AFRICA FREE ZONES ORGANIZATION WORKSHOP

Social and Environmental Sustainability: Emerging Issues for SEZs

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Free zones AFRICA

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Outline of Presentation

- Green industrialization vs Climate Change
- Trends in Global Emissions
- Emissions by Gas and by Sector
- Climate change impacts
- Trends in Emissions from the Industrial Sector in detail
- GHG Mitigation Options for Industry
- Green Growth
- Low-carbon, Green SEZs

Green Industrialization

- Why must we promote green industrialization?
  - (Prevention of Environmental pollution & Climate Change) – what is it?
- Weather vs Climate – The weather is what its like outside today, tomorrow, next week, or next month
- Climate is the long-term (~30-year) average. It is the long-term average that counts in describing the climate.
  - E.g A region that, over a 30-year average, has low rainfall and high temperature would be described as having a warm, dry climate. But this region could still have rainy, cold or snowy weather on certain days, weeks or months-.
- Climate change is a significant shift in this long-term average. It describes a change in the 30-year average weather patterns of a place or region
  - If there is a change in temperature or precipitation between one 30-year period and the next, then this constitutes climate change. Eg, if the average rainfall in the West Africa has increased between 1980 and 2010 compared to 1950 to 1980, so the regional climate has become wetter.

Green Industrialization

- **Global climate change** represents a significant shift in the worldwide average.
  - It describes a change in the 30-year average weather patterns for the whole planet.
  - For example, the global average surface temperature between 1980 and 2010 was considerably higher than the average for 1950 -1980. This means that globally, the climate has become warmer i.e. global warming.
- **Global Warming:**
  - Is the long-term trend of rising global temperatures

Is the Climate Warming?

- The Earth's climate is warming! (IPCC, 2014)
- The earth's average surface air temperature has increased by 0.8 °C (1.4 °F) since 1900
- Much of the increase taking place since mid 1970s
- Indirect estimates show that 1983 to 2012 was probably the warmest 30 year period in more than 800 years
- Evidence of warming are that:
    - lower atmosphere and upper layer of oceans have warmed
    - snow and ice cover are decreasing
    - Sea-level is rising
    - Greenland ice sheet is shrinking

Is the Climate Warming?

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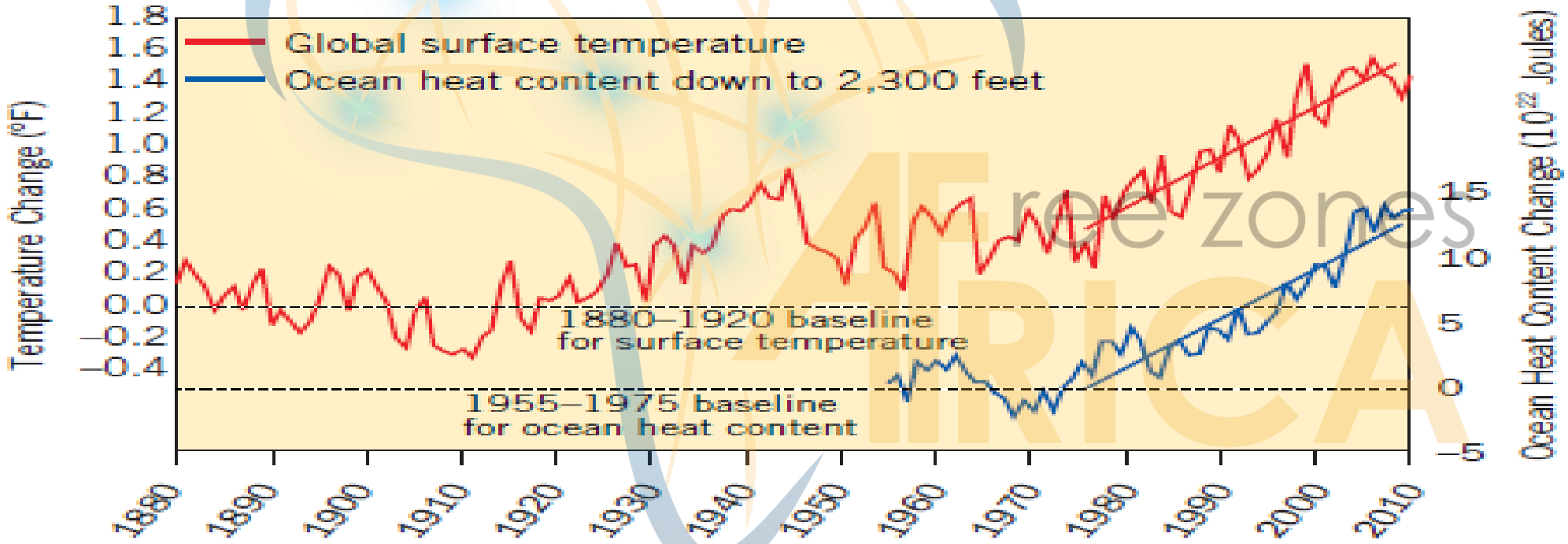
Global Warming Trend: Average Surface Warming and Ocean Heat Content



Global average surface temperature change (left axis) and ocean heat content change in upper 2300 feet (right axis).

Regulation of Earth's Climate

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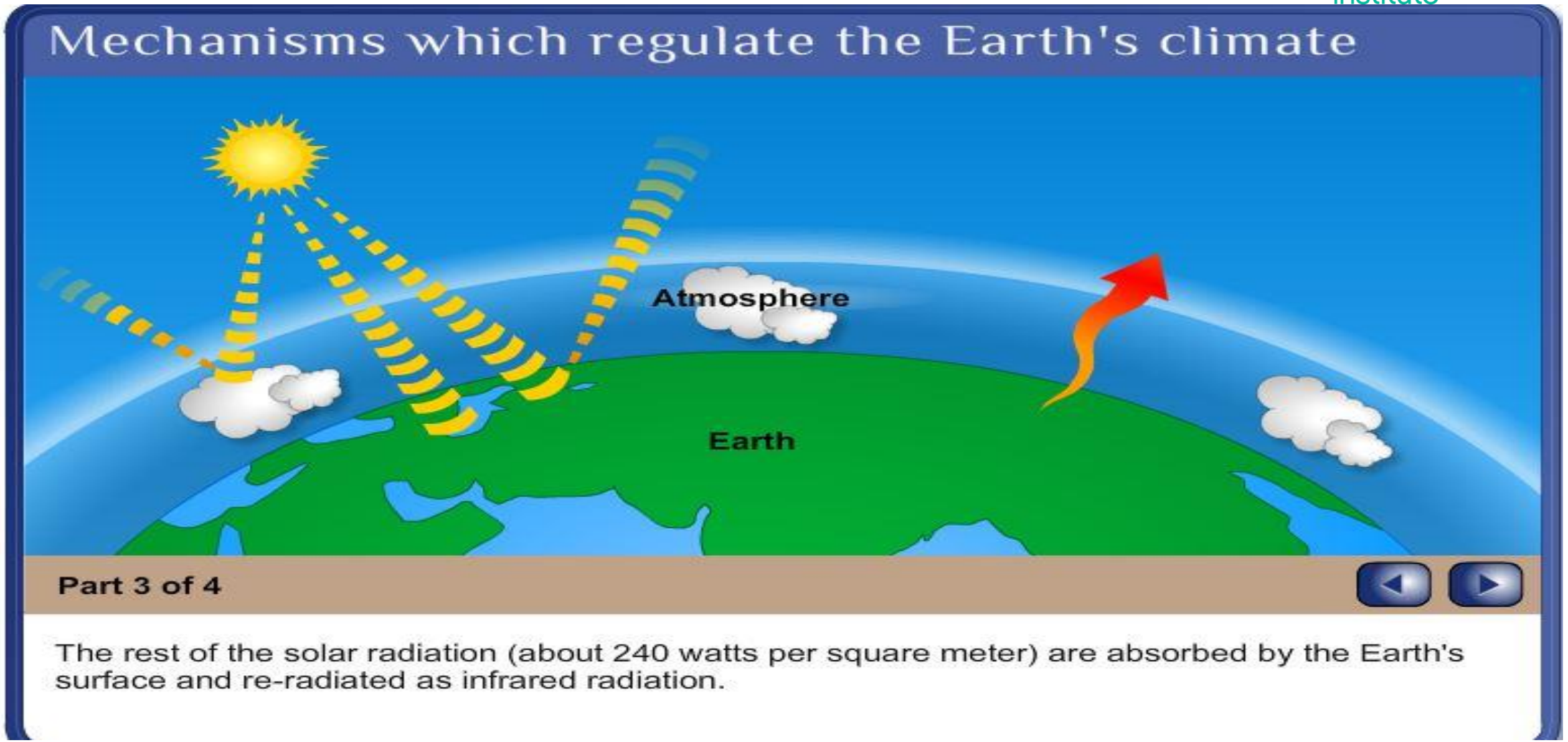

The Greenhouse Effect

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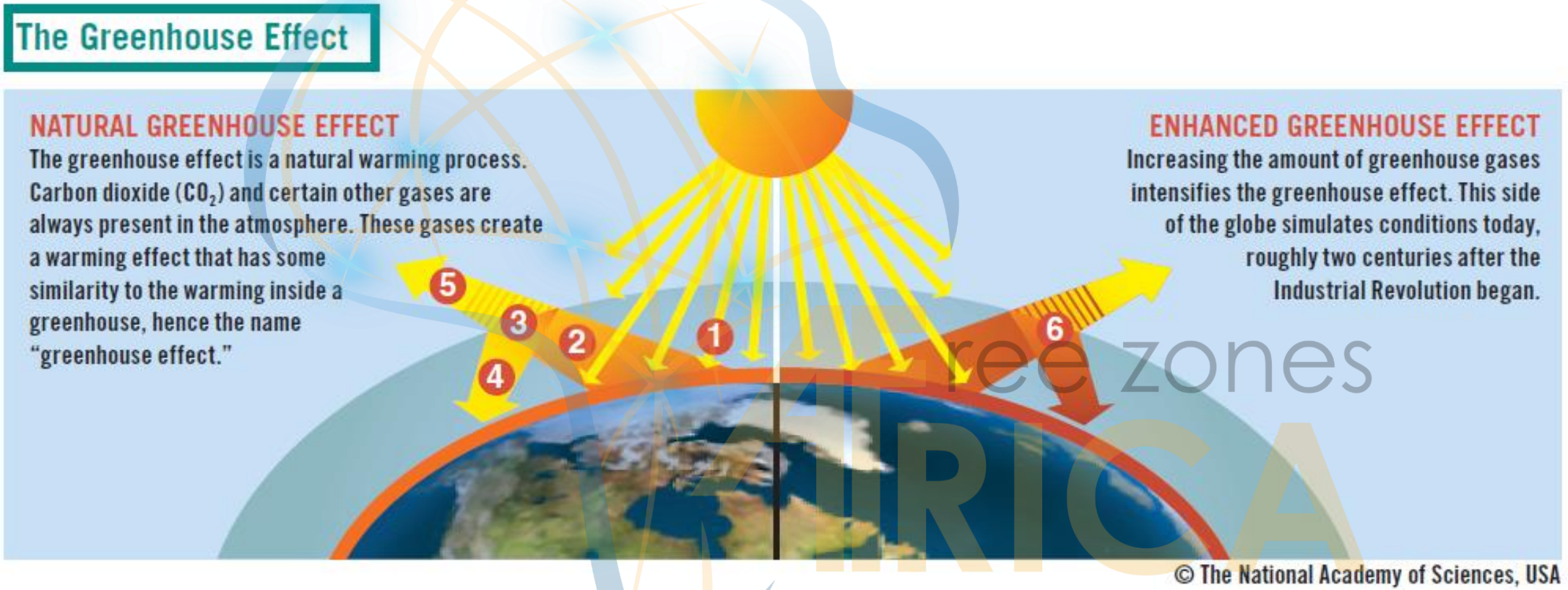


Illustration of the greenhouse effect (adapted with permission from the Marian Koshland Science Museum of The National Academy of Sciences). Visible sunlight passes through the atmosphere without being absorbed. Some of the sunlight striking the earth ❶ is absorbed and converted to heat, which warms the surface. The surface ❷ emits heat to the atmosphere, where some of it ❸ is absorbed by greenhouse gases and ❹ re-emitted toward the surface; some of the heat is not trapped by greenhouse gases and ❺ escapes into space. Human activities that emit additional greenhouse gases to the atmosphere ❻ increase the amount of heat that gets absorbed before escaping to space, thus enhancing the greenhouse effect and amplifying the warming of the earth.

What are GHG?

- These are the gases that causes warming of the climate
- The increased concentration of the Greenhouse gases (GHG) in the atmosphere causes climate change
- The GHG include the following: -

- **Carbon dioxide (CO_2)** is the most important greenhouse gas, representing over two thirds of climate forcing by anthropogenic greenhouse gas emissions. The main sources of CO_2 emissions are from fossil fuels combustion, deforestation, land clearing for agriculture, soil degradation.

- **Methane (CH_4)** is another powerful greenhouse gas, more than half of its global emissions now arise from human activities with fugitive emissions (gas which escapes) from fossil fuel extraction, belching from ruminants (e.g. cattle and sheep), rice paddies and landfill sites all being major sources.

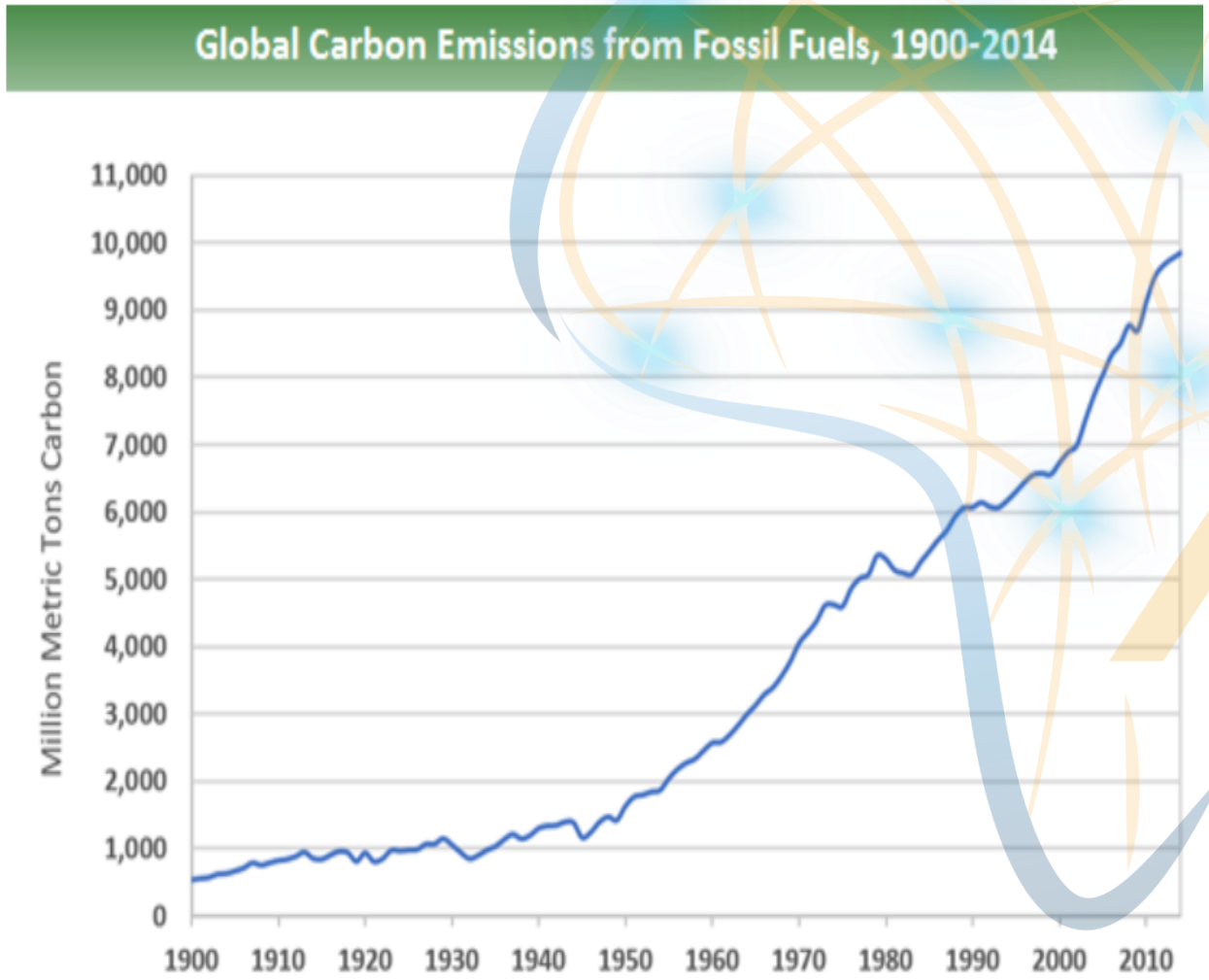
- **Nitrous Oxide (N_2O)** is another important greenhouse gas, with human activities responsible for the global increase in emissions. The main anthropogenic sources are application of nitrogen fertilizers to fields, manure and urine deposition from livestock, fossil fuel combustion and nylon manufacture.

Fluorinated Gases (F-Gases)

- **Chlorofluorocarbons (CFC),** from refrigerant and blowing agents in foams, insulations etc
- **Hydrofluorocarbon (HFC);** from air conditioners and refrigerants
- **Perfluorocarbon (PFC);** from medical equipment and electronics
- **Sulfur hexafluoride (SF6)** from electrical equipment and scientific research
- **Nitrogen trifluoride (NF_3)** - from electronics industry in the manufacture of semiconductor, photovoltaic cell,

• Human activities have increased the atmospheric concentrations of both the natural and man-made GHGs have been rising over the last century due to the industrial revolution

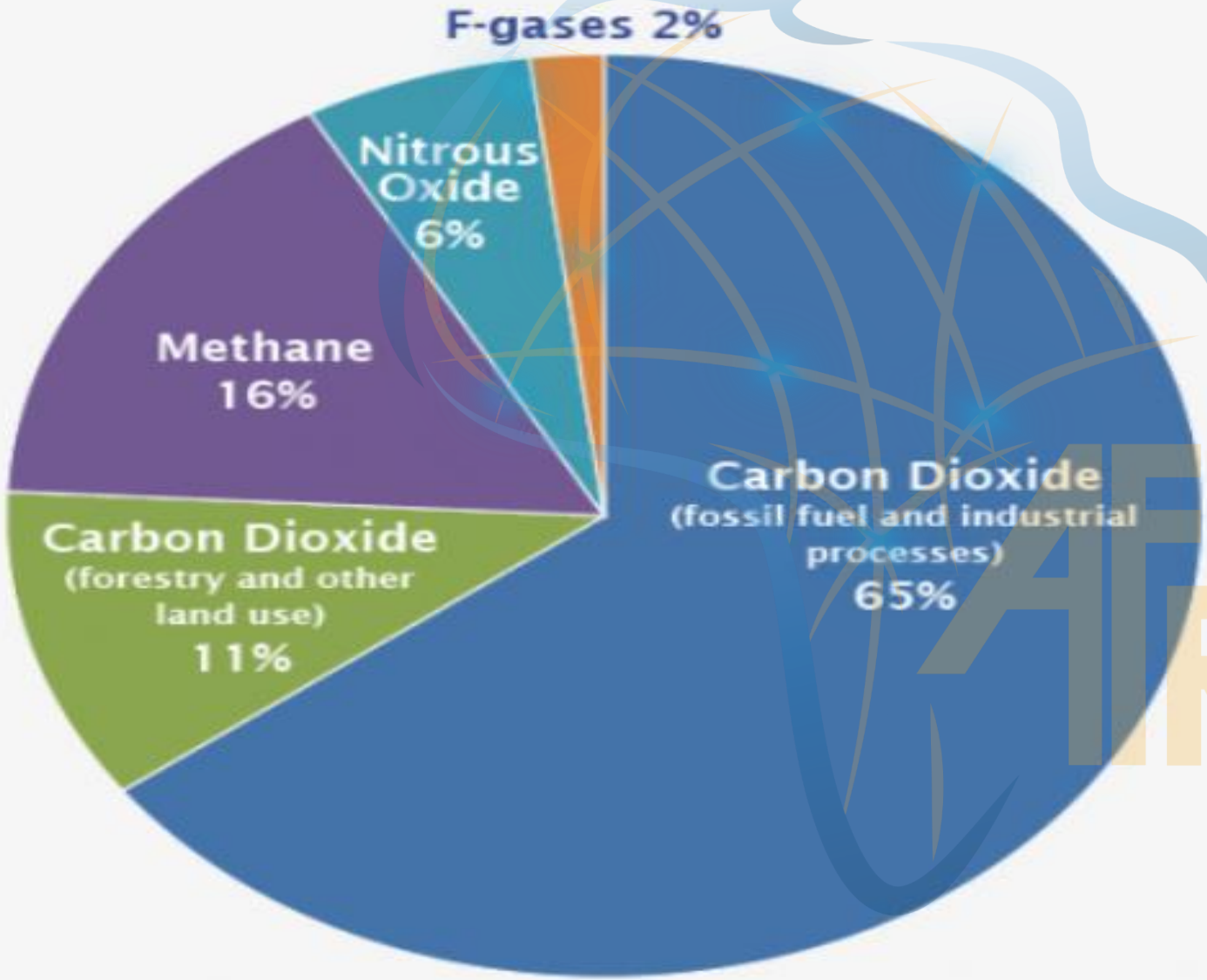
Trends in Global Emissions



Source: Boden, T.A., Marland, G., and Andres, R.J. (2017). Global, Regional, and National Fossil-Fuel CO2Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S.

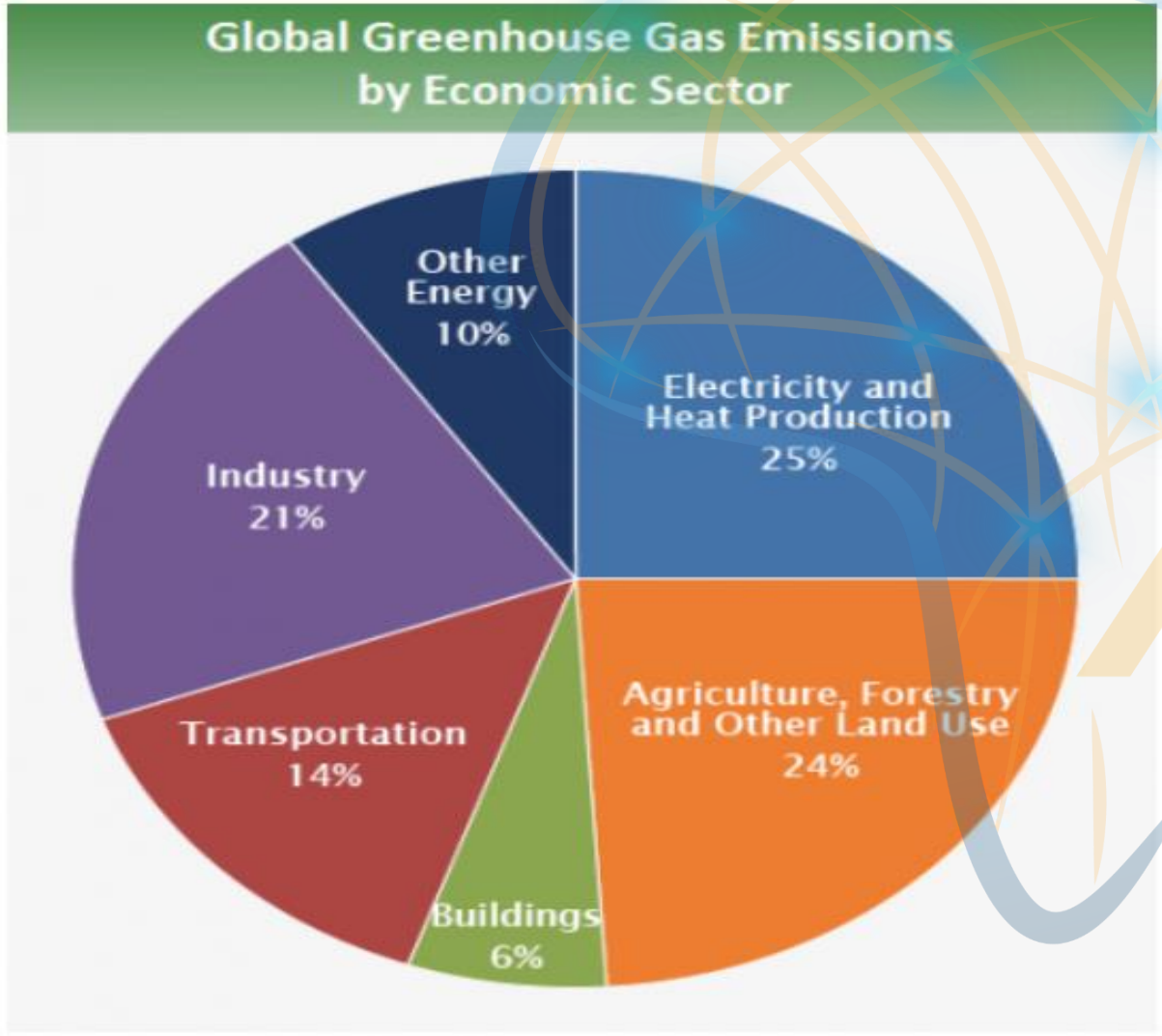
- Global carbon emissions from fossil fuel have significantly increased since 1900;
- CO_2 emissions have increased by about 90% since 1970;
- With emissions from fossil fuel combustion and industrial processes contributing about 78% of total GHG emissions increase from 1970 to 2011;
- The second largest contributors to emissions are Agriculture, deforestation and other land-use changes;
- Non- CO_2 GHG emissions have also increase significantly since 1900.

Global Greenhouse Gas Emissions by Gas



Source: IPCC (2014) EXIT based on global emissions from 2010.

Global Emissions by Economic Sector



Source: IPCC (2014); EXIT based on global emissions from 2010.

- ***Electricity and Heat production*** – 25% of 2010 global GHG emissions from coal, natural gas, and oil;
- ***Agriculture, Forestry and other Land-Use –*** 24% of 2010 global emissions from crop cultivation and livestock, and deforestation,
- ***Industry*** – 21% of 2010 global emissions from fossil fuel use, chemical, metallurgical and mineral transformation processes; and waste;
- ***Transportation –*** 14% of 2010 global emissions from fossil fuels combustion for road, rail, air and marine transportation.
- ***Other Energy*** – 10% of 2010 global emissions from fuel extraction, processing, refining, and transportation
- ***Buildings*** – 6% of 2010 global emissions from burning fuels for heating, cooking in homes.

What are Greenhouse Gases (GHG)

- Human activities emits about 6 billion tons of carbon each year
  - Anthropogenic emissions sources include: Electricity (fossil fuel, coal, natural gas), land-use change/Forestry; agriculture, industry, transport, mining, buildings
- The oceans and land actually take up about 3 billions tons more carbon each year than they emit i.e. they are net ‘sinks’
- 3 billion tons of carbon accumulates in the atmosphere each year and enhance the “greenhouse effect”

Impacts of Climate Change

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CLIMATE PROJECTIONS

1–2.5°C increase in average temperatures by 2060

More extreme weather, including more intense precipitation

Rising sea levels

KEY CLIMATE IMPACTS

Agriculture

Increased crop loss/failure
More pests, weeds, pathogens
Reduced food security

Water Resources

Increased sedimentation and runoff due to more intense rainfall
Decline in water quality

Human Health

Increased range for vector-borne diseases
Increased breeding sites for water pathogens and illnesses

Disasters

Damage to coastal infrastructure and production zones
Loss of life and productive assets

Trends in Industrial Sector Emissions

- The industrial sector accounted for 28% of final energy use in 2010;
- Global industry & waste/wastewater GHG emissions grew from **10.4 $GtCO_2eq$ in 1990 to 13 $GtCO_2eq$ in 2005 and to 15.4 $GtCO_2eq$ in 2010;**
- These emissions are larger than emissions from either buildings or transport end-use sectors;
- The emissions from the industrial sector are comprised of:
  - Direct energy-related CO_2 emissions for industry
  - Indirect CO_2 emissions from production of electricity & heat for industry
  - Process CO_2 emissions
  - Non- CO_2 GHG emissions
  - Direct emissions for waste/wastewater

Trends in Industrial Sector Emissions

- Total global GHG emissions for industry and waste/wastewater in 2010 comprised of:
  - **5.3 $GtCO_2eq$** in direct energy-related CO_2 emissions
  - **5.2 $GtCO_2eq$** in Indirect CO_2 emissions from production of electricity and heat
  - **2.6 $GtCO_2eq$** in process CO_2 emissions
  - **0.9 $GtCO_2eq$** in Non-CO_2 emissions and
  - **1.4 $GtCO_2eq$** in waste/wastewater emissions

- The 2010 direct and indirect emissions were dominated by **CO_2 (85.1%),** followed by **CH_4 (8.6%), HFC (3.5%), N_2O (2.0%), PFC (0.5%)** and **SF6 (0.4%)** emissions

Gas		2010 Emissions ($MtCO_2eq$)
Carbon dioxide	CO_2	13,139
Methane	CH_4	1,326.93
Hydrofluorocarbons	HFC	539.28
Nitrous oxide	N_2O	303.35
Perfluorocarbons	PFC	72.93
Sulphur hexafluoride	SF_6	61.21
Carbon Dioxide Equivalent (total of all gases)	**CO_2eq**	**15,443**

Note: CO_2 emissions from cement-forming reactions only; cement energy-related direct emissions are included in 'other industries' CO_2 emissions.

Industrial CO_2 Emissions by Source

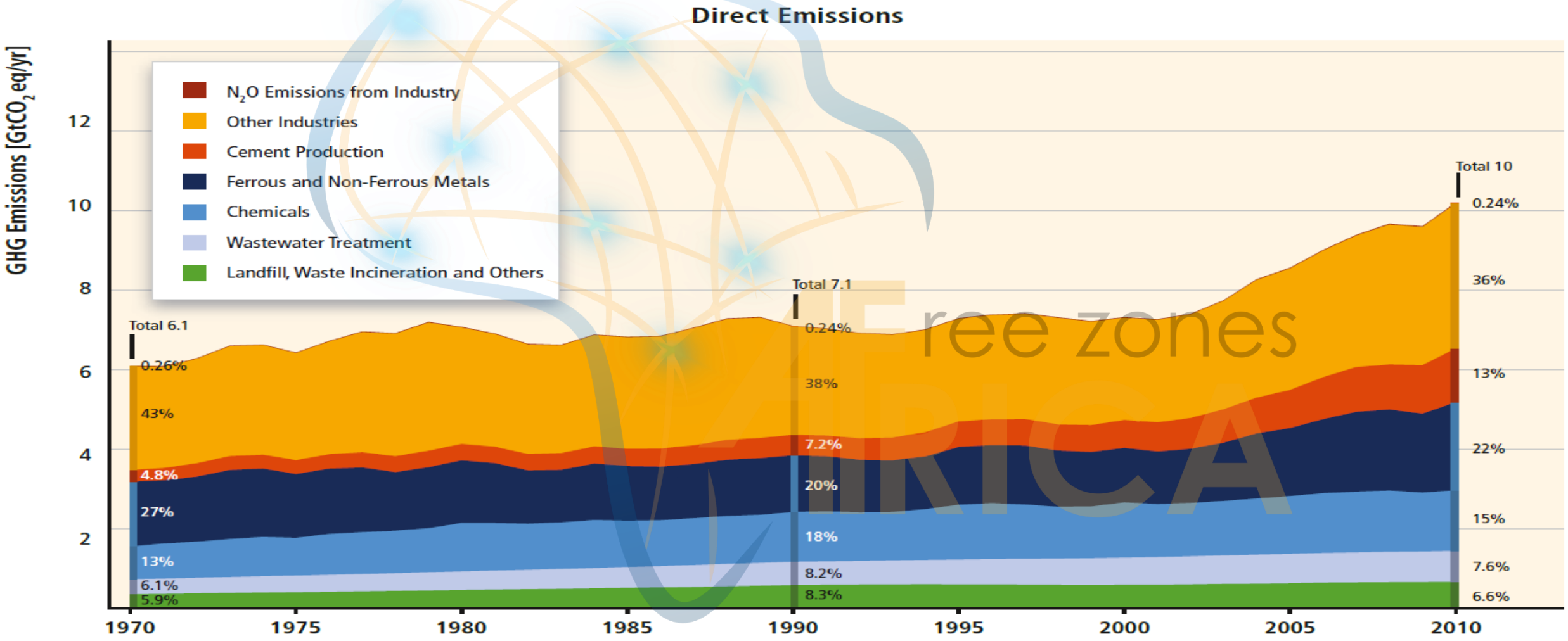

Figure 10.4 | Total global industry and waste/wastewater direct and indirect GHG emissions by source, 1970–2010 ($GtCO_2eq/yr$) (de la Rue du Can and Price, 2008; IEA, 2012a; JRC/PBL, 2013). See also Annex II.9, Annex II.5.

Industrial CO_2 Emissions

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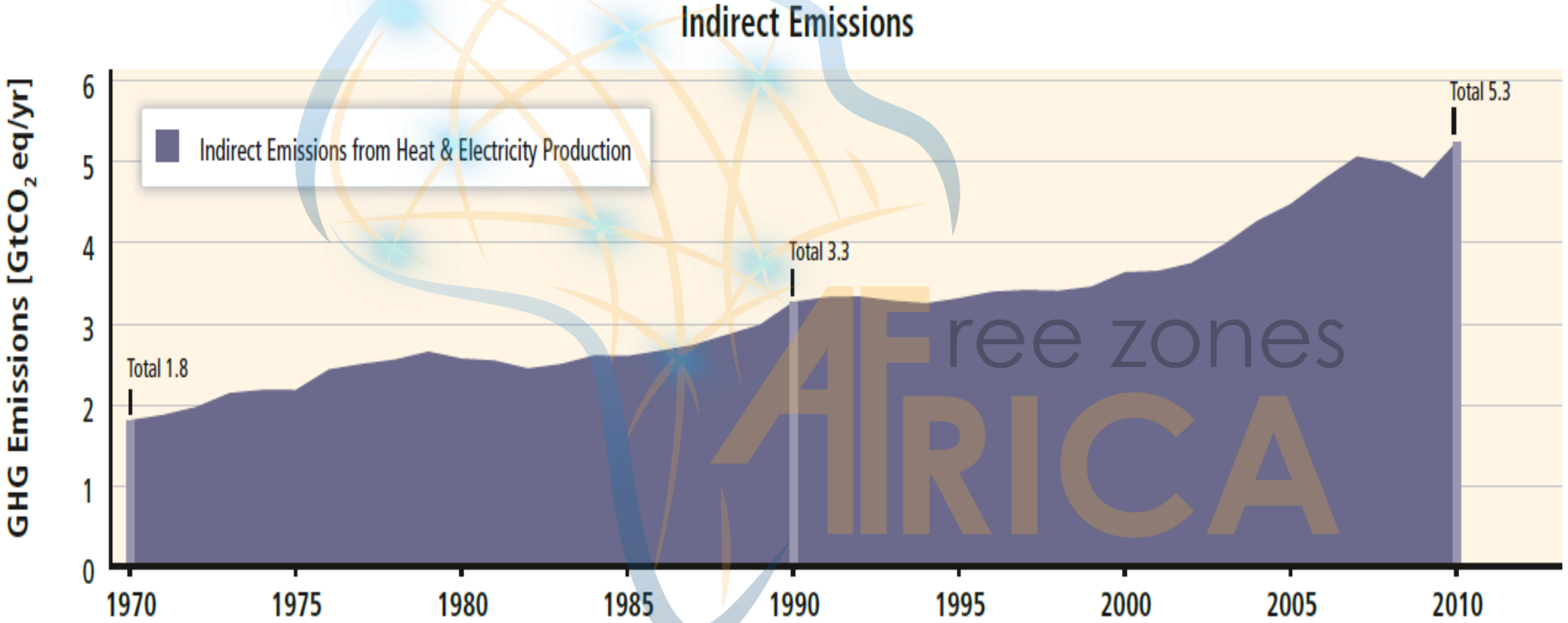

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Industrial CO_2 Emissions by Region

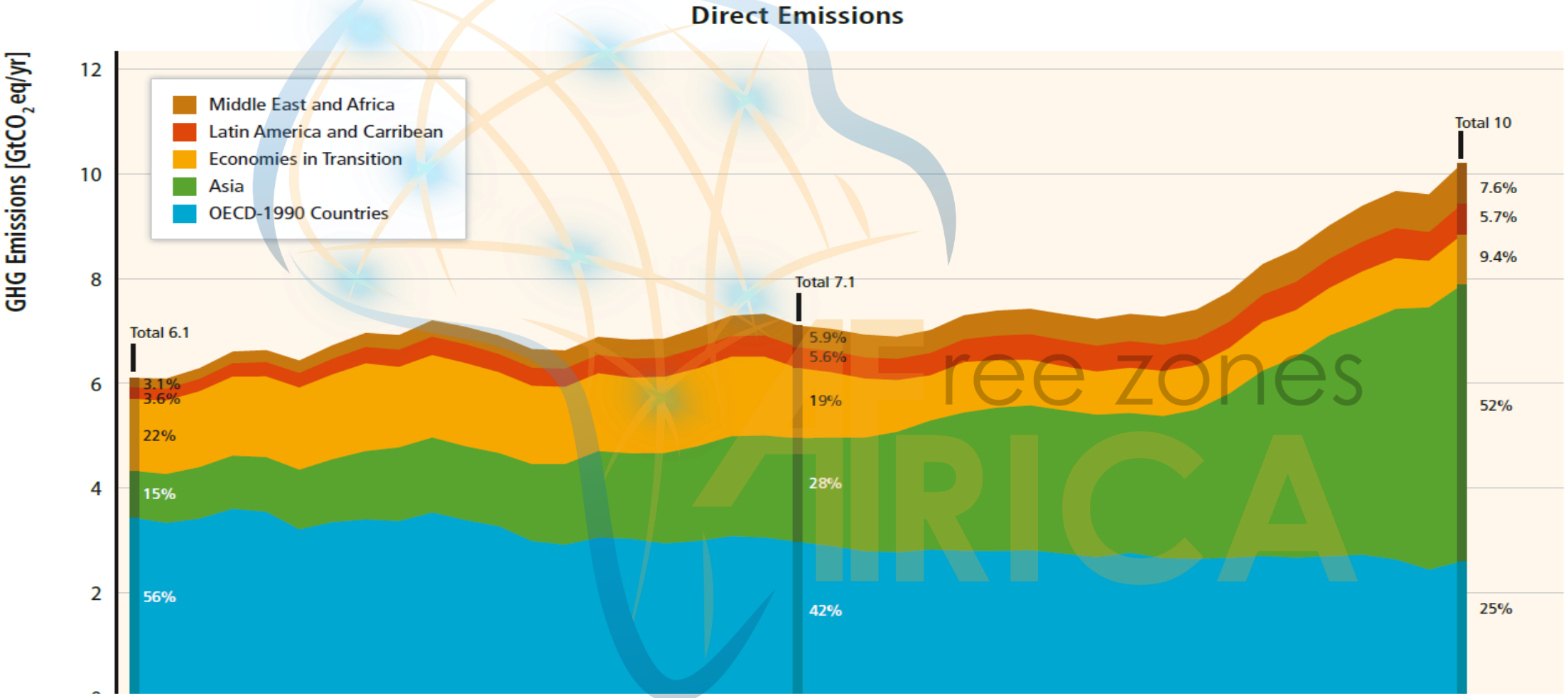

Figure 10.5 | Total global industry and waste/wastewater direct and indirect GHG emissions by region, 1970–2010 ($GtCO_2eq/yr$) (de la Rue du Can and Price, 2008; IEA, 2012a; JRC/PBL, 2013). See also Annex II.9, Annex II.5.

Industrial Non CO_2 GHG Emissions

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Table 10.4 | Emissions of non-CO_2 GHGs for key industrial processes (JRC/PBL, 2013)[1]

Process	Emissions ($MtCO_2eq$)		
	1990	2005	2010
HFC-23 from HCFC-22 production	75	194	207
ODS substitutes (Industrial process refrigeration)[2]	0	13	21
PFC, SF_6, NF_3 from flat panel display manufacturing	0	4	6
N_2O from adipic acid and nitric acid production	232	153	104
PFCs and SF_6 from photovoltaic manufacturing	0	0	1
PFCs from aluminium production	107	70	52
SF_6 from manufacturing of electrical equipment	12	7	10
HFCs, PFCs, SF_6 and NF_3 from semiconductor manufacturing	7	21	17
SF_6 from magnesium manufacturing	12	9	8
CH_4 and N_2O from other industrial processes	3	5	6

Industrial CO_2 Emissions by Region

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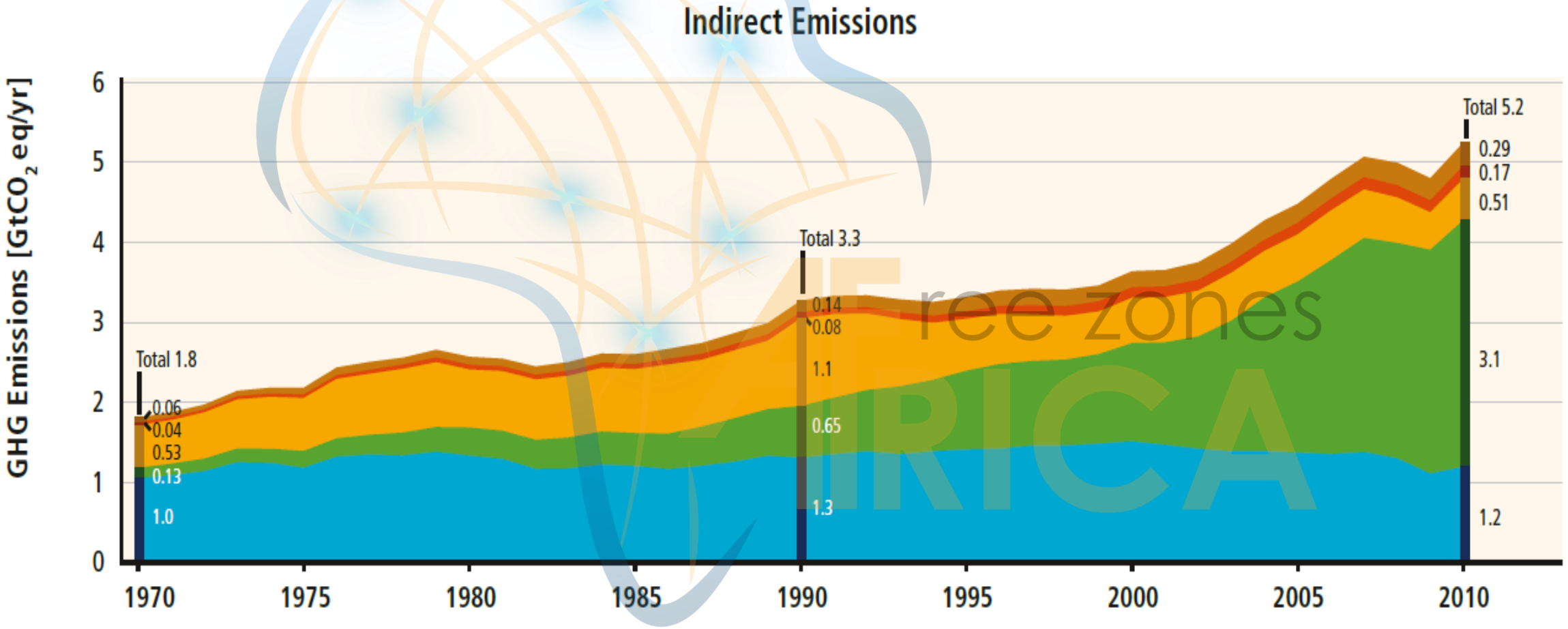

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GHG Mitigation Options for Industry

- GHG mitigation option for the industrial sector include the following:
  - Use of renewable energy sources (hydro, wind, solar, etc)
  - deployment of clean or low emission technologies
  - installation of technologies for carbon capture and storage
  - Resource Efficiency (Energy, water, materials, & waste)
    - Energy efficiency relating to systems and processes – steam systems; process heating systems (furnaces and boilers); electric motor systems (e.g. pumps, fans, air compressors, refrigerators, material handling)

GHG Mitigation Options for Industry

- Emissions efficiency (e.g. fuel and feedstock switching, carbon capture and storage)
- Material use efficiency in production (e.g. less scrap, new product design, recycling & re-use of materials & products)
- Using products more intensely, e.g. food, avoid food wastes
- Reducing overall demand for product services
- Solar thermal energy for drying and washing
- F-gases:
- Process optimization & thermal destruction to reduce non-CO_2 emissions
- Leak repairs, refrigerant recovery and recycling
- Proper disposal and replacement by alternative refrigerants
- Wastewater treatment and recycling

- Sustainable infrastructure and transport systems

Co-benefits of Mitigation

- Co-benefits include
- Enhanced competitiveness through cost reductions
- New business opportunities
- Better environmental compliance
- Health benefits – better air and water quality
- Better working conditions/environment
- Reduced wastes

Green Growth

- Concerns over climate change calls for a paradigm shift towards Green Growth
- For the last two centuries, economic growth has largely been at the expense of the environment;
- Industrialized countries have for decades pursued growth that increased pollution and global emission of GHG to the atmosphere;
- Today, the world is witnessing the consequences of such growth model, and Africa being the least contributor to GHG emissions, tend to suffer the most consequences;
- There is a broad consensus that pursuing green growth decouples carbon emissions and promotes inclusive growth and ensures environmental sustainability;
- Green growth enhances human wellbeing, social equity and shared economic opportunities while still “reducing environmental risks and minimizing the inefficient use of natural resources (UNEP, 2011a).

What is Green Growth? Contd

- Africa must transition to the new model of growth called *"Green Growth".* Green growth means different things to different people;
- There is no universally agreed definition of the concept, but there is a broad consensus on what it means;
- ***The WB*** describes it as *"growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disaster"* (World Bank, 2012).
- ***The OECD*** defines it as *"fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our wellbeing relies"* (OECD, 2011).
- ***GGGI*** defines green growth as "*the sustainable use of global resources to simultaneously achieve economic growth that is socially inclusive and environmentally sustainable*" (GGGI, 2017).

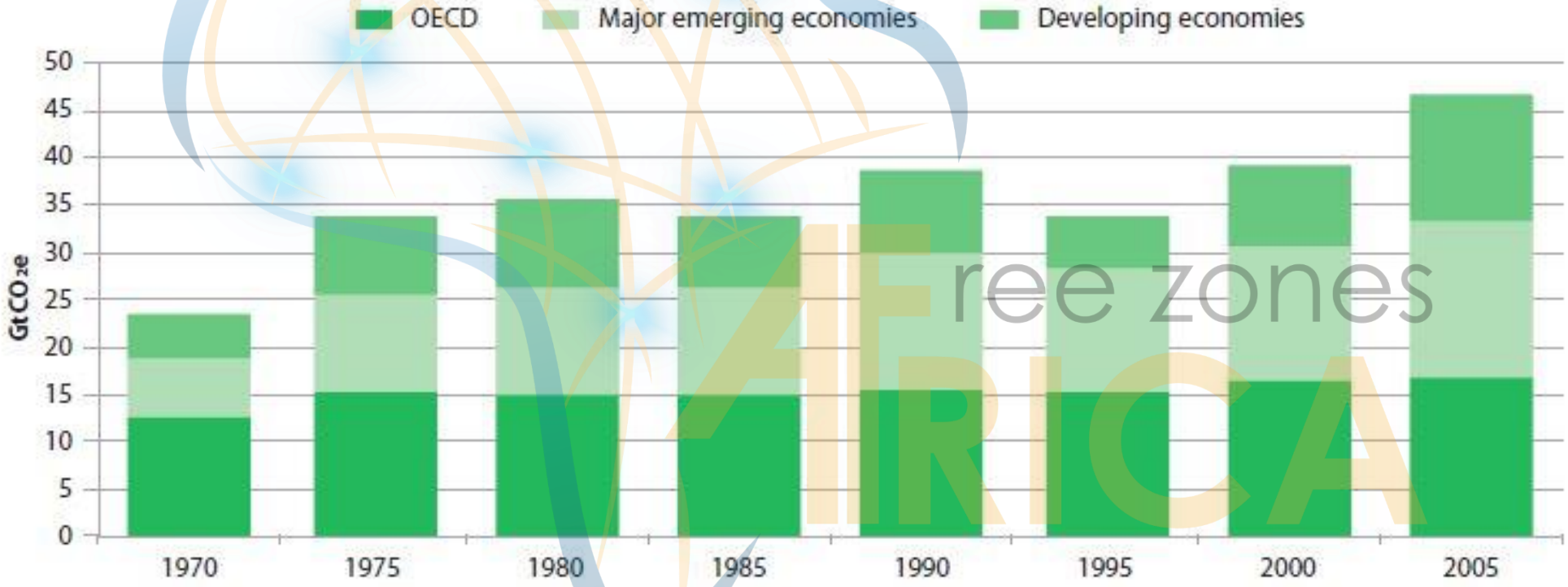
Why Green Growth Matters for DC

- DC are key to achieving global green growth because

1. The potential econ and social impacts of environmental degradation are important for DC
   - they are the most vulnerable to climate change and the most dependent on natural resources for econ growth;
   - DC face severe econ, social and ecological threats from energy, food and water insecurity due to climate change & extreme weather events;
   - They also face risks from premature deaths due to pollution, poor water quality and diseases associated with climate change.
2. DCs have the potential to increase GHG emissions if they continue conventional economic growth patterns,
   - They are becoming sources of global economic growth, emissions, and more intense use of natural resources

Why Green Growth Matters for DC,

Figure 1. GHG emissions: 1970-2005

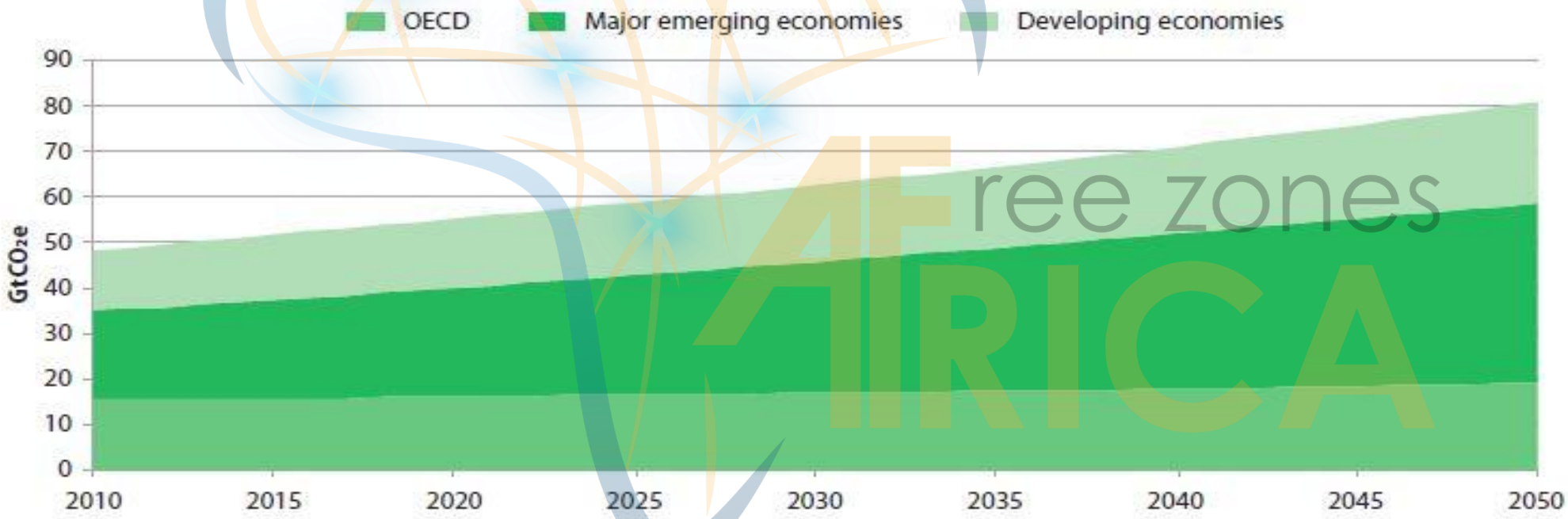


$GtCO_2e$ = Giga tonnes of CO_2 equivalent.

Source: OECD Environmental Outlook Baseline; output from ENV-Linkages.

Why Green Growth Matters for DC,

Figure 2. **GHG emissions by region: Baseline, 2010-2050**



$GtCO_2e$ = Giga tonnes of CO_2 equivalent.

Source: OECD Environmental Outlook Baseline; output from ENV-Linkages.

Why Green Growth Matters for DC,

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Figure 3. Global premature deaths from selected environmental risks: Baseline, 2010 to 2050

* Child mortality only.

Source: OECD Environmental Outlook Baseline; output from IMAGE (PBL).

Green Growth for Sustainable Dev

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- GG is about reconciling and reinforcing various aspects of econ, environmental and social policies;
- It promotes a cost-effective and resource-efficient way of guiding sustainable production and consumption choices;
- It could lead to the following Outcomes if designed and implemented effectively:

Green growth outcomes

Economic

1. Increased and more equitably distributed GDP – production of conventional goods and services
2. Increased production of unpriced ecosystem services (or their reduction prevented)
3. Economic diversification, *i.e.* improved management of economic risks
4. Innovation, access and uptake of green technologies, *i.e.* improved market confidence

Environmental

5. Increased productivity and efficiency of natural resource use
6. Natural capital used within ecological limits
7. Other types of capital increased through use of non-renewable natural capital
8. Reduced adverse environmental impact and improved natural hazard/risk management

Social

9. Increased livelihood opportunities, income and/or quality of life, notably of the poor
10. Decent jobs that benefit poor people created and sustained
11. Enhanced social, human and knowledge capital
12. Reduced inequality

Low Carbon Green SEZ?

- Increasing awareness about environmental sustainability and Climate Change is driving the development of sustainable SEZs;
- Today different terminologies are used interchangeably:
  - Pollution Control Zone/Environmental Compliance Zone
  - Eco-Industrial Park
  - Low-Carbon Green Zone

1. Pollution/Environmental Zone is the first stage towards low-carbon green zone: Main focus: effective pollution control & environmental compliance such as

- air pollution control
- sewage and wastewater treatment
- hazardous waste collection & disposal & envmntal training for managers

What is Low Carbon Green SEZ? Contnd

Eco-industrial Parks – goes beyond simple environmental management. It's a more advanced concept in terms of environmental sustainability;

- Main purpose – to manage the whole resources, energy and environmental impact in an integrated manner;

  - Eco-zones reuse and recycle resources within the industrial zone – industrial symbiosis;

  - Firms within the zone establish a network to exchange waste from one firm to another to be reused in another production process.

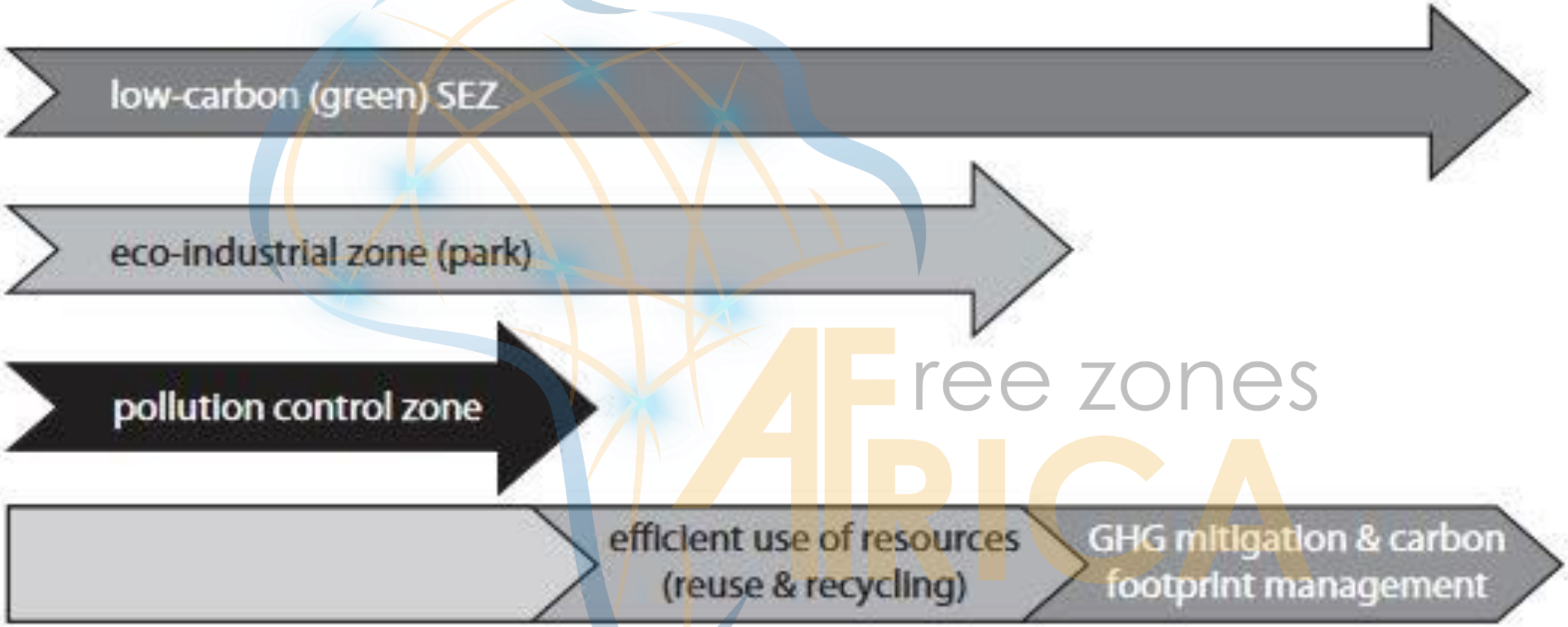
Definition: "*a community of manufacturing & service businesses located together on a common property. Members seek enhanced environmental, econ, & social performance through collaboration in managing environmental & resource use"* (Ernest 2001);

What is Low-carbon Green SEZ? Contnd

3. *Low-Carbon Green Zone* – most comprehensive and advanced concept in terms of environmental sustainability

- It entails:
  - pollution control and environmental management
  - reuse and recycle resources – industrial symbiosis
  - manages carbon footprint
  - Main attributes: using renewable energy; energy efficiency; use green building codes; waste reuse and recycling; promote climate-friendly investment; use clean tech R&D & deployment; use carbon finance mechanism.
- **Definition:** *are "SEZs that are designed, developed, and operated in a low-carbon, green, sustainable way, and hence they reduce the carbon footprint and effectively address climate change mitigation in the process of their economic and industrial activities in the zone*"

Figure 12.1 Spectrum of Environmentally Sustainable Zones



Source: Authors.

Note: GHG = greenhouse gases; SEZ = special economic zone.

Benefits of Low-carbon Green SEZs?

- Helps fight climate change through mitigation of GHG emissions

  - Maximizes the effectiveness of environmental infrastructure for industry, which otherwise could be expensive for individual companies;

  - Allows for synergy effects such as
    - efficient use of low-carbon management expertise
    - peer pressure to do what is right

  - Can serve as a useful platform to launch a low-carbon development strategy across the country

Developing Green SEZ Framework

- Low-carbon green SEZs framework can take different forms in different countries:
- Generally, Low-carbon green SEZs have 5 core components:
  1. GHG Mitigation Target
  2. Sustainable Infrastructure
  3. Climate-friendly Investment Generation
  4. Low-carbon Policy Incentives and Regulations
  5. Carbon Finance

Low-Carbon Green SEZ Components

- ***GHG Mitigation Target:***
  - The SEZ must commit to GHG mitigation & be at the center of its overall strategy
  - It must have a mitigation target & all firms must align to the target;
  - Eg. SEZ-wide 30% reduction of GHG emissions by 2020 or renewable energy mix of 15%
  - develop a baseline for GHG emissions
  - Monitor how much GHG emissions comes from which sector
- ***Sustainable Infrastructure:***
  - Planning, designing and building zone infrastructure using energy-efficient, resource-saving and low-carbon methods can reduce carbon footprint;
  - GHG reductions can be achieved by using renewable energy, energy efficiency, green buildings and waste reuse and recycling systems
- ***Climate-friendly Investment Generation:***
  - CFI aims to increase the use of clean energy, improve energy efficiency or reduce carbon footprint in the production of products and provision of services

Low-Carbon Green SEZ Components Contd

Develop climate-friendly investment promotion tools and methodologies to include green elements of business;

- attract green investments from green/climate funds

- ***Low-carbon Policy Incentives:***
  - put the right public policy framework for low-carbon SEZ success
  - eliminating trade & NTBs on climate-friendly products
  - institute green building codes, establish renewable energy and energy efficiency laws;
  - reduce taxes for green high tech investment and R&D support
- ***Carbon Finance:-***
  - Put in place carbon finance mechanism such as a Clean Development Mechanism to fund the development of Low-carbon green SEZs