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IFC's Approach to Climate Change in the Electricity Sector

Oct 2008

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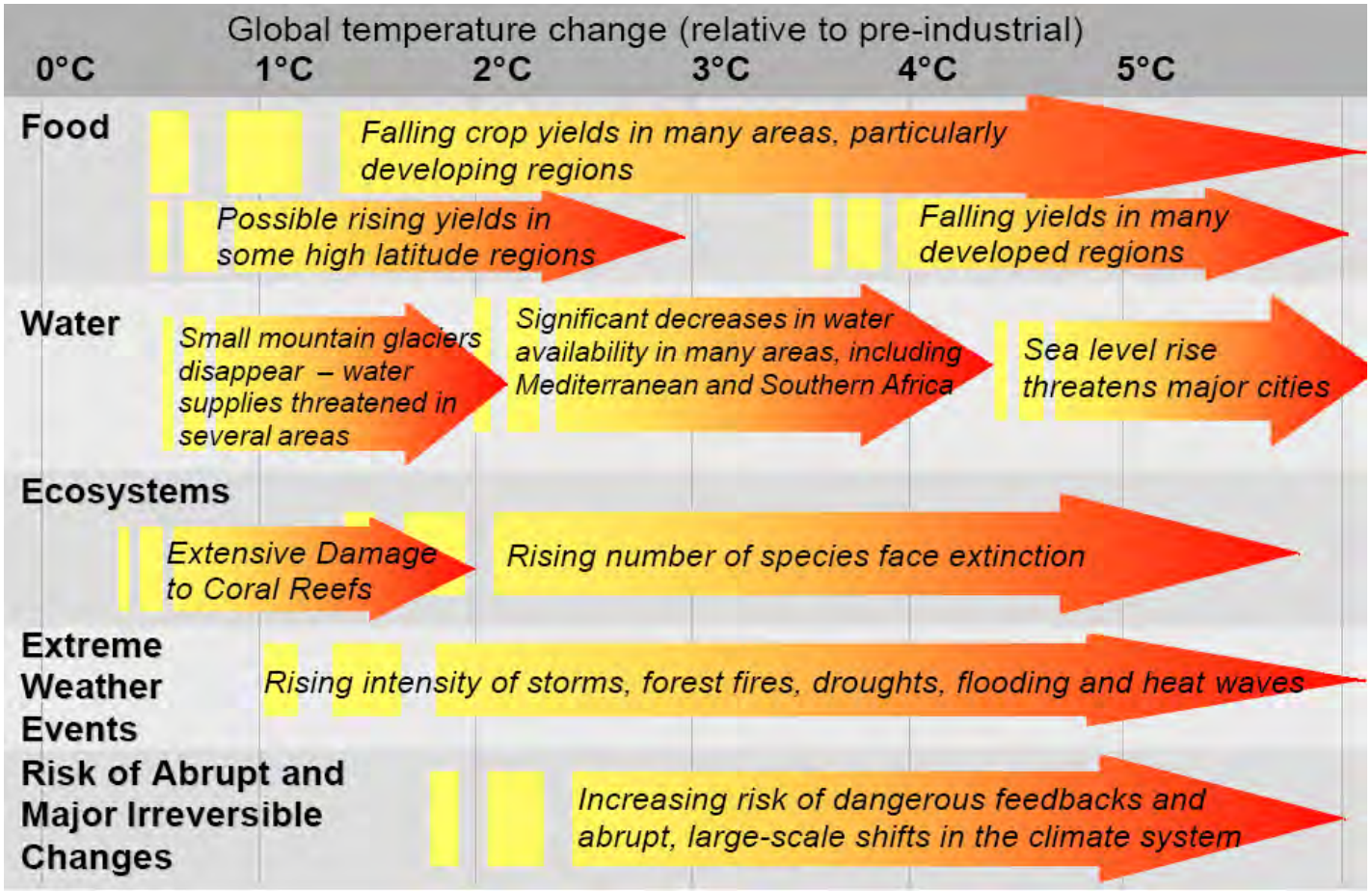
1. ***Climate Change, Economic Development, & the Electricity Sector***

2. ***Mitigating Climate Change: Efficiency, Technology, & Fuel Choice***

3. ***IFC's Approach***

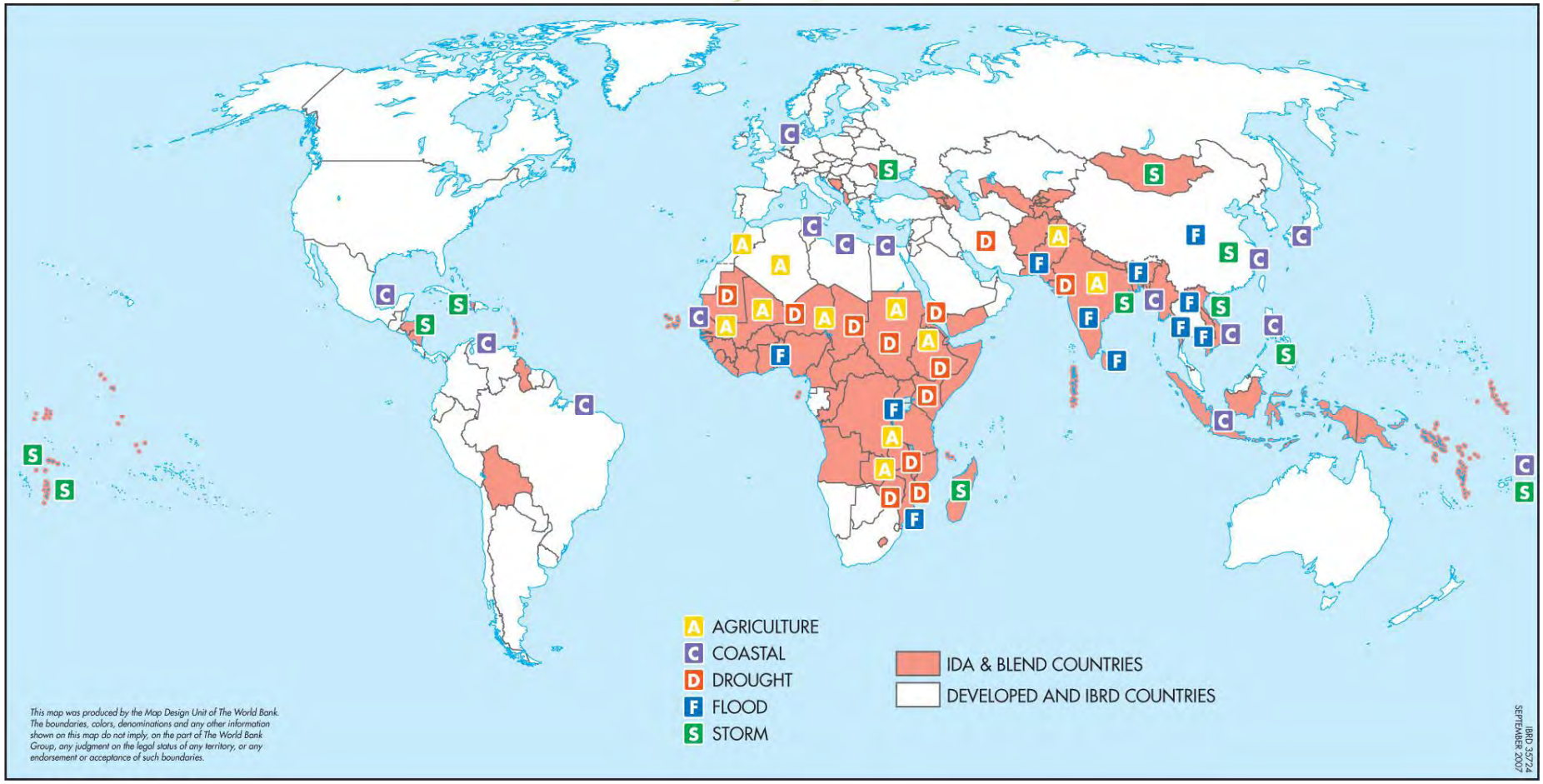
The expected economic and development impacts of climate change are severe



Direct economic costs of 1-5% of GDP are expected by the end of the century.

Source: WBG, IPCC

….and the impacts will be greatest in developing countries



Source: WBG

Developing economies are more reliant on agriculture and have less infrastructure and capital to adapt to changes in climate.

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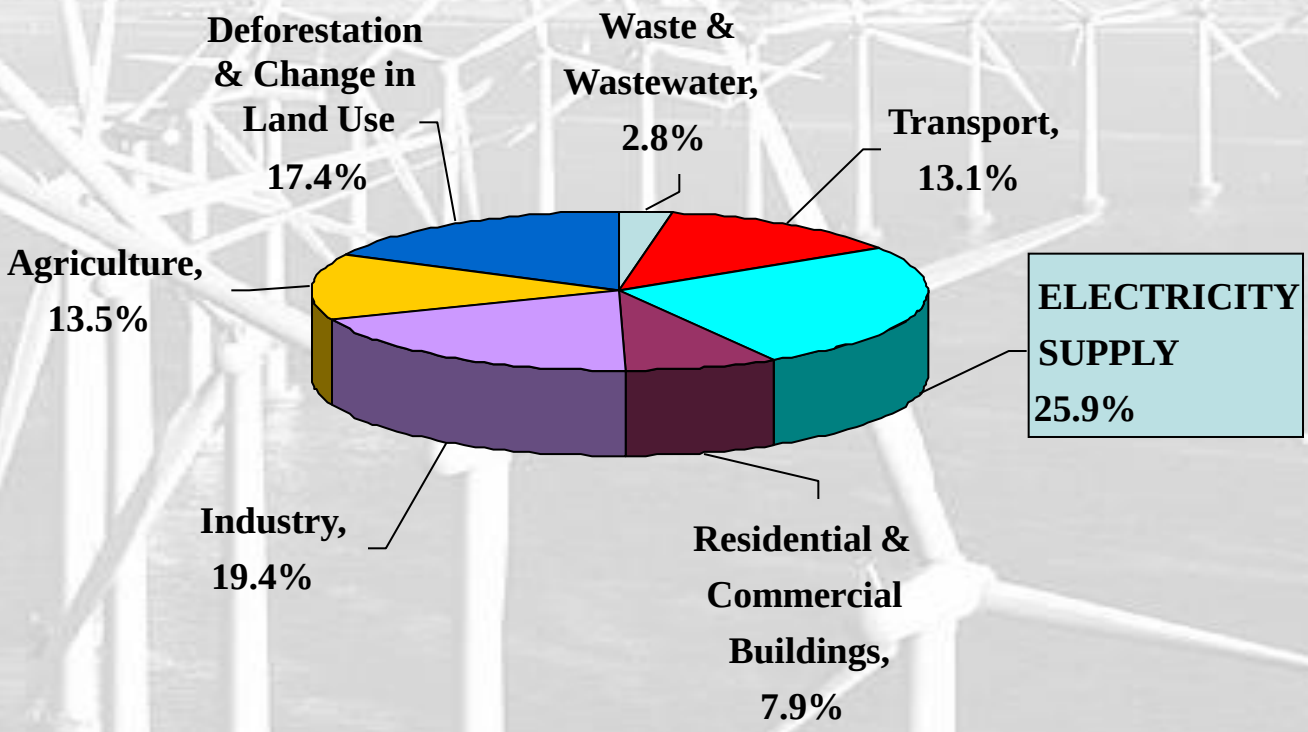
Electricity supply contributes 25% of current global greenhouse gas emissions and is expected to contribute 38% by 2030

Global Greenhouse Gas ("GHG") Emissions by Sector



With Business As Usual growth, GHG emissions from the electricity supply sector are forecast to grow 78% in the next 25 years

Source: IPCC Working Group III Report "Mitigation of Climate Change"

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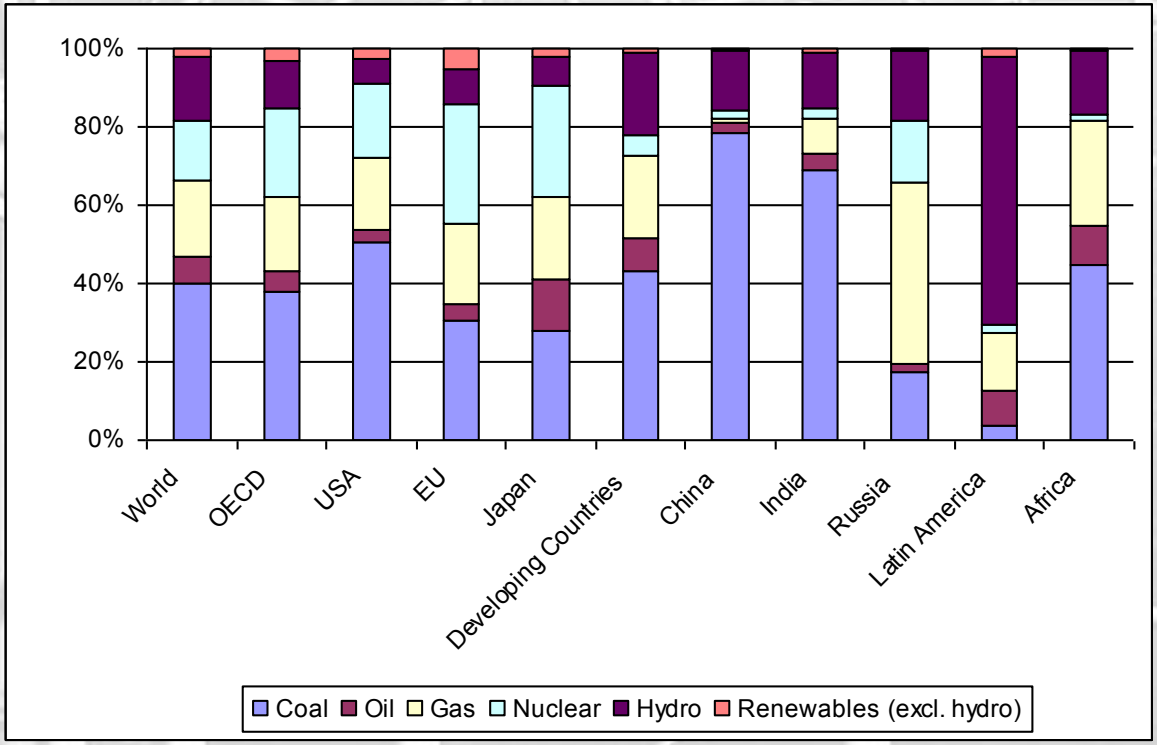
The most carbon intensive fuel (coal) is often the most available and lowest cost source of electricity

The % of electricity generated from coal is 40% worldwide and higher wherever there is significant resource



Renewables (excluding hydro) contribute only 2%, although this is expected to grow

Source: IEA World Energy Outlook 2007

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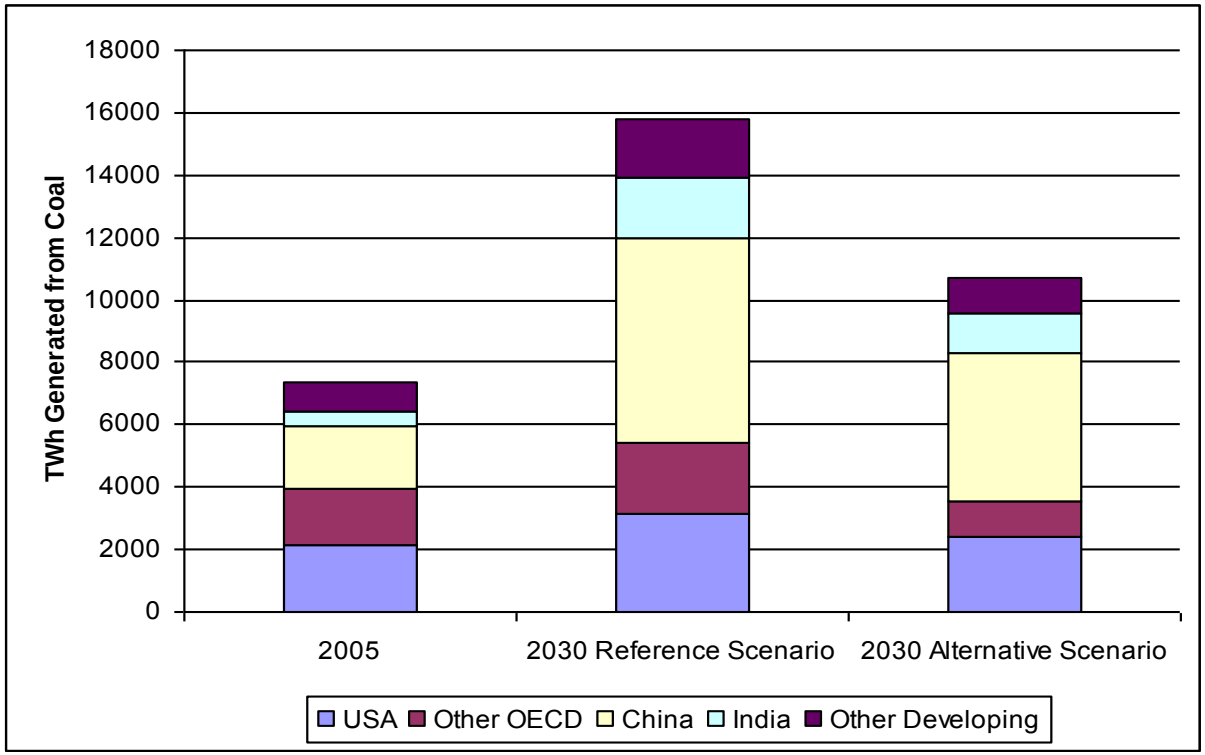
….and coal-fired electricity generation is expected to grow under all scenarios, particularly in fast growing India and China

Under Business as Usual growth, coal-fired generation in India and China is forecast to be greater in 2030 than coal-fired generation in the World today

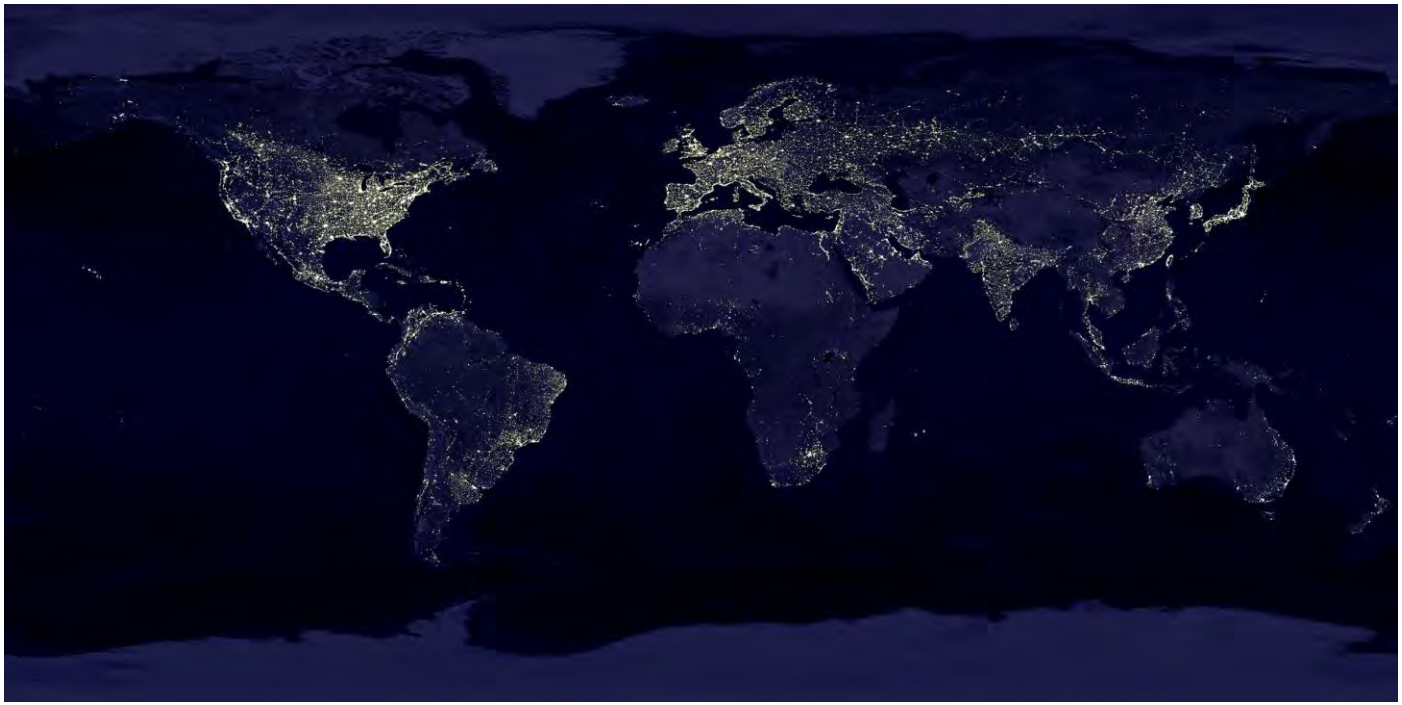


Note: the Reference Scenario represents business as usual, while the Alternative Scenario represents application of policies aimed at mitigating climate change which will attach a cost to emission of GHGs.

Source: IEA World Energy Outlook 2006

But many of IFC's client countries continue to experience power shortages

More than 1.7 billion people currently live without access to electricity



This includes 450 million in India and 500 million in Africa

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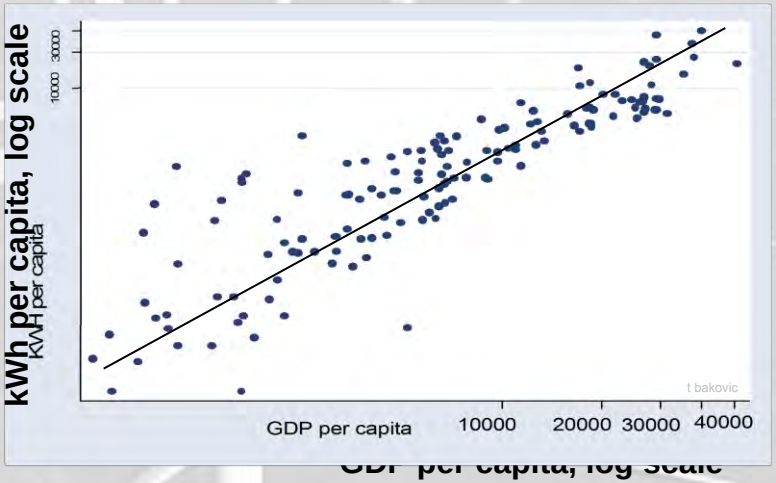
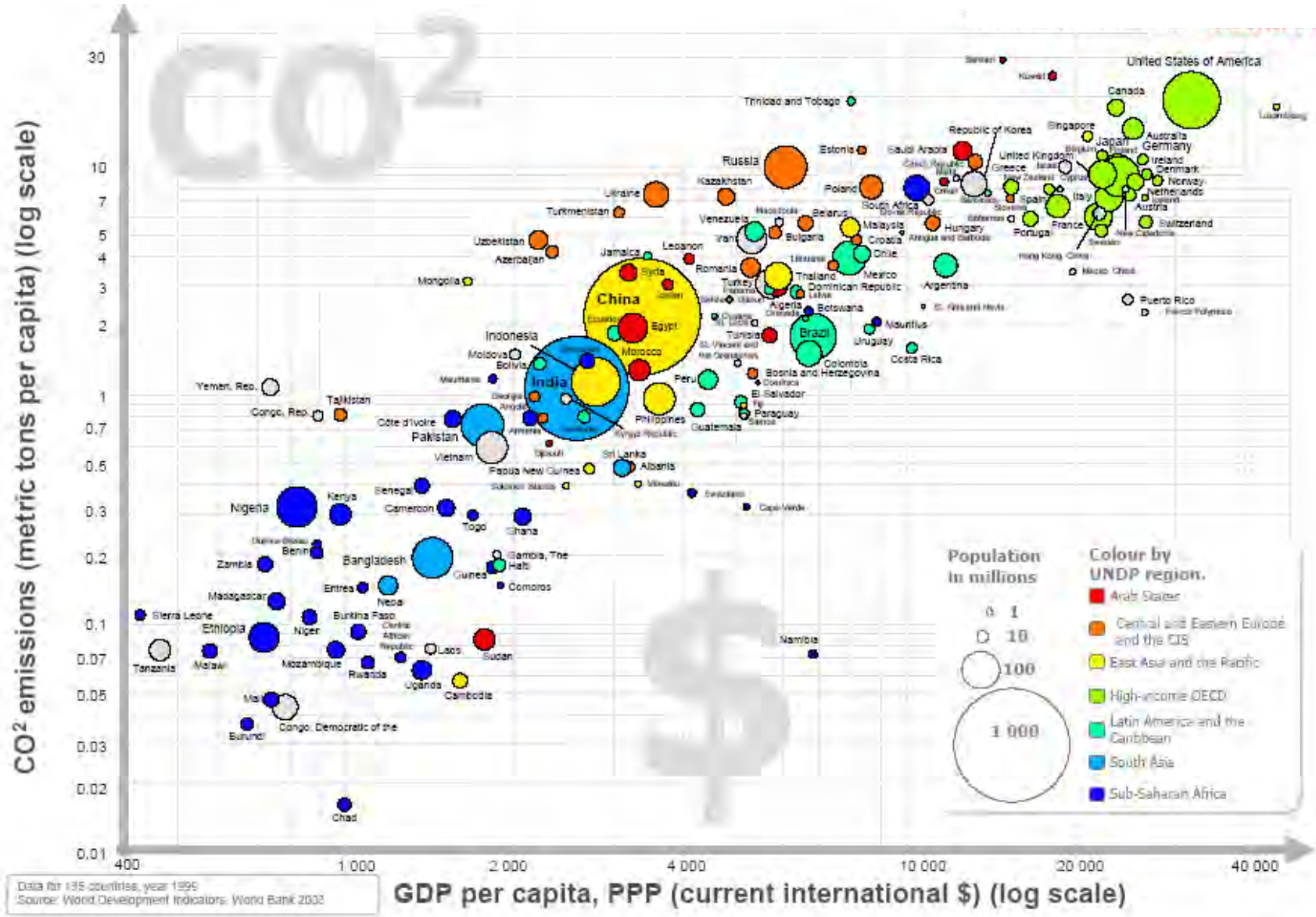
Access to electricity is a vital contributor to economic development, enabling

- Increased domestic & commercial productivity
- Access to modern utilities (light, heat, refrigeration, media)
- Improved health
- Increased opportunuities for education
- Improved standard of living
- Avoiding deforestation and pollution from small scale heating and lighting (diesel, kerosene, charcoal, wood)

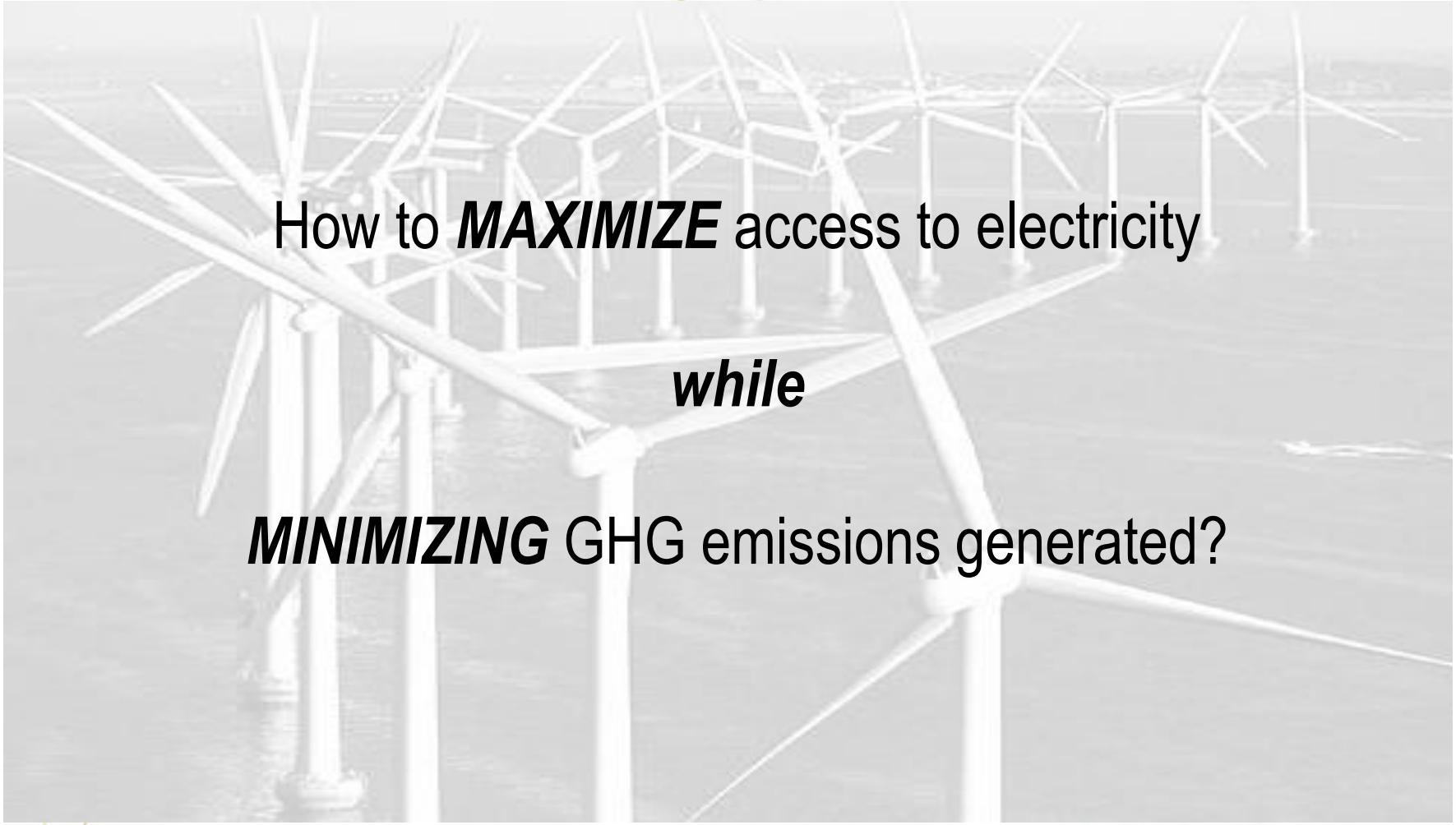
Connection between access to electricity and economic growth



And developing countries contribute far fewer GHGs on a per capita basis than developed countries



The development dilemma is therefore:



How to ***MAXIMIZE*** access to electricity

while

MINIMIZING GHG emissions generated?

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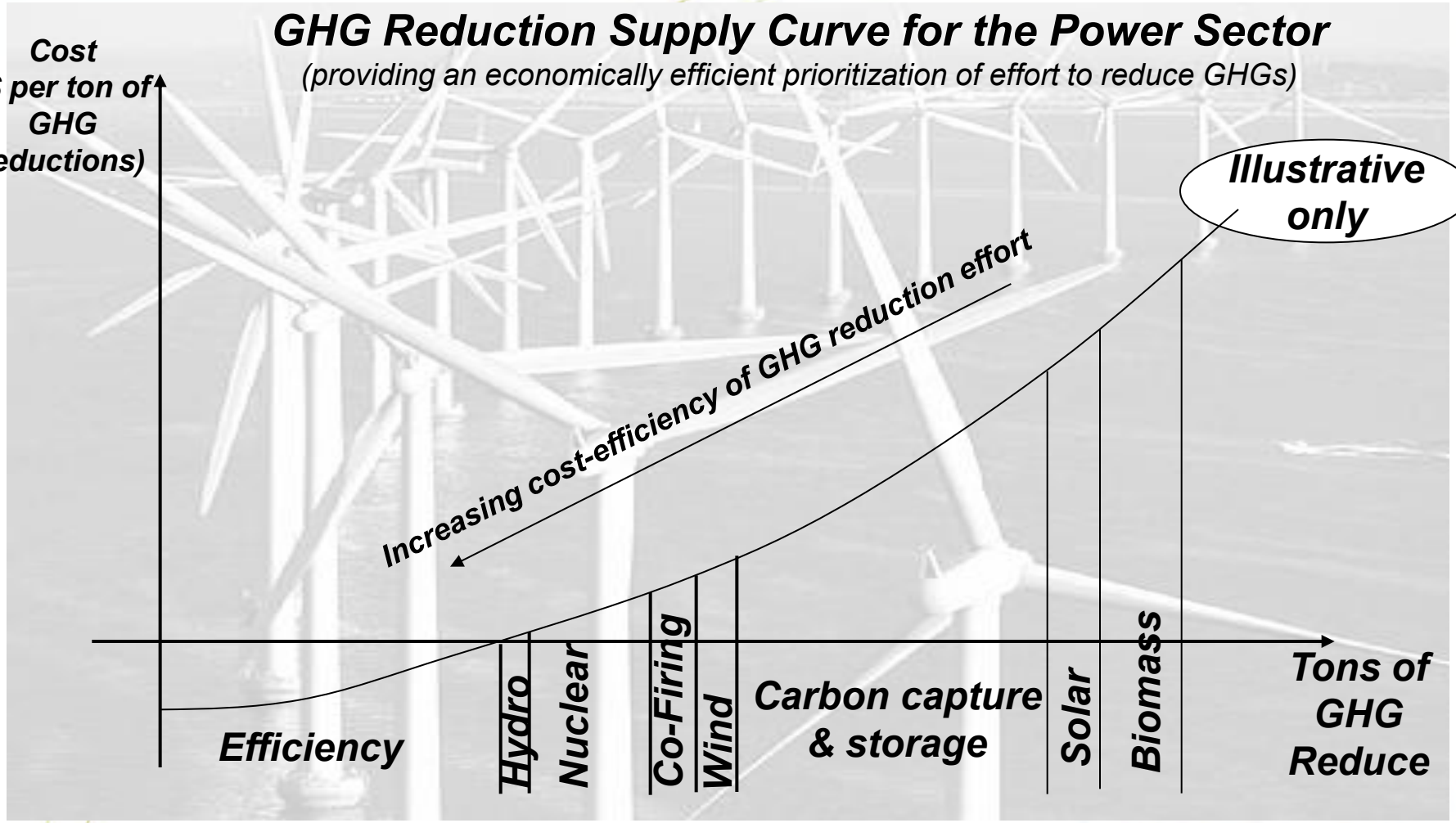
There is no single solution but marginal cost analysis of abatement activities can help to prioritize efforts



NOTE: The above curve is provided on an illustrative basis only as the exact order and scale of benefit from each solution is more complex, is often debated and varies significantly based on region of the world

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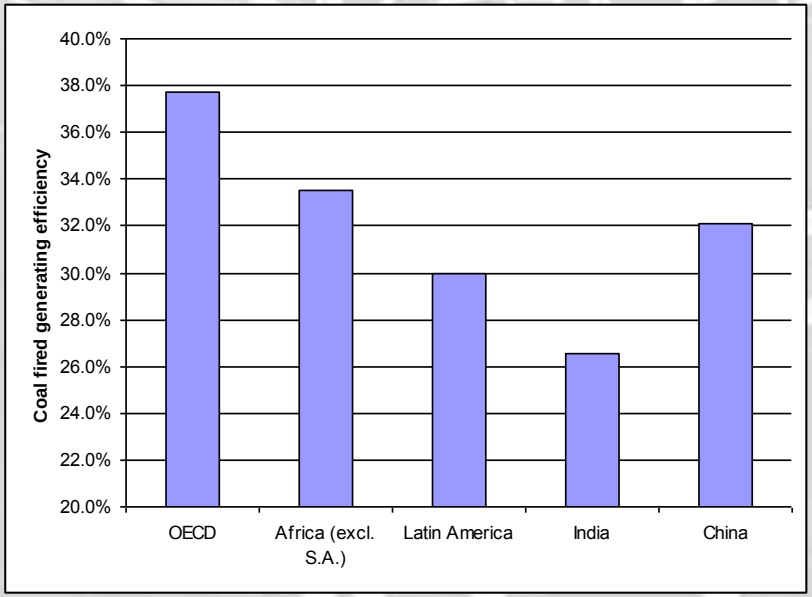
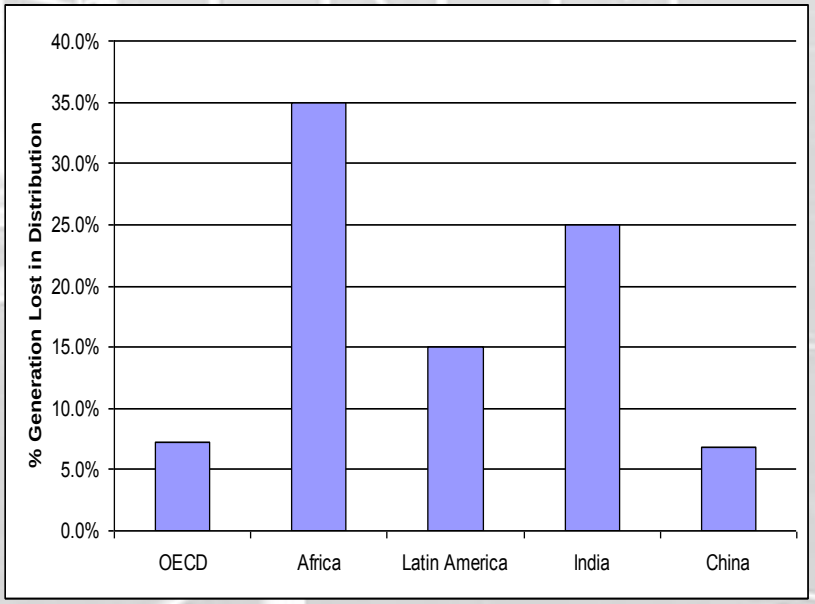
Substantial opportunities exist to improve generation and transmission & distribution ("T&D") efficiency

Generation efficiency is dramatically worse in IFC client countries



Distribution losses are dramatically higher in IFC client countries



Efficiency improvements deliver both environmental and economic benefits

Source: IEA Power Survey 2007 and IFC estimates (for Africa and L.America distribution losses)
Note: African coal generation efficiency is higher than expected. This is because the sample size is small.
Note: Distribution losses include technical losses and commercial losses – reduction of technical losses provides direct GHG reductions but reduction of commercial losses only results in smaller, secondary GHG reductions

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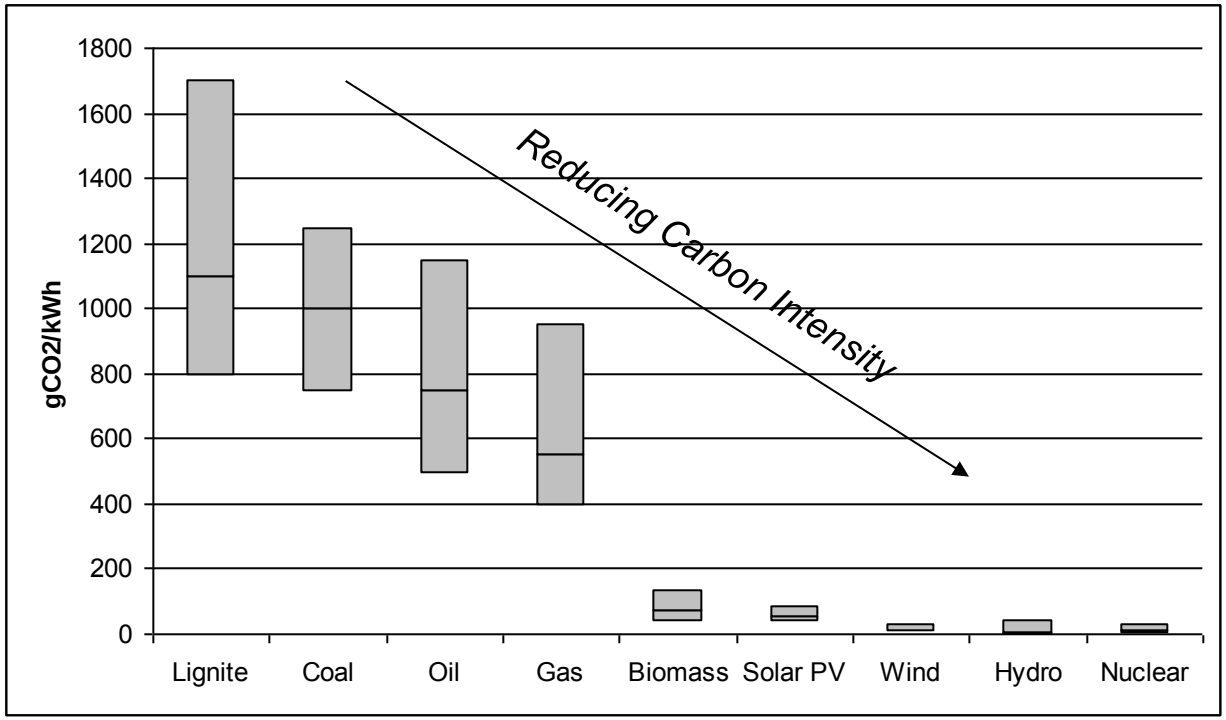
Fuel choice for electricity generation can substantially reduce GHG emissions

Full lifecycle[1] GHG emissions for selected forms of power generation



- ***Improvements can be made by increasing the use of less carbon intensive fuels***
- ***Equally large improvements can be made within a given fuel type (ie efficient coal <u>can</u> be better than inefficient gas)***

Source: A Guide to Life-cycle GHG emissions from electric supply technologies
Note: 1) ¨lifecycle¨includes upstream, operation and downstream phases of plant life 2) Mid-point line = mean value 3) 'fuel choice' is meant here in a broad sense, so the 'fuel' for hydro would be water. This is as opposed to the varying technologies used within a fuel group.

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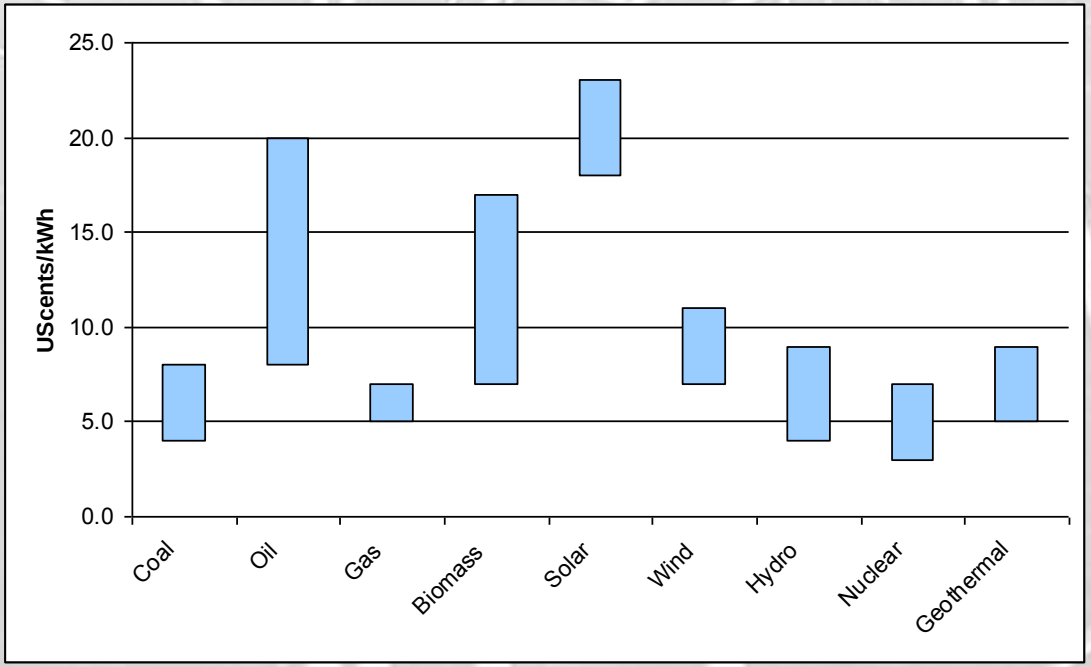
But low carbon fuels can come at a cost

Typical Levelized Power Generation Cost Ranges



Reducing Carbon Intensity

- ***Though carbon intensive, coal and gas are low cost fuels***
- ***Fossil fuel prices have been highly volatile in recent years***
- ***Hydro, wind and biomass can compete on cost***
- ***Regulation can level the playing-field but few IFC client countries have implemented laws to achieve this***

Source: MIT & Business Insights supplemented by IFC analysis & estimates

Note: Generation cost may vary significantly by region depending upon the costs of fuel, financing, operations and maintenance as well as the availability of the resource, hence the need for IFC estimates to illustrate the costs in its client countries.

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And multiple factors must be considered in selecting the optimal fuel type……

	Pros	Cons
Coal	• Large reserves • Low, stable costs	• Global pollutants (carbon intensive) • Local pollutants (SOx, NOx, Mercury) (can be mitigated)
Oil	• Effective at small scale • Quick to construct plant and easy to transport fuel	• High, volatile cost • Global air pollutants (carbon intensive) • Logistics and security of supply
Gas	• Least carbon intensive fossil fuel • Highly efficient • Large reserves	• Availability is limited • LNG is costly • Logistics and security of supply
Nuclear	• Zero GHG Emissions • Large scale possible • Can be cost competitive	• Concerns over nuclear proliferation • Management of waste • Public Safety • High investment cost
Hydro (Geothermal has similar characteristics)	• Low GHG emissions and cost competitive • Renewable resource • Proven technology	• Hydrological/environmental impacts (less with RoR) • Slow and complex to construct • Limited sites • Sensitive to climate change
Wind & Solar	• Low GHG emissions and sustainable • Fixed cost (no variable fuel cost component) • Renewable resource	• Relatively high cost (often needs subsidy) • Short term limits to supply of turbines • Intermitent so unable to provide controllable base load*
Biomass	• Low net GHG emissions and can be sustainable • Can be cofired with fossil fuels	• Relatively high cost (often needs subsidy) • Reliability and supply of feedstock • Limitations of scale

**** Apart from some concentrated solar power technologies with storage capacity***

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….within a country specific situation.

- Local natural resource endowment
  - Mineral resource: oil, gas and coal deposits
  - Climatic resource: hydro, solar, wind
- Regulatory framework
  - Tariffs or subsidies on fuel import
  - Tax incentives
  - Power pricing and feed-in tariffs
  - Carbon regulation and offsets
- Nature of supply and demand
  - Level of access to energy
  - Peak or baseload requirement
  - Size of demand
  - Stability of grid
  - Current energy mix

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IFC's approach in the electricity sector mirrors the dilemma faced by its client countries

Maximizing access to energy through private sector development of electricity generation and transmission

while

Minimizing GHG emissions generated

to

Maximize long-term development impact

Note: When economic and environmental interests are not aligned, costs and benefits, and local needs and priorities must be considered

IFC´s approach to climate change in the electricity sector focuses on efficiency and has four components

1. Demand Side Management
2. Transmission & Distribution
3. Grid Connected Generation
4. Distributed Generation

To be supported in all cases by:

- *Measurement of GHGs from investments & portfolio*
- *Piloting shadow price methodology for internal decision making*
- *Carbon financing and any concessionary funding where possible*
- *Piloting new technologies*
- *Sensitivity to country/region context*

1) *Possible metrics include: households reached, GHG/household reached, GHG/MW. The portfolio will continue to reflect the situation in IFC's target markets and emission data is likely to be erratic due to the lumpy nature of IFC's investments*
2) *GHG emissions measurement must reflect the whole lifecycle and be relative as well as absolute eg mine mouth coal generation could be more GHG efficient than imported gas generation.*
3) *The shadow pricing methodology will seek to replicate a market mechanism to inform decisions both in terms of optimizing long-term economic development and also identifying credit risk from potential future GHG regulation*

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Demand Side Management activities will require innovative approaches

- Energy efficiency funding through financial intermediaries
- Direct investment in energy services companies (ESCOs)
- Packaged investment and assistance to T&D companies with focus on demand side management
- Technical assistance to identify and develop opportunities for combined access to energy and energy efficiency improvements
- Cooperation with World Bank to influence policies that provide incentive for efficient use of electricity
  - e.g. real price tariffs for power
  - e.g. auctioning of peak-shaving and 'negawatt' concessions
  - e.g. subsidy programs for efficient end-use equipment

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Distribution and Transmission investments will focus on loss reduction

- Funding to privatizations and concessions of transmission and distribution companies
- Direct funding for refurbishment capex and loss reduction programs
- Technical assistance for energy audits to identify and develop loss reduction programs
- Cooperation with World Bank to influence government policies that provide incentive for efficient transmission and distribution of electricity

IFC's approach to grid connected generation will apply the following prioritization within each country specific context

Priority:	Activity:	Role:
1.	Promote renewable generation (hydro, wind, geothermal, solar and biomass) with direct equity/debt, financial intermediaries (banks & PE), integrated carbon finance, and advisory services.	▪ Provide highly competitive pricing and substantially increased tenors to reflect asset life (eg hydro) and reduced GHG regulatory risk ▪ Access support funds for *almost* viable options ▪ Accept & support transparent subsidy schemes ▪ Demonstration & capacity/scale building (accepting higher technology risks)
2.	Promote use of less carbon intensive fossil fuels (gas): support infrastructure such as LNG terminals, and transmission and distribution, and finance efficient generation plants.	▪ Supply chain development ▪ Concession structuring

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IFC's approach to grid connected generation will apply the following prioritization within each country specific context (cont.)

Priority:	Activity:	Role:
3.	Improve efficiency of installed generation base - Advisory support to identify efficiency opportunities - Financing privatization and refurbishment with efficiency focus - Financing cogeneration in industrial settings - Financing biomass co-firing where possible - Direct and indirect (funds) investment in clean technologies	▪ Catalyzing focus on efficiency ▪ Demonstrate more efficient technologies ▪ Improving the efficiency of the installed base

IFC's approach to grid connected generation will apply the following prioritization within each country specific context (cont.)

Priority:	Activity:	Role:
4.	Promote high efficiency use of coal in greenfield projects (client facilities must be in top quartile of country's generation efficiency)*: - Prioritize Super Critical, Ultra-Super Critical and IGCC where scale allows and where efficiency improvements are possible - In all cases, verify proposed technology is most appropriate taking into account fuel availability, economic factors, and GHG considerations	▪ Catalyze use of higher efficiency technology ▪ Landmark demonstration of new technologies in developing countries ▪ Access concessionary funds to address incremental costs of efficient technology
5.	Finance oil power plants based on economic factors and where it is the *only* option: small countries dependent on fuel imports, remote/ island communities, emergency situations.	▪ Identify opportunities for integration with renewables

* *See Annex A for more detail on IFC's approach to investment in coal fired power*

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Distributed generation activities will require innovative approaches

- Direct investment in demonstration projects using off-grid renewables
- Targeted microfinance schemes
- Technical assistance programs to engage the private sector in distributed generation
- Output based aid to buy down the higher costs of energy

Annex A: IFC's Approach to Coal-Fired Power

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IFC's track-record of investment in coal-fired power generation

- Between 1967 and 2009, IFC has financed 15 coal projects out of a total of 160 power projects
- Currently IFC has 5 coal projects in our portfolio out of 67 power projects (or 7%)
- In $ terms, the % share of coal is 30% in a total portfolio of $2.8 billion

IFC selectivity criteria for financing Coal Projects as defined in WBG Strategic Framework for Climate Change

IFC will only invest in coal-fired power generation when it can demonstrate that:

1. the project will provide development impact (including improving energy security, reducing power shortage, or increasing access);
2. assistance is being provided by the government and/or WBG to identify and prepare low-carbon projects in that country;
3. energy sources in the country are optimized, and the possibility of meeting the country's needs through energy efficiency and conservation have been considered;
4. viable alternatives to the least cost option (after including environmental externalities) have been considered and donor financing for the incremental costs is not available;
5. the project will utilize the best appropriate available technology to allow for high efficiency and therefore lower GHG emissions intensity;
6. it has incorporated environmental externalities in project analysis.

Source: Strategic Framework for Development and Climate Change, October 2008, Technical Report, pages 29-30