Uso dell'energia e qualità dell'aria a livello locale e globale

Prof. Andrea Contin
16 Maggio 2018

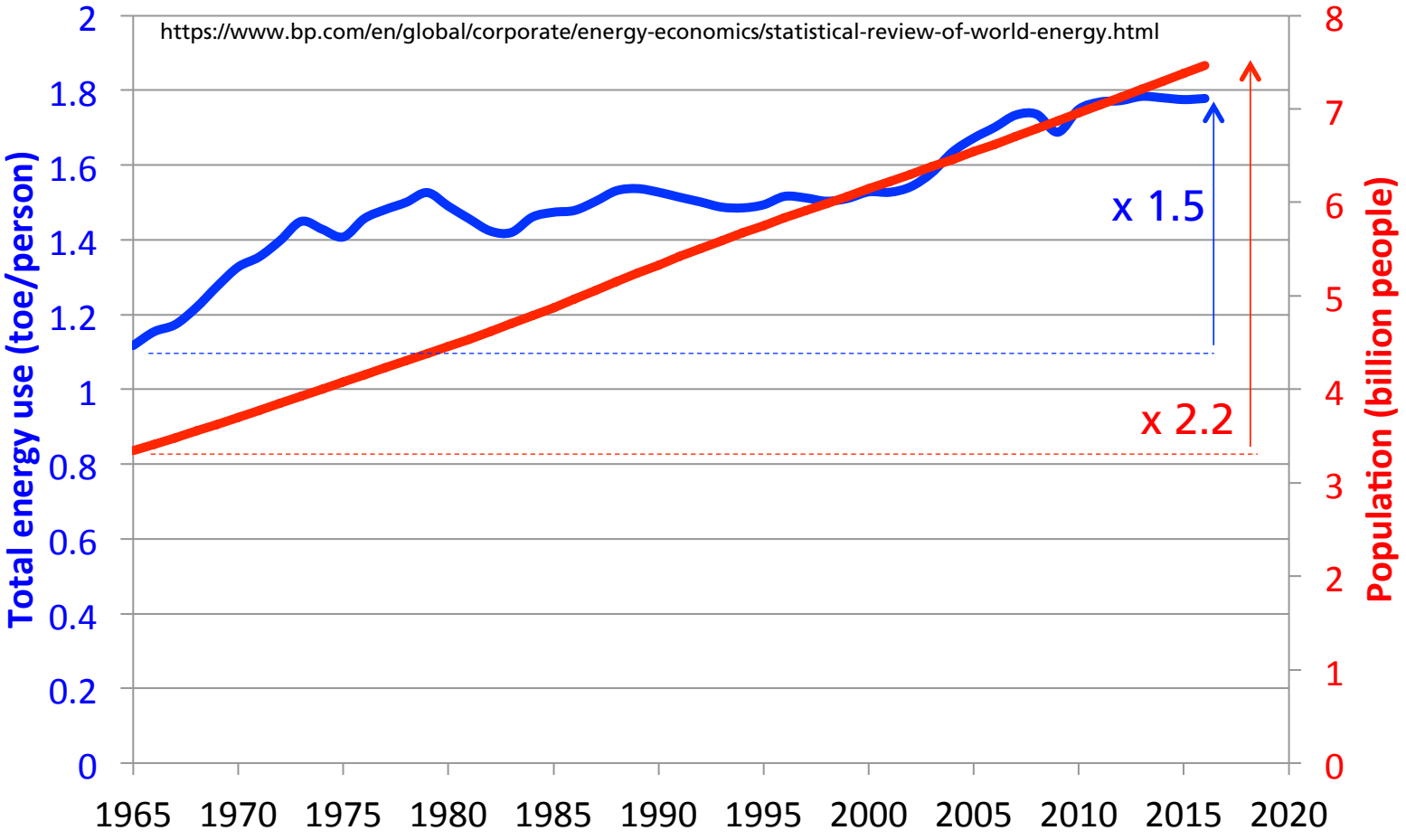
Aria: quali prospettive per Ambiente e Salute

The problem

- Energy production and use is the single most important man-made sources of air pollutant emissions

- Unregulated, poorly regulated or inefficient fuel combustion produce:
  - 85% of particulate matter
  - almost all of the sulfur oxides (SO_x)
  - almost all of the nitrogen oxides (No_x)

World energy consumption



But … more than 2.7 billion people still use wood and other solid fuels for cooking, and kerosene for lighting or cooking

UN Development Goals (2015-2030)

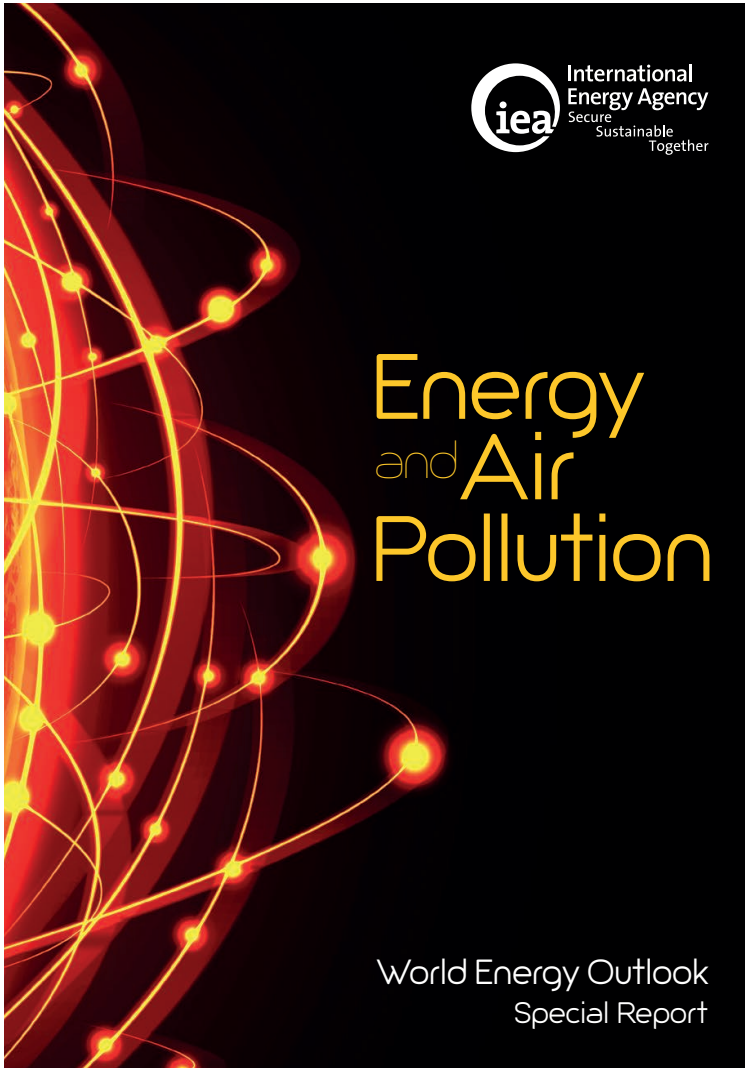
UN Development Goal 7

Target 7.1: Ensure universal access to affordable, reliable and modern energy services by 2030.

Target 7.2: Increase substantially the share of renewable energy in the global energy mix by 2030.

Target 7.3: Double the global rate of improvement in energy efficiency by 2030.

IEA Special Report (2016)



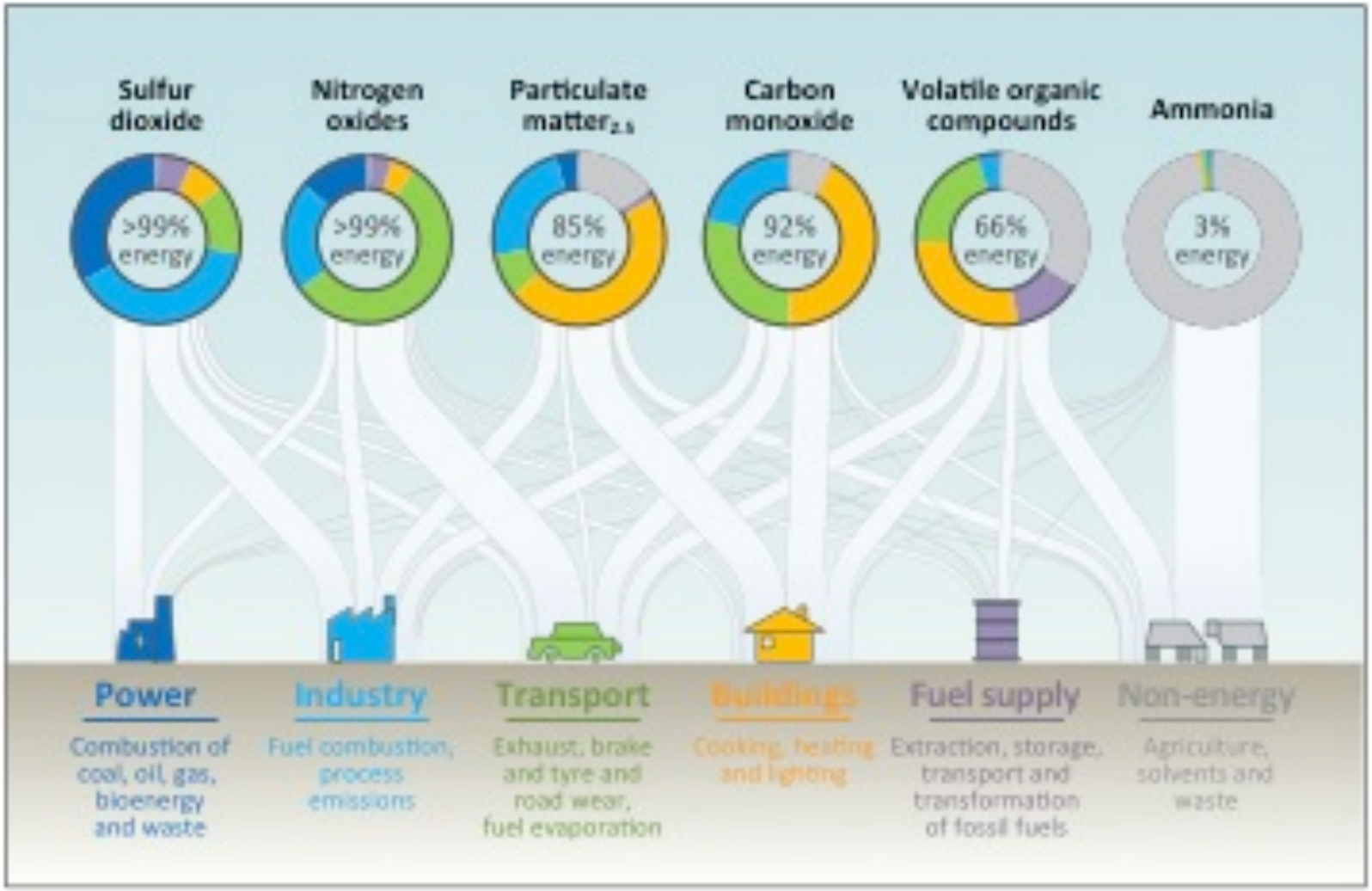
International Energy Agency
9 rue de la Fédération
75739 Paris Cedex 15, France
www.iea.org

This study – released as a World Energy Outlook (WEO) Special Report – reflects the IEA's new vision. An IEA that is truly international in its outlook must tackle the issues of greatest concern to developing, as well as developed, countries.

No country can claim to have fully overcome the air pollution challenge, and the IEA is uniquely placed to bring decision makers together and provide evidence-based analysis and policy advice.

In establishing itself as a global hub for clean and efficient energy, the IEA is seeking to help all countries of the world overcome the negative environmental impacts of energy use.

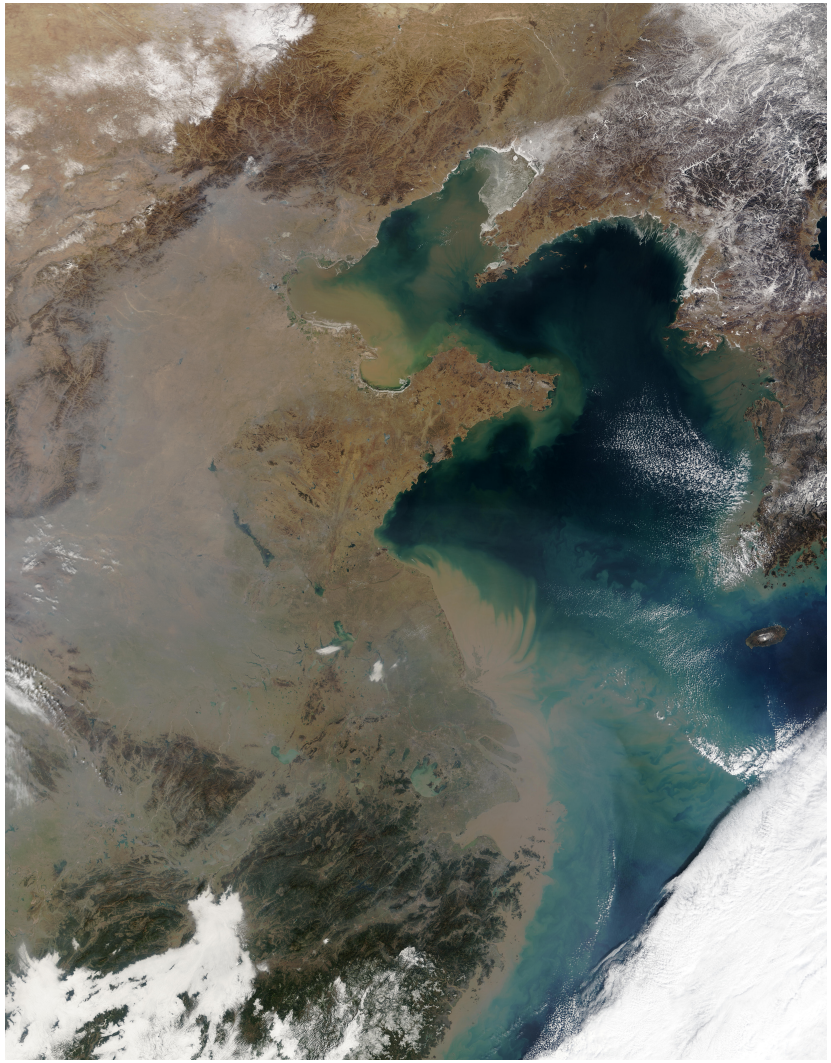
Primary air pollutants



Po Valley Brown Cloud

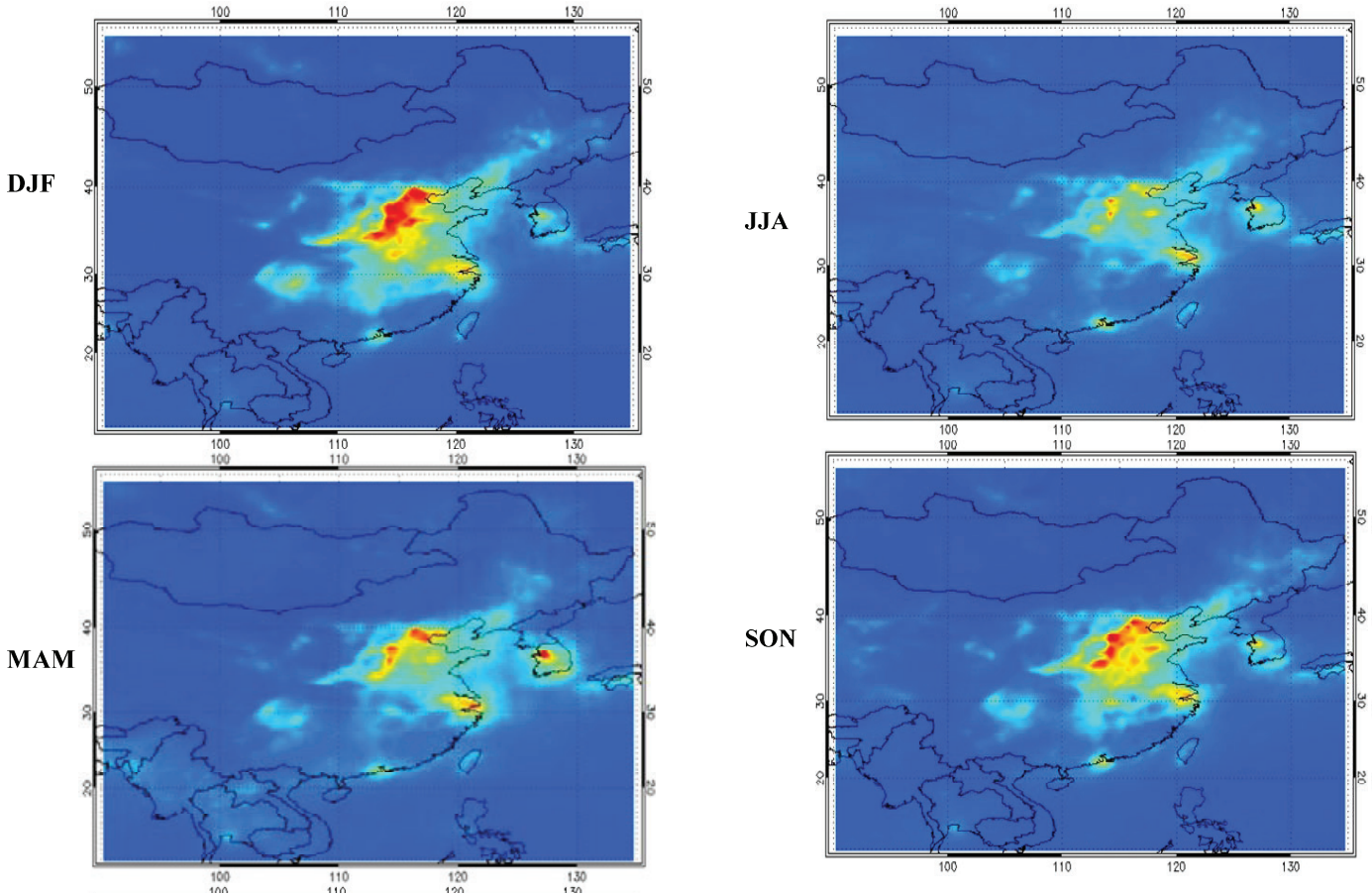
https://earthobservatory.nasa.gov/IOTD/view.php?id=84701

Asian Brown Cloud



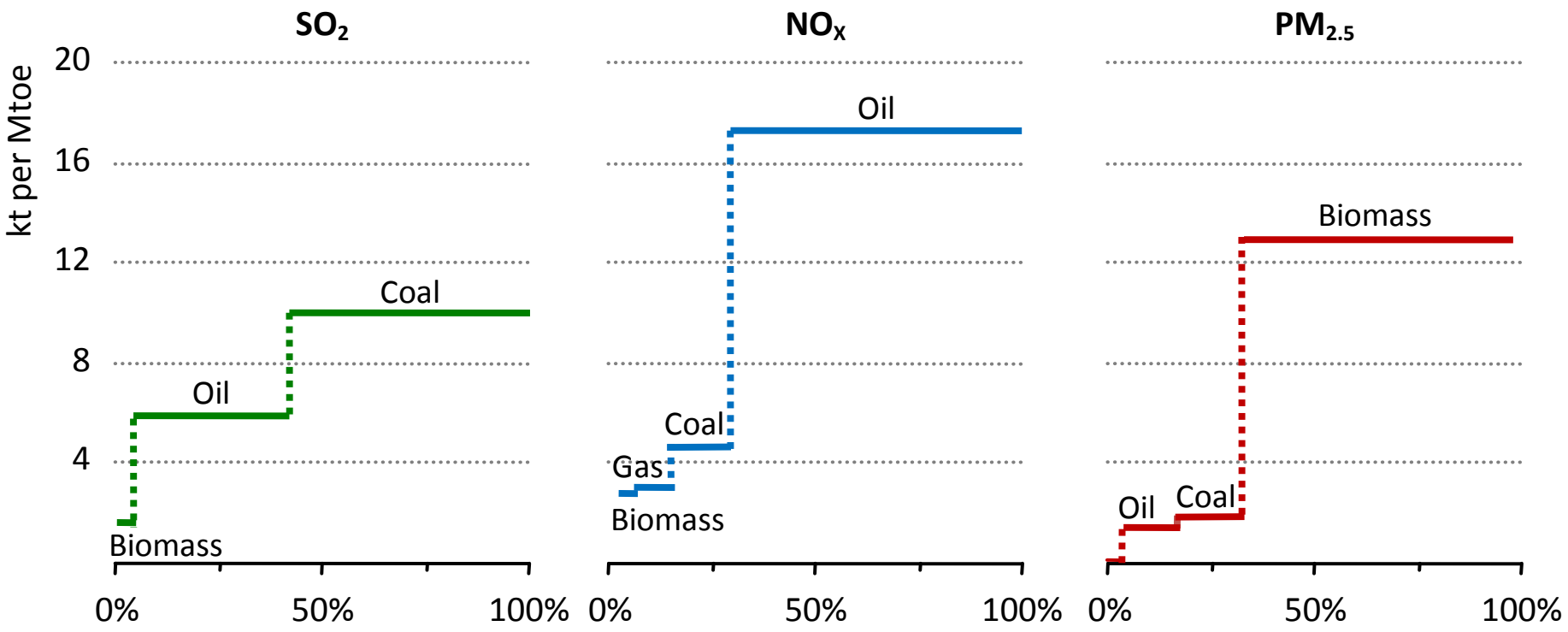
Public Domain, https://commons.wikimedia.org/w/index.php?curid=81354

NO_x in China



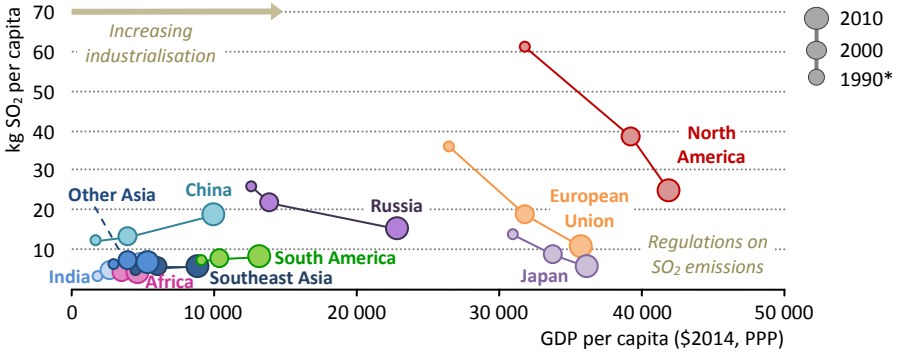
Nadir–viewing imaging spectrograph recording direct and atmosphere–backscattered sunlight in the ultraviolet–visible (UV–VIS) range from 264 nm to 504 nm aboard NASA's EOS Aura satellite.

Emissions by fuel

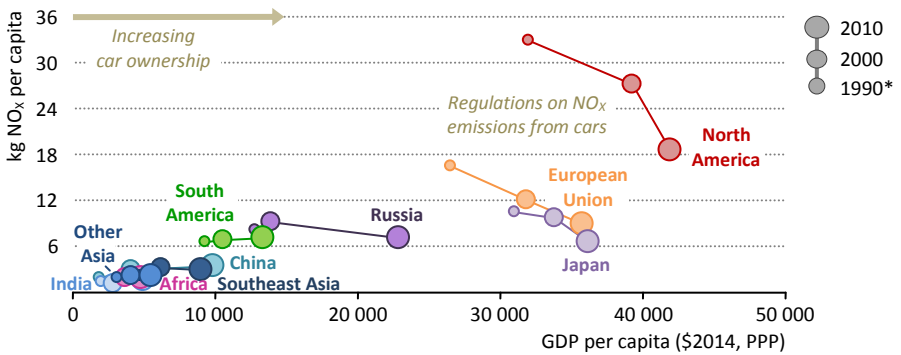


Emissions per capita

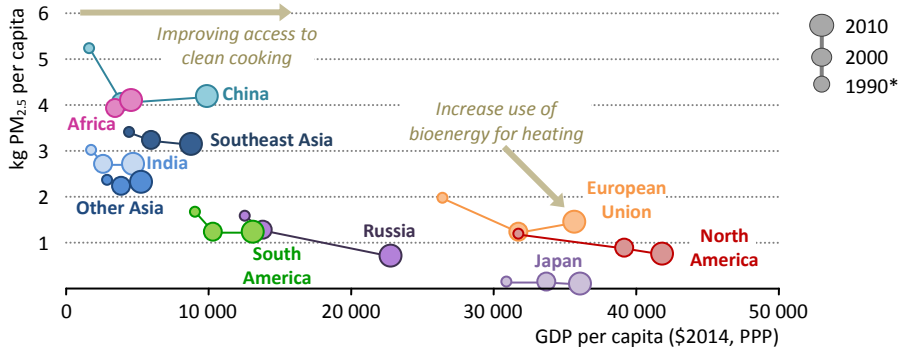
a) SO_2 emissions from industry and power generation sectors



b) NO_X emissions from transport sector



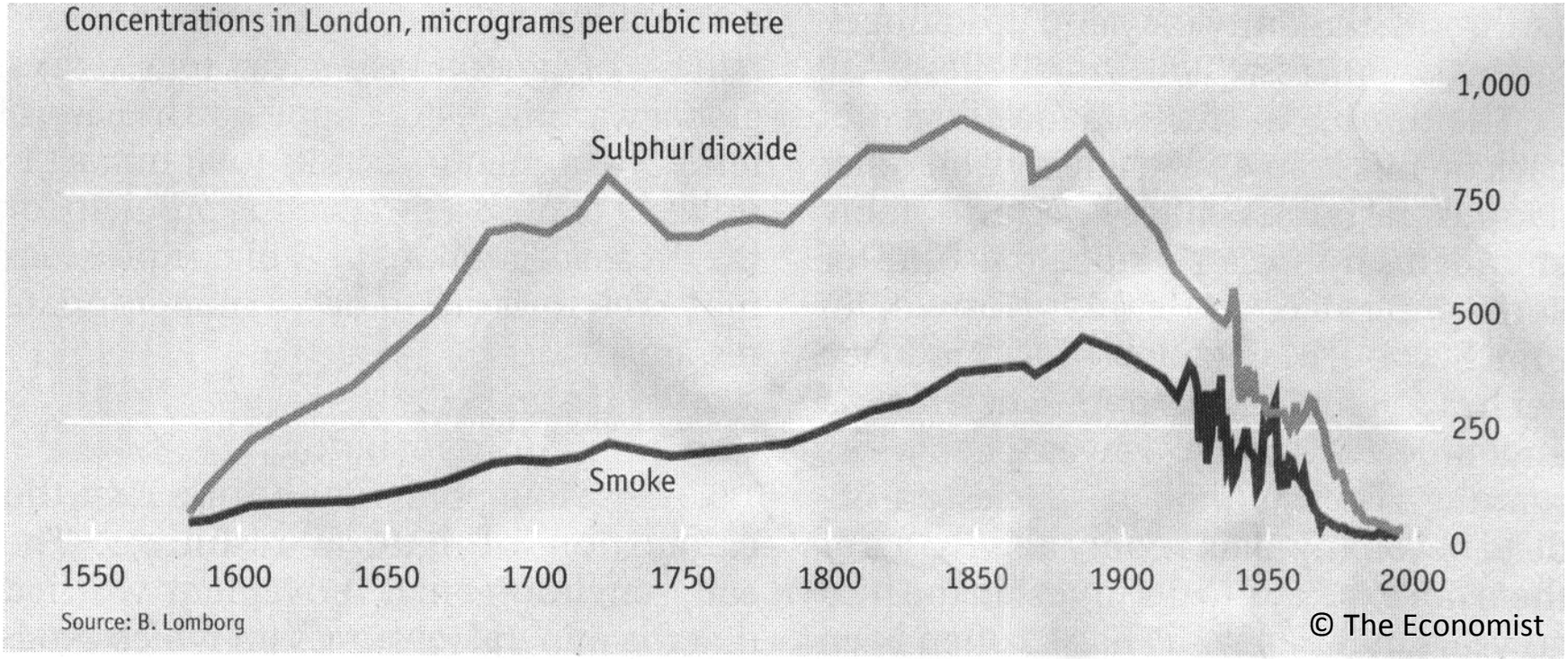
c) $PM_{2.5}$ emissions from buildings sector



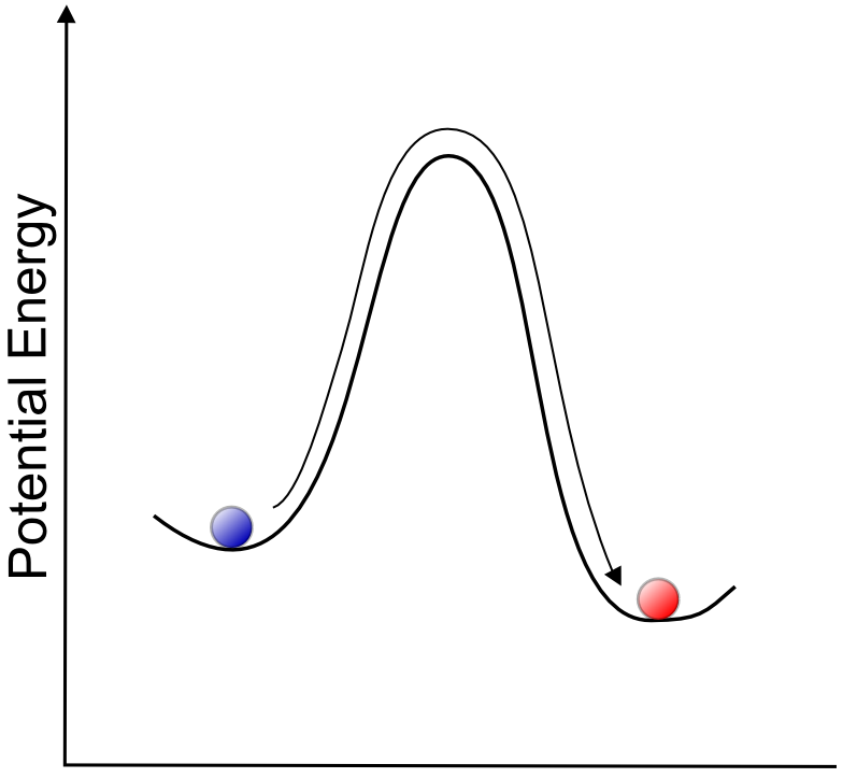
World Energy Model (WEM): www.worldenergyoutlook.org/weomodel/
Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS): www.iiasa.ac.at/web/home/research/modelsData/GAINS/GAINS.en.html

Pollution in London

The hard way to development



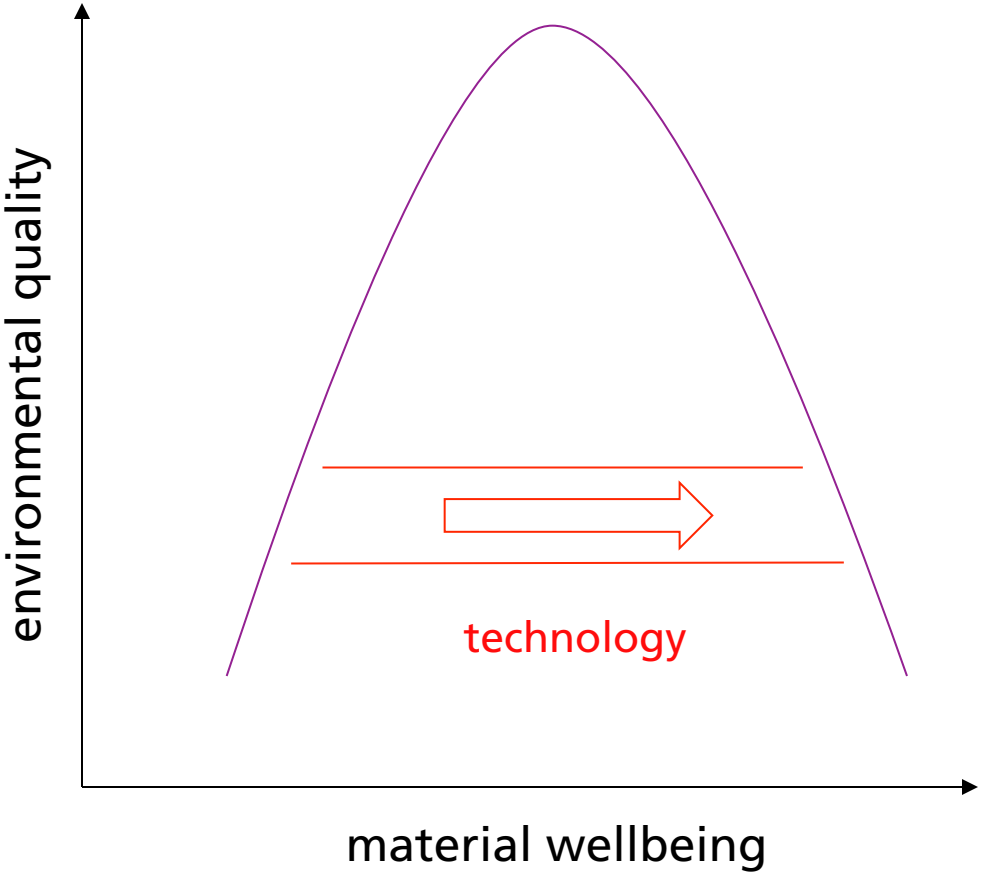
Potential energy barrier



In Classical Physics, a particle needs kinetic energy to overcome a potential energy barrier.

In Quantum Physics, a particle-wave has a finite probability to "overcome the barrier", as its position is not completely defined and it can exists both inside and outside of the barrier. This effect is called "quantum tunneling".

Tunneling effect



UN Development Goal 7 - Indicators

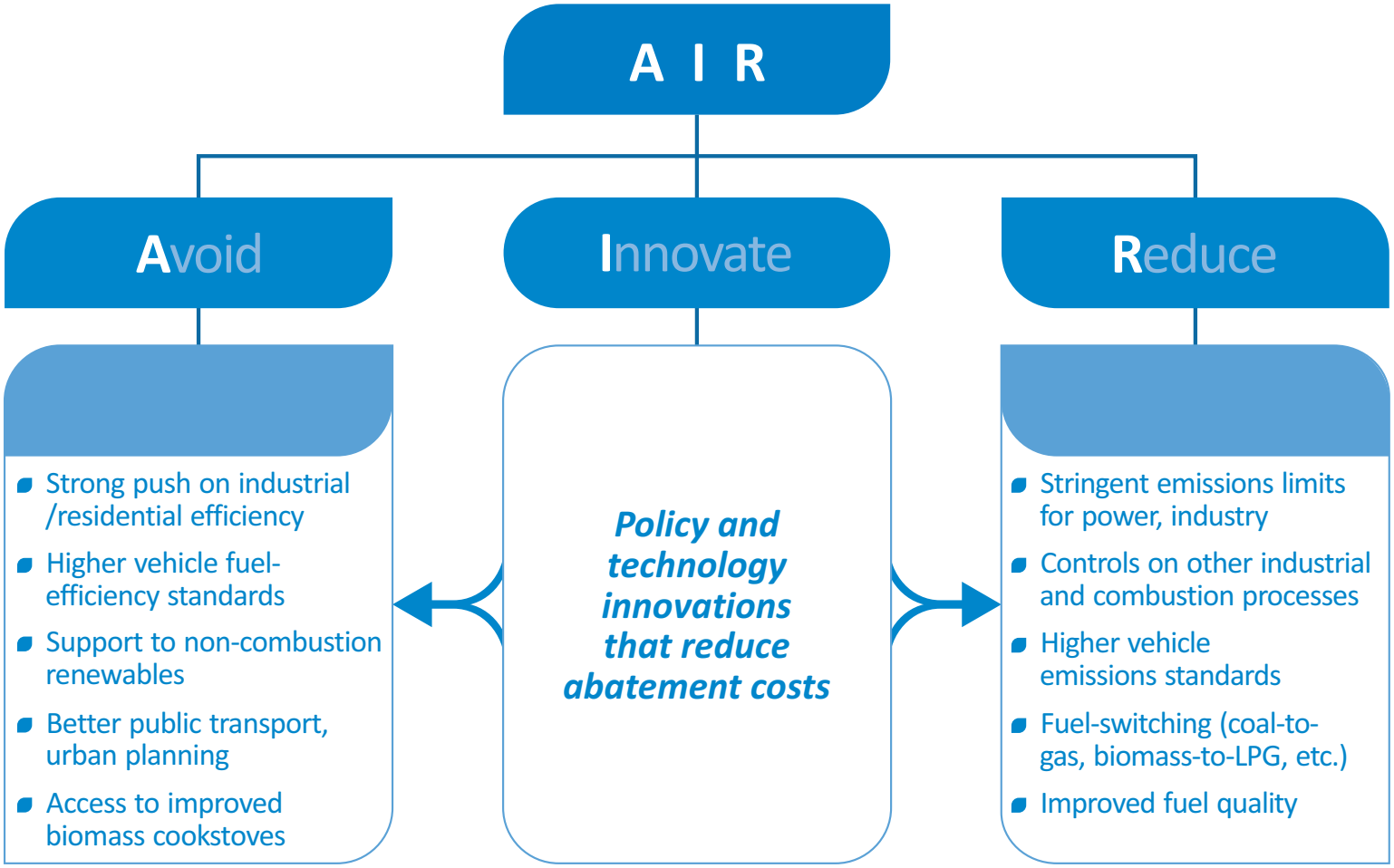
7.a Enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology

Indicator: Mobilized amount of United States dollars per year starting in 2020 accountable towards the $100 billion commitment

7.b Expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States and landlocked developing countries, in accordance with their respective programmes of support

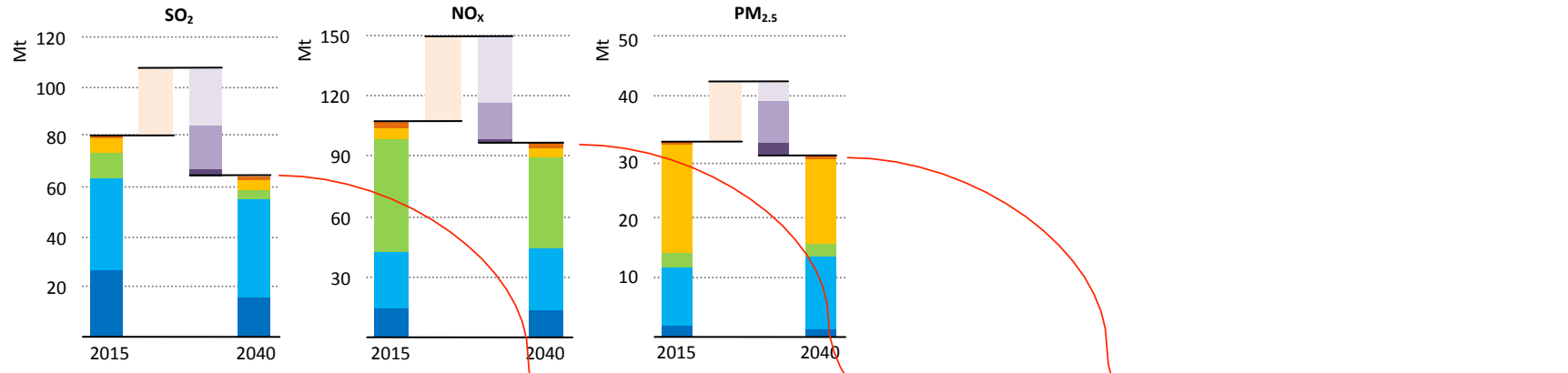
Indicator: Investments in energy efficiency as a percentage of GDP and the amount of foreign direct investment in financial transfer for infrastructure and technology to sustainable development services

IEA: Clean Air Scenario



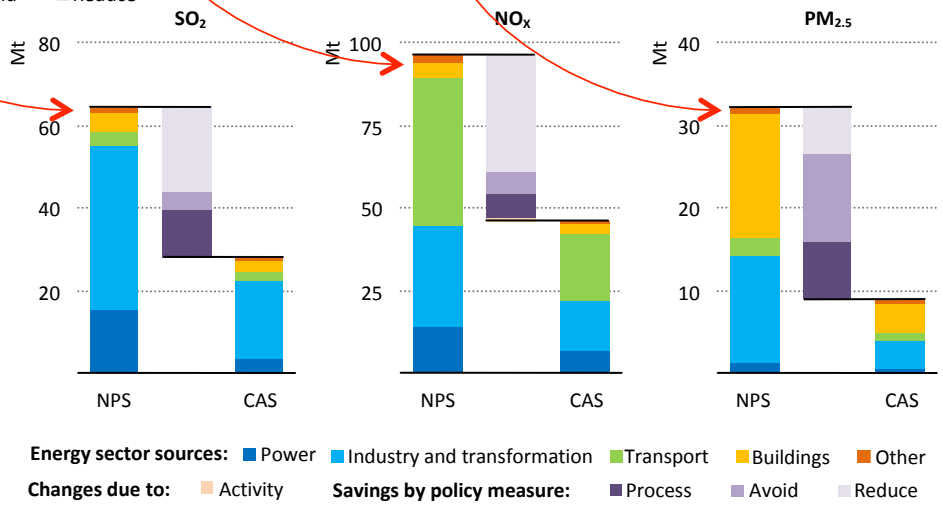
"New Policies" (BAU) and "Clean Air" Scenarios

New Policies Scenario



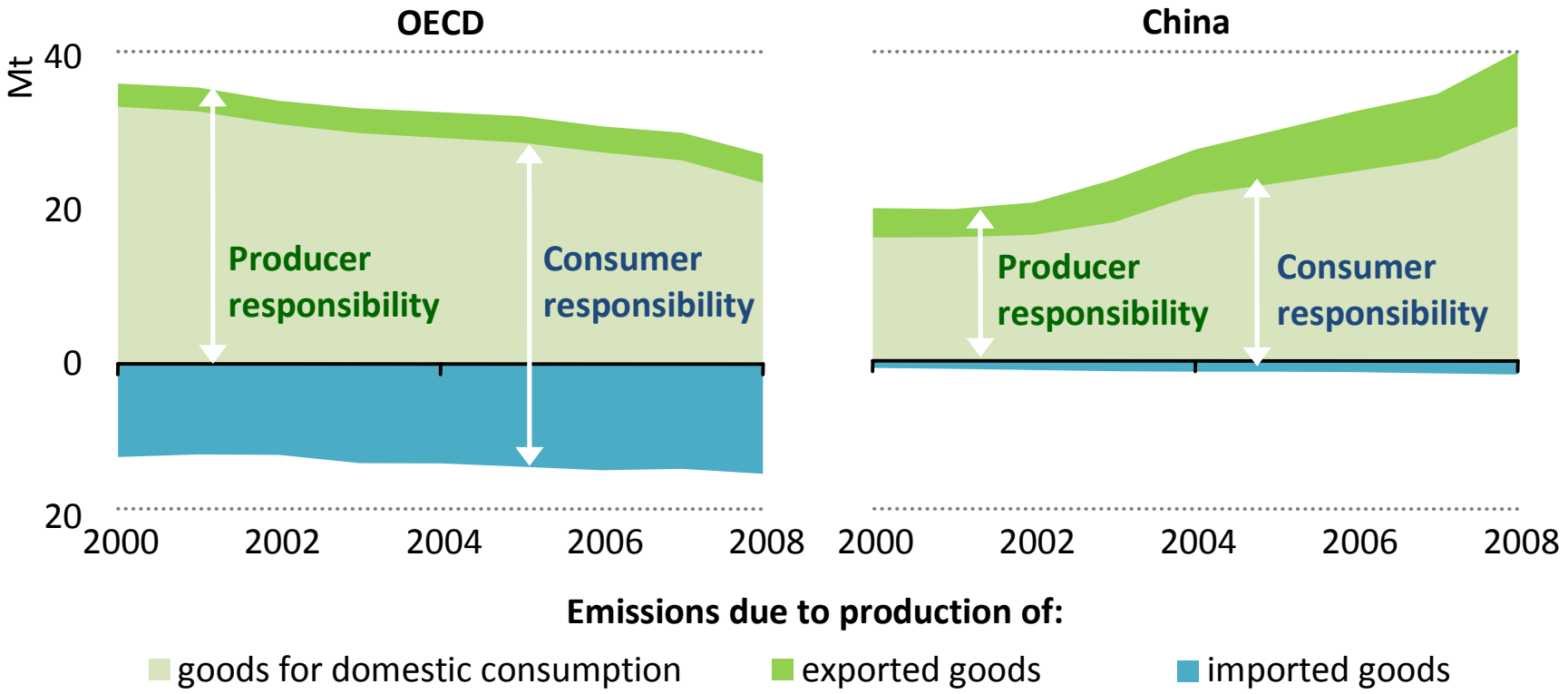
Sources: IEA; IIASA.

Clean Air Scenario



Note: NPS = New Policies Scenario; CAS = Clean Air Scenario. Sources: IEA; IIASA.

Producers vs. Consumers



Source: Analysis from Politecnico di Milano, based on data retrieved from the World Input Output Database (Timmer, 2015).

Maritime transportation

- Maritime transportation is of the utmost importance for international trade, transporting more than 80% of internationally traded goods
- Maritime transportation tends to use the cheapest available fuels
- Maritime transportation accounts for 90% of transport sector SO_2 emissions (9 Mt)
- The sulfur content of maritime bunker fuel oil can be as high as 3.5%, while the oil products used in road transport can contain as little as 10 ppm
- Main problems faced by coastal residents living near shipping lanes or ports
- In port cities that usually are big urban conglomerations, emissions from navigation account for even more significant shares of local pollution
- Vessels may spend days waiting at anchor just a few miles offshore, or at berth, to load or offload goods, while continuing burning oil for power
- Over 40% of the time spent in ports by the world's shipping fleets occurs in Asia, followed by Europe at 31%
- Hong Kong was the first in the Asia region to pioneer with research, monitoring and raising awareness with measures designed to first encourage voluntary fuel switching, and, in 2015, to require all vessels to use only 0.5% sulfur content fuels while at berth in its port
- Possible solutions: "cold ironing", whereby vessels at berth plug in to onshore power supply in order not to run on-board diesel generators, or use of LNG while in port

cleanPort
mobilità navale a LNG

(E-R Region POR-FESR 2014-2020)

Design, standardisation and future implementation of the necessary infrastructure to supply LNG to naval vessels during entry and exit

University of Bologna:
- CIRI - Meccanica Avanzata e Materiali - UO Materiali avanzati e applicazioni per la nautica
- CIRI EA - UO Biomasse

Companies:
- North-Adriatic Sea Port Authority: port regulations
- Graf: LNG storage and distribution
- Rosetti Marino: manufacturing of naval equipment powered by LNG
- Gesmar: management and use of tugs fed with LNG

Innovation Center:
- CIFLA (Centro Innovazione - Fondazione Flaminia)

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA
AUTORITÀ PORTUALE DI RAVENNA
GRAF OIL & GAS DIVISION
ROSETTI MARINO
GESMAR GROUP
FONDAZIONE FLAMINIA CENTRO PER L'INNOVAZIONE

http://www.cleanportravenna.it

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
SEDE DI RAVENNA

Prof. Andrea Contin
Director
Interdepartmental Center for Research
on Environmental Sciences

andrea.contin@unibo.it