Introduction to Climate Technologies for Mitigation

ECN

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The Climate Technology Centre and Network

- Operational arm of the UNFCCC Technology Mechanism
- Consortium of organizations from all regions
- Mission to stimulate technology cooperation and enhance the development and deployment of technologies in developing countries
- Technologies include any equipment, technique, knowledge and skill needed for reducing greenhouse gas emissions and for adapting to climate change effects
- Core services include:
  - Technical assistance to developing countries
  - Knowledge platform on climate technologies
  - Support to collaboration and partnerships

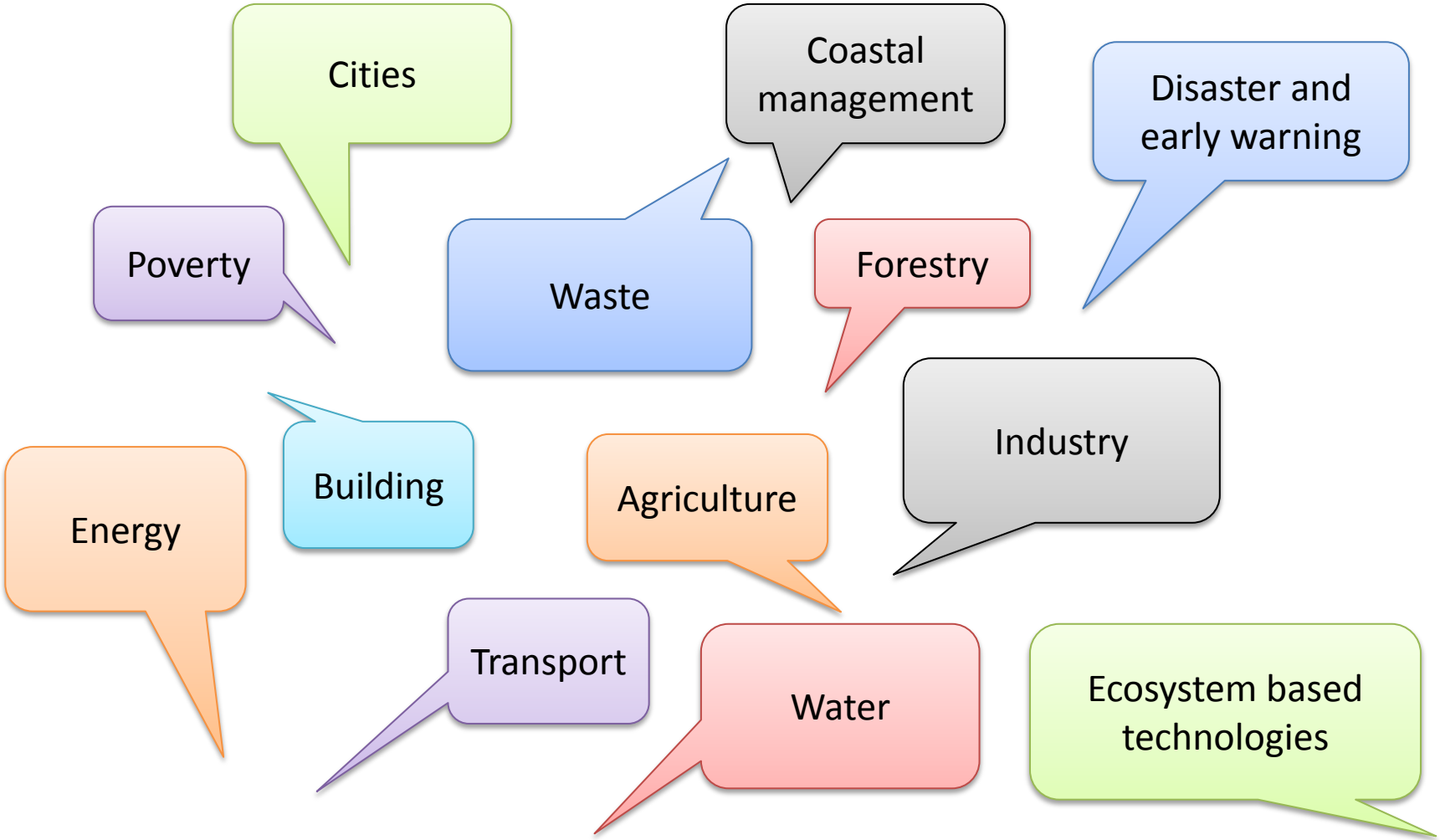
UNEP

United Nations
Framework Convention on
Climate Change

UNIDO

CTCN Webinar Series

An introduction to climate technologies…



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- **To ask a question (Q&A after presentation)**
  - Select the “questions” pane on your screen and type in your questions
- The presentations will be made available after the webinar

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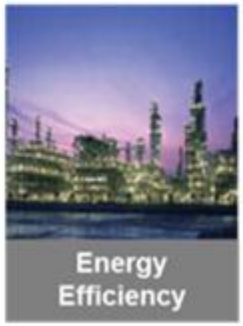
I. Introduction

- Who we are
- Objective of the webinar
- What is the problem?
- The need to scale-up efforts
- Why mitigation technology?
- Opportunities for action

A. Who we are – ECN

Energy research Centre of the Netherlands

- Knowledge and technology for a sustainable energy system



Experience working in: Argentina, Brazil, Colombia, Ghana, Indonesia, Kenya, Kuwait, Mexico, Mozambique, Pakistan, South Africa, Thailand and others

Global Sustainability Group

- Climate and energy strategies
- Developing country partners

1. Scoping & Prioritizing
2. Policy and Planning
3. Renewable Energy Deployment
4. Increased Policy Effectiveness

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A. Who we are – Presenters

Donald Pols is senior manager of the Global Sustainability group at ECN Policy Studies. He brings more than 15 years' experience working on climate and environment issues in Africa, Asia and Europe.

Lachlan Cameron is a policy advisor and technical analyst specialising in international climate policy, renewable energy support and themes such as nationally appropriate mitigation actions (NAMAs) and intended nationally determined contributions (INDCs).

Natalie Harms recently worked on making mitigation actions, access to finance and natural resource management in Southeast Asia more equitable. She focuses on NAMAs, Intended Nationally Determined Contributions (INDCs) and capacity development.

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B. Objective of this webinar

- Introduction to **climate change and mitigation**
- Share information on **low-carbon development** options
- Overview of **mitigation technologies**
- CTCN: Accelerate **technology transfer**

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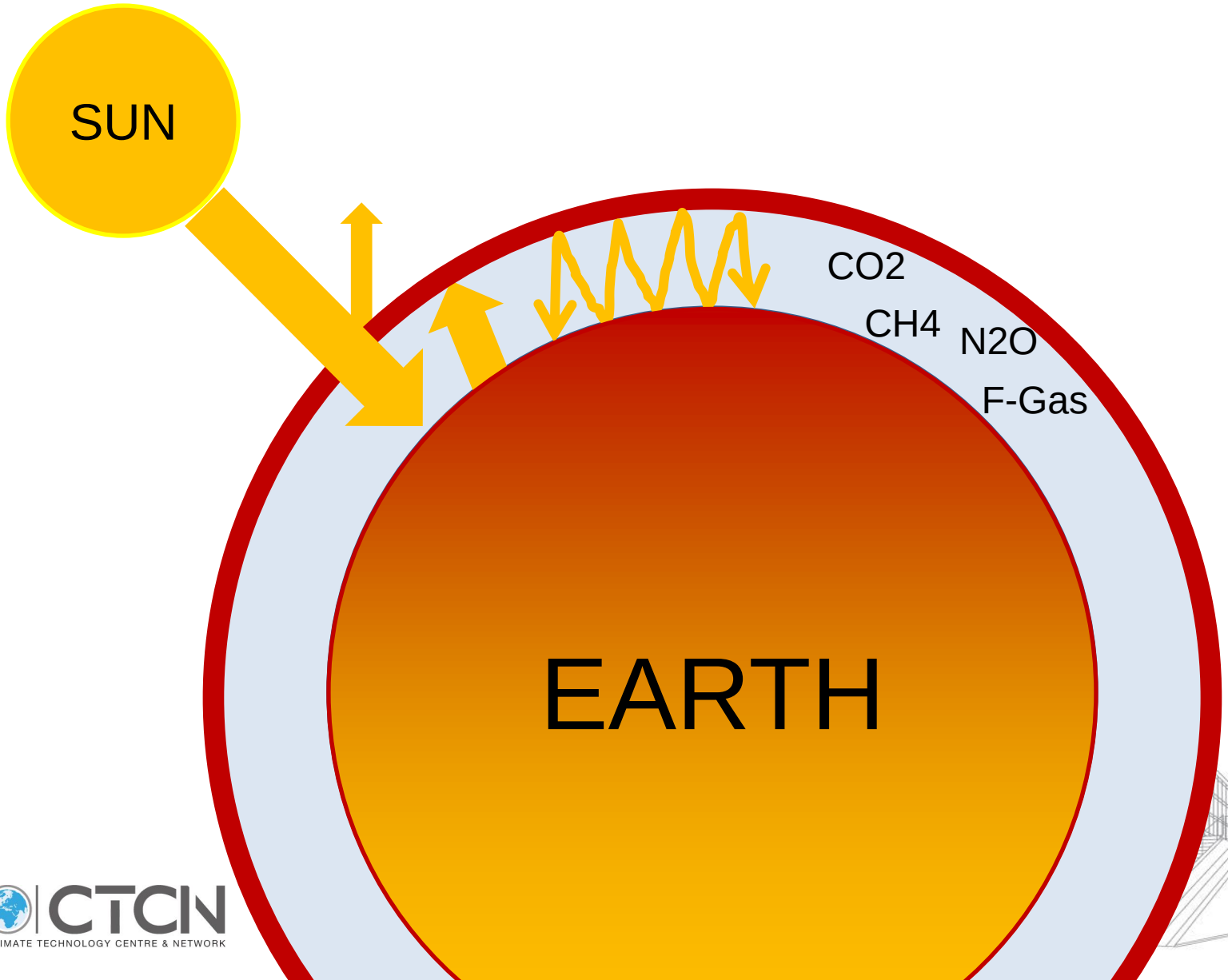
C. What is the problem? – Greenhouse effect



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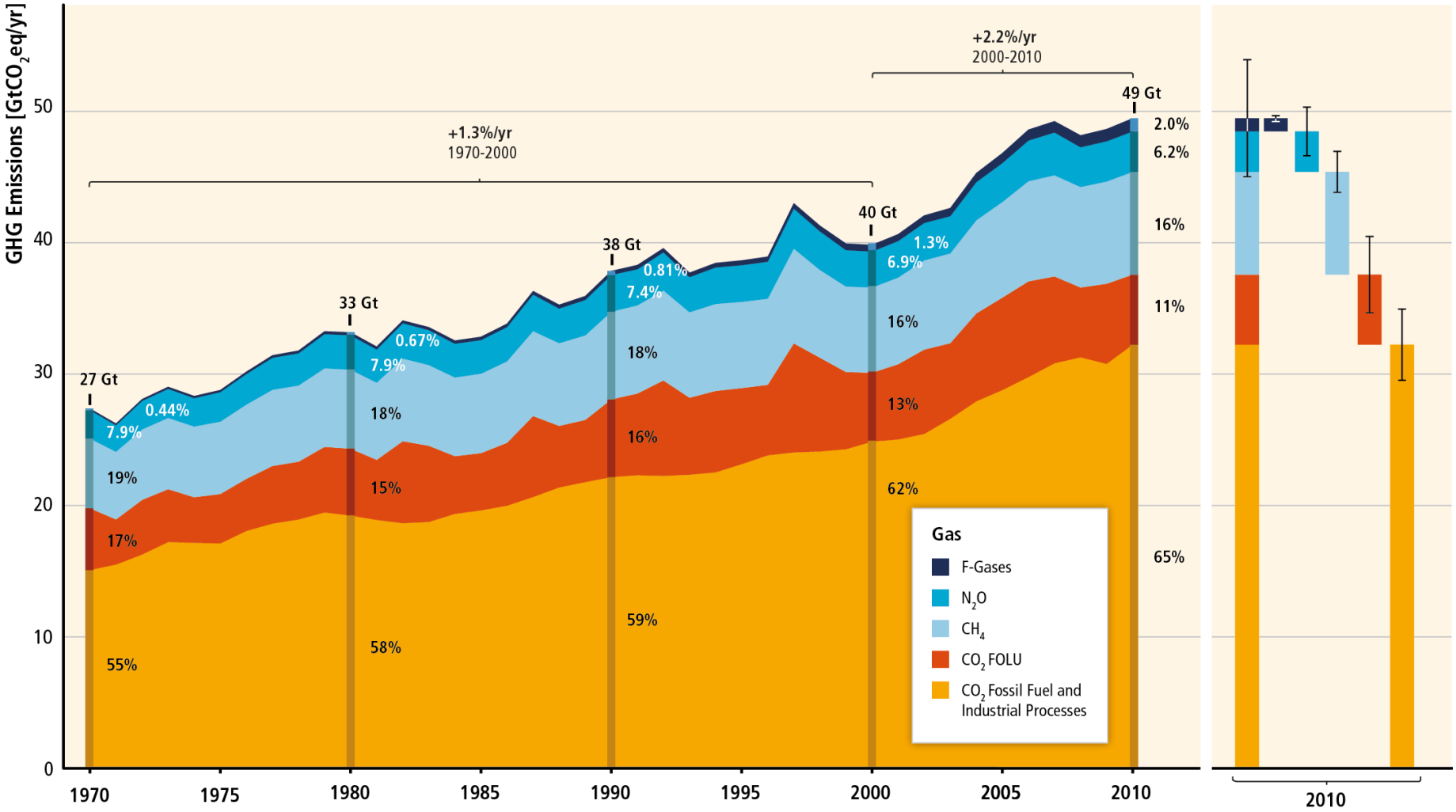
C. What is the problem? – Climate change

GHG emissions grow despite reduction efforts.



Source: IPCC, 2014, AR5

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C. The need to scale-up efforts – 2° goal

Source: NASA, 2012, http://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=3901

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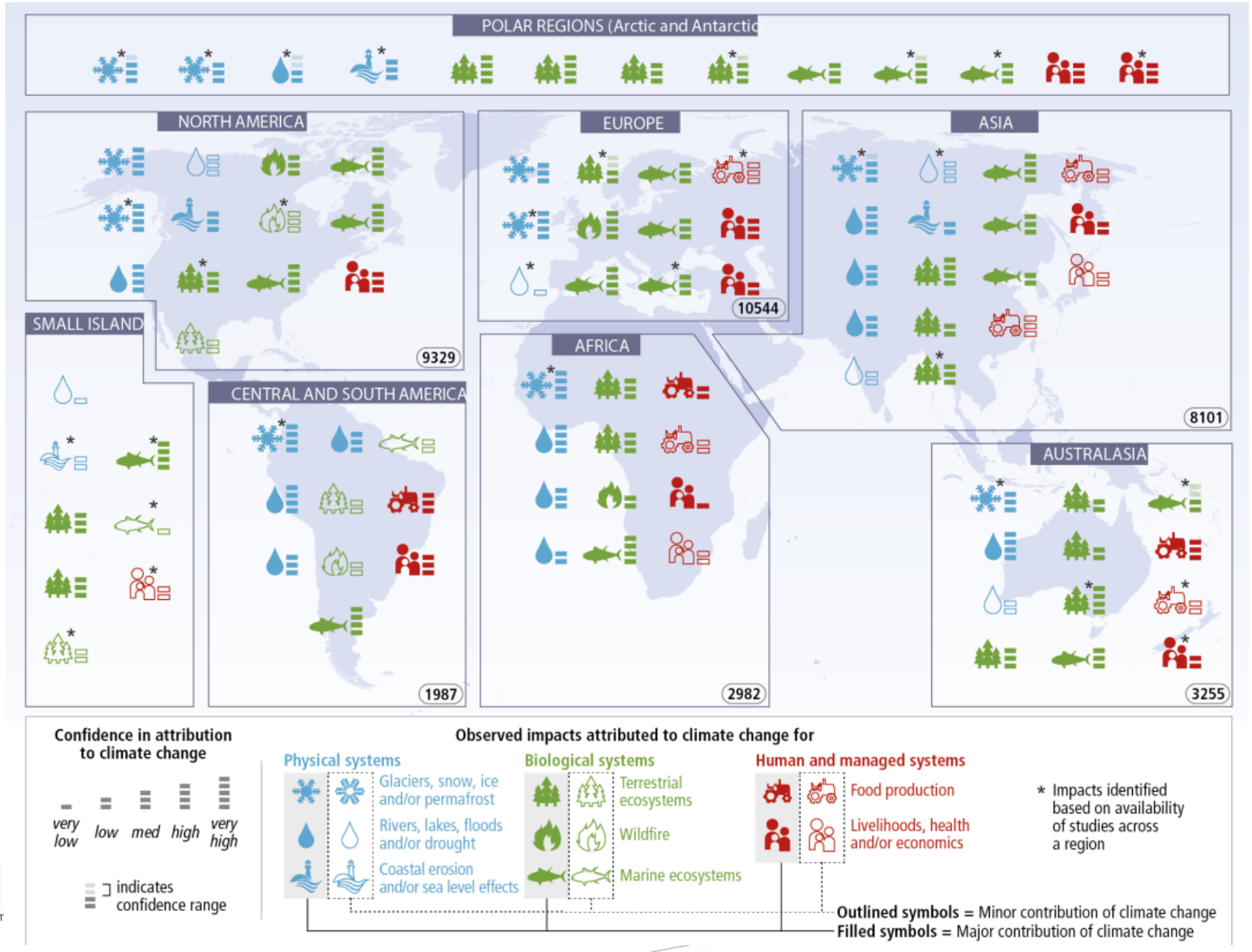
C. What is the problem? – Impacts



IPCC, 2014: *Climate Change 2014: Synthesis Report*.

CLIMATE T

C. Why mitigation technology?

What is technology?

‘hardware’ equipment + ‘software’ know-how

What role does technology play?

Cost of mitigation versus Cost of adverse effects of climate change

Urgency

Driver for growth and development

What do we need?

International cooperation
Finance
Technology transfer

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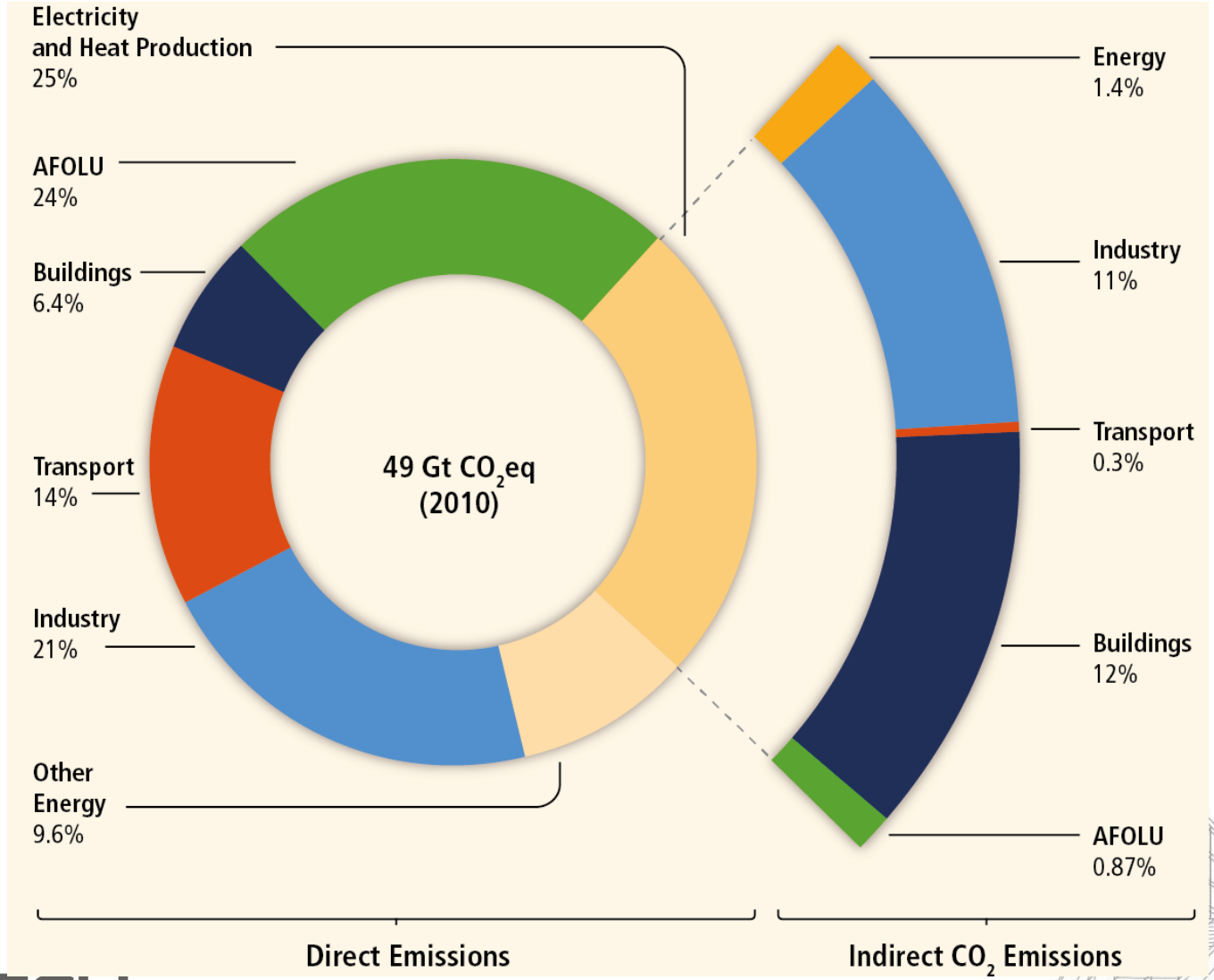
C. Opportunities for action – Across sectors

GHG emissions by economic sectors



Source: IPCC, 2014, AR5

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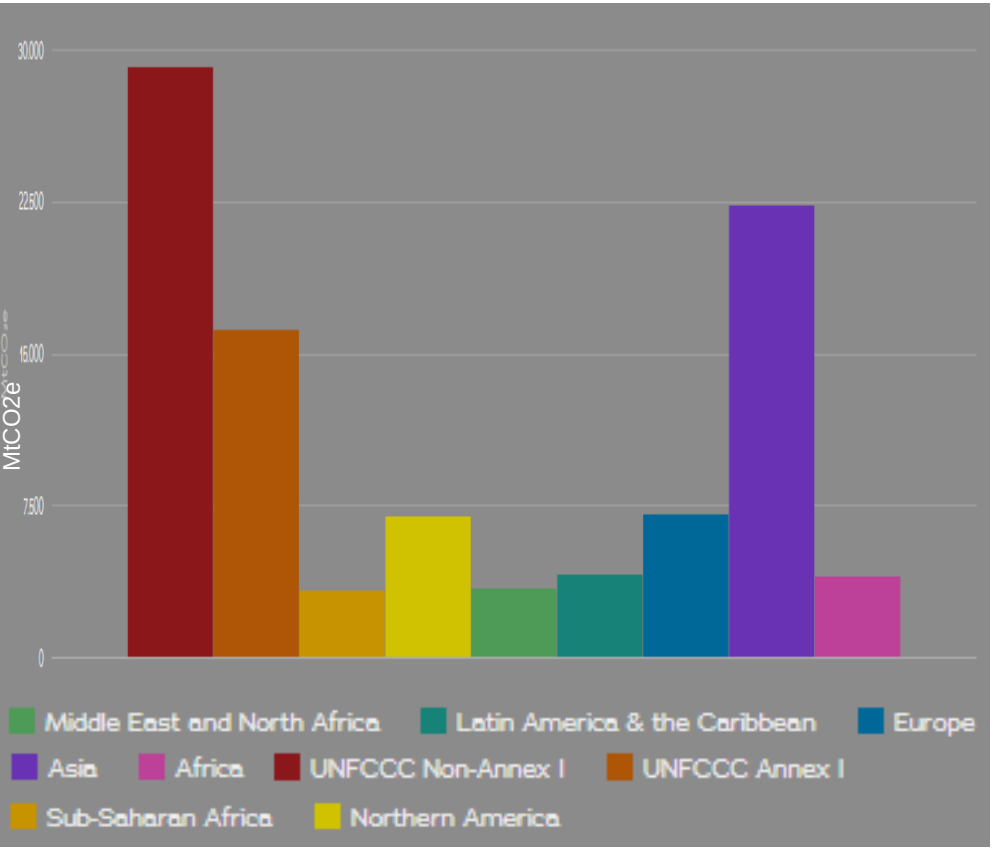
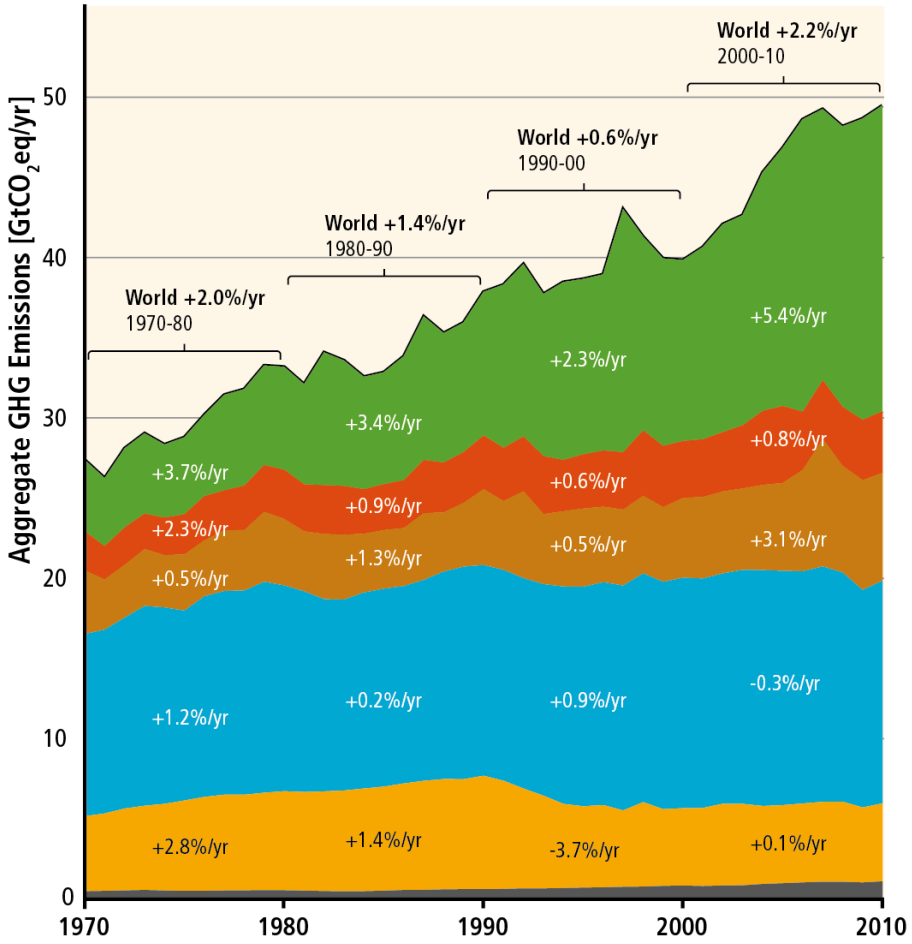
C. Opportunities for action – Worldwide

Total GHG emissions by region - 2011



Source: WRI Climate Analysis Indicator Tool (CAIT)

GHG emissions per region 1970-2010



Source: IPCC, 2014, AR5

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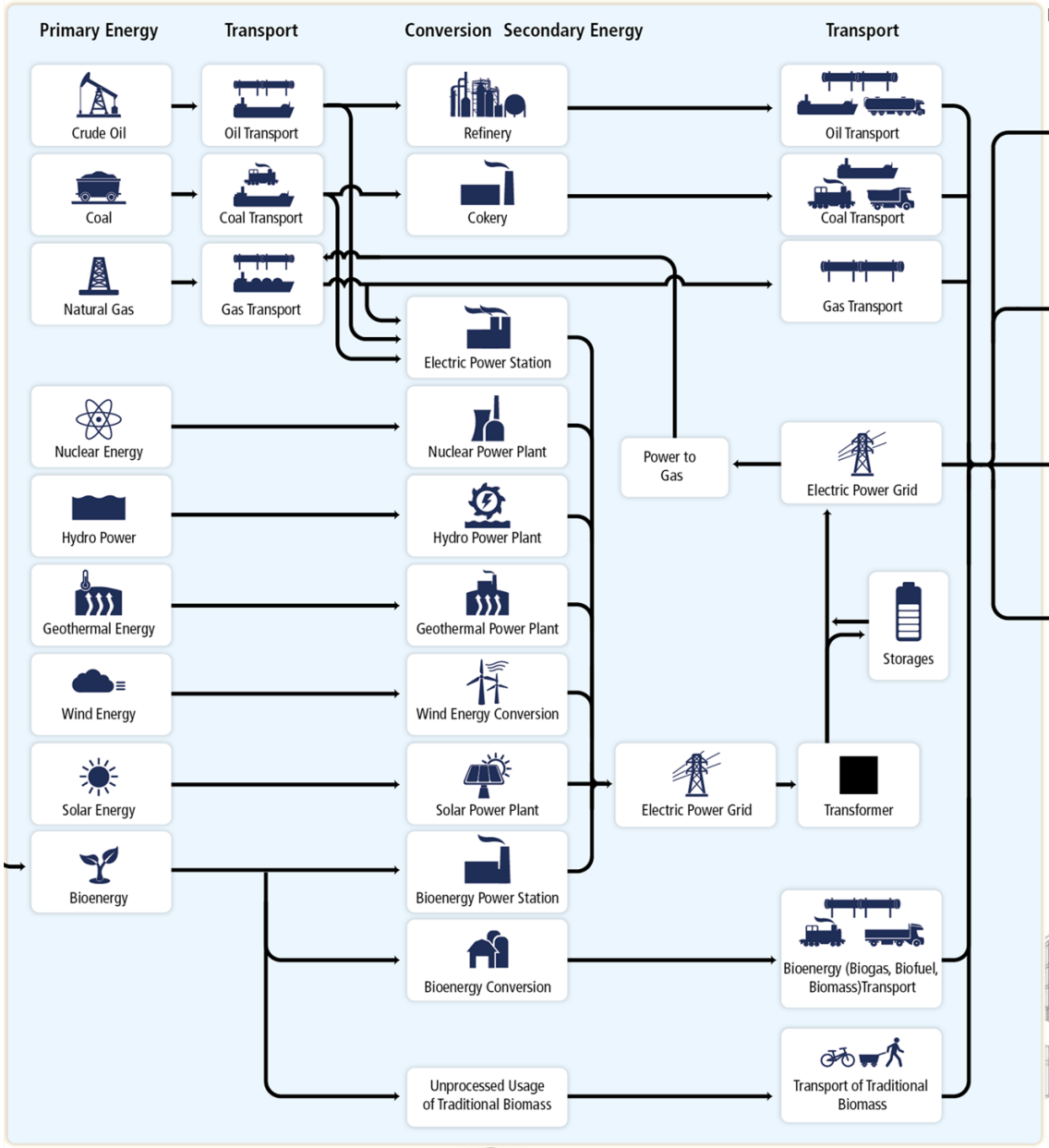
II. Sector-Specific Technologies

- Scope
- Key technologies
- Policies, cost and benefits
- Examples

A. Energy supply – Scope

Energy supply paths



Source: IPCC, 2014, AR5

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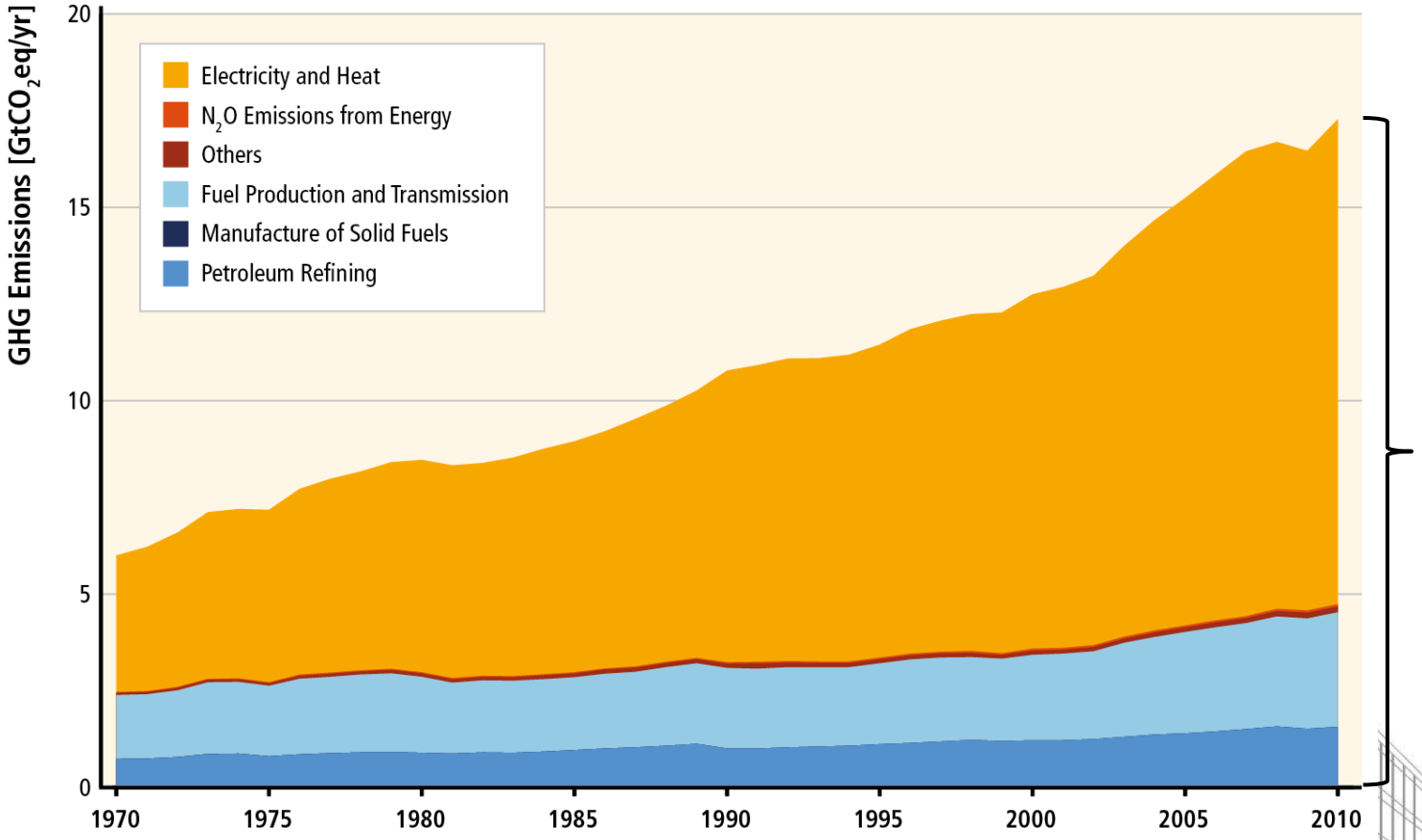
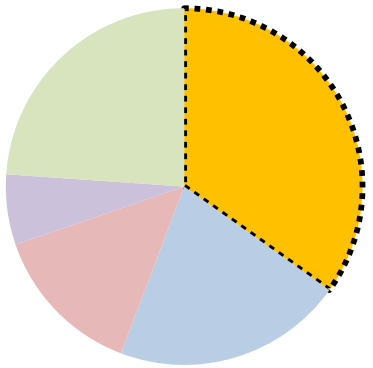
A. Energy supply – Emissions

GHG emissions from energy supply





35% of total GHG emissions

Source: IPCC, 2014, AR5

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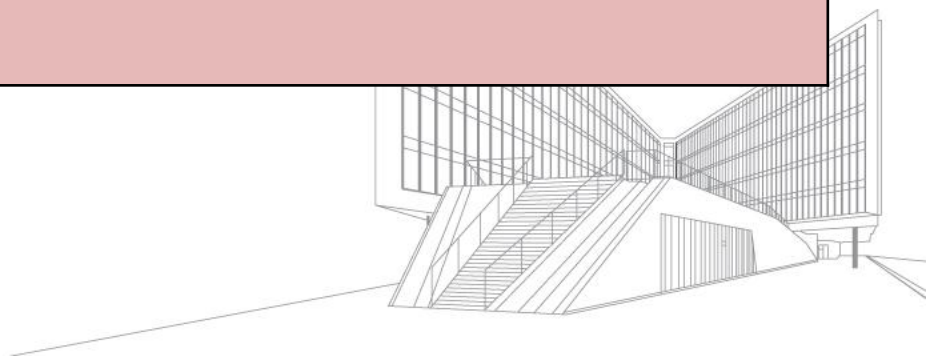
A. Energy supply – Key technologies

What are mitigation options?

Fossil fuel switching Shift from coal to gas; Less energy-intense sources; New technologies to access shale gas & unconventional oil	**Energy efficiency** Reduce losses; More efficient power plants; Reduce fugitive emissions; Combined heat and power plants
Low-GHG energy supply Nuclear Power Renewable energy • Solar • Hydro • Wind • Biomass • Ocean wave	**Carbon capture and storage (CCS)** Capture and isolate CO2; Suitable geological structures; Monitoring technology



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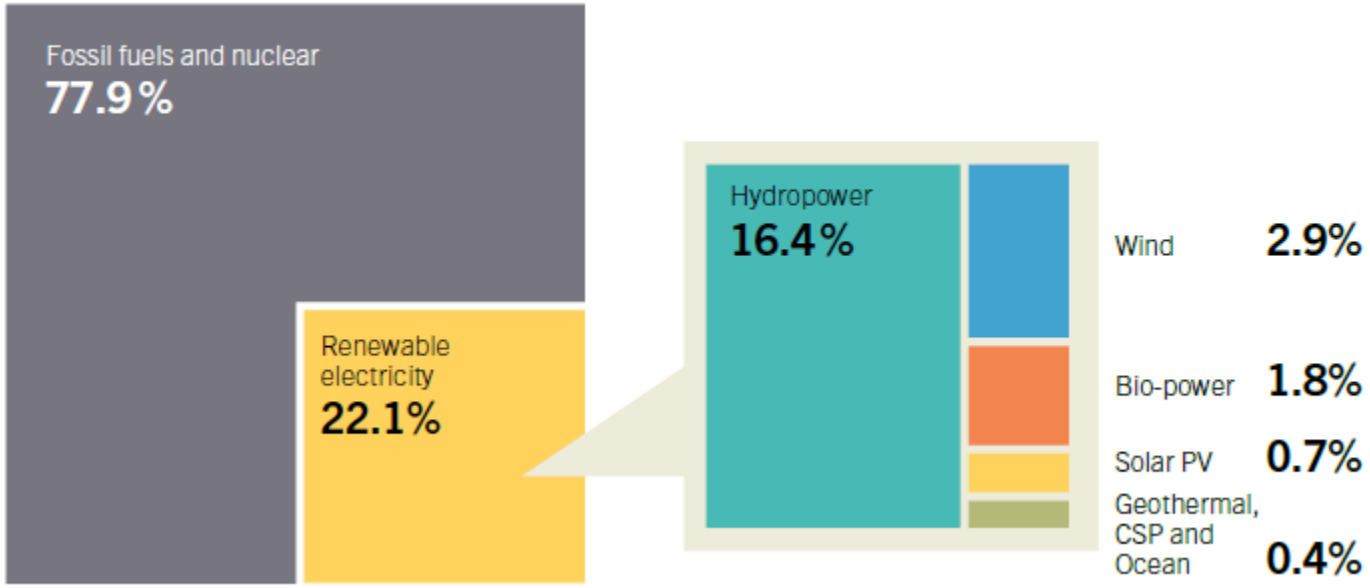
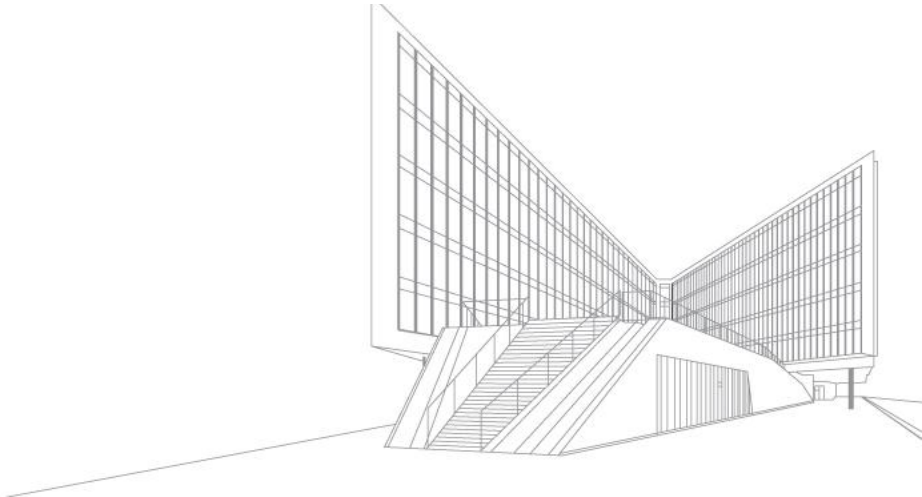
A. Energy supply – Key technologies: renewables

Estimated Renewable Energy Share of Global Electricity Production, End-2013



Source: REN21, 2014, Renewables 2014 Global Status Report



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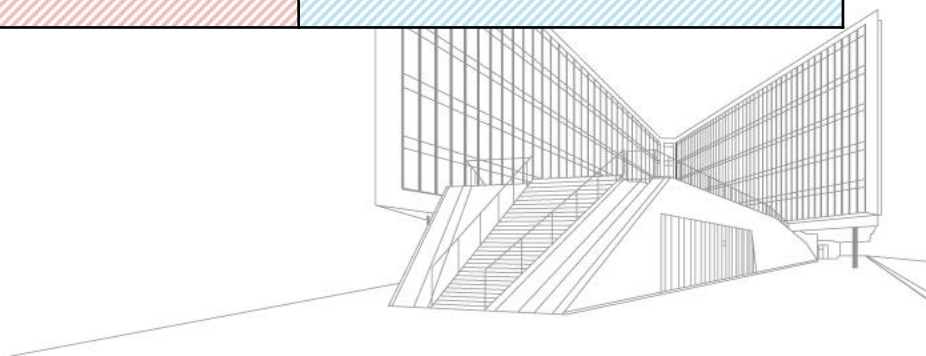
A. Energy supply – Key technologies: renewables

Solar Photovoltaics (PV) Concentrating solar power (CSP) Solar heating Fuel production	**Hydro** Dams & reservoirs Run-of-river In-stream	**Wind** Onshore turbines Offshore turbines
Bioenergy Boilers Pellet-based heating Ethanol production Liquid biofuel Biochar Gasification combined-cycle power plants Lignocellulose-based fuels	**Geothermal** Hydrothermal reservoirs Enhanced geothermal systems (EGS)	**Ocean Energy** Barrages Submarine turbines Heat Exchangers

Less mature / R&D phase



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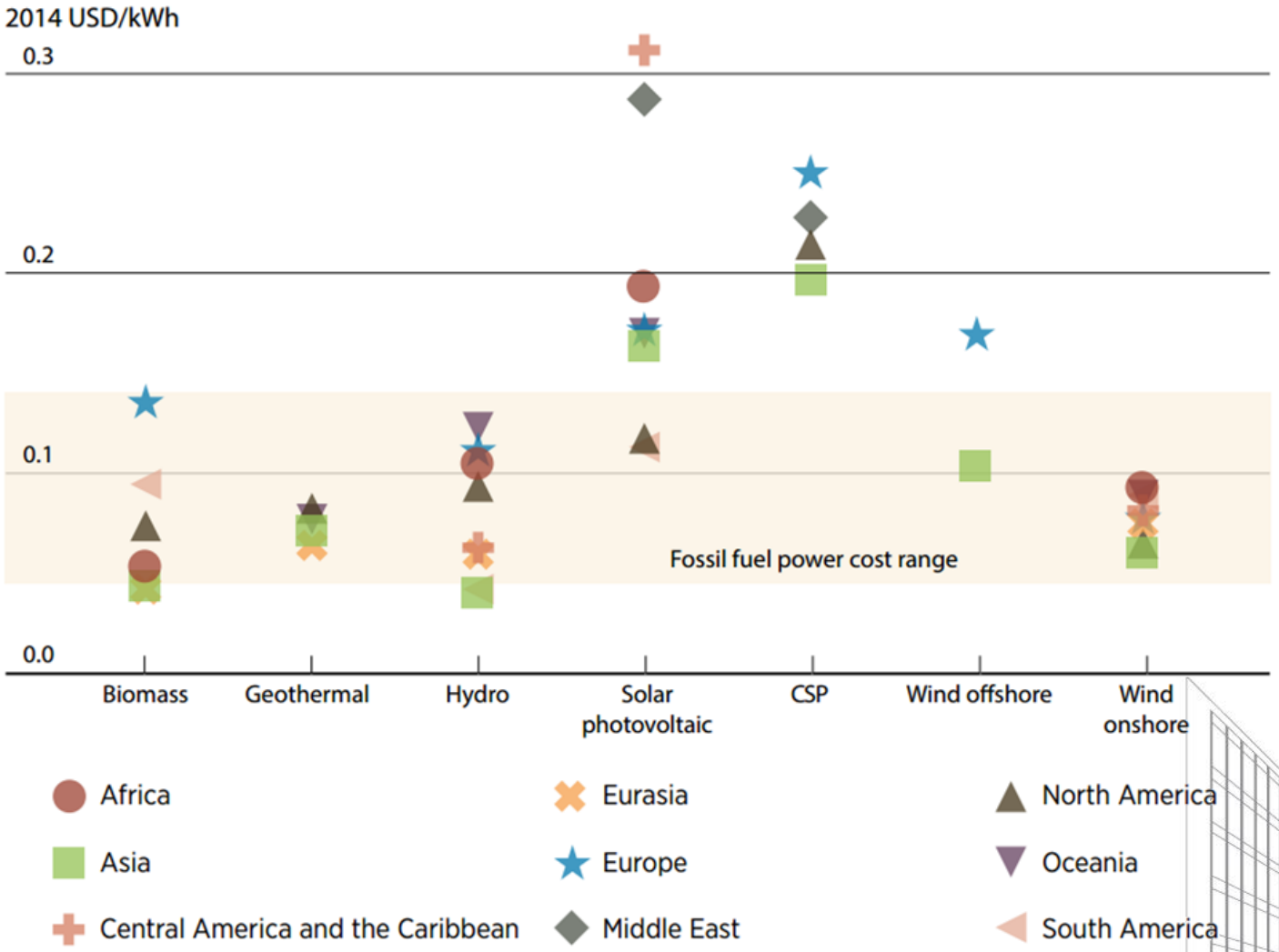
Energy supply – Key technologies: RE costs



Weighted average cost of electricity by region for utility-scale renewable technologies (2013/2014)

Source: IRENA Renewable Cost Database.

Note: Real weighted average cost of capital of 7.5% in OECD countries and China; 10% in the rest of the world.

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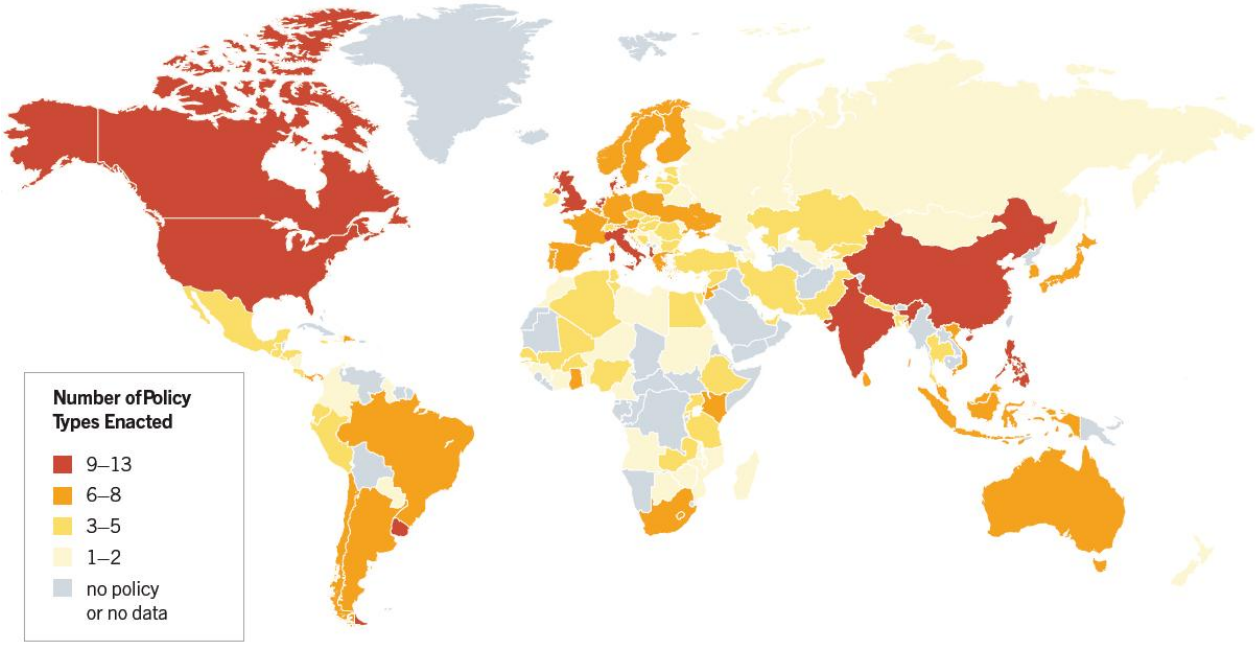
A. Energy supply – Policies and benefits



Countries with Renewable Energy Policies, Early 2014

- Less air pollution
- Job creation
- Access to energy
- Energy security
- Energy access

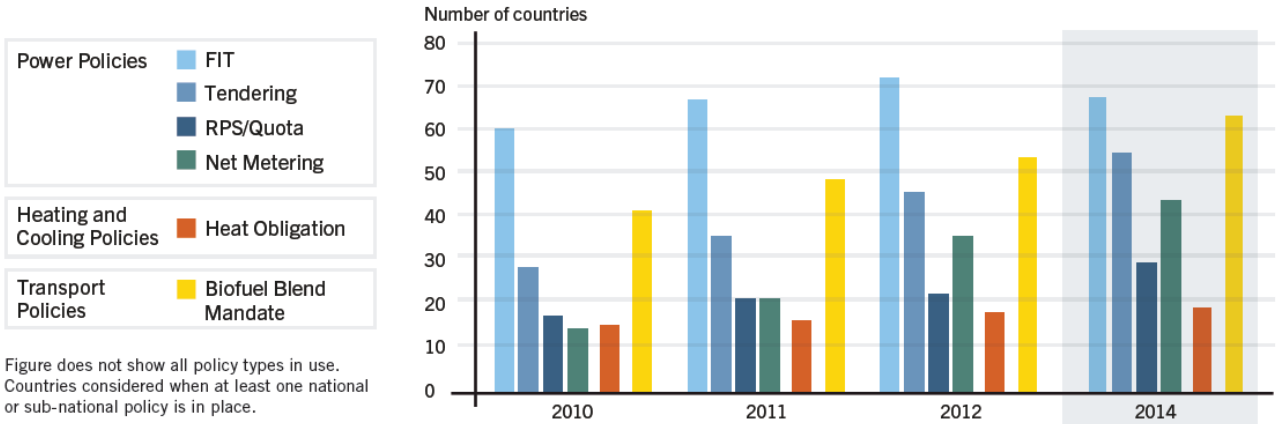


Figure does not show all policy types in use. Countries considered when at least one national or sub-national policy is in place.

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Source: REN21, 2014, Renewables 2014 Global Status Report

A. Energy supply – Example

Micro hydropower and PV in Indonesia

Source: GIZ, 2014, http://www.giz.de/en/worldwide/24209.html

Lake Turkana Wind Farm, Kenya

Source: Business Today, 2015, http://businesstoday.co.ke/sites/default/files/Kenya-wind-energy.jpg

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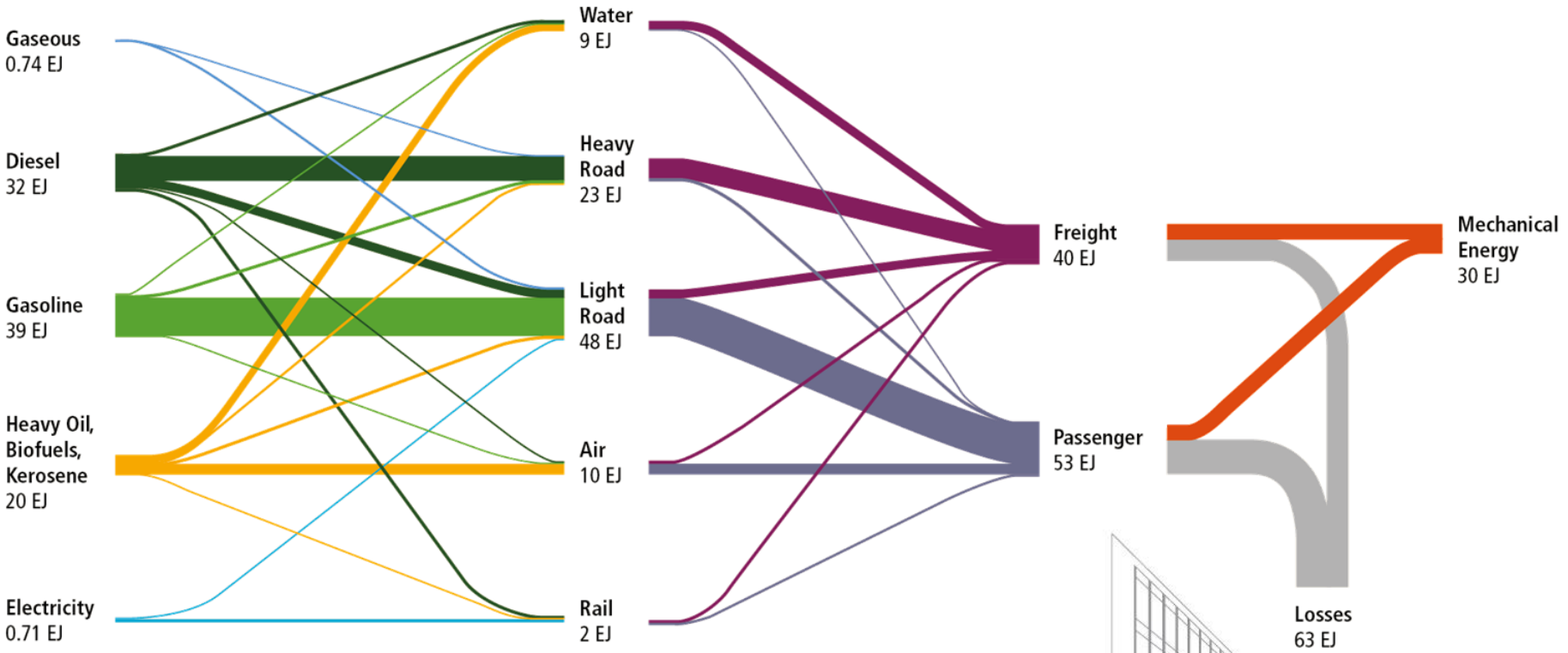
B. Transport – Scope

Final energy consumption of fuels by transport sub-sectors in 2009



Source: IPCC, 2014, AR5

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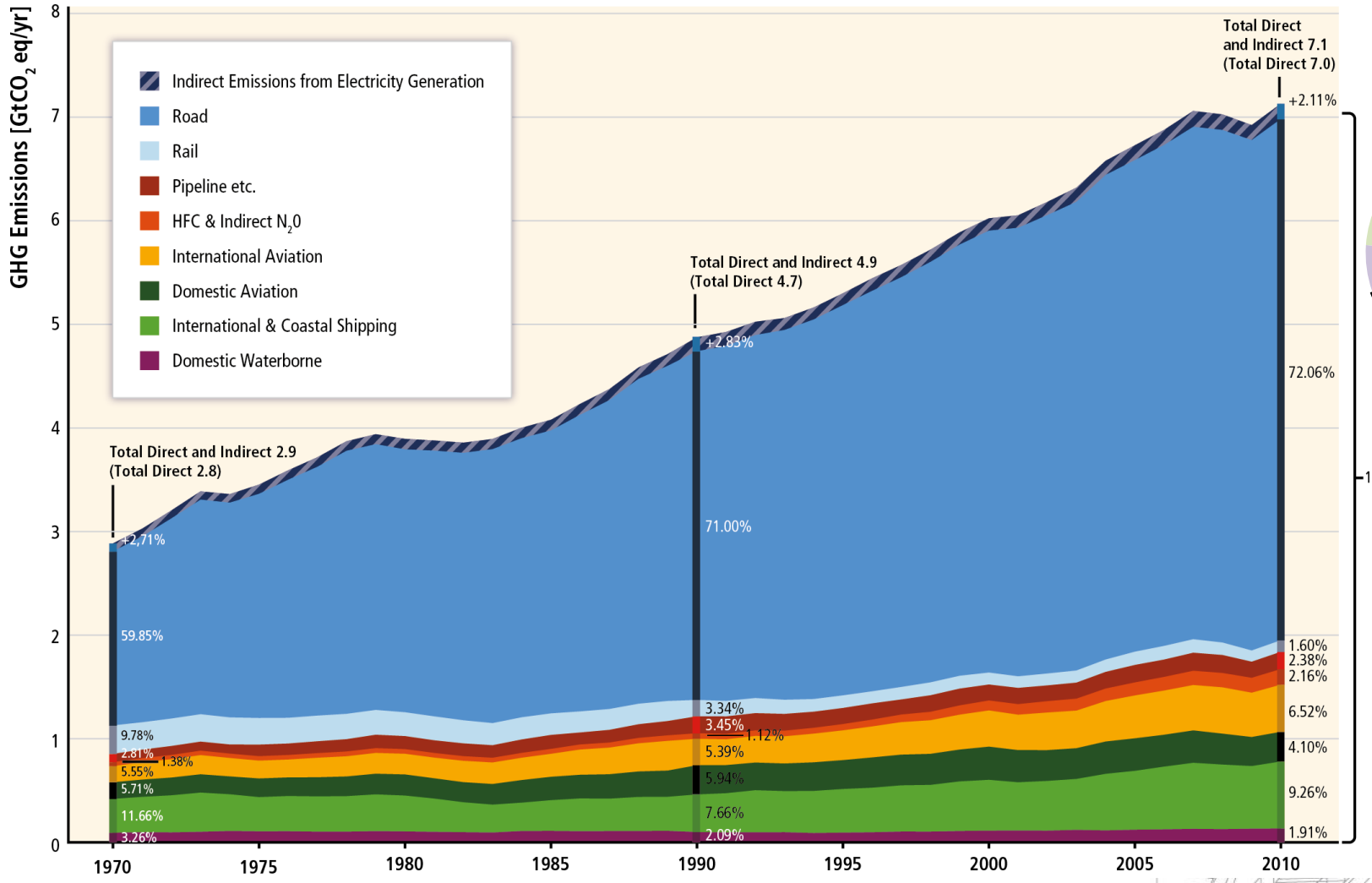
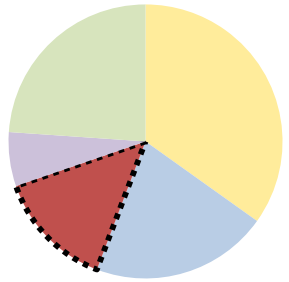
B. Transport – Emissions

Transport-related CO2 emissions by mode 1970-2010





L4% of total GHG emissions

Source: IPCC, 2014, AR5

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B. Transport – Key Technologies

Reduce levels of transport activity

Behavioural issues such as journey avoidance

Restructuring freight logistics systems

Infrastructure and Modal choice

Infrastructure and Urban Planning

- Availability of public transport systems
- Walkable urban spaces
- Bicycle lanes

Use of low-GHG systems and modes

- Bicycles
- Mass rapid transit systems
- Clean options for freight (train)

Reduce carbon content of fuel

Cleaner gasoline and diesel (unleaded)

Catalytic exhaust after-treatment systems

Alternative fuel or components

- Natural gas (LPG)
- Biofuel/-diesel
- Hybrid technology

- Electric propulsion
- Hydrogen

Increase energy efficiency of vehicles

More efficient engines (direct injection)

More efficient design (aerodynamic, light)

Driver behaviour changes

Less commercialised

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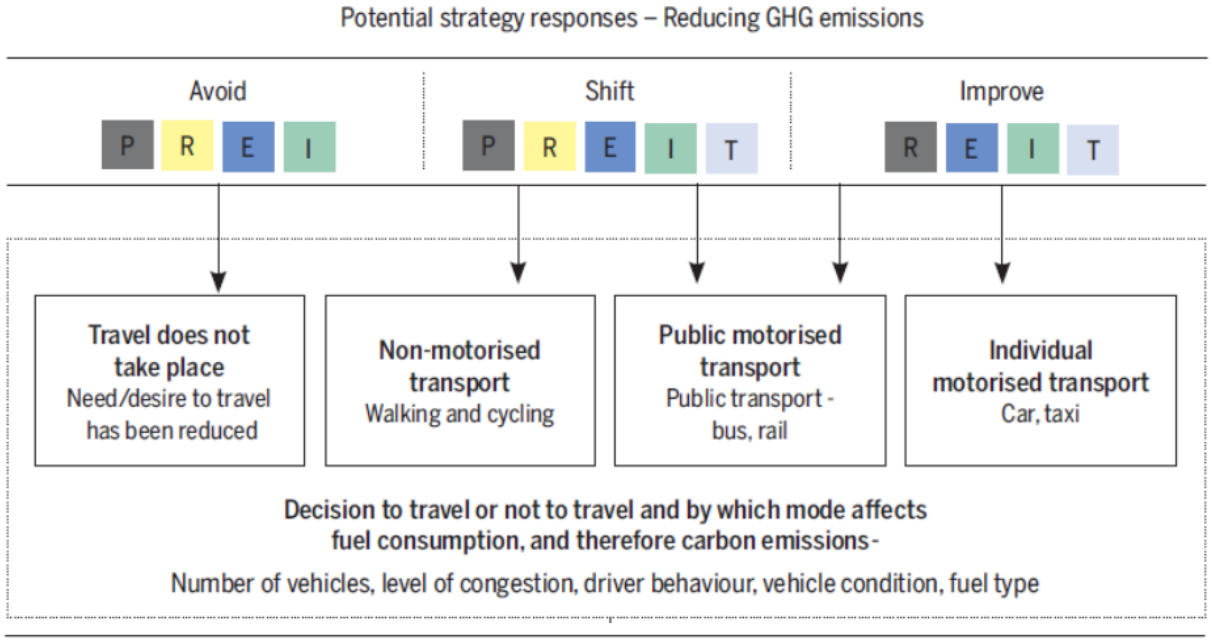
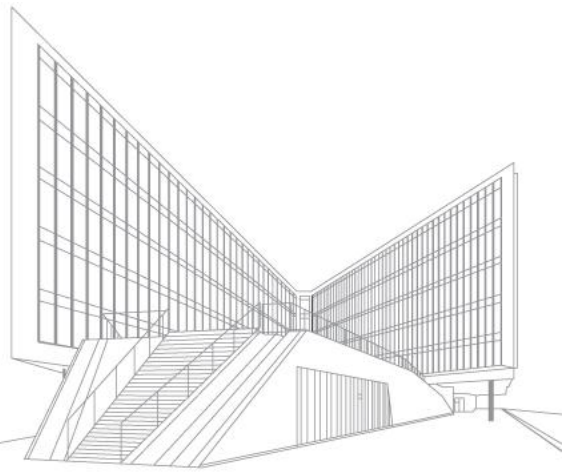
B. Transport – Policies and benefits



- Less pollution
- Less accidents
- Less congestion
- Increased mobility
- Energy security
- Job creation

Available Instruments

Planning Instruments (P)	Regulatory Instruments (R)	Economic Instruments (E)	Information Instruments (I)	Technological Instruments (T)
Smart land use planning	Emissions standards	Fuel taxes	Public awareness	Tele-work
Non-motorised transport infrastructure	Traffic norms (speed limits)	Road pricing	Mobility management	Vehicle improvements
Pedestrian areas	Low emissions zones	'Feebates'	Eco-driving courses	Fuel improvements
		Public transport subsidies		



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B. Transport – Example

Bus rapid transport (BRT) system in Belo Horizonte, Brazil

Source: EMBARQ, 2014, http://www.embarq.org/sites/default/files/styles/slide/public/14325514130_b614fe02bc_k.jpg?itok=Zx5E-A5P

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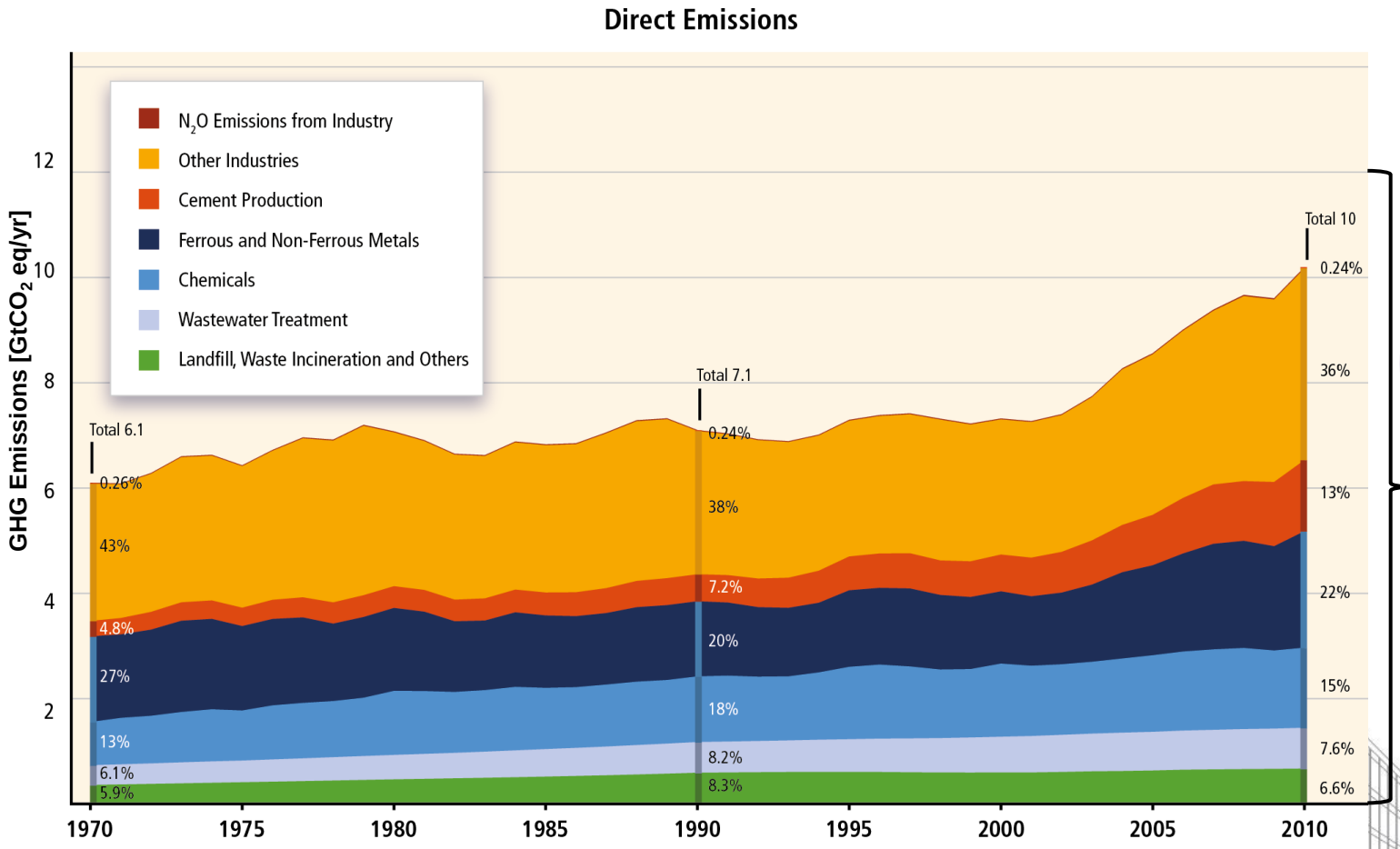
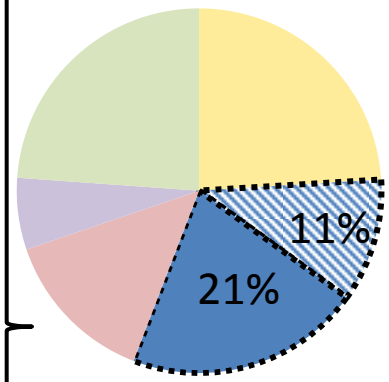
C: Industry – Scope and Emissions

GHG emissions from industry





32% global GHG emissions

Source: IPCC, 2014, AR5

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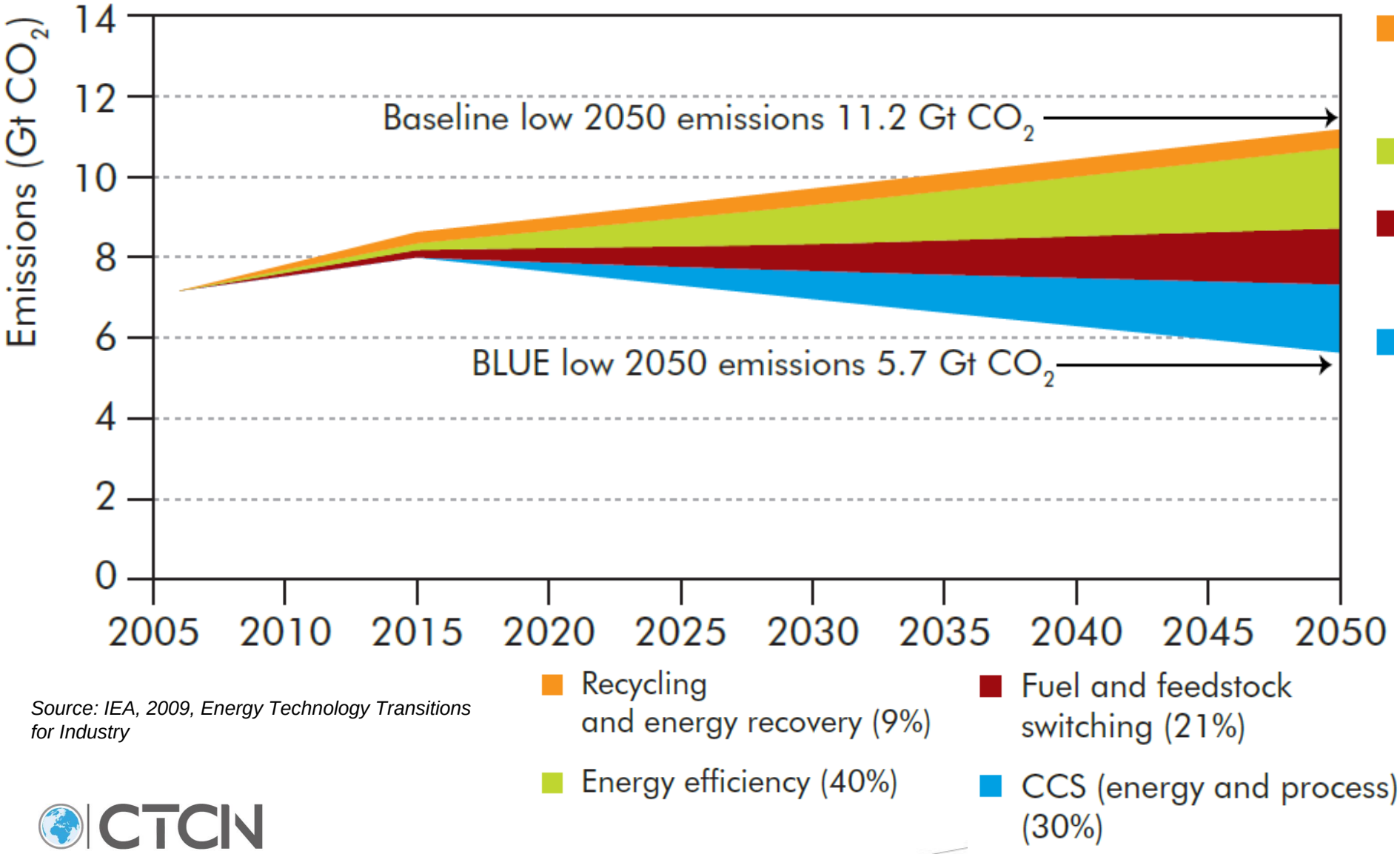
C. Industry – Key technologies

Technologies for reducing direct CO2 emissions from industry



Source: IEA, 2009, Energy Technology Transitions for Industry

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C. Industry – Key technologies

What are mitigation options?

Energy efficiency
- Steam systems
- Process heating systems
- Electric motor systems
- Electronic control systems
- Improved heat management
- Recycling

Emissions efficiency
- Fuel switching (RE, gas)
- Combined heat and power (CHP)
- Alternative refrigerants

- Waste/biomass use
- Solar thermal energy
- CCS

Material efficiency

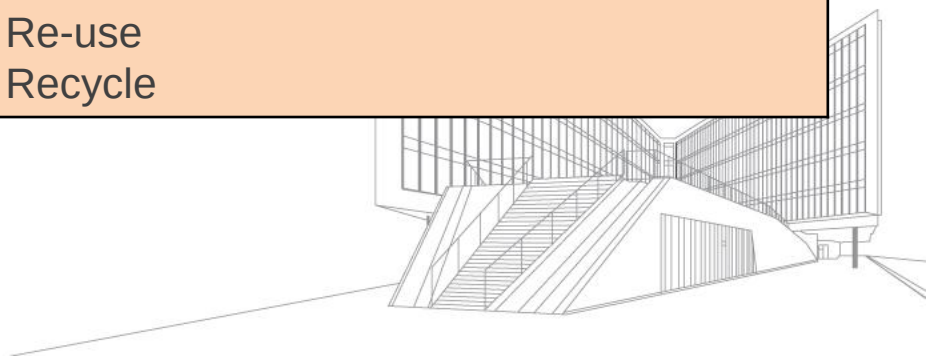
In production
- Reduce losses
- Re-use

In design
- Light-weighting
- Substitution

Changing consumption
- Intensive use
- Less waste
- Longer use
- Reduced demand

Waste management
- Reduce
- Re-use
- Recycle

Less widespread / R&D phase



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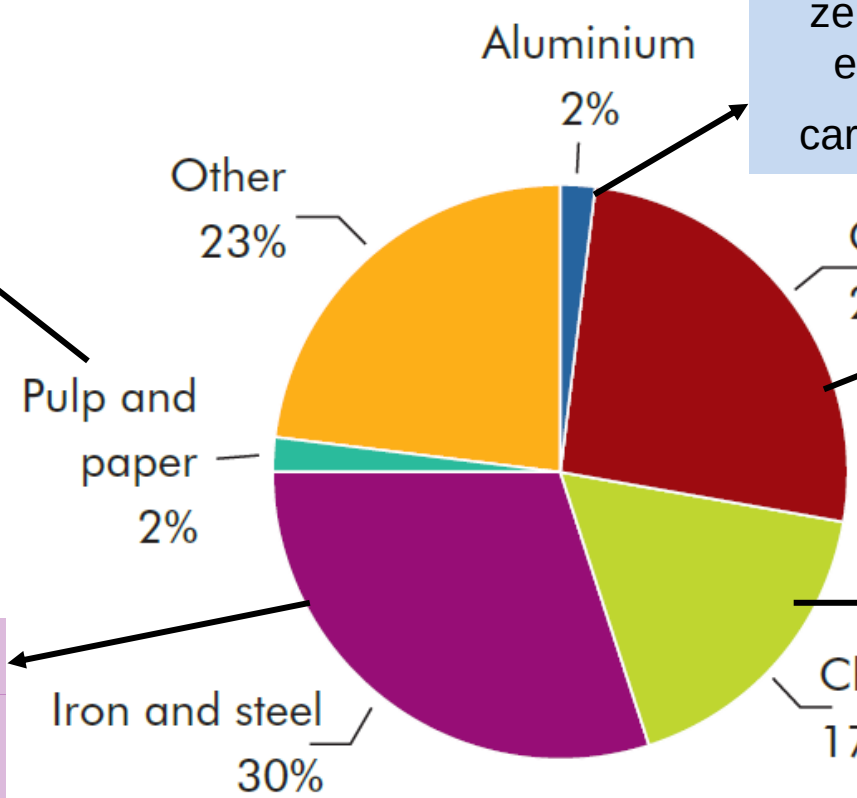
C. Industry – Key technologies: Sub-sectors

Direct CO2 emissions in industry by sub-sector



heat loss

zero carbon electricity

carbothermic

EE

fuel-switching

CCS

process intensification

progress integration

CHP

recycle and recovery

catalysis, membranes

CCS

gas-based DRI

biomass/waste electricity

CCS

EE

biomass

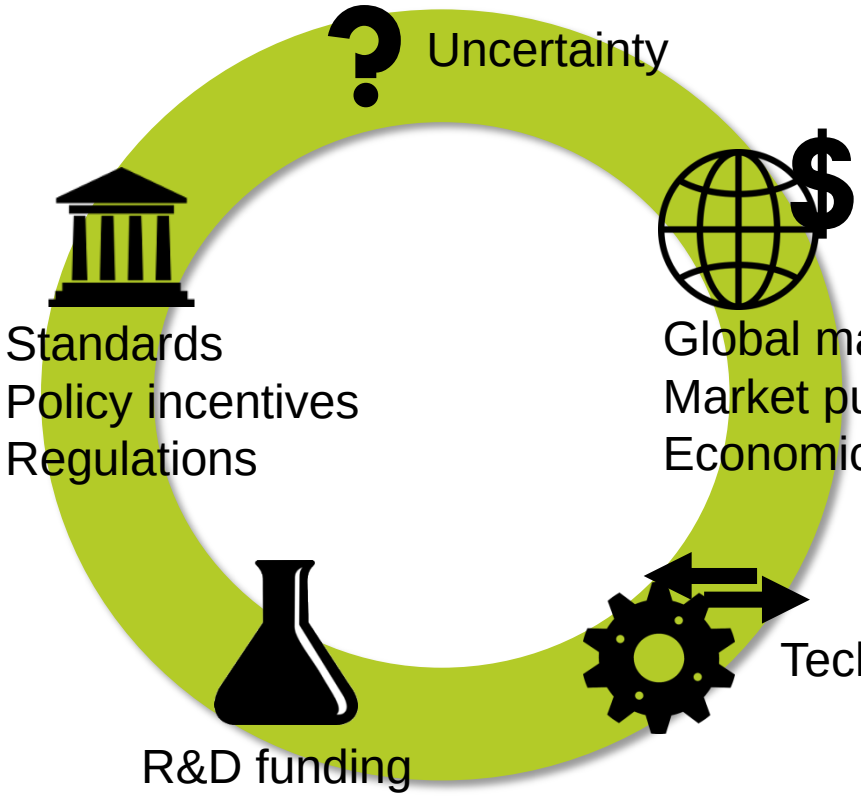
CHP

gasification

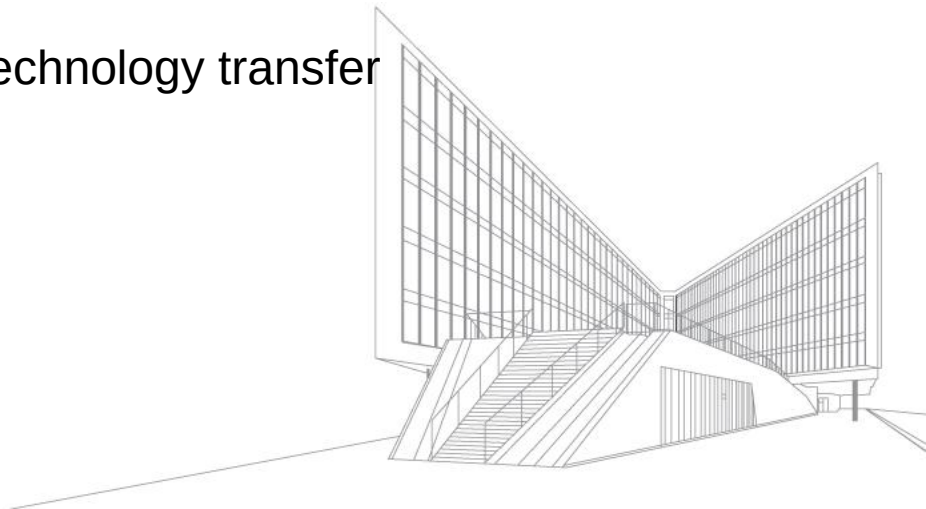
Source: IEA, 2009, Energy Technology Transitions for Industry

C. Industry – Policies, cost and benefits

What are policy implications?



- Energy security
- Job creation
- Less pollution
- Health
- Ecosystem



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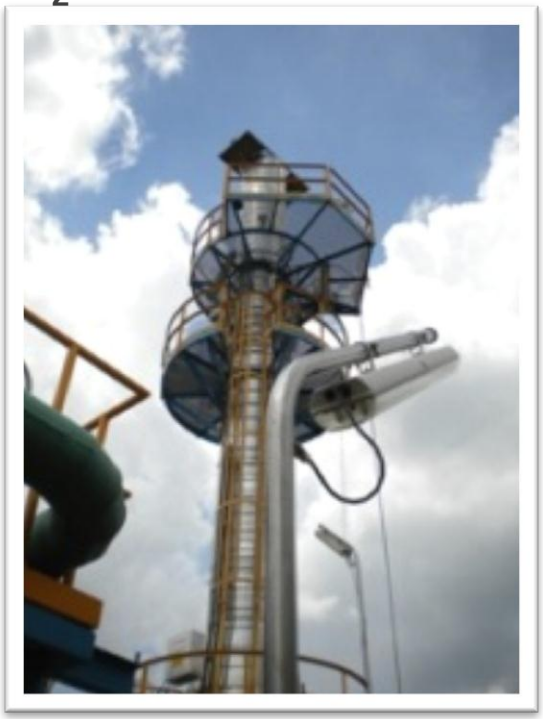
C. Industry – Example

N_2O Emission Reduction Project, Brazil



https://wbcarbonfinance.org/images/Forweb 1Dez_24_2010_141.jpg

Sustainable Cement Production, Indonesia

http://www.indocement.co.id/aspx/home2.aspx#

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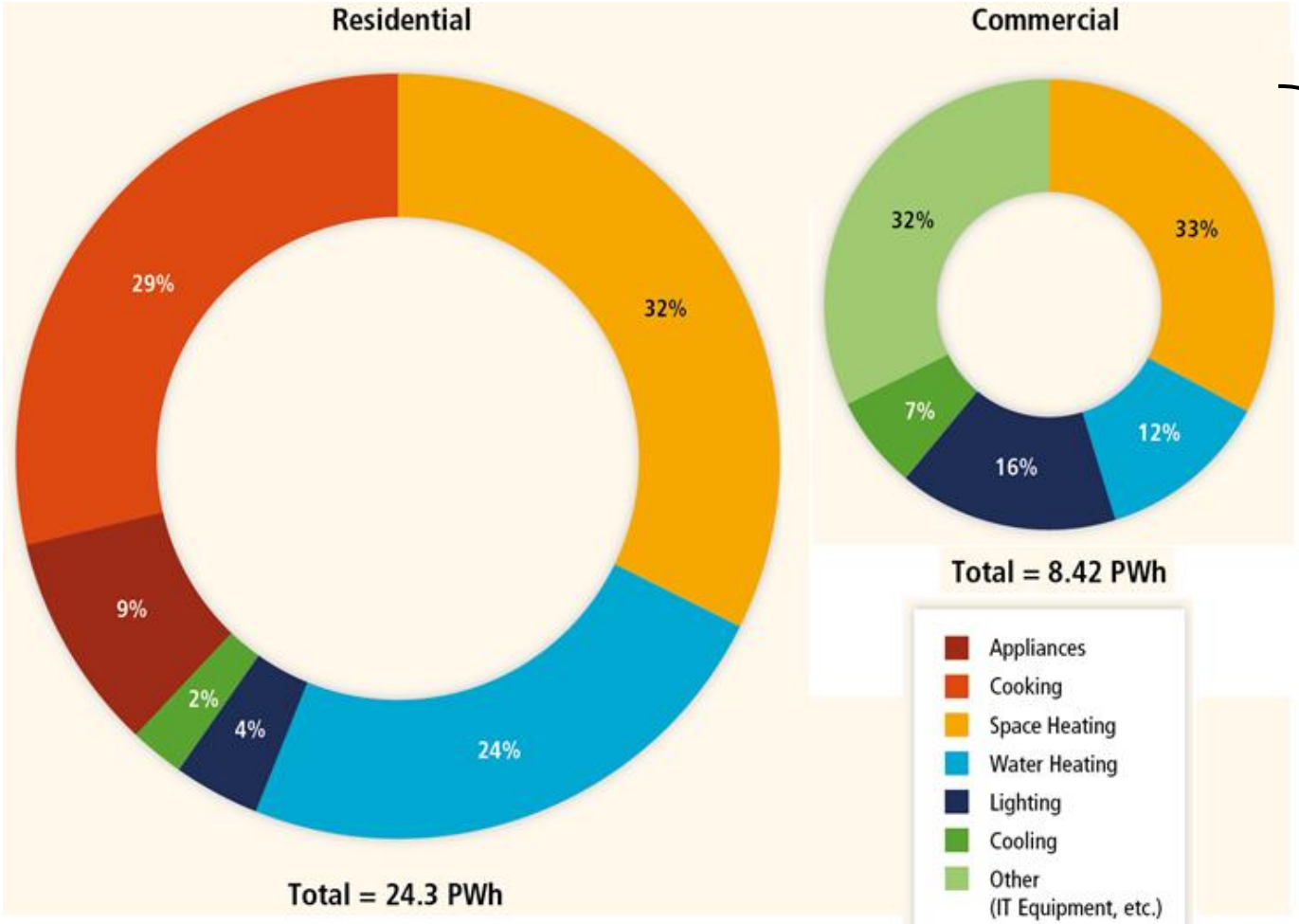
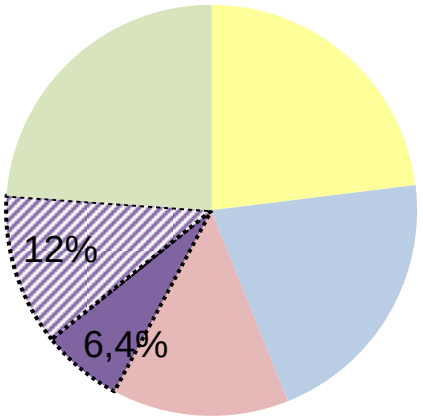
D. Buildings and settlements – Scope

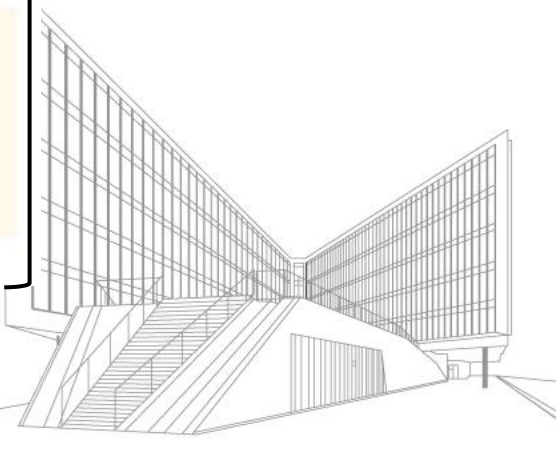
Energy use and GHG sources from buildings





~19% global GHG emissions

Source: IPCC, 2014, AR5



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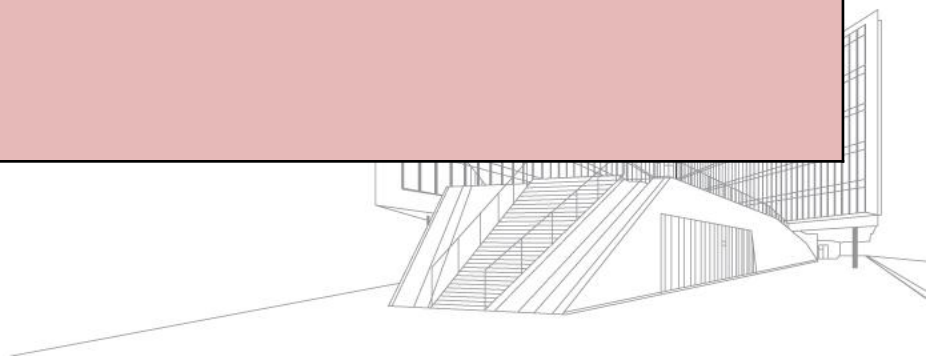
D. Buildings and settlements – Key technologies

What are mitigation options?

Carbon efficiency Integrates RE services Fuel-switching (electricity) Natural refrigerants Clean cook stoves	**Energy efficient technology** Efficient appliances Efficient lighting/daylighting Efficient heating/ventilation/AC (eHVAC) Automation & control systems (BACS) Heat pumps Evaporative cooling Smart metres & grids
Infrastructure efficiency Passive house Energy plus buildings Integrated design process Advanced building control systems Efficient energy systems Co-generation Thermal storage Waste heat	**Demand reduction** Behavioual change Lifestyle change Smart metering



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D. Buildings – Policies, cost and benefits

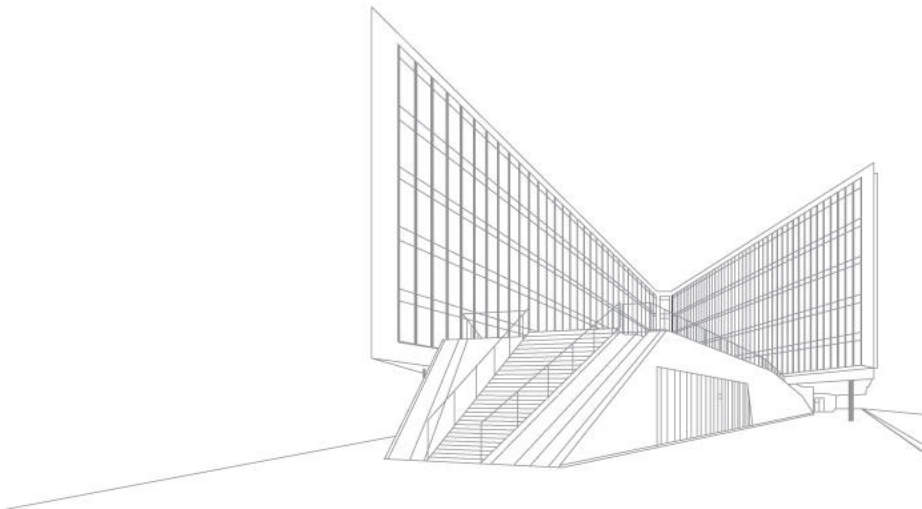
Barriers:
Imperfect information
No incentives
Lack of awareness
Transaction costs
Lack of finance
Service levels
Corruption
Subsidies
High discount rates

Policy options:
Building codes
Appliance standards
EE requirements
Programmes/regulations
Financing instruments

!

Long building lifespan
New versus retrofit
Lock-in risk & urgency

- Energy security
- Lower need for subsidies
- Health
- Environmental benefits
- Employment
- Energy access
- Improved productivity
- Improved quality of life



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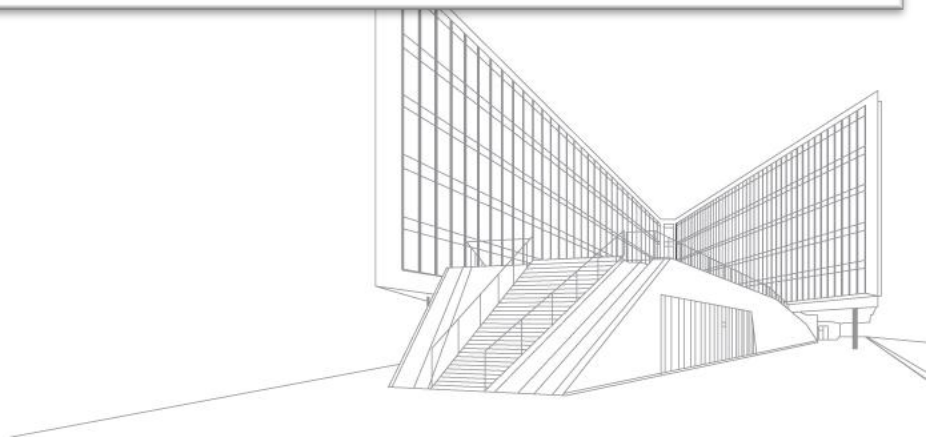
D. Buildings and settlements - Example

The Indira Paryavaran Bhawan, India

Source: REHAU, 2015, http://www.rehau.com/in-hi/



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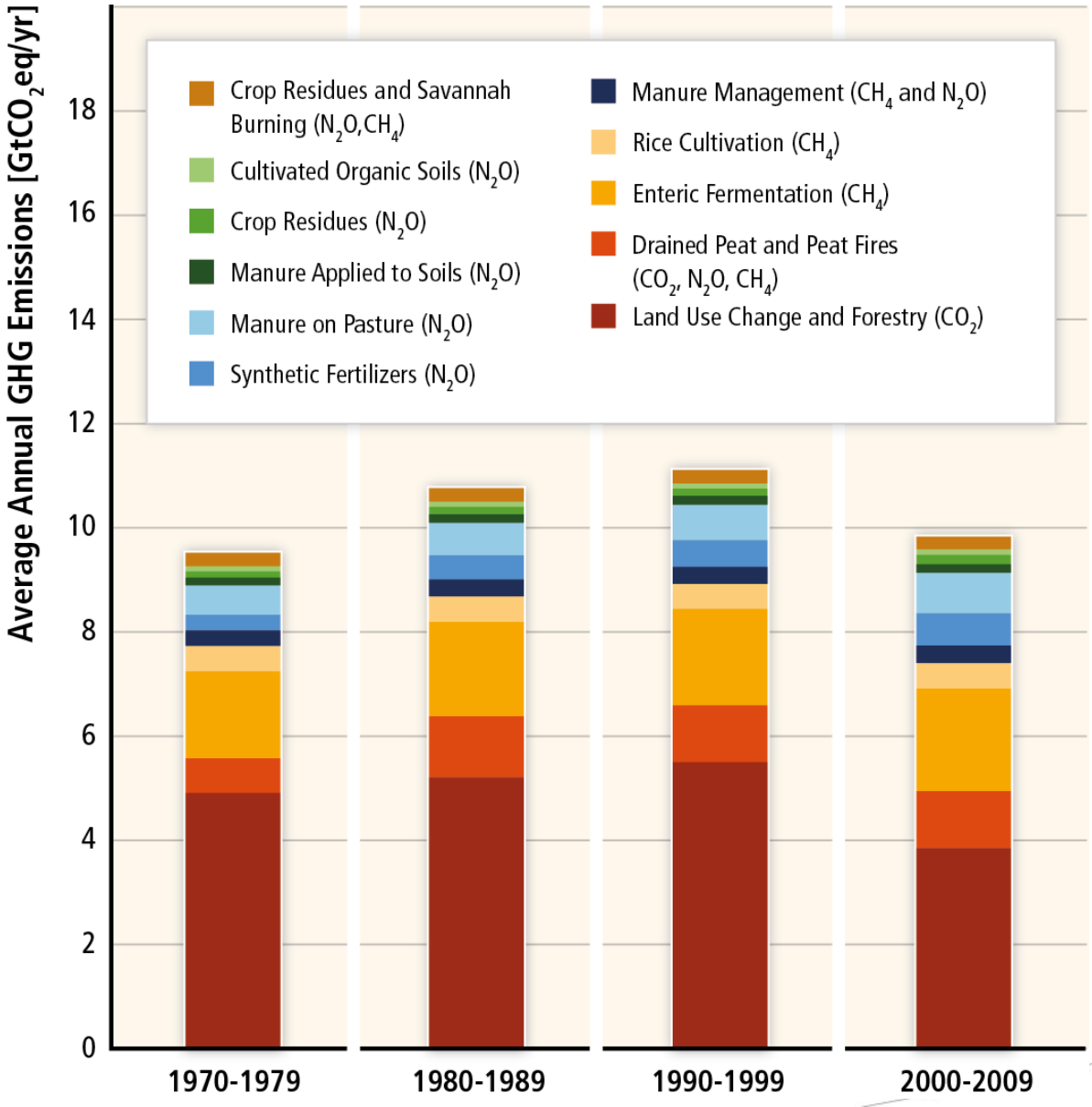
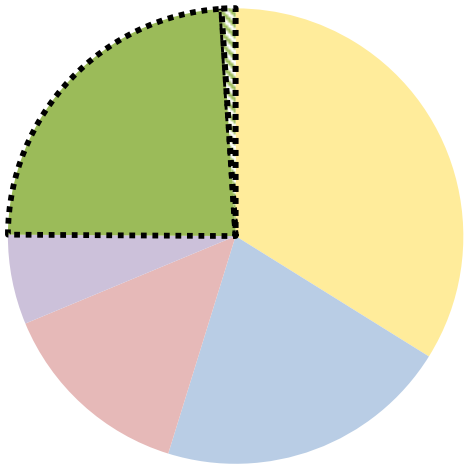
E: Agriculture, forestry and land use – Scope

GHG emissions from AFOLU





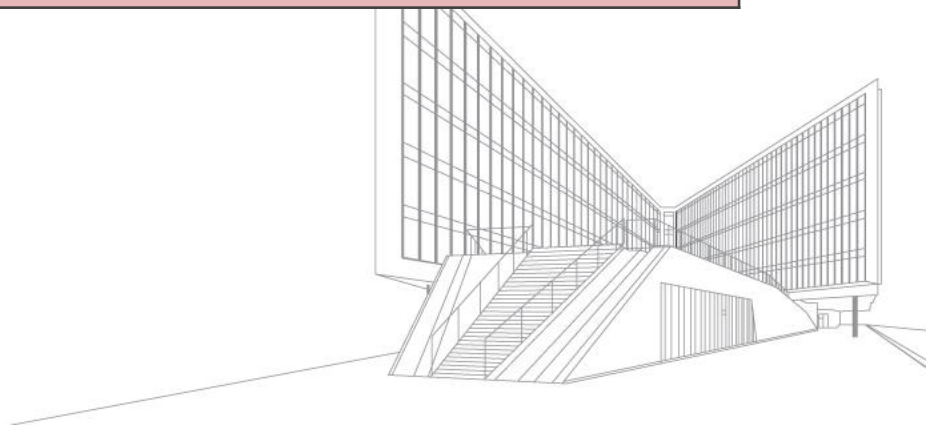
~25% global GHG emissions

Source: IPCC, 2014, AR5

E. AFOLU – Key technologies

What are mitigation options?

Enhance sinks (sequestration) Improved land use/management Afforestation Reforestation Stocking density (forest, soil)	**Reduce** CH4 from rice, livestock, manure N20 from fertilisers, manure CO2 from fossil fuel use Carbon stocks (forest, peatlands) Carbon losses
Avoid/substitute Low GHG service products Fuel-switching Bioenergy	**Demand-side** Losses in food supply chain Changes in human diet Wood consumption



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E. AFOLU – Key technologies – Sub-sectors

Reducing deforestation
Afforestation/reforestation
Forest management
Forest restauration

Cropland management
Nutrient management (fertiliser)
Tillage
Biochar
Irrigation
Organic agriculture
Bioenergy

Feeding
Breeding
Manure management
Biodigesters

Agroforestry
Mixed biomass production systems
Integration of production and processing

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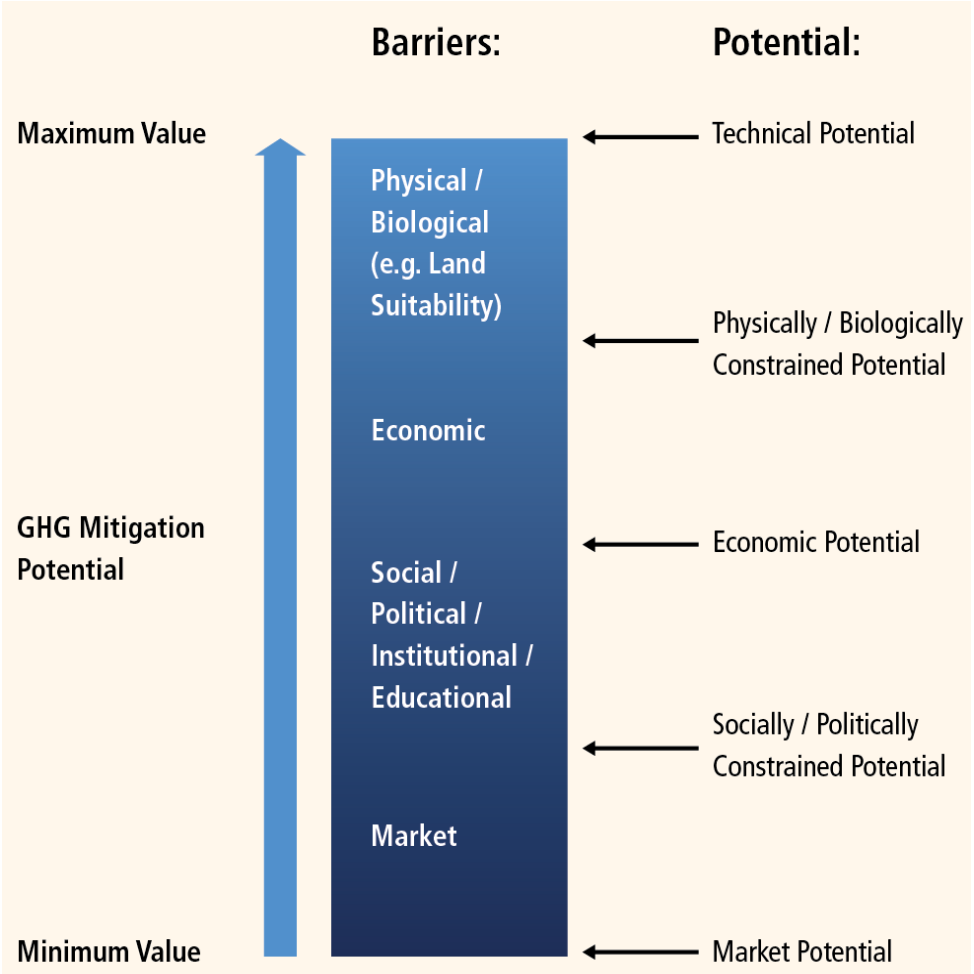
E. AFOLU – Policies, cost and benefits



Source: IPCC, 2014, AR5

Institutional issues	Land tenure rights Conflicting policies Participative mechanisms Benefit sharing mechanisms
Social issues	Food security Local knowledge/culture Animal welfare Human health Equity
Environmental issues	Land availability Biodiversity Water and soil resources Ecosystem resilience
Technology issues	Infrastructure Innovation/transfer Acceptance
Economic issues	Income Employment Financing mechanisms Economic activity

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E. AFOLU – Example

Smallholder agriculture project, Western Kenya

Source: ViAgroforestry, 2012, http://www.viagroforestry.org/files/2012/03/kenya_maurice_Agro_745-745x300.jpg

Biochar project in Indonesia

Source: http://www.id.undp.org/content/dam/indonesia/img/environtment/project/DSC_2629.JPG/_jcr_content/renditions/cq5dam.web.540.390.jpeg

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III. Summary and Outlook

A. Take-Away Messages

→ GHG emissions continue to increase

→ Economic and population growth and technology

→ There is an urgent need for action to remain below 2 degrees

→ International cooperation and technology transfer is essential

→ Mitigation action can lead to many co-benefits

→ Cross-sectoral mitigation strategies are more effective

→ Technology, structure, behaviour, lifestyle and culture

→ Participate in other CTCN webinars

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B. For More Information

Cross-sectoral

- IPCC, 2014: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change
- ClimateTechWiki: A Clean Technology Plattform

Sector-specific

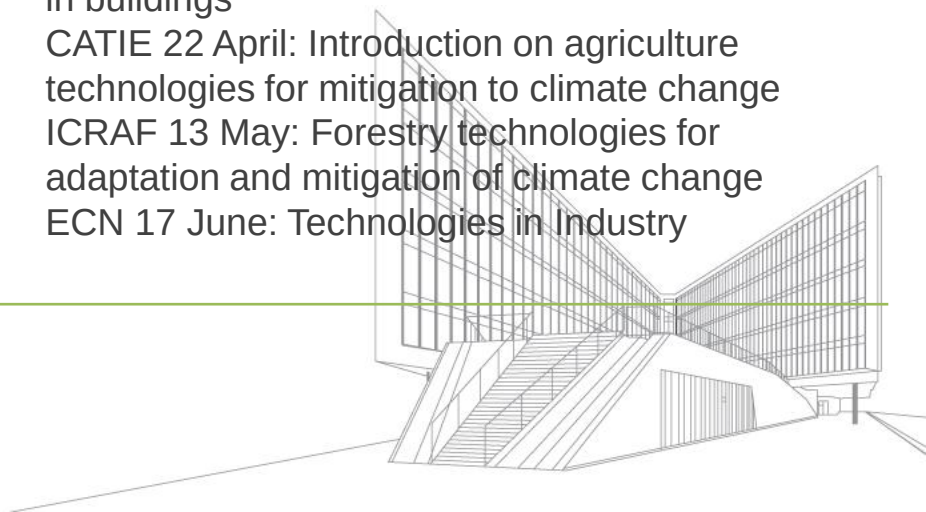
- IEA, 2009: Energy Technology Transitions for Industry
- UNEP, 2011/12, Technologies for Climate Change Mitigation – Building Sector, Industry, Agriculture

Energy / Renewable energy

- IPCC, 2011: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation. Prepared by Working Group III of the Intergovernmental Panel on Climate Change.
- IEA, 2013: Energy Technology Initiatives – Implementation through Multilateral Co-operation.
- IEA, 2014: World Energy Outlook
- IRENA: Technology Briefs

CTCN webinars

- ENDA 11 March: Introduction to climate technologies related to energy poverty and access
- TERI 25 March: Introduction to renewable energy technologies
- TERI 1 April: Introduction to climate technologies in buildings
- CATIE 22 April: Introduction on agriculture technologies for mitigation to climate change
- ICRAF 13 May: Forestry technologies for adaptation and mitigation of climate change
- ECN 17 June: Technologies in Industry



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Thank you for participating in this webinar

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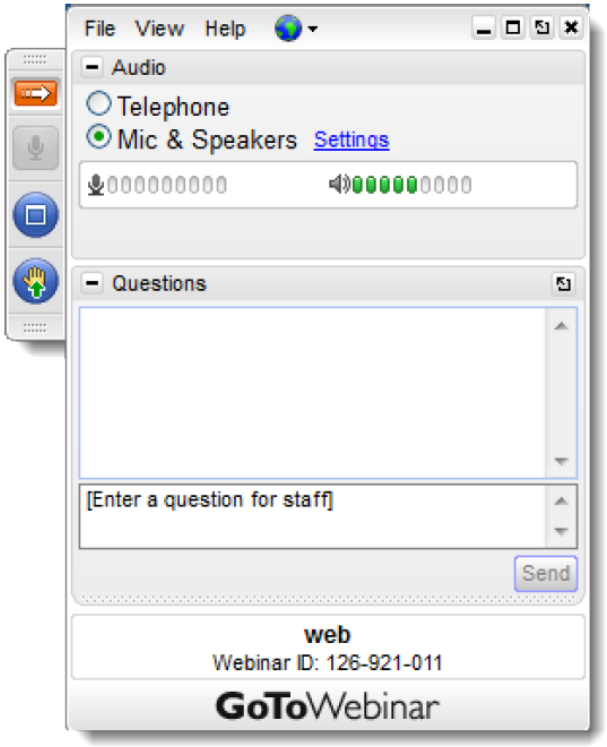
ECN

Questions and Answers

- Please type your question into the “Questions” pane and click “Send”
- Kindly limit yourself to one specific short question
- Kindly refrain from giving broad statements
- Send us an email



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