Winning the War on Carbon:

Can we save the Planet? Can we save Ourselves?

Britain's Royal Marines capture oil installations in the Faw Peninsula of southern Iraq.

CNN 2003

'To turn the tools of a solar transition over to utilities and fossil-fuel corporations, which is the present policy of [governments] and mainstream environmental organizations, is to guarantee that the coming Solar Age will arrive a century behind its time, and that it will be every bit as autocratic as today's fossil-fuel economy.

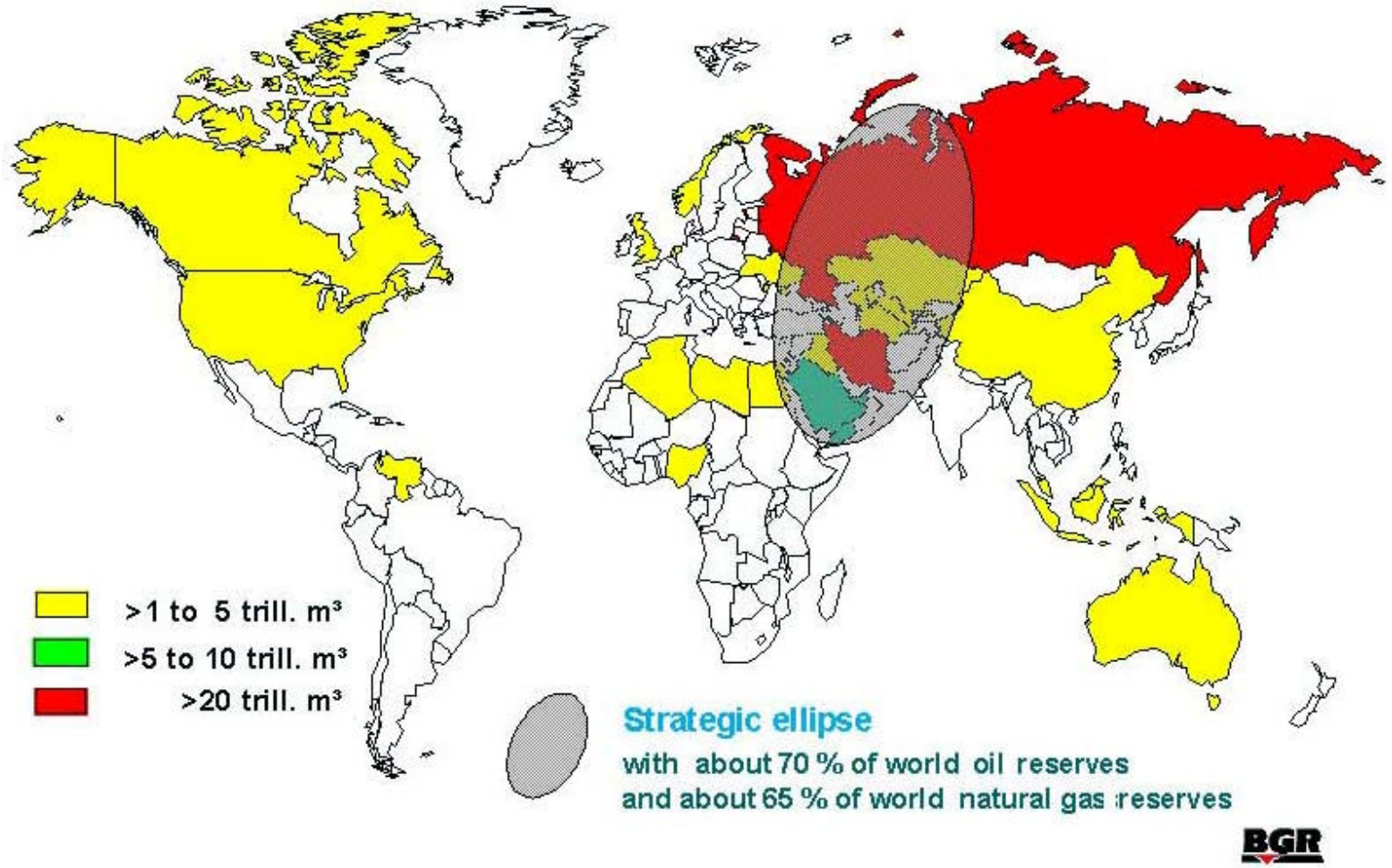
We believe that a solar revolution will necessarily occur at the expense of the private energy monopolies, and that such a revolution will not take place without a passionate public fight."

Daniel Berman and John O'Connor

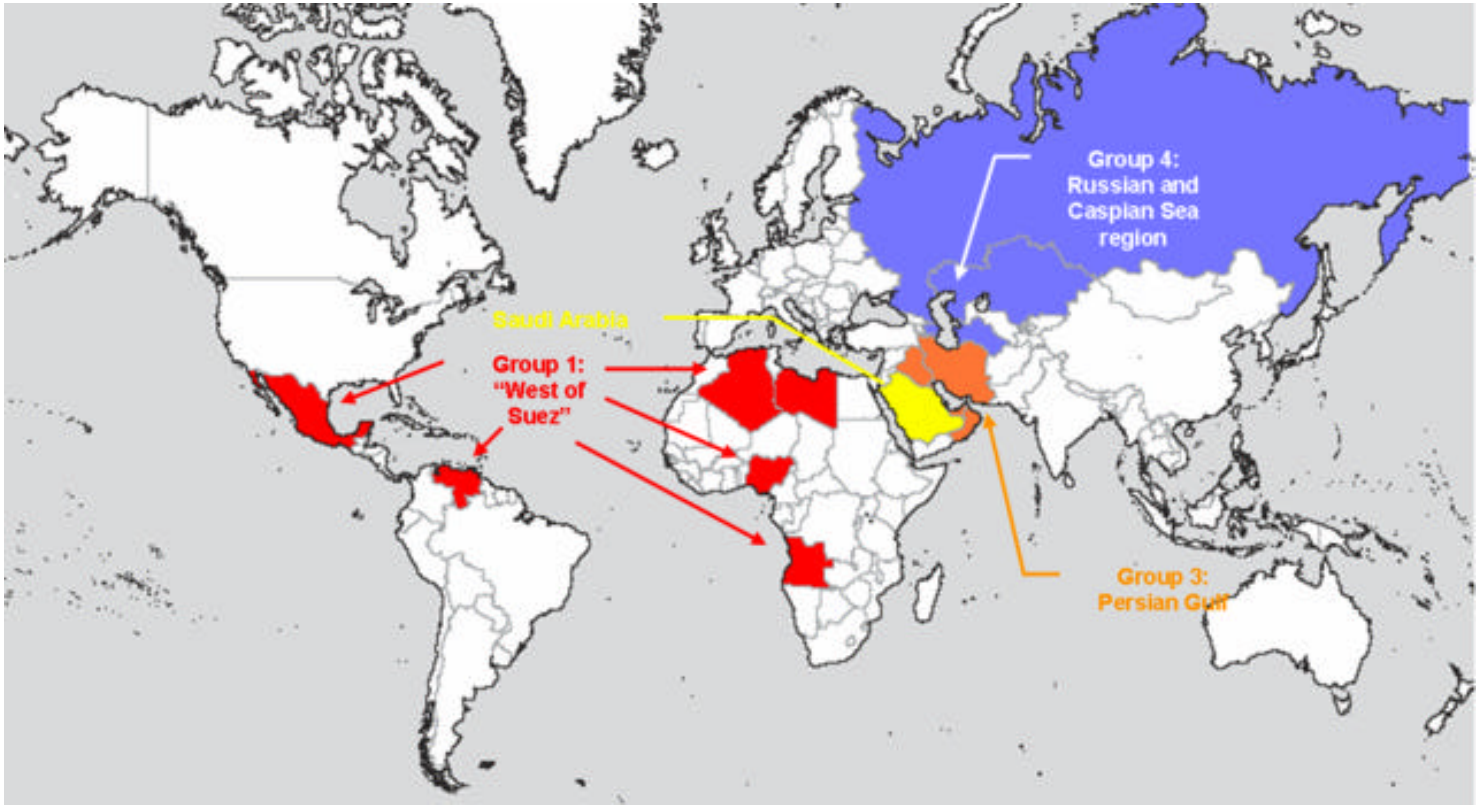
Who Owns the Sun? 1996

The Battle for Global Fossil Fuel Reserves

…the Carbon Theater of Today



…the Carbon Theater of Tomorrow



Aug/2005 (AP): "Televangelist Pat Robertson calls for assassination of Hugo Chavez."

Feb/2006 (CNN): "A Nigerian militant commander in the oil-rich southern Niger Delta has told the BBC his group is declaring "total war" on all foreign oil interests."

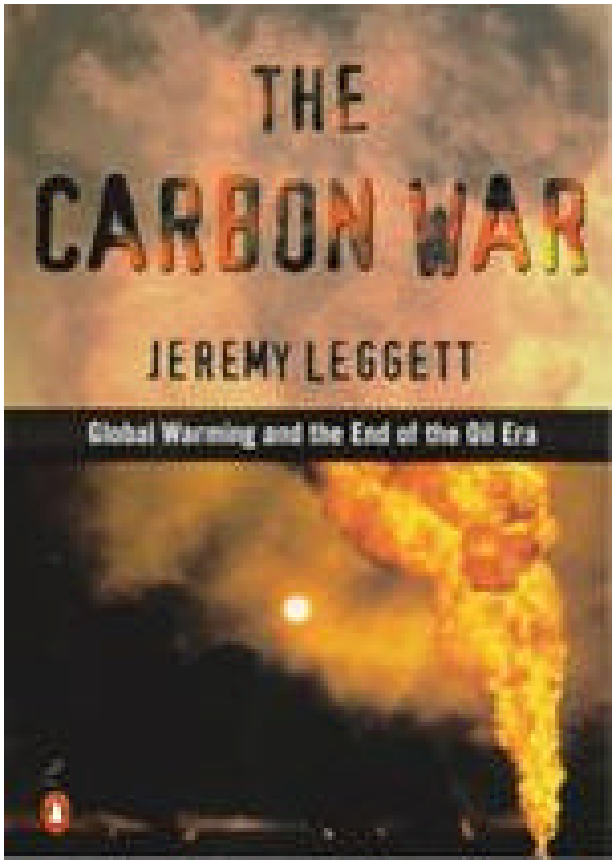
Key Battlefields

- climate change scientists versus oil-industry lobbyists who tried to derail their message concerning global warming

- peak oil whistleblowers versus “offical” government and industry geologists concerning global oil reserves

- multi-national government and corporate interests versus global “terrorist threats” from “unstable parts of the world”

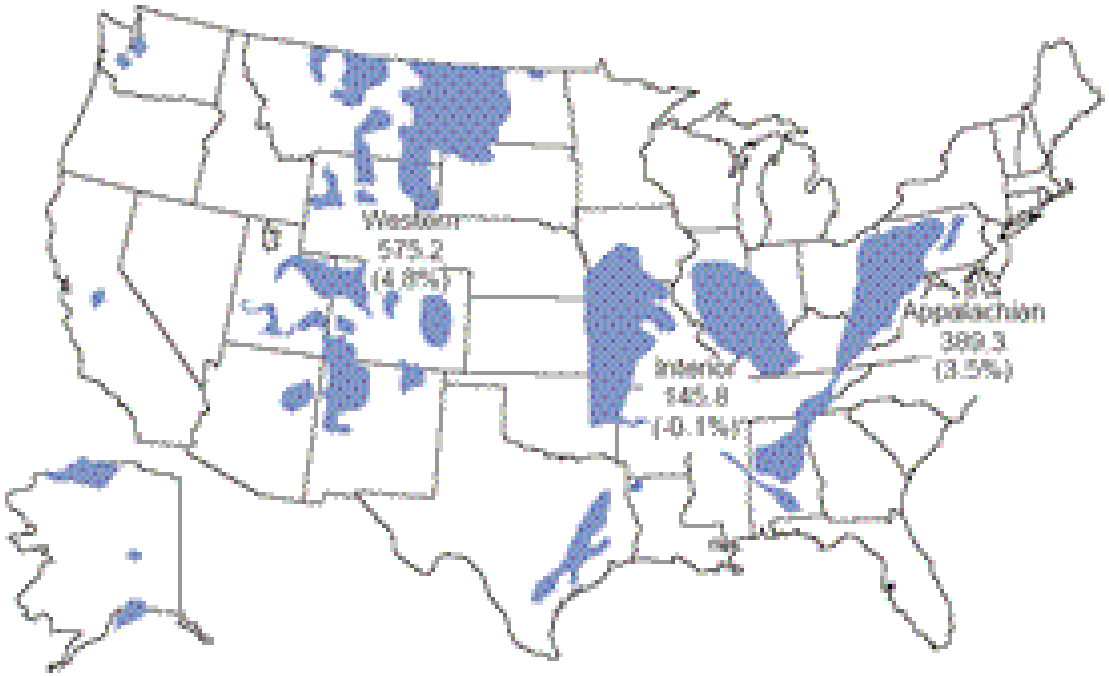
- citizens (comsumers), the renewable energy and energy efficiency industries versus the economic interests of the carbon-based energy industry and governments that subsidize their business agenda



POLITICAL, ECONOMIC & TECHNOLOGICAL

1999

the emerging domestic battlefield … Coal



"Here we have a serious problem: America is addicted to oil, which is often imported from unstable parts of the world.

Tonight, I announce the Advanced Energy Initiative -- a 22 percent increase in clean energy research at the Department of Energy, to push for breakthroughs in two vital areas. To change how we power our homes and offices, we will invest more in **zero-emission, coal-fired plants**; revolutionary solar and wind technologies; and clean, safe nuclear energy."

State of the Union Address, 2006
George W. Bush

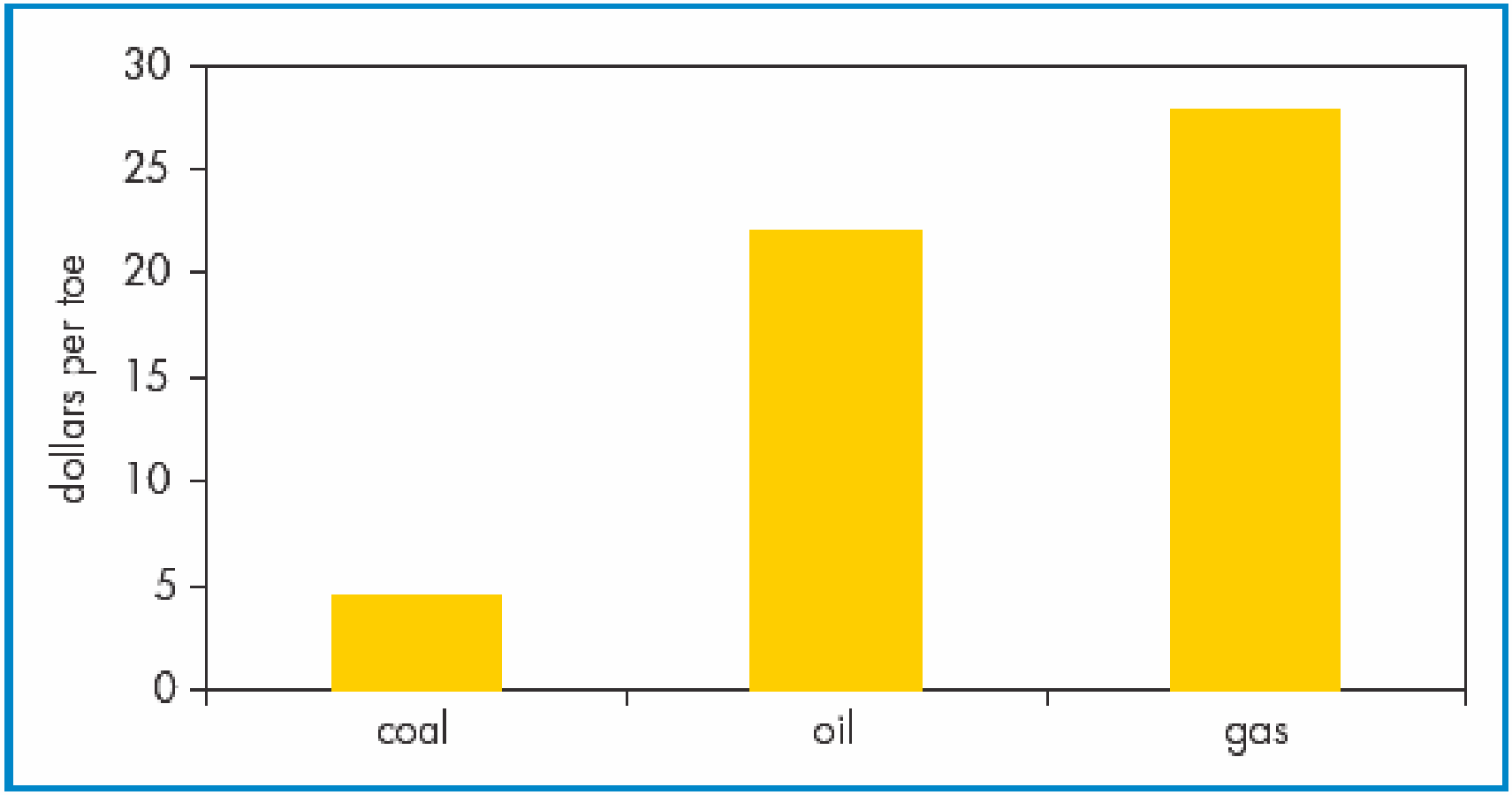
yet the $200 billion global fossil fuel subsidy continues
…not to mention the cost of securing Iraqi oil long-term ($318 Billion …and counting)

Pathological Disconnect

CLEAN COAL?

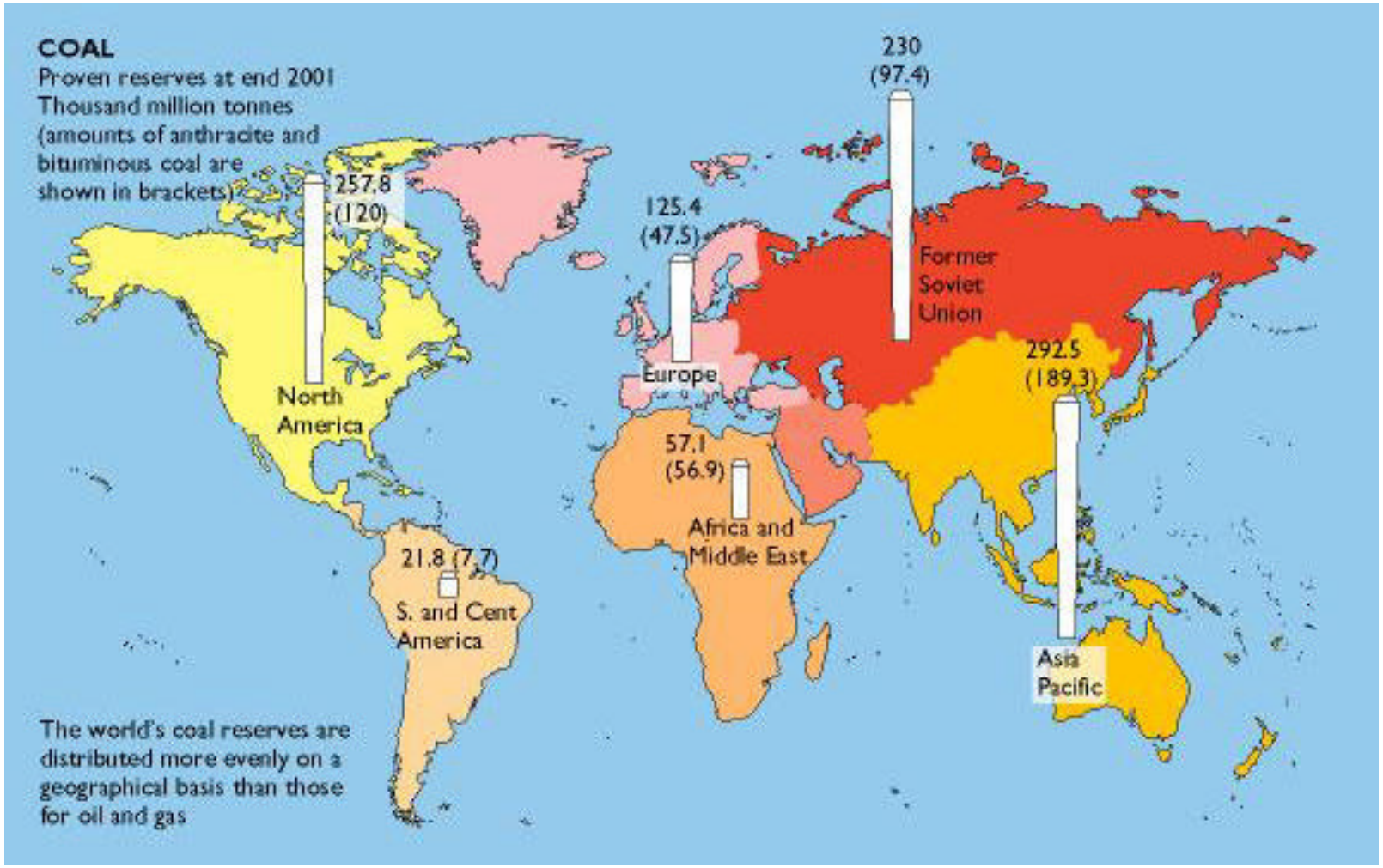
TVA's Bull Run clean coal-fired power plant in East Tennessee.

Figure 2.2: **Capital Intensity of Fossil Fuel Supply, 2001-2030**



USD $16 trillion will be invested in new energy infrastructure by 2030, including $10 trillion in electric power generating plants – the majority coal-fired plants.

Global Fossil Fuel Reserves … Coal



Assumptions: (the carbon reduction target)

- A 25% reduction in global carbon emissions is required each decade for the next three decades in order to stabilize Earth's climate.

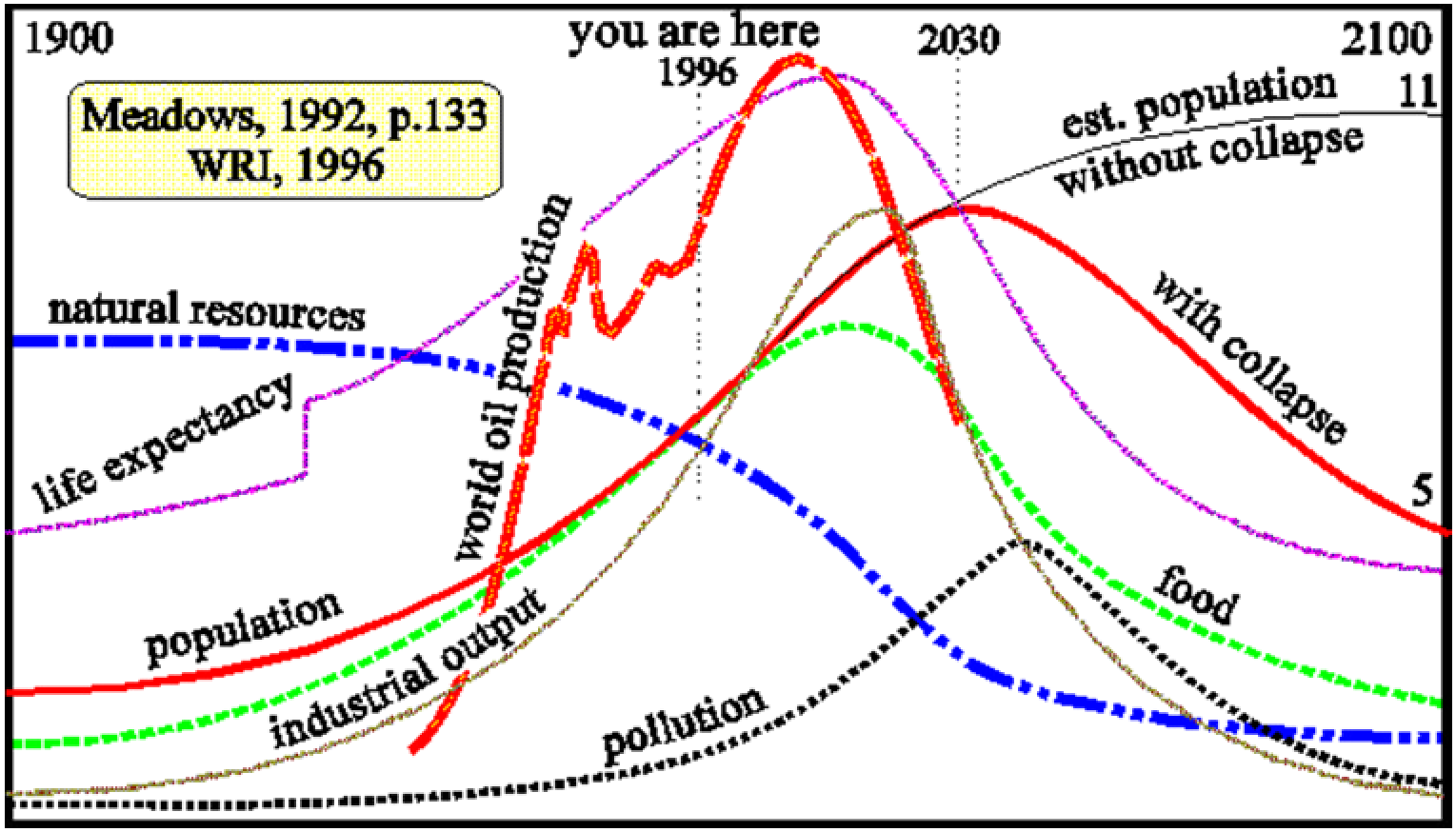
- Missing that target will result in irreversible negative social and ecological consequences – the collapse of critical global ecosystems and the human population.

- World governments and multi-national corporations are incapable of achieving targeted reductions in carbon emissions without social and economic coercion.

- Energy probability studies suggest an 80% likelihood that the carbon emissions reduction target will be missed due to global social and economic disruptions.

- Only a global social revolution – a consumer-based revolution – combining energy efficiency and renewable energy technologies development with massive voluntary reductions in current levels of energy consumption in transportation and electrification will achieve this target.

Are we at risk of Global Collapse? ***Yes!***



www.oilcrisis.com

REVISED ESTIMATE : Population Growth: 9.5 Billion; Die-off: 4.5 Billion

The Key Challenge: Escaping the Carbon Grip

Carbon Lock In

(Gregory C. Unruh, 2000),

“Industrial countries have become locked-into fossil fuel-based energy systems through path dependent processes driven by increasing [financial] returns to scale.

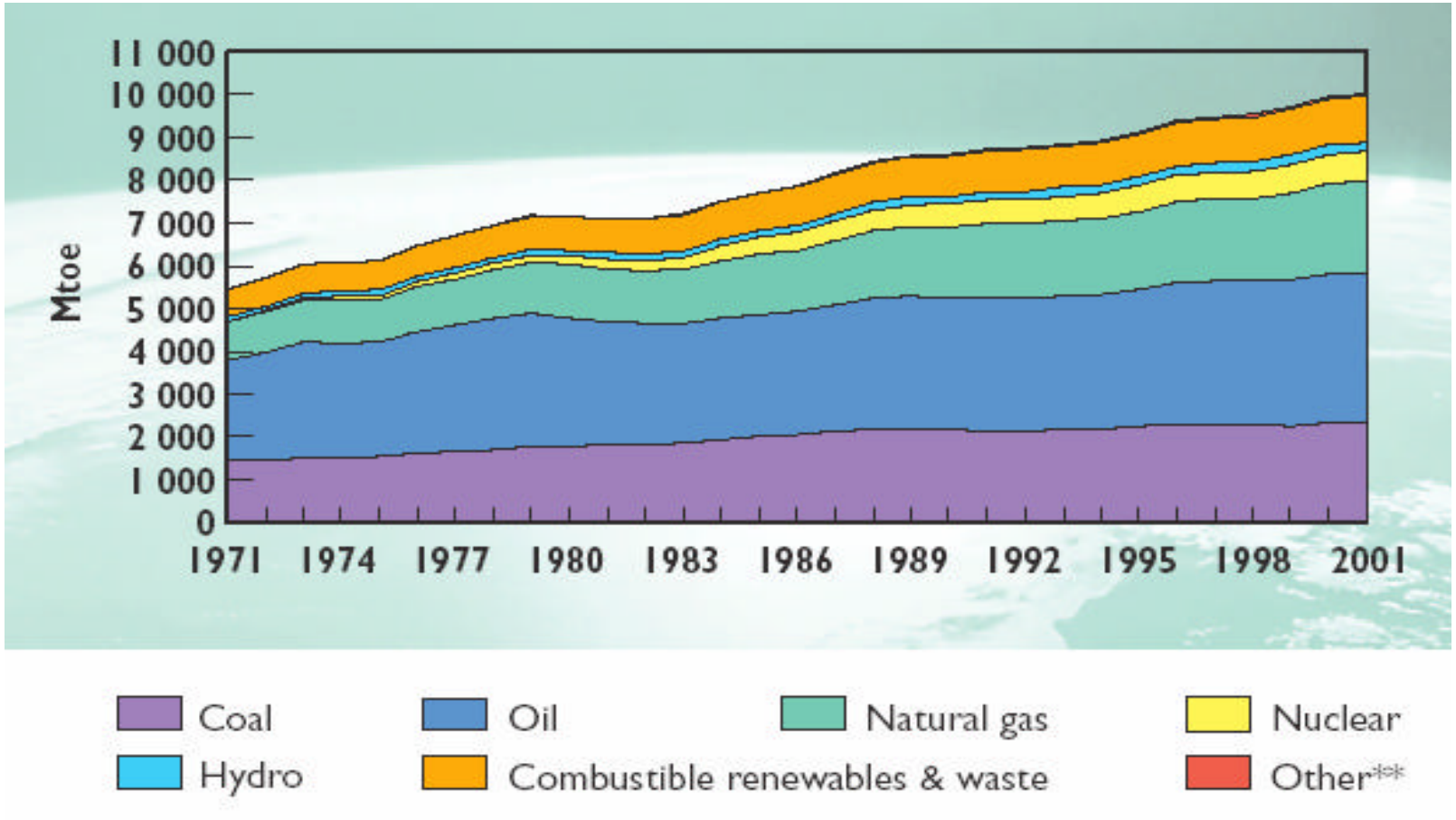
Carbon lock-in arises through technological, organizational, social and institutional co-evolution, “culminating” in what was termed as the *techno-institutional complex* (TIC).

In order to resolve the climate problem, an escape from the lock-in condition is required. However, due to the self-referential nature of TIC, escape conditions are unlikely to be generated internally, and it is argued that exogenous forces are required.”

characteristics of the techno institutional complex:

Scale of World Energy Supply (1971 - 2001)

IN MILLION TONS OIL EQUIVALENT (Mtoe)

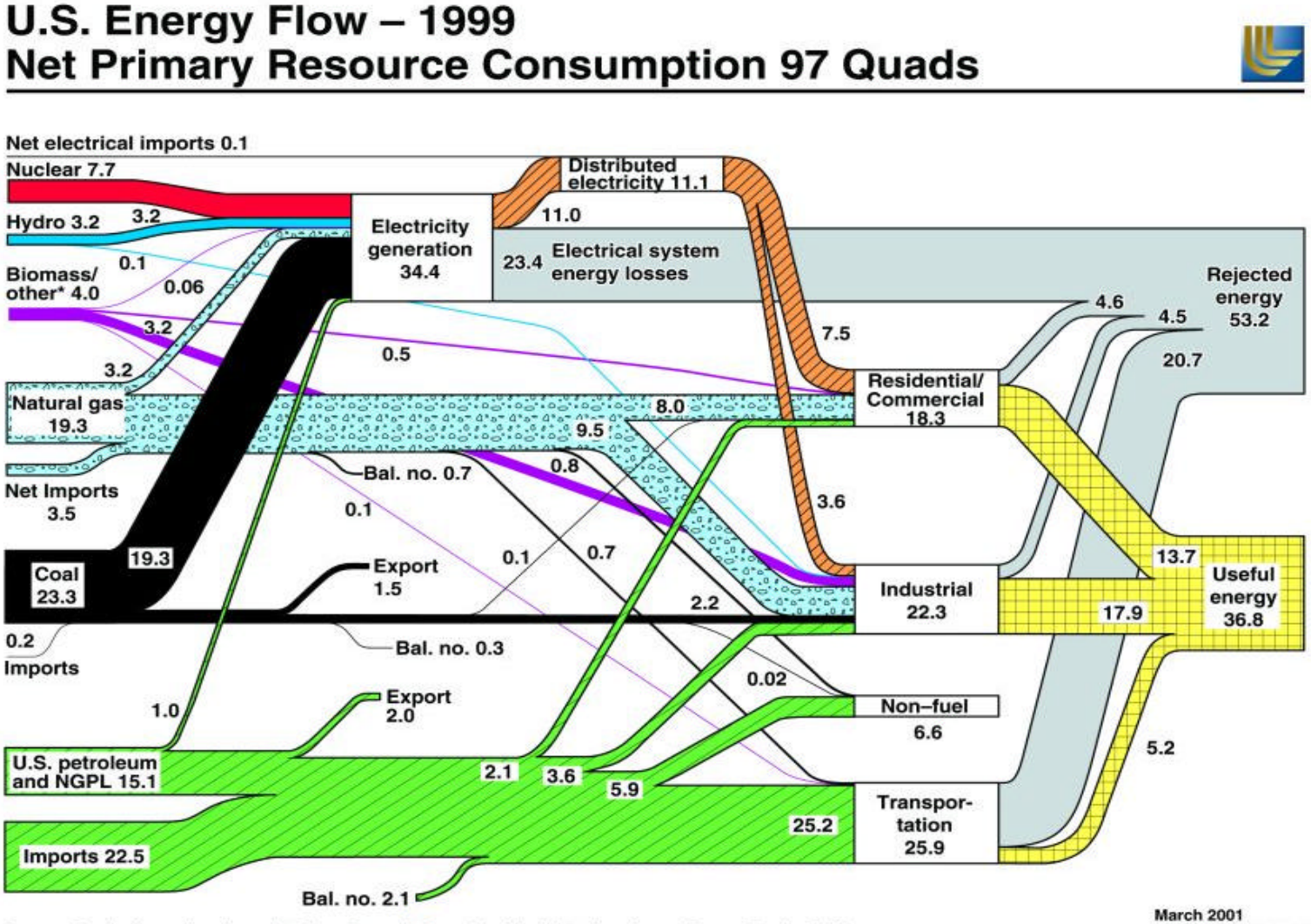


Combustible Renewables for 2.4 Billion People = 11%

U.S. (300 Million People) Share of Total Global Energy Consumption = 25%

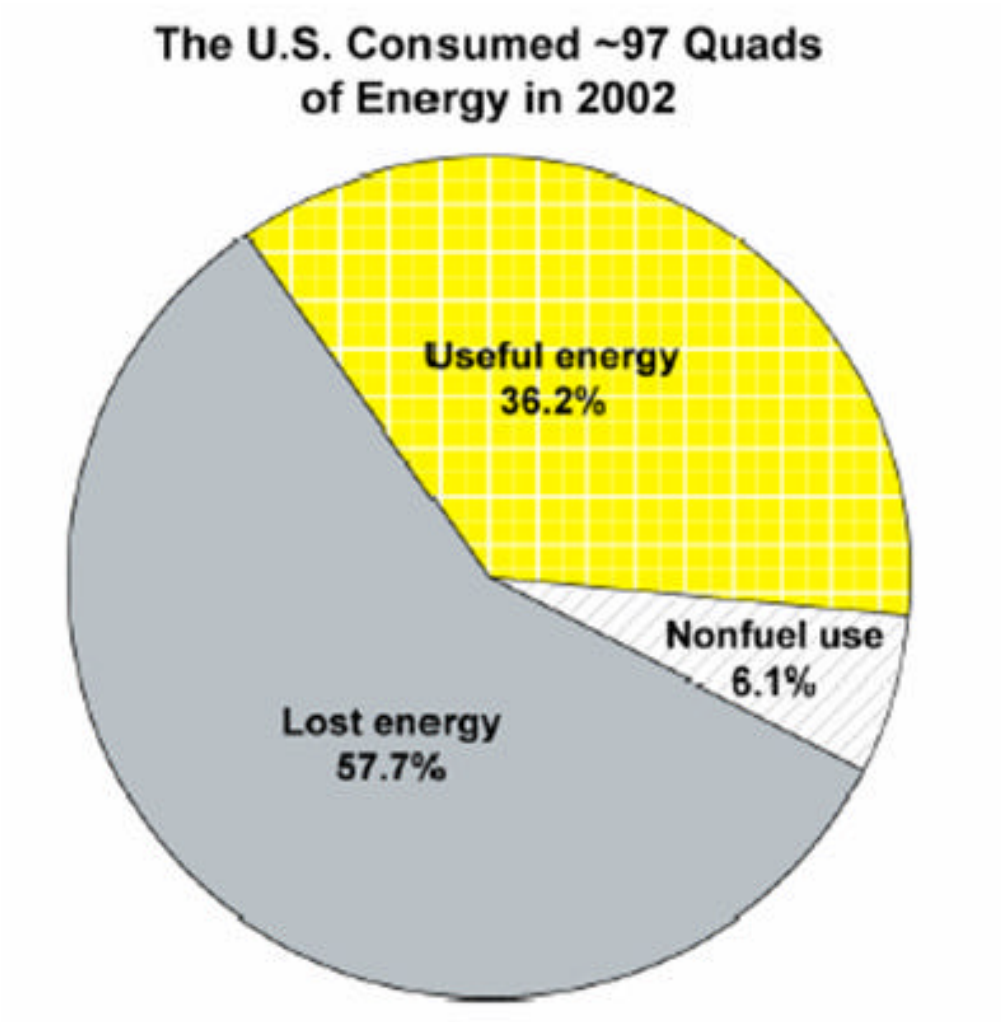
USD $3 Trillion Global Energy Industry

Centralized, Macro Grid scale Development

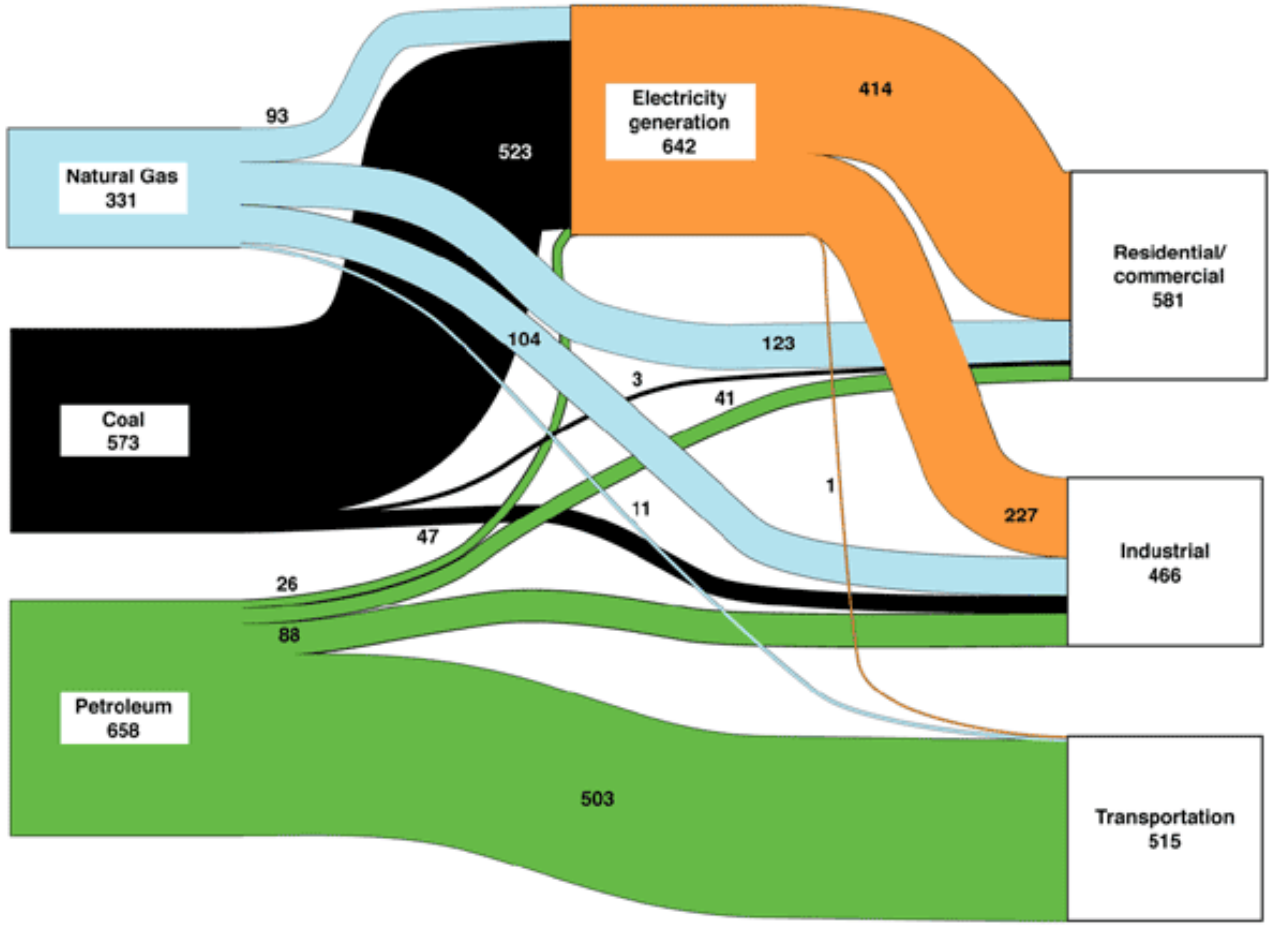


Source: Production and end-use data from Energy Information Administration, *Annual Energy Review 1999*
*Biomass/other includes wood and waste, geothermal, solar, and wind.

Low Efficiency: Grid scale Development Promotes Waste / Distributed Power Systems Promote Efficiency



U.S. 2000 Carbon Emissions from Energy Consumption — 1547* MtC



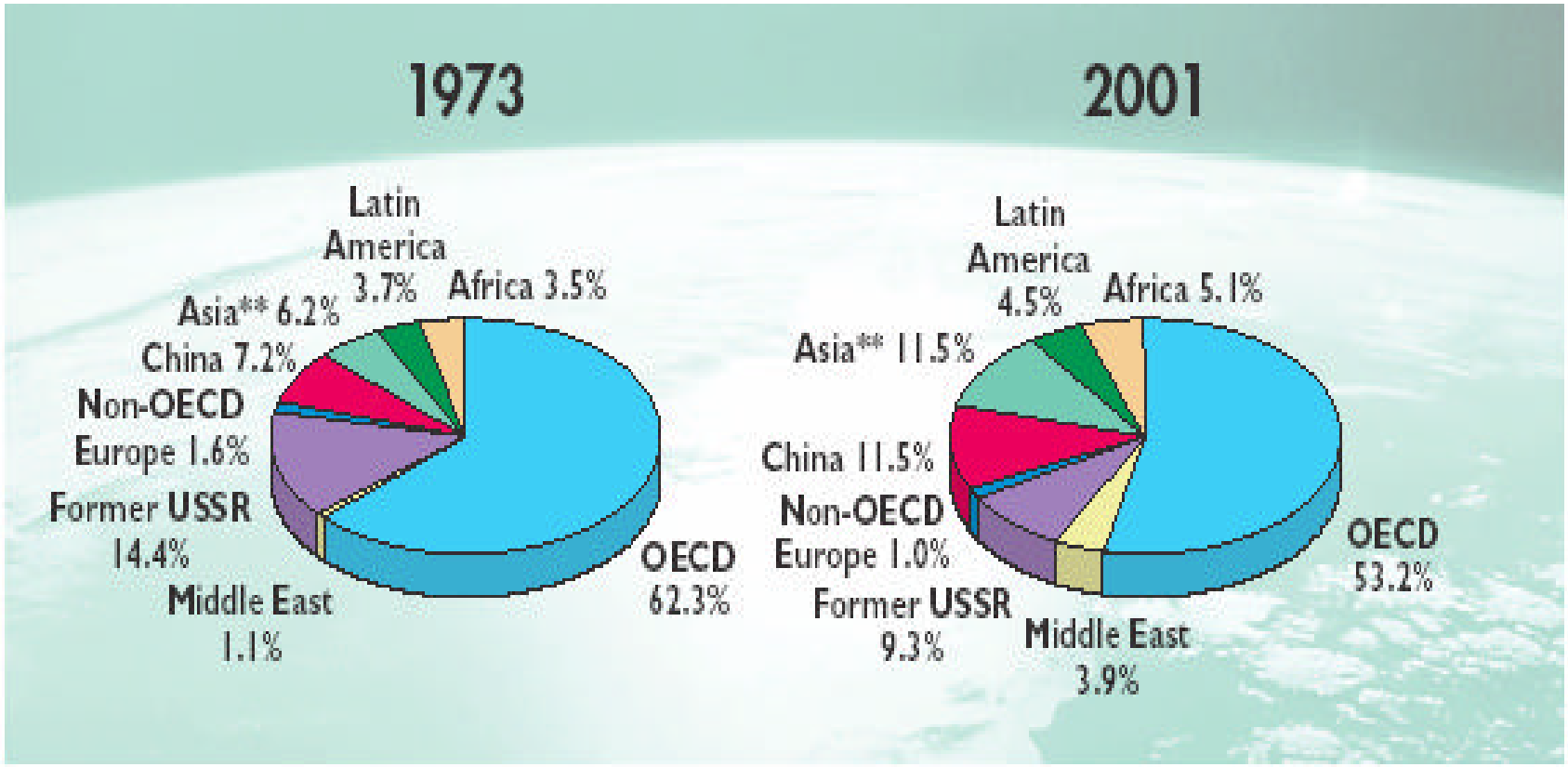
Source: Energy Information Administration
*Includes adjustments of 14 million metric tons of carbon from U.S. territories, less 28 MtC from bunker fuels

Lawrence Livermore National Laboratory, April 2002
http://eed.llnl.gov/flow/

Globalization: OECD Centered

World Energy Consumption by Region (1973- 2001)

% of Total World Consumption

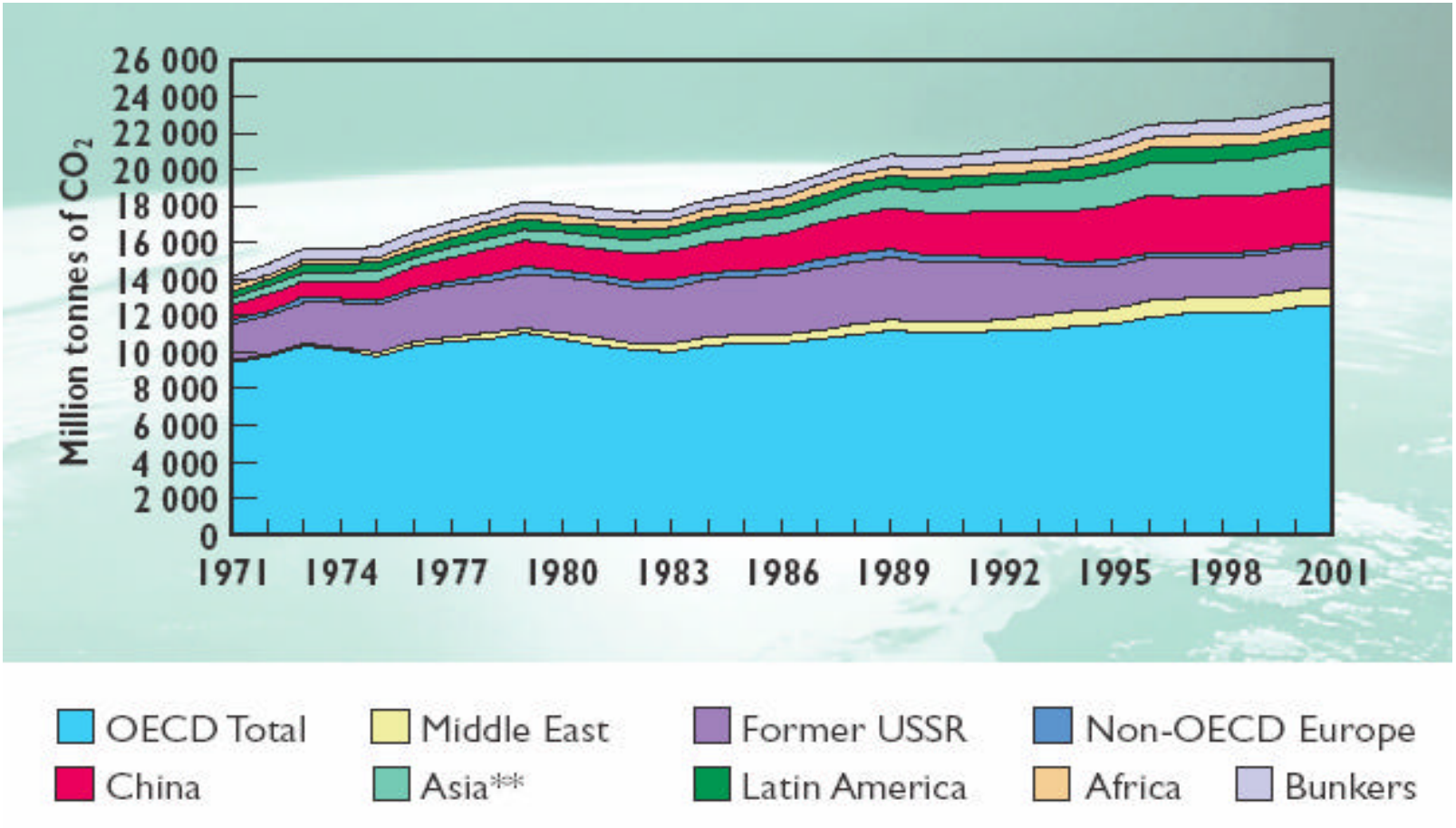


OECD NATIONS DRIVE POLICY AND INVESTMENT

OECD – Organization for Economic Co-operation and Development

Failed Policies (Kyoto): World CO2 Emissions (1971 - 2001)

MILLION TONS CO_2 (Mtoe)



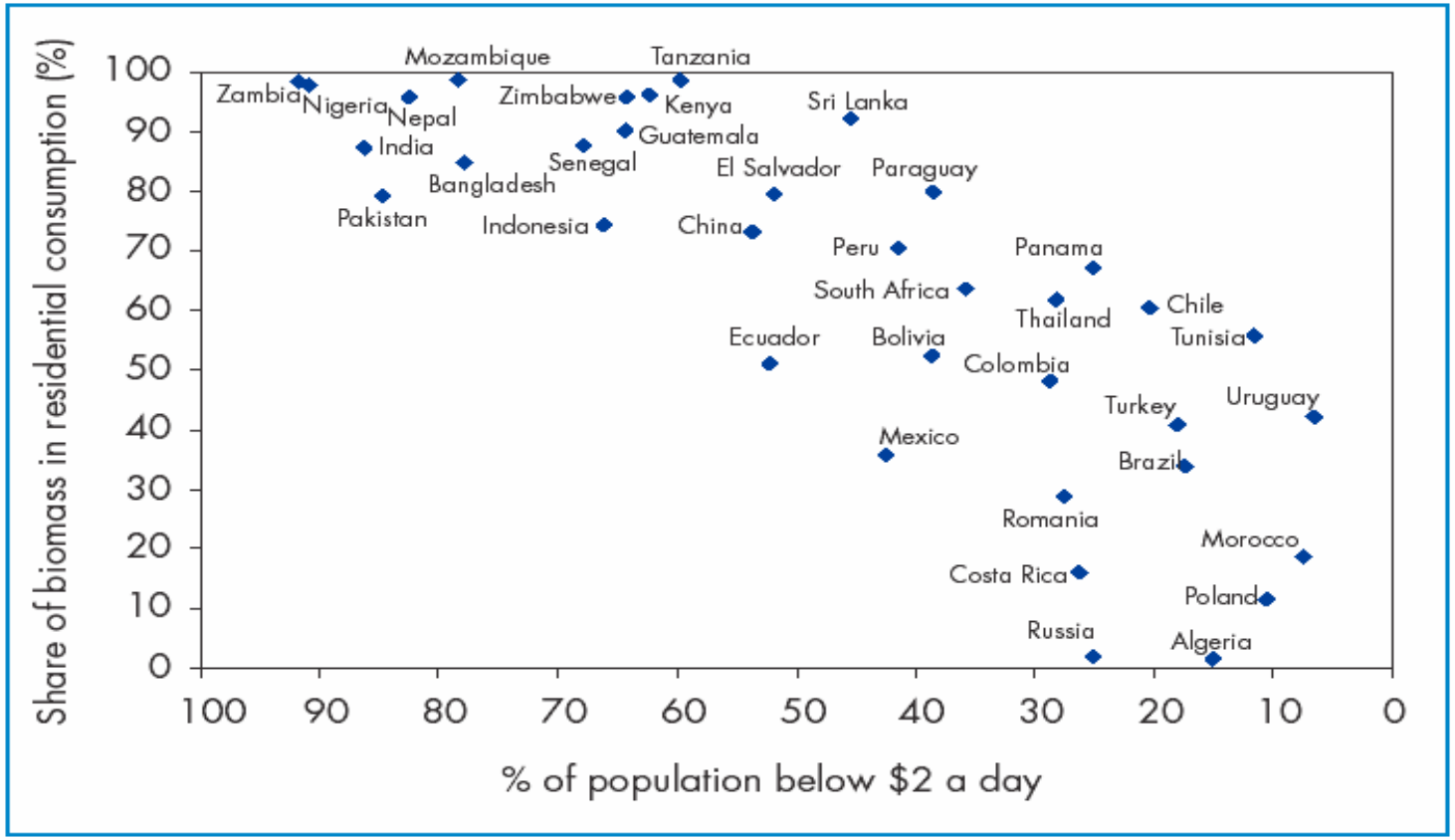
2.4 Billion Population Using Combustible Renewables = 5%

U.S. (300 Million Population) Share of Total Global Carbon Emissions = 30%

CHINA ADDS 1,000 MEGAWATTS OF COAL-FIRED POWER PLANTS EVERY 10 DAYS

Structural Poverty

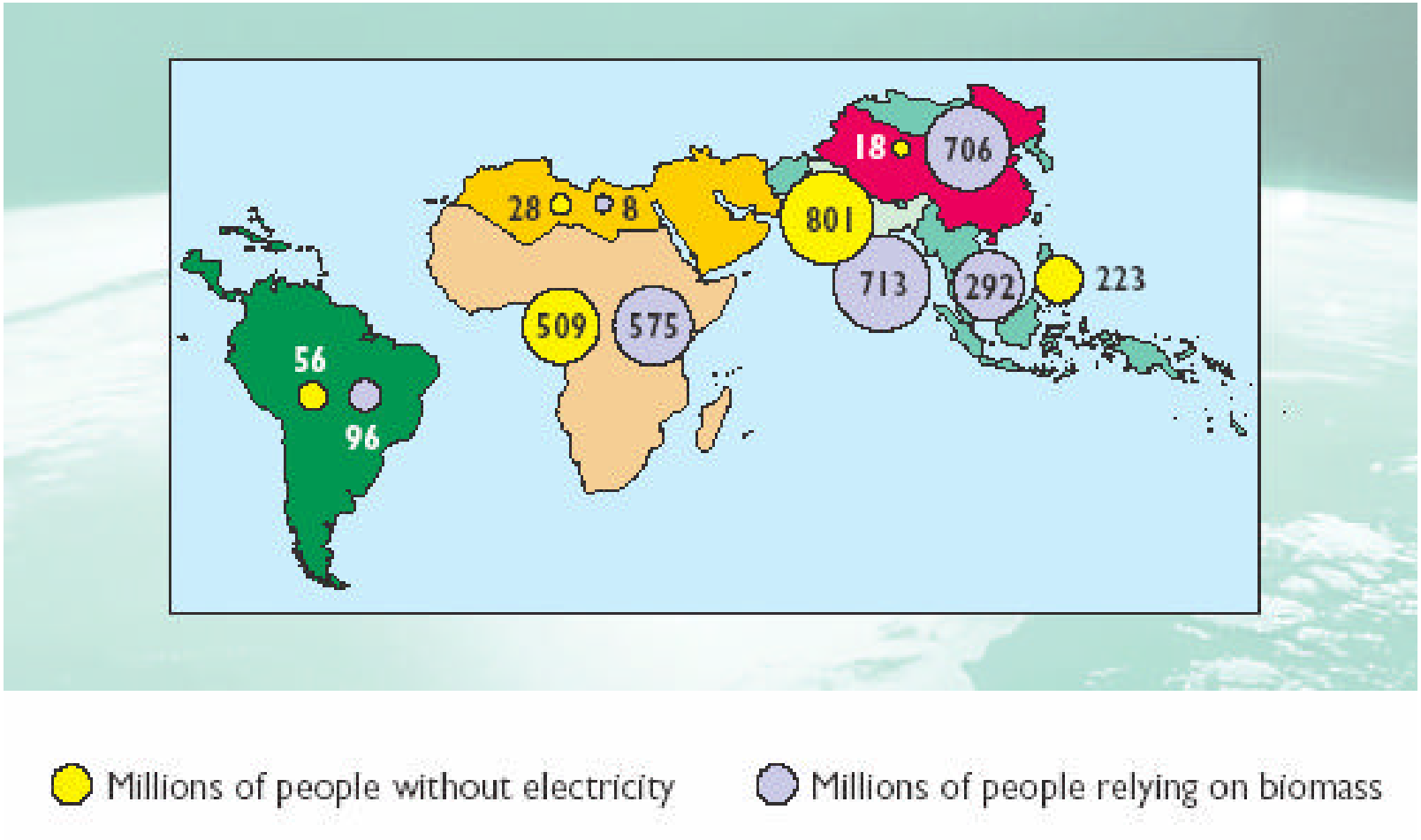
Figure 13.11: **The Link between Poverty and Share of Traditional Biomass in Residential Energy Consumption**



Source: IEA analysis and the World Bank's *World Development Indicators* for income statistics.

1.3 billion people live on less than $1 a day, 3 billion live on less than $2 a day

Inequities of Resource Distribution

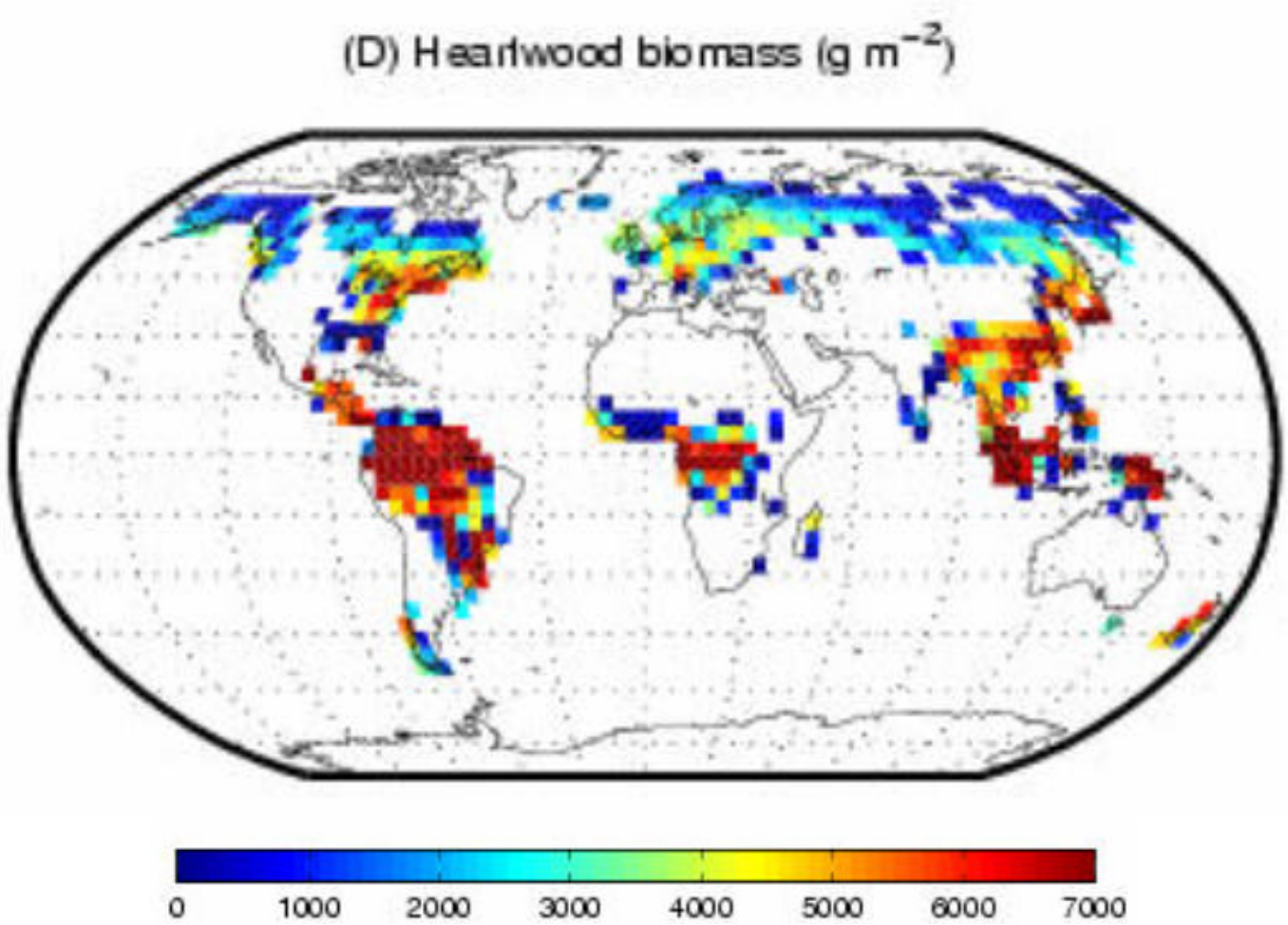


2.4 Billion People Using Combustible Renewables = 5% of Carbon Emissions

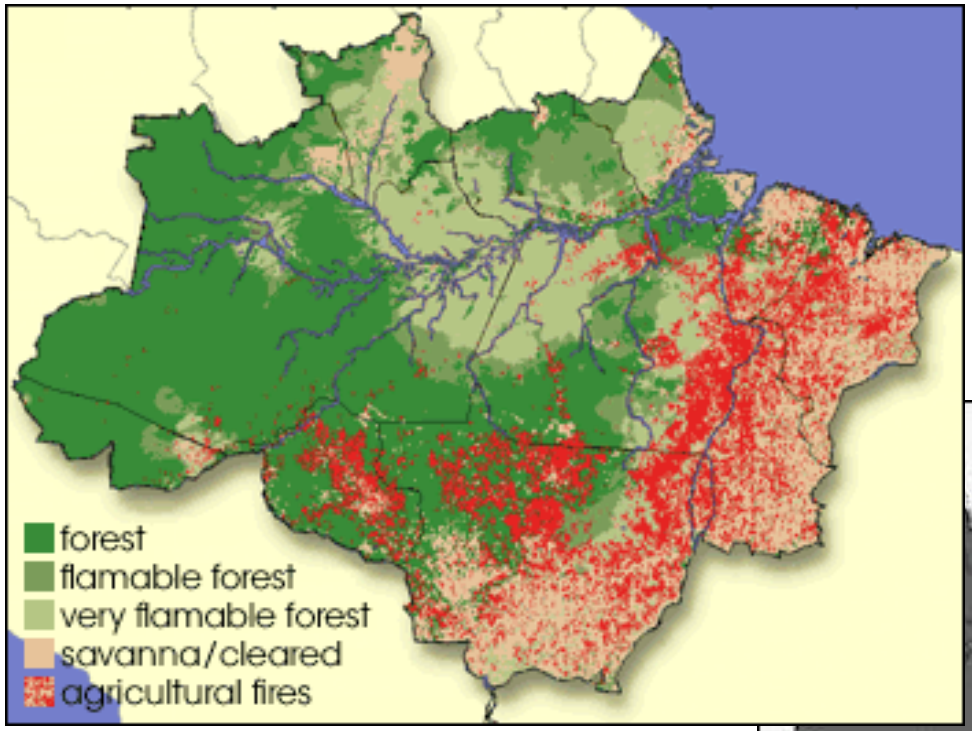
1.6 Billion (25%) with No Access to Electricity / 80% in Africa & India

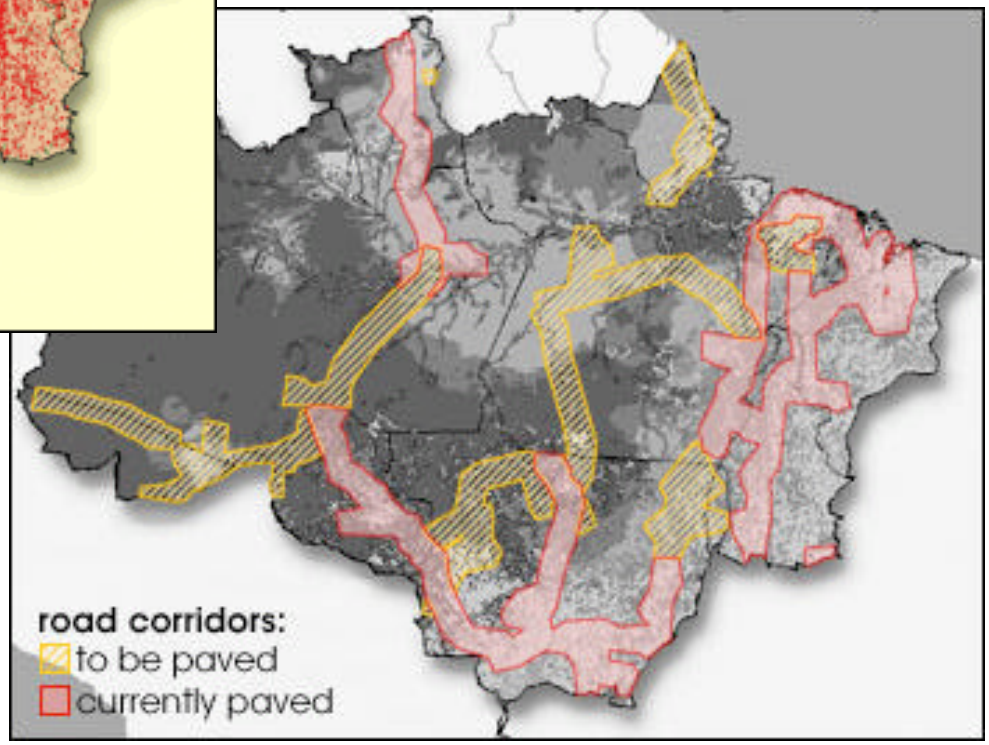
Loss of Capacity for Carbon Sequestration (Oceans)

…Massive Release of Carbon in Woody Biomass



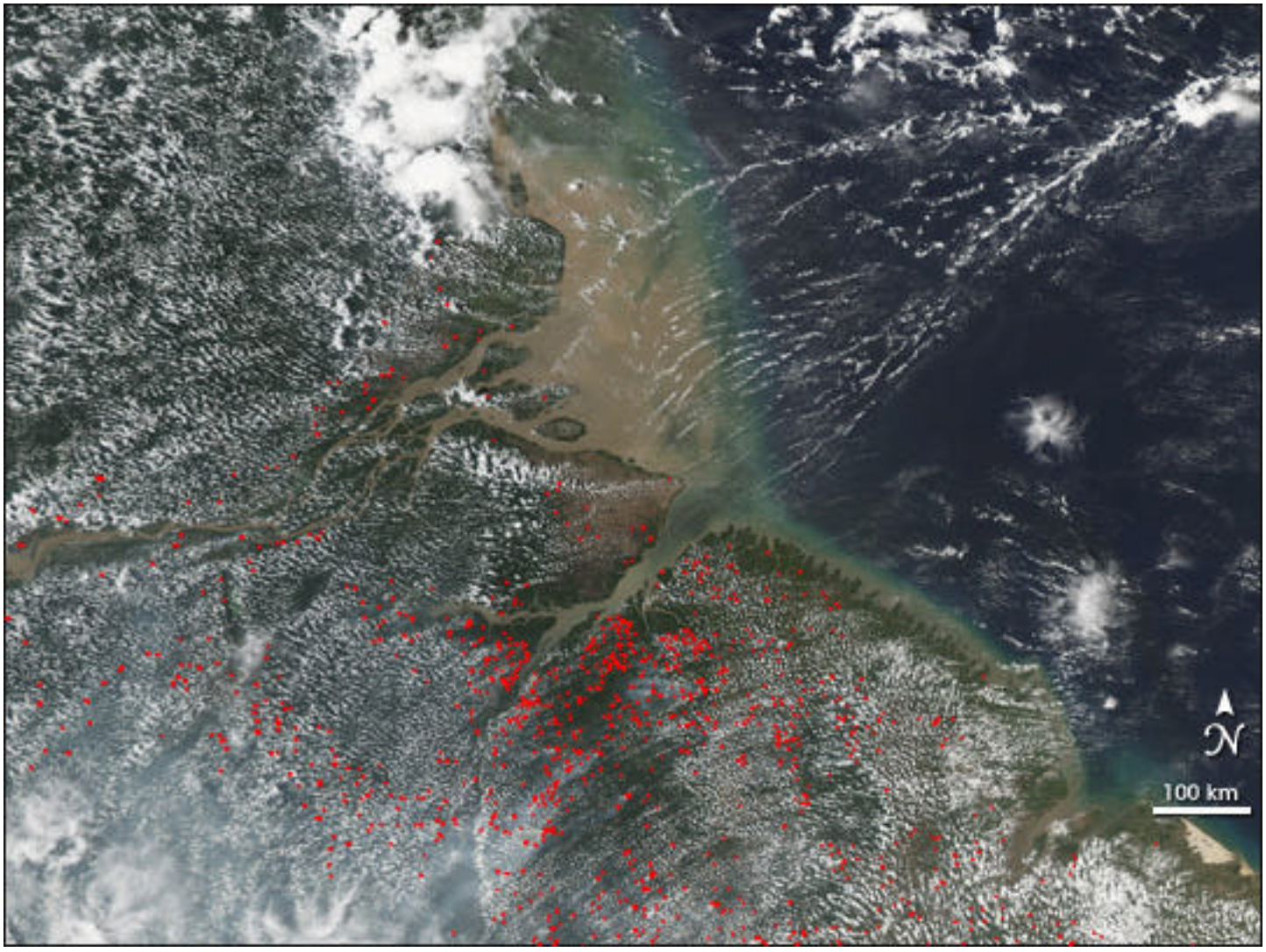
Planned Resource Depletion



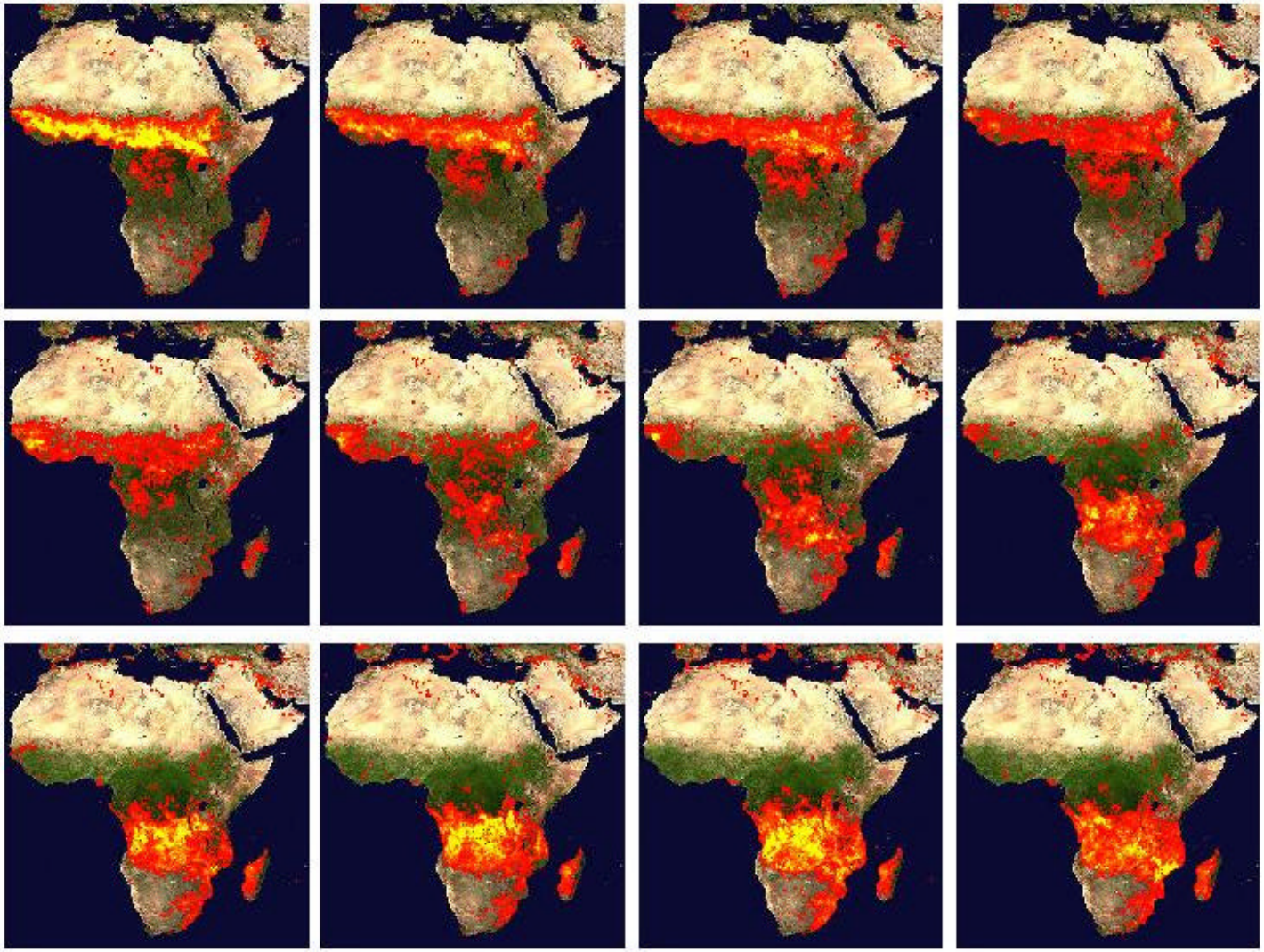


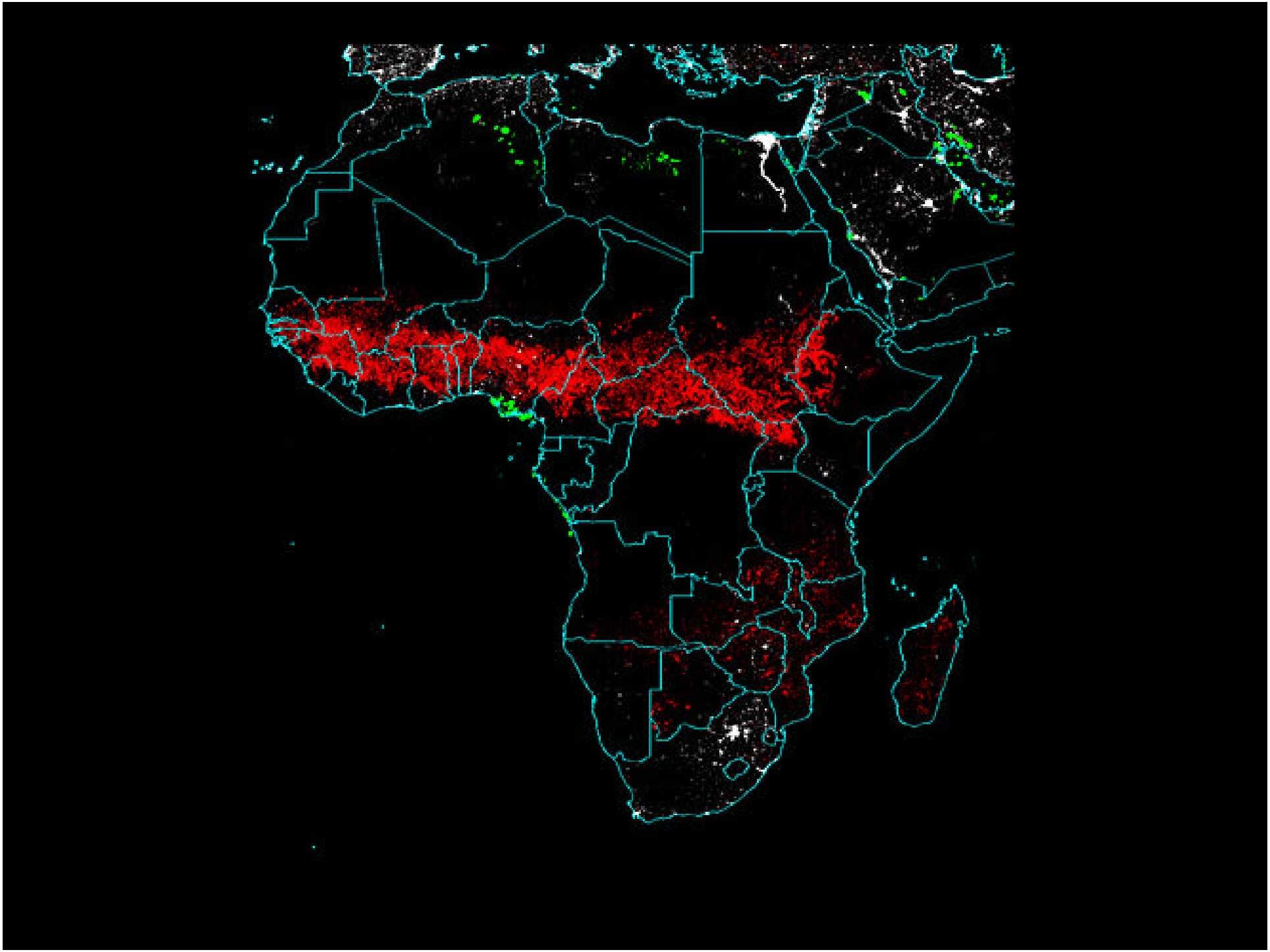
humans burn up to 8.2 million sq km of grasslands and forests annually

Mouth of the Amazon River

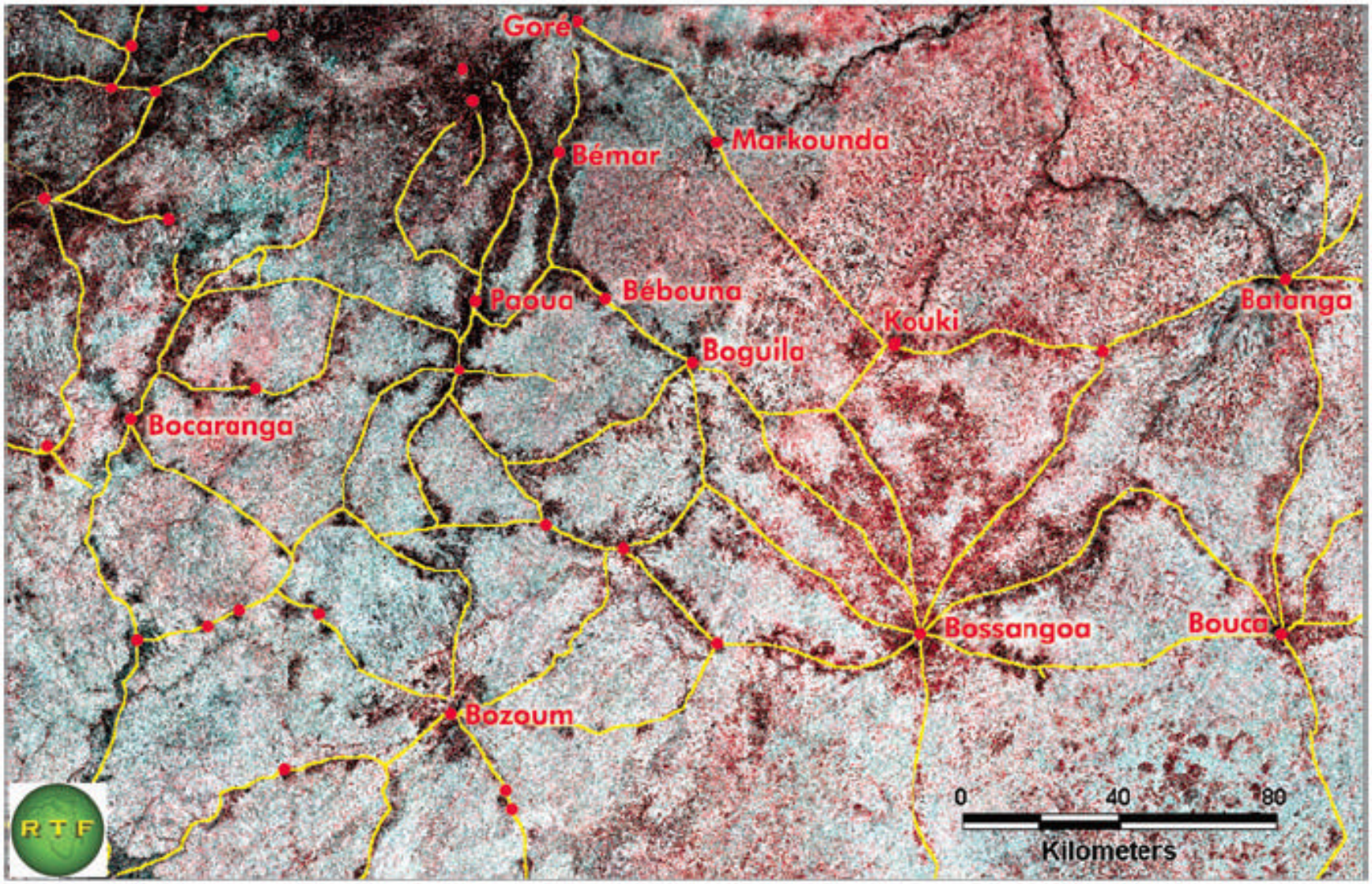


NASA Earth Observatory: 12 Month Burn Pattern

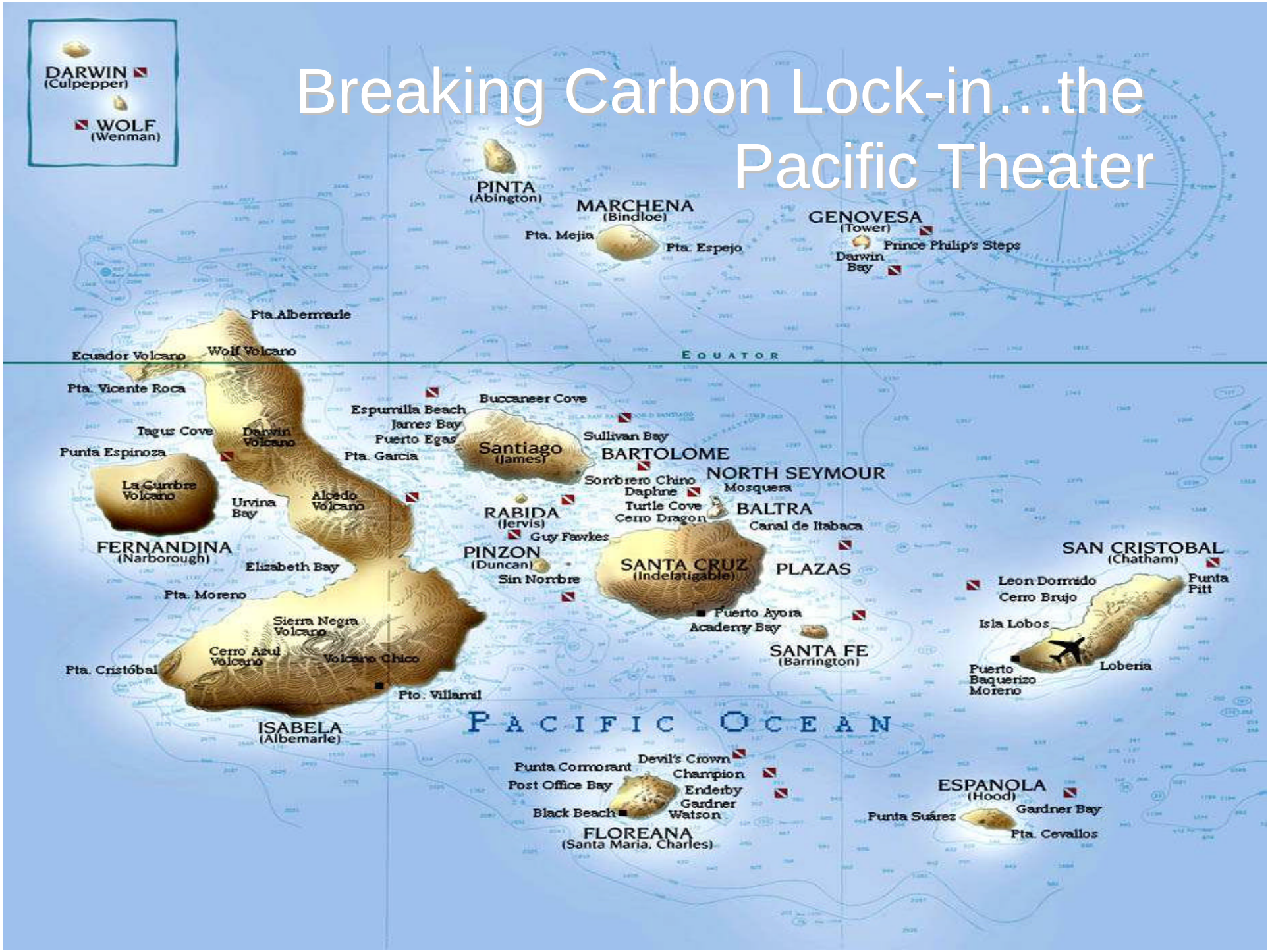




Charcoal Web – Central Africa Republic



Breaking Carbon Lock-in…the Pacific Theater



Renewable Electrification of the Galápagos (ERGAL)

RENEWABLE ENERGY APPLICATION LABORATORY

of the Galápagos Archipelago

COLLABORATING AGENCIES

RE-POWERING THE GALÁPAGOS ECONOMY

Asociación SEBA • Centro Nacional de Control de Energía • Consejo Nacional de Electrificación

Consejo Nacional de Modernización • e7 Network for Expertise on the Global Environment

Empresa Electrica Provincial Galápagos, Elecgalápagos S.A. • Fondo de Solidaridad

Fondo de Electrificación Rural y Urbano Marginal • Floreana Parish Council

Fideicomiso Mercantil Proyecto Eólico San Cristóbal • Galápagos National Institute

German Bank for Reconstruction and Development • Global Environment Facility

German Ministry of Cooperation • Galápagos National Park Service • Ministry of Environment

Inter-American Development Bank • Ministry of Education and Culture

Ministry of Energy, Mines and Minerals • Spanish Cooperation Agency (Project Araucaria)

United Nations Fund for International Federation Partnerships • United Nations Development Programme

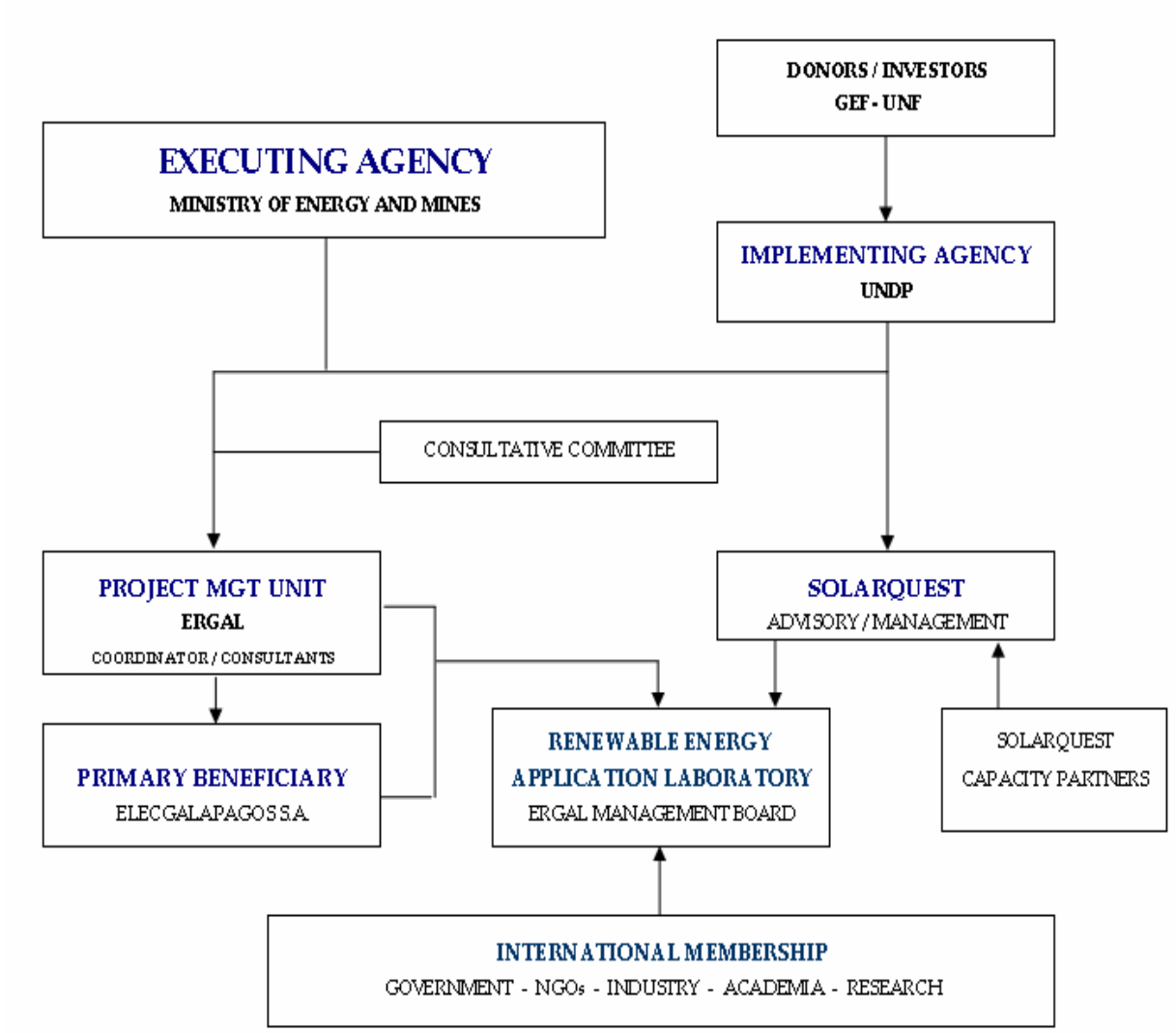
United Nations Foundation • World Wildlife Fund

SolarQuest®

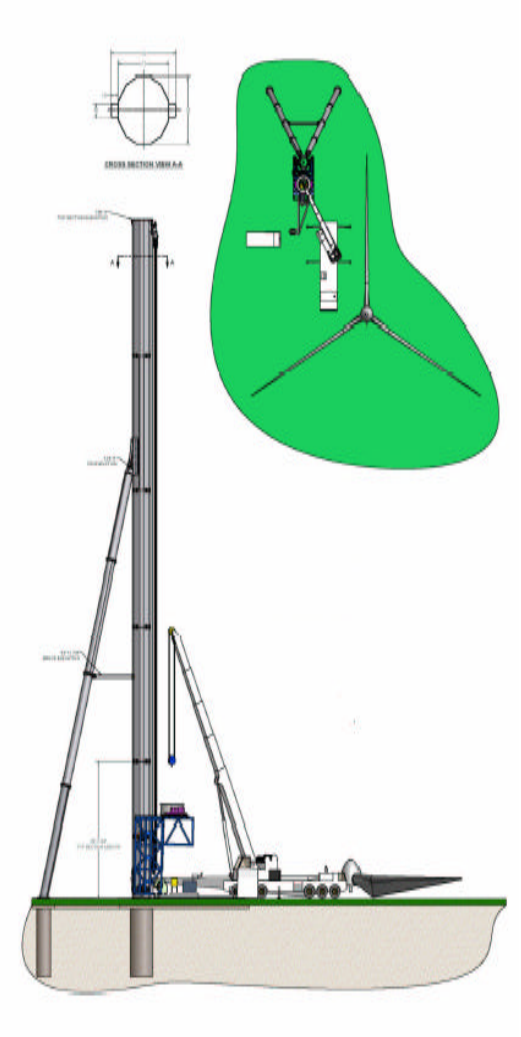
Renewable Electrification of the Galápagos (ERGAL)

RENEWABLE ENERGY APPLICATION LABORATORY

of the Galápagos Archipelago



USD $33 Million- Solar (Photovoltaic) and Wind



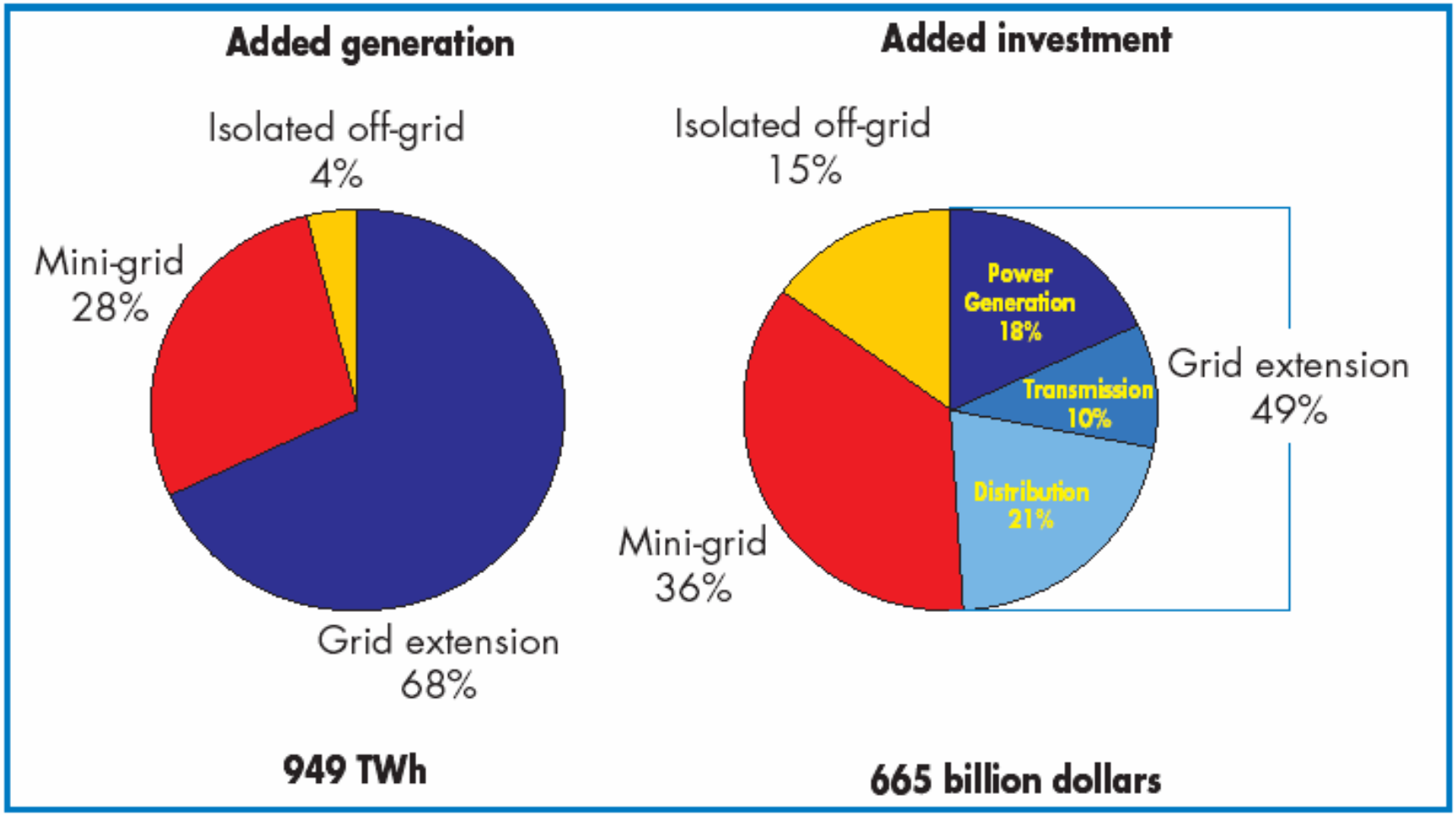
Renewable Electrification of the Galápagos (ERGAL)
RENEWABLE ENERGY APPLICATION LABORATORY
of the Galápagos Archipelago

MISSION STATEMENT

The mission of the Renewable Energy Applications Laboratory of the Galápagos Archipelago is to develop, evaluate and promote “best practices” in sustainable energy resource development throughout the world.

This mission will be achieved by creating an advanced renewable energy and energy efficiency technologies applications “test-bed” on the electricity grids in the Galápagos in order to assess the field performance of state-of-the-art renewable energy systems components and energy efficiency appliances, and by providing human capacity building and technical assistance services to member nations and other international stakeholders.

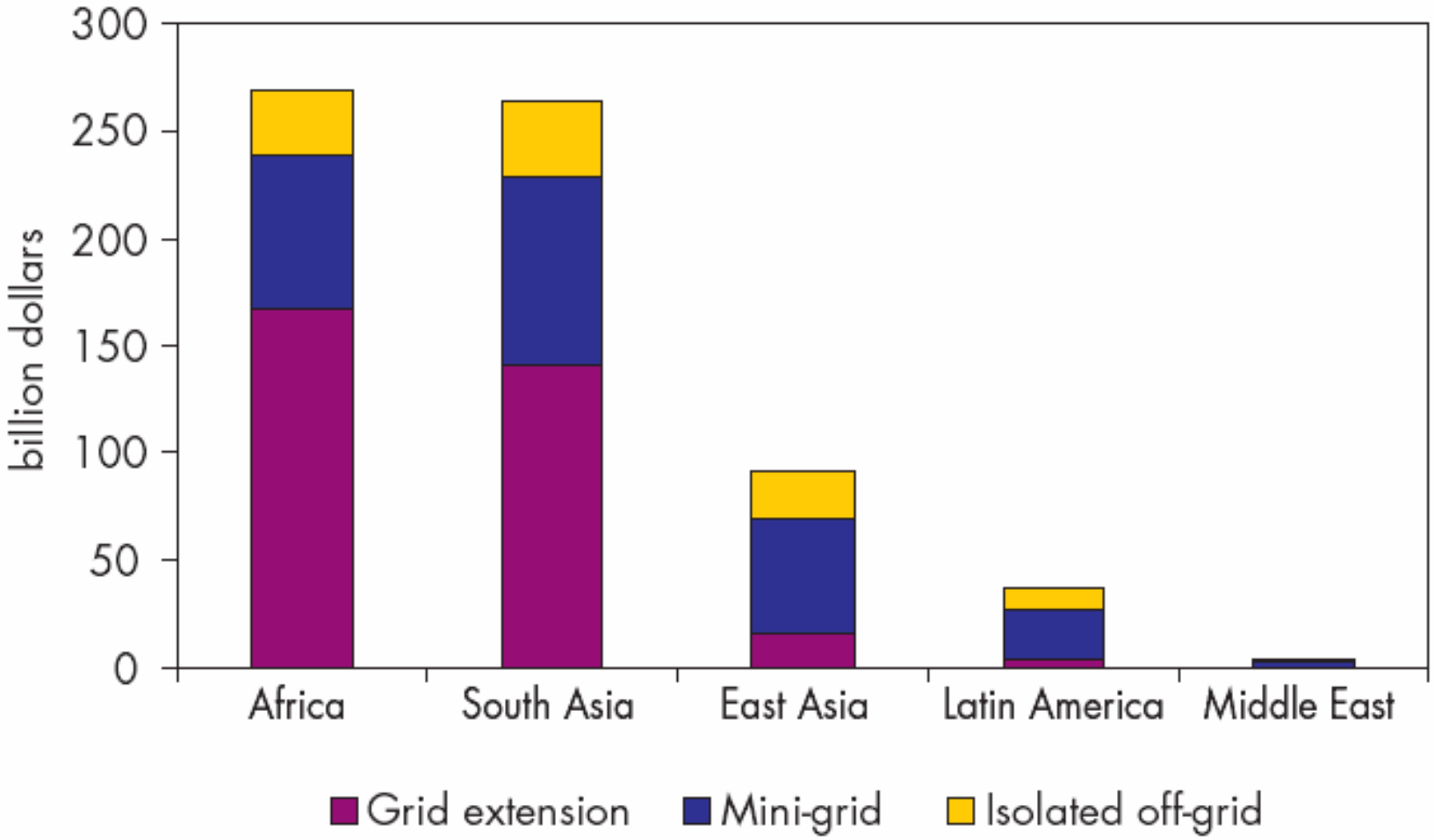
Deep-Rural Energy Development to 2030



Geographical Distribution

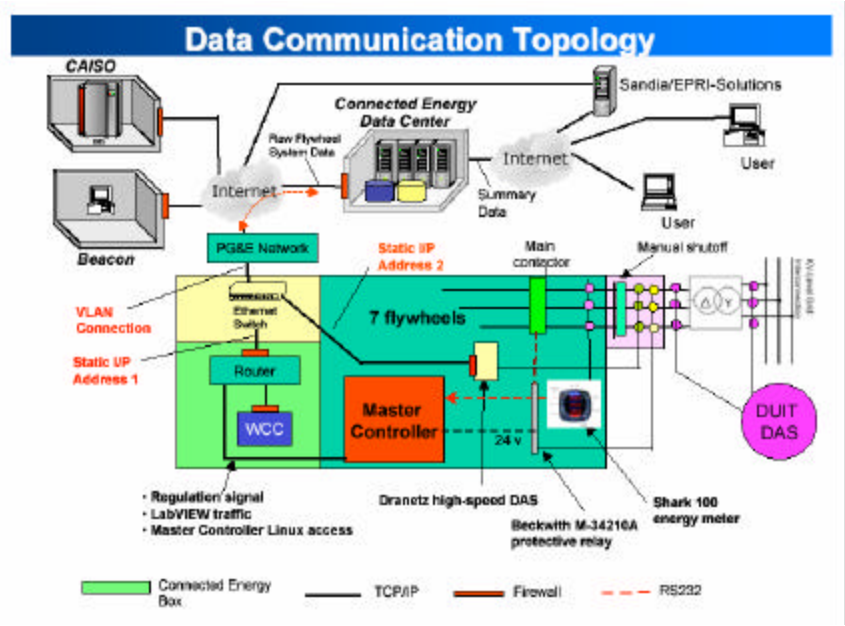
Africa: $110 Billion - South Asia: $125 Billion

East Asia: $90 Billion - Latin America: $43 Billion



Technical Assistance Services Development-

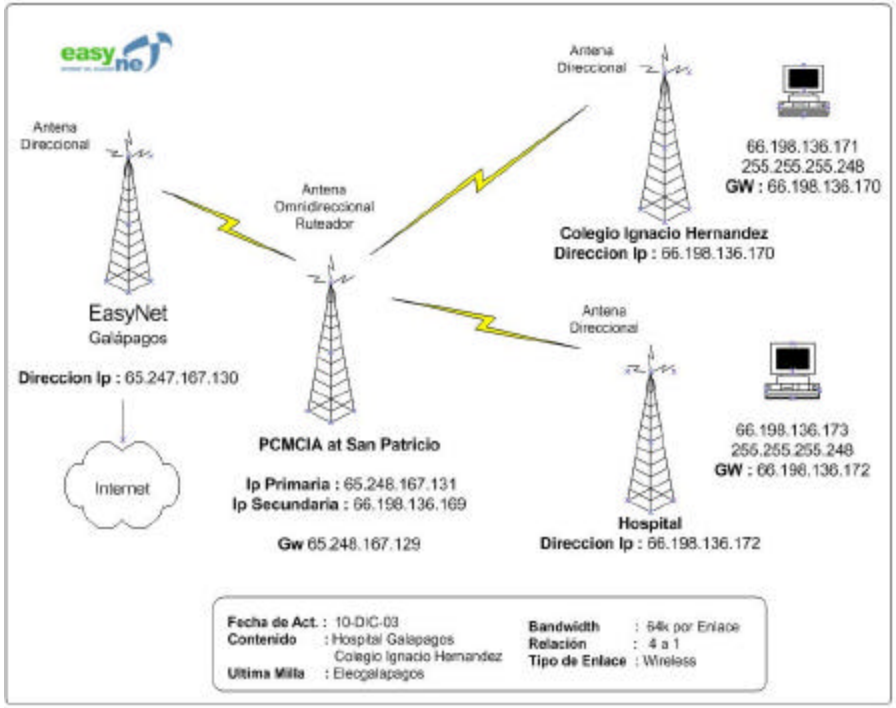
Achieved through Collaborative Student Research



MICRO-GRID MANAGEMENT: Assessing electric grid security from issues of intermittancy.	BEST-PRACTICE DISSEMINATION: Promoting best-practices through outreach and membership services.
TECHNOLOGY TEST-BED: Field testing unproven technologies in micro-grid applications.	DEMAND SIDE MANAGEMENT: Assessing supply and demand issues to achieve cost-effectiveness.
INFORMATION SERVICES: Providing real-time energy systems data for performance analysis.	DEVELOPMENT ASSISTANCE: Providing members with multi-sector technical assistance services.

ICTs INFRASTRUCTURE

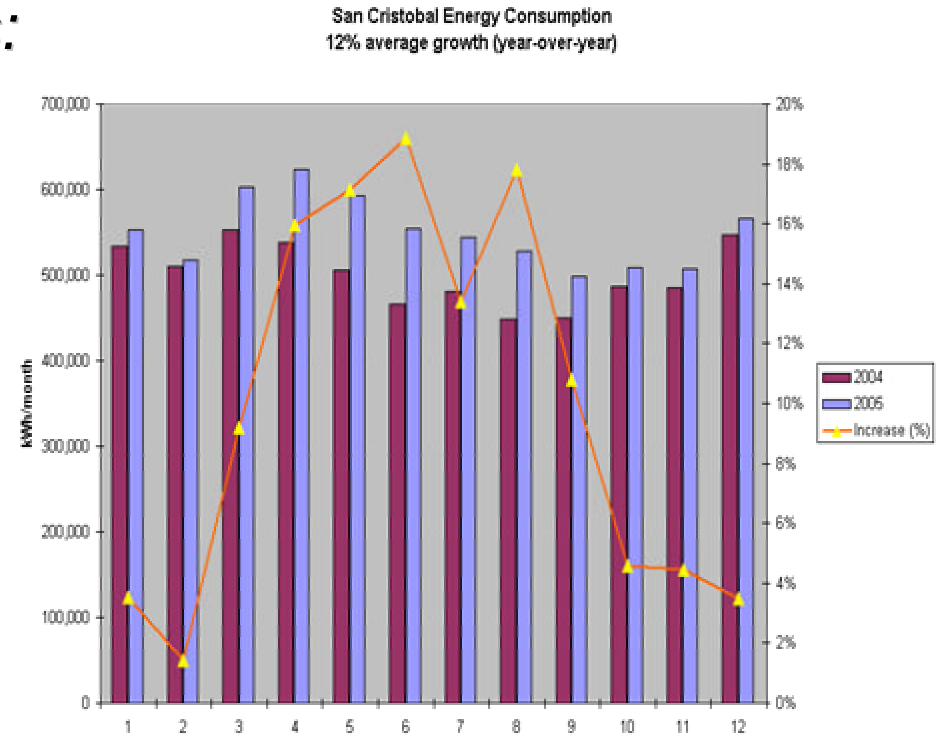
- Satellite and terrestrial connected, 802.11b Wireless Local Loop (WWL) to 4 sites on San Cristobal, one site on Santa Cruz
- 3 School computer labs, language learning lab, utility administrative offices, thermal electric power plant connected to Internet
- Professional development for Internet-based distance learning technology and training for peer educators

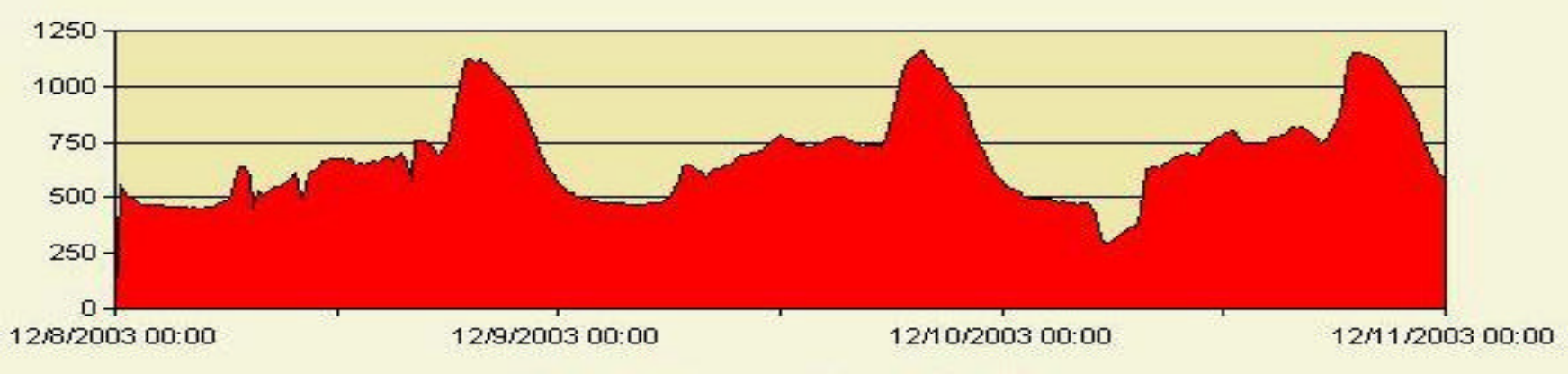


Primary Research Tasks:

1. *Analyze energy efficiency survey to establish existing and new load characteristics based on conservation measures.*

2. *Research load balance applications to capture excess power generation from 2.5 mw wind turbine facility for productive economic uses.*





Public Outreach: Television, Radio, Community Presentations, Reports Presentation to International and National Stakeholders

Consumer Audits

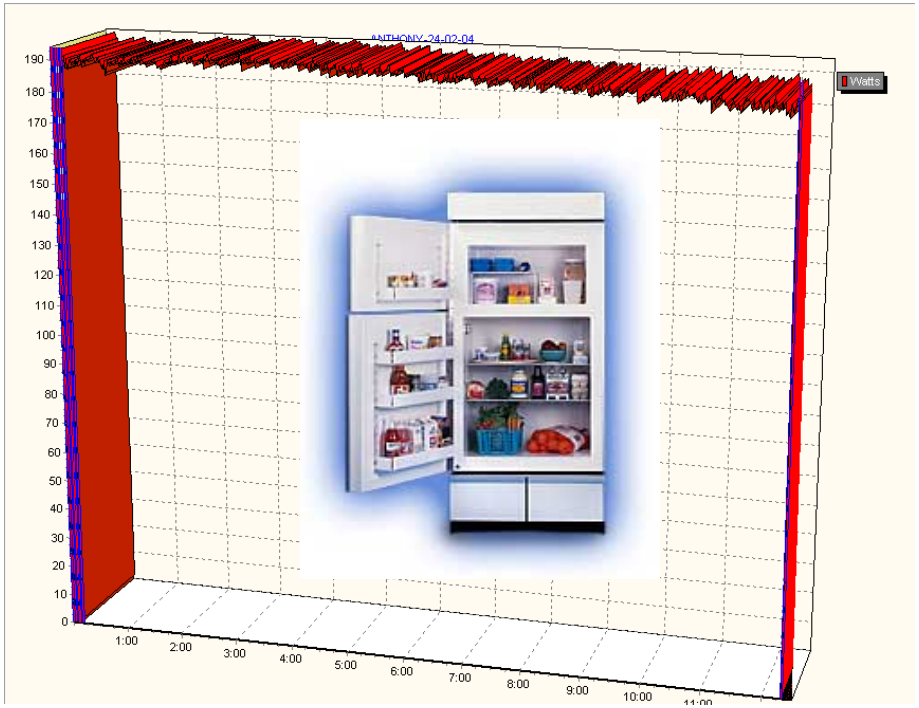
• Refrigerators • Televisions
• Water Pumps • Lighting • Radios
• Kitchen Appliances • Hot Water Heaters

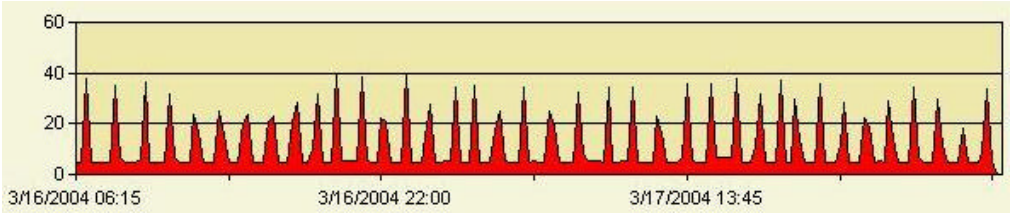
SERVICE-LEARNING / ENERGY AUDIT

Excess Refrigeration Consumption

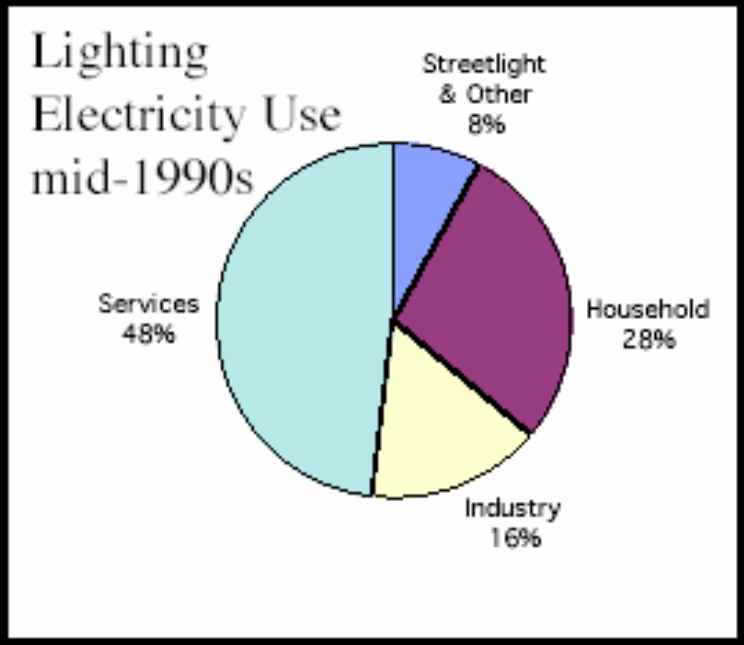
<u>Residential / Commercial</u>:

- Approximately 6,000 (+/-) refrigerators in the Galapagos;
- Based on student audits, 36% (2,160 units) are consuming energy continuously;
- Energy consumption from refrigerators in poor condition is approximately 4 MWh annually, representing a cost to consumers of nearly (USD) $1 million dollars annually (including government subsidies);
- Installation of high efficiency AC and DC refrigeration systems may achieve substantial reduction of energy consumption and savings to the consumer;
- Payback based on savings may be less than 2 years on a USD $1.5 demand side management program for refrigeration alone.





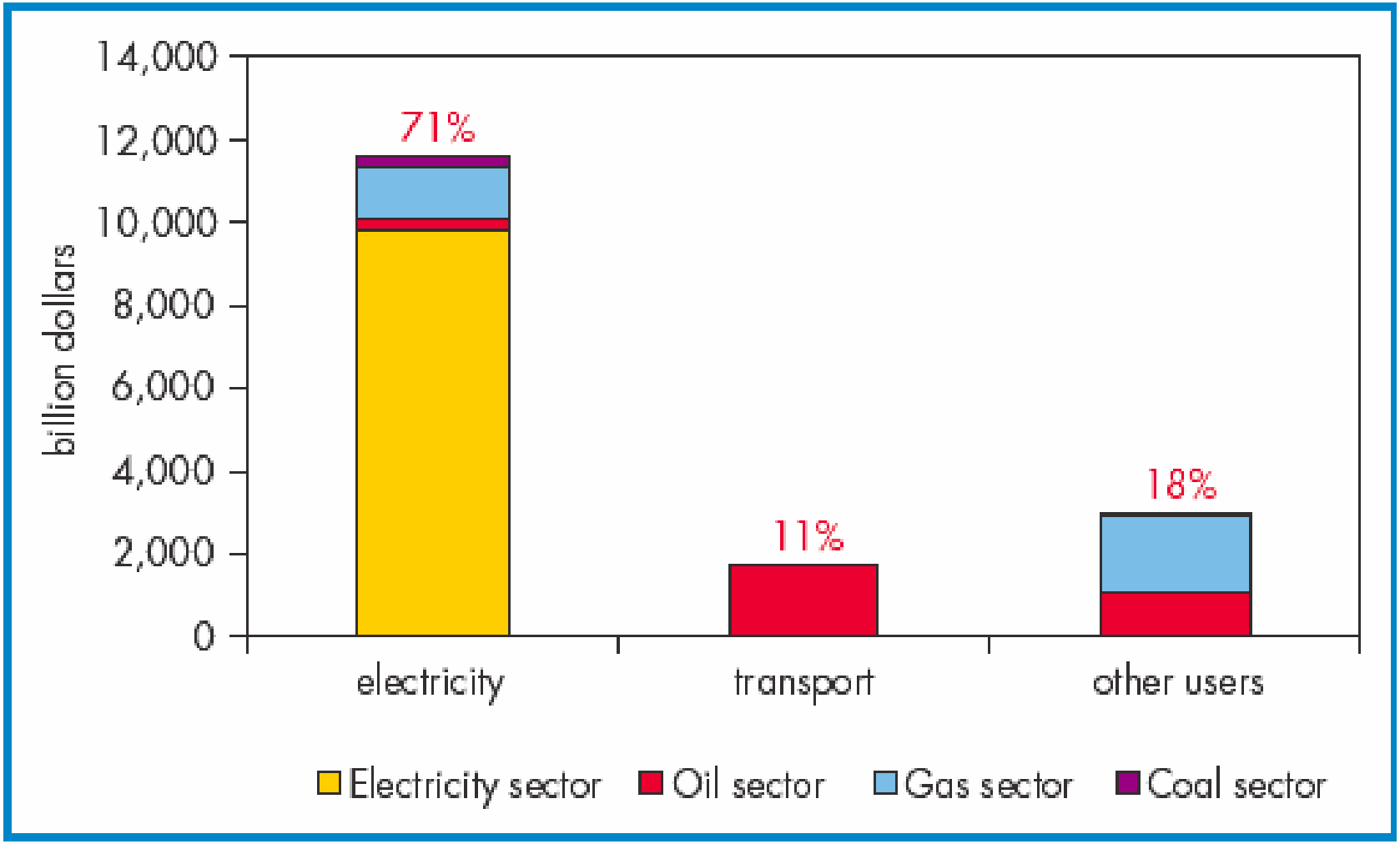
Global Lighting Energy: 178 Countries



- Cost: $185 Billion/year electricity $25 billion fuel
- Power Plants: ~2000 (200 MW each)
- $C0_2$ Emissions: ~2Bt/year
- Direct Fuel: 1.3 Mboe/day (Brazil, Algeria, Libya, or Indonesia)
- Savings: $75-$115B/year (> Canada, France, or Germany TWh)

Conservatisms: most estimates go back to mid-1990s; excludes HVAC-interactions; T&D losses at 10%; electricity price $0.1/kWh; savings potential excludes daylighting

Figure 2.1: **Cumulative World Energy Investment by Energy Use, 2001-2030**



USD $16 Trillion Investment thru 2030

$10 Trillion in Electric Power Plants


Divest Carbon Portfolio
Invest in …
Renewable Nations

Evan Mills, Ph.D.
International Association for Energy-Efficient Lighting &
Lawrence Berkeley National Laboratory

June 2002

ABSTRACT

This paper presents the first global estimate of lighting energy use, costs, and associated greenhouse-gas emissions. Based on a compilation of estimates for 41 countries representing approximately 63% of the world's population, we develop a model for predicting lighting electricity use for other countries where data are lacking. The corresponding lighting-related electricity production for the year 1997 is 2016 TWh (21103 Petajoules), equal to the output of about 1000 electric power plants, and valued at about $185 billion per year. Global lighting electricity use is distributed approximately 28% to the residential sector, 48% to the service sector, 16% to the industrial sector, and 8% to street and other lighting. The corresponding carbon dioxide emissions are 1775 million metric tonnes per year. Lighting electricity demand in the 23 International Energy Agency (IEA) countries represents approximately half of the world's total lighting use. Our parallel examination of global fuel-based household lighting suggests that it represents an amount of primary energy of 3600 PJ ($48 billion), equal to 115% of that used to provide household electric lighting in all IEA countries, and 244 MT carbon dioxide emissions. Although one in three people obtain light with kerosene and other fuels, representing about 20% of global lighting costs, they receive 0.2% of the resulting lighting energy services. While collecting end-use energy data is arguably not a high national priority in most countries, this lack of attention is particularly problematic in this instance given that lighting is usually a preferred target for energy savings campaigns and policies. Without such data, precise scenarios of future lighting electricity demand cannot be developed. Improved work in this area seems merited given our estimated global savings potential of $75 to 115 billion/year.

Annual Global Lighting Turnover

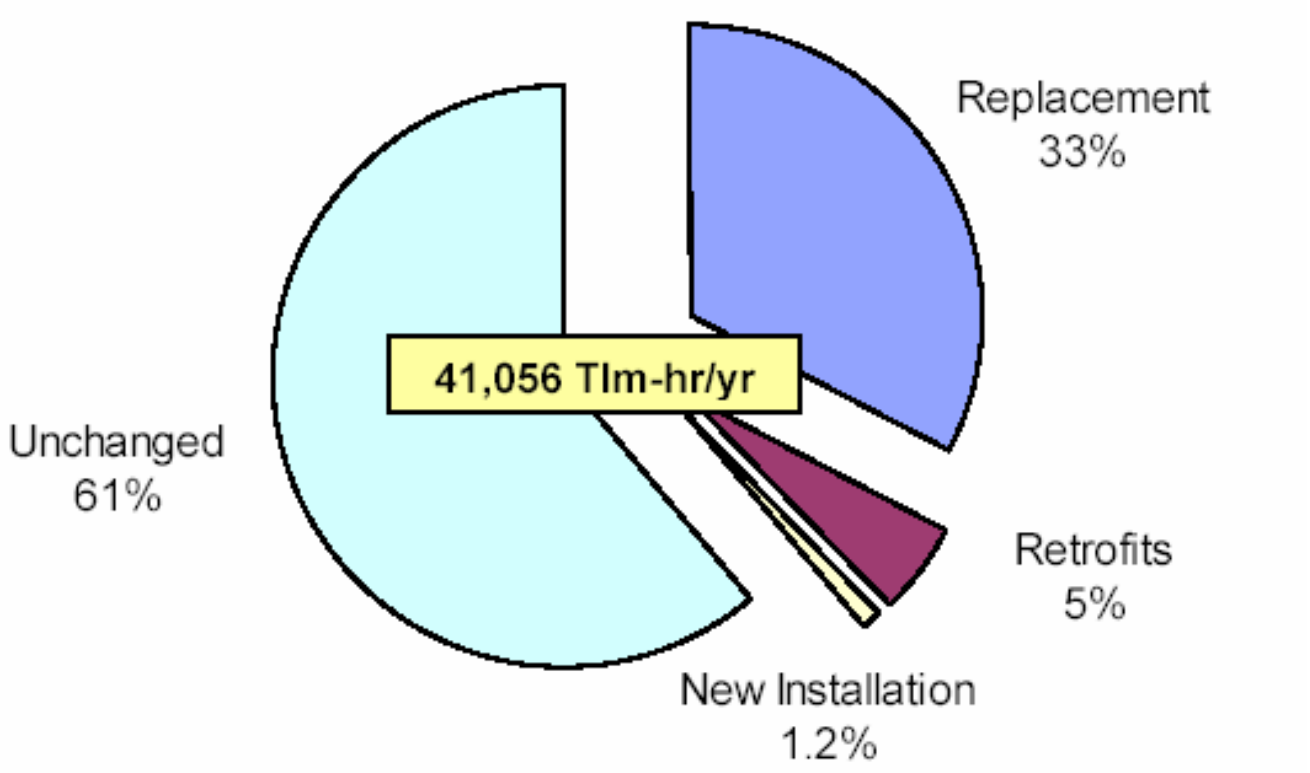
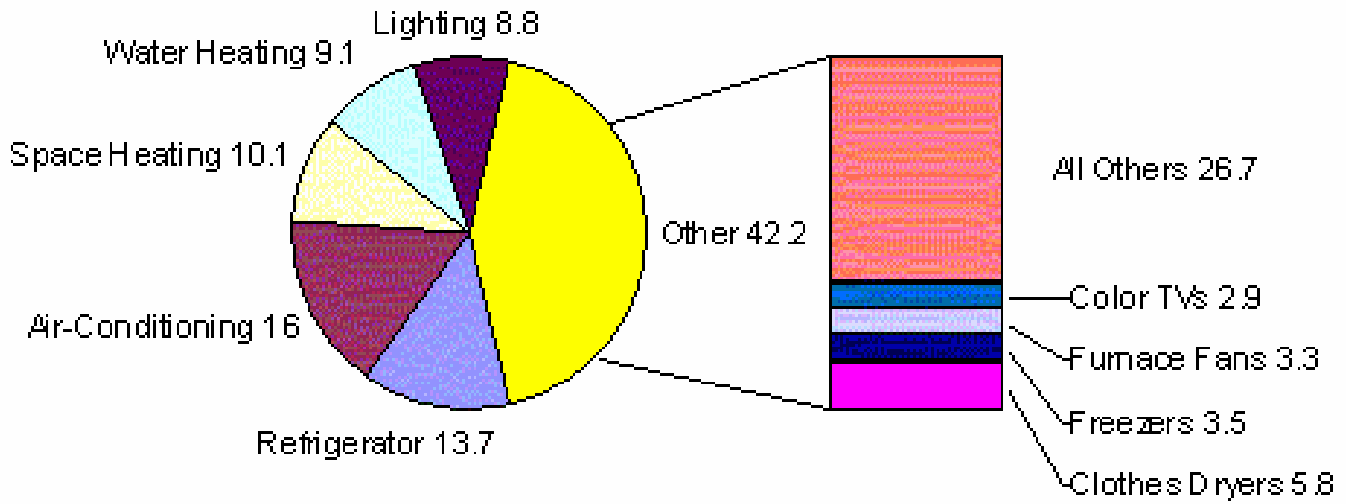


Figure 3-1. Annual Lumen Market Turnover in 2005

Figure 1. Percent of Total Electricity Consumption in U.S. Housing Units, 2001



Source: Energy Information Administration, Form EIA-457A, B, C. E. and H of the 2001 Residential Energy Consumption Survey.

107 Million Households

10% Standby Power Loss / 20% Spinning Reserves

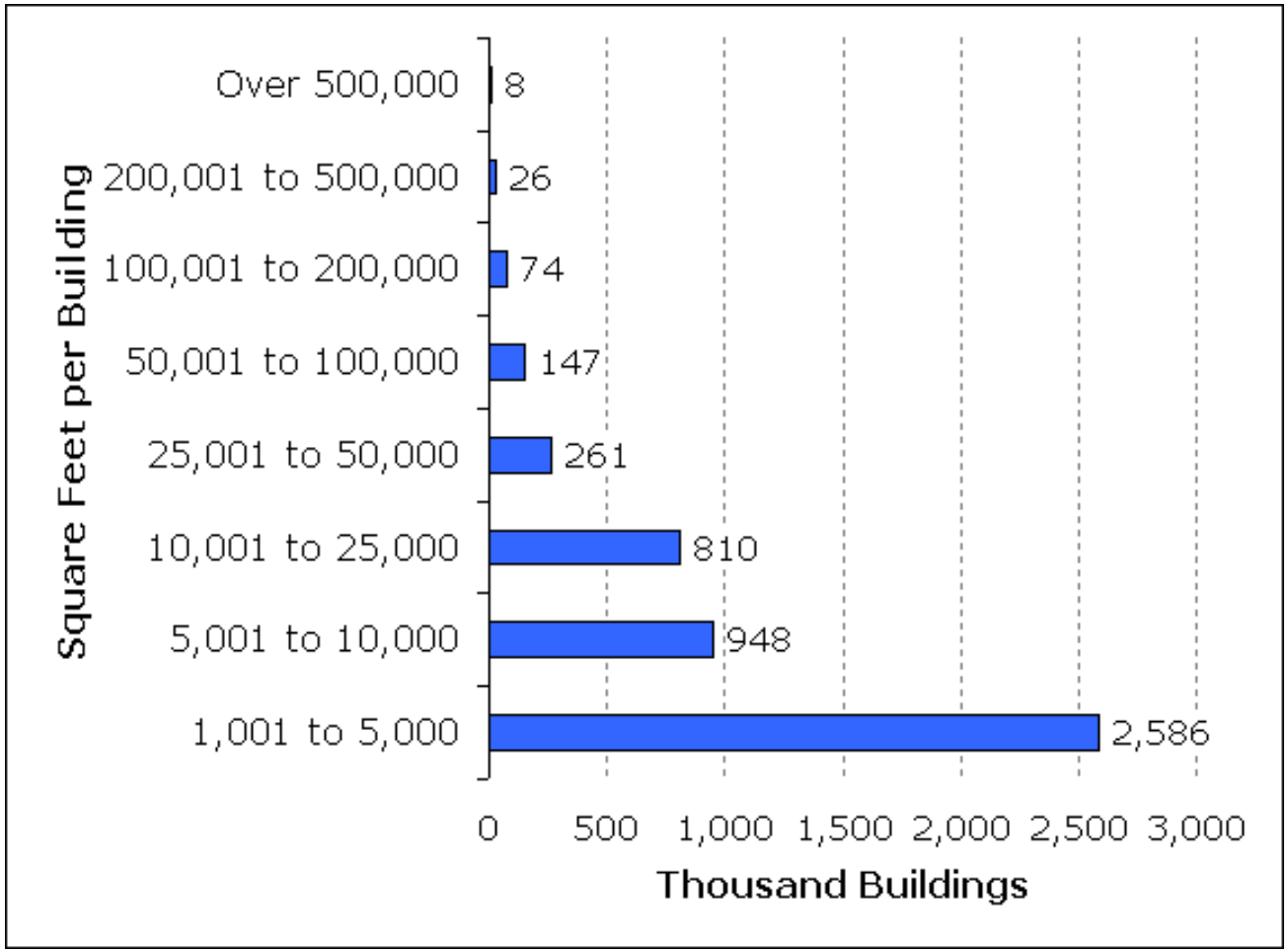
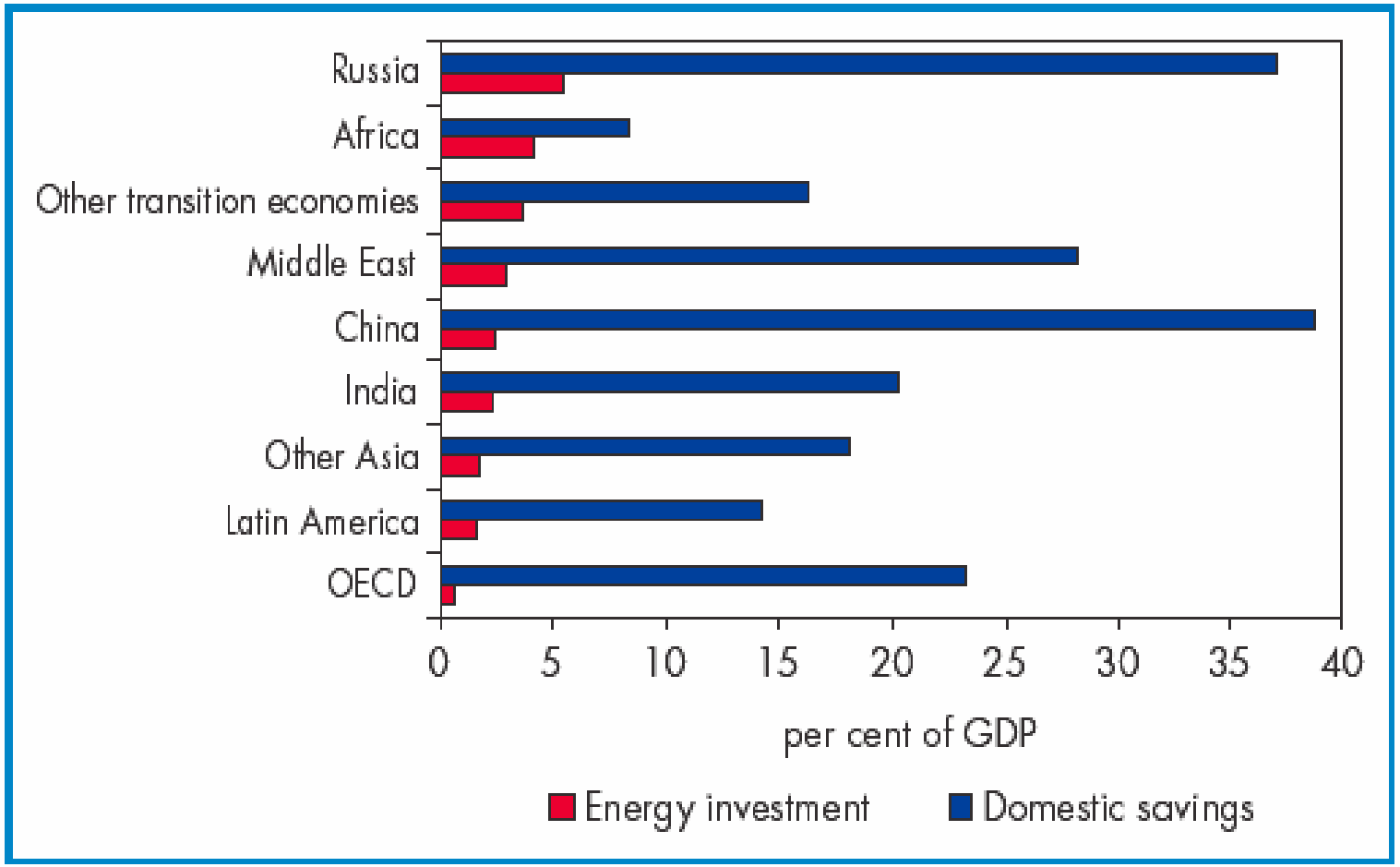
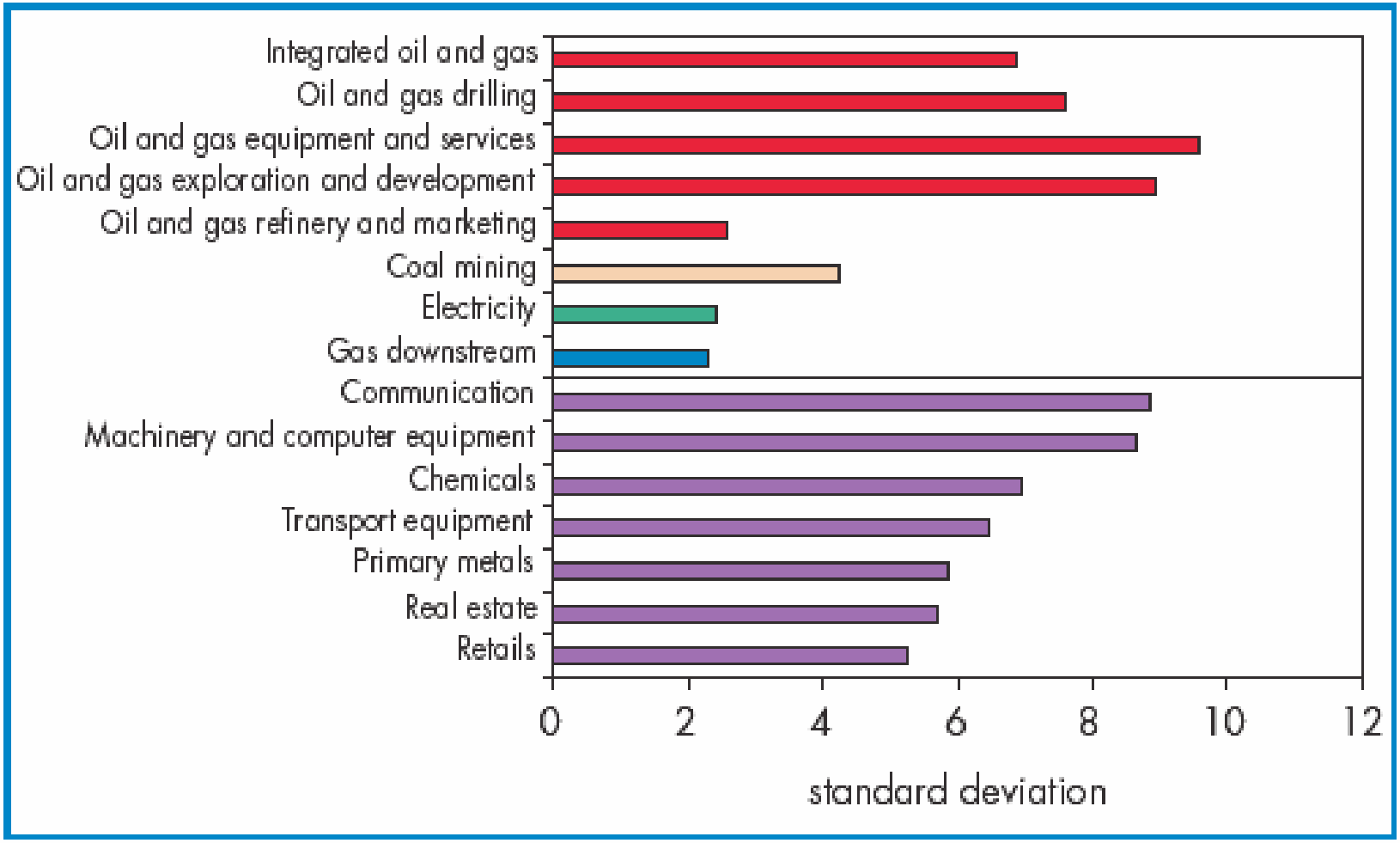


Figure 3.1: **Energy Investment and Domestic Savings as a Percentage of GDP by Region**



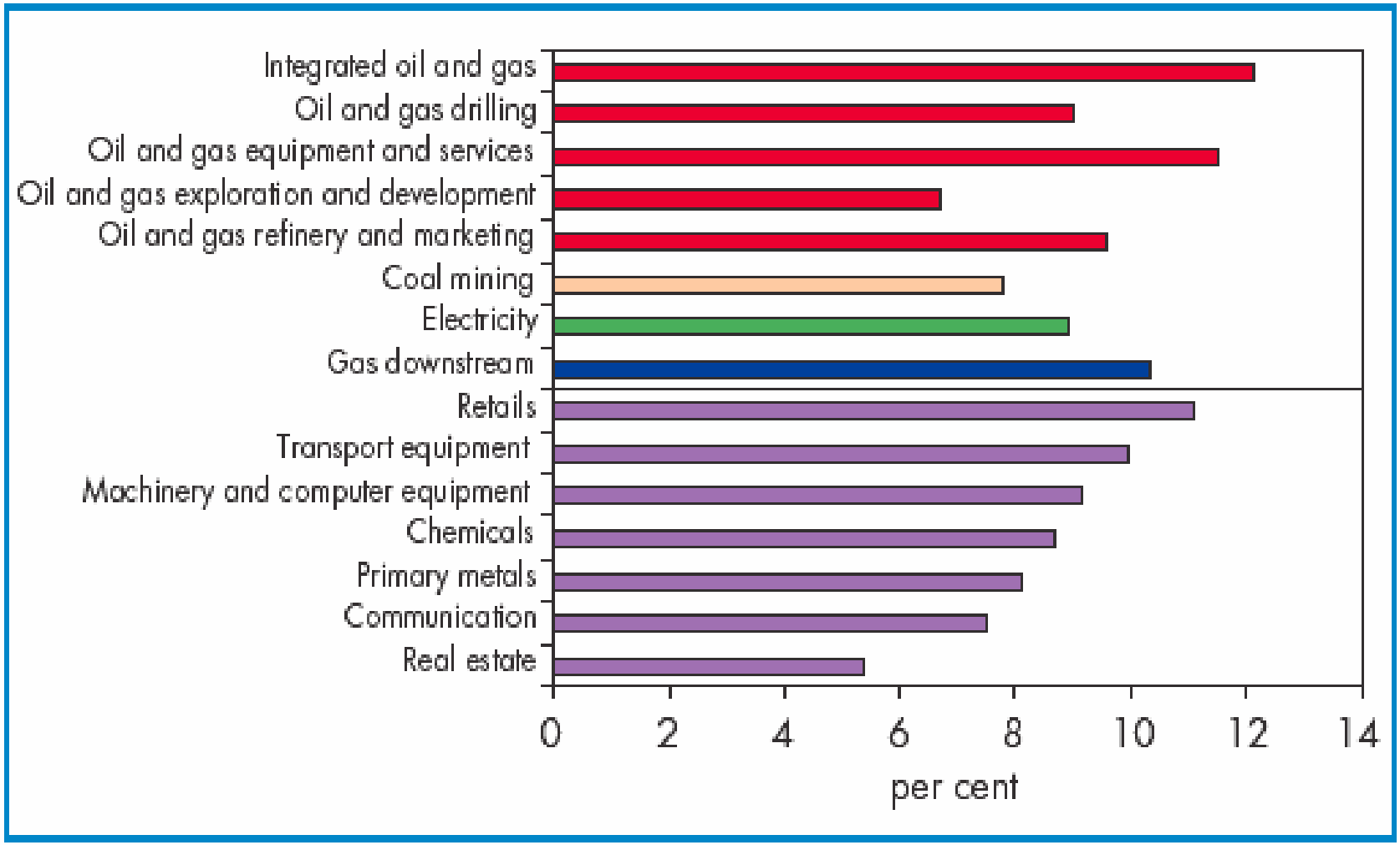
Note: Domestic savings as a percentage of GDP is based on 2000 data. The share of energy investment in GDP is based on projected averages for the period 2001-2030.
Source: World Bank (2003a); IEA analysis.

Figure 3.6: **Volatility* of Return on Investment by Industry, 1993-2002**



* Measured by the standard deviation of ROI over the period 1993-2002. Standard deviation measures how widely actual values are dispersed from the average.

Figure 3.5: **Average Return on Investment* by Industry, 1993-2002**



* Operating income divided by invested capital.