Workshop - "The *Science of Climate Change & Climate Change Vulnerability & Adaptation*"

Energy & Climate Change

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Institute of Meteorology of Cuba (INSMET).

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Content

1. Energy, Society and Security.
2. Consumption Patterns and Sources.
3. Emission Patterns and Sources.
4. Way Forward.

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ENERGY, SOCIETY AND SECURITY.

Energy Security

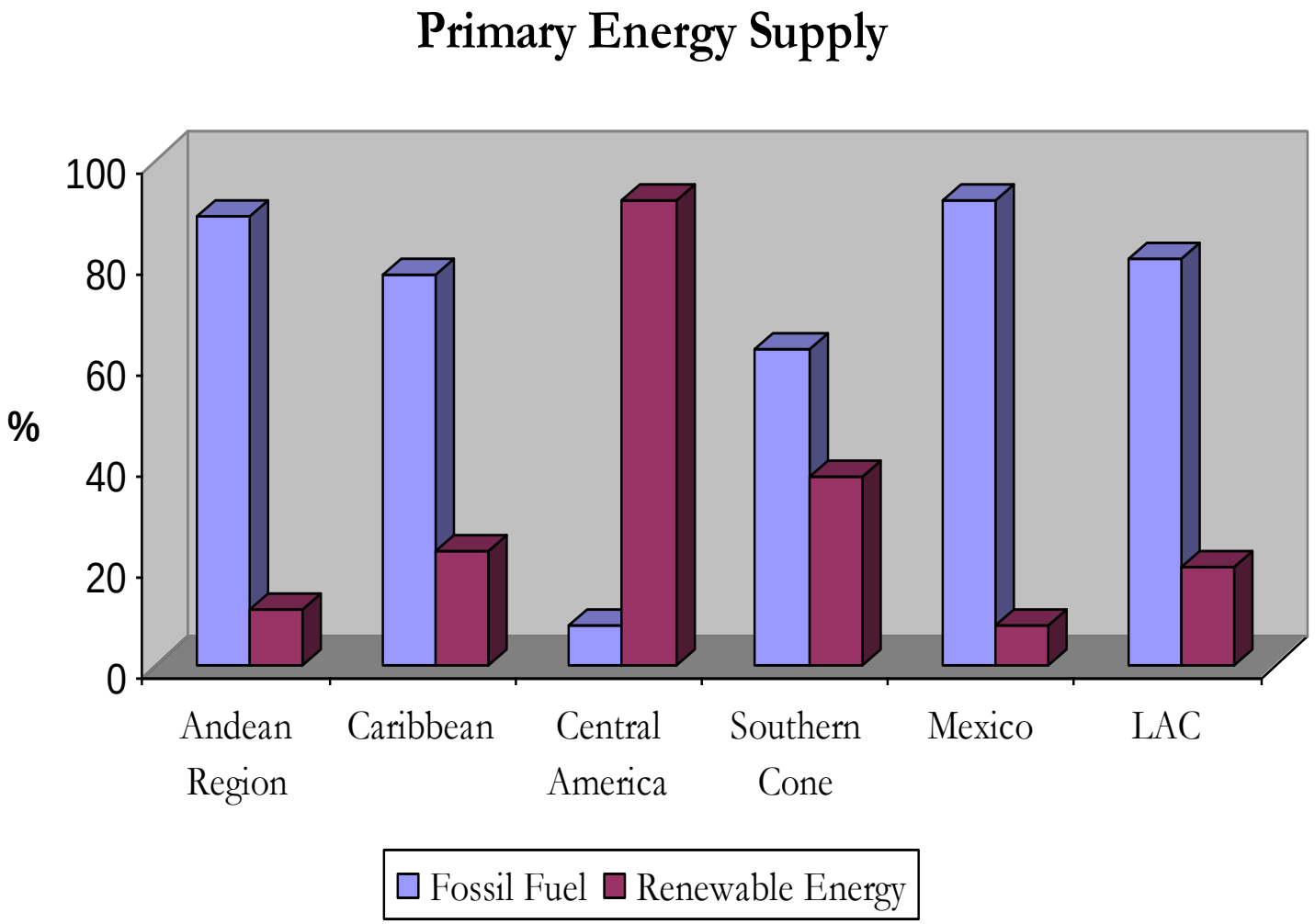
- Energy is critical for growth and development of all economic, social and environmental parameters of society.
- Maturing societies must plan to supply more and efficient energy services with development.
- Decisions around energy source, usage, energy mix, dependence and treatment of wastes (emissions) must consider the following;
  - **Accessibility** *(of affordable energy; indigenous vs. imported energy options*).
  - **Acceptability** *(of the energy sources used, particularly in environmental , health and safety terms).*
  - **Availability** *(how secure and reliable are those sources when needed?).*

(World Energy Council 2007)

Energy Security

- Fossil fuel imports accounts for as much as **95% of total primary energy** for some SVEs and SIDs.
- REN options are a critical hedge against times of energy scarcity BUT currently only 3% of the energy mix in Caribbean.
- Endowments are varied and limited. Most SIDs, SVEs and some LDCs may not harness > 25 – 30% for the national energy mix.
- **Accessibility** of affordable local or imported fuels; **acceptability** of the options in sensitive and vulnerable ecosystems; and **availability** when needed for small economies will influence the selection of the best fuel options.

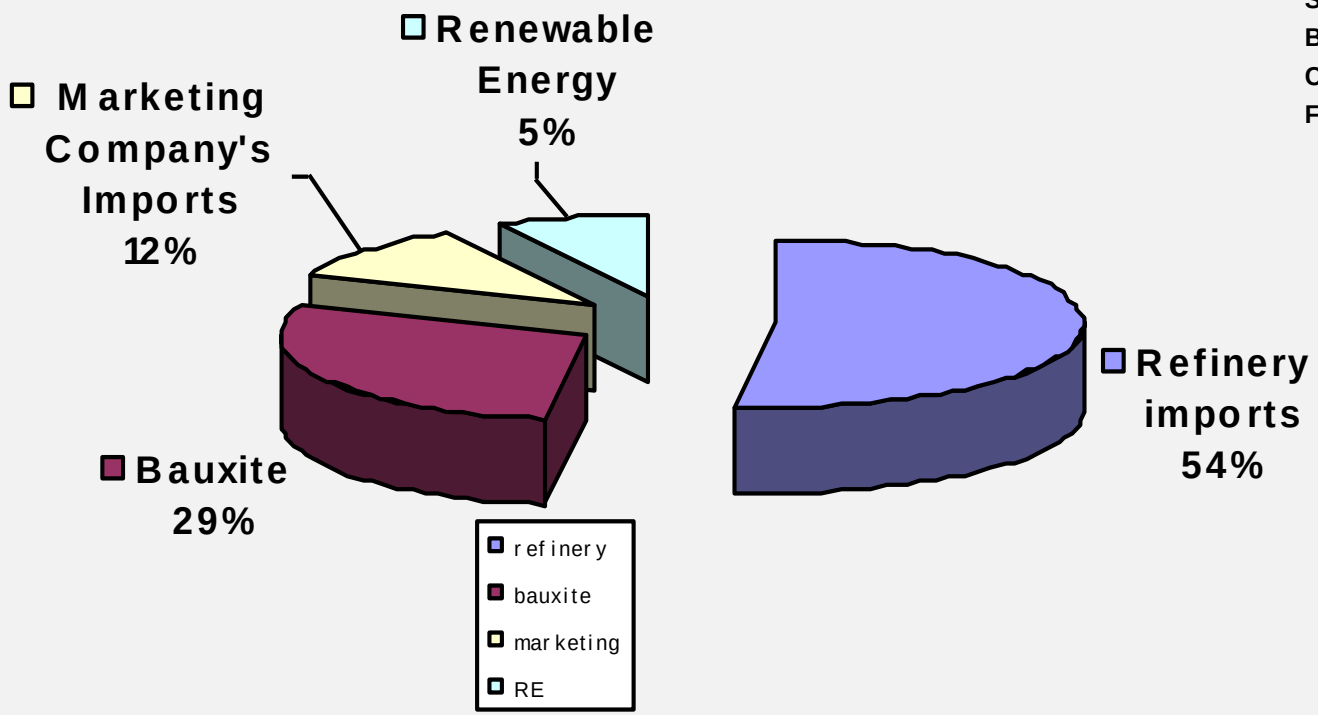
LAC Energy Supply



Source: OLADE SIEE, 2005

Jamaica's Energy Situation

Jamaica's Energy Supply by source



Renewable Energy

Hydro, Wind, Solar, Bagasse, Charcoal, Fuelwood, Other

- Jamaica imports over 90% of its energy needs.

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CONSUMPTION PATTERNS & SOURCES

World Consumption

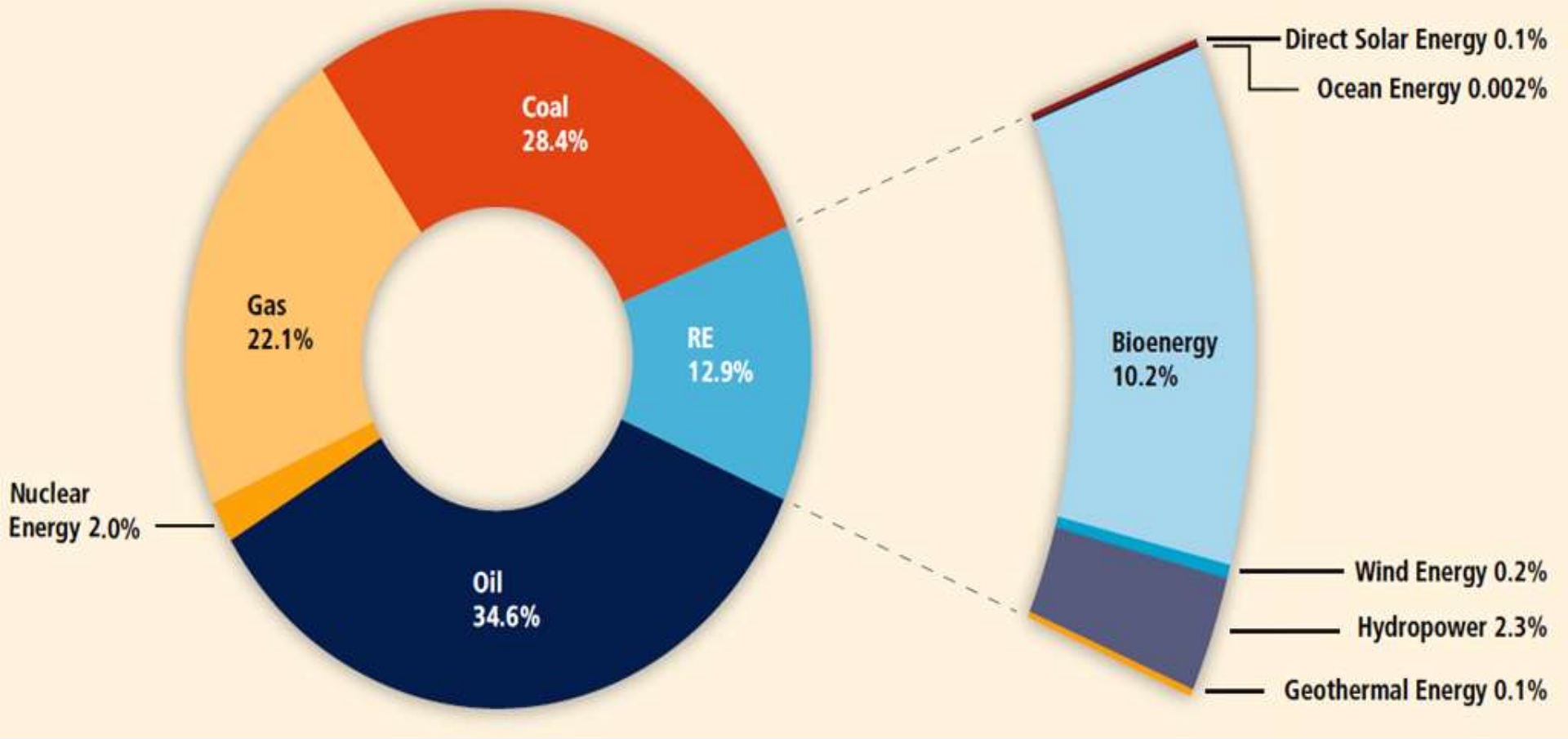
- Global energy use approx **245 million barrels per day of oil-equivalent (MBOE)** energy.
  - Transportation.
  - Electricity.
  - Farms and factories.
  - Heating and cooling buildings.
  - other.

- By 2030, with projected economic and population growth, the world's total energy demand is expected to be approximately 35% higher than 2005, despite significant gains in energy efficiency.

  (Exxon Mobil 2009)

- Among anthropogenic sources for GHG, various uses of energy is by far the greatest contributor.

Global Energy Sources



Energy Consumption By Regions

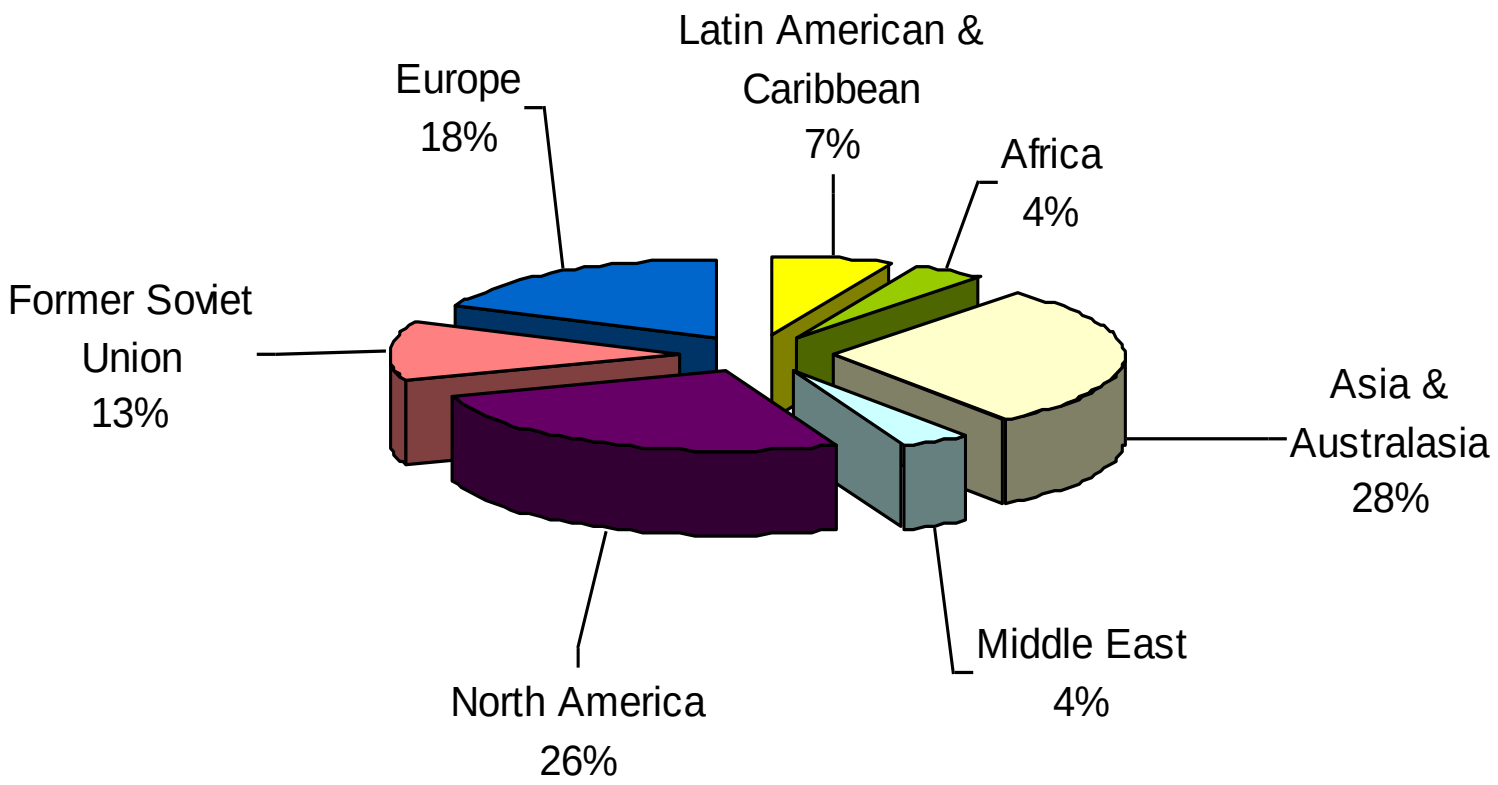
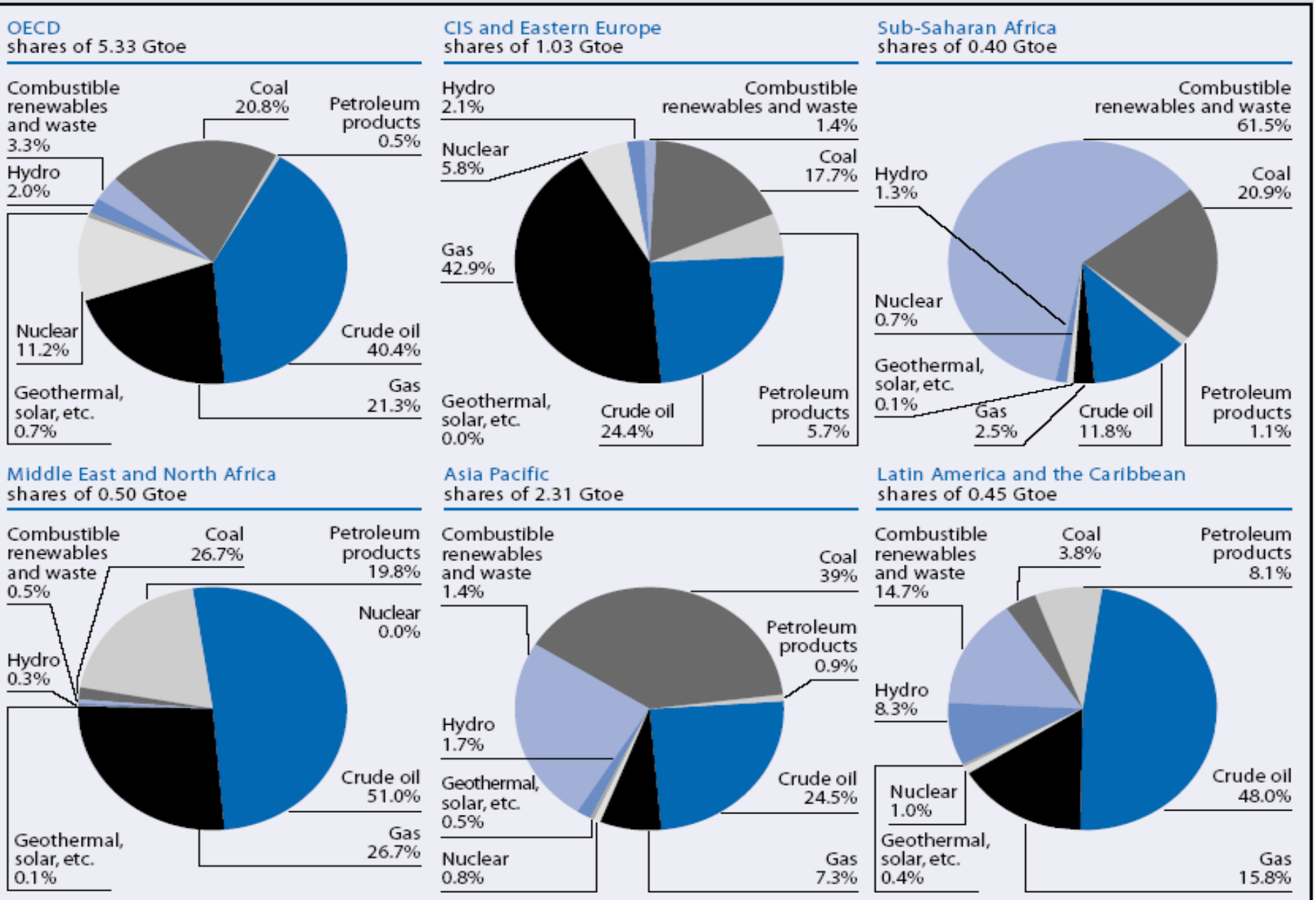


FIGURE 7. PRIMARY ENERGY USE IN VARIOUS REGIONS, BY ENERGY SOURCE, 2001

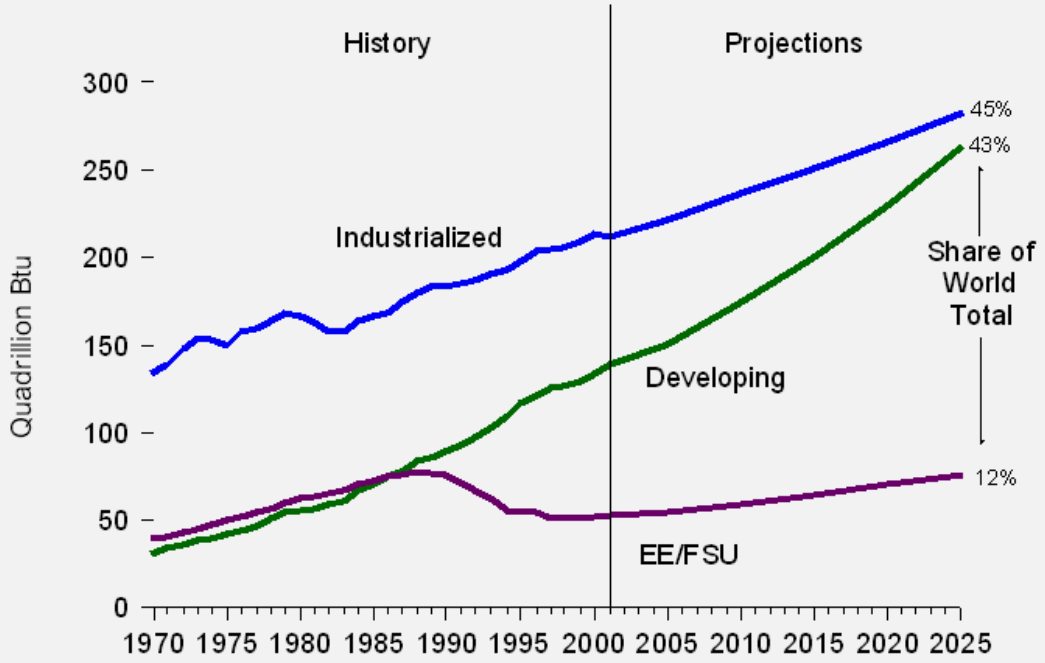


Source: IEA, 2003c.

Energy Consumption Projections

Energy consumption trends do not necessarily match wealth & resources.

World Marketed Energy Consumption by Region, 1970-2025



Source: EIA, *International Energy Outlook 2004*

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EMISSION PATTERNS & SOURCES

Energy and Emissions

- Global energy consumption has increased nearly 70% since 1971 and rising.

- Energy demand increasing > 2%/yr for the past 25 years and will maintain this rate over the next 15 years (BAU case).

(International Energy Agency (IEA).

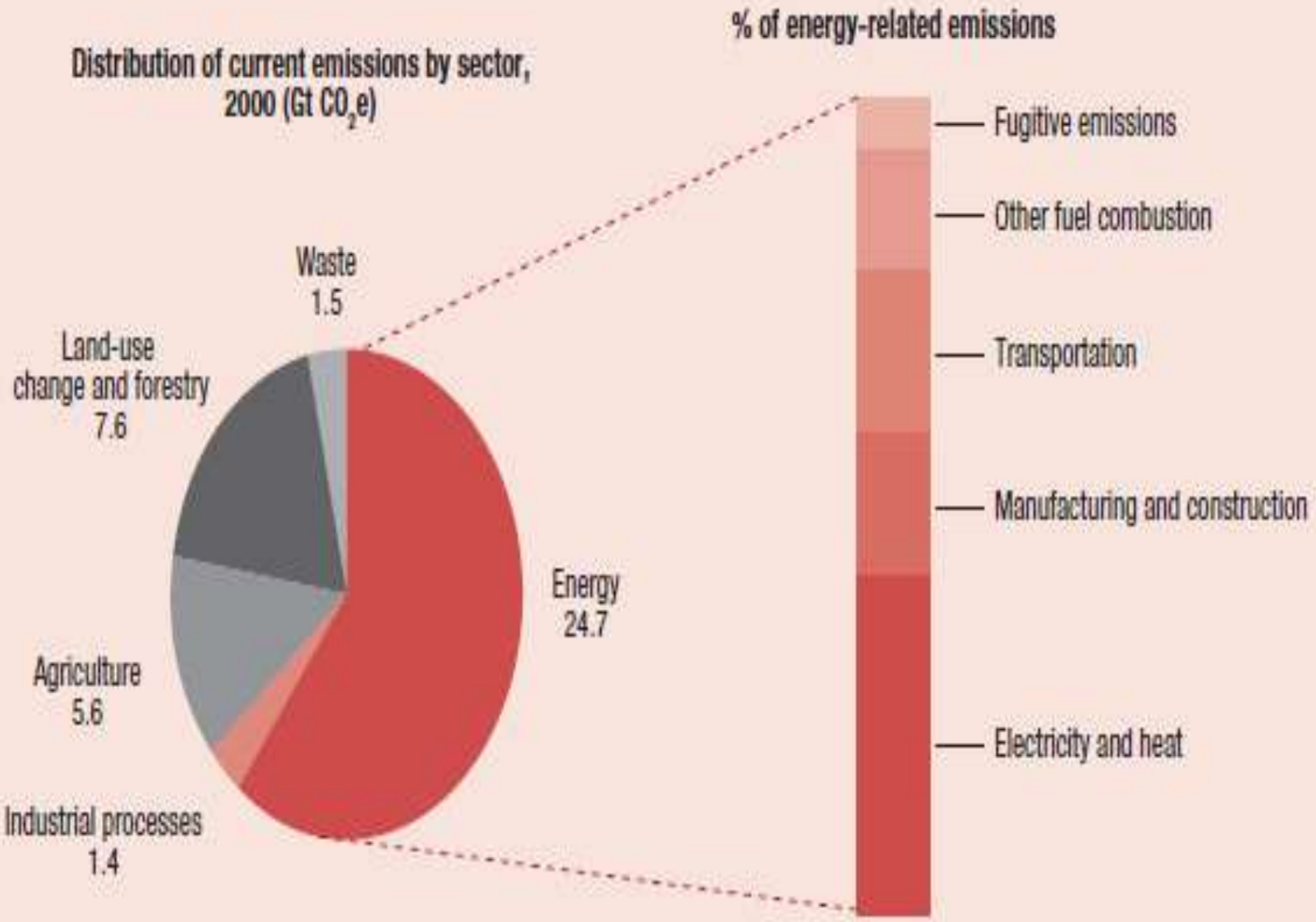
- Rising energy use contributes to increasing GHG emissions from FF as FF supply ~ 90% of the world's commercial energy.

- By 2010, IEA projects that global energy consumption – and annual CO_2 emissions – will have risen by almost 50 % from 1993 levels.

(World Resources Institute –WRI).

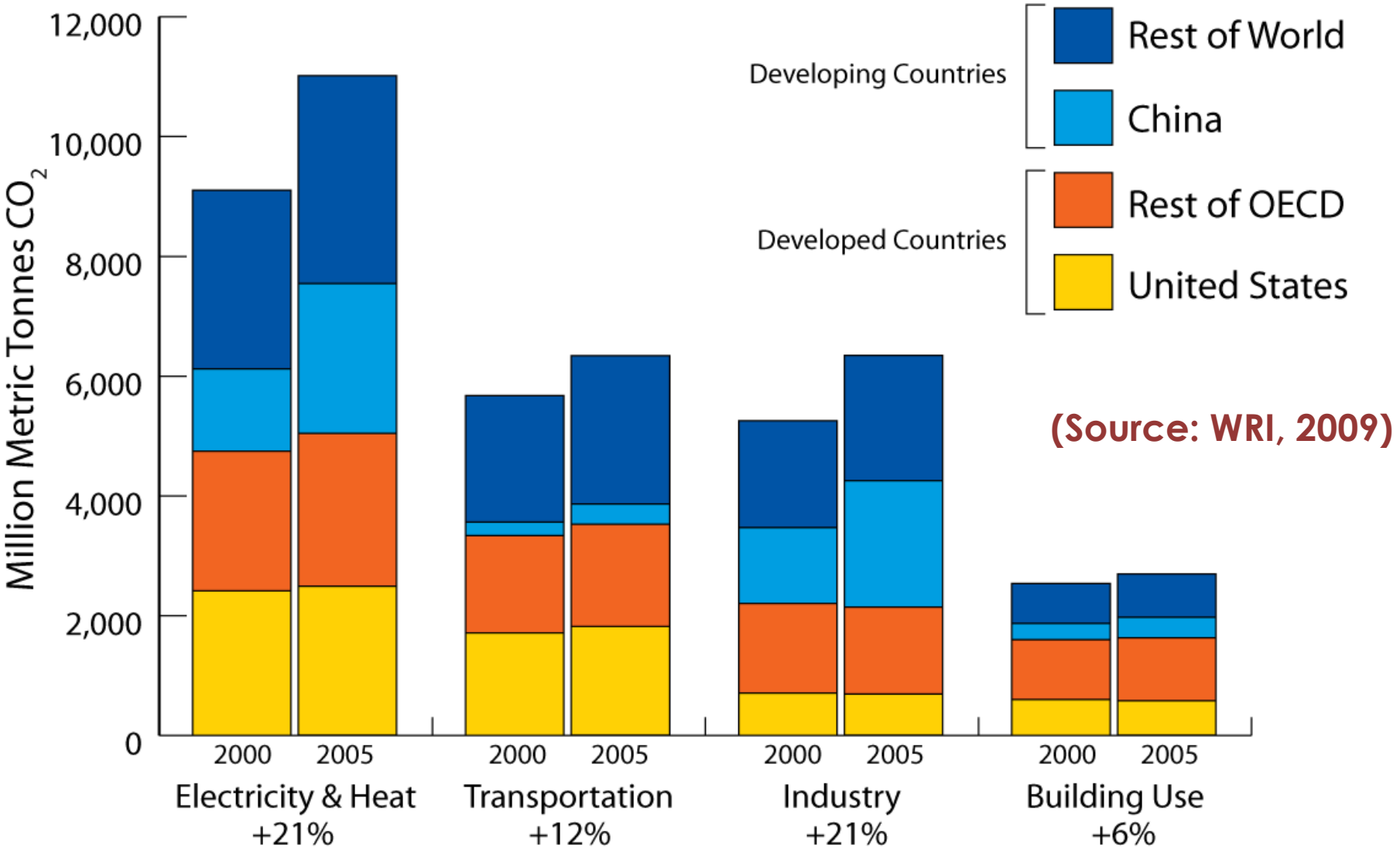
Developing Nations Contribution to GHG

- Developing nations' share of commercial energy consumption was expected to grow to nearly 40% by 2010.
- Factors driving this increased energy demand:
  - rapid industrial expansion and infrastructure improvement.
  - high population growth and urbanization.
  - rising incomes allowing purchase of energy-consuming appliances and cars.
- CO_2 emissions would rise even faster to about 45% of global emissions.
- Buildings in Caribbean SIDS are estimated to contribute 15 – 50% of their GHG emissions (GEF).



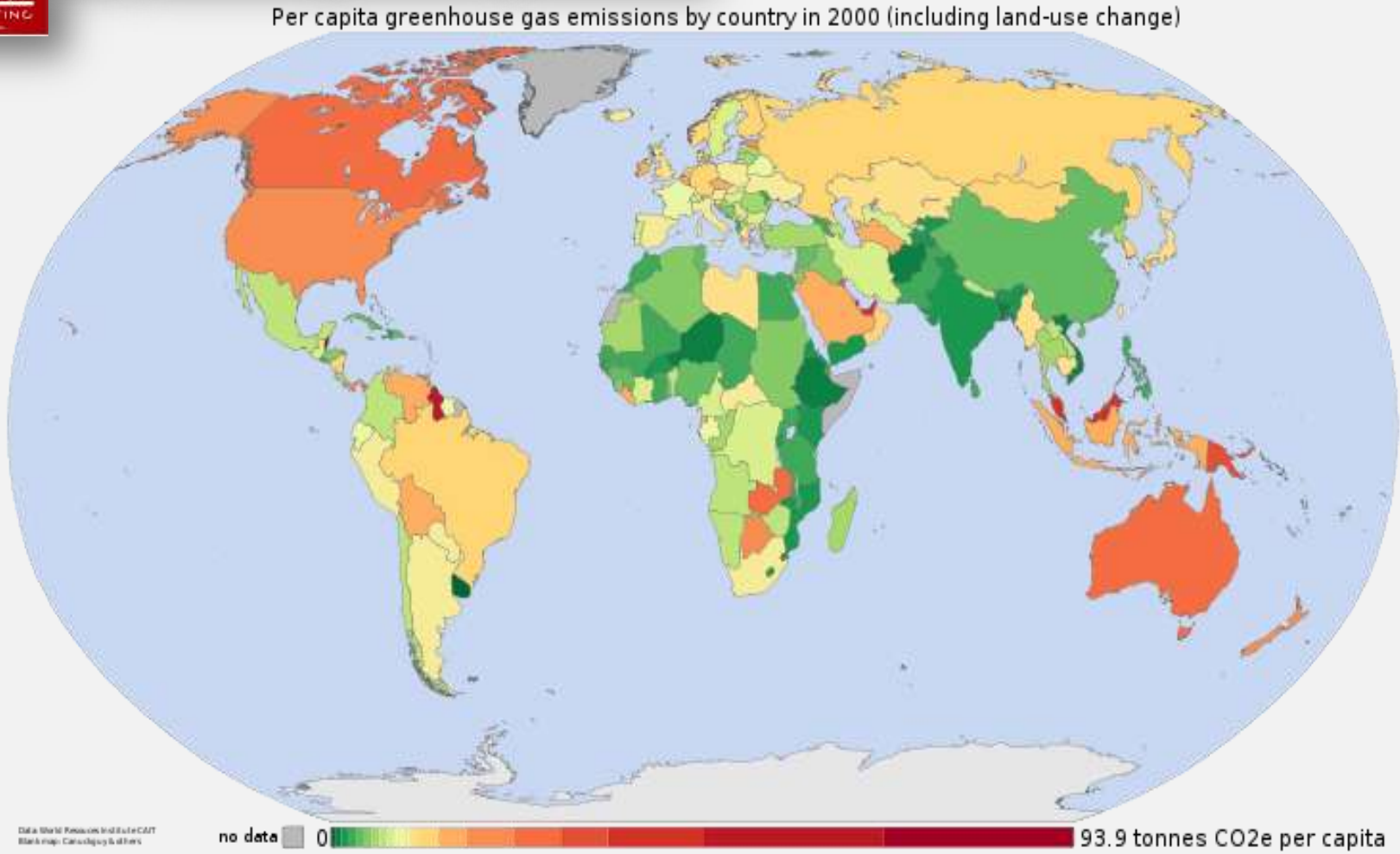
Source: WRI 2007a.

Global CO_2 Emissions Growth in Select Sectors: 2000-2005



(Source: WRI, 2009)

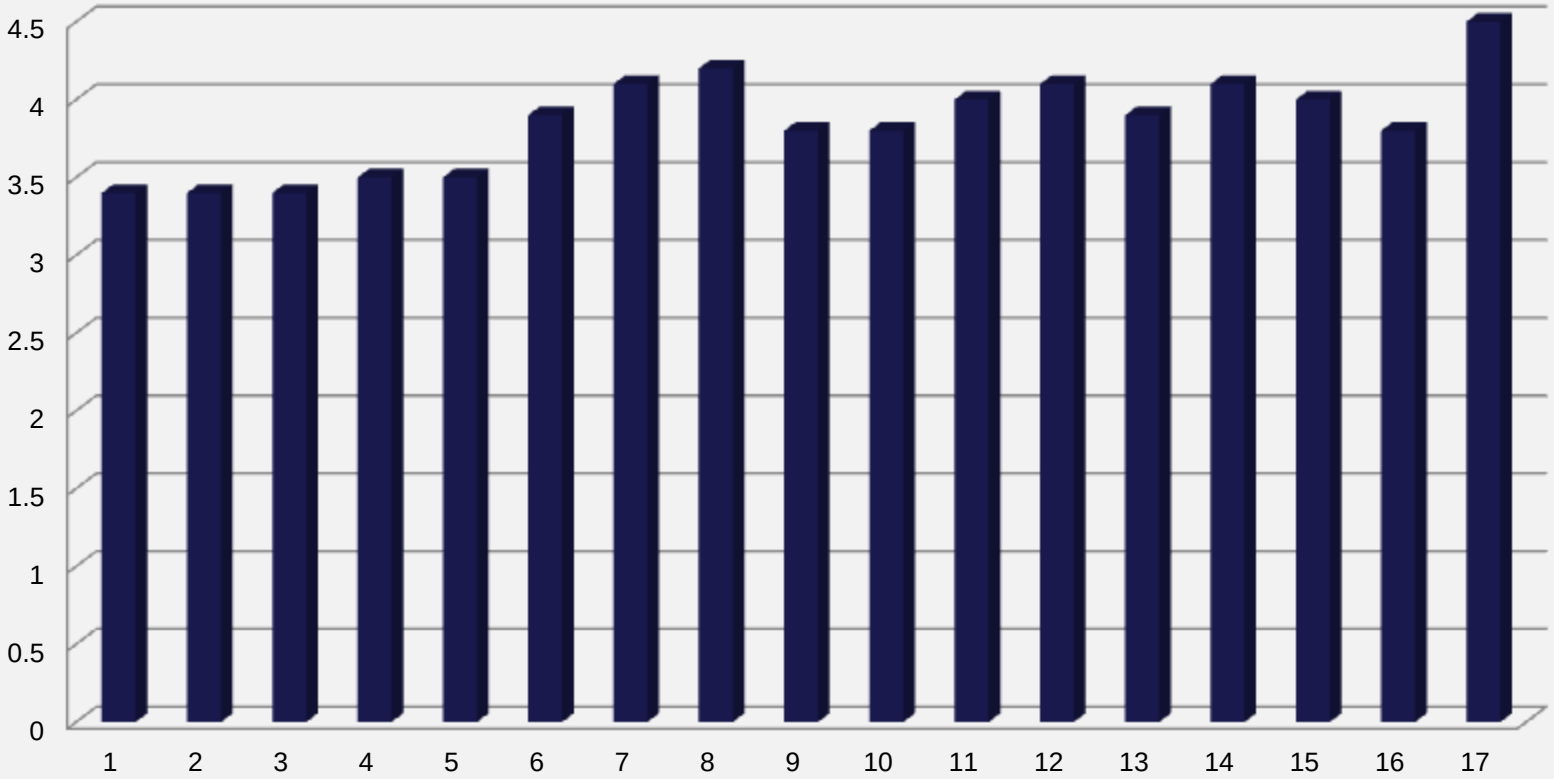
Per Capita GHG Emissions by Country



Sources - carbon dioxide, methane, nitrous oxide, perfluorocarbon, hydrofluorocarbon and sulphur hexafluoride emissions (WRI, CDIAC, USEPA, other). Other Emissions are not included.

GHG Emissions.

Jamaica's CO_2 /capita/annum (1990 - 2006) metric tonnes



Jamaica ranked 84th of 140 countries

Energy Efficiency

- EE in industry contributes to decoupling economic growth and environmental impact while reducing industrial energy intensity and improving competitiveness.
- **Industry consumes > 1/3 global primary energy and generates > ¼ - 1/3 energy-related CO2 emissions.**
- Estimated annual energy use growth of industry => 1.8 % - 3.1 % over the next 25 years.
- Industrial efficiency is below the technically feasible and economic optimum. Technical potential to decrease energy intensity and emissions by up to **26 % and 32 % respectively** = 8.0 % and 12.4 % reduction in total global energy use and CO2 emissions (IEA).
- EE in industry is a cost-effective measure to decouple linkage between economic growth demands and environmental degradation (vis a vis climate change). (UNIDO 2012).

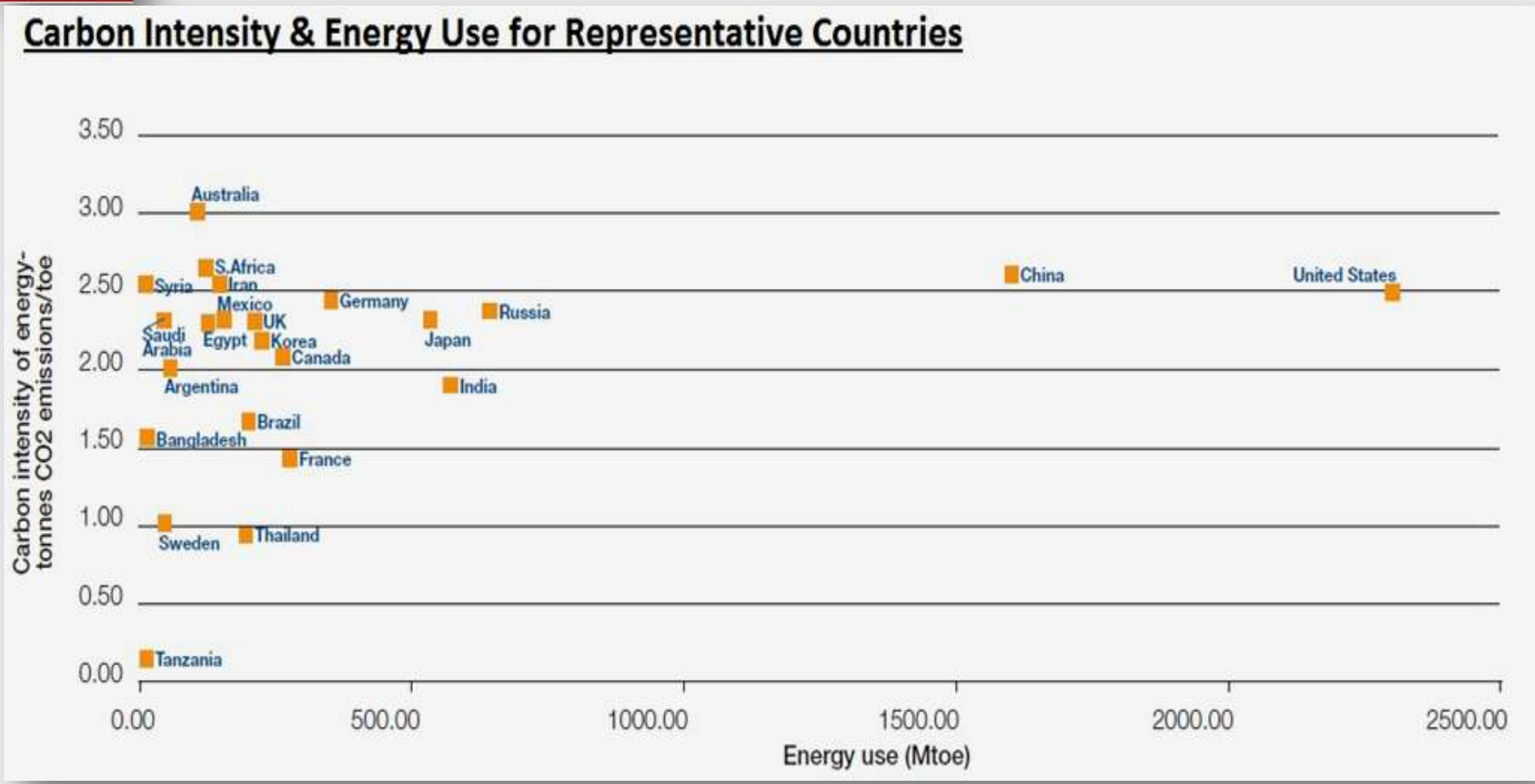
Carbon Intensity

- Main factor for CO_2 emission is **carbon intensity** of energy (CO_2 produced/unit of energy used).
- **Energy demand and energy intensity** *(quantity of energy required/unit output or activity)* are less influential in CO_2 emission levels.
- Countries with high proportions of renewable and nuclear (e.g. Brazil and France) have low carbon intensities; countries which use high proportions of coal (e.g. China and Australia) have high intensities.

Carbon Intensity - Fossil Fuels

Fuel	Specific Carbon Content (kg_C/kg_{fuel})	Specific Energy Content (kWh/kg_{fuel})	Specific CO_2 Emission (kg_{CO2}/kg_{fuel})	Specific CO_2Emission (kg_{CO2}/kWh)
Coal (bituminous/ anthracite)	0.75	7.5	2.3	0.37
Gasoline	0.9	12.5	3.3	0.27
Light Oil	0.7	11.7	2.6	0.26
Diesel	0.86	11.8	3.2	0.24
LPG - Liquid Petroleum Gas	0.82	12.3	3.0	0.24
Natural Gas, Methane	0.75	12	2.8	0.23
Crude Oil				0.26
Kerosene				0.26
Wood [1)]				0.39
Peat [1)]				0.38
Lignite				0.36
Bio energy	0	-		0[2)]

Carbon Intensity



Source: WEC, 2007

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WAY FORWARD

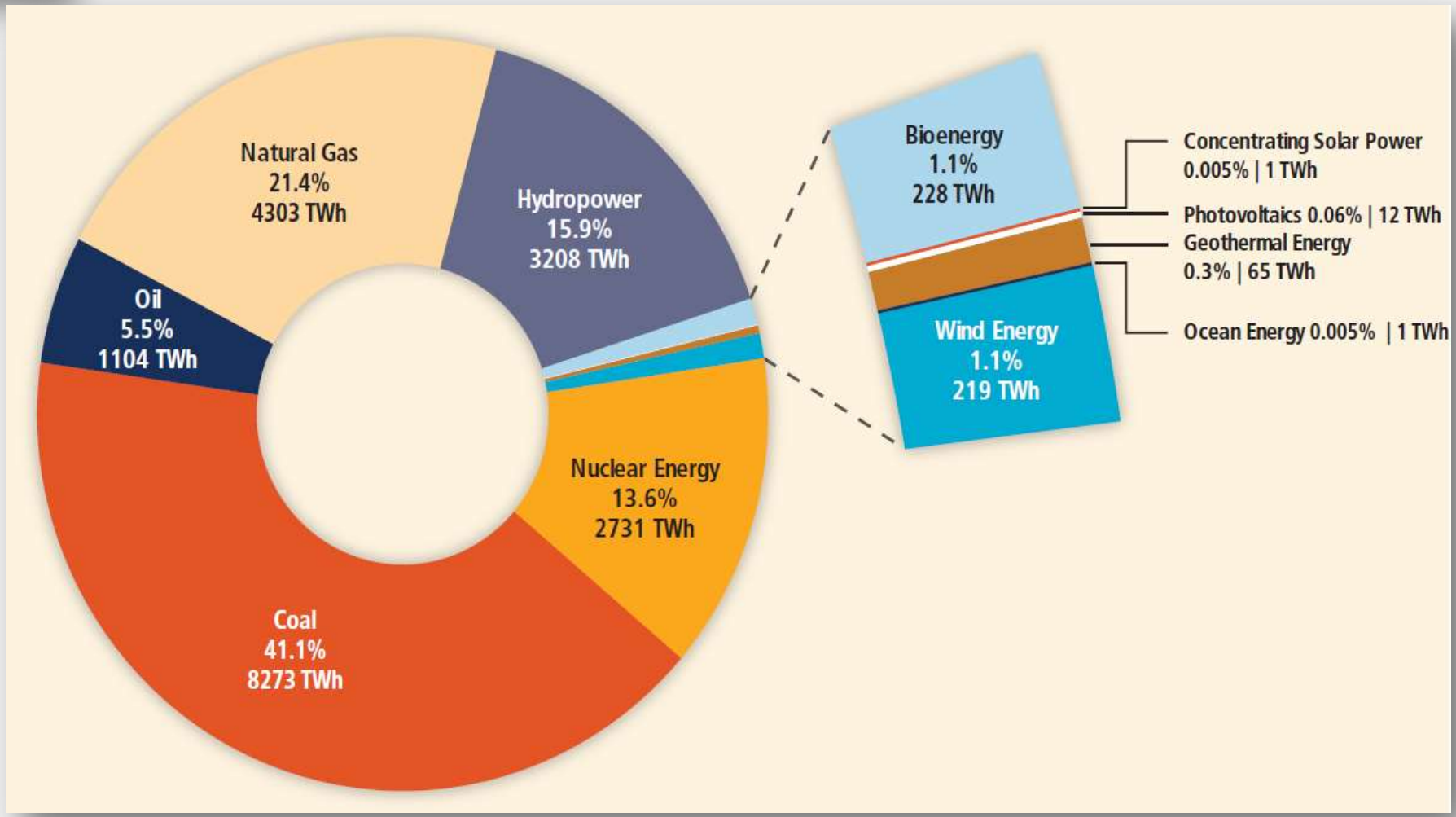
Carbon Intensity

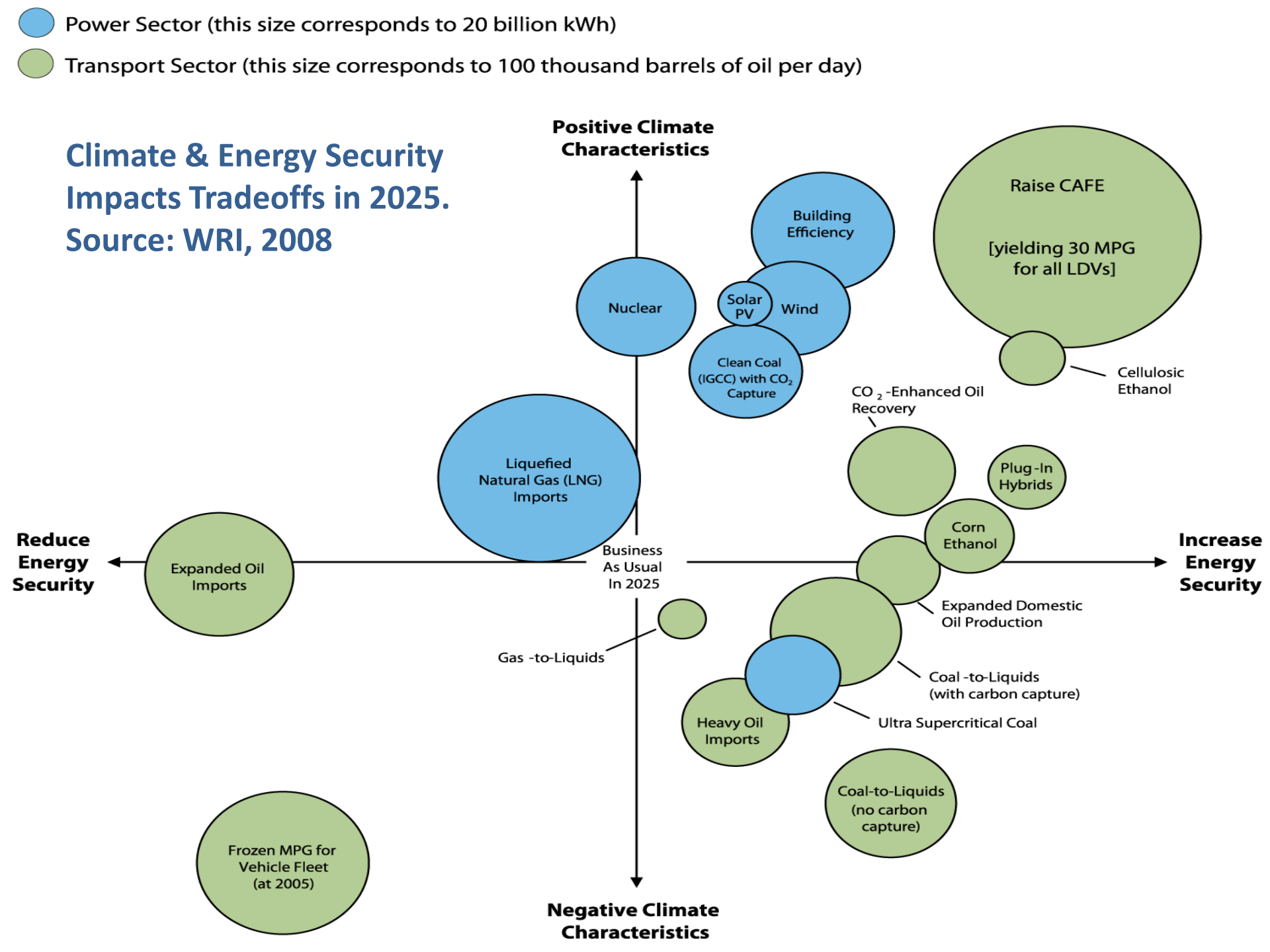
*"The most significant impact on emissions can be made by **reducing carbon intensity** rather* than energy intensity".

*"In the short to medium term, the sector which gives most scope for reduced carbon intensity and emissions is **electricity**, because of the availability of low or zero carbon technologies".*

Source: Energy and Climate Change, World Energy Council 2007

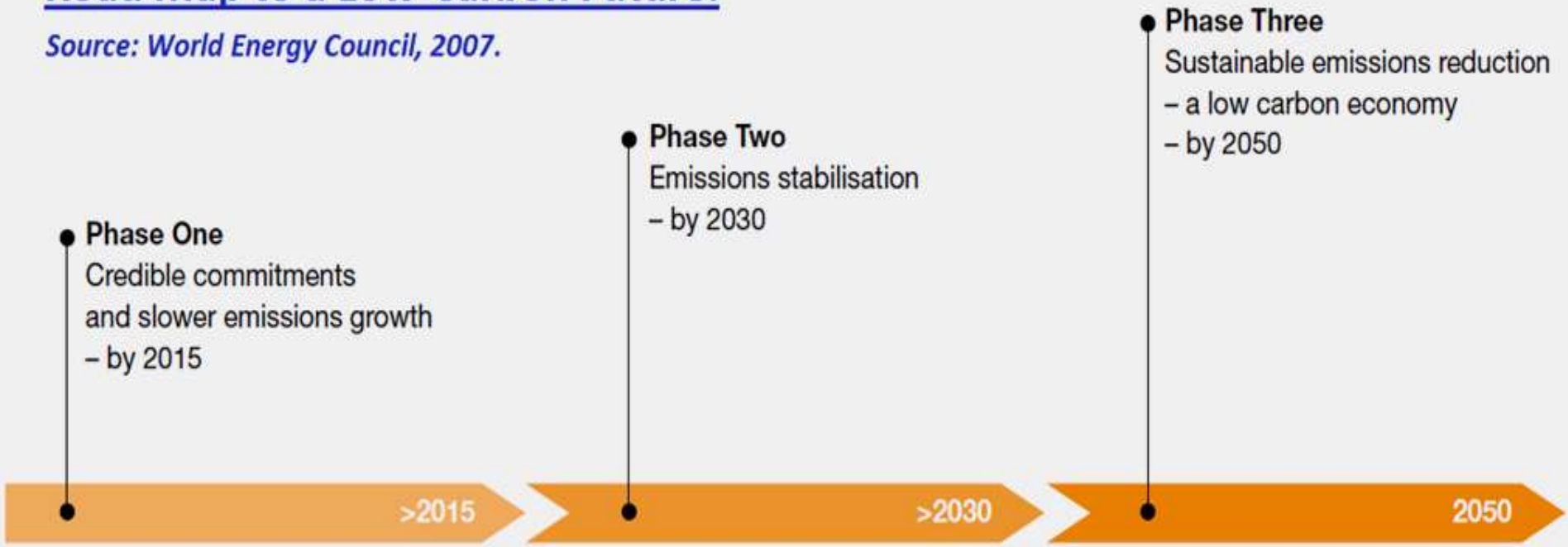
Global Electricity Generation By Source




Power Sector (this size corresponds to 20 billion kWh)
Transport Sector (this size corresponds to 100 thousand barrels of oil per day)
Climate & Energy Security Impacts Tradeoffs in 2025. Source: WRI, 2008
Positive Climate Characteristics
Negative Climate Characteristics
Reduce Energy Security
Increase Energy Security
Business As Usual In 2025
Nuclear
Building Efficiency
Solar PV
Wind
Clean Coal (IGCC) with CO2 Capture
Raise CAFE
[yielding 30 MPG for all LDVs]
Cellulosic Ethanol
CO2-Enhanced Oil Recovery
Plug-In Hybrids
Corn Ethanol
Liquefied Natural Gas (LNG) Imports
Expanded Oil Imports
Gas-to-Liquids
Expanded Domestic Oil Production
Coal-to-Liquids (with carbon capture)
Ultra Supercritical Coal
Heavy Oil Imports
Coal-to-Liquids (no carbon capture)
Frozen MPG for Vehicle Fleet (at 2005)

Road Map to a Low-Carbon Future:

Source: World Energy Council, 2007.



- GHG reduction commitment.
- EE, RE, alternatives & lower-C intensity for powergen.
- Policy incl. C-tax credits.
- Clean coal technologies.
- Low-C & RE transport fuels.
- Technology development.

- New energy infrastructure and technology.
- Nuclear, Carbon-Capture-Storage.
- RE & micro CHP.
- Energy efficient building designs.
- Hybrids vehicles & C-closure biofuel.

- Advanced power gen & transport technologies.
- Zero-C & advanced energy storage tech.
- Nuclear fusion.
- Universal electro-hydrogen economy.

Sustainable Energy Policy

- Firstly – most efficient possible use of energy.
- Secondly – balanced and diversified portfolio of energy resources is required (coal, oil, NG, nuclear and RE sources).
- Thirdly - conserve and improve the quality of the environment by reducing emissions [and other negative outputs] from energy production and consumption.
- Fourthly - scientific breakthroughs and technological innovations are essential to achieving energy security goals, improving the use of today's energy resources and paving the way for a transformed energy future.

Excerpts from Remarks by Secretary of Energy Spencer Abraham.
Clean Coal Conference
Washington, DC. November 17, 2003