



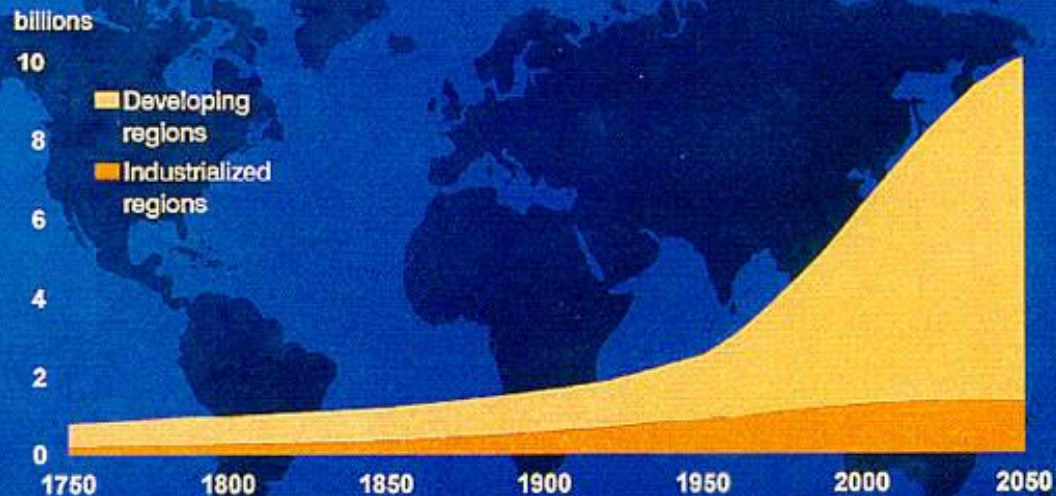
Towards the sustainability of the energy sector: the role of technology innovation

Roberto Cimino

Vice President, Technology Scenario and R&D Planning, Eni

Bologna, June 20, 2018

World Population Growth

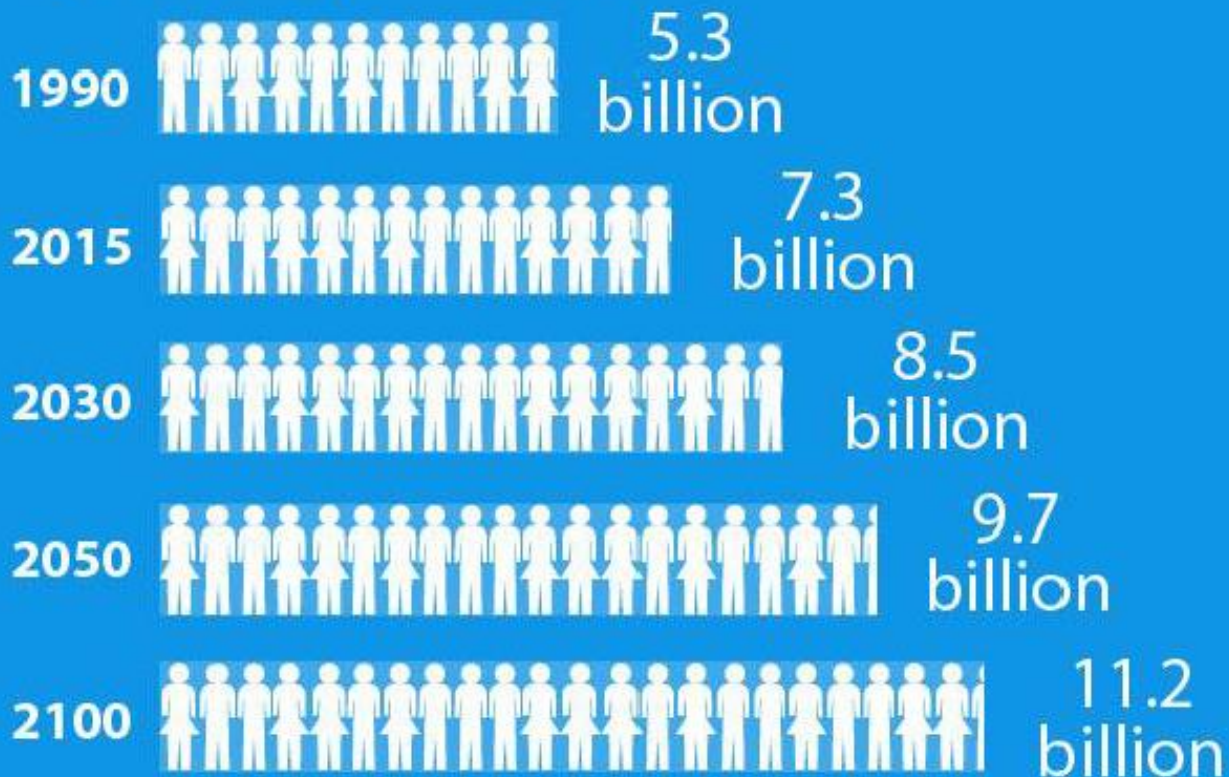


World
Resources
Institute

Sources: United Nations Population Division and Population Reference Bureau, 1993.

World Population

Projected world population until 2100

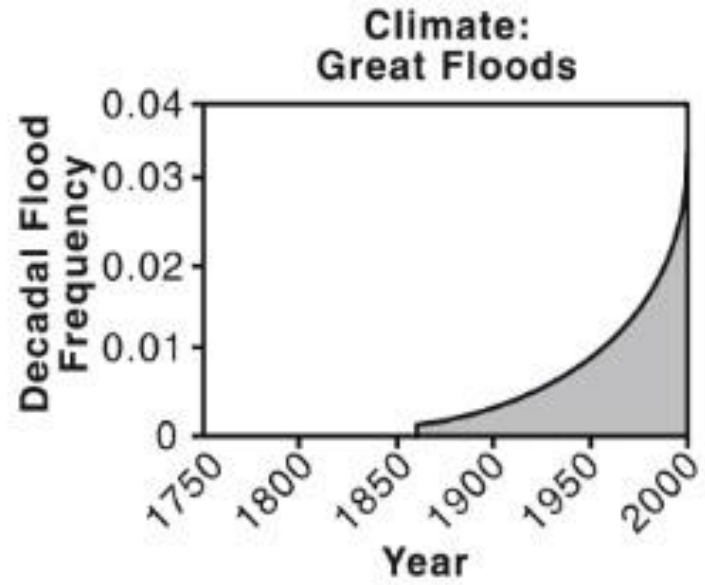
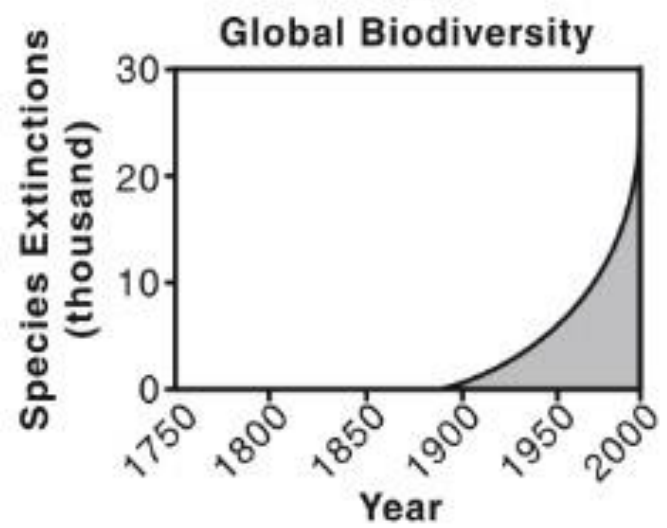
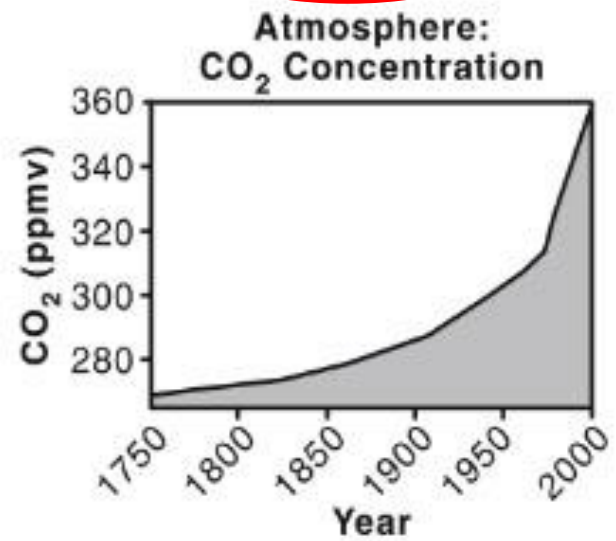
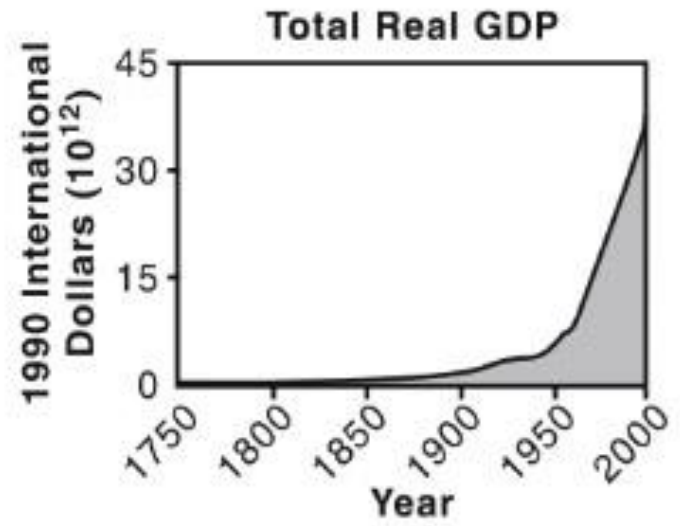
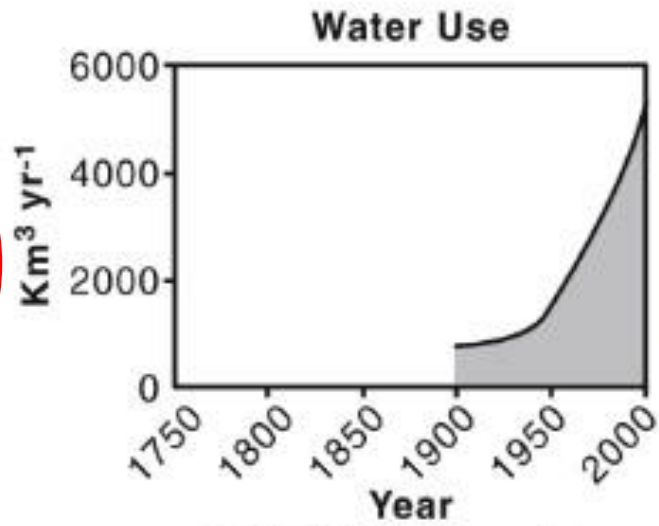
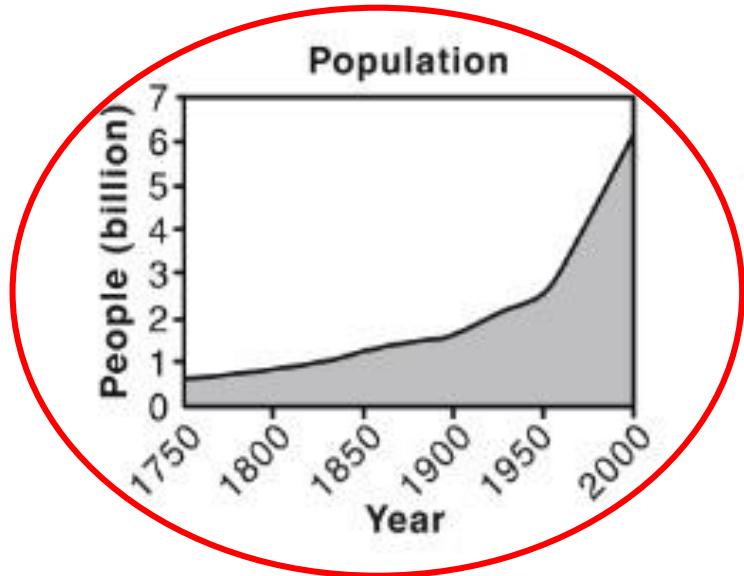


Source: United Nations Department of Economic and Social Affairs,
Population Division, *World Population Prospects: The 2015 Revision*
Produced by: United Nations Department of Public Information



2015
TIME FOR
GLOBAL ACTION

Why population growth is important?...



The water-food-energy nexus

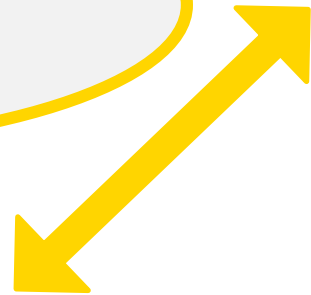
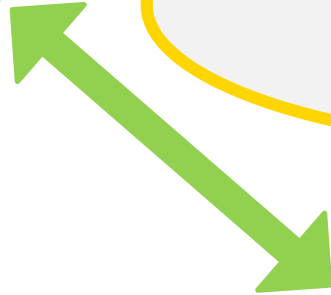


- **Food** production requires **water**

Energy-intensive desalination efforts use **energy** to produce **drinkable water**



- **Food** production requires **energy** to plant and harvest
- **Crops** are converted into **biofuels** in some countries



- Demand for **food**



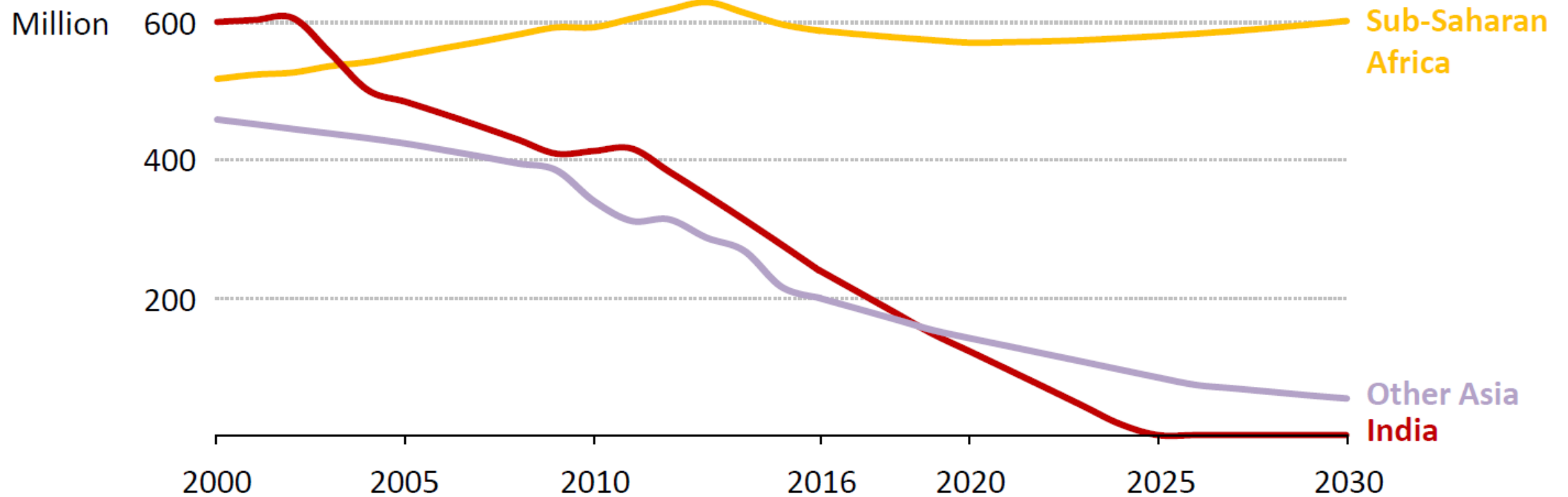


1970's



Access to energy!

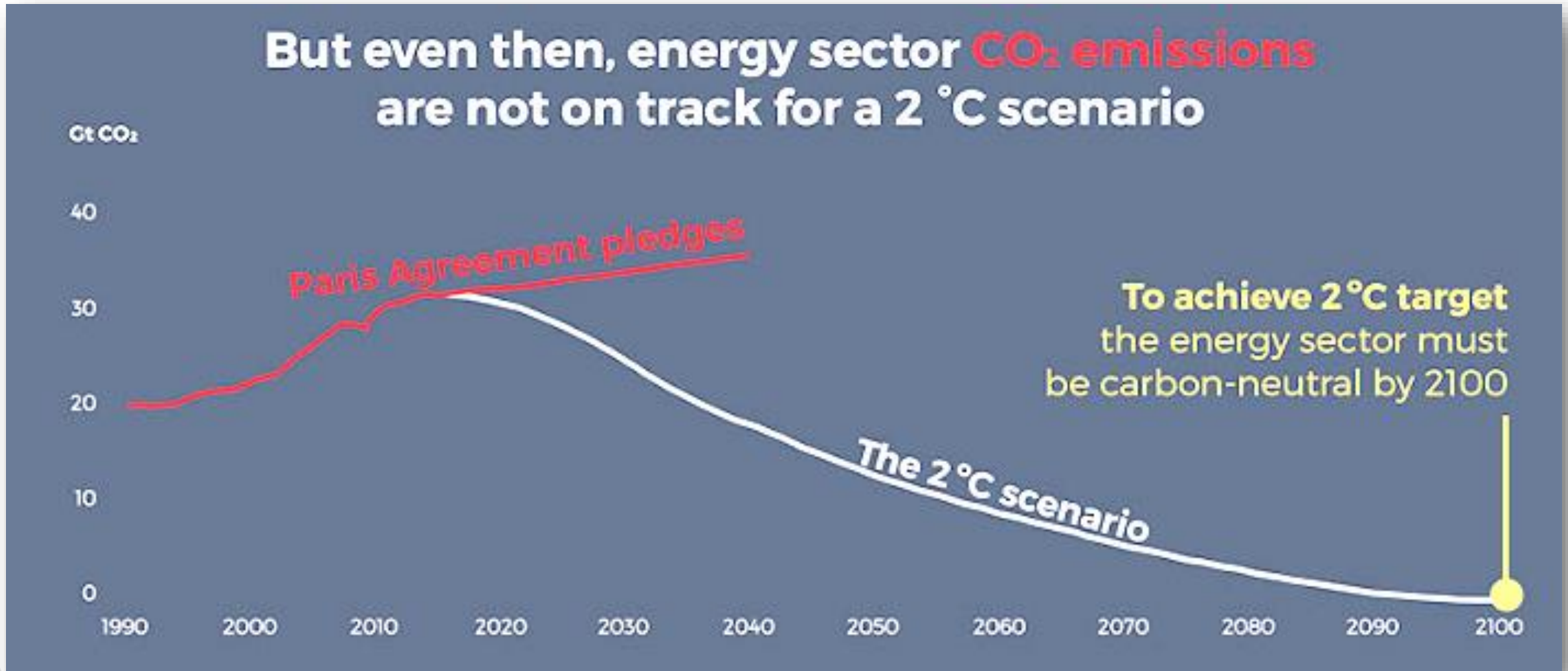
People with no access to electricity



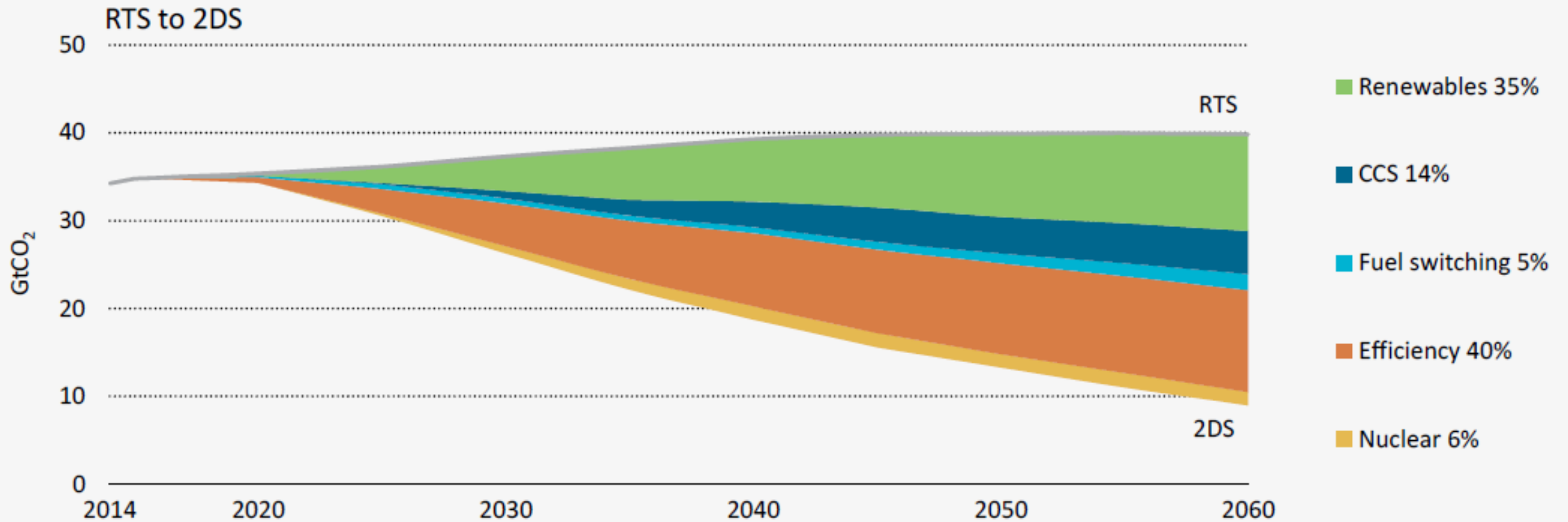
IEA, World Energy Outlook, Fatih Birol presentation, Rome, December 1, 2017;
<http://www.climateactionprogramme.org/news/solar-power-will-bring-electricity-to-millions-of-africans-says-development> ;
<http://www.climateactionprogramme.org/news/growth-in-solar-power-is-bringing-power-to-millions-in-remote-communities>



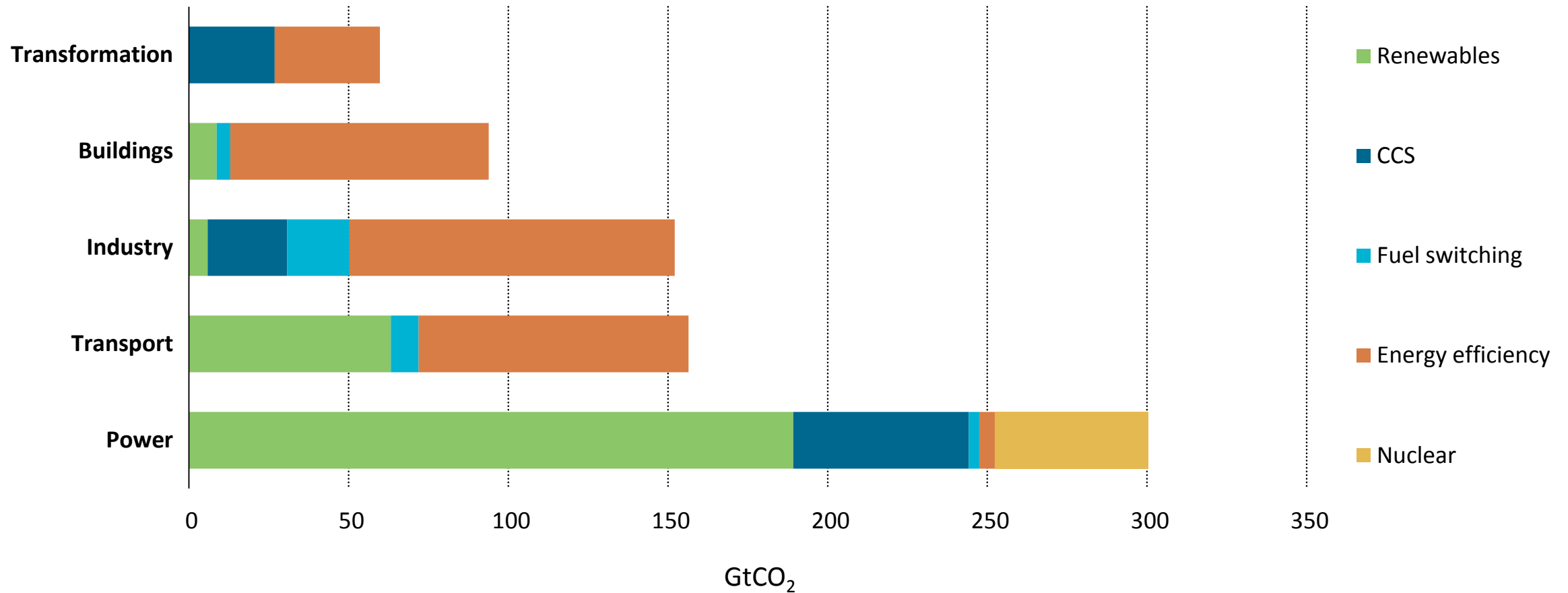
CO2 emissions trend after Paris agreement (CoP 21)



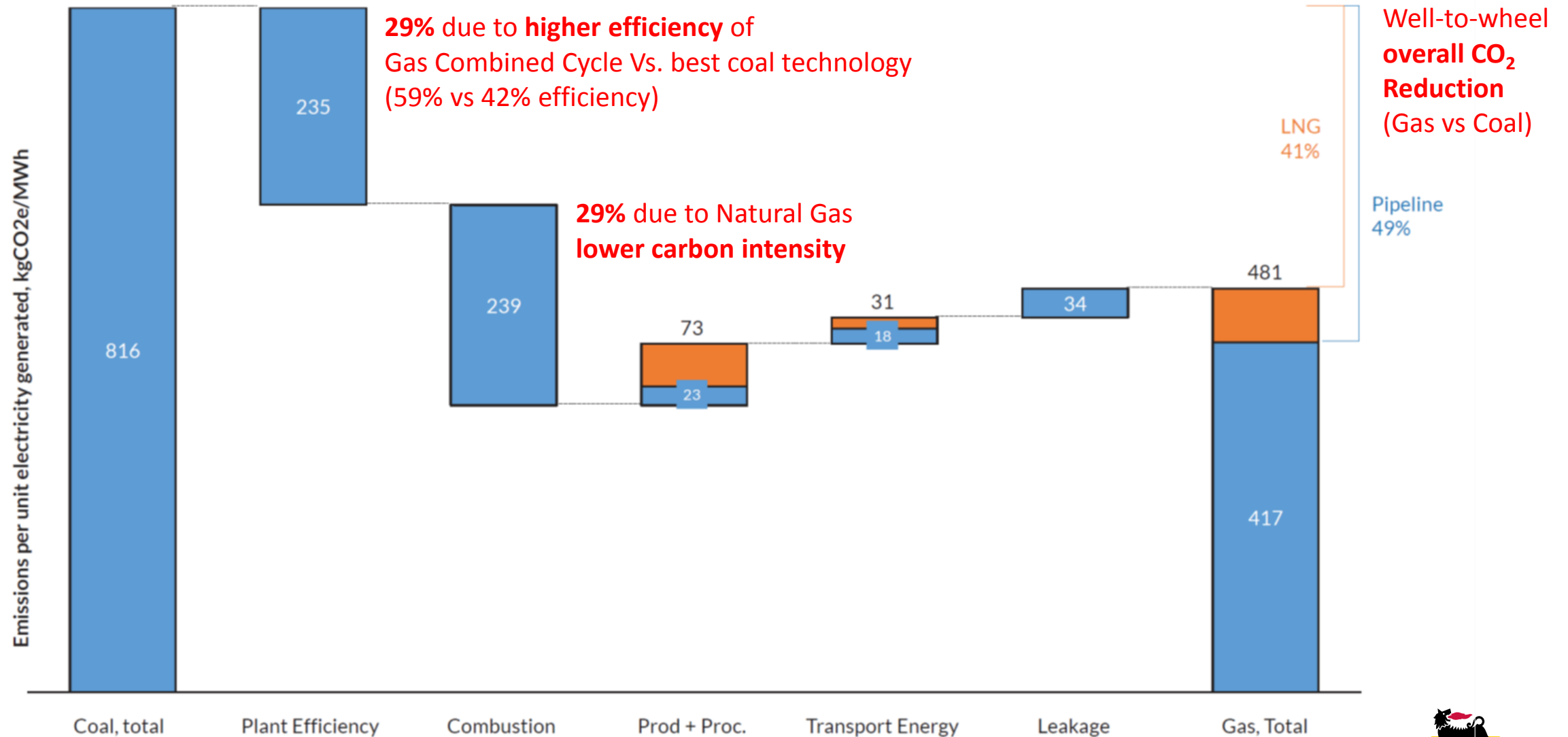
Scenarios of global CO2 emissions reductions



Cumulative CO2 reductions: role of technologies (2DS/SDS)



Reductions in CO₂ emissions by substituting coal with NG (Power Sector)



Decarbonizing the economy: is it possible?

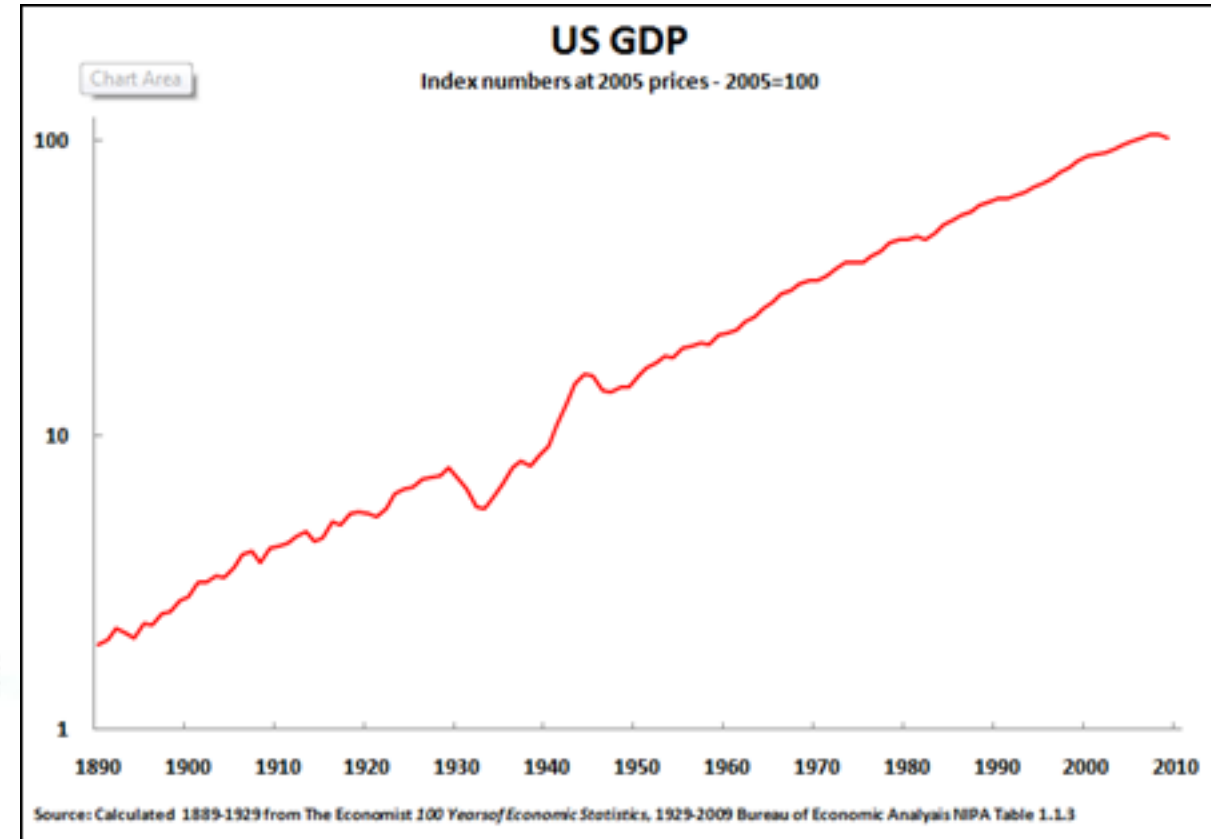
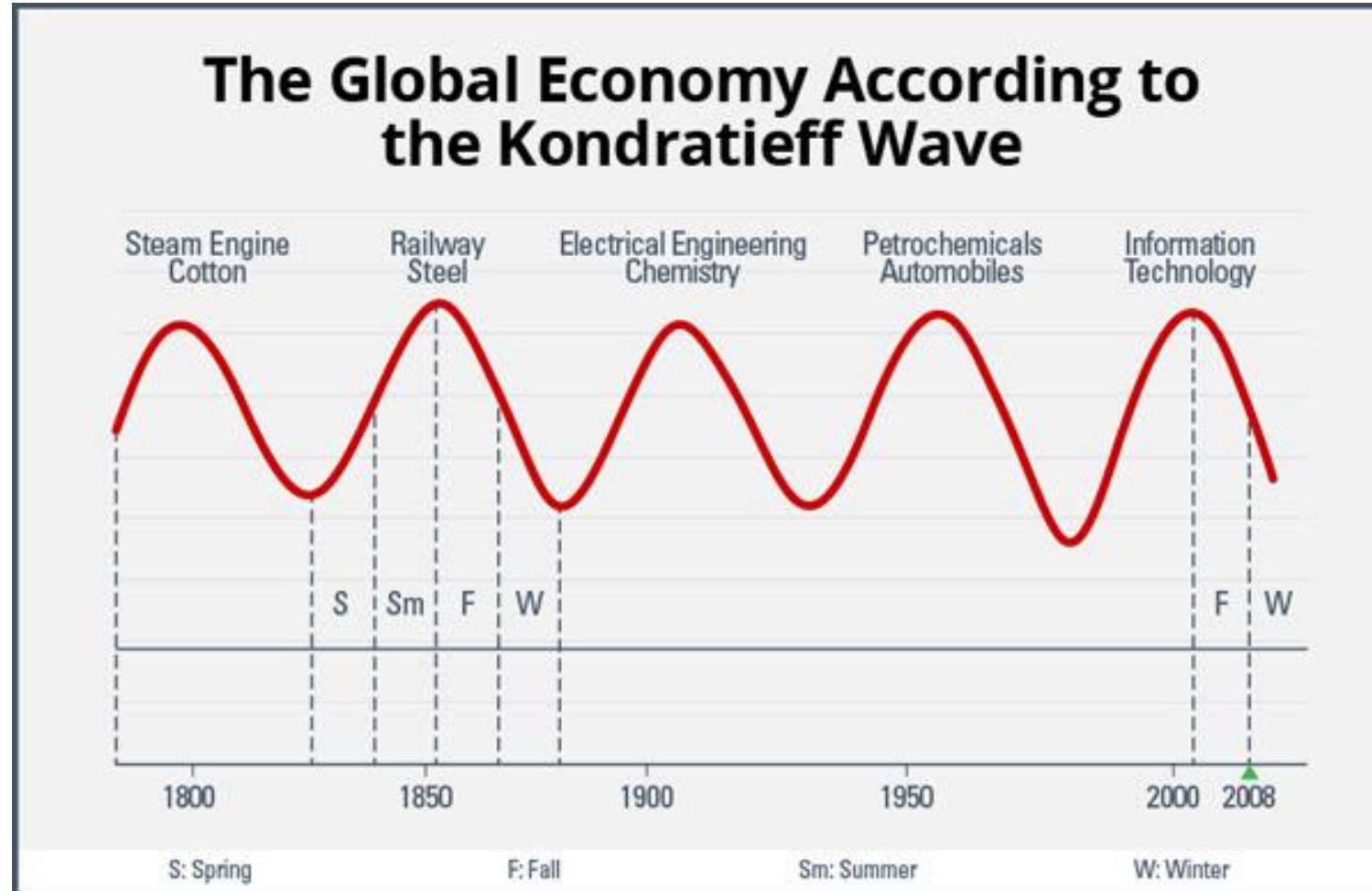


Figure 7.1. Decarbonization of Economic Activities in the United States.
Expressed in kilograms of carbon per unit of GDP at constant 1990 prices
[kgC/US(1990)\$].

The role of technology: Kondratieff Waves



Nikolaij
Kondratiev
1892-1938

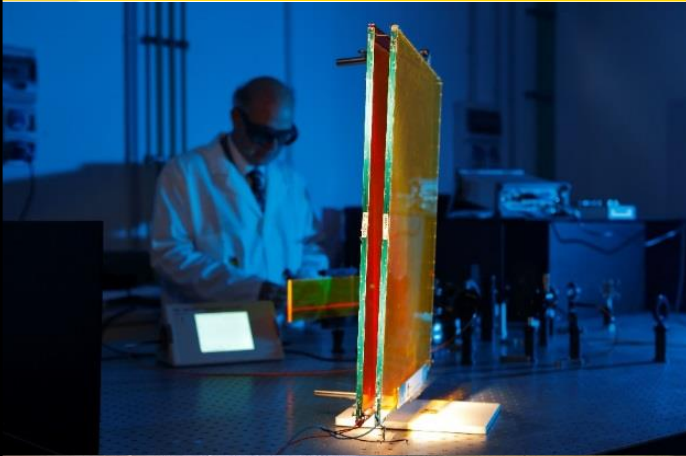


Research & Innovation in Eni

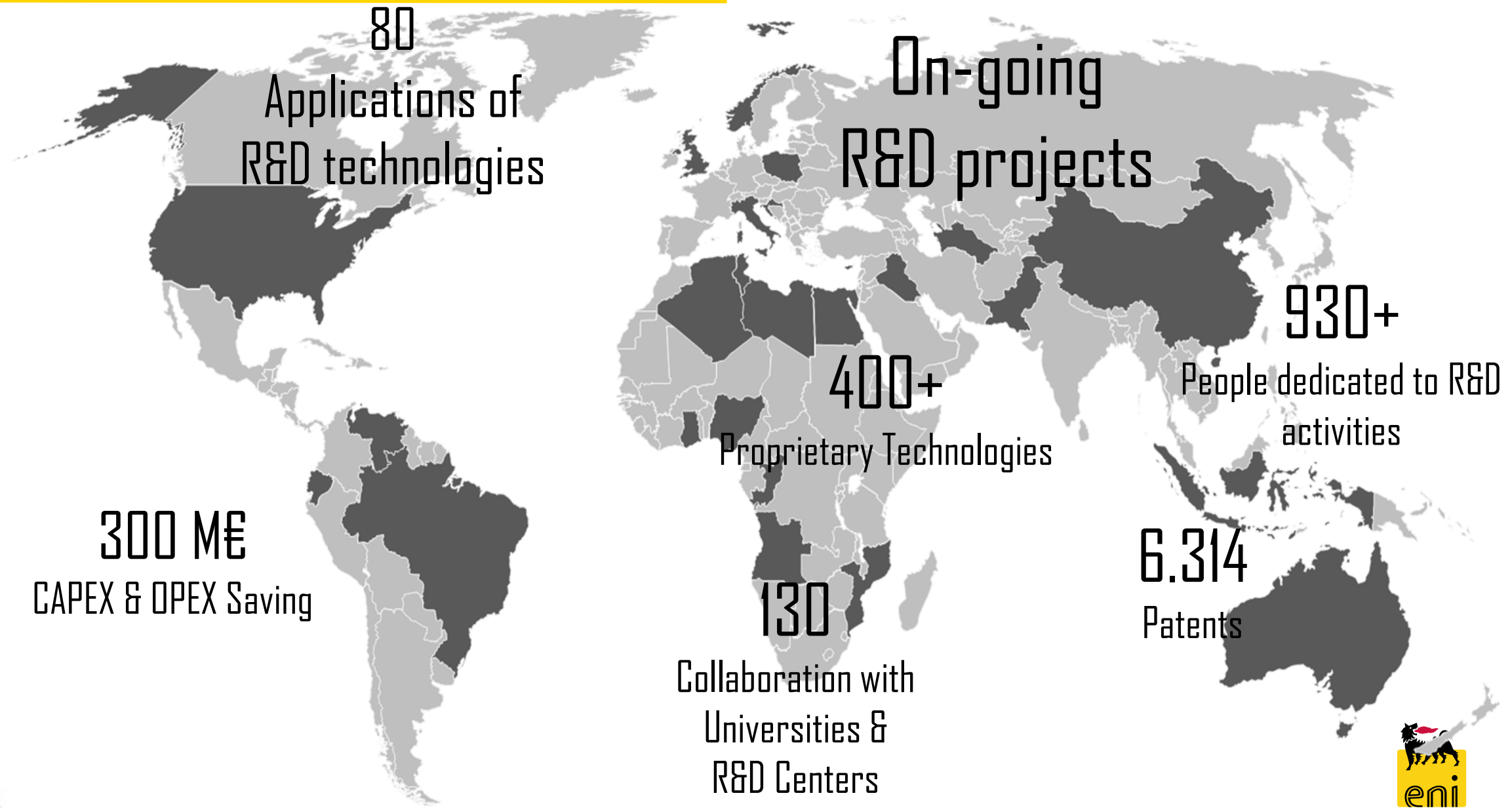
Since 2010 Eni has invested over 1.5 B€ in R&D

60% of R&D investments in Upstream / Downstream, 40% in Renewable Energy, Green Technologies and Energy Transition.

*Research centers: **San Donato Milanese** (Upstream & Downstream Labs), **Novara** (Istituto Donegani - Renewable Energy Labs), **Mantova** (Versalis – Petrochemistry), **Stavanger-Norway** (Eni Norge - HSE, Environment and Subsea Technologies) and **Venice** (Robotics and Prototyping)*



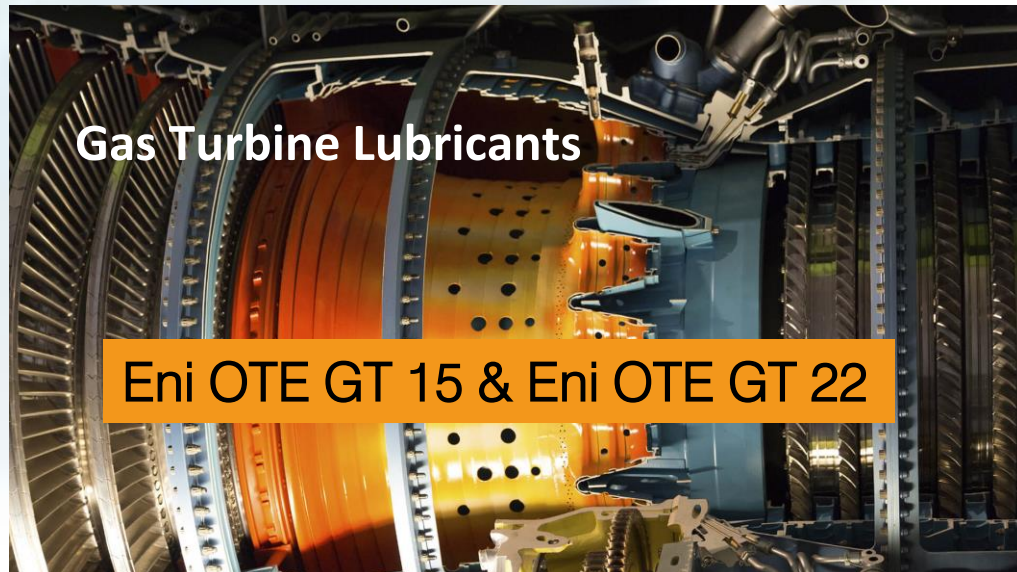
Eni R&D – Key facts



High Sustainability Products

New fuels and lubricants for

- *energy efficiency*
- *emissions reduction*
- *durability of vehicles and industrial equipment*
- *renewable sources exploitation*



Engine Oils

Eni i-Sint Bio Tech 0W-20
Eni i-Sigma Bio Tech 10W-30

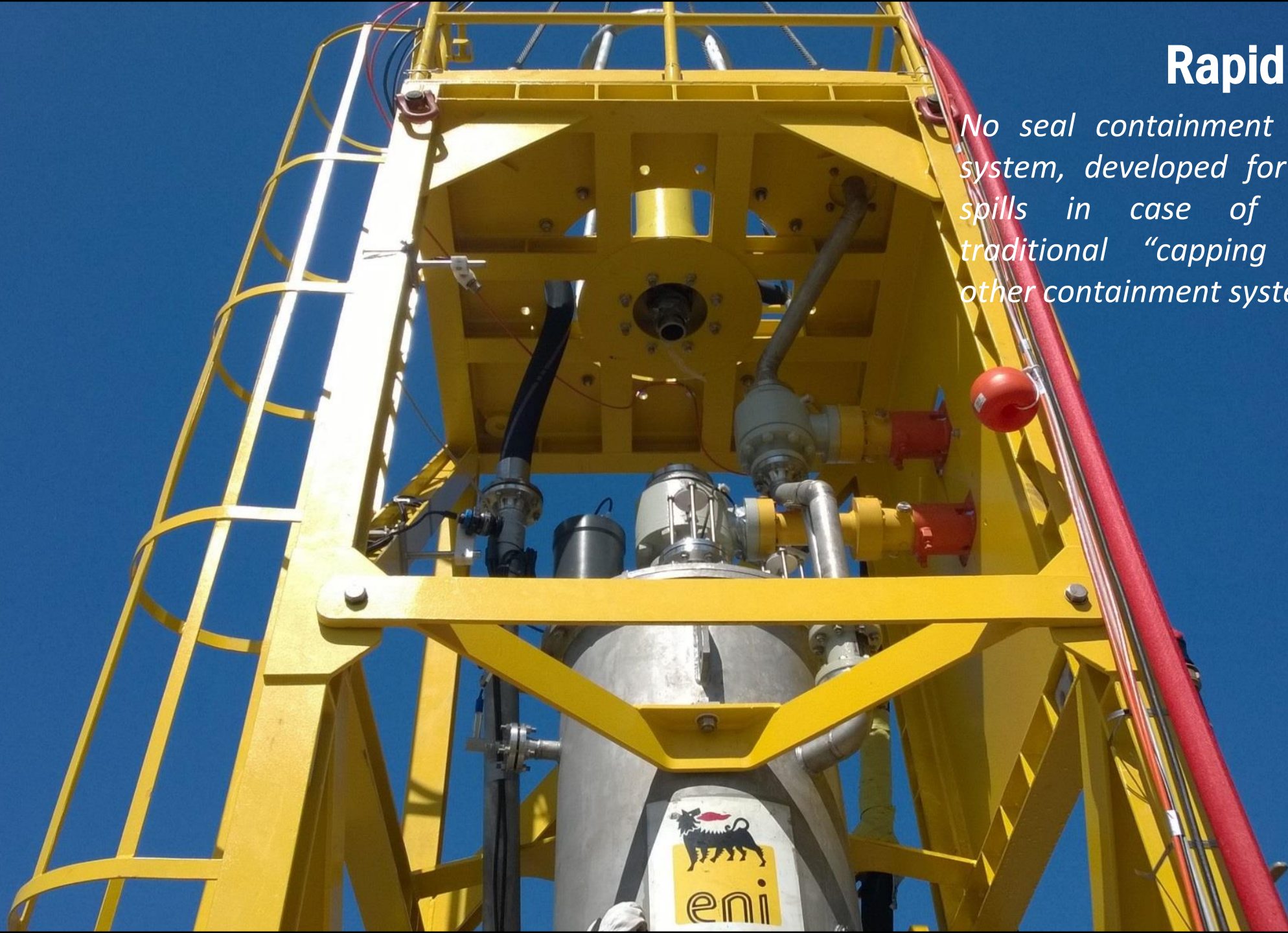
Robotics: Clean Sea

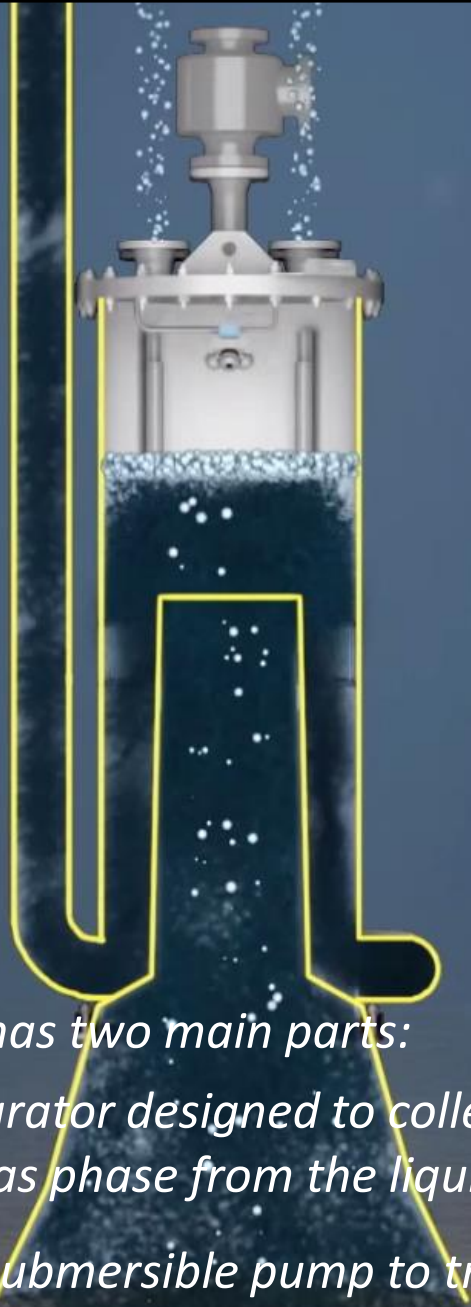


Clean Sea system is an advanced underwater robot, Eni patented, designed for environmental monitoring and asset integrity inspection, tested in several marine environments

Rapid CUBE

No seal containment proprietary system, developed for subsea oil spills in case of failure of traditional "capping stack" or other containment system





This technology has two main parts:

- *a subsea separator designed to collect the oil spill and to separate gas phase from the liquid phase*
- *an electrical submersible pump to transfer up to 12 kbbl of liquids per day to a well testing equipment installed onboard a drilling rig*



Environmental Technologies

- *Passive sampling methods*
- *Mobility and bioavailability of contaminants in soil*
- *Bio-markers for environmental remediation (fingerprinting)*
- *DNA microarray for monitoring of the natural attenuation*
- *Phytoremediation of polluted soils*
- *EKRT - Electro Kinetic Remediation Technology*
- *Technical feasibility evaluations*



Solar Energy – Printable Polymer Solar Cells



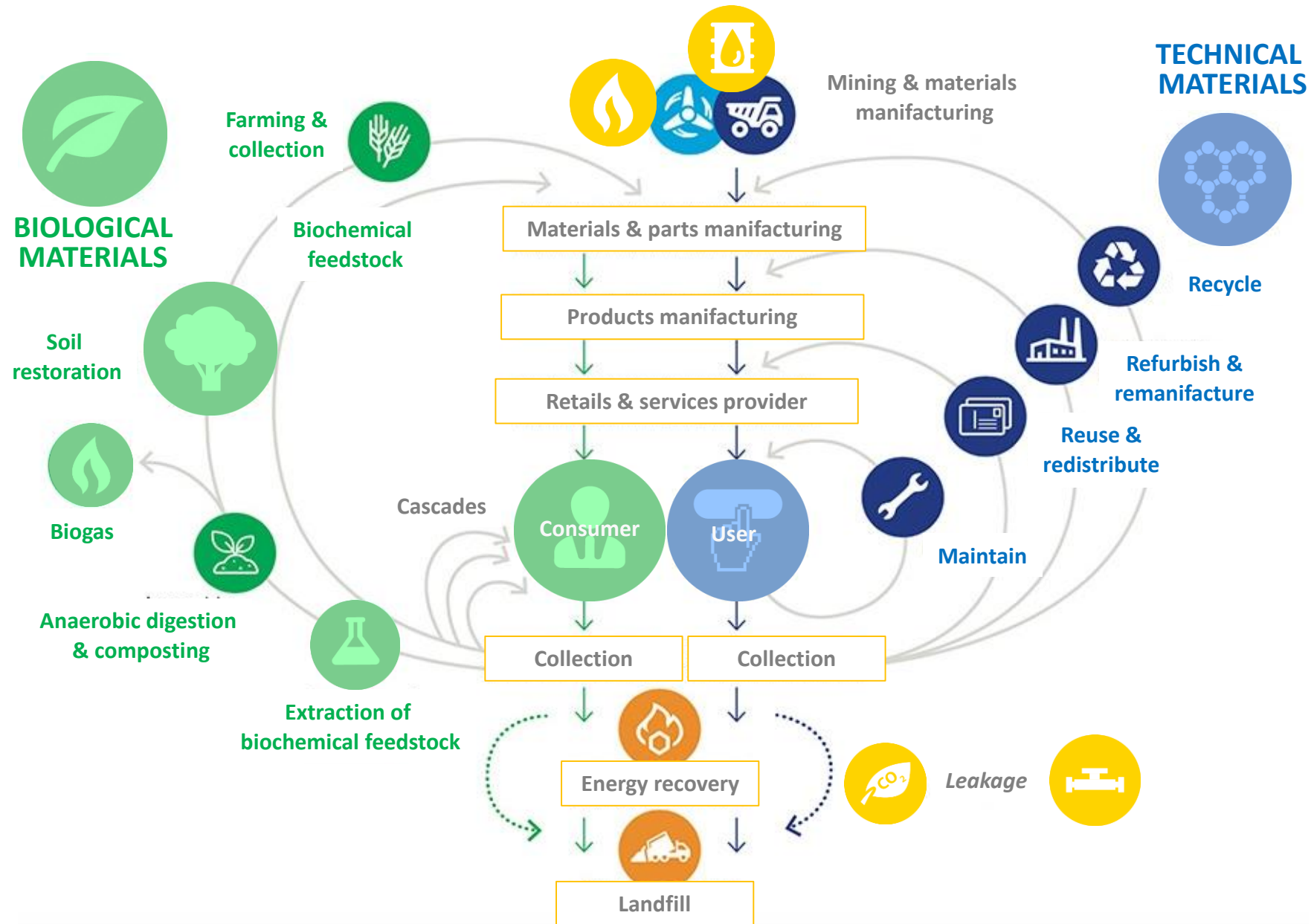
- *Low cost organic PV on flexible substrate for portable devices*
- *Low weight: 100 times less than commercial modules*
- *Suitable for low illumination environment*
- *Heat-resistant*

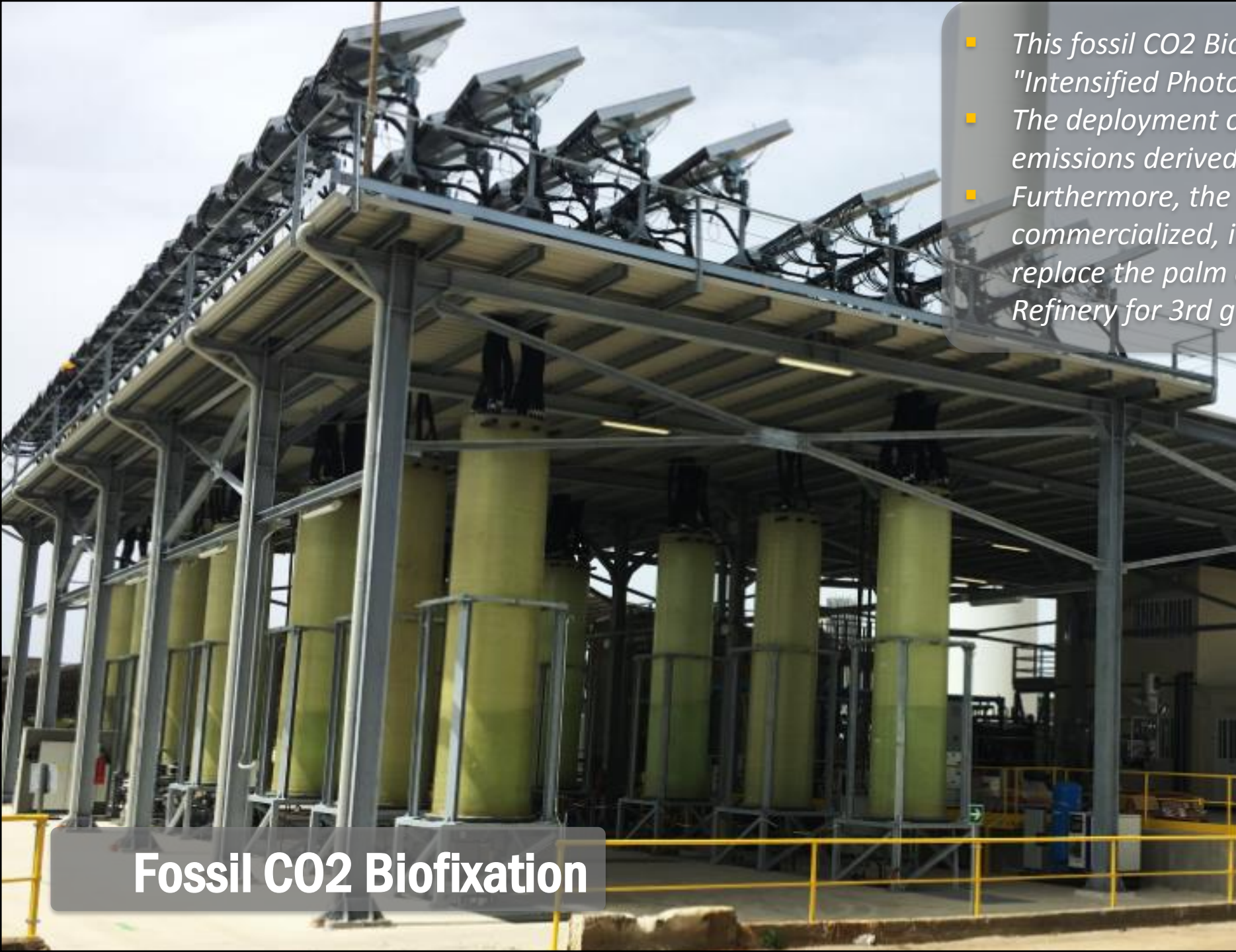
Concentrating Solar Power



- *A new, proprietary, cost-effective technology for solar energy conversion, also in co-production with fossil fuels*
- *CO2 emissions reduction*
- *Thermal energy storage for delayed use (night or no sun)*
- *Ongoing demonstration in an industrial site*

The circular economy





- *This fossil CO2 Biofixation plant is based on "Intensified Photosynthesis reaction".*
- *The deployment of this technology will reduce CO2 emissions derived from several upstream assets.*
- *Furthermore, the bio-products can be commercialized, in particular the algal bio-oil can replace the palm oil as a feedstock of Eni Green Refinery for 3rd gen Green Diesel production.*



Fossil CO2 Biofixation

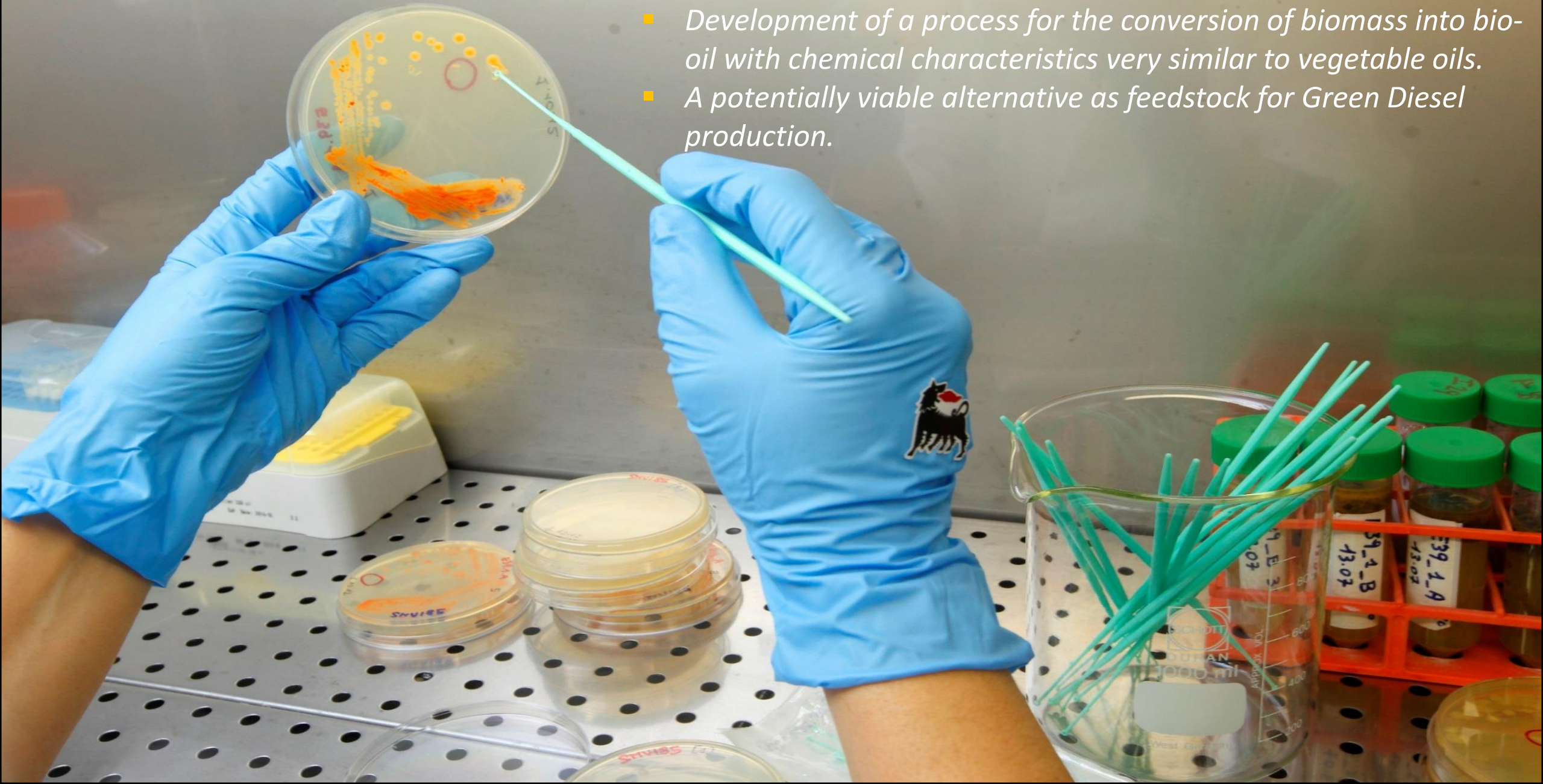


Waste to fuel

This proprietary technology converts solid organic waste (not in competition with agricultural food production) into bio-oil that can be used for producing electricity or diesel fuel by using thermochemical conversion processes.

Advanced Biofuels

- *Development of a process for the conversion of biomass into bio-oil with chemical characteristics very similar to vegetable oils.*
- *A potentially viable alternative as feedstock for Green Diesel production.*



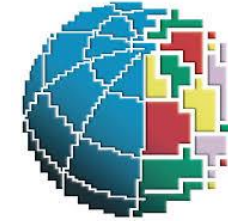
Open Innovation



POLITECNICO
MILANO 1863



UNIVERSITA' DI PAVIA
DIPARTIMENTO DI
SCIENZE DELLA TERRA
E DELL'AMBIENTE



INGV



POLITECNICO
DI TORINO



Elettra Sincrotrone Trieste



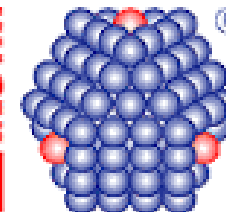
Massachusetts
Institute of
Technology



Consiglio
Nazionale delle
Ricerche



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



Cooperations with UniBO



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



Competence Center I4.0 BI-REX

Eni involvement as end user:

Big Data for manufacturing: platforms integration

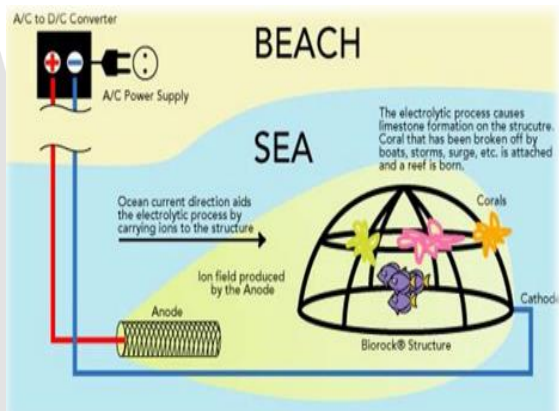
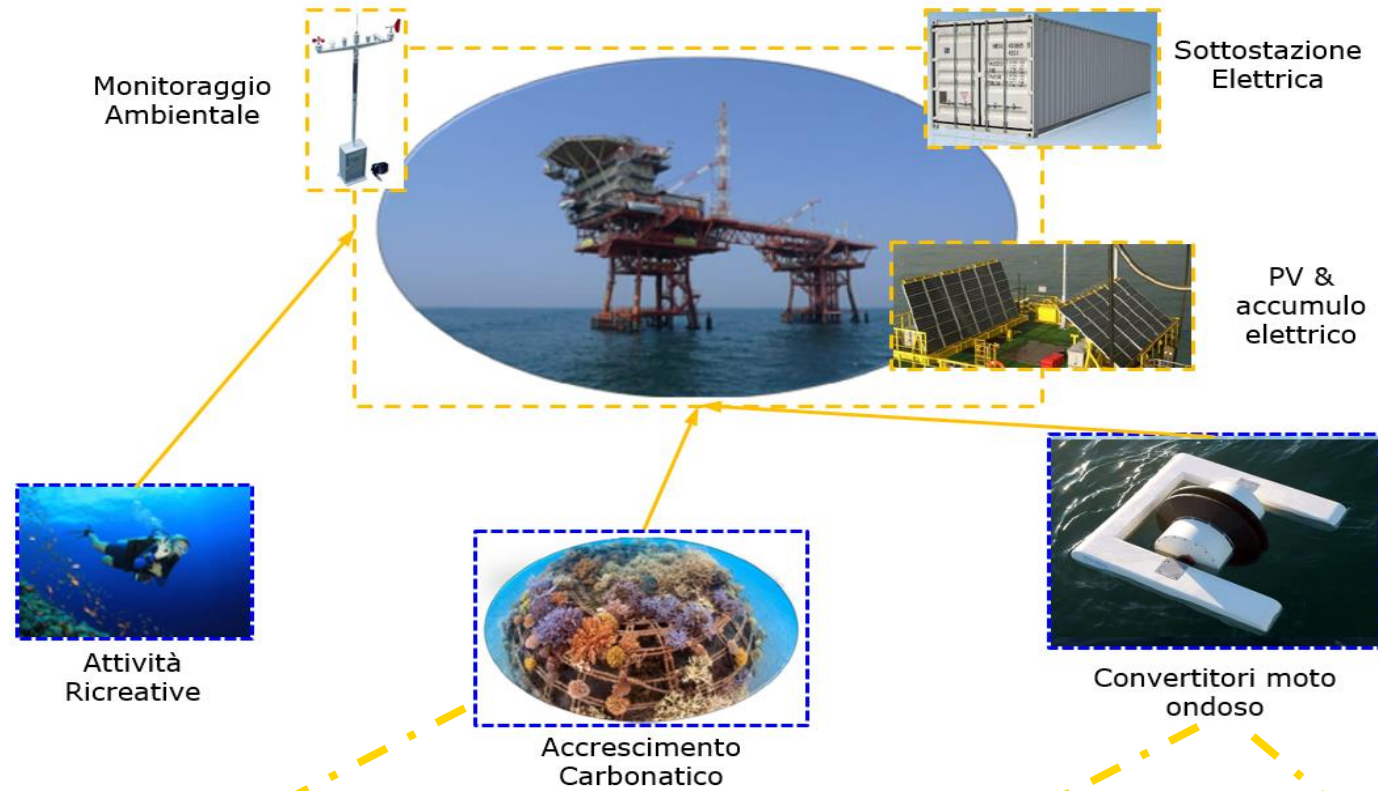
Data Analytics / Machine Learning: predictive diagnostics

Framework Agreement eni- Bologna University

06/2017 – 06/2020

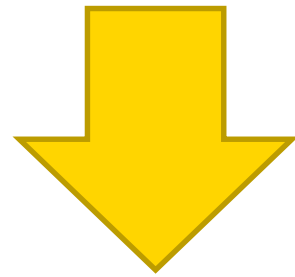


Reusing offshore platforms in the Adriatic Sea (ArpaE, University of Bologna, Aster)



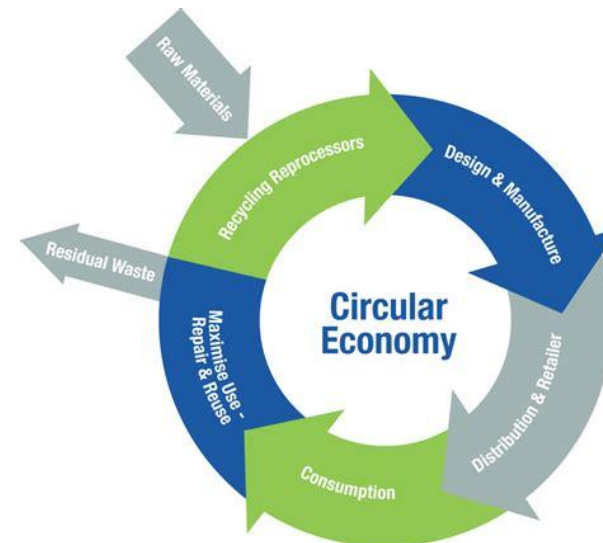
The global energy system : drivers of change

- Global **population** growth, **urbanization**
- Increasing **water, food** and **energy** demands
- **Climate change** issue



Towards the decarbonization

Towards a circular economy approach





**May you live in
interesting times.**