Sustainable Development

Concepts , Issues and Challenges

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Paper presented by

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"Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Historical Background

- UN Conference on Environment and Development, or the 1992 Earth summit in Rio de Janeiro – unanimously adopted Agenda 21, a blueprint for sustainable development.

- Millennium Development Goals – UN General Assembly resolution 55/2, outlined 8 targets aimed at reducing poverty and promoting sustainable development

- World Summit on Sustainable Development – reaffirmed the commitment to Agenda 21 and Millennium Development Goals

Pillars of Sustainable Development

- Economic Development – poverty eradication
- Social Development – active participation of women; education; good governance
- Environmental Protection – prevent environmental degradation and patterns of unsustainable Dev.

  At the local, national, regional, and global levels

Economic Development

- Poverty eradication
- Halve, by 2015, the proportion of the world's people with income less than $1/day
- Basic health services for all, reduce health threats
- Increase food availability
- Combat desertification, mitigate effects of drought and floods
- Provision of clean drinking water
- Enhance industrial productivity

Changing Unsustainable Patterns of Consumption and Production

- *Cleaner production technologies*
- *Developing cleaner, more efficient energy technologies*
- *Maintain urban air quality and health, and reduce greenhouse gas emissions*
- *Sound management of chemicals throughout the life cycle, and of hazardous wastes*

Protecting the Natural Resource Base

- Prevent water pollution to reduce health hazards and protect ecosystems
- Watershed and groundwater management
- Support desalination of seawater, water recycling
- Ensure the sustainable development of oceans, marine environmental protection

Priority Areas for Action

Priority areas for action, identified by UN Secretary-General Kofi Annan

- **W**ater and sanitation
- **E**nergy
- **H**ealth
- **A**griculture
- **B**iodiversity protection and ecosystem management

Water and Sanitation

"Water is not only the most basic of needs but is also at the center of sustainable development."

- Around 1.2 billion people still have no access to clean drinking water
- Around 2.4 billion people do not have adequate sanitation.

Water and Sanitation

Some key issues:

- Prevent water pollution to reduce health hazards
- Protect ecosystems
- Introduce technologies for affordable sanitation, industrial and domestic wastewater treatment
- River basin, watershed and groundwater management
- Support desalination of seawater, water recycling
- Marine environmental protection - oceans, seas, the Earth's ecosystem

Energy

"Some 2 billion people lack access to electricity and rely on traditional fuel sources such as firewood, kerosene, or biomass for their cooking and heating."

Energy

Some key issues:

- Focus on access to energy in rural areas
- Energy conservation and energy efficiency – building design & management, better mass transportation, advanced and innovative cleaner technologies
- Promotion of renewable energy
- Action on climate change – ratification by countries of the Kyoto Protocol

Health

"Good health is vital for eradicating poverty and achieving sustainable development."

Some key issues:

- Reduce mortality rates in 2015: by 66.7% for children & infants under 5; by 75% for maternal mortality rates
- Control & eradicate communicable diseases, reduce HIV prevalence, combat malaria, tuberculosis
- Ensure that chemicals are not used and produced in ways that harm human health
- Reduce air pollution

Agriculture

"Agriculture is central to sustainable development. About 70% of the poor in developing countries live in rural areas and depend in one way or another on agriculture for their survival."

Some key issues:

- Address serious soil fertility problems
- Diversification of crops
- Increase water-use productivity
- Apply R&D to increase productivity in crops and livestock

- (Sustainable development in the agriculture, forestry and fishery sectors conserves land, preserves water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable." (FAO 994))

Take a look at the Global Agriculture

between 1960 and 2000:

- world population doubled from 3 to 6 billion people
- global economy increased more than sixfold

to meet this demand:

- food production increased 2 ½ times
- water use doubled
- wood harvests for pulp and paper production tripled
- timber production increased by more than half

Who is eating?

Source: http://www.millenniumassessment.org/

Livestock Development

- Livestock development
  - Sustainable animal productio
  - Improving productivity of animals
  - Feed supplementation for increasing livestock production
  - Improving fertility and disease diagnosis

Fertilizer Use

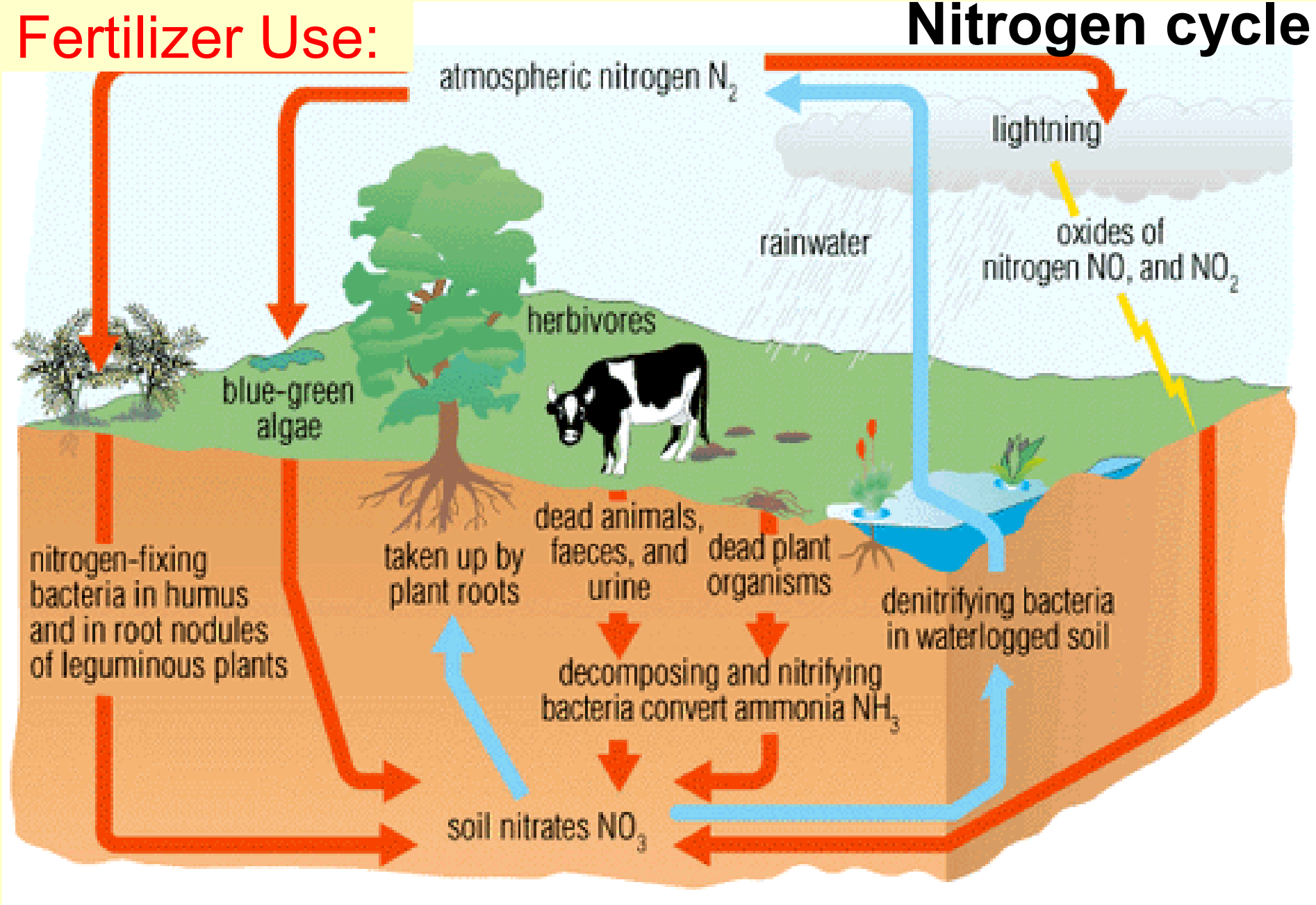
With high yielding varieties of crops, most soils are unable to supply the needed amounts of plant nutrients.

Fertilizers are chemicals that supply plant nutrients, mostly N, P and K.

Manufacture of N-based synthetic fertilizers requires fossil fuels as raw materials.

Fertilizer Use:

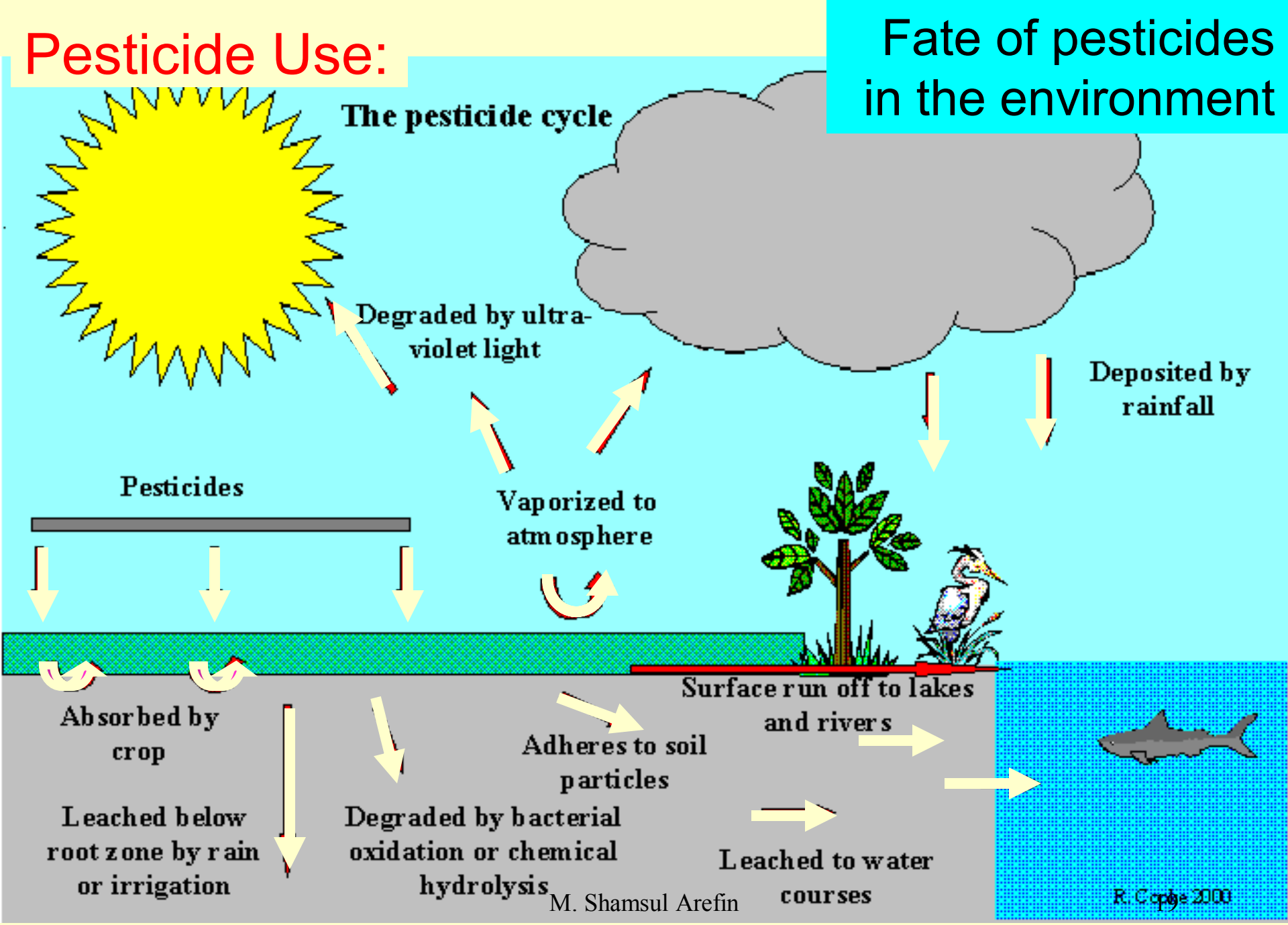
Nitrogen cycle



Source: http://www.allrefer.com/pictures/s4/p0001901-nitrogen-cycle

Pesticide Use:

Fate of pesticides in the environment



Source: http://www.ecifm.rdg.ac.uk/pesticides.htm

Biodiversity

Biodiversity is a modern term which simply means " the variety of life on earth". This variety can be measured on several different levels.

- **Genetic** - variation between individuals of the same species. This includes genetic variation between individuals in a single population , as well as variations between different populations of the same species.

Species - species diversity is the variety of species in a given region or area. This can be determined by counting the number of different species

Ecosystem - Communities of plants and animals, together with the physical characteristics of their environment (e.g. geology, soil and climate) interlink together as an 'ecosystem'. Ecosystem diversity is more difficult to measure because there are rarely clear boundaries between different ecosystems

Biodiversity

- **Biodiversity - is a term we use to describe the variety of life on Earth.**

- **It refers to the wide variety of ecosystems and living organisms like animals, plants, their habitats and their genes.**

- **Biodiversity** is the degree of variation of life forms within a given ecosystem.

- Rapid environmental changes typically cause mass extinctions.

Biodiversity & Ecosystem Management

"Biodiversity and the ecosystems are the living basis of sustainable development."

Biodiversity & Ecosystem Management

Some key issues:

- Significantly reduce the rate of biodiversity loss by 2015
- Reverse the trend in natural resource degradation
- Restore fisheries to their maximum sustainable yields
- Protection of the marine environment from land based sources of pollution

Ecology

- The word "ecology" ("Ökologie") was used first in 1866 by the German scientist Ernst Haeckel (1834–1919).

- **Ecology** is the interdisciplinary scientific study of the distribution and abundance of organisms and their interactions with their environment

- Ecology is a sub-discipline of biology, the study of life. An observations on the natural history of plants and animals.

- Ecology is not synonymous with environment. It is closely related to physiology, evolutionary biology, genetics.

- An understanding of how biodiversity affects ecological function is an important focus area in ecological studies.

- Ecosystems sustain every life-supporting function on the planet, including climate regulation, water filtration, soil formation.

Picture of biodiversity

German Federal Environment Minister Sigmar Gabriel cited estimates that up to 30% of all species will be extinct by 2150.

Degradation of Ecosystems

- Degradation of ecosystems (forest, fresh water, marine, etc.)

- Upsetting the carbon cycle, resulting in global warming and climate change and the consequences

- Depletion of the ozone layer

- Pesticide, heavy metals and other persistent toxic chemicals like DDT poisoning the web of life

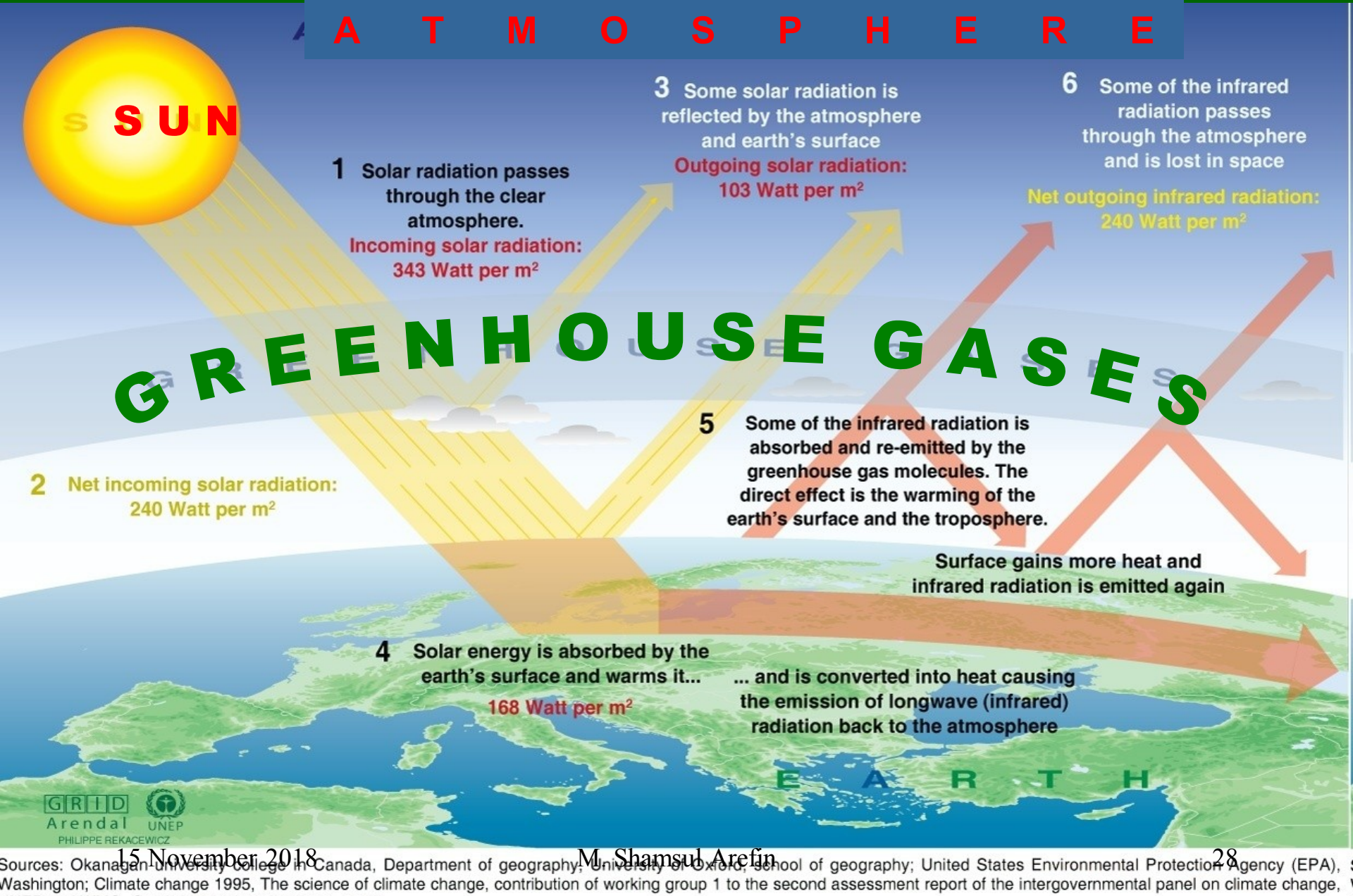
- Loss of clean air

Issues of Sustainable Development

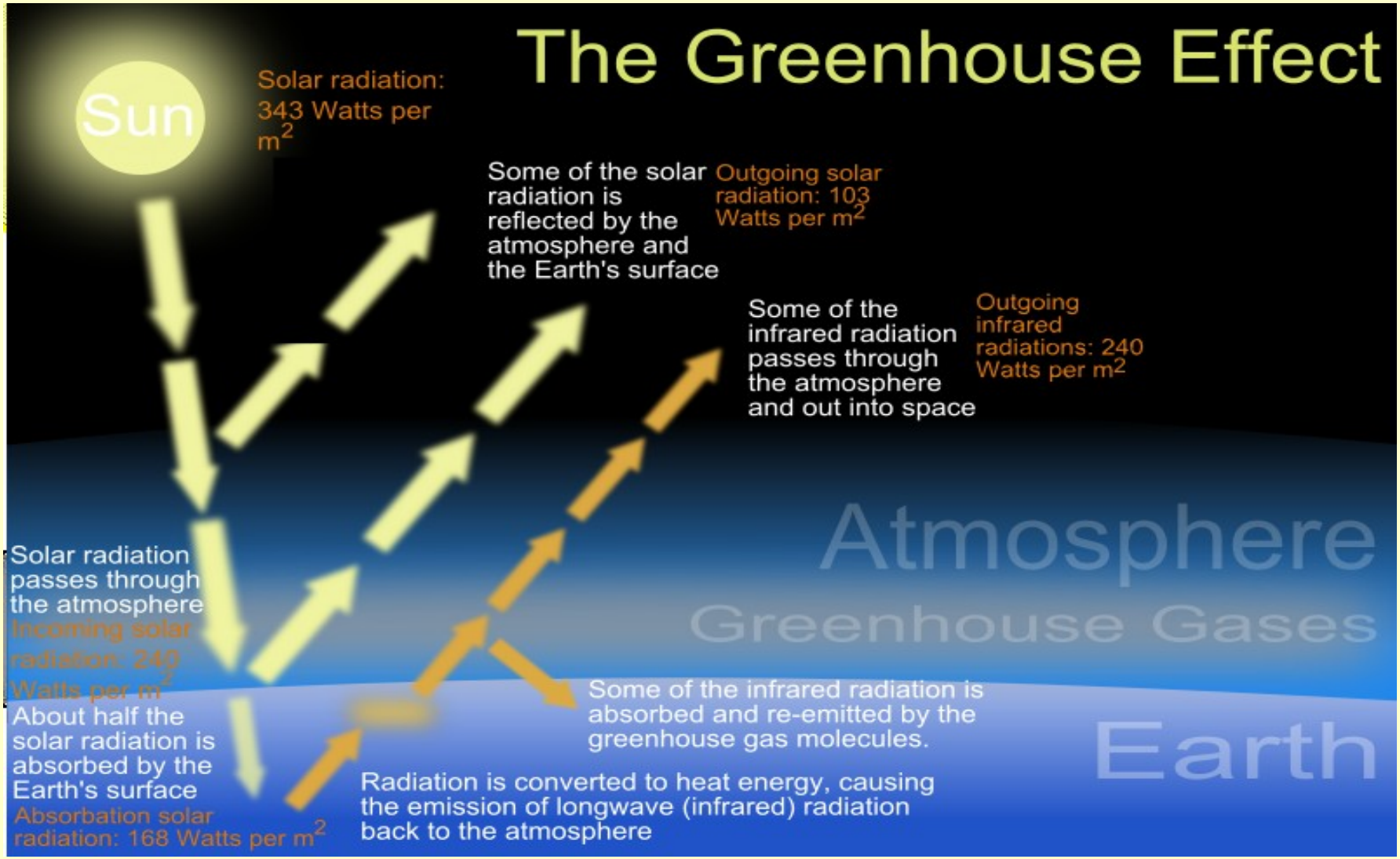
- How can we all live well and live within the means of one planet?

- This is the question of the 21st century. If we do not design ways to live within the means of one planet, sustainability will remain elusive

The Greenhouse Effect



Sources: Okanagan University College in Canada, Department of geography; University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.



Source: Intergovernmental Panel on Climate Change (IPCC), UN

GHG

- Gases that trap heat in the atmosphere are called greenhouse gases
- Greenhouse gases are those that can absorb and emit infrared radiation.
- In order, the most abundant greenhouse gases in Earth's atmosphere are

  - Water vapor
  - Carbon dioxide
  - Methane
  - Nitrous oxide
  - Ozone

Emission of GHGs in Bangladesh

- GHG emission is low and negligible
- Per capita GHG emission is 230 kg only

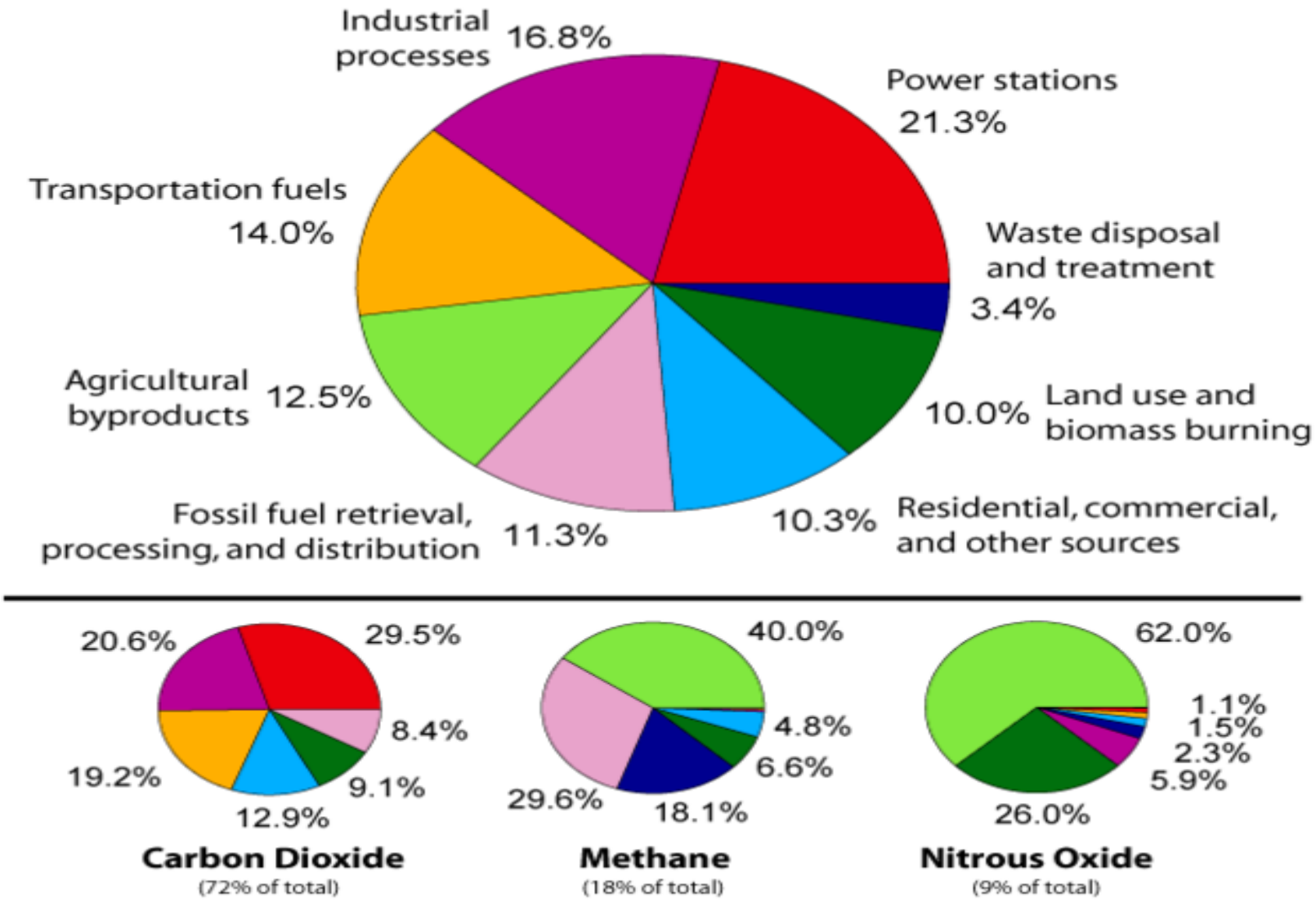
Sectoral consumption of electricity

- Industries (46%)
- Residential (45%)
- Commercial (7%)
- Others (2%)

Large part of GHG is coming from electricity generation and transport sector

- Landfills also generate GHG

Annual Greenhouse Gas Emissions by Sector



Source "Special Report on Emissions Scenarios: (Data) IPCC SRES Emissions Scenarios - Version 1.1 (July , 2000)"

Global Warming

The burning of fossil fuels, land use change and other industrial activities since the industrial revolution have increased the GHGs in the atmosphere in such a level that the earth's surface is heating up to temperatures that are very destructive to life on earth.

Consequences

Consequences

- D*eath of coral reefs*
- *Spread of dengue and other diseases*
- *Heavy rains & severe draughts*
- *Floods, storms, & hurricanes*
- *Changed rainfall patterns*
- *Warming and aridity*
- *Loss of biodiversity*

Renewable energy

are flows of energy that are regenerative or virtually inexhaustible.

- Dr. Raymond Wright

Sustainable energy

is energy which is replenishable within a human lifetime and causes no long-term damages to the environment.

Source: http://www.jsdnp.org.jm/glossary.html

Global primary energy consumption in 2006

$\approx 15.8\ TW = 15.8 \times 10^{12}\ W$

Global population in 2006 ≈ 6.56 billion

Global energy consumption per person in 2006

$$\approx \frac{15.8 \times 10^{12}\ W}{6.56 \times 10^{9}}$$

≈ 2.4 kW

Source: International Energy Annual 2006 (posted Dec 19, 2008)
http://www.eia.doe.gov/iea/

Energy Options

Fossil fuels (coal, oil and natural gas)

Hydropower

Nuclear energy

Solar energy

Wind energy

Geothermal energy

Ocean (wave, tidal and ocean thermal) energy

Biomass energy

Biofuels (bioethanol or biodiesel) energy

Nuclear Energy

Nuclear waste and the retired nuclear plants could remain radioactive for hundreds of future years.

Uranium is available on earth only in limited quantities. Uranium is being converted during the operation of the nuclear power plant so it won't be available any more for future generations.

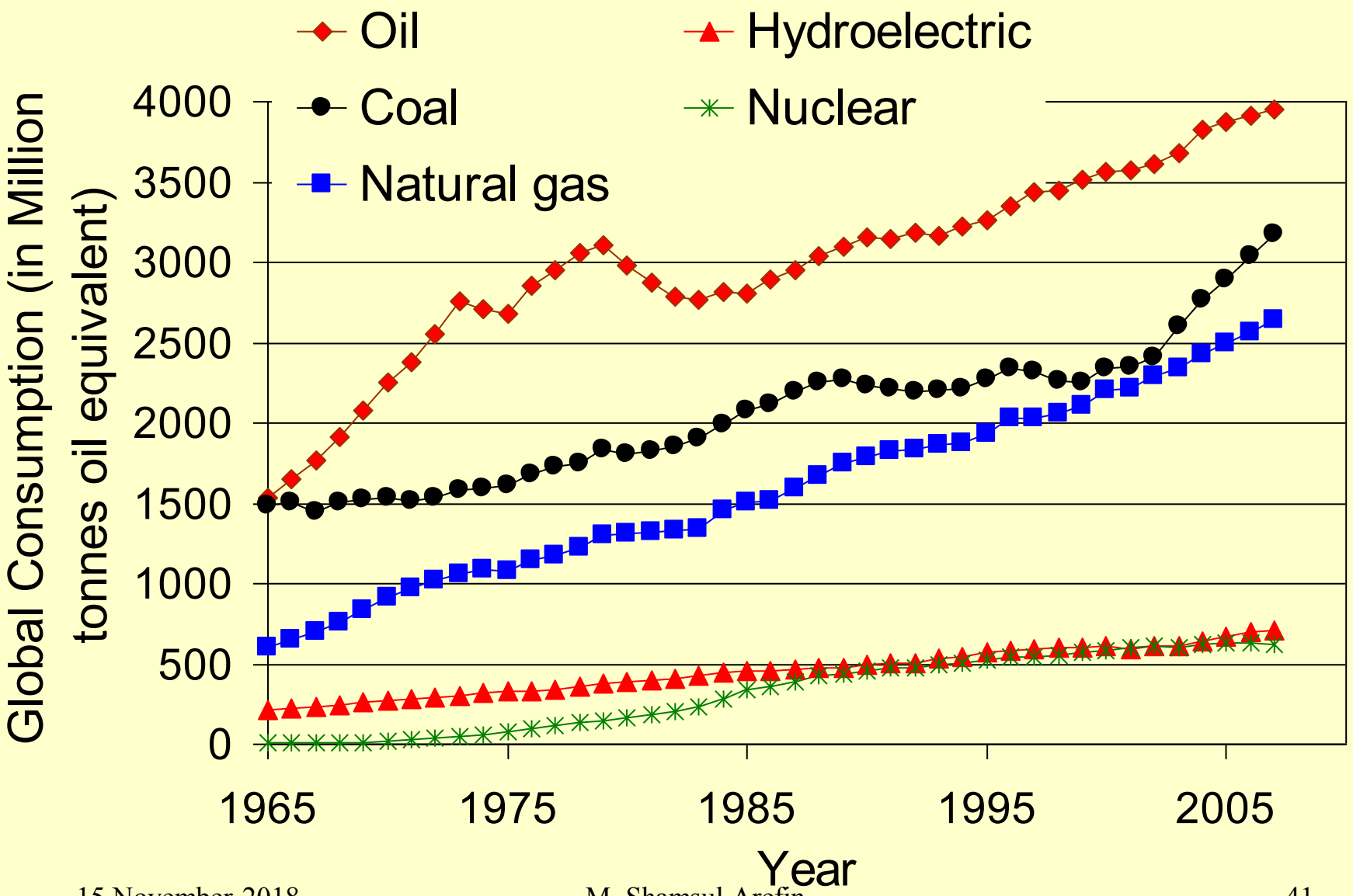
Therefore nuclear power is not a sustainable source of energy.

Nuclear Energy

- Nuclear fission provides 16% of the world electricity production and 7% of the total energy consumption.
- Current usage of uranium is about 65,000 t/yr.
- The world's present measured resources of uranium in the cost category somewhat below present spot prices is about 5.5 Mt.
- They could last for over 80 years at the current usage rate.

Source: http://www.world-nuclear.org/info/inf75.html

Fossil fuels

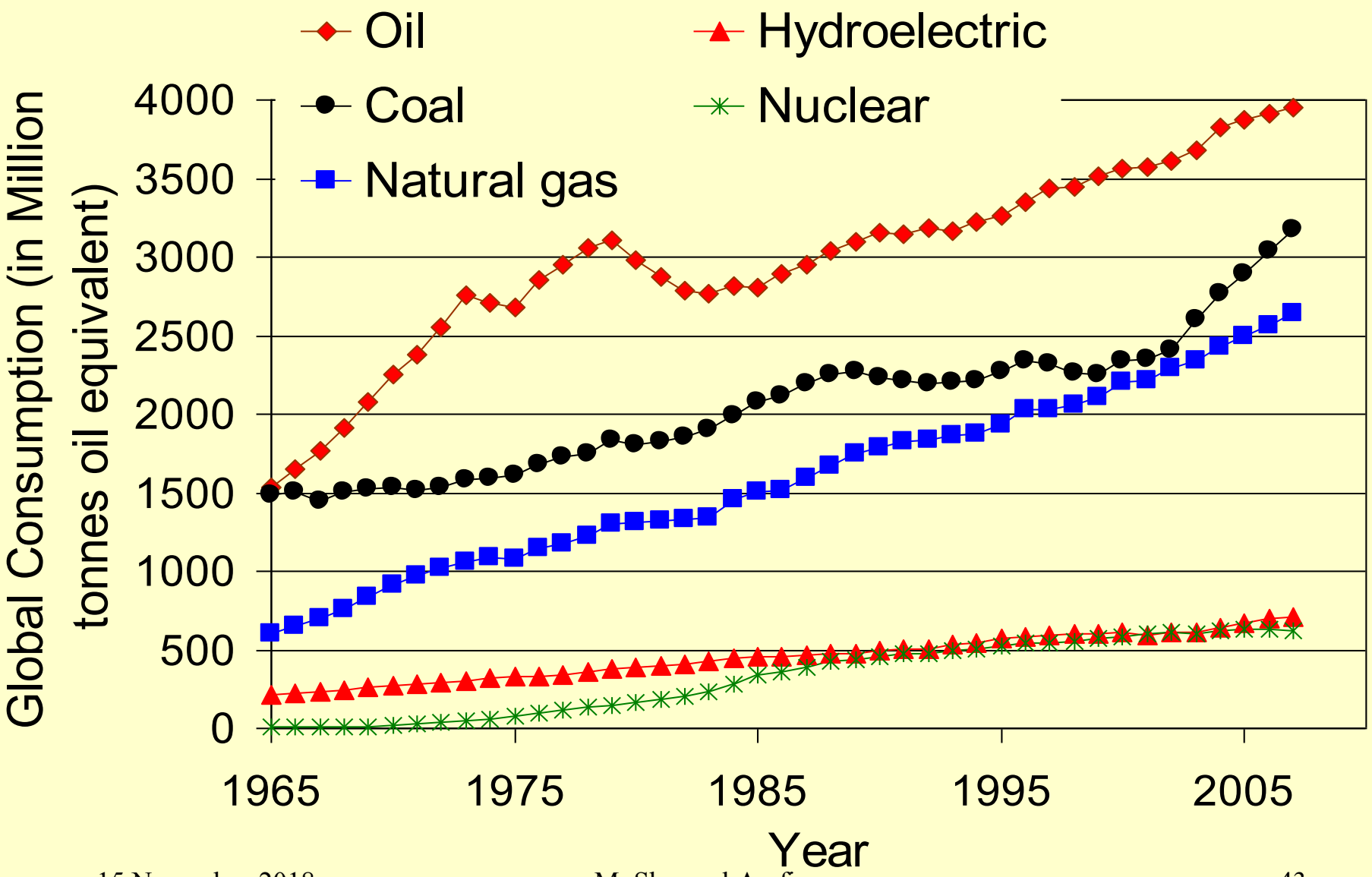


Source: BP Statistical Review of World Energy June 2008

Fossil fuels

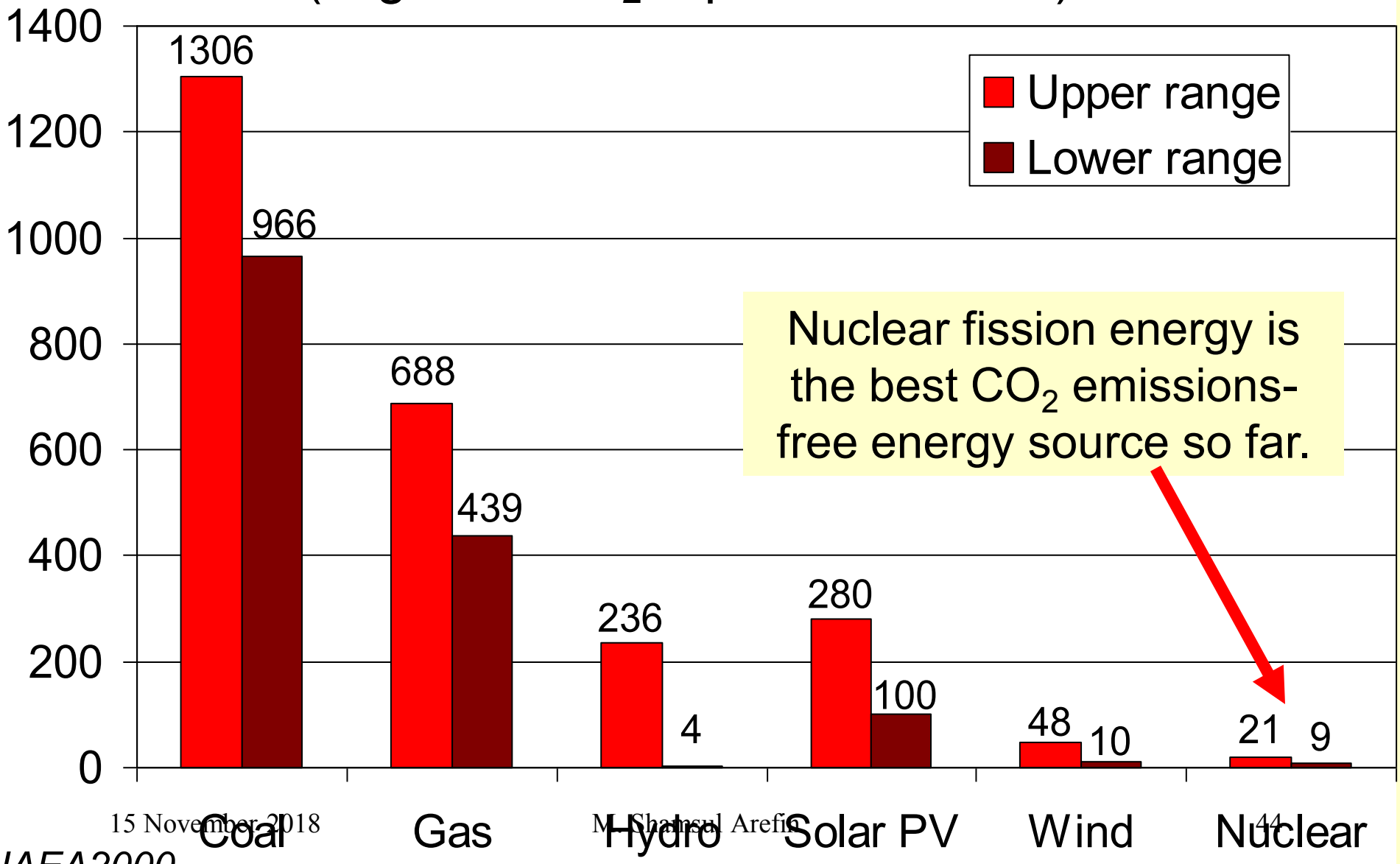
- For energy (electricity and heat), we depend heavily on the combustion of fossil fuels like coal, oil and natural gas.
- Fossil fuels burning is responsible for about 85% of the anthropogenic CO_2 emissions produced annually, and therefore the major cause for global warming.
- Fossil fuels are non-renewable sources of energy.
- Fossil fuel is not a sustainable energy source.

Fossil Fuels



Source: BP Statistical Review of World Energy June 2008

Indirect CO_2 emissions from life cycle (in grams CO_2 equivalent / kWh)



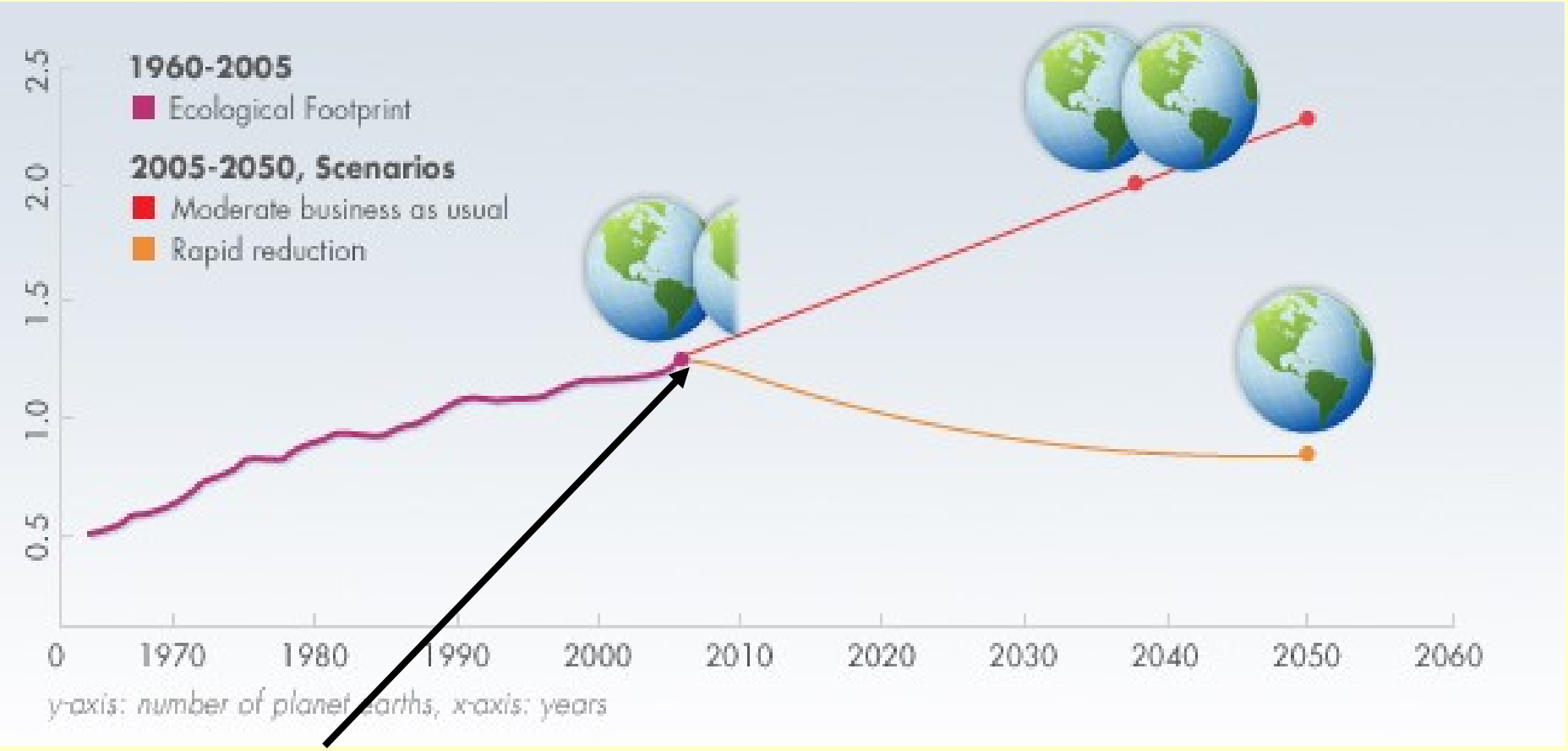
IAEA2000

One option: Emissions Reduction

Reduce Population

More people

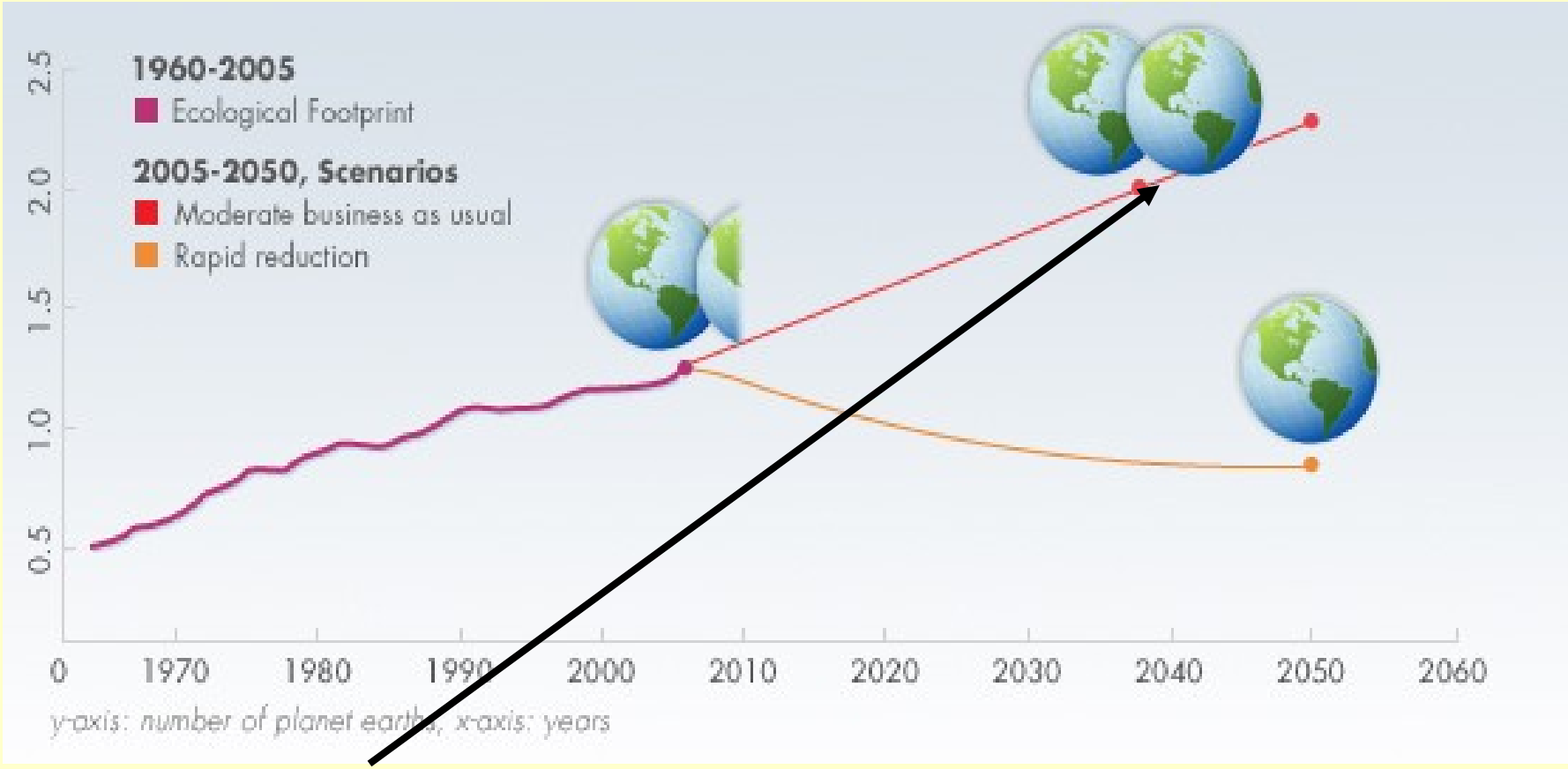
More pollution



EF is 1.3 times the bio capacity in 2005. That is to say we need 1.3 planets to provide the resources we use and absorb our waste.

This means, in 2005, it took the Earth one year and four months to regenerate what we use in a year.

Source: http://www.footprintnetwork.org



EF will be 2 times the bio capacity by the mid 2030 if current population and consumption trends continue according to moderate UN scenarios.

It means by the mid 2030s we will need the equivalent of 2 Earths to support us.

Source: http://www.footprintnetwork.org

Ecological Footprint (EF)

- EF measures how much land and water area a human population requires to produce the resource it consumes and to absorb its wastes, using prevailing technology.
- EF does not include an economic indicator.

Sustainable global EF per capita

= Total Bio capacity per capita

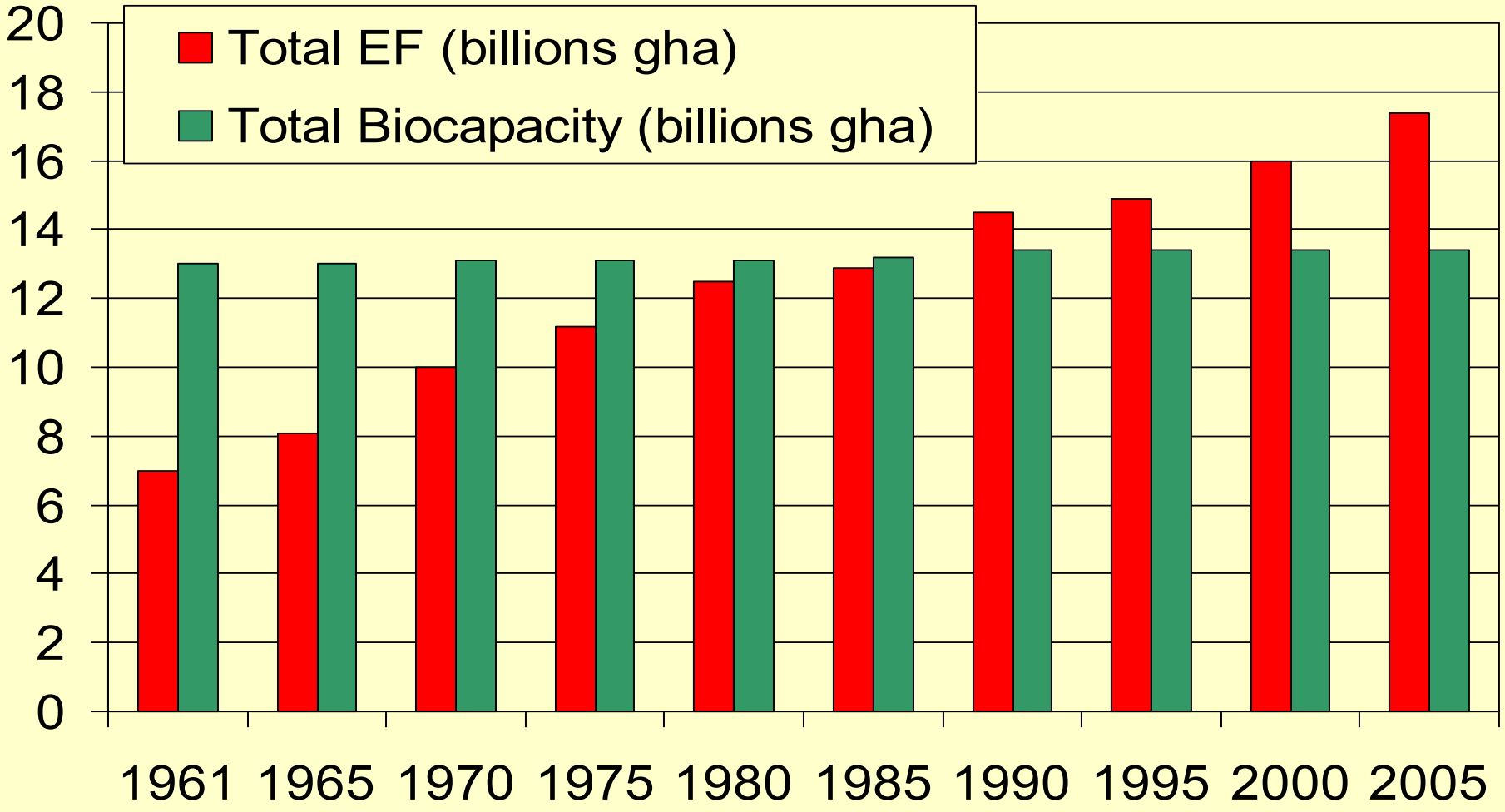
Source: http://www.footprintnetwork.org

Biocapacity

Biocapacity is shorthand for biological capacity, which is the ability of an ecosystem to produce useful biological materials and to absorb wastes generated by humans.

Source: http://www.footprintnetwork.org

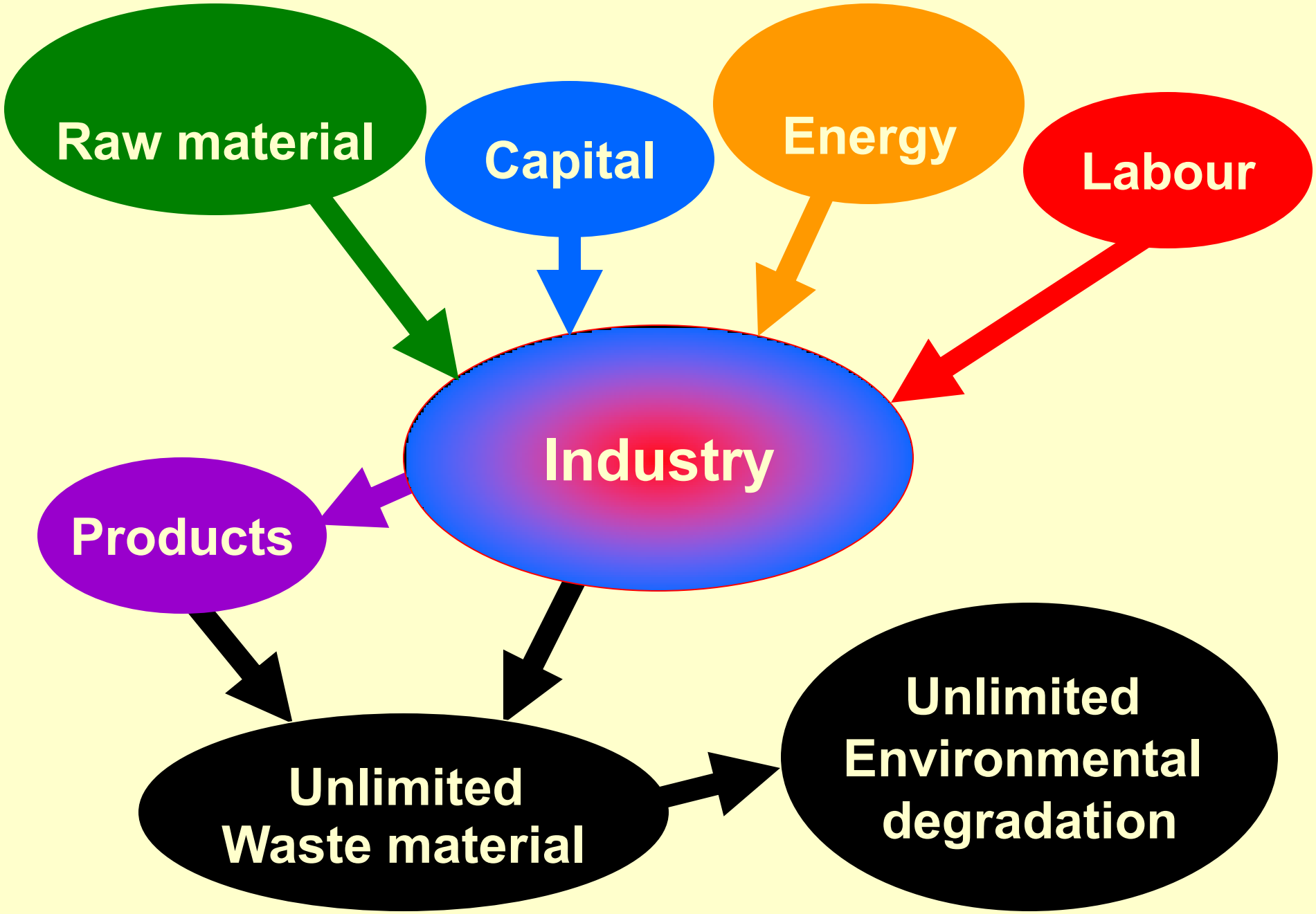
For the World



Before 1986, the world consumed resources and produced CO_2 at a rate consistent with what the planet could produce and reabsorb.

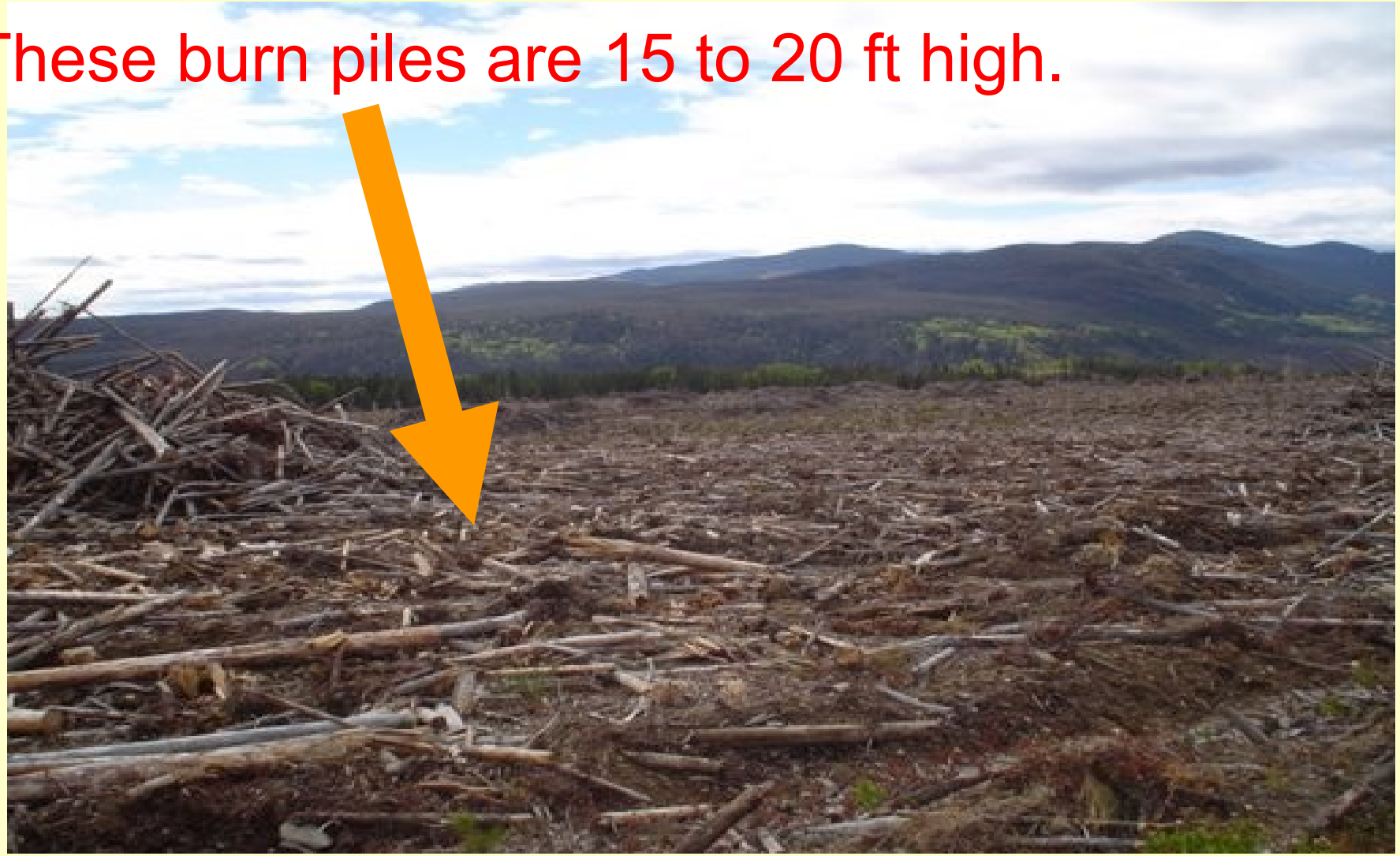
Source: http://www.footprintnetwork.org

We should place a limit on CO_2 emissions to ensure sustainable development


Raw material
Capital
Energy
Labour
Industry
Products
Unlimited
Waste material
Unlimited
Environmental
degradation

Forest industry waste

‘Most "wood" companies only handle one type of wood and burn the rest.’



Factory waste

More than 500 factorie (mostly textiles) line the banks of the 200-mile Citarum river, near the Indonesian capital of Jakarta.

Source: http://rekkerd.org/citarum-river-a-shocking-display-of-abuse/

Computer industry waste

Source: http://www.greenpeace.org/international/photosvideos/photos/close-up-of-a-huge-pile-of-com

WAY AHEAD

Measures of Human Well-being

stable job

well paid job

low infant mortality

life free of avoidable morbidity

low inflation

long life

adequate housing

adequate nutrition

high GDP per capita

civil liberties

care of the environment

good education level

free markets

good income distribution

Source: Montenegro, A., An Economic Development Index, http://129.3.20.41/eps/dev/papers/0404/0404010.pdf

Hydroelectric Power

Why hydroelectric power is important?

- Once the dam is built, the energy is virtually free.
- No waste or pollution produced.
- Much more reliable than wind, solar or wave power.
- Water can be stored above the dam ready to cope with peaks in demand.
- Hydro-electric power stations can increase to full power very quickly, unlike other power stations.
- Electricity can be generated constantly.

Hydroelectric Power

Hydroelectric Power

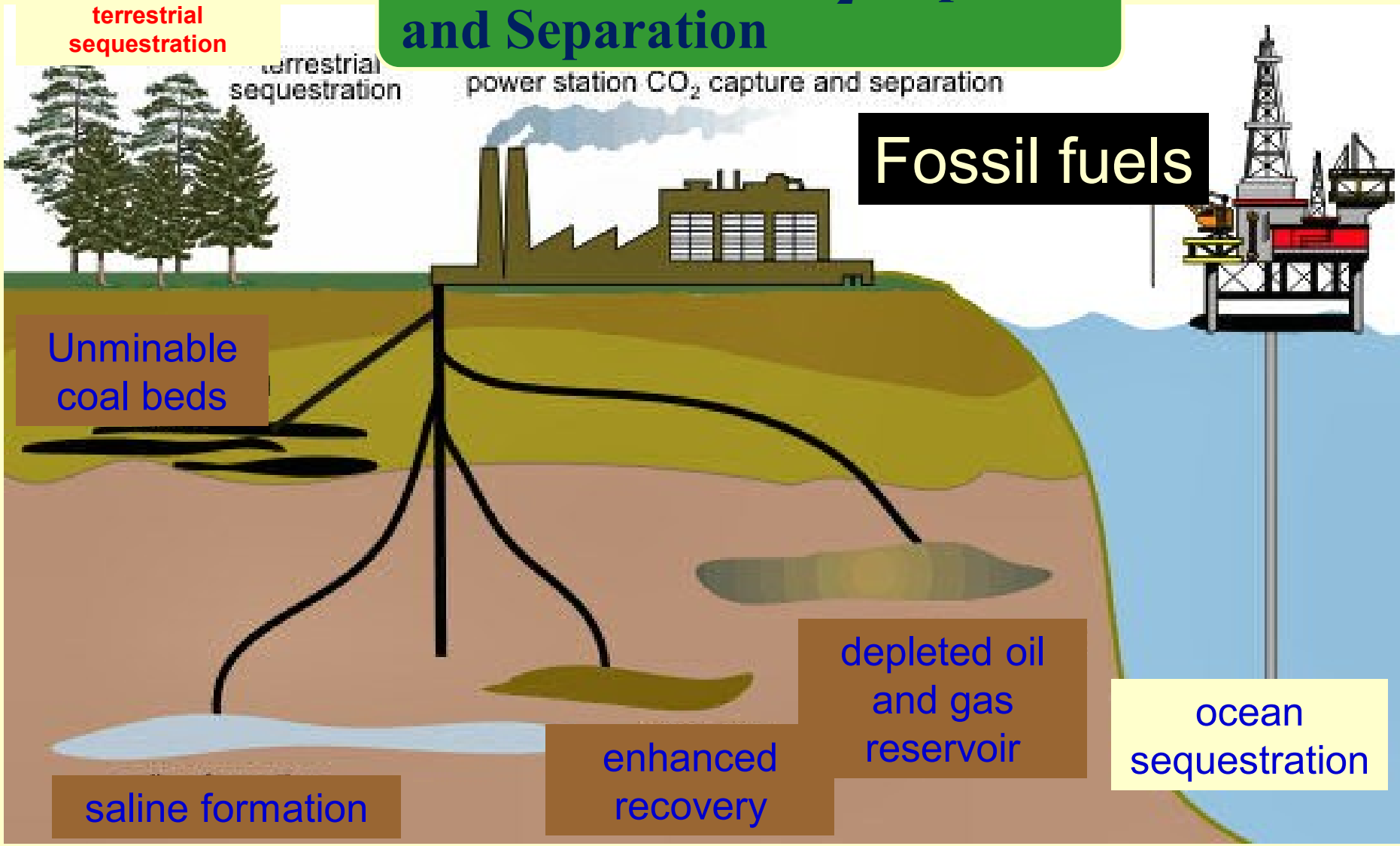
Problems with hydroelectric power

- Barriers in the natural flow of a river prevents fish from migration, alters ecosystems, and threatens the livelihoods of local communities

- the world's 52,000 largest dams release 104 million metric tons of methane (a greenhouse gas) annually

- reservoirs fill up with sediment and cost billions of dollar

Power Station CO_2 Capture and Separation



CCS is controversial since permanent storage of CO_2 underground is not guaranteed

Conclusion

It is good to have increased food production which might have helped reducing the number of undernourished people.

The first of the Millennium Development Goals (MDGs)

is to

Eradicate Extreme Poverty and Hunger

The seventh of the MDGs is to

Ensure Environmental Sustainability

How to achieve both the goals simultaneously?

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