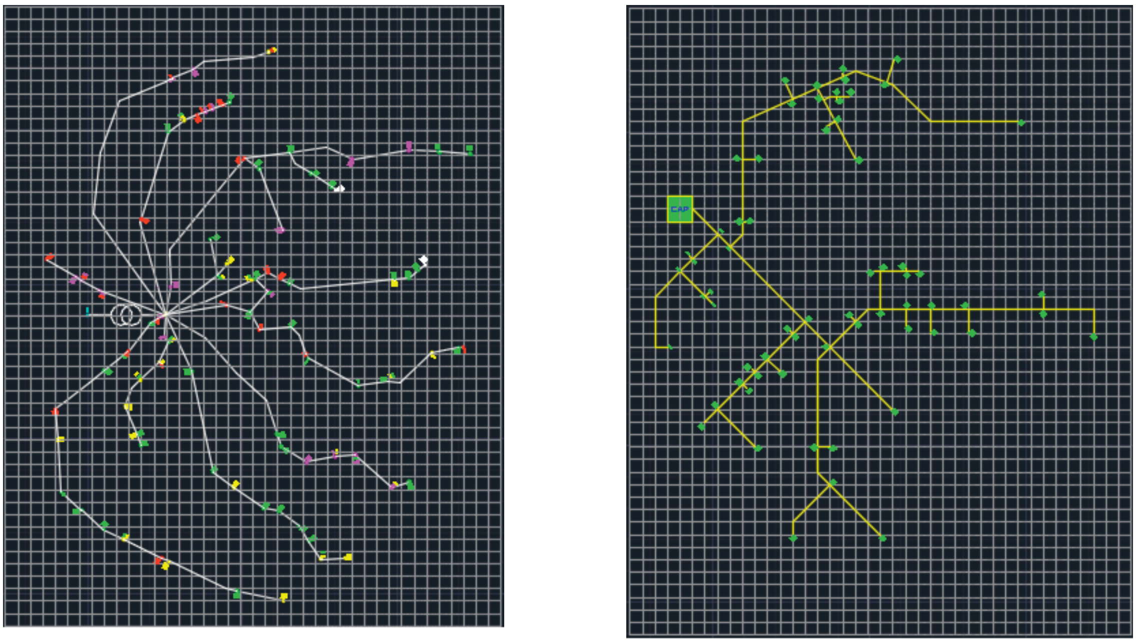
'E. Vaccariello, M. Cavana, P. Leone, Impact of Renewable Power Generation Penetration on Back-Up Thermal Power Plants and Storage Capacity, submitted to Energy, 2018'

Energy integration - networks integration



Power and gas network co-simulation in a prevalent urban district. Own elaboration

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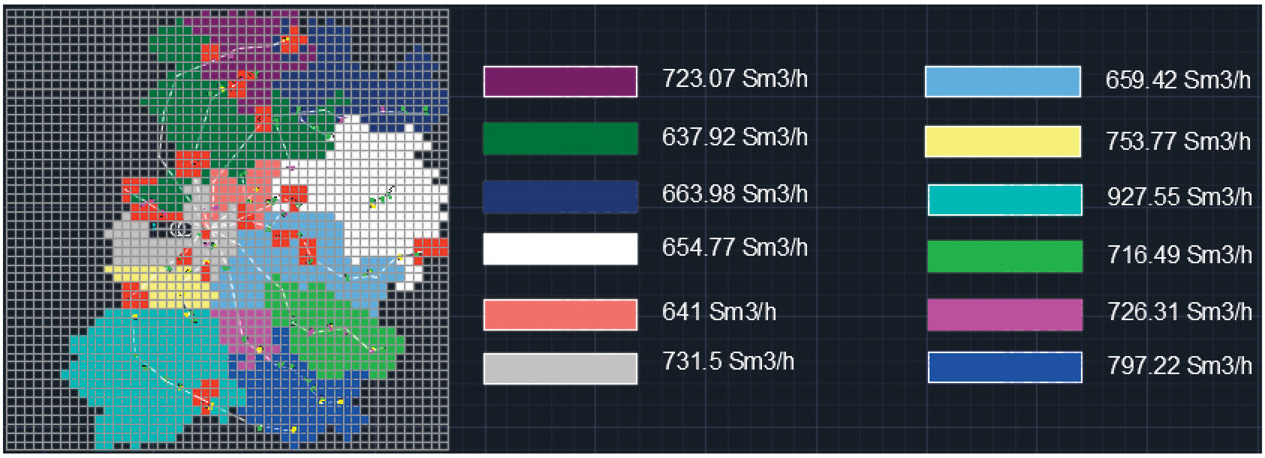
'M. Cavana, P. Leone et al., The evolution of gas networks in the decarbonized scenarios of heating sector, Heat in the pipe project, Politecnico di Torino'

Energy integration - distribution level

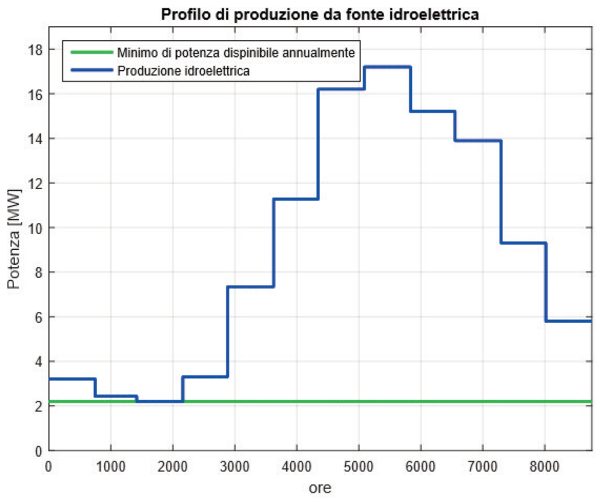


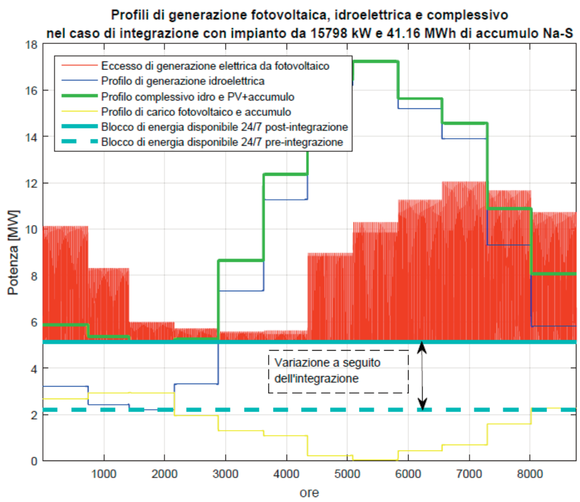
Heating demand clusters. Own elaboration

POLITECNICO DI TORINO

'M. Cavana, P. Leone et al., The evolution of gas networks in the decarbonized scenarios of heating sector, Heat in the pipe project, Politecnico di Torino'

Energy integration - hybridization





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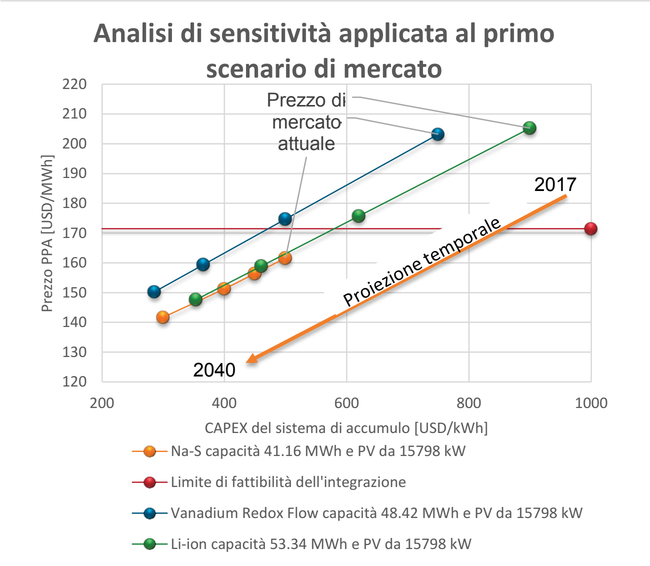
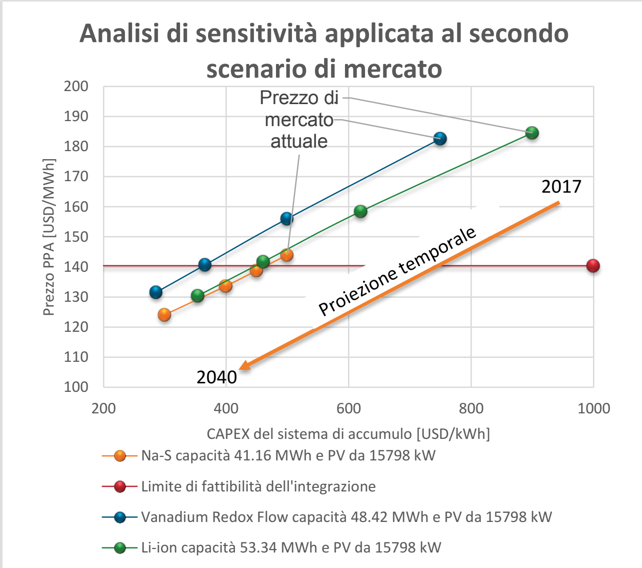
'F. Rosso, P. Leone, Techno-economic feasibility of a hydro-solar hybrid plant, paper in preparation, 2018.'

Energy integration - hybridization





Scenario 1		
Prezzo energia PV	Prezzo energia idro	Prezzo energia batterie
USD/MWh	USD/MWh	USD/MWh
0	20	50

Scenario 2		
Prezzo energia PV	Prezzo energia idro	Prezzo energia batterie
USD/MWh	USD/MWh	USD/MWh
30	30	50

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'F. Rosso, P. Leone, Techno-economic feasibility of a hydro-solar hybrid plant, paper in preparation, 2018.'

Energy integration - land use

Free-ice surface, 13,000 Mha

1,600 Mha - arable land and permanent crops

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'P. Leone, Sustainable energy, Politecnico di Torino, 2018.'

Energy integration - land use

50 Mha- modern energy system

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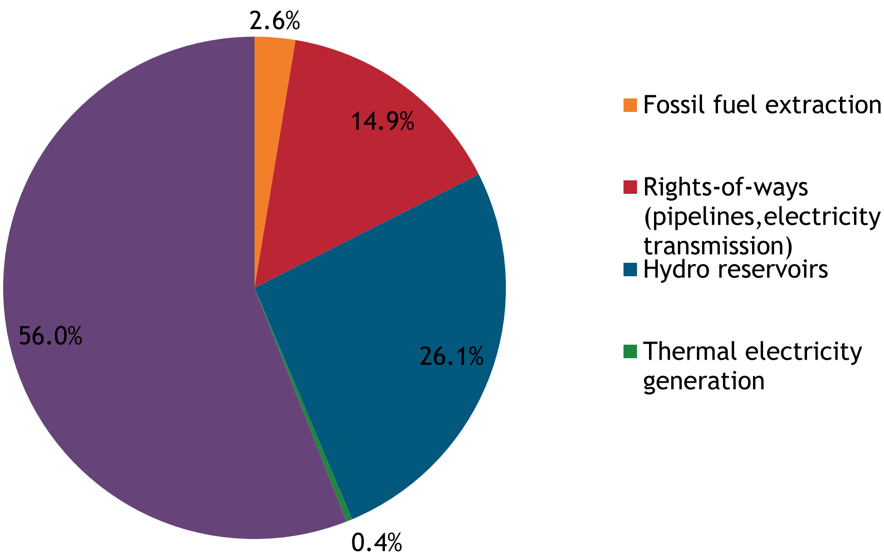
‘P. Leone, Sustainable energy, Politecnico di Torino, 2018.'

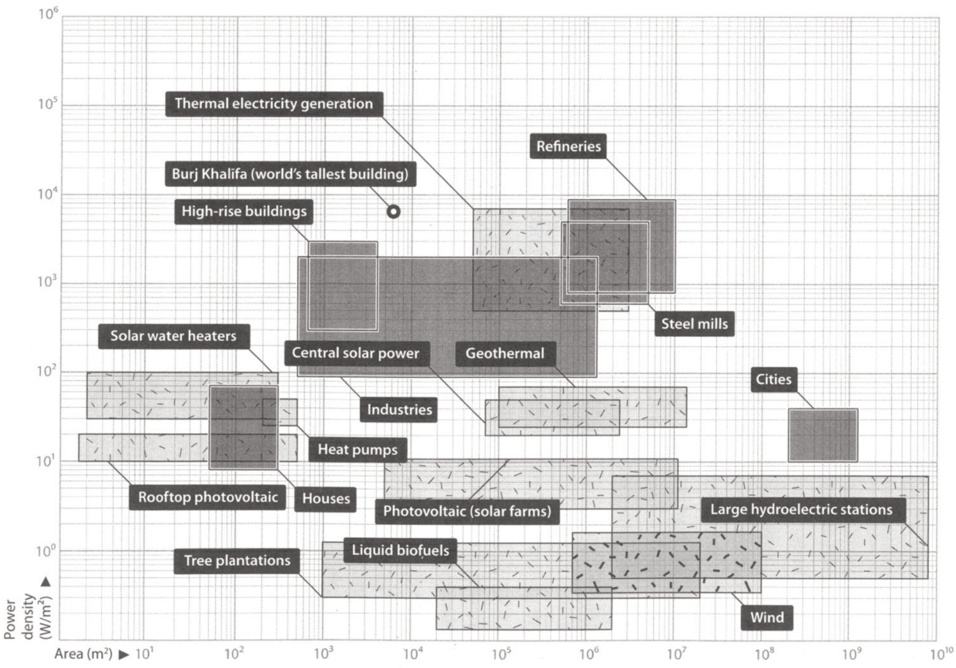
Energy integration - land use



POLITECNICO DI TORINO

‘P. Leone, Sustainable energy, Politecnico di Torino, 2018.'

Energy integration - land use



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'V. Smil, Power Density, MIT Press, 2016.'

Renewables in Ethiopia

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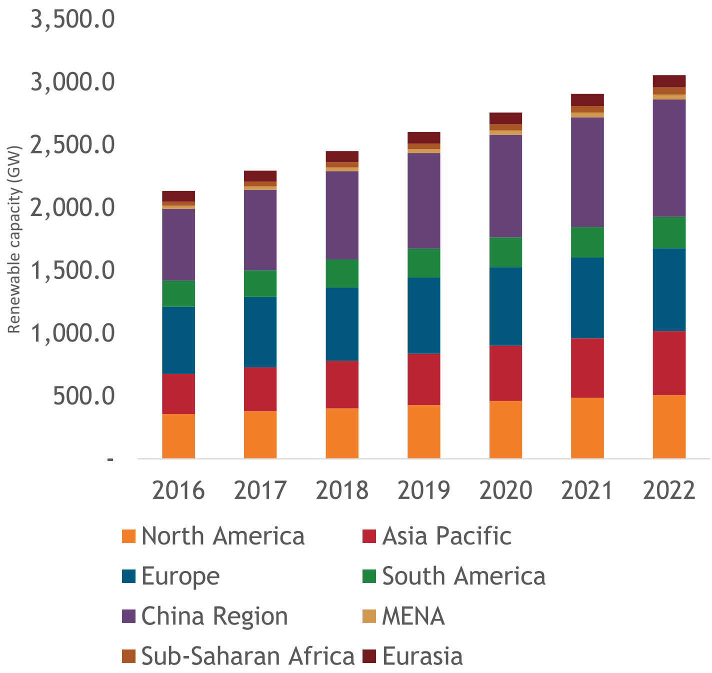
Renewables in Sub-Saharan Africa



- Renewable capacity in SSA expands from 33GW in 2016 to 58 GW
- Higher world growth rate 9.6%/year

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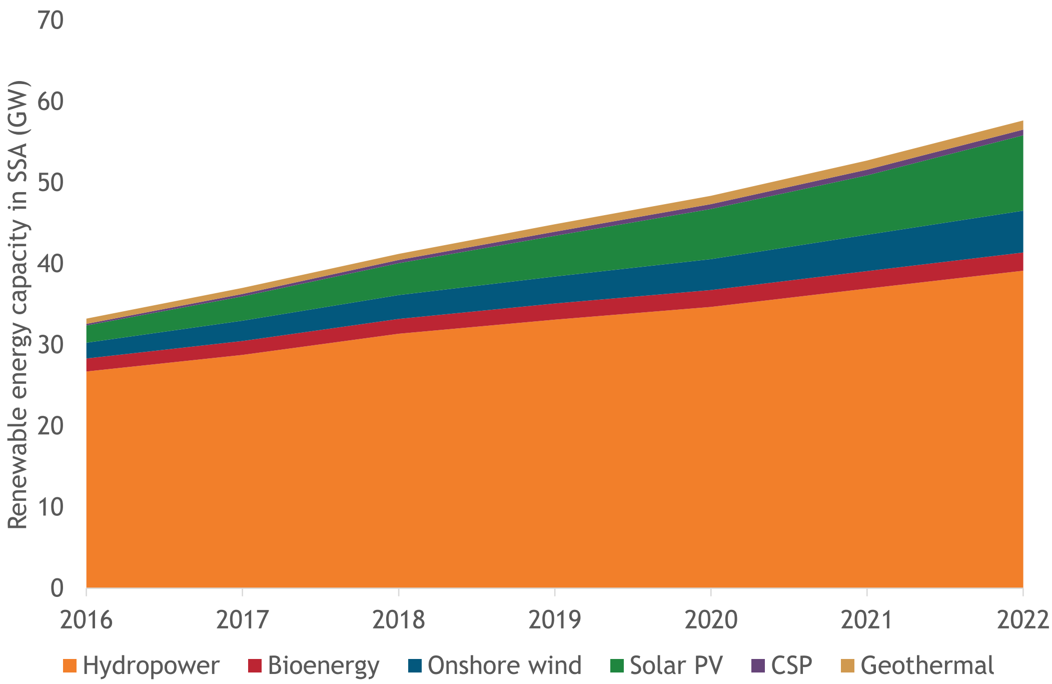
'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

Renewables in Sub-Saharan Africa



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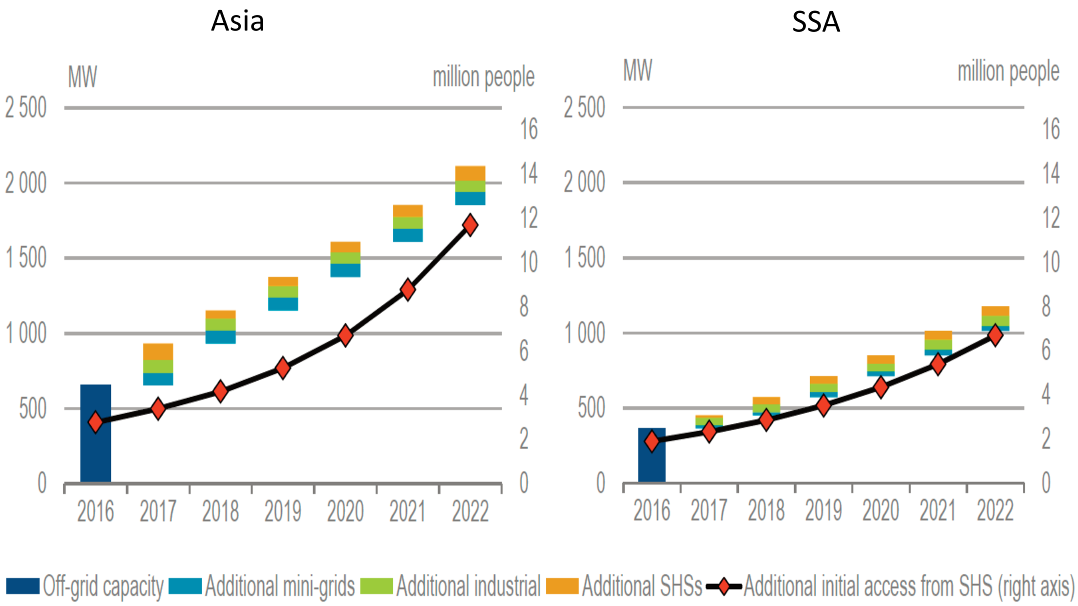
'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

Renewables in Sub-Saharan Africa



❖ 3350 MW in Asia and SSA including (36% industrial applications, 33% SHSs, 31% mini-grids)

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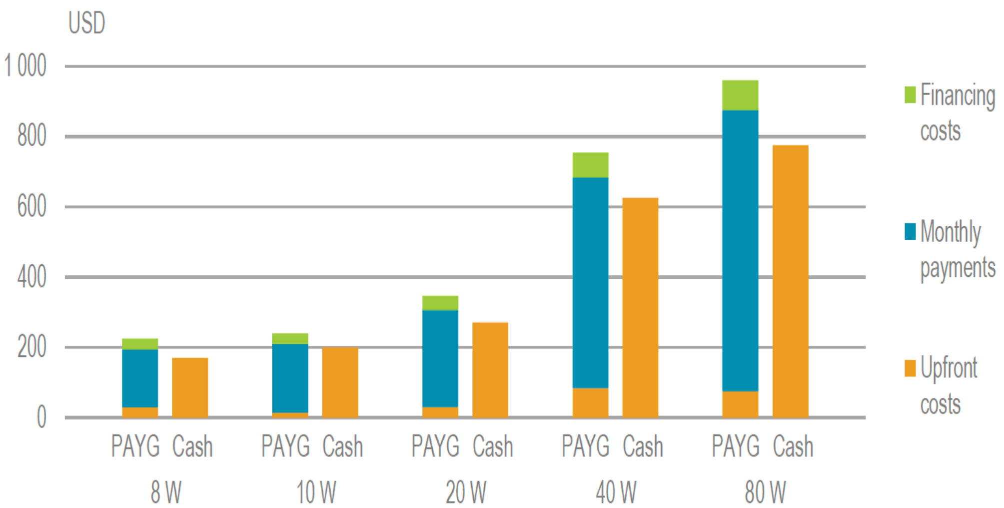
'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

Renewables in Sub-Saharan Africa



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'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

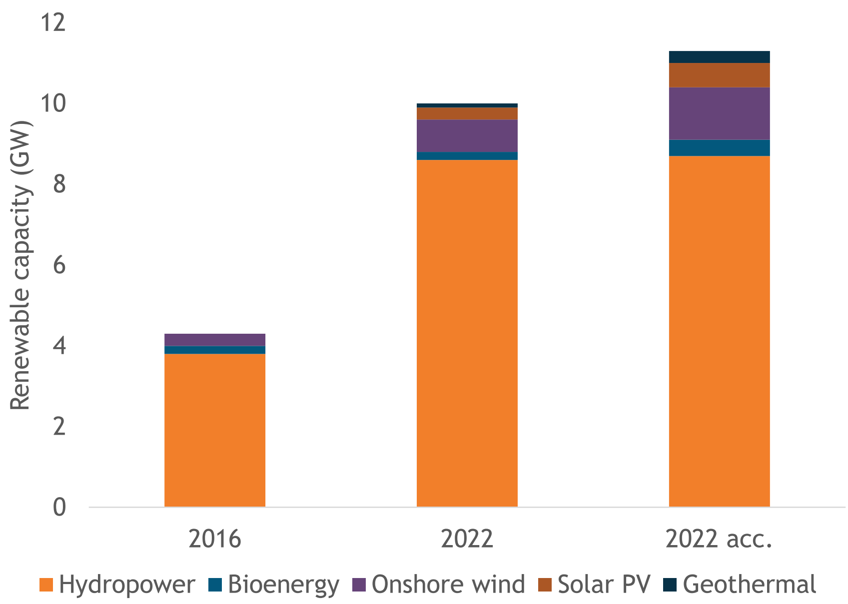
Ethiopia

- Renewable capacity is expected to expand by 5.6 GW, the largest growth in SSA, surpassing South Africa
- 86% of new capacity is hydroelectricity
- With 38 TWh of estimated electricity production in 2022, Ethiopia will be a power exporter in the region, provided that interonnection lines are built.

	Drivers	Challenges
Ethiopia	Fast-growing power demand Excellent resources Long term targets for renewable capacity and electrification	Market access for IPPs; lack of cost-reflective tariffs; availability of financing for large infrastructure; grid delays

'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

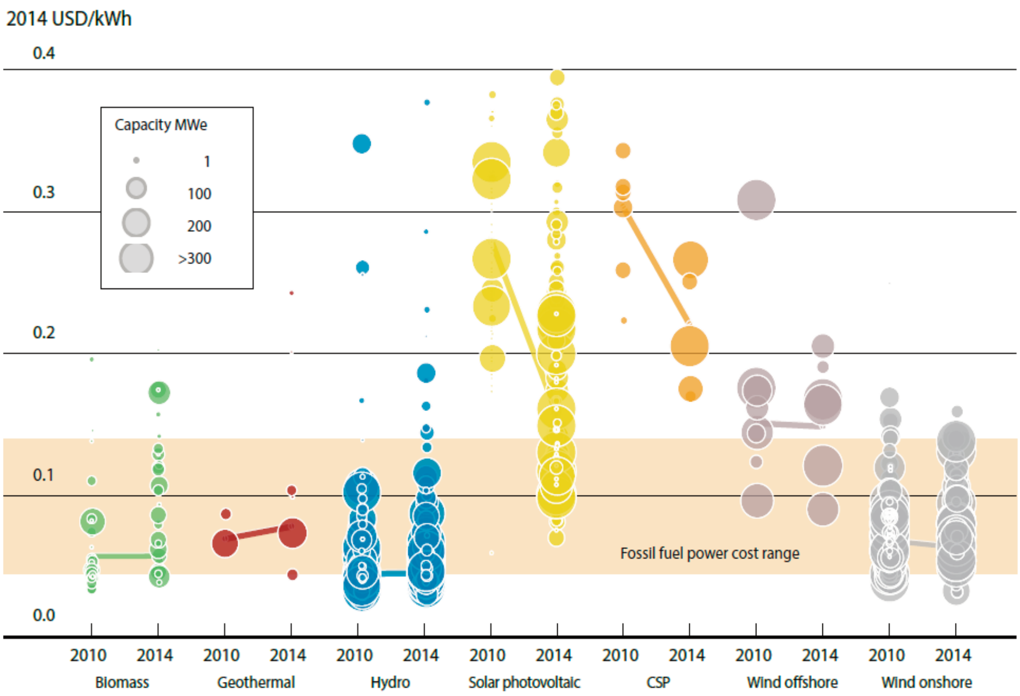
Ethiopia



'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

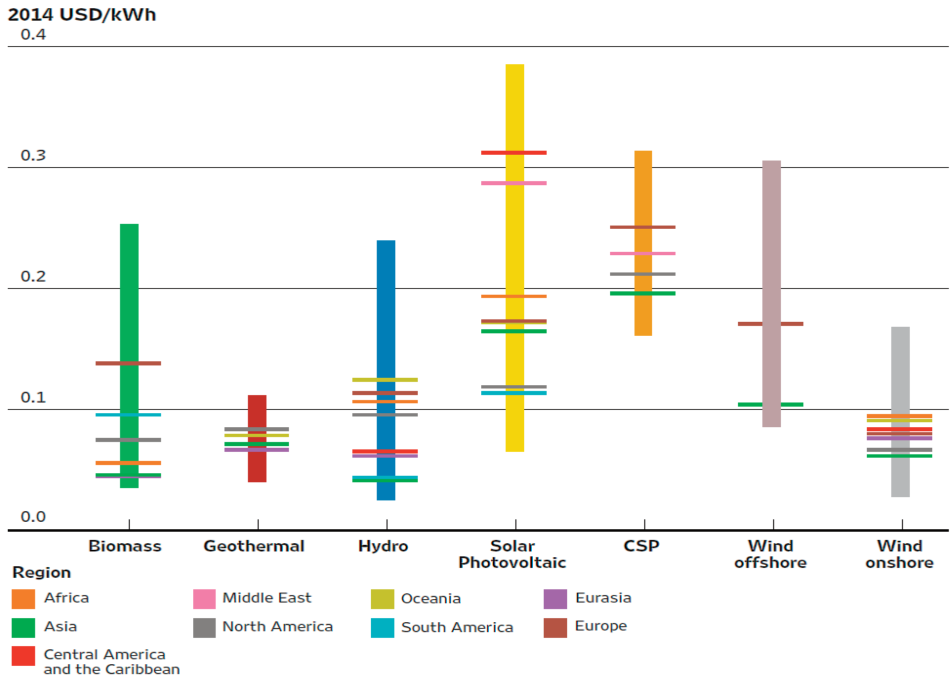
Renewable energy cost trends

Renewable - overview



Renewable Power Generation Costs in 2014.: International Renewable Energy Agency, 2014.

Renewable - overview



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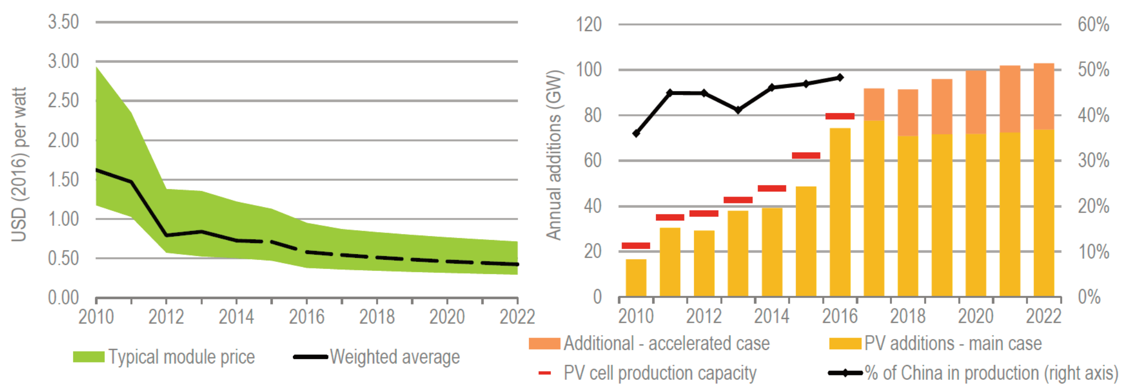
Renewable Power Generation Costs in 2014.: International Renewable Energy Agency, 2014.

Renewable - solar



Sources: SPV Market Research (2017a), "Photovoltaic manufacturer capacity, shipments, price and revenues 2016/17"; SPV Market Research (2017b), *The Solar Flare – Issue 1.*

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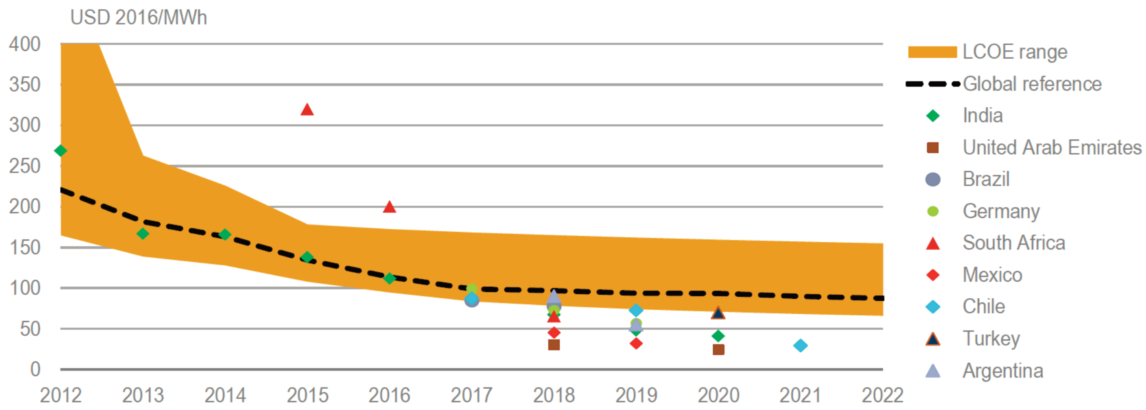
'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

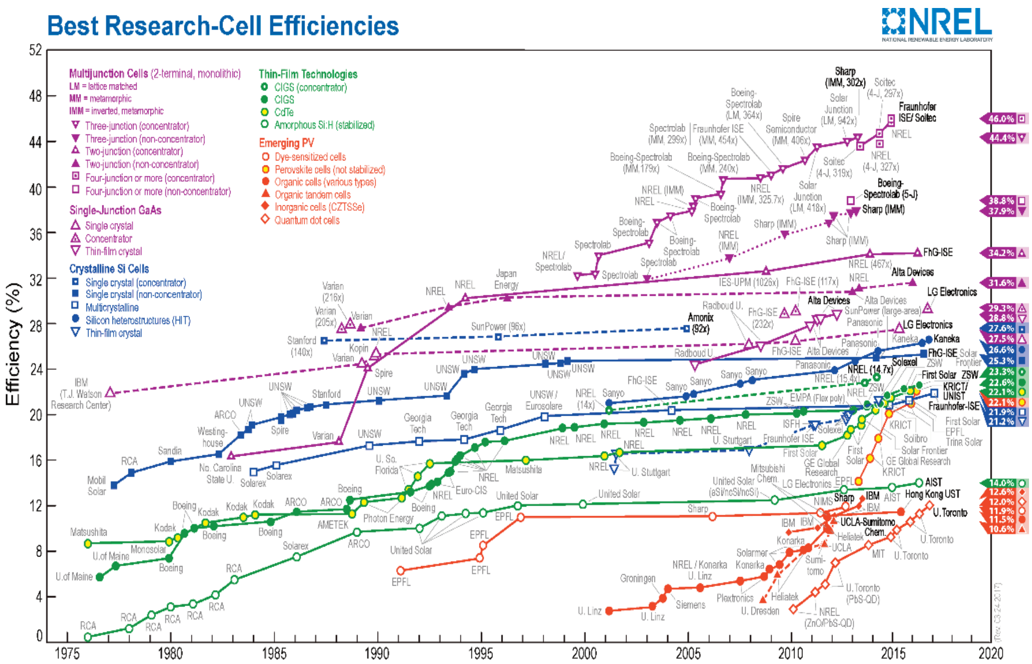
Renewable - solar

LCOE and auction results



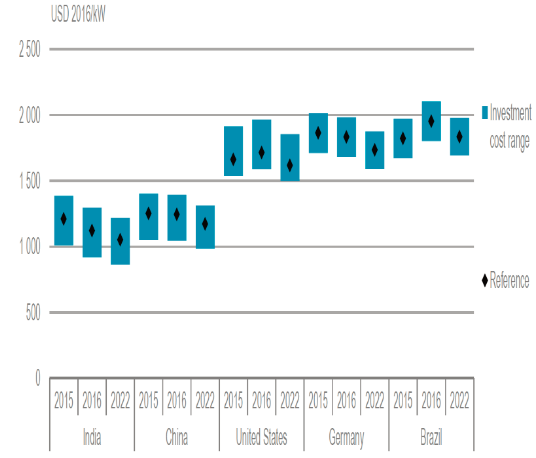
'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

Renewable - PV solar efficiencies

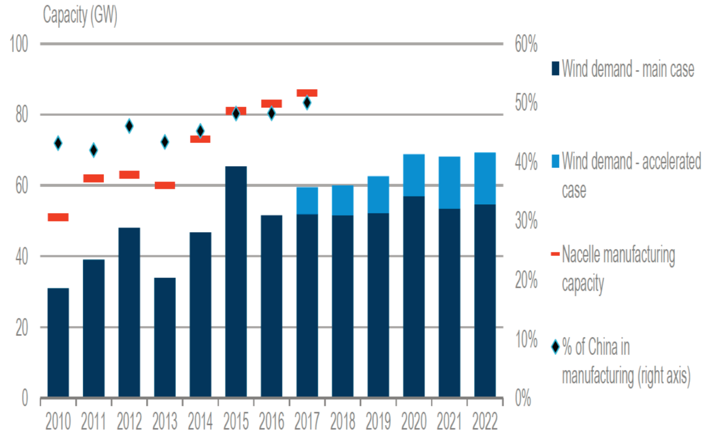


National Renewable Energy Laboratory. Efficiency Chart. [Online] 2017

Renewable - wind



Source: Analysis based on IRENA (2017), *Costing Alliance*, dataset provided to the IEA.

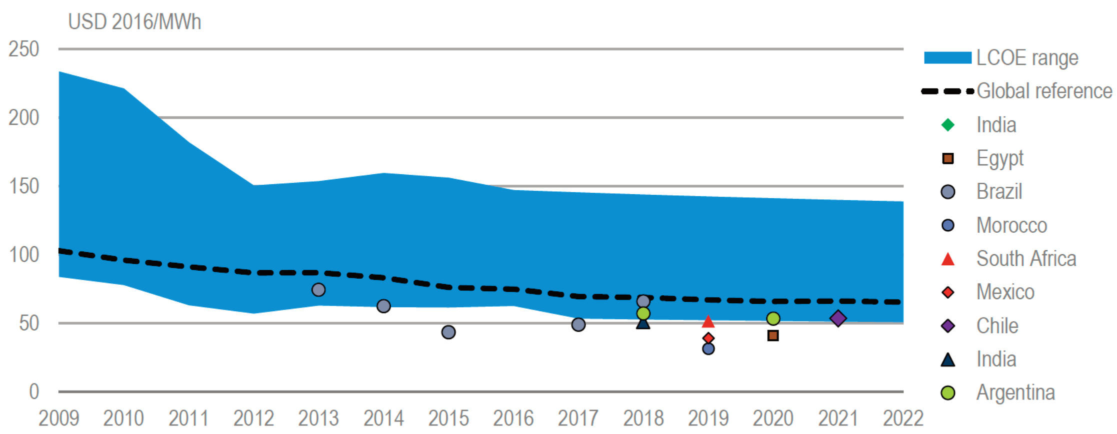


Source: Nacelle manufacturing data compiled from BNEF (2017), *Wind Manufacturing Plants Database.*

'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

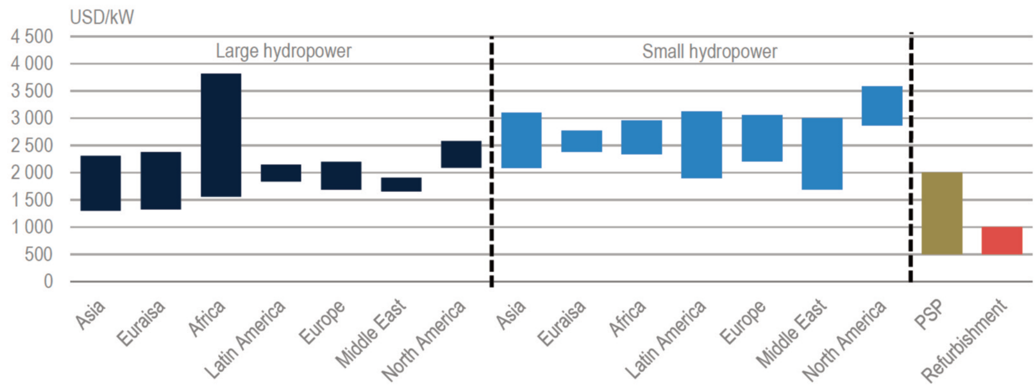
Renewable - wind

LCOE and auction results



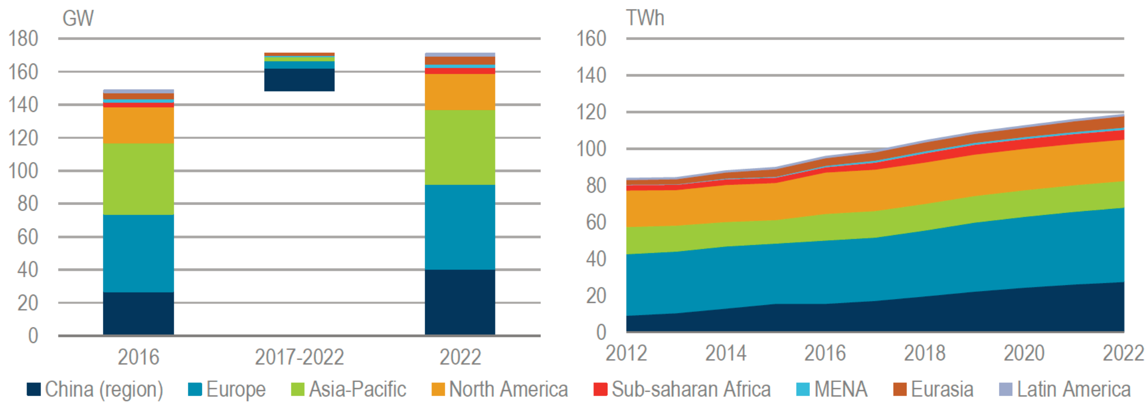
'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

Renewable - hydropower



Source: Analysis based on IRENA (2017), *Costing Alliance*, dataset provided to the IEA; IEA (2017), *World Investment Report*; IEA and MME (2012), *Technology Roadmap: Hydropower*; HEA (2016), *Global Technology Roadmap*.

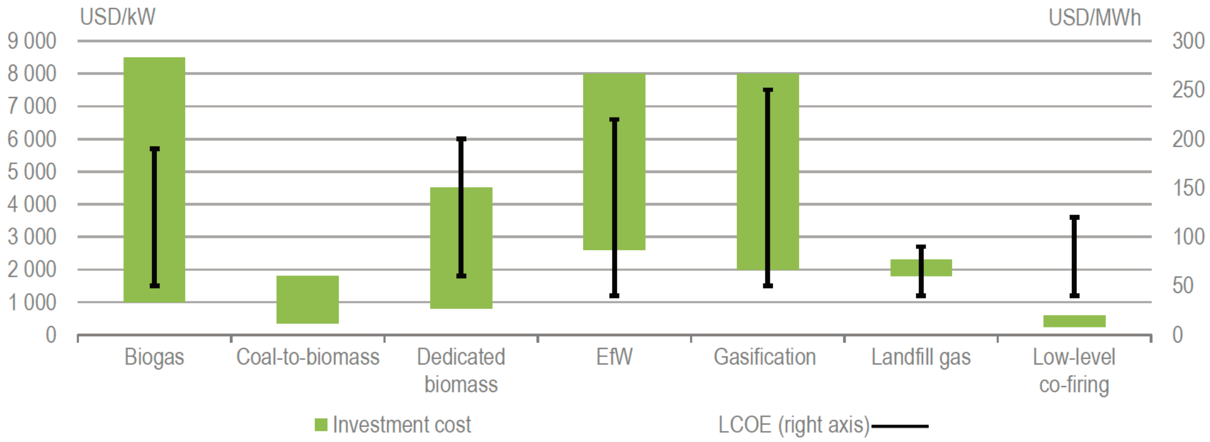
Renewable - PSP capacity



Note: MENA = Middle East and North Africa.

Sources: PSP capacity is from an IEA unit level project database compiled from Platts (2017), *World Electric Power Plants Database*; US DOE (2017), *Global Energy Storage Database*; Geth (2015), "An overview of large-scale stationary electricity storage plants in Europe: Current status and new developments", *Renewable and Sustainable Energy Reviews*, Vol. 52, pp. 1212-1227; Buss et al. (2016), "Global distribution of grid-connected electrical energy storage systems", *International Journal of Sustainable Energy Planning and Management*, Vol. 9, pp. 31-56.

Renewable - bioenergy



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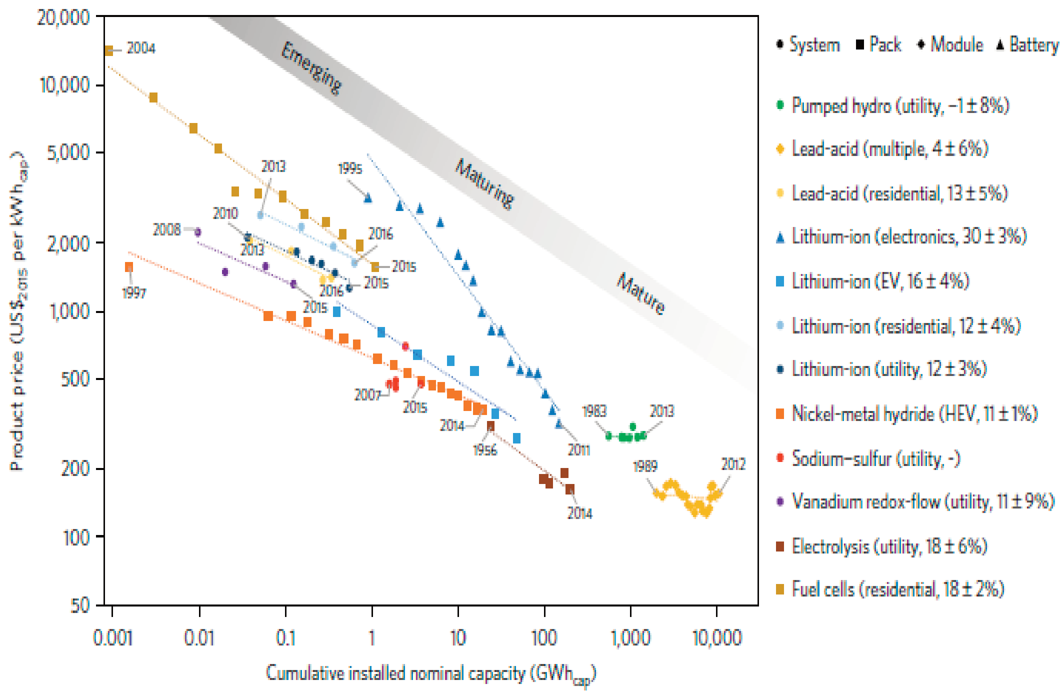
'International Energy Agency (2017), Renewables 2017, OECD/IEA, Paris'

Storage prices



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The future cost of electrical energy storage based on experience rates. Schmidt, Hawkes,Gambhir,Staffel. 17110, s.l. : Nature Energy, 2017, Vol. 2.

Thank you all | Grazie a tutti

Questions ?

pierluigi.leone@polito.it

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Modern and energy efficient technologies in building, transport & industry - Implications for government policy

Policy responses to climate change: sustainable development and energy transition

Prof. Pierluigi LEONE

Outline

- Introduction
- Energy end-use trends
- Energy technology transformation: buildings, industry and transport
- Policy implications
- Tracking energy efficiency policies with indicators
- Energy efficiency in a life-cycle perspective
- Energy efficiency in Ethiopia

Introduction

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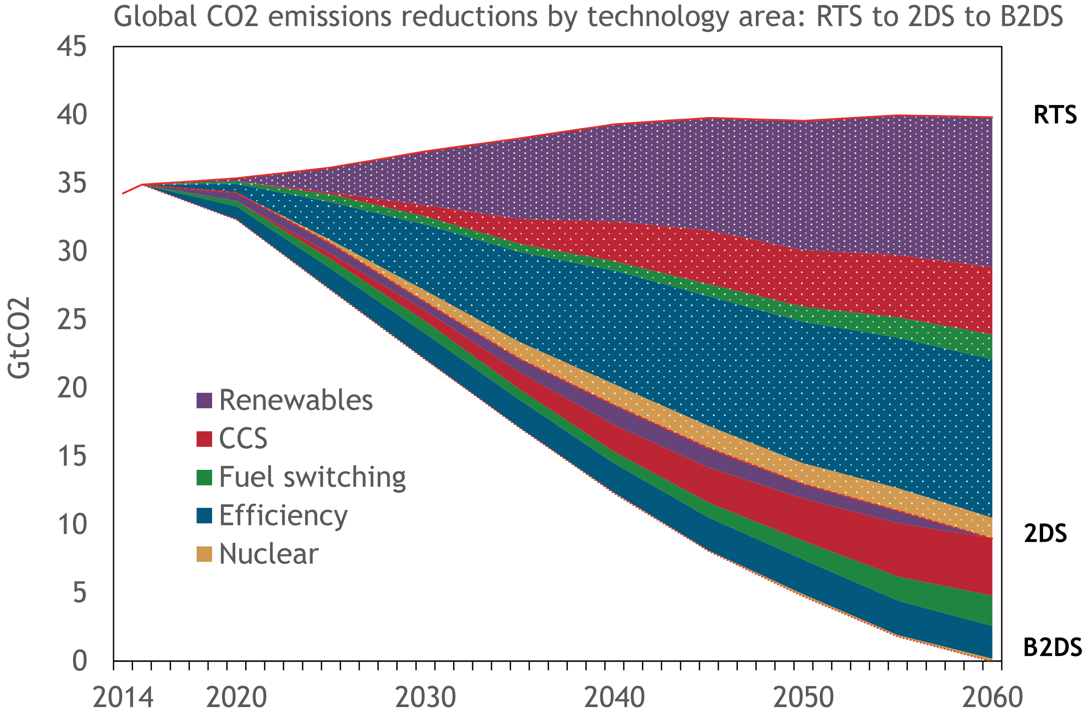
Efficiency as a key to achieve climate mitigation



'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

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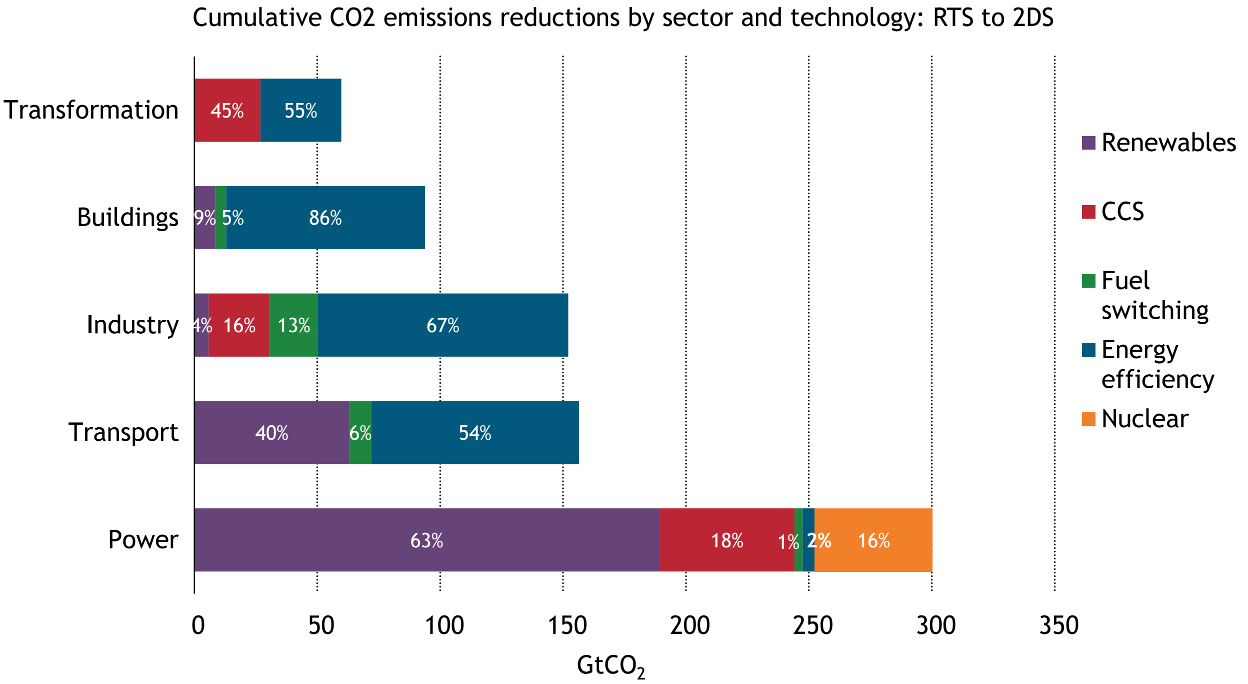
Efficiency as a key to achieve climate mitigation



'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Energy end-use trends

Building sector - Key numbers

30% Share of global building sector in final energy consumption

53% Share of global building sector in final electricity demand

26% Share of global building sector in global energy-related CO_2 emissions

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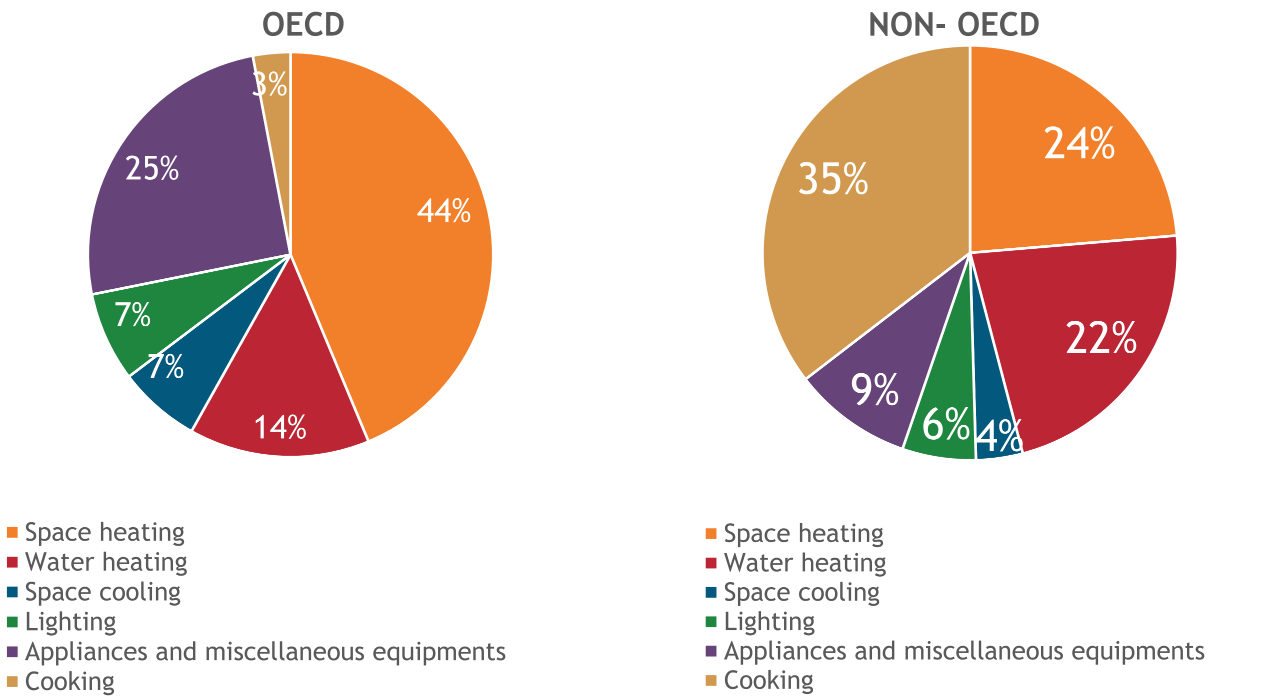
'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Trends in the global building sector



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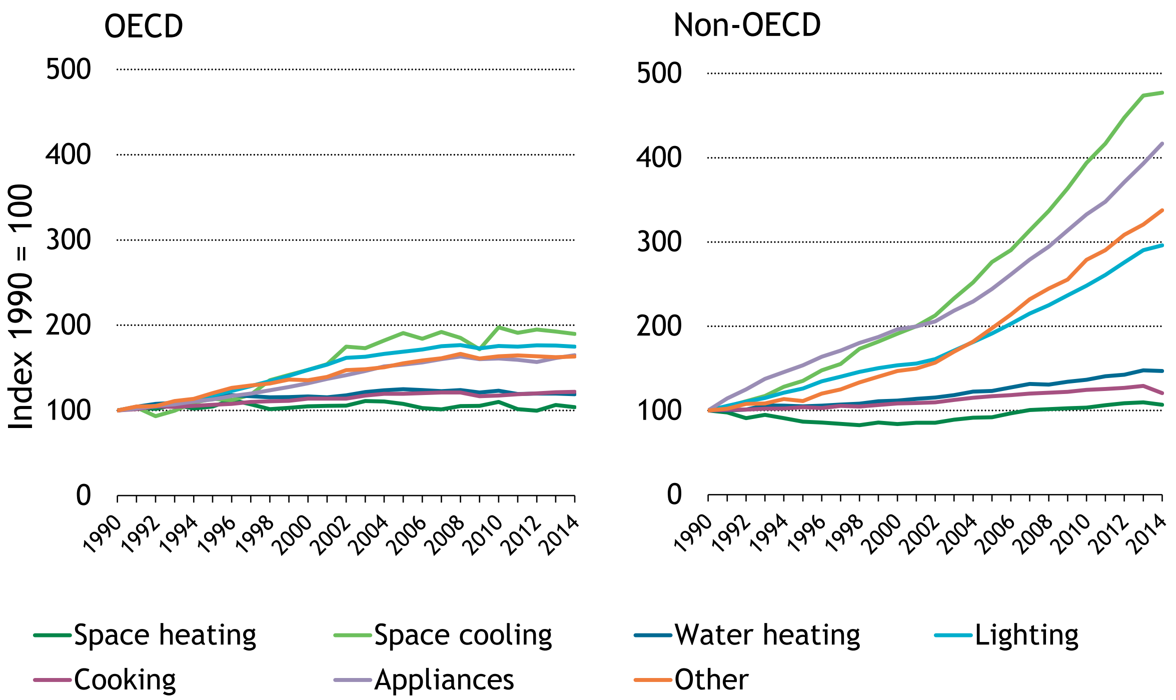

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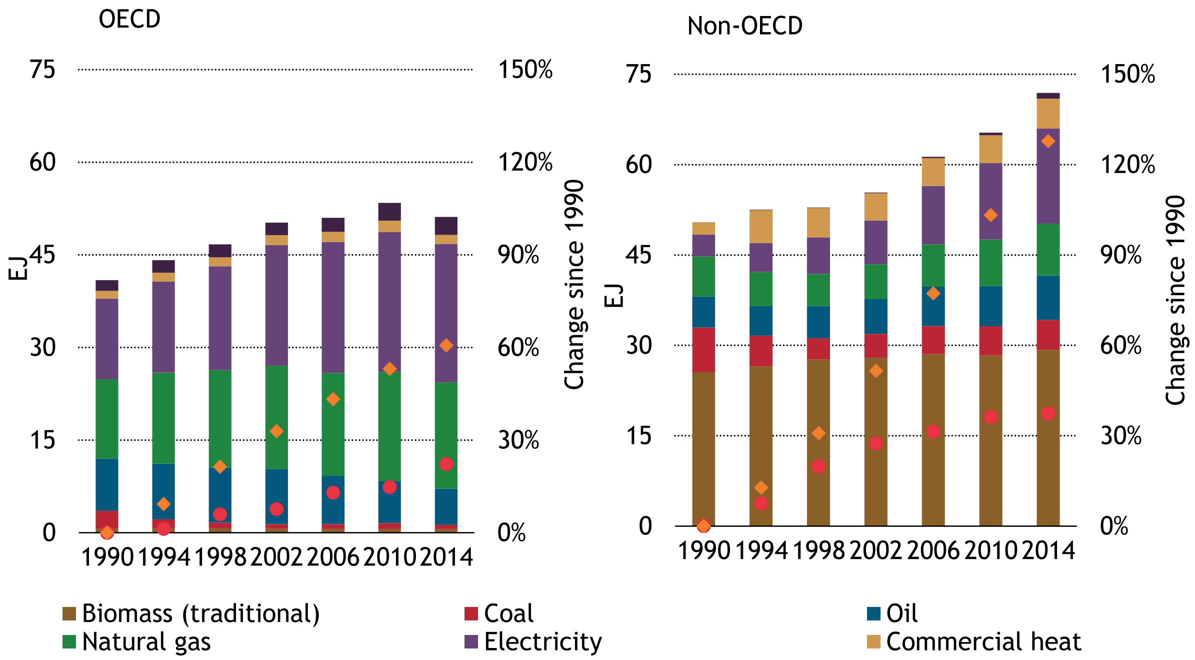
'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Trends in the global building sector



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'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Industry sector - Key numbers

38%	Share of global industry sector in final energy consumption
42%	Share of global industry sector in final electricity demand
24%	Share of global industry sector in global energy-related CO_2 emissions (upstream power generation is considered)

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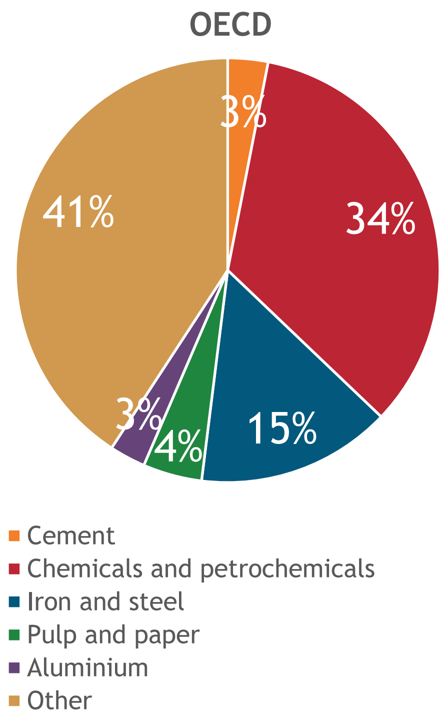
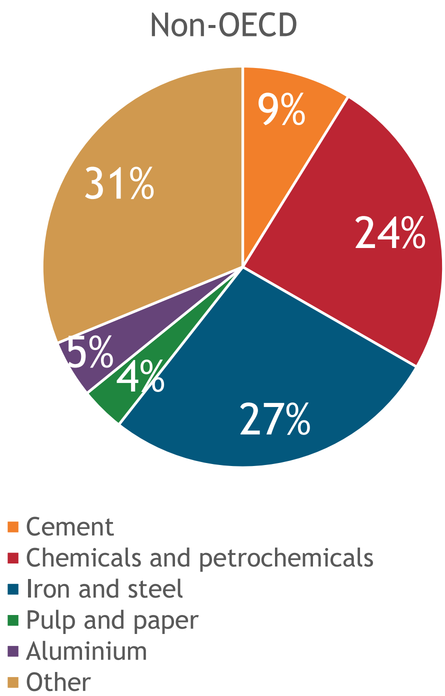
'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Trends in the global industry sector





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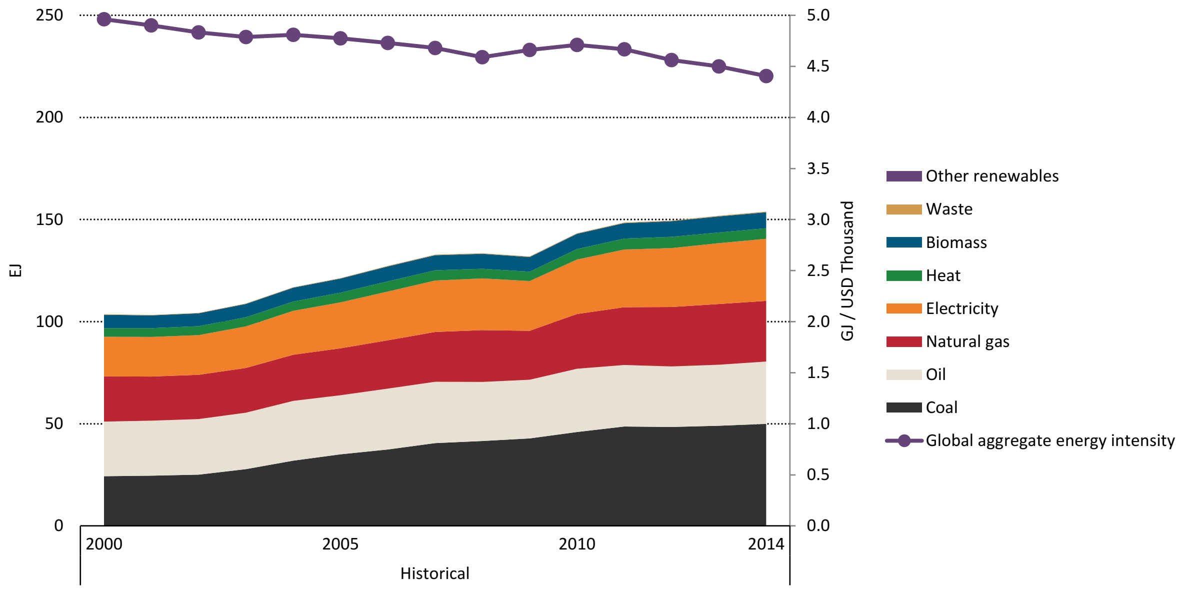
'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Trends in the global industry sector



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'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Transport sector - Key numbers

28% Share of global transport sector in final energy consumption

1.6% Share of global transport sector in final electricity demand

23% Share of global industry sector in global energy-related CO_2 emissions

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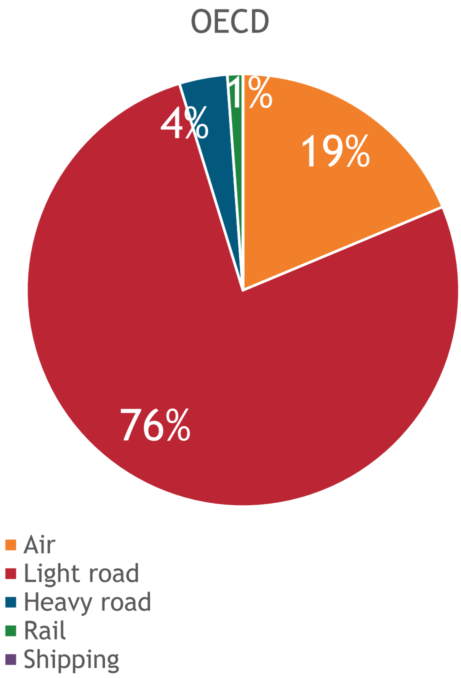
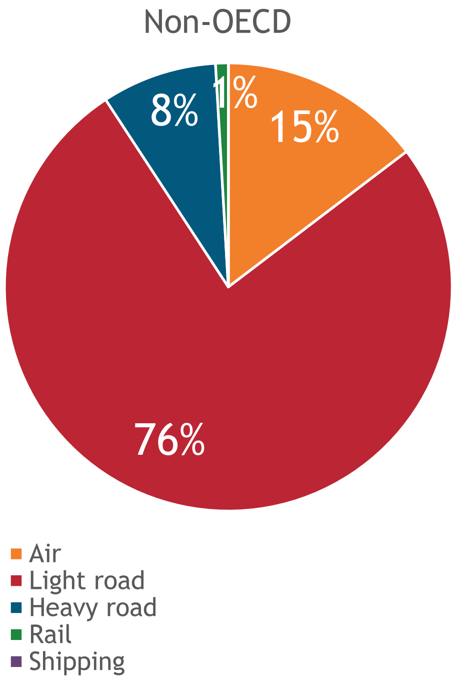
'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

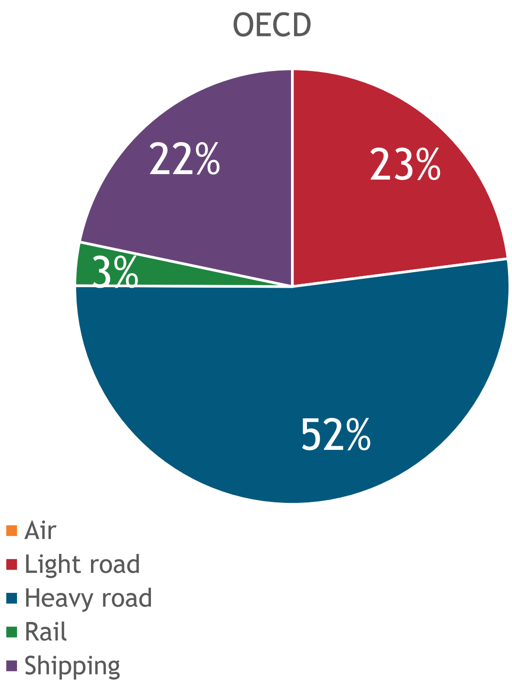
Trends in the global transport sector - passengers

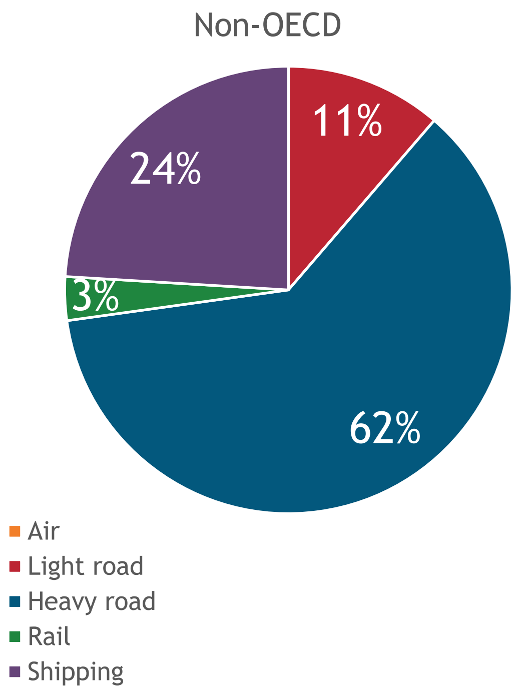




'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Trends in the global transport sector - freight





'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Energy technology transformation: sustainable buildings

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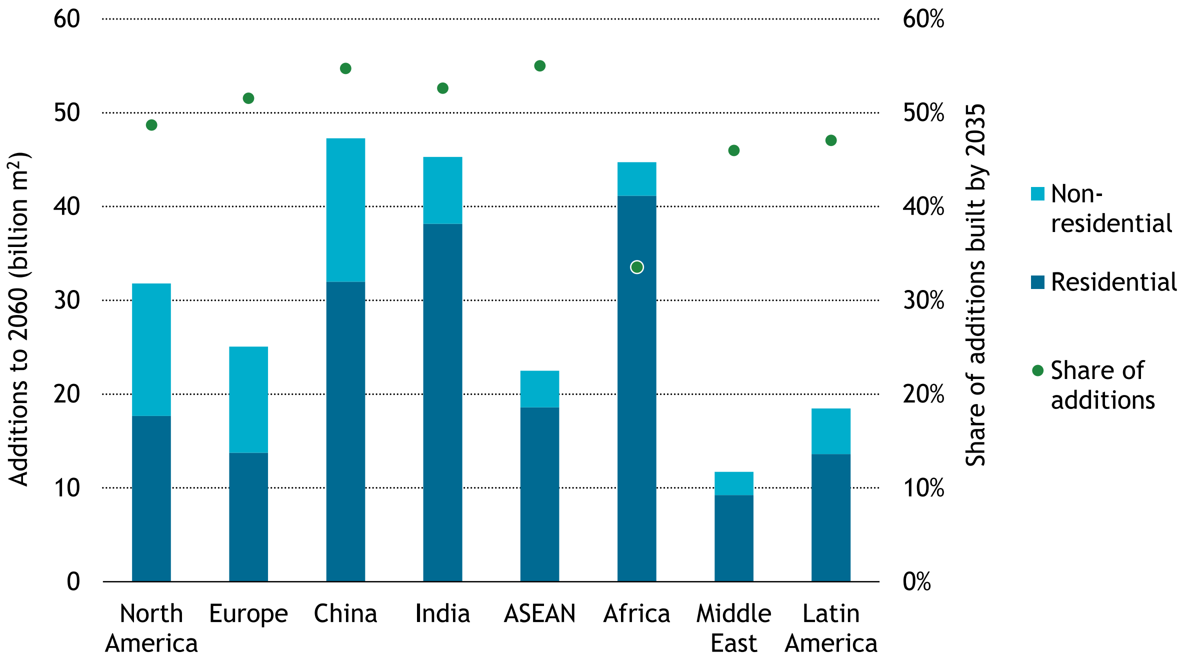
Outlook in the global building sector



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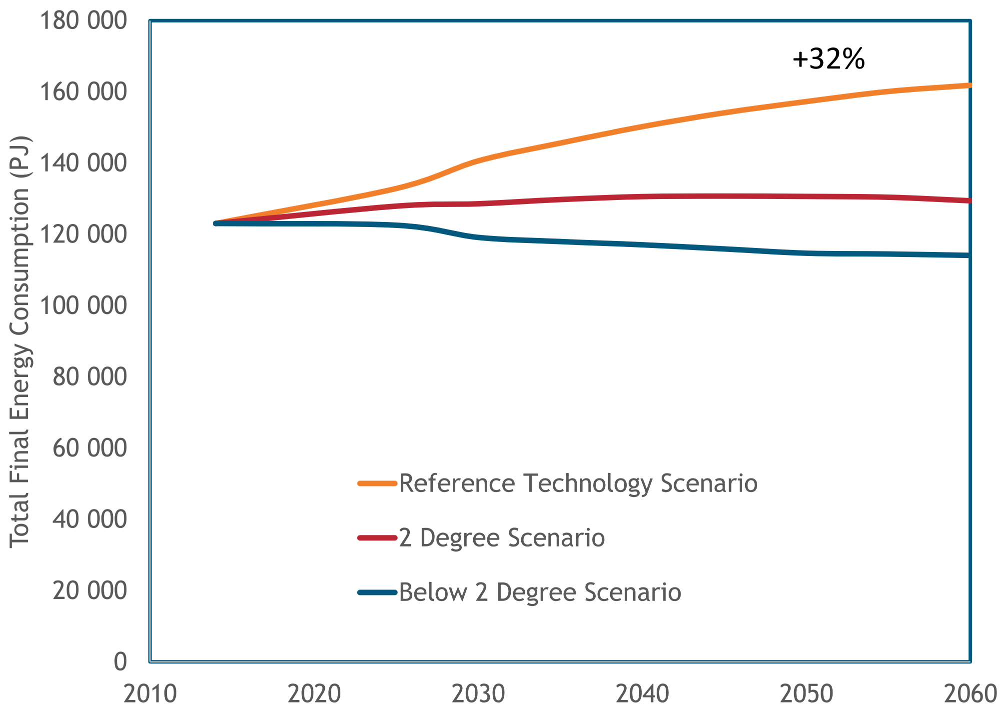
Outlook in the global building sector



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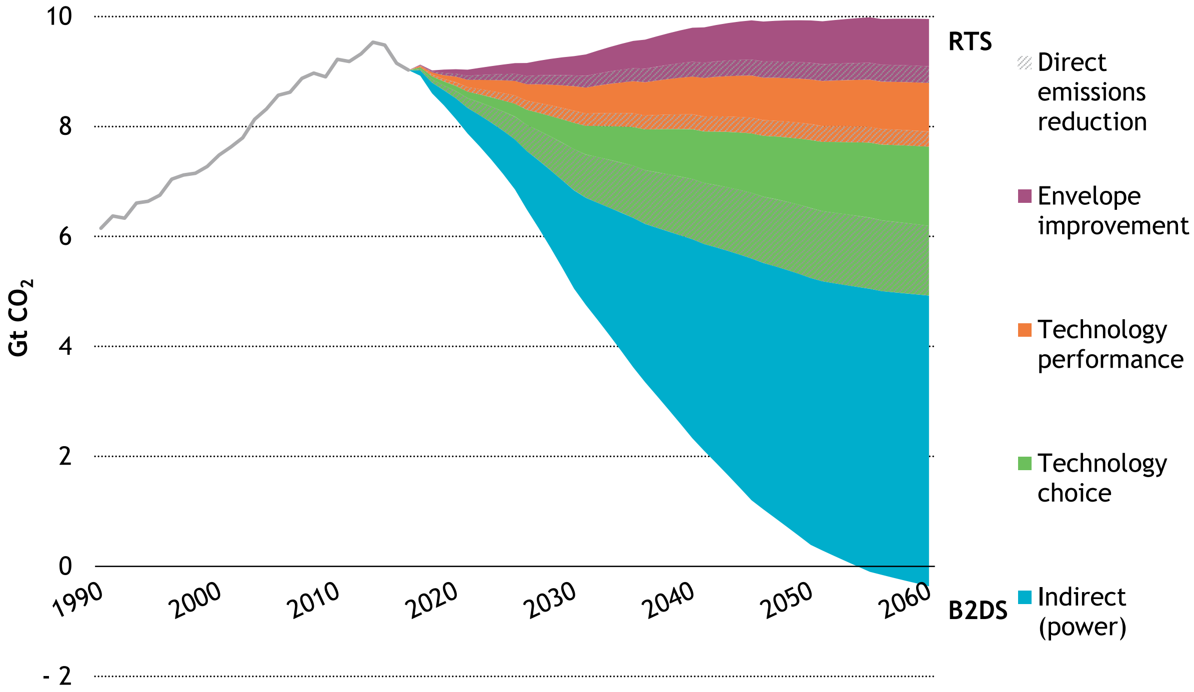
Outlook in the global building sector



'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Energy technology transformation: Low-carbon industry

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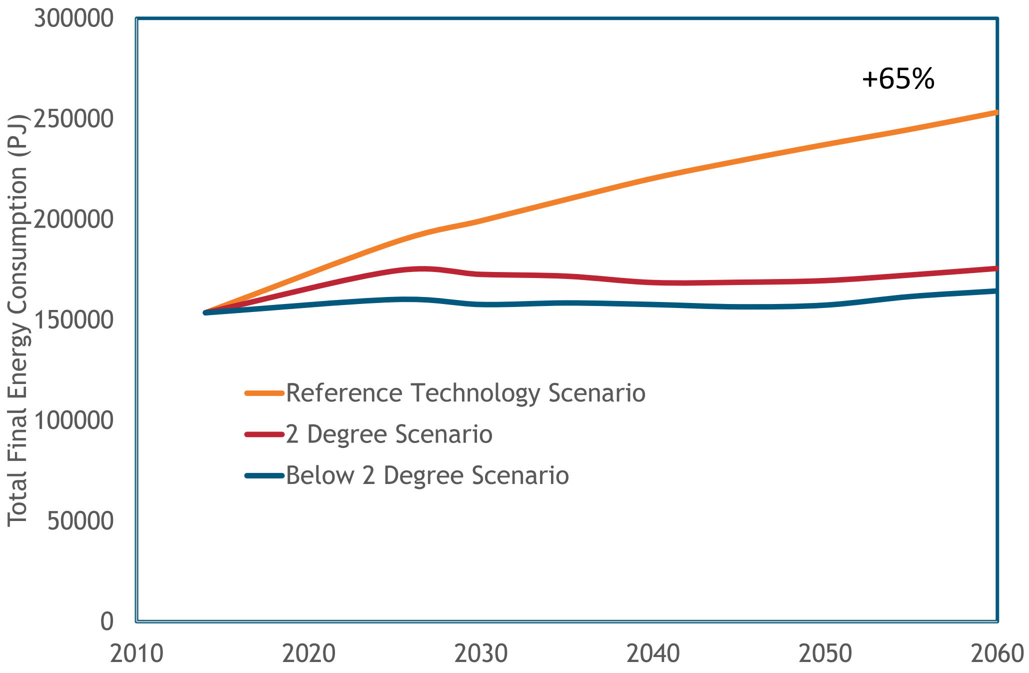
Outlook in the global industry sector



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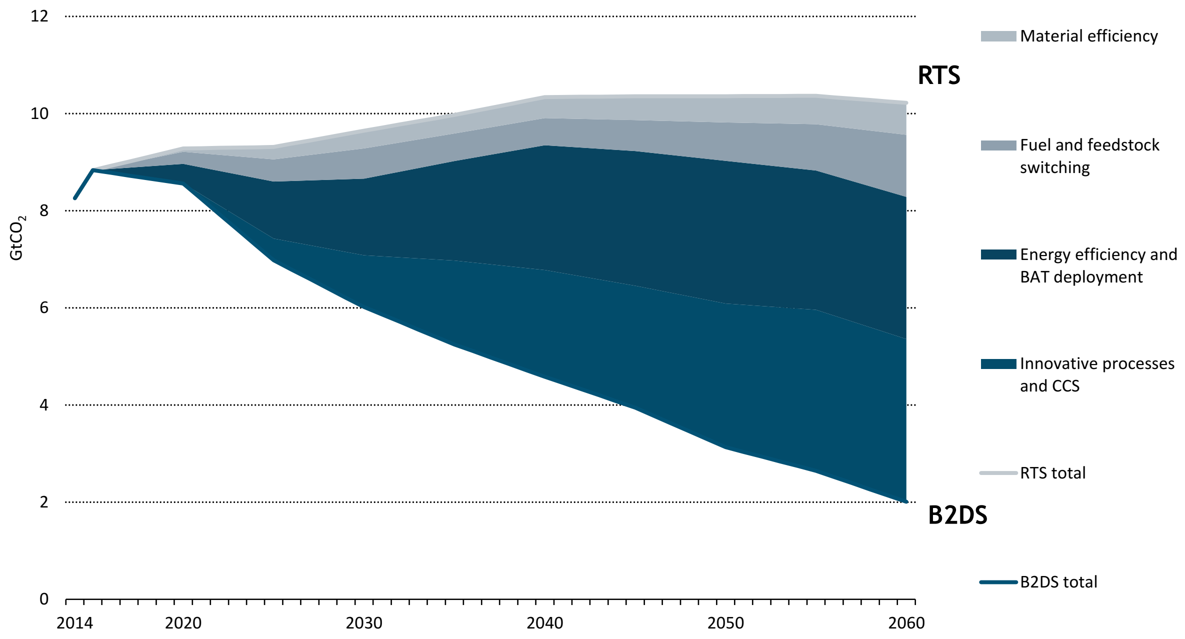
Outlook in the global industry sector



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'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Energy technology transformation: sustainable transport

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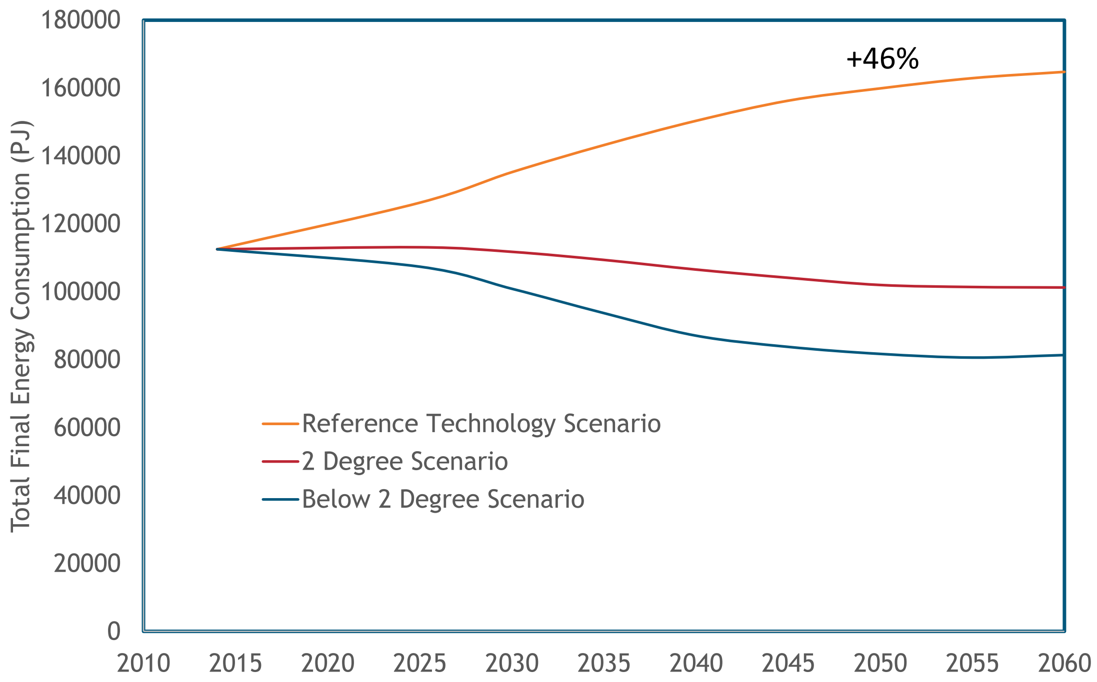
Outlook in the global transport sector



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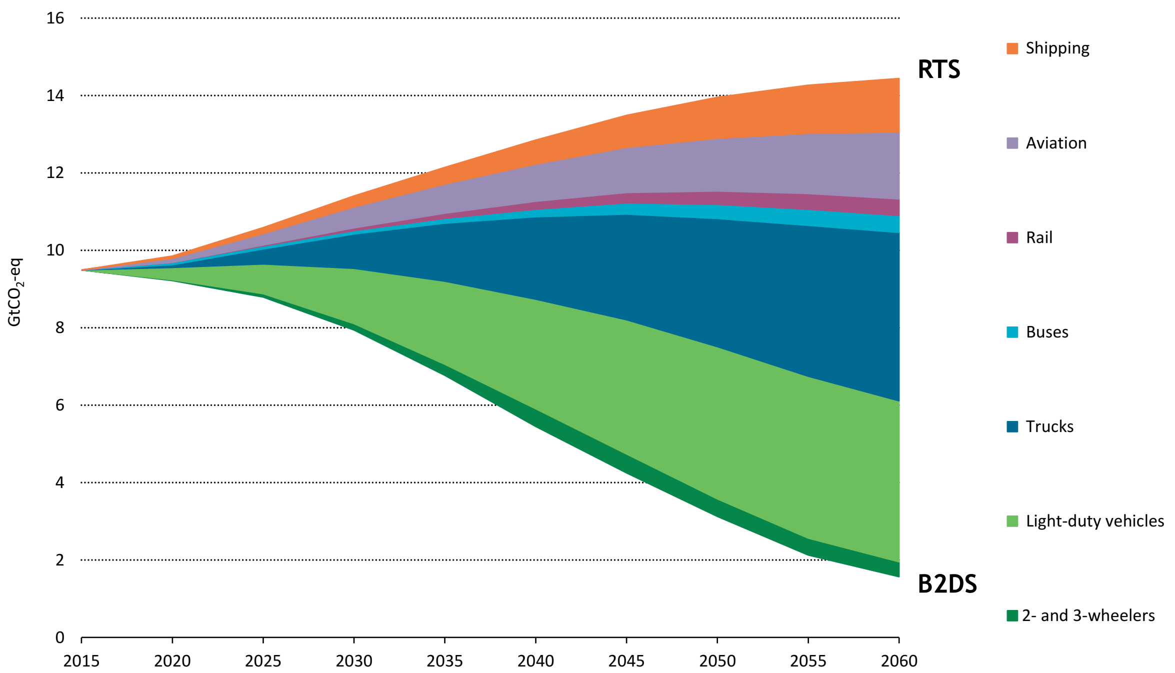
'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Outlook in the global transport sector



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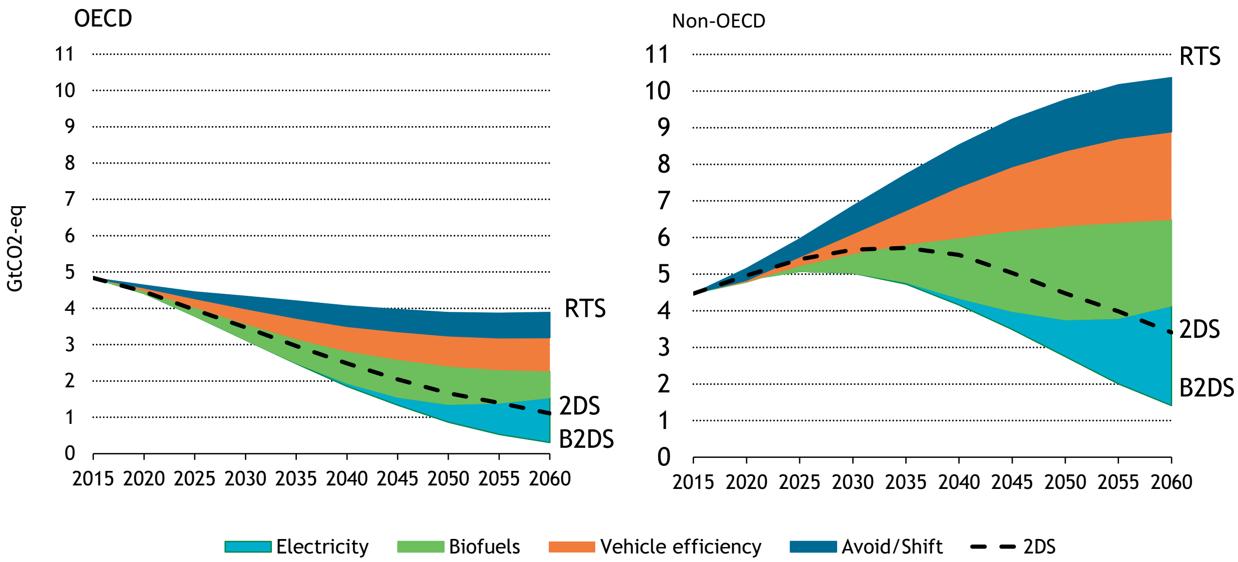
'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Outlook in the global transport sector



'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Policy implications

Policy for enabling infrastructure

Implementing Renewable Energy Initiatives in Africa

The 11th ICA Annual Meeting
2015 Abidjan, Côte d'Ivoire

Building Quality Infrastructure for Africa's Development

The 12th ICA Annual Meeting
2016 Abidjan, Côte d'Ivoire

Toward Smart & Integrated Infrastructure for Africa
An agenda for digitalisation, decarbonisation and mobility

The 13th ICA Annual Meeting
20 October 2017 Roma, Italy (by Italy)

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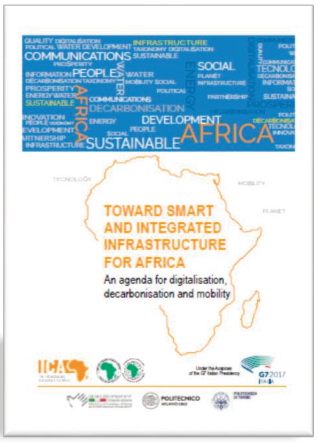
'E. Colombo, P. Leone et al., Toward Smart & Integrated Infrastructure for Africa An agenda for digitalisation, decarbonisation and mobility, Background paper ICA 2017"

Policy for enabling infrastructure



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Launched at the G8 Gleneagles Summit in 2005, the **Infrastructure Consortium for Africa (ICA)** has the aim to help **improving the lives and economic well-being of Africa's people by fostering and supporting an increase in the infrastructural investment in the continent**, from both public and private sources. The ICA recognizes the strategic role that development of infrastructure has for the economy and for the social stability of the region. Using its convening power, the **ICA acts as a catalyst accelerating the development of Africa's infrastructure** with the aim at removing some of the technical and policy barriers to infrastructural investment. The 13th ICA Annual Meeting is held in Rome, Italy, on October 20th 2017 under the co-chairmanship of the Italian G7 Chair and the AfDB. The Plenary Meeting **"Towards the promotion of smart and integrated infrastructures in Africa: an agenda for digitalization, decarbonisation and mobility"**, is focused on the nexus between Infrastructure, Next Production Revolution and SDGs.

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'E. Colombo, P. Leone et al., Toward Smart & Integrated Infrastructure for Africa An agenda for digitalisation, decarbonisation and mobility, Background paper ICA 2017"

Policy for enabling infrastructure

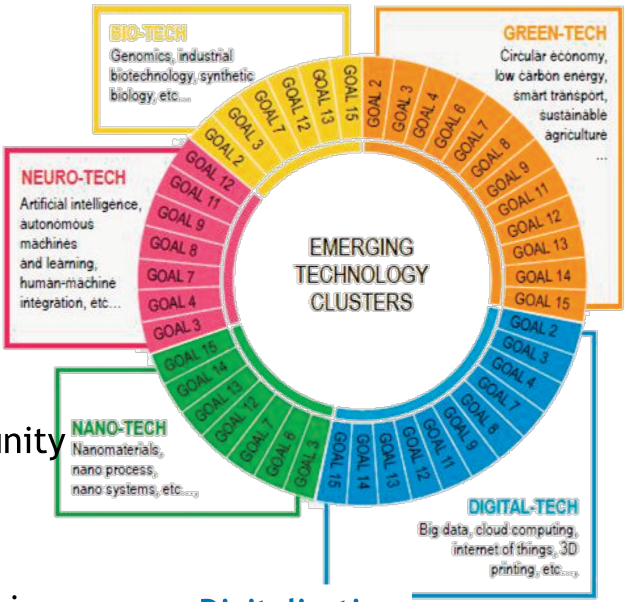
DIGITALISATION, DECARBONISATION & MOBILITY

- Clusters of **emerging technologies** are pivotal within the NPR and SDGs and may comply with Paris Agreement
- **Digital & Green Tech** appears as the most relevant ➔the core of ICA 2017.

⬇

- **Africa may jump into this enabling stage for** further leapfrogging opportunity
- A **new generation of leaders is also envisaged** to tranform the potential innovation into effective power for Africa

Decarbonisation & Mobility



Digitalisation

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Policy for enabling infrastructure

FROM QUALITY to SMART-I INFRASTRUCTURE

- **to** be drivers of investment & growth **Africa's countries** require **Infrastructure development** to respond efficiently and effectively
- **SMART-I Infrastructure** attributes rational

ICA 2016

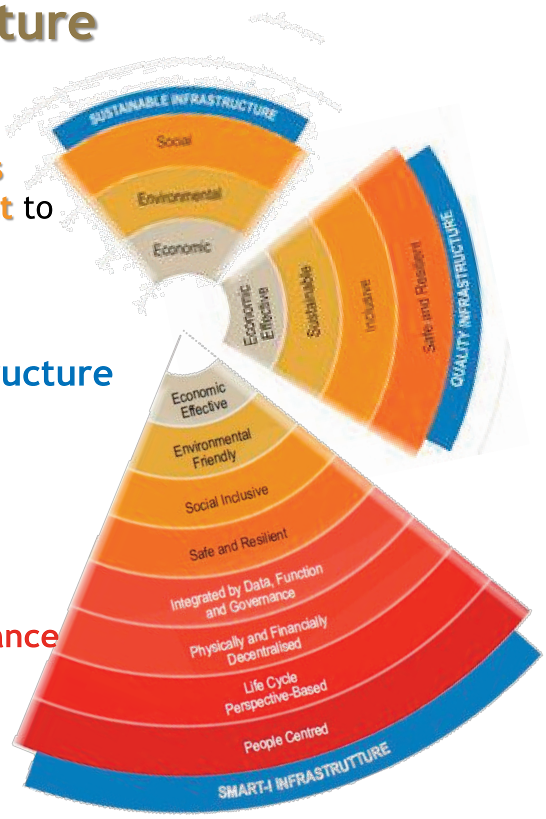
From Sustainable and Quality Infrastructure

- ✓ Economic effectiveness
- ✓ Environmental Friendly
- ✓ Social Inclusive
- ✓ Safe and Resilience

To SMART-I Infrastructure

- ✓ Integrated by data, function & governance
- ✓ Physical and Financially Decentralised
- ✓ Life Cycle Perspective - Based
- ✓ People-Centred

ICA 2017



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Policy for enabling infrastructure

SMART-I INFRASTRUCTURE TAXONOMY

Integrated by data, function and governance: infrastructures have to rely on innovative ways of sharing **massive amount of data**, **interconnecting functions** and **cross-sectorial policies** or **regulatory frameworks.**

Physical and Financially Decentralised: capillary technologies may be **more massively available** to citizens, increase efficiency and inclusiveness; capitals & infrastructure owners are no longer limited to large creditworthy entities

Life Cycle Perspective: infrastructures for NPR need to lead to new **production & consumption patterns** driven by **rational use of resources (energy, water, raw materials); accountability goes** along the whole life cycle of each supply chain.

People-Centred: a multi-dimensional involvement of **citizens** as consumers, influencers, producers and agents of the change need to be enabled by capacity bulding and empowerment

…legacy from **"G7 Summit, Outreach Session on Africa"**

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'E. Colombo, P. Leone et al., Toward Smart & Integrated Infrastructure for Africa An agenda for digitalisation, decarbonisation and mobility, Background paper ICA 2017"

Technology & policy strategy for sustainable building

Action area	
Whole building	• Enforce building energy codes • Policies and market incentives to reduce hidden and upfron cost • Strengheten infrastructure and capacity
Building envelope	• Minimun energy performance for building envelope • Accelerate diffusion of high performance technology • Increase access to finance
Space heating	• Promote solar thermal and heat pump technologies • MEPS above 120%-150% • Prevent expansion of fossil fuel related infrastructure • Promote system integration technologies for net-zero energy communities
Space cooling	• Promote solar cooling technologies • MEPS above 350%-400%
Water heating	• Uptake of heat pump and solar thermal water heaters • Promote system integration technologies for net-zero energy communities
Lighting	• Ban traditional light bulbs • MEP above 120 lm/W
Appliances	• MEPS • Market access
Cooking	• Bring to market clean cooking technologies

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'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Technology & policy strategy for low-carbon industry

Action area	
Tracking progress	• Improve statistics • Setting benchmarking initiatives
Energy efficiency and BAT	• Support energy audits and energy system management • Incentivise BATs • Set standards
Material efficiency	• Incorporate price signals into consumers' products related to externalities • Promote hierarchy of waste utilization: reuse prior to recycling prior to energy production
Fuel and feedstock switching	• Carbon pricing mechanisms • Remove fossil fuel subsidies
Low-carbon innovation	• Property right • Public-private partnership
Transition to low carbon energy systems	• Life-cycle assessment • Demand response in electricity markets

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'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Technology & policy strategy for sustainable transport

Action area	
Light-duty vehicles	• Fuel taxes • Vehicles taxes • ZEV mandates • Regulatory limits Fuel economy/GHG emissions • Access restrictions. Differentiated road pricing and parking fees • Suitable infrastructure
2- and 3-wheelers	• Regulatory limits for pollutants and GHGs • Differentiated taxes
Bus and rail	• Travel demand management policies • Densification and urban form • Promoting public transport
Trucks	• HCVs • Optimizing routing • Platooning • Backhauling • Last-mile efficiency measure • Re-timing delivery
Aviation	• Carbon taxes • Fuel efficiency standards • Increase biofuel share
Shipping	• Efficiency standards • Fuel quality regulation and switching

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'International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris'

Tracking energy efficiency policies with indicators

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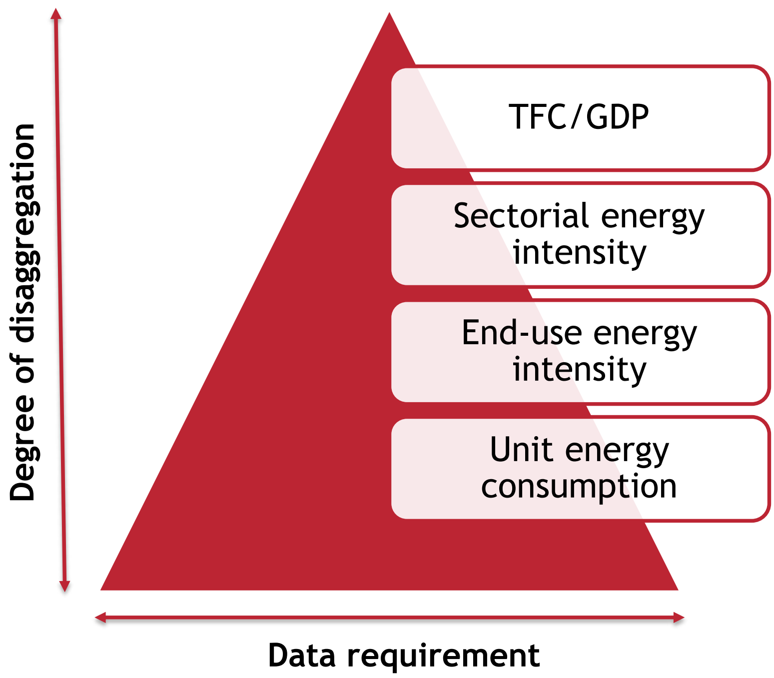
Energy efficiency indicators - IEA Approach



- Hierachical approach → provide an overwiew from country-wide perspective to end-use level.
- Level of analysis depends on available data and outcome of the implementing policy

- **Driving forces of demand?**
- **The state of energy consumption?**
- **Response that policy should enable?**

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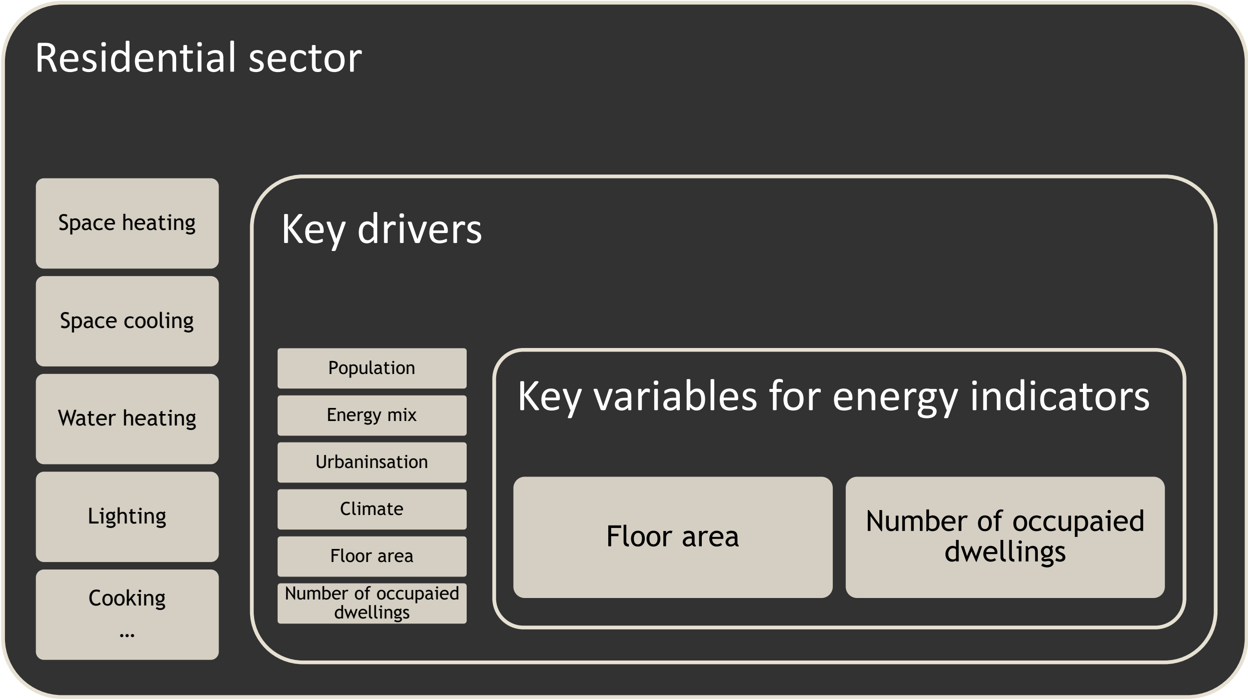
'International Energy Agency (2014), Energy efficiency indicators: essentials for policy making, OECD/IEA, Paris'

Energy efficiency indicators - Residential sector



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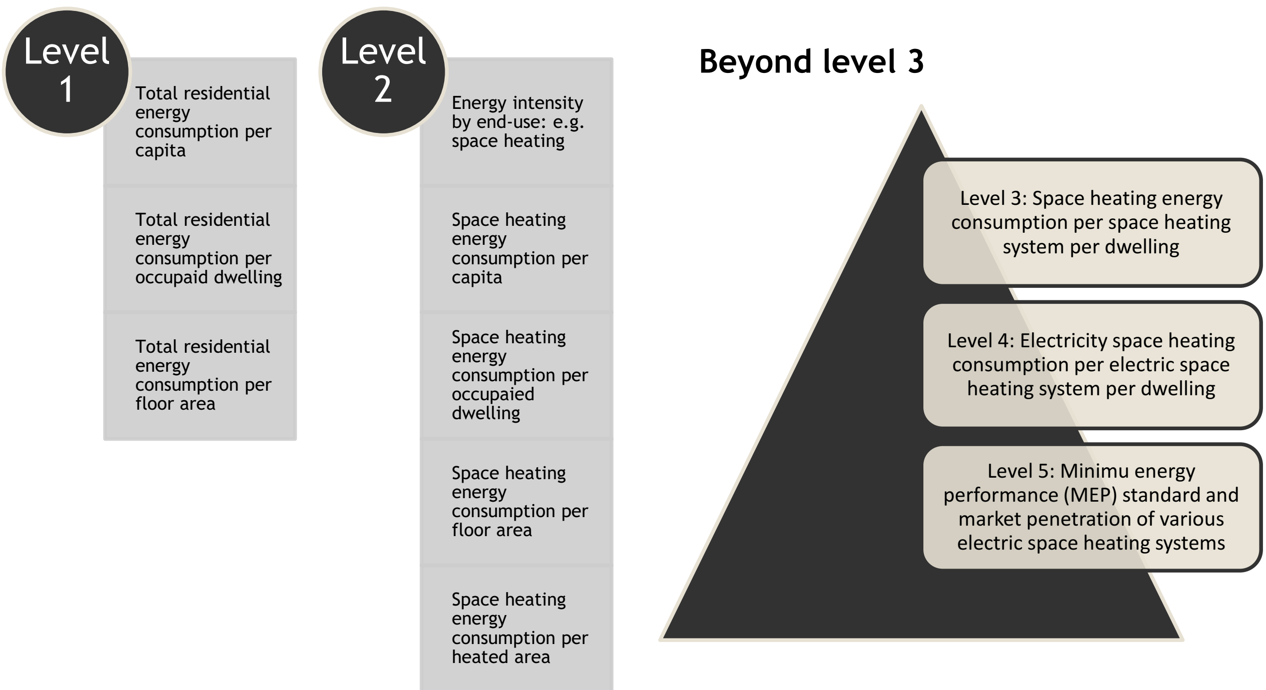
Energy efficiency indicators - Residential sector



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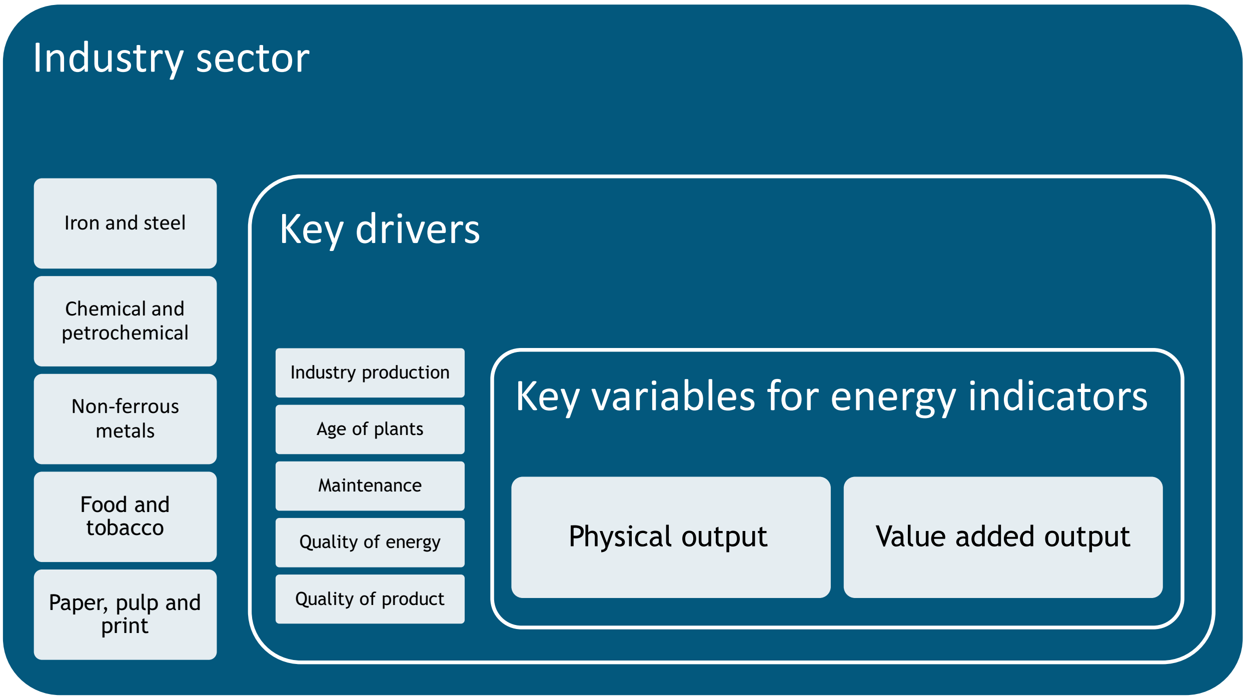
'International Energy Agency (2014), Energy efficiency indicators: essentials for policy making, OECD/IEA, Paris'

Energy efficiency indicators - Industrial sector



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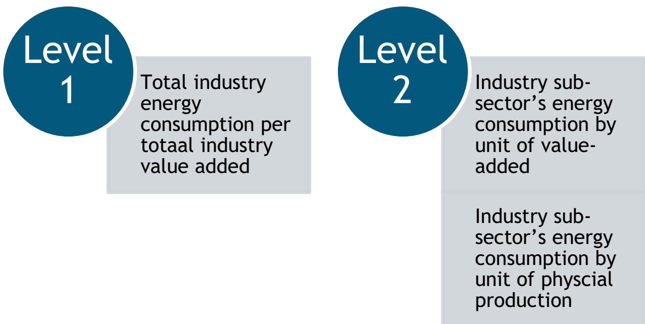
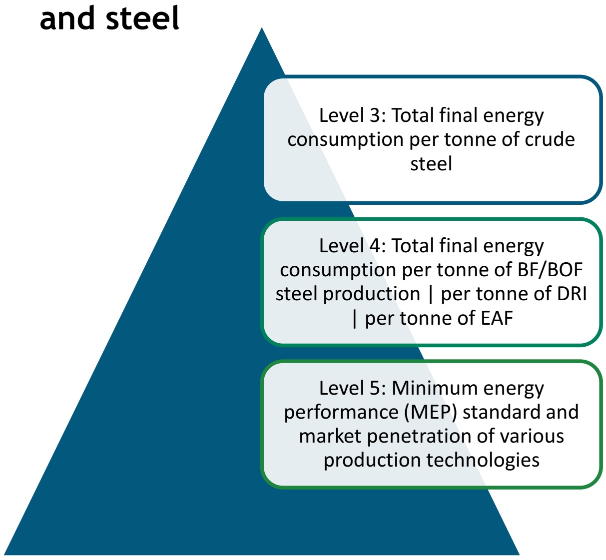
Energy efficiency indicators - Residential sector



Beyond level 3: example for Iron and steel



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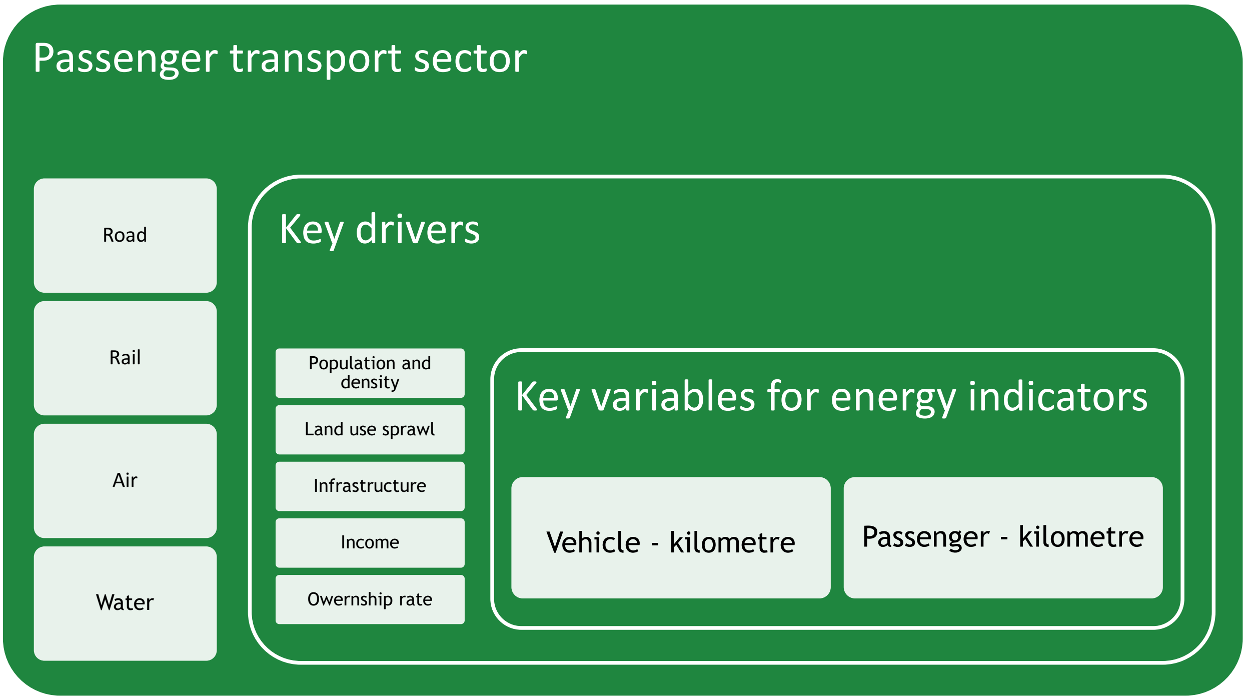
'International Energy Agency (2014), Energy efficiency indicators: essentials for policy making, OECD/IEA, Paris'

Energy efficiency indicators - Transport sector



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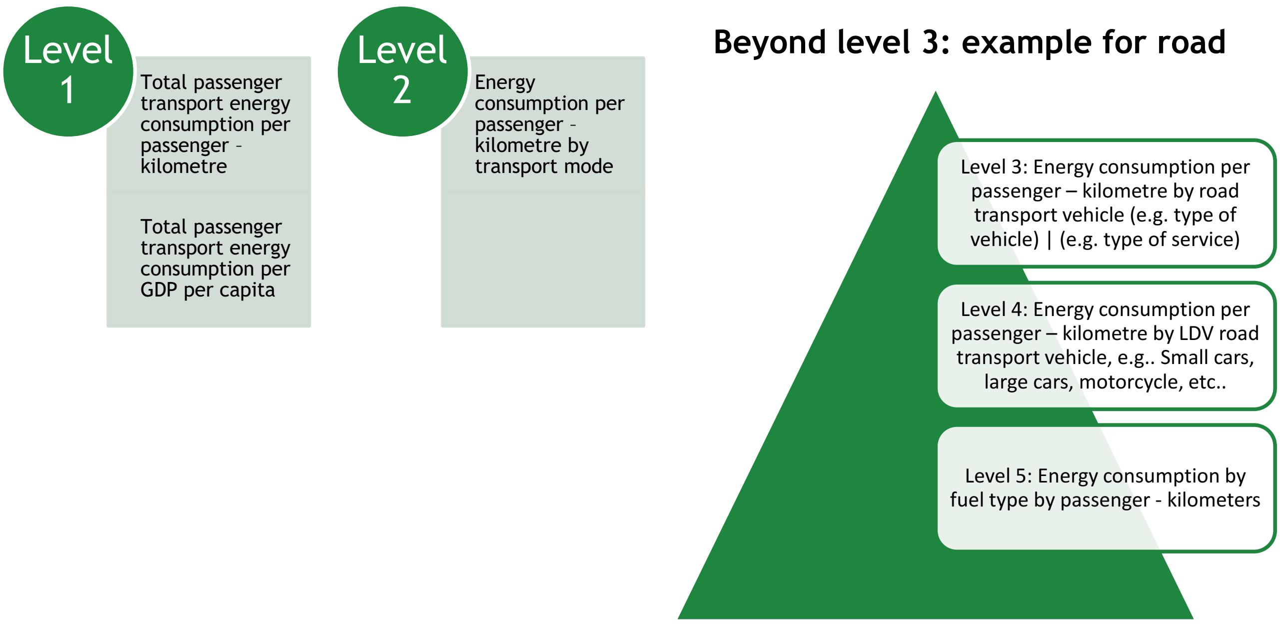
Energy efficiency indicators - Transport sector



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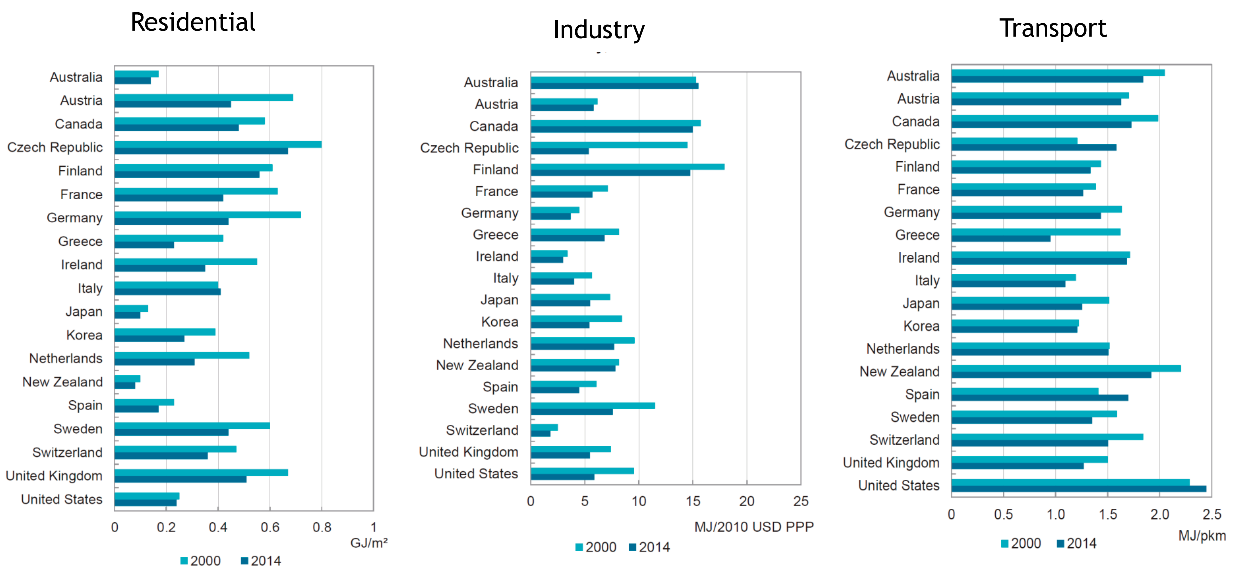
Examples of sectorial indicator trends



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'International Energy Agency (2017), Energy efficiency indicators: highlights, OECD/IEA, Paris'

Energy efficiency in a life-cycle perspective

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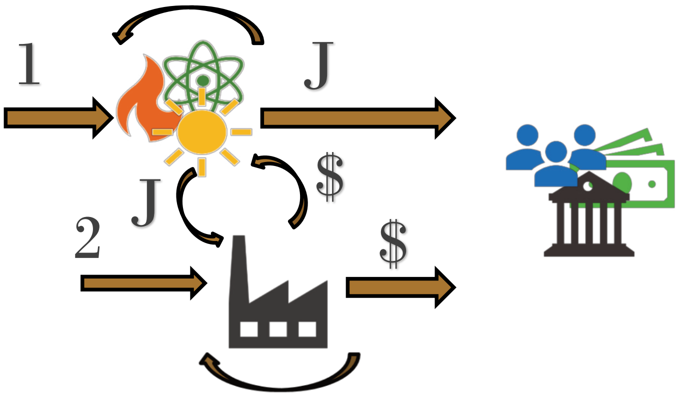
Methodology

❖ Hybrid Input/Output models

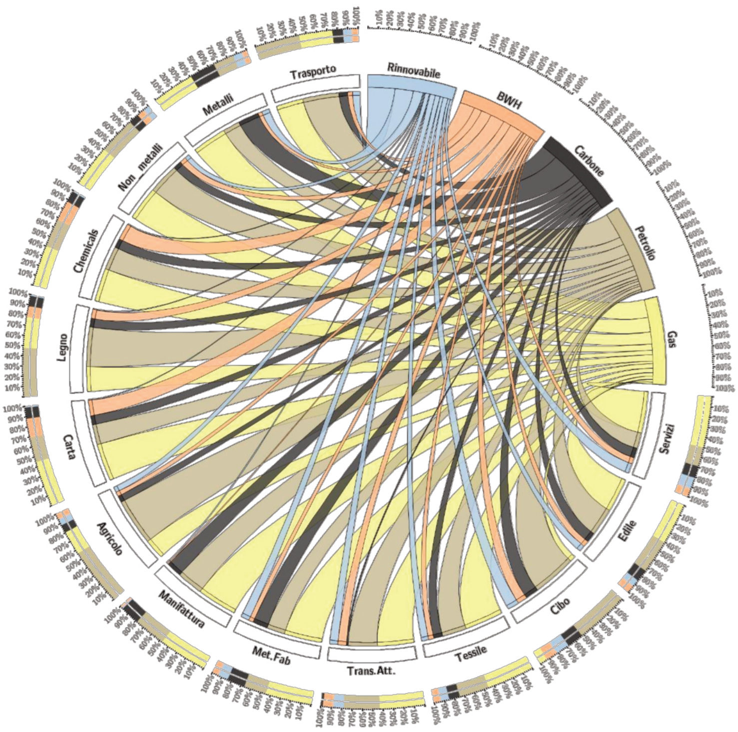
$$\begin{cases} x_1^* = e_{11}^* + e_{12}^* + f_1^* \\ x_2 = z_{21} + z_{22} + f_2 \end{cases}$$

$$\mathbf{x}^* = \mathbf{L}^* \mathbf{f}^*$$



❖ Economic data from OECD
❖ Energy data from IEA
❖ ISIC Standard
❖ 5 different energy sectors: oil products, coal, natural gas, electricity, biofuels and waste heat

Sample results for Italy - 2011



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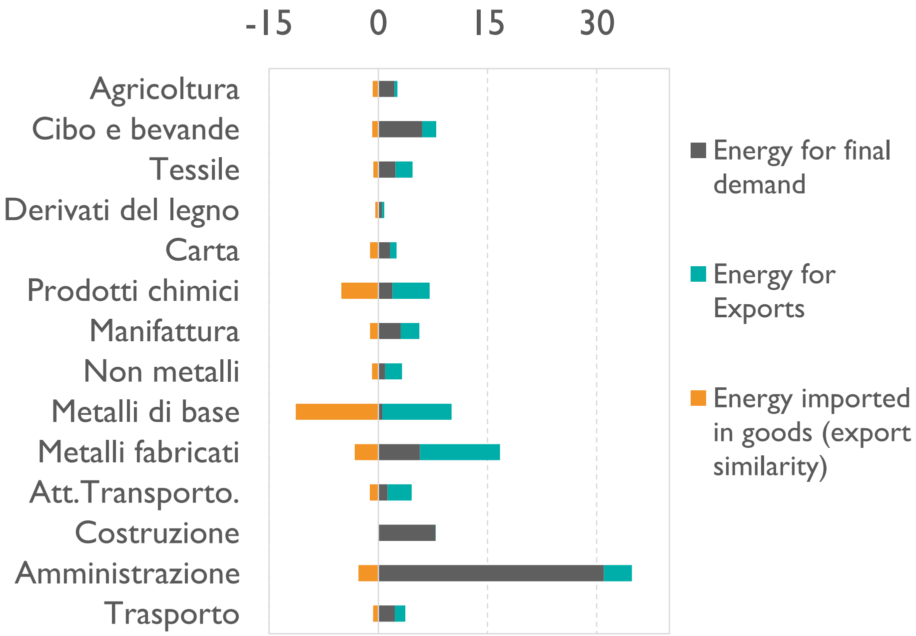
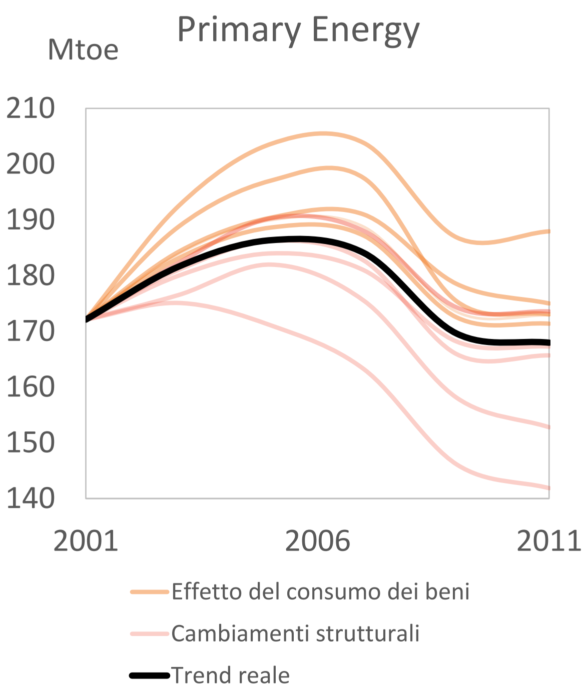
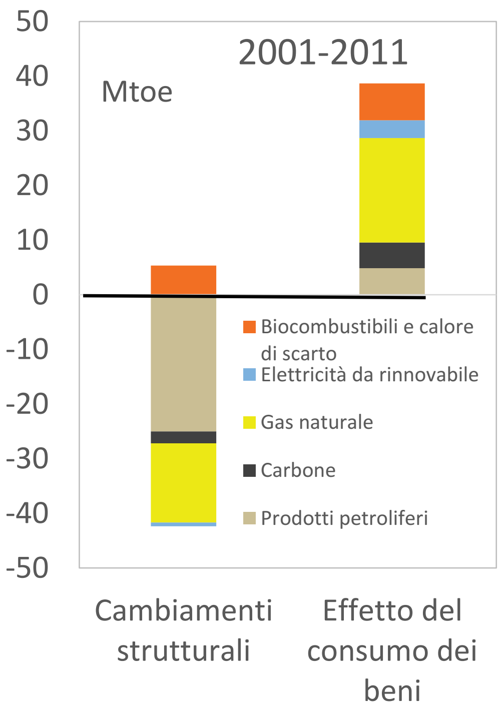
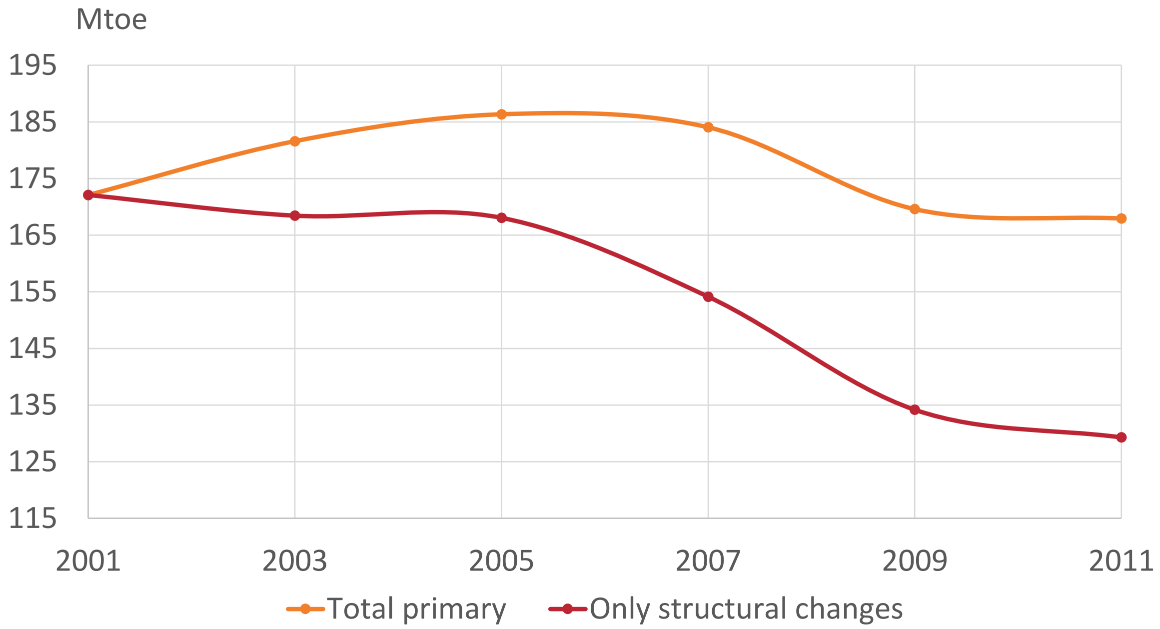


Decomposition final consumption - 2001 - 2011

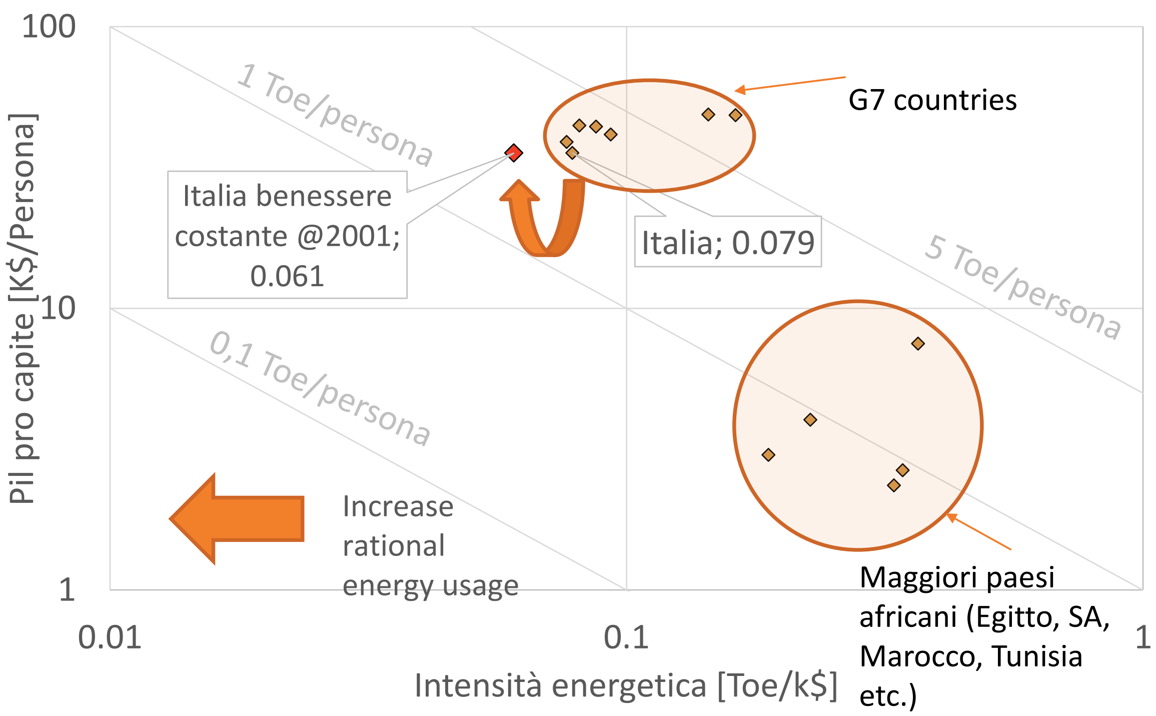




Decomposition final consumption - 2001 - 2011



Decomposition final consumption - 2001 - 2011



Energy efficiency in Ethiopia

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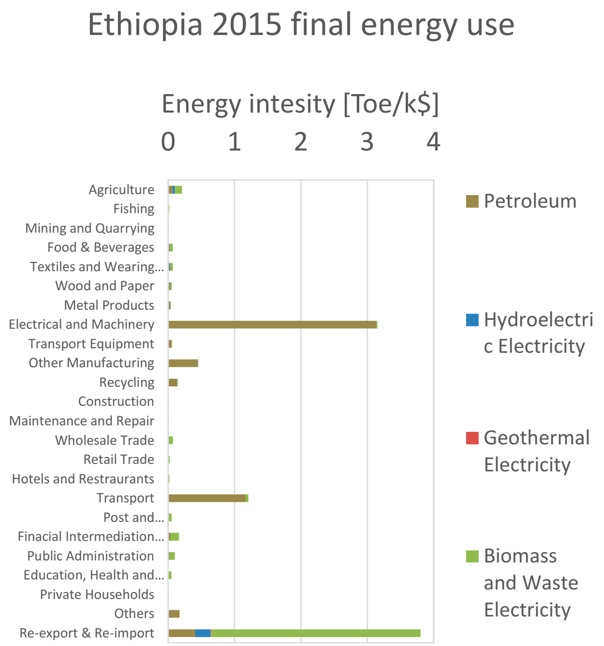
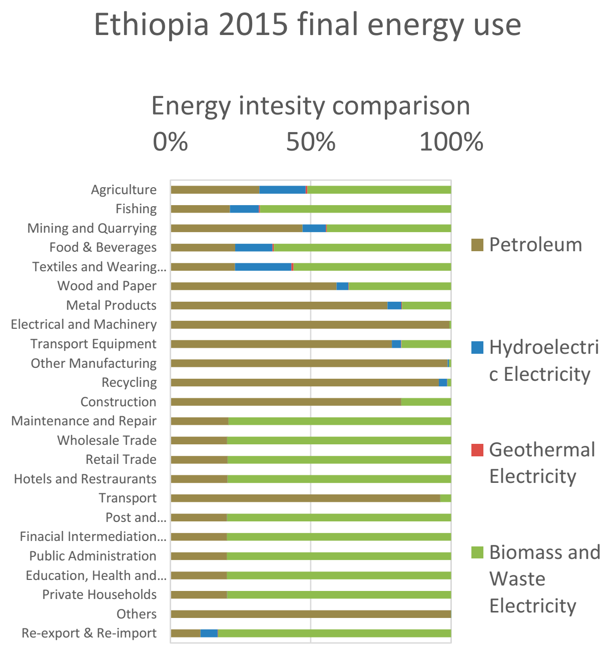
Ethiopia final consumption - 2015





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‘L. Rosciarelli, P. Leone, Politecnico di Torino”

Thank you all | Grazie a tutti

Questions ?

pierluigi.leone@polito.it

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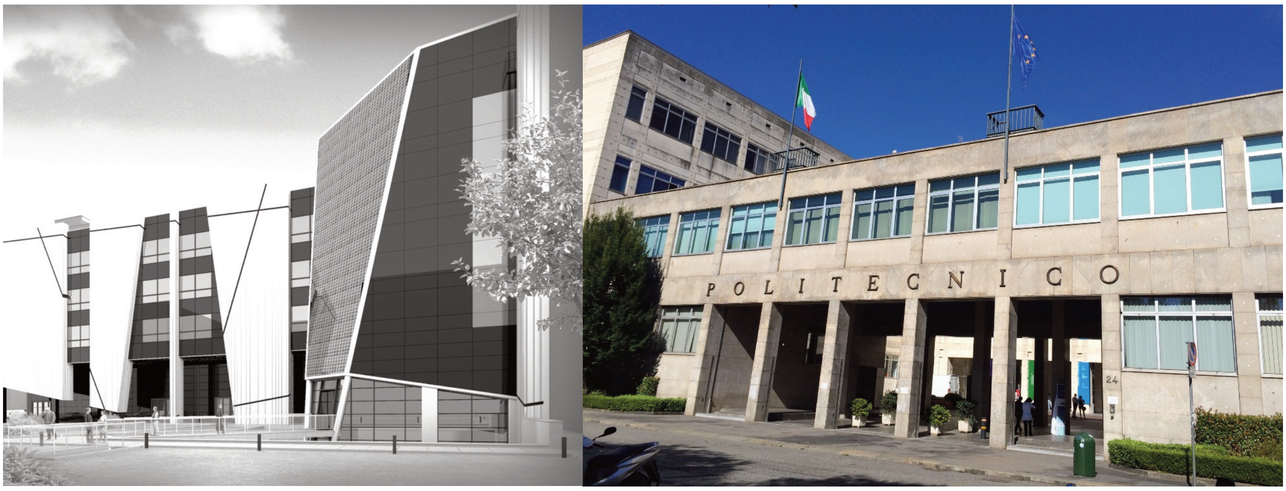
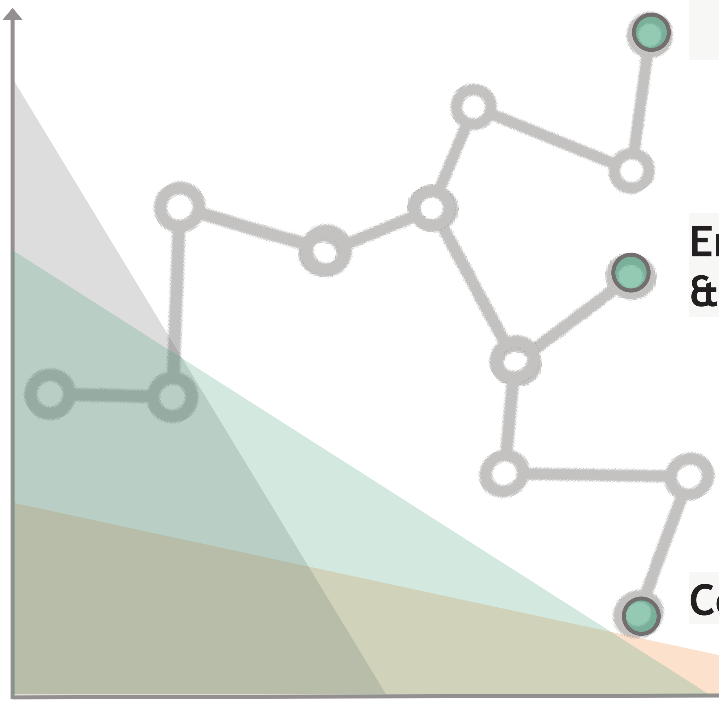


Understanding energy consumption patterns
How to approach energy planning and energy efficiency paths

Chiara Delmastro, Politecnico di Torino, March 2018

Outline



Global Overview

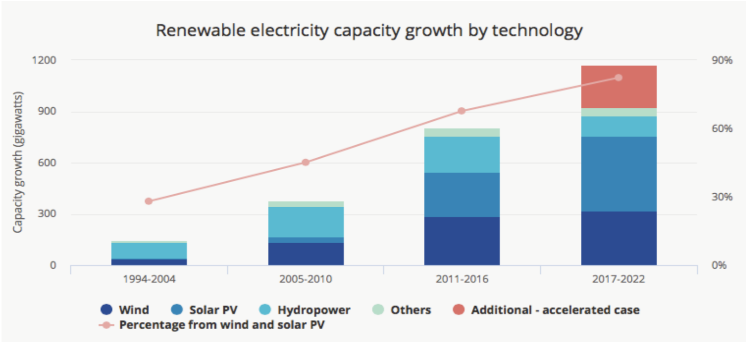
- Consumption patterns and major trends
- Global energy challenges

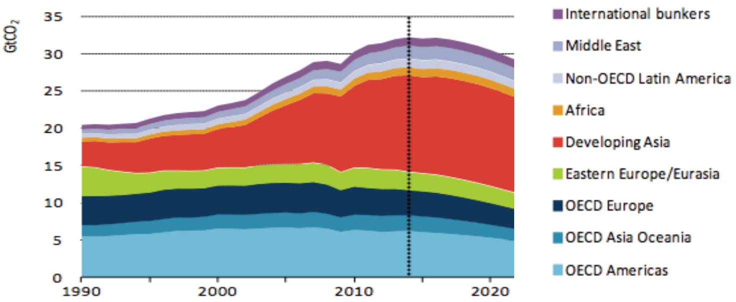
Energy Planning & Policies

- Buildings
- Introduction to integrated energy planning
- Scenario Making
- Energy efficiency policies
- Tracking energy efficiency

Collective activity

Consumption patterns and major trends





- USA leader for oil & gas production
- Solar PV cheapest Source of electricity generation
- China moves to be lightest service oriented
- Transformation of electricity demand

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Credits for images and data: International Energy Agency, WEO 2017; Renewables 2017, IEA; Perspective for the energy transition 2017, IEA.

Global energy challenges

- 2 times more efficient than today
- +580 bcm of additional gas demand
- 3250 GW of PV solar capacity
- + 15% added investments only

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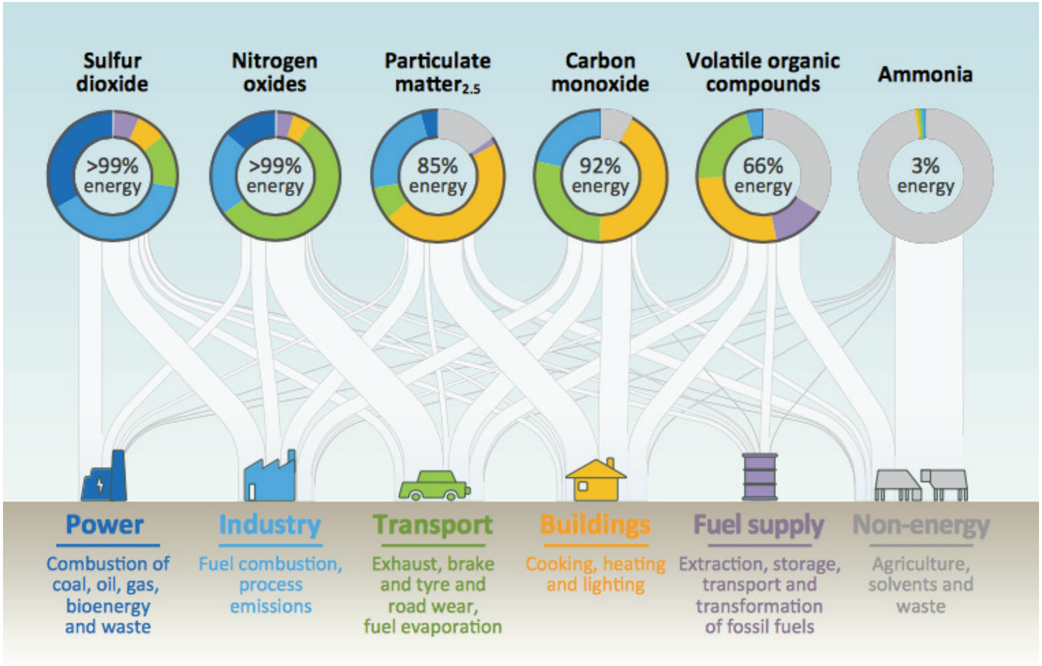
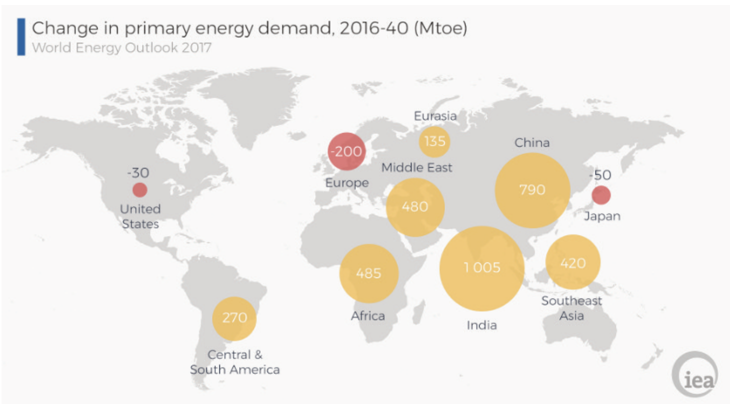
Credits for images and data: International Energy Agency, WEO 2017

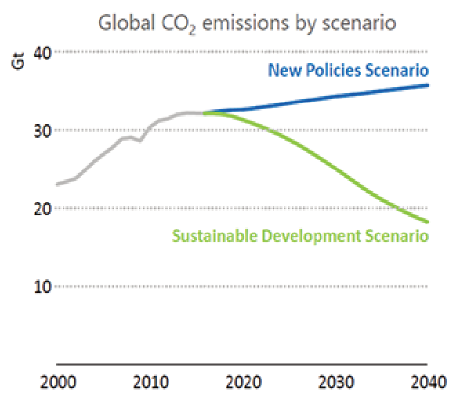
Global energy challenges: improve air quality



Credits for images and data: International Energy Agency, WEO 2016 Special Report on Air Pollution

Global energy challenges: address climate change





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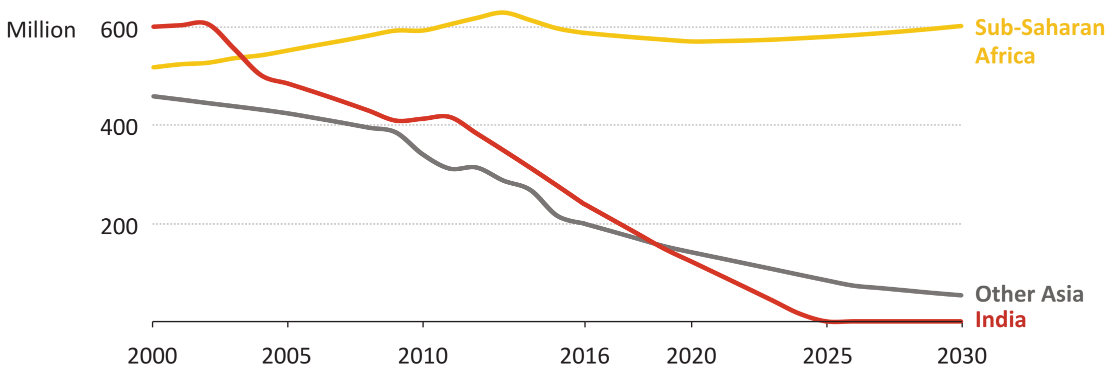
Credits images and data: International Energy Agency, WEO 2017

Global energy challenges: achieve universal energy access

Population without electricity access



Credits images and data: International Energy Agency, WEO 2017 Special Report on energy access

Global energy challenges: how to proceed

- Understand the drivers of energy demand evolution
- Gauge solutions based on impacts on China, India & SSA
- Develop both technological and policy solutions

Actions need to be properly channelled and energy planning may support the definition and prioritization of these actions

Credits : Catherine Wolfram, BerkeleyHASS

Energy planning: integrated, long-term and cross-sectoral

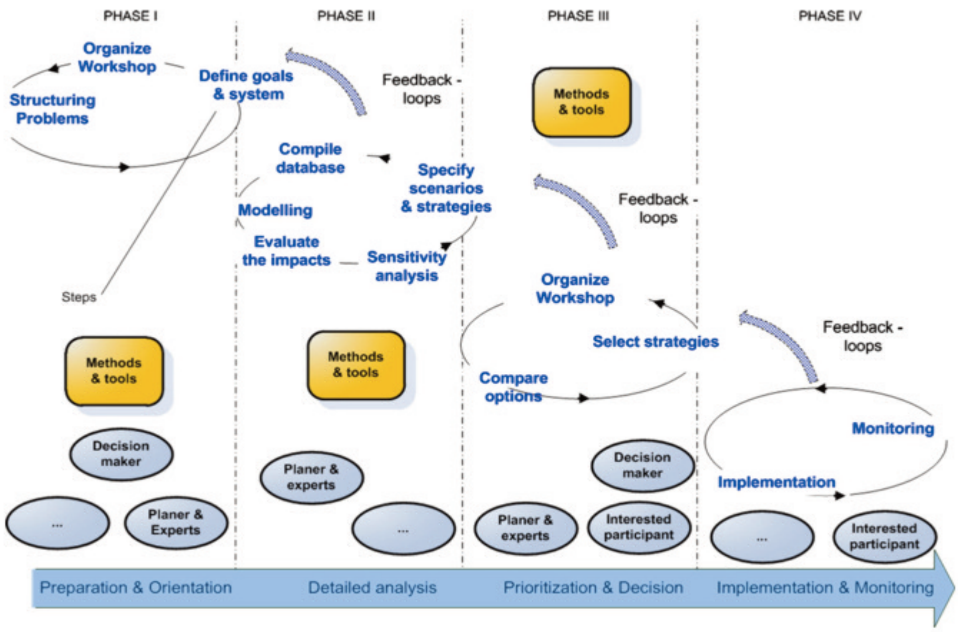


Image credits : Mirakyan& De Guio, Renewable and Sustainable Energy Reviews 22 (2013) 289–297

Energy planning: preparation phase

- Involving Stakeholders
- Setting the objectives and methodologies
- Data collection

Phase I -Preparation phase

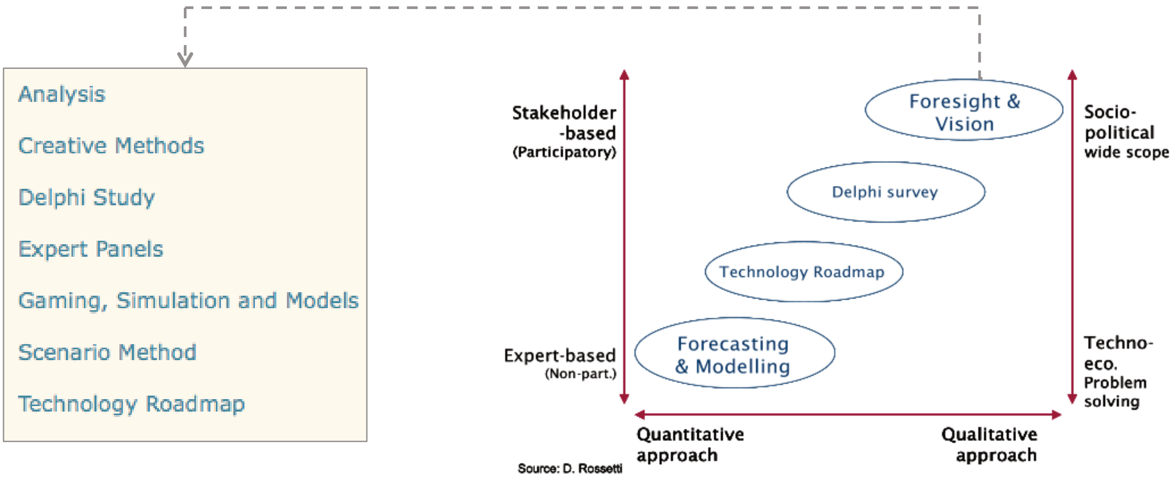
QUALITATIVE & PARTICIPATIVE APPROACH → QUALITATIVE SCENARIOS

↕

Phase II - Detailed analysis phase

MODELLING APPROACH → QUANTITATIVE SCENARIOS

Energy planning: preparation phase



Source: Rossetti di Valdalbero (2010).

Image credits : Rossetti di Valdalbero (2010)

Energy planning: preparation phase - data collection

Historical data:
Understanding current trends

Demand drivers, technologies and policies:
Estimating future trends

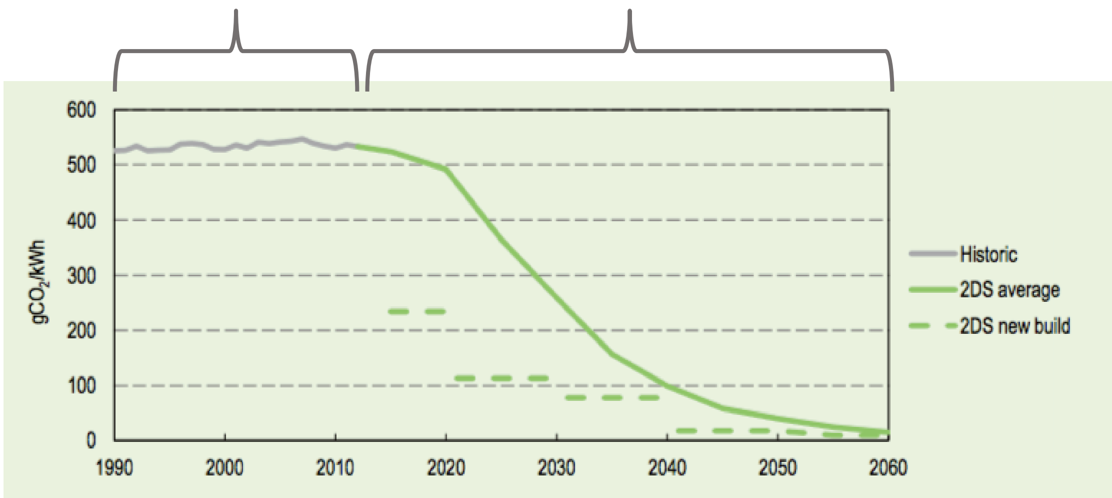
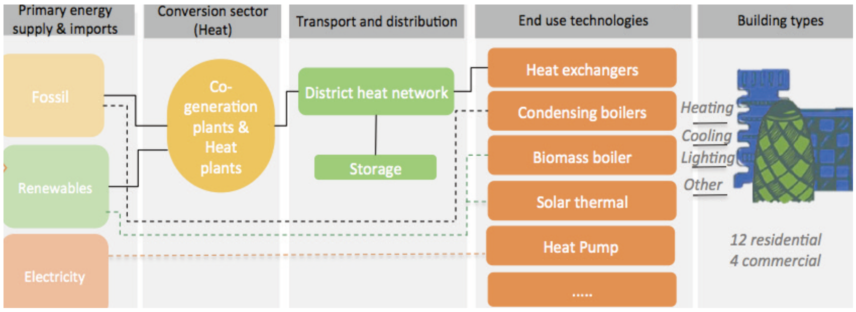
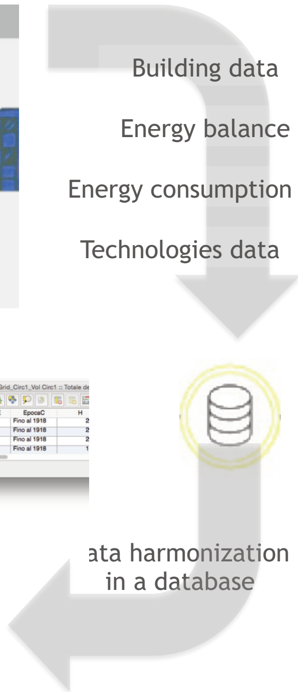


Image credits : IEA, ETP 2017

Energy planning: preparation phase

REFERENCE ENERGY SYSTEM

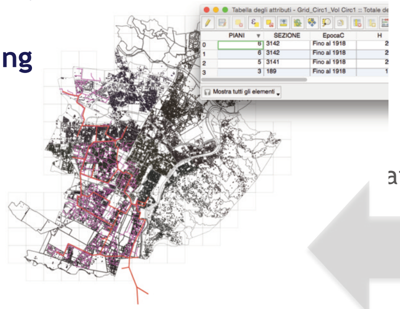




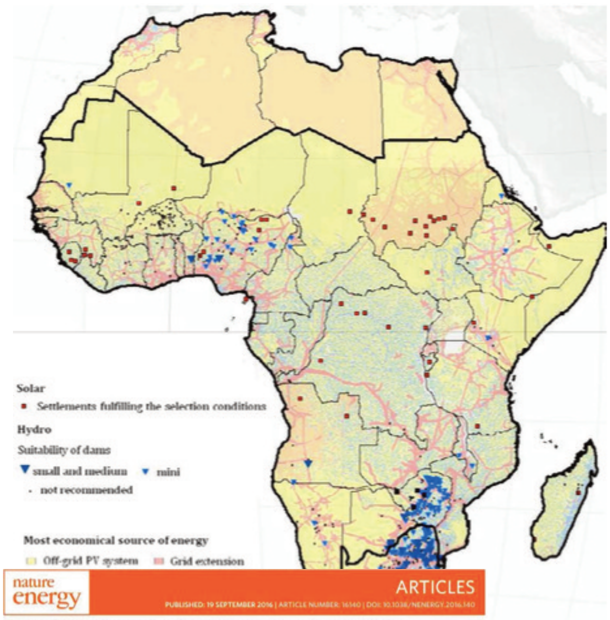
CREATION OF A GIS DATABASE

GIS is fundamental for territorial analyses:

- identifies infrastructures/ building distributions;
- calculates geometrical characteristics of buildings;
- allows managing data (big databases);
- identifies critical areas;
- effective way to show results;



Energy planning: preparation phase



Identification of advantageous electricity generation options in sub-Saharan Africa integrating existing resources

Sándor Szabó[1]*, Magda Moner-Girona[1], Ioannis Kougias[1], Rob Bailis[2] and Katalin Bódis[3]

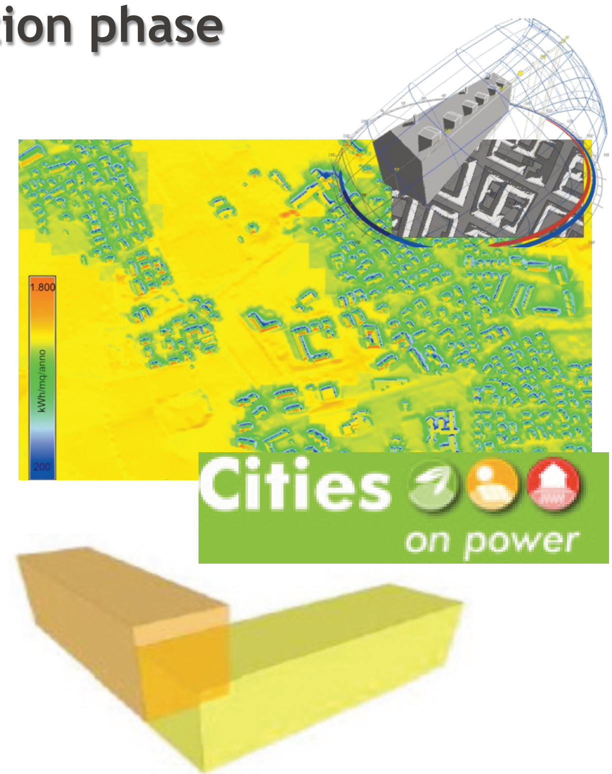


Image credits : Szabo et al., Nature energy (2016); Cities on Power project

Energy planning: preparation phase - demand driver

Sub-sector / Driver	Industry	Transport	Buildings
Floor area			Space heating; space cooling; lighting
Population			Water - heating; Cooking
Stock			Electrical Appliances
Passenger kilometre		Car; rail; bus; shipping	
Tonne kilometre		Truck; rail; domestic shipping	
Value added	Food, beverage, tobacco, paper, pulp, chemicals, metals, manufacturing etc.		

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Energy planning: detailed analysis phase

“Scenarios compare on long-terms different behavior based on assumption and constrains while forecasting is usually applied in short term models and it is based on extensive historical data analysis. “

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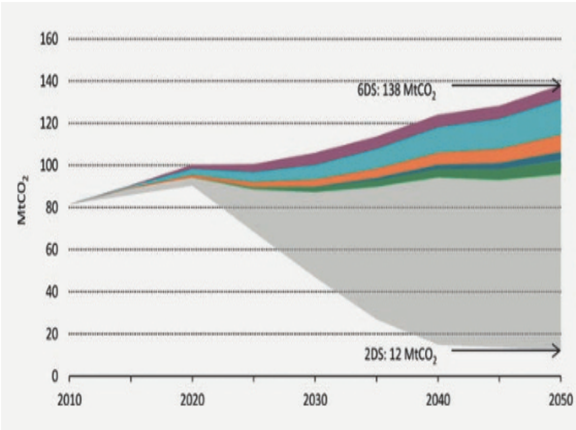
Video credit : MIT, Centre for Transportation and Logistic (2012)

Energy planning: detailed analysis phase

- displaying alternative **hypothetical sequences of events**
- quantification of the **effect of different targets**
- comparison of alternative economic/energetic **configurations**.



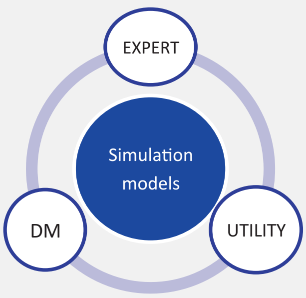
- the **Business as Usual**: representing the continuation of historical trends;
- the **Policy Scenarios**: impact of new policies on the continuation of present trends;
- the **Exploratory Scenarios**: explore several plausible configurations;
- the **Normative Scenarios**: simulate some necessary norms for identifying the most suitable.

Energy planning: detailed analysis phase - bottom-up engineering models

WHAT WILL HAPPEN?
WHAT CAN HAPPEN?

- *Energy balance*
- *Energy service demand*
- *Technical (& economic) parameters*
- *Environmental parameters*
- *Capacity investments*
- *…..*

EXPLORATIVE SCENARIOS
Possible future

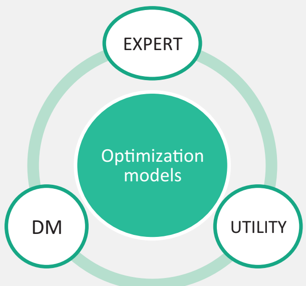


- *Operation of technologies*
- *Energy flows*
- *Emission trajectories*
- *……….*

HOW TO REACH THE TARGET?
WHAT CAN HAPPEN?

- *Energy balance*
- *Energy service demand*
- *Technical & economic parameters*
- *Environmental parameters*
- *…….*

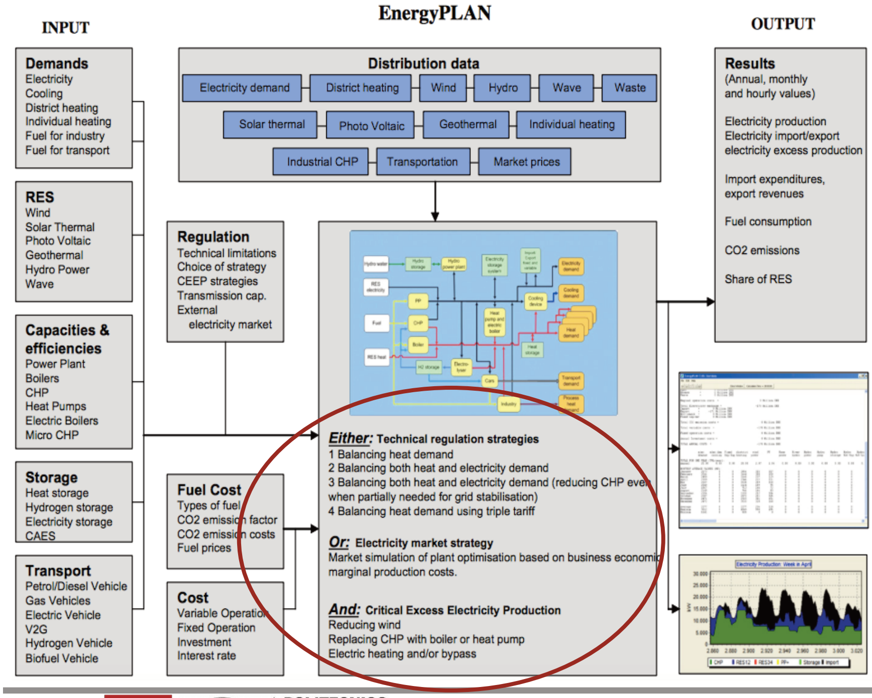
NORMATIVE SCENARIOS
Preferable future



- *Capacity investments*
- *Least cost solution to satisfy the demand*
- *Emission trajectories*
- *Marginal price of commodities*
- *……….*

CROSS SECTORAL

Energy planning: detailed analysis phase
Simulation - EnergyPLAN



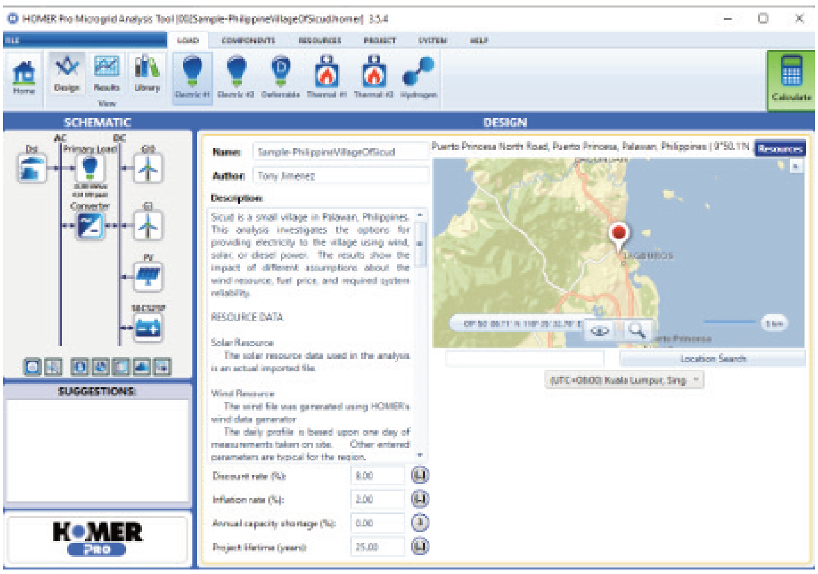
- Operational optimization;
- Feasibility studies;
- Large scale integration of renewables;
- Energy system analyses;
- Study of zero carbon system configurations;

- Dynamic over a year, but not over the time horizon;

SSA users:
-> Faculty of Electrical Engineering, Universiti Teknologi, 81310 UTM Johor Bahru, Malaysia

Image credits : Henrik Lund, Department of Development and Planning, Aalborg University, Denmark

Energy planning: detailed analysis phase
Simulation - HOMER

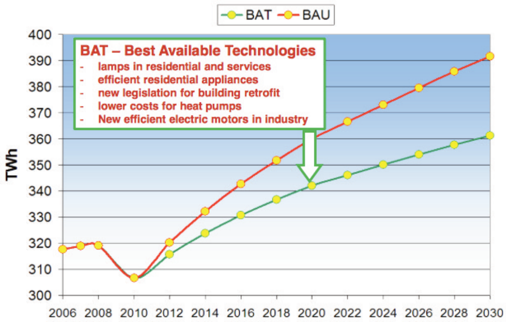


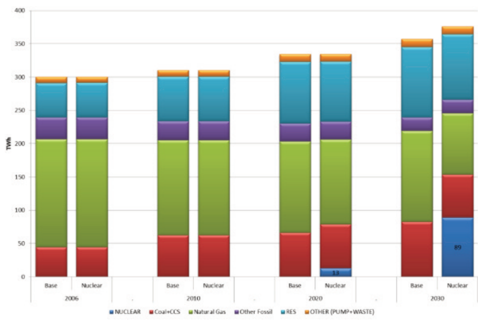
- Biomass
- Hydro
- Combined Heat & Power
- Advanced Load
- Advanced Grid
- Hydrogen
- Advanced Storage
- Multi-Year
- MATLAB Link

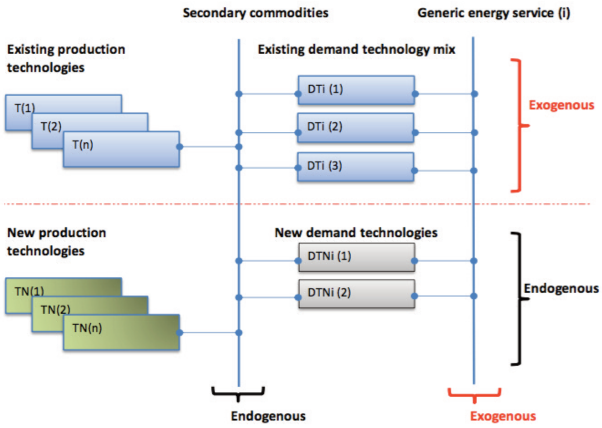
ENERGY CENTER POLITECNICO DI TORINO

Image credits : https://www.homerenergy.com/products/pro/index.html

Energy planning: detailed analysis phase Optimization, TIMES Model



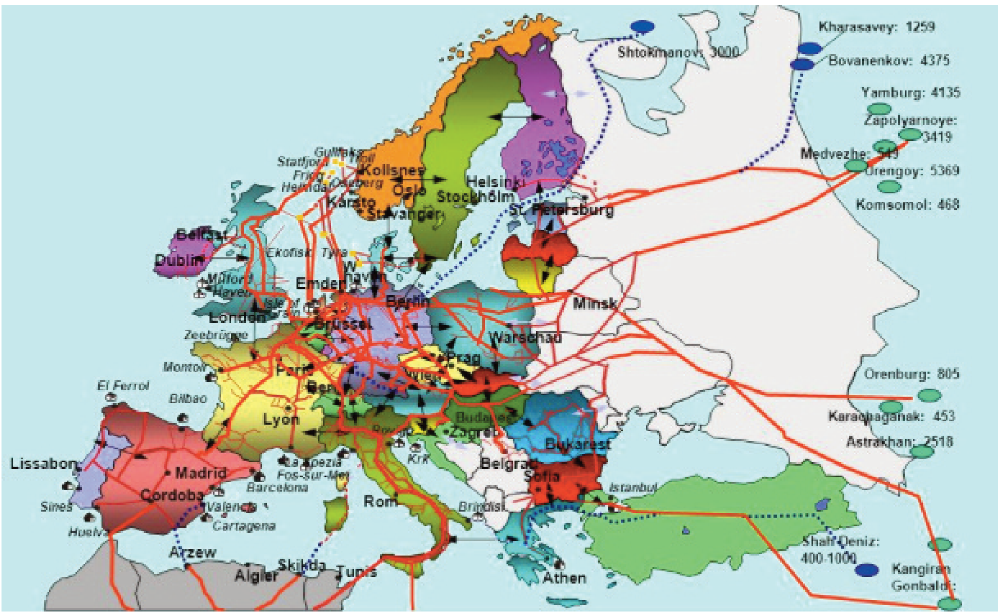




POLITECNICO DI TORINO

Credits : Matisse – Monet Projects, Politecnico di Torino, E4SMA, RSE (Ricerca Sistema Energetico)

Energy planning: detailed analysis phase Optimization, TIMES Model



POLITECNICO DI TORINO

Credits : REACCESS Project, Politecnico di Torino, E4SMA

Energy planning: detailed analysis phase

Criteria for scenarios - technical feasibility

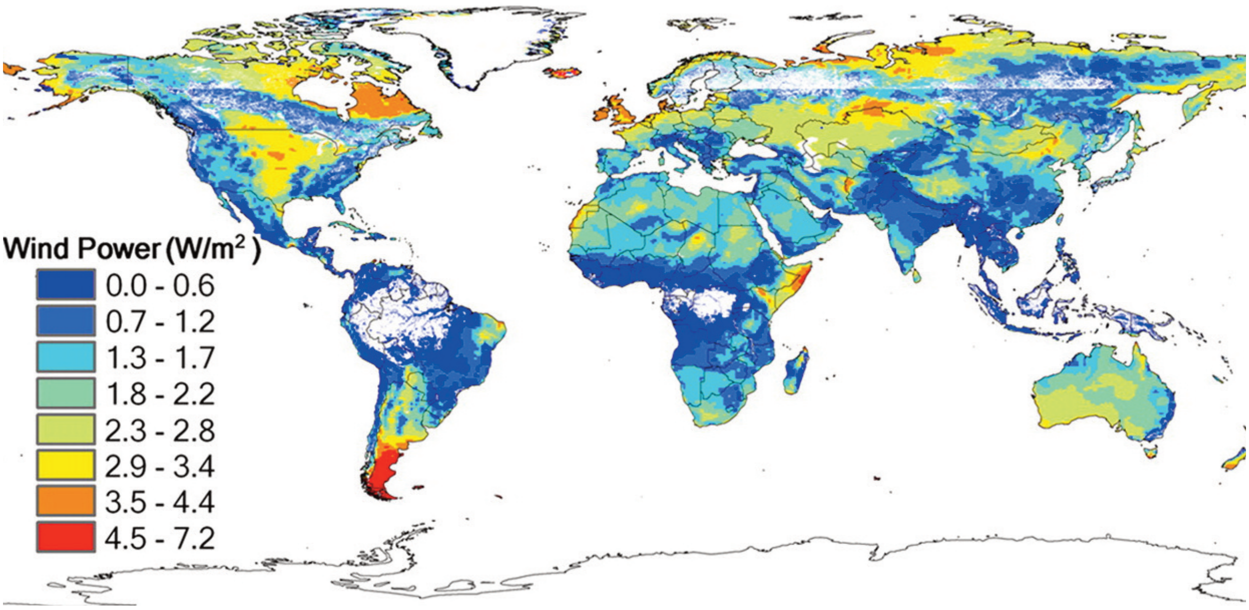
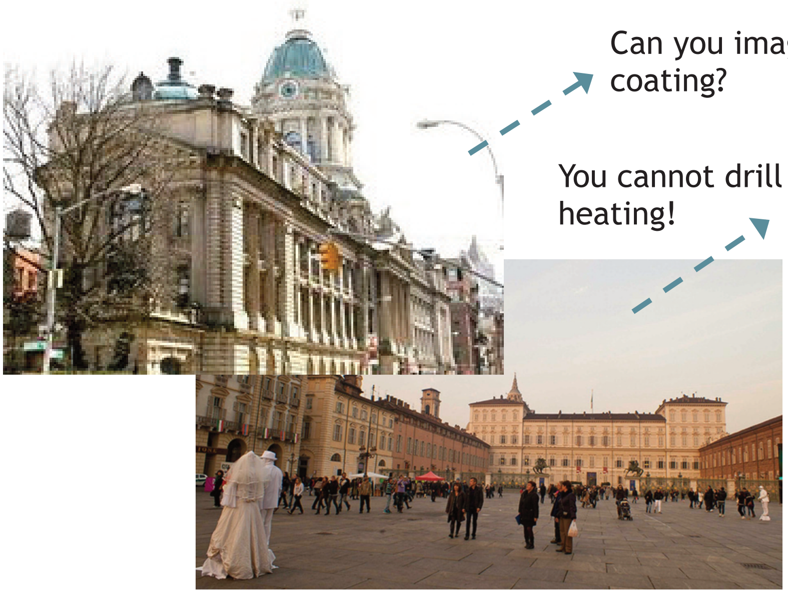


Image credits :

Energy planning: detailed analysis phase

Criteria for scenarios - physical & logistic feasibility



Can you imaging building coating?

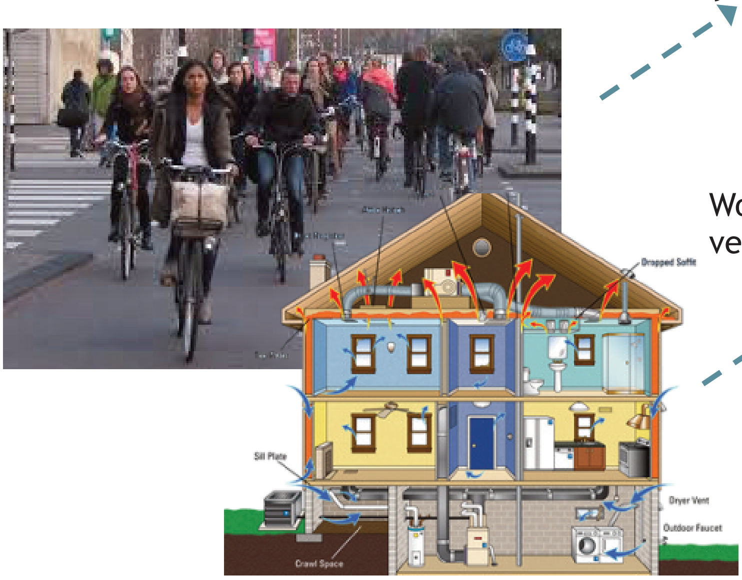
You cannot drill → No district heating!

Energy planning: detailed analysis phase

Criteria for scenarios - social acceptance (involving citizens → behavioural theories)

Are you willing to use bicycles every day for going at work?

Would you install mechanical ventilation in your own house?

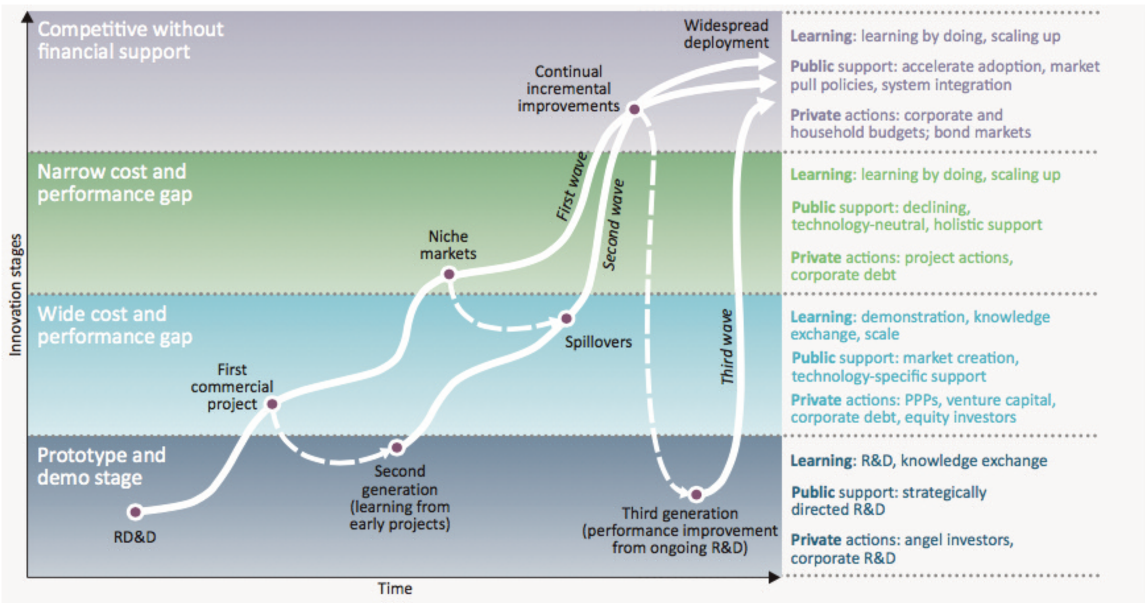


POLITECNICO DI TORINO

ENERGY CENTER

Energy planning: detailed analysis phase

Criteria for scenarios - market constraints



Notes: PPP = public–private partnerships. RD&D = research, development and demonstration. R&D = research and development.

POLITECNICO DI TORINO

ENERGY CENTER

Image credits : IEA, ETP 2017

Energy planning: detailed analysis phase

Criteria for scenarios - involved actors

Who is involved in
your strategy proposal

ENERGY CENTER POLITECNICO DI TORINO

Image credits : Source: "Revisiting Urban Planning in East-Asia, South-East Asia, and the Pacific"

Energy planning: detailed analysis phase

Criteria for scenarios - policy instruments

Category	Type of instruments
Regulation	Minimum Energy Performance Standards Building Codes
Information	Energy Labels Information Campaigns/Centres Metering and informative billing
Technical Support	Energy audits Education and training
Financial Instruments	Subsidies and Loans Fiscal instruments (tax exemptions) Feed-in tariffs for energy savings
Co-operative Instruments	Public procurement Bulk purchasing Technology procurement Recycling scheme
Voluntary agreements	Voluntary agreements
Obligation schemes	White certificates Cap-and-investment scheme and suppliers obligations

ENERGY CENTER POLITECNICO DI TORINO

Image credits : Source: "Revisiting Urban Planning in East-Asia, South-East Asia, and the Pacific"

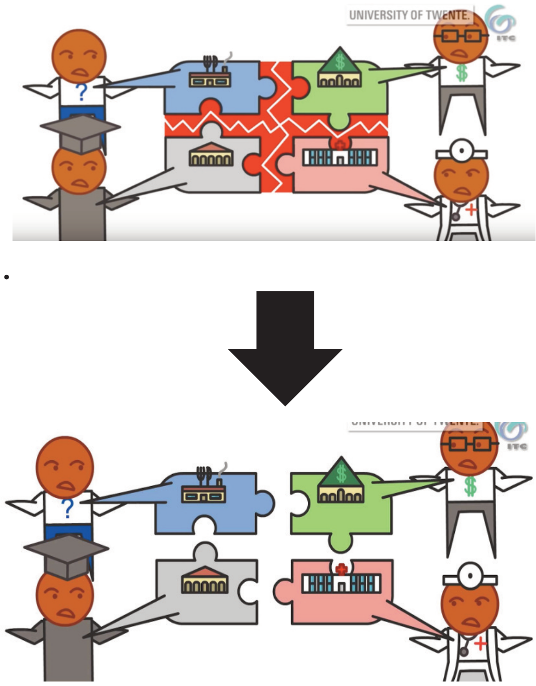
Energy planning: prioritization and decision

Multi Criteria Decision Making can help the decision makers to generate better decisions when there is more than one criterion (Bogetoft & Pruzan, 1997).

- Multiattribute utility theory (“US school”).
- Outranking methods (“French school”).
- Interactive methods.
- Multiobjective programming.

…

Since 1970, numerous developments:
conferences, papers, books, applications, software...



ENERGY CENTER POLITECNICO DI TORINO

Image credits : Twente University

Energy planning: Implementation and monitoring

Finding Indicators - ISO 37120 smart city indicators

ENERGY CENTER POLITECNICO DI TORINO

Image credits : http://open.dataforcities.org

Energy planning: Implementation and monitoring

Decomposition analysis – for a greater understanding of energy demand and energy efficiency policy effectiveness

- Growth: change in the level of action that creates demand for energy *(e.g. Population, passenger km, tonne km, value added)*.
- Structure: mix of activities in the economy *(e.g. Floor area/ population, number of HH/population, Appliances stock/ population, share of passenger km by mode, person per vehicle, share of value added)*.
- Efficiency: the amount of energy used per unit of activity *(end-use consumption/floor area or /number of household, energy/ vehicle km, energy per tonne km, energy per value added)*.

ENERGY CENTER POLITECNICO DI TORINO

Reference : IEA, Energy Efficiency 2017

Energy planning: Implementation and monitoring

Decomposition analysis – performance metrics

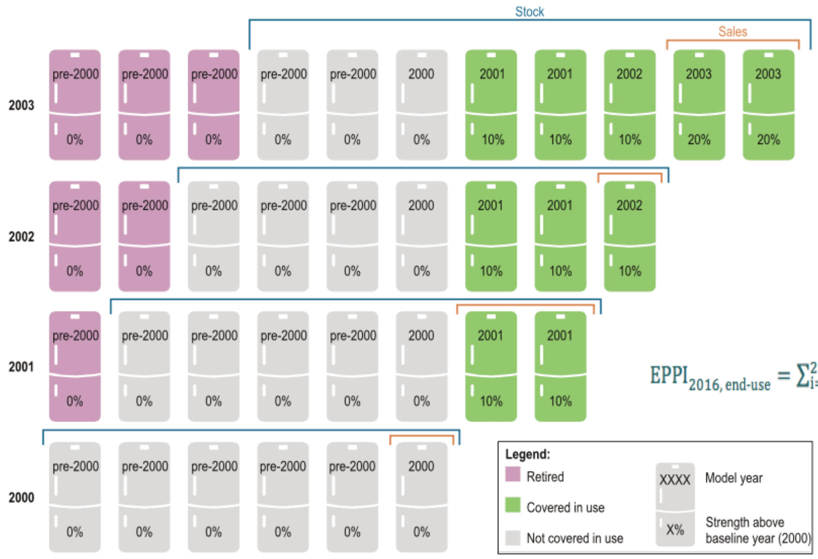
Sector	End -use service	Metric
Buildings	Space heating and cooling	Increase of EP related to: 1) envelope; 2) efficiency of heating system, 3) efficiency of cooling equipment
Buildings	Water heating	Increase of performance level of water heating equipment
Buildings	Appliances	Increase in minimum performance levels
Transport	Light and heavy duty vehicles	Increase vehicle fuel economy or emission standards
Industry	Motor driven system	Increase of minimum performance levels for electric motors
Industry	Industry sector	Energy savings targets from mandatory scheme weighted by consumption of the businesses

ENERGY CENTER POLITECNICO DI TORINO

Metrics reference : IEA, Energy Efficiency 2017

Energy planning: Implementation and monitoring

Decomposition analysis – performance metrics



$$EPPI_{2016,\,end\text{-}use} = \sum_{i=2000}^{2016} \left(\frac{Sales_{Model\ Year\ i}}{Stock_{2016}} \times Strength_{Model\ Year\ i} \right)$$

Image reference : IEA, Energy Efficiency 2017

Thank you all | Grazie a tutti

Questions ?

chiara.delmastro@polito.it

Carlo Strazza
Friday, 2nd March 2018

How to leverage private finance to expand electric power generation from renewable energy

Summary

- RINA overview
- Global investments trends in renewable energy
- International initiatives, ODA funding, bilateral and multilateral flows
- The drivers and barriers to expand renewable energy investments
- Main areas of support to stimulate private engagement
- The effectiveness of public sector interventions to attract private financing
- Insights from case studies

Summary

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Competence and Experience

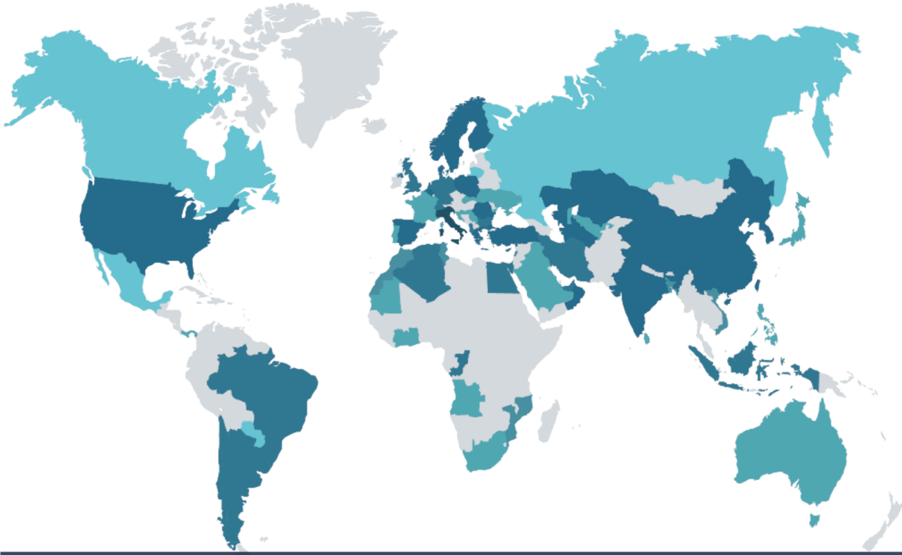
OVER 150 YEARS OF EXPERIENCE

RINA provides certification, testing, inspection and consulting services across the Energy, Marine, Certification, Transport & Infrastructure and Industry sectors through a global network of 170 offices in 65 countries.

RINA is a member of key international organizations and an important contributor to the development of new legislative standards.

What is RINA today

RINA



3700
Colleagues

170+
Offices

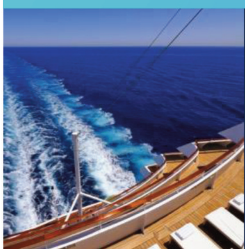
65+
Countries

LEVEL OF RINA PRESENCE

Our markets

RINA

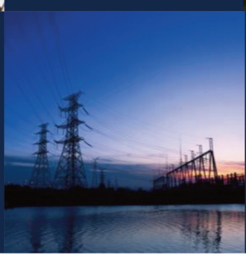
SERVICES FOR:



Marine

Industry

Energy



Transport & Infrastructure

Certification

ENERGY

ENERGY

- **30,000+ Km** Inspected and supervised pipelines
- **250+** Certified and requalified platforms
- **100+** LNG projects
- **160 GW+** Installed capacity plant engineering services
- Inspection and expediting activities on **150+** conventional, nuclear and renewables plants
- Coral South FLNG Project - Certification and Technology validation
- AIM Provider for ENI Group - Worldwide frame Agreement
- Aramco Worldwide contract - Vendor Inspection and Expediting
- Technical due diligence on **1,4 GW** investment - Global solar largest portfolios worldwide (Terraform)

FIGURES

- **3M+** hours of inspection
- **1M+** hours of engineering

ENERGY - POWER

SERVICES

- Power plant design
- Power equipment design
- Architect/Owner's engineering
- Power systems planning
- Grid connection studies
- Protection studies
- HVAC & HVDC services
- Power systems software
- Earthing & lightning protection
- Construction monitoring and project management
- Full technical due diligence
- Environmental and social studies and permitting
- Sustainability studies
- Inspection, Expediting and Material Management
- Vendor Qualification and Auditing
- QA/QC and Site Supervision

Environment & Climate Change

- **Mitigation**:
  - CDM/JI projects, new CDM methodologies (waiting for the new market mechanism)
  - emission inventories & action plans
  - National & Sector Strategies (LEDs, NDC, NAMA)

- **Adaptation**
  - Climate Vulnerability and Risk Assessment
  - Technological & Financial Support Tools

- **Institutional & Capacity Building**
- **Climate Policy Advisory**

Clients:
IMELS, EC, World Bank, EIB, UK Aid, EBRD, DFID, Private Industries

Membership & Affiliations

- **CTCN:** operational arm of the UNFCCC Technology Mechanism which promotes the transfer of environmentally sound technologies for low carbon and climate resilient development
- European Financing Institutions Working Group on Adaptation to Climate Change **(EUFIWACC)** - "Integrating Climate Change Information and Adaptation in Project Development: Emerging Experience from Practitioner"
- **EGE** (audit EED)
- **ETS** experts (Verification)
- Expert Reviewer for **IPCC** Flagship reports
- **ICP** Certified Project & Verification Consultants
- **RES4MED – RES4AFRICA**

CDM Programme of Activities – Solar Energy

Client: UNEP

Location: Tunisia, Montenegro

Scope of work:

- UNEP launched 3 CDM PoAs: Prosol Tertiary and Prosol ELEC in Tunisia, Montesol in Montenegro
- Preparation of the project documentation (PIN, CDM-POA-DD, CDM-CPA-DD)
- Technical assistance for the registration of the CDM PoA (Letter of Approval, validation, submission to UNFCCC

New Methodology & PDD - New Direct Reduction Plant (DRP)

Client: Suez Steel Co.

Location: Egypt

Scope of Work:

- Drafting of the new baseline methodology
- UNFCCC comments analysis and integration
- Final new methodology issuance
- Project Design Document (PDD) elaboration
- Local stakeholders consultations
- Development of the monitoring and verification plan

Climate Risk Assessment for the Rehabilitation of a Railway

Client: UK Aid

Location: Malawi

Scope of Work:

- evaluation of the potential impacts of climate change on the railway Mchinji-Nkaya looking within a overall feasibility study for the rehabilitation of the line
- the climate risk assessment concerned the analysis of the current risk and the evaluation of the expected scenarios based on the identified vulnerabilities

Scoping Study For Climate Change & Environmental Programme

Client: DFID

Location: Southern Africa (Mozambique, Malawi, Zambia)

Scope of Work:

- climate change impacts &vulnerability
- potential GHG emissions
- current legislative framework and pledges on climate change mitigation and adaptation
- climate finance landscape at regional
- Potential measures to mitigate GHG emissions
- possibility of compliance framework on environmental standards with a specific focus on GHG emissions
- possibility for the introduction of a support mechanism

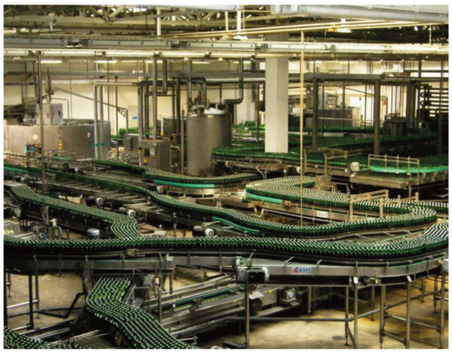
Support to UN-Based Knowledge Sharing Mechanism for Climate Technologies

Client: EC DG CLIMA

Location: EU

Scope of Work:

- improve the technology cooperation
- Facilitate exchange of information about climate technologies for adaptation and mitigation
- identify industries and sectors suitable for climate technologies deployment
- develop and validate concepts for operationalizing building on the Clean Technology Center and Network (CTCN) and existing EU instruments.
- dedicated workshops, oriented to different and well specified geographical EU areas



Technical Assistance Increased Institutional Capacity in Environmental, Social & Climate Finance - BOAD

Client: EIB

Location: Togo, Benin, Ivory Coast, Senegal & Guinea Bissau

Scope of Work:

- implementation of BOAD Environment & Climate Strategy 2019
- Identification of climate project portfolio
- Support to the Finance Committee to liaise with GCF
- Development of Procedures and Directives
- Implementation of Pilot Projects
- Implementation of a Environmental and Social Impacts Reporting System
- Training on Technical Requirements and Procedures E&S Risk Assessment


EXAMPLES OF APPROVED CDM PROJECTS:

Kambi Wind Farm Project (Cyprus, 2010)

This project is aimed at installing and operating a wind farm which will be producing renewable electricity from wind. The electricity produced will be fed into the Cypriot national grid and then sold.
Amount of emission reduction: 12,864 tCO_2e/y

Oulja Landfill Gas Recovery and Flaring (Morocco, 2007)

The purpose of the project is to capture and flare the biogas produced at the OULJA landfill, through the installation of a specific system. The activity will result in GHG emission reduction by combustion of the recovered methane.
Amount of emission reduction: 32,481 tCO_2e/y

Biomass Based Steam Generation at Galam Factory (Israel, 2007)

The project goal is to generate steam for industrial use through controlled burning of wood chips from municipal tree trimmings (biomass), instead of the current practice of using residual fuel oil.
Amount of emission reduction: 26,956 tCO_2e/y

Moldova Energy Conservation and GHG Emissions Reduction (Republic of Moldova, 2006)

This project aims at GHG emission reduction as result of heat supply and efficiency improvements and fuel switching measures for a series of public buildings (kindergarten, schools, hospitals, policlinics, etc.).
Amount of emission reduction: 11,567 tCO_2e/y

LOCAL CONTACTS:

Serbian Ministry of Environment and Spatial Planning

National Authority for Implementation of Projects under the CDM of the Kyoto Protocol (Serbian DNA)

Omladinskih brigada 1
11070 Belgrade (Serbia)
www.ekoplan.gov.rs/DNA

Contact person:
Ms. Danijela Bozanic
danijela.bozanic@ekoplan.gov.rs
Phone: +381 11 31 31 355

For further information, please visit:
www.unfccc.int
www.cdmrulebook.com
www.cd4cdm.org

SUPPORTING INSTITUTION:

Ministry for the Environment Land and Sea, Republic of Italy

Department for Sustainable Development, Climate change and Energy
Task Force for Central and Eastern Europe
Via Cristoforo Colombo, 44
00147 – Rome (Italy)
Phone: +39 (0)6572 281 01/02/04
www.minambiente.it
pia-sdg@mminambiente.it

TECHNICAL ADVISOR:

D'Appolonia S.p.A.

Via San Nazaro, 19
16145 Genoa (Italy)
www.dappolonia.it
gianluca.cassulo@dappolonia.it

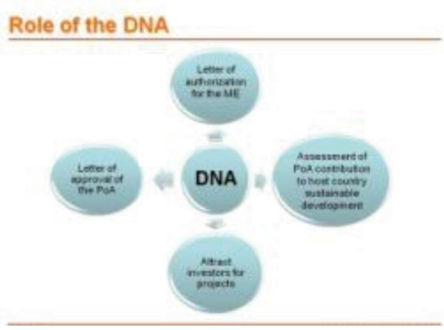
Support to Climate Change Mitigation and Adaptation in the ENPI South Region

Client: European Commission

Location: Algeria, Egypt, Morocco, Jordan, Lebanon, Palestine, Israel, Tunisia

Scope of work:

- Strengthening the General negotiation and implementation capacity in the field of low carbon development and climate resilience
- Strengthening institutional Mitigation and adaptation Capacity and promoting closer dialogues;
- Improving the capacity to use climate finance mechanism



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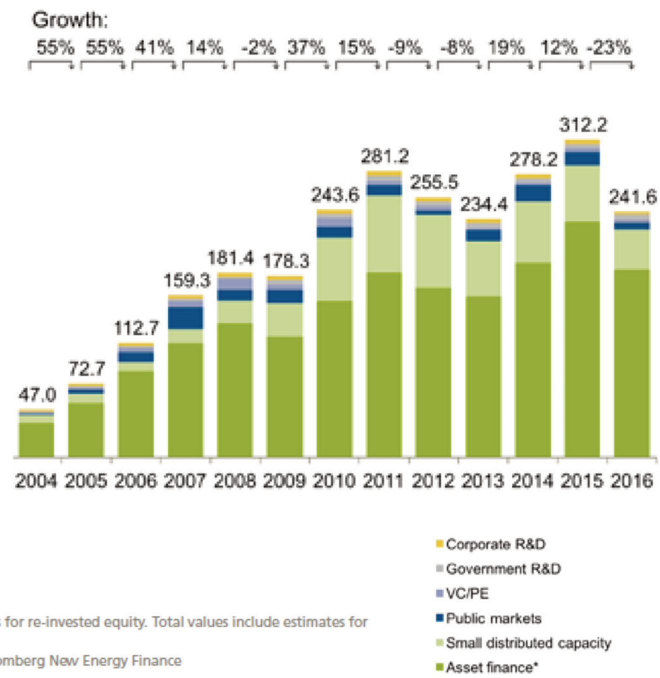
Global investments trends in Renewable Energy

GLOBAL OVERVIEW

- "More for less"
- Global new investment in renewables fell by 23% to the lowest total since 2013
- Record installation of renewable power capacity worlwide
- Africa had in 2016 its lowest level of renewables investment since 2011



*Asset finance volume adjusts for re-invested equity. Total values include estimates for undisclosed deals
Source: UN Environment, Bloomberg New Energy Finance

Global investments trends in Renewable Energy

REASONS BEHIND THE DROP IN THE INVESTMENTS

- Lower average capital cost (CAPEX) for projects starting in 2016:
  PV – 13% vs 2015; Onshore wind – 11.5%, Offshore wind -10%

- Time shift between financing and commissioning

- Policy changes
  The peak in 2015 was partially driven by a rush to complete projects before an expected fall in policy support in key markets. Examples included cuts in feed-in-tariffs in China, Germany, Japan and the UK

Global investments trends in Renewable Energy

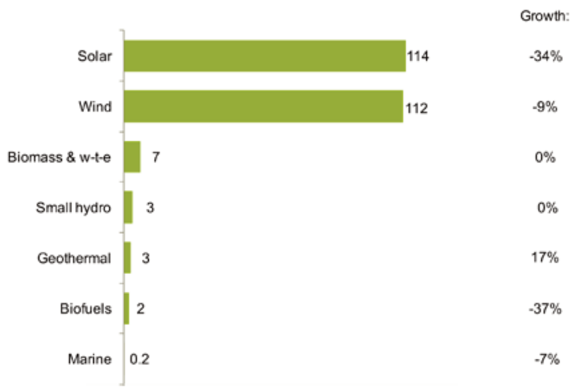
TECHNOLOGY TRENDS

- Renewable energy investment continues to be dominated by just two sectors – solar and wind

- Both suffered declines in dollar investment in 2016

- The smaller sectors had mixed fortunes:
  Biofuels: its lowest figure during the whole 2004-16 period and only 8% of its 2006 peak

GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY SECTOR, 2016, AND GROWTH ON 2015

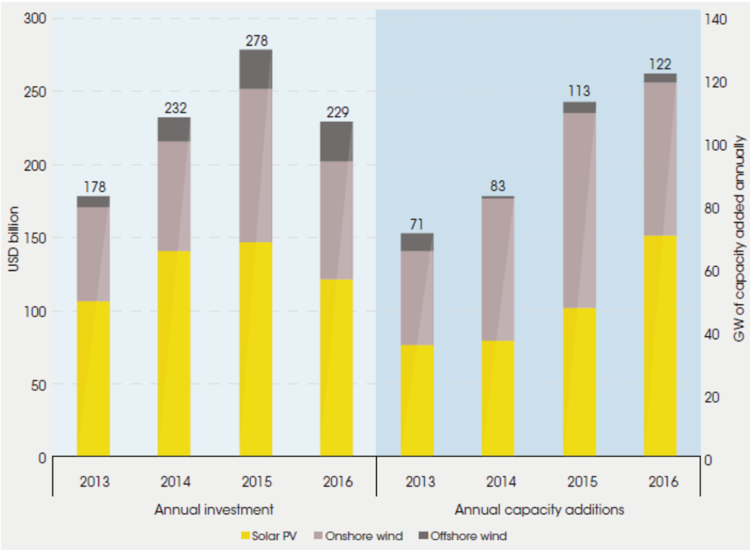


New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals
Source: UN Environment, Bloomberg New Energy Finance

Global investments trends in Renewable Energy

TECHNOLOGY TRENDS

Solar PV and wind power annual investment and capacity additions, 2013-2016



Based on: IRENA, 2017a

Global investments trends in Renewable Energy

TECHNOLOGY TRENDS

- Solar PV projects are relatively quick to construct and can be built in less than a year after financing is completed.

    On average, solar PV construction times are shortest in Europe and Asia.

- Onshore wind construction times are also comparatively short, again averaging less than one year.

    Onshore wind projects are typically built fastest in Europe and North America.

- Construction of offshore wind projects averages close to two years after financing is agreed.

Technology	Number of years
Solar PV	0.5
Wind onshore	0.8
Bioenergy	1.7
Wind offshore	1.7
Geothermal	1.9
Solar thermal	2
Marine	2.2
Small hydro	2.3

Based on: BNEF, 2017

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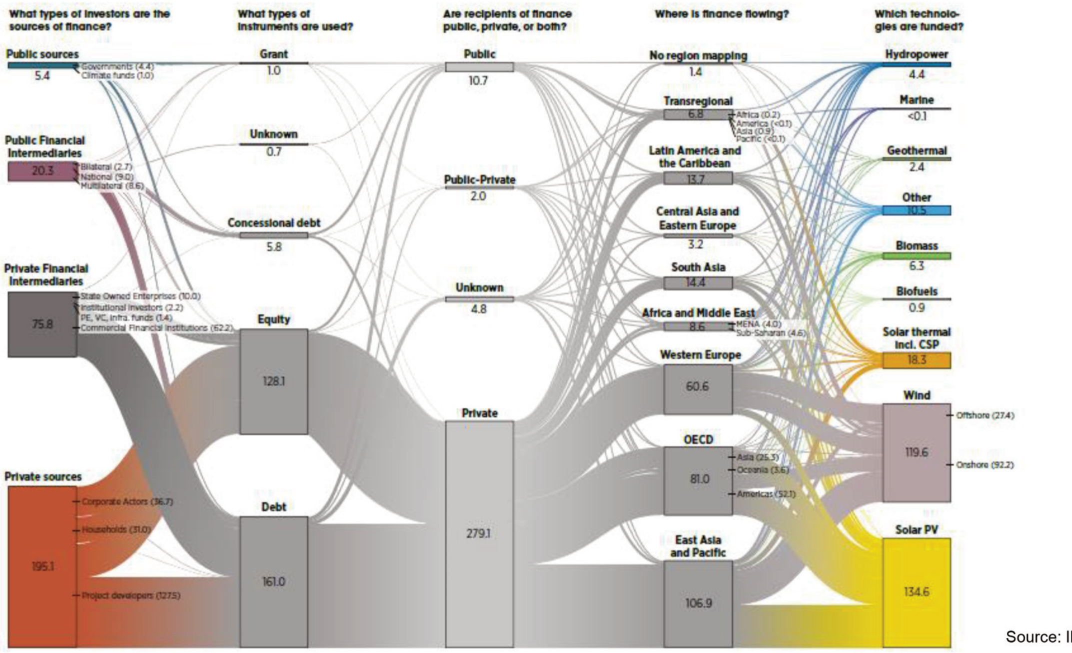
International initiatives, ODA funding, bilateral and multilateral flows

GLOBAL LANDSCAPE OF RENEWABLE ENERGY FINANCE 2015/2016



Values are averages of the data from the two years, in USD billion.

Source: IRENA 2018

International initiatives, ODA funding, bilateral and multilateral flows

RINA

MAPPING THE INITIATIVES AND PROGRAMS

• Initiatives and programs that have been officially launched (i.e. planned initiatives were not included);

• Initiatives and programs supported by Pan-African public actors and / or international development partners (donors and implementers);

• Multi-country initiatives and programs, including single-country initiatives or programs with a planned multi-country roll-out;

• Initiatives and programs covering all energy sub-sectors with the exception of initiatives or programs focused exclusively on large-scale fossil-based energy (coal, oil, gas) and/or nuclear energy

SUSTAINABLE ENERGY FOR ALL

RES4AFRICA

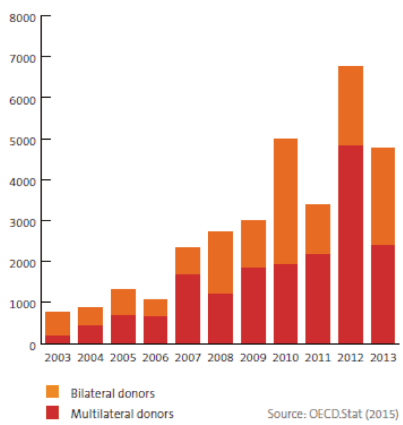
Africa-EU Energy Partnership

International initiatives, ODA funding, bilateral and multilateral flows

RINA

MULTILATERAL DONORS

- The 3 largest multilateral donors in the energy sector in Africa are the World Bank, the EU institutions and the African Development Bank
- While all three participate in and manage various multi-country programs, the bulk of multilateral lending is disbursed via loans and grants to individual national governments
- The EU institutions deliver their ODA via a mix of thematic and geographic programs with direct as well as indirect implementation modalities, including in particular blending instruments.



SUSTAINABLE ENERGY FOR ALL

RES4AFRICA

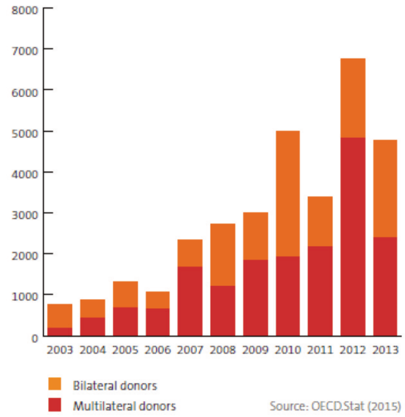
Africa-EU Energy Partnership

International initiatives, ODA funding, bilateral and multilateral flows

BILATERAL DONORS

The major bilateral donors channel a large part of their ODA through a variety of country-level delivery mechanisms, e.g.:

- The Agence Francaise de Développement (AFD) represents the main implementing agency of French ODA, which is provided in the form of grants, loans and technical assistance.
- German country-level ODA is disbursed via country-level technical assistance programs, managed by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and different forms of financial assistance (primarily channeled through Germany's development bank, Kreditanstalt fuer Wiederaufbau (KfW), in the form of concessional lending and other financial instruments).
- Japanese ODA is organized in a similar fashion with the Japanese International Cooperation Agency (JICA) and the Japanese Bank for International Cooperation responsible for technical and financial assistance, respectively.



International initiatives, ODA funding, bilateral and multilateral flows

INITIATIVES AND PROGRAMS

- Over the course of the last 15 years, ODA to the African energy sector has increased substantially and the energy sector accounted for approximately 10% of ODA in Africa
- Multilateral donors provided nearly 60% of energy ODA
- Numerous initiatives launched to support the Continent in achieving a sustainable energy supply; this has led to an increasing need for exchange, capacities and coordination in the sector

High-level initiatives	
Africa Clean Energy Corridor	Africa Renewable Energy Initiative (AREI)
Africa Energy Leaders Group (AELG)	Presidential Infrastructure Champion Initiative (PICI)
Africa-EU Energy Partnership (AEEP)	Program for Infrastructure Development in Africa (PIDA)
Africa Power Vision	SE4ALL (Africa Hub)
High-level initiatives with an operative program	
Africa 50	New Deal on Energy for Africa
Africa Renewable Energy Access Program (AFREA I & II) – ESMAP	Power Africa
ElectriFI	Public Private Infrastructure Advisory Facility (PPIAF)
Energies pour l'Afrique	World Bank Guarantee Program
Global Alliance for Clean Cookstoves	
Operative programs and delivery mechanisms	
ACP-EU Energy Facility	GET FIT Uganda
AFREA Gender and Energy Program	Global Energy Efficiency and Renewable Energy Fund (GEEREF)
Africa Clean Cooking Energy Solutions Initiative (ACCES)	Green Mini-Grids Africa Regional Facility
Africa Energy Guarantee Facility (AEGF)	IRENA/ADFD Project Facility
Africa Enterprise Challenge Fund (AECF)	Lighting Africa
Africa-EU Renewable Energy Cooperation Program (RECP)	Mediterranean Solar Plan (MSP)
African Development Bank Partial Risk Guarantee (PRG)	NEPAD Bioenergy Programme for Africa
Africa Renewable Energy Fund (AREF)	NEPAD Continental Business Network (CBN)
Biofuels Programme for Household and Transport Energy Use	NEPAD Infrastructure Project Preparation Facility (NEPAD-IPPF)
Carbon Initiative for Development (CI-Dev)	PIDA Service Delivery Mechanism (SDM)
Clean Technology Fund (CTF)	Private Infrastructure Development Group
EEP Africa – Energy and Environment Partnership	Regional Energy Project for Poverty Reduction
Energising Development (EnDev)	Regional Technical Assistance Program (RTAP)
Energy Access Ventures	Renewable Energy Performance Platform (REPP)
Energy Africa Campaign	Renewable for Poverty Reduction Program (REPoR)
EREF ECOWAS Renewable Energy Facility	Renewable Energy Solutions for Africa (RES4Africa)
EU-Africa Infrastructure Trust Fund (ITF) / Africa Investment Facility (AfIF)	Scaling Solar
EU Development Finance Institutions (EDFIs) Private Sector Development Facility	Strategic Climate Fund – Scaling Renewable Energy Program (SREP)
EU Energy Partnership Dialogue Facility (EUEI PDF)	Sustainable Development Investment Partnership (SDIP)
European Union's Technical Assistance Facility (TAF)	Sustainable Energy Fund for Africa (SEFA)
Geothermal Risk Mitigation Facility	

Summary

- RINA overview
- Global investments trends in renewable energy
- International initiatives, ODA funding, bilateral and multilateral flows
- **The drivers and barriers to expand renewable energy investments**
- Main areas of support to stimulate private engagement
- The effectiveness of public sector interventions to attract private financing
- Insights from case studies

The drivers and barriers to expand renewable energy investments

BARRIERS TO RE DEVELOPMENT IN AFRICA

Although major technical and financial breakthroughs have been achieved internationally with respect to renewable energy, (excl. large hydro) their contribution to Africa's energy problems remains minimal.

To increase their contribution using market-based approaches, major barriers to the wider dissemination of renewable energy on the African continent will need to be overcome.

These barriers can be categorized as being

- **policy, regulation and institutional;**
- **information and technical capacity;** and
- **financial.**

The drivers and barriers to expand renewable energy investments

RINA

POLICY, REGULATION AND INSTITUTIONAL

Barriers

- lack of enforcement mechanisms
- low budgetary allocations
- projects externally financed

Drivers

- institutional capacity
- regulation measures (i.e. performance standards, equipment standards)
- voluntary agreements (e.g. government & private sector)

The drivers and barriers to expand renewable energy investments

RINA

INFORMATION AND TECHNICAL CAPACITY

Barriers

- unavailability of accurate & well organized RE resource data
- poor mainteinance of imported systems
- lack of adequate after-sales service

Drivers

- domestic technical skills
- high and middle level technical manpower in business development, manufacturing and overall management
- monitoring and evaluation (public sector)

The drivers and barriers to expand renewable energy investments

FINANCIAL

Barriers

- AfDB estimation: total investment required to ensure universal access to RE in Africa (by 2030) = US$30 billion per year
- private sector «small player», more prevalent in small scale

Drivers

- government support
- support from financial institutions i.e. insurance companies, broker institutions
- donor support (suitaiblity, impact and cost effectiveness)

The drivers and barriers to expand renewable energy investments

LESSONS LEARNT

- **Supporting country leadership** should be central to donor approaches
- **Capacity development design and sequencing should fit specific country circumstances** rather than reflect standard or imported solutions, and not merely viewed as a transfer of skills
- **Donor support should be provided in a coherent, coordinated, and programmatic manner**: complementary rather than competitive or duplicative
  - ODA Recipient Countries Government should stress on the need of coordinated initiatives with and among donors

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Main areas of support to stimulate private engagement

- **Entrepreneurship and Business Acceleration**
- **RET-related Finance Products**
- **Market Development Mechanisms**
- **Legal and regulatory Framework Strengthening**

Main areas of support to stimulate private engagement

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ENTREPRENEURSHIP AND BUSINESS ACCELERATION

- actions designed to assist entrepreneurs in turning ideas into sustainable businesses, or to scale up an existing initiative or business line
- direct training and capacity building to managers, owners of entrepreneurial businesses, agencies, government
- collaborations and networks to assist RET providers and firms using such technologies to share knowledge
- pooling resources and potentially sharing R&D and intellectual property rights (IPR)
- involve consulting firms, business incubators or technical experts
- are based on collaborations between national governments, the private sector and the international community

Main areas of support to stimulate private engagement

RINA

RET-RELATED FINANCE PRODUCTS

- instruments aimed at providing companies interested in RETs with early stage financing and risk capital not available from traditional financing sources, such as seed capital, venture capital, soft loans and loan guarantees
- operate on the demand side promoting growth in RE markets by technology-specific consumer credit which can overcome the financial barriers surrounding high capital cost goods, such as off-grid renewable energy technologies (RETs)

  e.g. a high demand for solar water heaters (SWHs) in Tunisia was stimulated by making available low-cost commercial loans, offered specifically for SWHs

Main areas of support to stimulate private engagement

MARKET DEVELOPMENT MECHANISMS

- range of instruments aimed at increasing demand for the products of local SMEs and facilitate the overall growth of the RET market
- stimulate industrial demand for RET through feed in tariffs, renewable energy certificates, product labeling and certification, standards
- involve SME, governments

Main areas of support to stimulate private engagement

LEGAL AND REGULATORY FRAMEWORK STRENGTHENING

- set of laws and related regulations to strengthen the enabling environment for clean technology SMEs, create incentives, define obligations for the supply-side and demand-side of clean technology markets
- use: sector-specific tax incentives; emission reduction credits; taxation on pollution or natural resource use; import tax reductions or waivers; and incentives to attract skilled labor
- involve governments, policy makers and entrepreneurs

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The effectiveness of public sector interventions to attract private financing

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TYPICAL STEPS: The Analytical Framework

Key Learning Questions
- What are the main barriers to the mobilization of commercial investment for RE project development?
- How effective has public finance (including climate finance) for upstream technical assistance and analysis been in creating the conditions for commercial investment?
- How effective have the different financing instruments and mechanisms (grants, concessionary debt, viability gap financing, guarantees, etc.) been in attracting commercial finance?
- What are the main risks to commercial investment that are not addressed through conventional financing instruments and what role can the development finance community play in mitigating them?

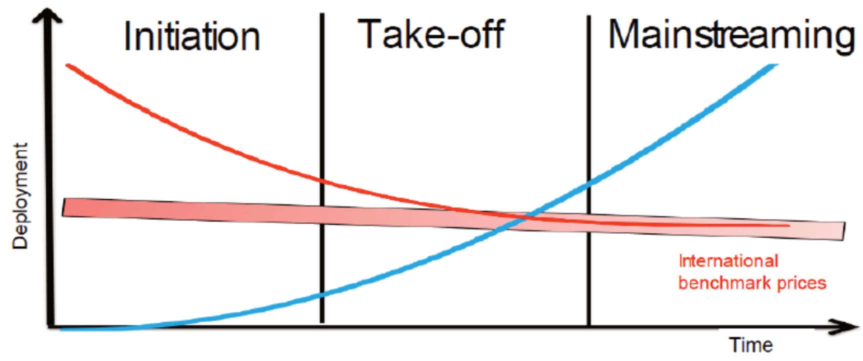
Stakeholders and stakeholders' perception
- Private (developers, contractors, commercial banks, private equity funds, legal advisors)
- Development finance institutions (multilateral, bilateral, private and public windows)
- Public (ministries, regulators, state-owned utilities, TSO)

Barriers and Interventions
- Barriers to Commercial Investment
- Public Interventions

Country Journey
- **Initiation**
- **Take-off**
- **Mainstreaming**

The effectiveness of public sector interventions to attract private financing

The RE policy journey and changing policy priorities



- The first examples of the technology deployed under commercial terms
- **Secure support needed to encourage early investors.**
- Local supply chain absent.
- Define regulatory framework e.g. permitting procedures may be unclear or lengthy).

- The market starts to grow rapidly.
- **Policy priority is to encourage costs to converge with international benchmarks**
- Manage total support costs remain within the expected envelope.
- Refine regulatory procedures.

- The annual market has reached a significant scale
- The supply chain is well established
- Generation prices are consistent with international norms and approach fossil based alternatives
- **Technical and market integration becomes key issue**

Source: IEA

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Assessing the Effectiveness of Public Sector Interventions in Attracting Commercial Financing for the Development of Grid-Connected Solar Projects

RINA has participated as sub-contractor to conduct an assessment of the effectiveness of public sector interventions in attracting commercial financing for the development of grid-connected solar projects for World Bank Group (August 2017 - ongoing)

We provide: Desk review and Stakeholder Consultation, Input to the Country Case Studies, Global Review of PV and CSP Markets, Review of Grid Integration Issues

Seven Countries, including Morocco, Senegal, South Africa

Assessing the Effectiveness of Public Sector Interventions in Attracting Commercial Financing for the Development of Grid-Connected Solar Projects

Barriers to Commercial Investment

- Technology Risk
  - Is the technology proven in other jurisdictions?
  - Is there local experience with the technology?
- Country Risk
  - Overall country risk profile
  - History of successful investment in country
- Project Risk
  - Is the project viable?
    - Are there **revenues** sufficient? Can the risks be mitigated?
      - Plant output (GWh/year)
      - Selling price
      - Fiscal considerations
    - Are **costs** manageable? What are the risks of cost overruns?
      - Development costs
      - Financing costs
      - EPC / O&M costs

Assessing the Effectiveness of Public Sector Interventions in Attracting Commercial Financing for the Development of Grid-Connected Solar Projects

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Public Interventions

- Legal framework for renewable energy
- Planning for renewable energy expansion
- Incentives & regulatory support
- Grid integration
- Off-taker risk
- Financing mechanisms
- Strengthened regulatory and operational capacity of public sector counterparts

Scaling Solar and Storage Program

RINA

RINA has been engaged by World Bank Group as technical advisory to explore the possibility of expanding its Scaling Solar Initiative to include battery storage systems in a new Scaling Solar and Storage ("SSS") program.

https://www.scalingsolar.org/

Scaling Solar | WORLD BANK GROUP

Unlocking Private Investment in Emerging Market Solar Power

Scaling Solar brings together a suite of World Bank Group services under a single engagement aimed at creating viable markets for solar power in each client country. The "one stop shop" program aims to make privately funded grid-connected solar projects operational within two years and at competitive tariffs. When implemented across multiple countries, the program will create a new regional market for solar investment.

- ADVICE
- SIMPLE AND RAPID TENDERING
- FULLY DEVELOPED TEMPLATES
- COMPETITIVE FINANCING AND INSURANCE
- RISK MANAGEMENT AND CREDIT ENHANCEMENT

Scaling Solar and Storage Program

- RINA tasked with updating the technical requirements of the existing Scaling Solar tender documentation (RFQ, RFP and PPA) to be suitable for use in solar-plus-storage projects.
- Work undertaken in 5 stages
- Task 1: Applicable Standards, Codes and Regulations

  Considered existing and in development standards relevant to the design, installation and maintenance of energy storage and solar-plus-storage systems for inclusion within the Scaling Solar documentation.
- Task 2: Technical requirements for RFQ, RFP and PPA with a time-shifting service profile.

  Determined possible amendments and recommendations to the Scaling Solar tender documentation, mainly:
  - RFQ: Bidder experience / track record and minimum technical and functional requirements that the bidder will need to meet during the RFP stage.
  - RFP: Bidder and equipment vendor technical requirements, minor revisions to the existing PV requirements.
  - PPA: Minimum functional specification, metering requirements, testing and commissioning, performance guarantees, commercial bidding parameters and associated bonuses/penalties.

Scaling Solar and Storage Program

- Task 3: Workshop for World Bank to discuss RINA findings during Tasks 1 and 2

  Attended a workshop in Washington D.C. to discuss RINA findings during Tasks 1 and 2 and agree an approach for the market testing phase.
- Task 4: Market research phase

  Sent questionnaires to Independent Power Providers (IPPs) and Vendors setting out our proposed approach for the Scaling Solar with Storage commercial set-up and technical requirements.

  Respondents were asked to provide opinion on the suitability of the potential changes to the Scaling Solar documentation.
- Task 5: Market research findings and final recommendations

  Consolidation of industry sentiment on documentation revisions and final recommendations for amendments to the Scaling Solar documentation.

E T H I O P I A

Ethiopia is the fourth country to join Scaling Solar. Ethiopia Electric Power signed an agreement with IFC to advise on developing up to 500MW of solar power under the initiative. Although Ethiopia has huge renewable energy potential it currently has an energy shortfall of 500MW, with over 70% of its energy coming from hydropower. Solar power will help diversify Ethiopia's energy mix and allow it to manage its water resources more effectively. This is vital bearing in mind the severe droughts that have afflicted the country. Scaling Solar will provide a quick to build, reliable complement to hydropower, drawing on Ethiopia's irradiation levels of 1500 to 200 kilowatt hours per square metre.

https://www.scalingsolar.org/

Upgrade of existing distribution network in Ethiopia

Ethiopian Electric Power Corporation (EEPCo) has received World Bank funding to **upgrade the existing distribution networks** of 8 major regional towns and electrify approximately 100 towns and villages in 5 regional states in order to enhance power supply reliability and enable network extensions to supply new customers by means of the Energy Access Project.

RINA provided Contract supervision services to EEPCo for two independent pieces of work, consisting of:

(a) urban distribution upgrading component and

(b) rural electricity access project component.

Upgrade of existing distribution network in Ethiopia

PROJECT

ENERGY ACCESS PROJECT

The project's development objectives were to:

(i) establish a sustainable program for expanding the population's access to electricity and improving the quality and adequacy of electricity supply, thus supporting broad-based economic development and helping to alleviate poverty;

(ii) reduce environmental degradation and improve energy end-use efficiency;

(iii) reduce the barriers to the wide spread adoption of renewable energy technologies, in particular solar photovoltaic (PV) and micro-hydro power generation in rural areas, thereby contributing to the reduction in greenhouse gas (GHG) emissions via displacement of kerosene and diesel that would otherwise be used for lighting and electricity generation; and

(iv) provide technical support for institutional and capacity building of key sector agencies, including for regulatory, fiscal and institutional reforms in the mining sector.

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Upgrade of existing distribution network in Ethiopia

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Project Financing in Renewable Energy Projects

Addis Ababa. March 2nd 2018

Riccardo Bicciato

BonelliErede

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Contents

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Introduction

Investment in renewable energies requires significant upfront investments

From an investor's perspective, is fundamental to have mitigations in place against different risks, from construction to operation

Many structured finance mechanisms and capital market instruments are available

The most common form of financing large scale renewable projects in a developing country remains **project financing**

Project finance can be considered as a winning financing technique due to the opportunity to effective allocate project risks

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Project Finance: key features

It is a type of financing which does not depend from the creditworthiness of the Sponsors, but from the capacity of the project to generate a cash flow sufficient to repay the financial debt and remunerate the capital invested by the Sponsors

Special purpose vehicle (SPV)

The borrower is an SPV. The SPV is autonomous from the Sponsors both economically and as a legal entity: this allows a situation of juridical and economic isolation called «ring fence»)

Security package

Security interest over all the assets of the project (e.g. pledge over shares/quota of the SPV; pledge/assignment of receivables arising from the project contracts and insurance contracts; mortgage; pledge over bank accounts; floating charge)

No recourse or limited recourse financing

The Lenders have no recourse (unusual) or limited recourse against the Sponsor. Normally there is a limited recourse against the Sponsors:

- Limited in time (e.g. until the end of the construction period)
- Limited in the amount (only in case of non satisfactory financial tests the Sponsor are obliged to inject equity and up to a specific amount)

Cash flow is the king

The cash flow has to be sufficient to cover the payment of operative costs and the repayment of the loan (capital plus interests). Dividends will be paid at the end of the agreed waterfall

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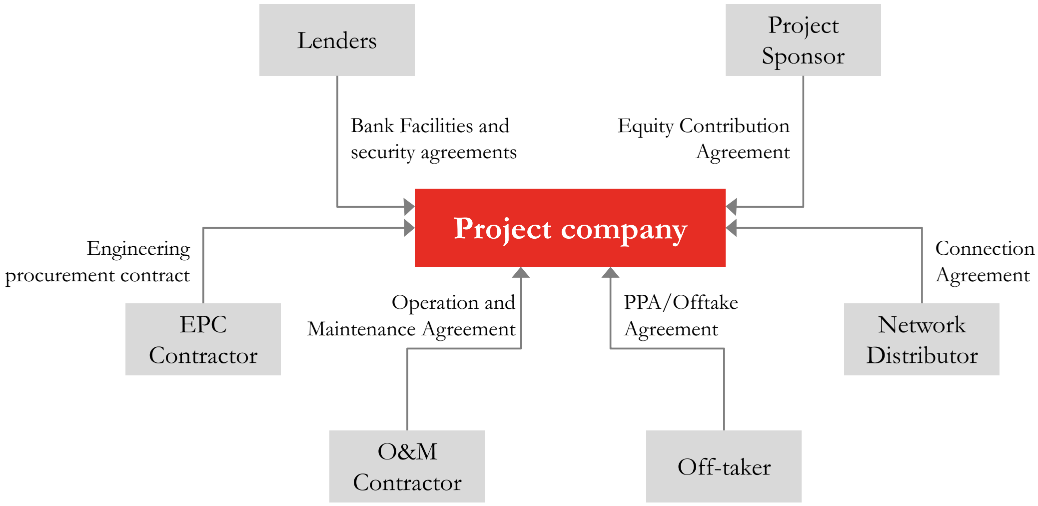
Renewable project finance structure

Every project has its own contractual structure.
The chart below shows a typical contract framework for a renewable project



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Allocation of the risks (1/2)

Risks are allocated as much as possible to each of the parties involved

- Construction risk
- Operation and management risk
- Environmental risk
- Off-take risk
- Political risk
- Certain financial risks
  - Interest rate risk
  - Exchange rate risk
  - Inflation risk

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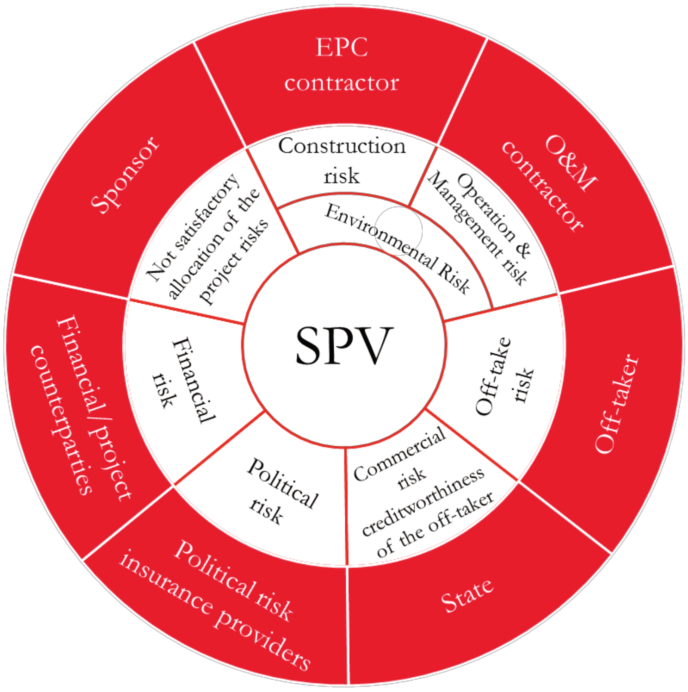
Allocation of the risks (2/2)

Securing financing for a renewable energy project in a developing country depends on a careful analysis of the bankability issues that will be faced throughout the project

A project is bankable if the construction (or pre-completion) and the operational (or post-completion) risks have been appropriately allocated to the various players, in form and substance satisfactory to the lenders



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Construction risk (1/3)

This risk is allocated to the EPC contractor. The following table lists some of the key risks that the EPC contract aims to cover, together with possible mitigations, in case such risks are not satisfactorily addressed in the EPC

Risk	Key Concern	Mitigation in case the risk is not addressed in the EPC Contract
Single point of responsibility	The lenders want the project company to deal with a single point of responsibility	If the EPC contractor is represented by a consortium: all members must be jointly and severally liable If there is a split EPC Contract the following mitigations may be put in place: • Wrap - up guarantee to be issued by one of the contractors guaranteeing the obligations of all the contractors • Interface and coordination agreement to, among other things, deal with the interference risks among the contractors and to resolve and settle any disputes that arise in performing the works
Completion date	A fixed completion date or a date within a fixed period of time from the execution of the EPC Contract shall be guaranteed by the contractor	Delay liquidated damages (DLDs) to compensate the project company for loss and damages due to the delay in completing the work. The payment obligations for DLDs shall be secured by a bond or a retention on each payment or a parent company guarantee

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Construction risk (2/3)

Risk	Key Concern	Mitigation in case the risk is not addressed in the EPC Contract
Fixed price	Avoid costs overrun	Specific provisions to prevent the revision of the contract price, as far as technically and legally possible, save for variations which will be subject to the approval of the lenders (so called reserved discretions)
Performance	Ensure that the plant performs as foreseen in terms of reliability and output	Performance liquidated damages (PLDs) Right of rejection if the plant performs below the minimum level The payment obligations for PLDs must be secured by a performance bond, a retention on each payment or a parent company guarantee
Cap on liability	To benefit from a large cap on the contractor's liability as most contractors refuse to accept an unlimited liability under the EPC contract	The cap should be at least equal to the contract price with a sub-cap for DLDs and PLDs to be appropriately allocated taking into account the features of the project

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Construction risk (3/3)

Risk	Key Concern	Mitigation in case the risk is not addressed in the EPC Contract
Warranties	In renewable projects, it is essential that the project company directly benefits from the manufacturers' warranties and have them assigned on the project completion date or in case of contractor's default or bankruptcy	Agreement by and between the contractor, the project company and the manufacturer Security over the warranties for the benefit of the project company and the lenders Insurance products that guarantee the required output to be considered if manufacturer warranties are not obtainable
Serial defects	In renewable projects, which often use a large number of same components, it is critical to be protected against the same defect that may affect a group of components	Provisions in the EPC contract specifically addressing this risk (e.g. testing procedure and replacement obligations at the cost and expense of the contractor)

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Operation and management risk

Market Risk

- Is the risk that the revenue are less than those expected and foreseen in the financial model. This risk varies from market to market

Performance Risk

- It is a sponsor/project company risk which is allocated to O&M contractor unless the SPV or one of the sponsors has the right experience and track record for similar projects
- This risk is mitigated through a long term service agreement with specific performance target obligations and tailored liquidated damages performance structure and bonus

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Environmental risk (1/2)

The environmental is a risk which is relevant during the construction and the operation phase

Lenders are very focus on environmental and social/community standards and responsibility

92 financial institutions in 37 countries have adopted the Equator Principles

The **Equator Principles*** (EPs) is a risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in projects and is primarily intended to provide a minimum standard for due diligence and monitoring to support responsible risk decision-making

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*http://equator-principles.com/

Environmental risk (2/2)

The Equator Principle have greatly increased the attention and focus on social/community standards and responsibility, including

- Robust standards for indigenous peoples
- Labor standards
- Consultation with locally affected communities within the project finance market

Multilateral development banks, including the European Bank for Reconstruction & Development, and export credit agencies through the OECD Common Approaches are increasingly drawing on the same standards as the EPs

Equator Principles Financial Institutions (EPFIs) commit to **implementing the EPs in their internal environmental and social policies**, procedures and standards for financing projects and will not provide Project Finance or Project-Related Corporate Loans to projects where the client will not, or is unable to, comply with the EPs

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Off-take risk (1/3)

The off-take risk is the risk that the project will not generate the expected revenues or, at least, sufficient revenues to service the debt and pay the project company's expenses (and, preferably, to generate a return for the project sponsor)

In a developing country this risk is usually mitigated by entering into a long term off-take contract aiming at mitigating the market risk reducing the volatility of the expected cash flows from the operation of the project

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Off-take risk (2/3)

The following table lists some of the key risks that an off-take agreement should cover

Risk	Key Concern	Mitigation
Off-take	Cover fixed costs of the plant, return on investment of the project sponsors and debt service	Off-taking obligations on a take-or-pay or take--and-pay basis
Foreign exchange	Protect the project from a currency risk to the extent the off-taker's payment obligations are in a currency different from the project company's financial debt	Off-taker's payment obligations denominated in or linked to the exchange rate of the same currency of the power producer to avoid/mitigate the currency risk
Change in law (including tax)	Protect the cash flow of the project from change in law that may reduce it	Allocate to the off-taker any change in law (including tax)

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Off-take risk (3/3)

Risk	Key Concern	Mitigation
Termination	Inability to repay the financial debt in case of termination/revocation of the PPA	Termination payment at least equal to the outstanding amount of the project financing and, in case the termination occurs due to a default attributable to the off-taker, the termination payment should also cover a return on equity
Connection to the grid	Failure/delays in providing the connection to the transmission system or to provide sufficient load and dispatch for plant testing	Clearly allocate this risk to the off-taker

Commercial risk (creditworthiness of the off-taker)

The creditworthiness

- The creditworthiness of the off-taker is another important risk to be considered in a PPA
- An inadequate creditworthiness of the off-taker, depending also on the size of the project and the maturity of the energy sector in the relevant country, may require a **sovereign guaranty or other form of financial support to support the off-taker's payment obligation**

The sovereign guarantee

In certain projects in particular those guaranteed by and export credit agency a sovereign guarantee will be the only instrument to enhance the bankability of a project when:

- The reference energy market is at an initial phase of its development
- There is not enough confidence on the creditworthiness of the government entity that will purchase the energy

Political risk

The political risk is a risk linked to adverse actions – or inactions of governments or war, civil strife, and terrorism

The political risk is mitigated through political risk insurance providers, which may be:

- **Private political risk insurance providers** which are profit-oriented companies offering coverage for developing and developed countries and for varying tenors
- **Public political risk insurance providers** which are national export credit agencies (ECAs), which may cover both export credit/trade transactions, as well as longer-term investments

  ECAs usually support investors and lenders from their home country going into developing countries, and may also have mandates to support development and be self-sustaining
- **Multilateral agencies** (such as MIGA) which provides special programs for small and medium investors, companies, and banks from developing countries

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Financial Risk

Interest risk

- The interest risk is the exposure to the fluctuation in the interest flows associated with floating-rate debt
  - Investors can mitigate interest rate risk through financial contracts like forward contracts, interest rate swaps and futures

Exchange rate risk

- The exchange rate risk is the exposure of the devaluation of the local currency over time
  - It is necessary to use s currency edge with a third party provider to protect against currency risk

Inflation risk

- Inflation risk or purchasing power risk is the chance that the value of cash flow from an investment will change in the future because of changes in purchasing power due to inflation
  - In emerging countries inflation can be high and increasing. The most effective way of mitigating this risk is indexing the revenues to inflation

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Not satisfactory allocation of the project risks (1/2)

In principle, whatever risks that is considered excessive by the lenders or that cannot appropriately be assessed or mitigated within the contractual framework of a project must be backed by the project sponsors

- The recourse on the project sponsors may be less or more limited depending on the nature of the risk to be mitigated

It may be in the form of a sponsor guarantee or in the form of equity contributions either by way of subordinated debt or capital injections

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Not satisfactory allocation of the project risks (2/2)

The terms and conditions of the facility agreement reflect the assessment of the overall riskiness of the project by the lenders

Risks that cannot be appropriately assessed or allocated may result in a deterioration of the terms and conditions of the facility agreement such as:

- More conservative debt to equity ratio
- Shorter tenor of the debt
- Need for a stand-by facility
- Higher arranging and commitment fees
- Stringent representations and covenants

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Conclusion

1. Project finance is a valuable form of financing large scale renewable projects in a developing country
2. Securing financing for a renewable energy project depends on a careful identification and allocation of the project risks from the construction to the operation phase
3. Project risks not allocated or mitigated appropriately will have a negative impact on the bankability of the project which may result in a stop of the project (worse scenario) or in higher recourse to the sponsors, increase of the overall costs of the financing and deterioration of the terms and conditions of the financing

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Questions?

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Rural Electrification
Off-grid renewable energy solutions - Financing issues

Addis Ababa. 2 March 2018

BonelliErede

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Introduction

Universal grid access

- To achieve universal grid access in current low-access countries by 2030 will require over **17 billion USD per year**, including about 12 billion USD per year for new transmission and distribution capacity (IEG Independent Evaluation Group 2015-World Bank Group Support to Electricity Access)
- The largest share of this investment would be in **Sub-Saharan Africa**, given the size of the population without access and the challenges of making effective infrastructure investments there

Traditional model for power system

- The traditional development model for power systems based on centralized production and network extensions require substantial funding but the good news is that the development of a decentralized generation methods, not connected to the main electrical network (off-grid) or organized around a local mini-grid offer a **cost-effective and environmentally sustainable tool to accelerate the pace of electrification**

Advances in off-grid renewable energy

- The advances in off-grid renewable energy development have been impressive from all standpoints
- Today, **solar PV-based solutions**, whose cost has substantially declined over the years, are ideal for adaptation to local conditions, ranging from lanterns to household systems to village-powering mini-grids

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Financing and bankability issues are the main obstacles

Off-grid rural electrification projects are not always bankable for a number of reasons

1. Poor regulatory framework
2. Setting the tariff and designing the appropriate subsidy is a complicated exercise
3. Small size of the deals
4. Off-take risk and revenue generation risk

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1 Regulatory framework

Financing and bankability issues

There is a lack of a strong policy and regulatory environment which strongly penalize the attractiveness of this sector

Off-grid renewable energy solutions

Off-grid renewable energy solutions are often not contemplated by the regional and national electrification and planning process:

- The relevant frameworks are designed for traditional development model for power systems based on centralized production
- The frameworks have to be adapted to support off-grid solutions
- The policy shall be sustainability and scalability oriented

The regulatory framework must be certain in the long term period

In particular:

- Permits and authorizations: One stop shop; Standard documentation
- Tariff regulations: Well designed (Cost reflective); Not change as the investments will be based on specific economic assumptions in the medium-long term period
- Arrival of the national grid: Exit options; Compensation

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be ❷ Tariff and subsidies

Financing and bankability issues

A consistent part of the costs and expenses of a project will be covered by tariff mechanisms and subsides

Cost reflective, flexible and affordable tariffs

- **Cost reflective**: the tariff should at least cover the running costs and should recover the cost imposed on the system by customers
- **Flexible**: it has to address the peculiarities of the project and the end users
- **Affordable**: the tariff mechanism shall ensure reasonable returns and affordable prices for the end users

A subsidies system

A well designed **subsidies system** is very important to:

- reduce the investment risk connected to the rural electrification market; and
- overcome market imperfections

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be ❸ Size of the deal

Financing and bankability issues

Financing institutes view the majority of the off-grid renewable energy projects as small in size and, therefore, unable to cover the high transaction costs for investment preparation and financing

A solution to this problem could be:

a **Bundling of mini-grid projects in a defined geographical area**

- Reduce the finance costs and project-specific risk
- Increase the size of the deal, therefore, increasing the appetite for lending which otherwise will be inaccessible for a low value transaction

b **Bundling the projects under a concession scheme**

- A well designed concession scheme may enhance the bankability of the project as provide for more certainty in the relationship between the private investors and the public authorities

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Off-take and revenue generation risk

Financing and bankability issues

Low income of the end users reduce the ability to pay the actual costs of setting up an electrification scheme. This risk is highly perceived if the project is developed in a low population density area

Possible solutions

- PPA with public entities that then resell the electricity to the end users
- PPA with an anchor clients (telecommunication towers, rural health centers) where the excess energy could be supplied to the surrounding communities

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Conclusions and call for actions

Off grid renewable projects offer a cost-effective and environmentally sustainable tool to accelerate the pace of rural electrification

The access to financing is difficult and unless the bankability issues are solved these projects may be financed only through equity or with financing granted by donors or governmental agencies

Off grid renewable projects may be bankable but an holistic approach has to be implemented and requires the involvement and the commitment of all the key players

The **policy makers** shall design a specific legal framework:
- Permitting and licensing process shall be streamlined
- The tariff regime shall be cost reflective but flexible enough and based on what will be affordable and acceptable to the end users
- Clear exit option in case of grid arrival

Financial entities/Donors/ Multilateral Agencies/ Export Agencies shall put in place :
- A new finance structure to blend different sources of finance and adapt them to the off-grid sector
- and new guarantee schemes to backing up financing and addressing key investment risks, including political, currency and off-take risk

The **private sector** shall collaborate with the public sector in identifying mutually satisfactory conditions for the development of off grid renewable projects (e.g. pre-agree on a bundling strategy for a specific area)

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