



International Resources Group



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INTEGRATING ENERGY POLICY AND CLIMATE POLICY
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Renewable Energy and Energy Efficiency Outlook:
Global Priorities for Mitigating Climate Change

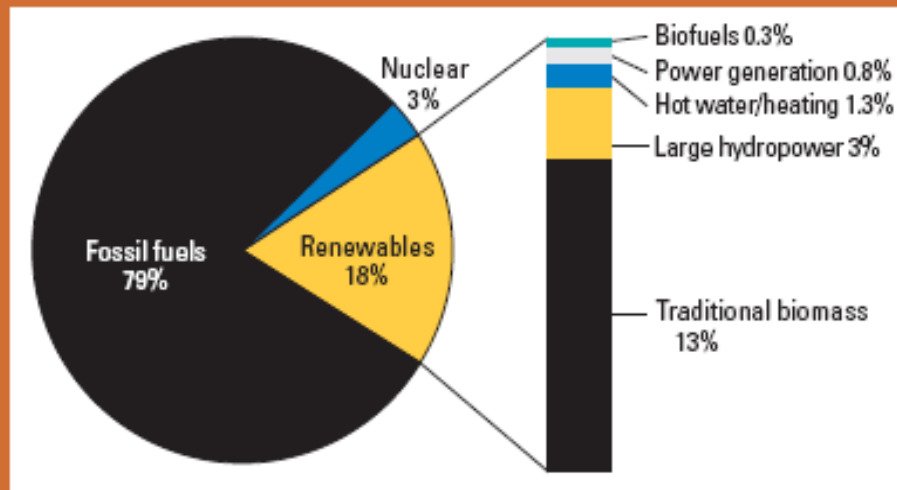
Dr. Pat DeLaquil



Renewable Energy Share of Global Final Energy Consumption

- Renewable energy provides electricity, heat, motive power, and water pumping for tens of millions of people in rural areas of developing countries, serving agriculture, small industry, homes, schools, and community needs.
- Twenty-five million households cook and light their homes with biogas, and 2.5 million households use solar lighting systems.

Figure 1. Renewable Energy Share of Global Final Energy Consumption, 2006



Source: Renewable Energy Policy Network



Renewable Energy Share of Global Electricity Generation

- New renewable electricity generation capacity reached an estimated 240 GW worldwide in 2007, a 50% increase over 2004.
- New renewable electric plants were 5 percent of installed capacity and 3.4 percent of global power generation in 2006.

Figure 2. Share of Global Electricity from Renewable Energy, 2006

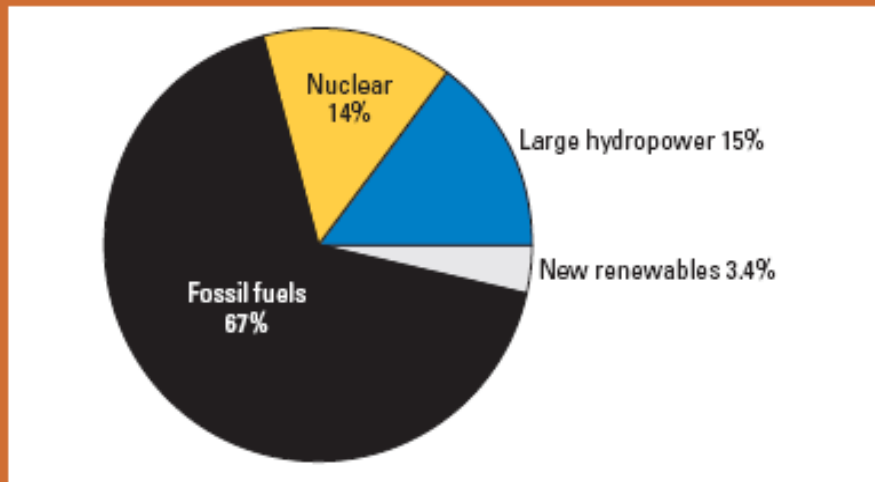
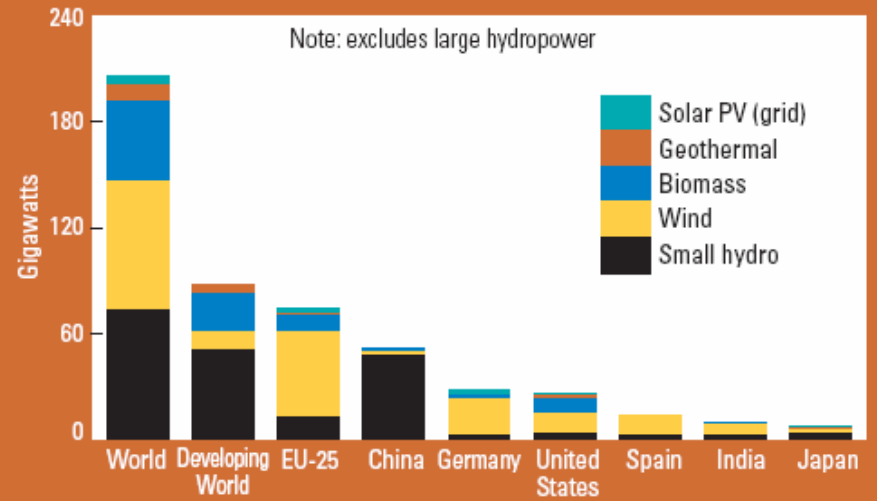


Figure 7. Renewable Power Capacities, Developing World, EU, and Top Six Countries, 2006

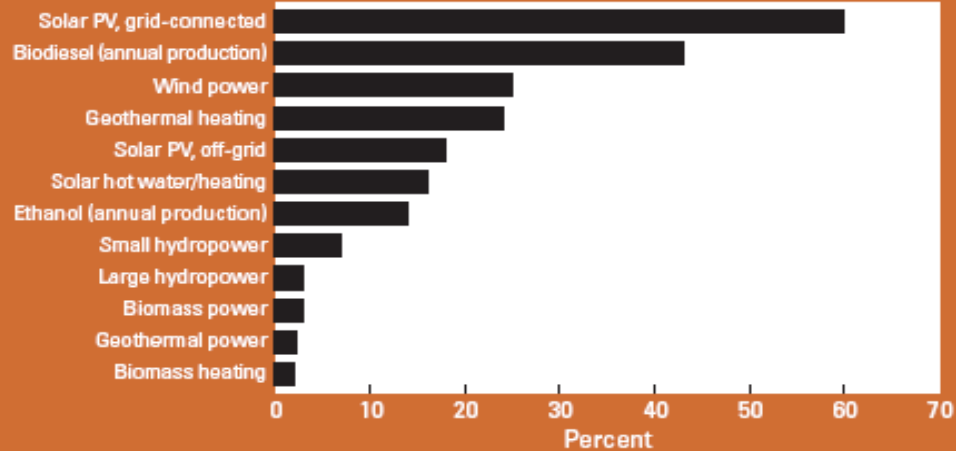


Source: Renewable Energy Policy Network



**Most New RE technologies are growing at 15%-30%/yr
 Several are close to cost-competitive without incentives**

Figure 3. Average Annual Growth Rates of Renewable Energy Capacity, 2002–2006



Source: Renewable Energy Policy Network

**Global Installation/Production Growth:
 Solar, Wind, Biofuels**

	2003	2007	2017 (est.)
Solar PV Installations	620 MW	2,821 MW	22,760 MW
Wind Power Installed	8000 MW	20,060 MW	75,781 MW
Biofuels Produced	7 Billion Gallons	15.6 Billion Gallons	45.9 Billion Gallons

Source: Clean Edge, Inc., 2008



Renewable Energy: Solar Water Heating

- Rooftop solar heat collectors provide hot water to nearly 50 million households worldwide.
- Existing solar hot water/heating capacity increased by 19% in 2006 to reach 105 GW-thermal globally.

Table R5. Solar Hot Water Installed Capacity, Top 10 Countries/EU and World Total, 2005 and 2006

Country/EU	Additions 2005		Existing 2005		Additions 2006		Existing 2006	
	million square meters				gigawatts-thermal			
China	14.5	78	19.5	97	67.9			
European Union	2.0	16.0	3.0	19.3	13.5			
Turkey	0.4	9.0	0.7	9.4	6.6			
Japan	0.3	7.0	0.2	6.7	4.7			
Israel	0.2	5.3	0.3	5.4	3.8			
Brazil	0.4	2.7	0.4	3.1	2.2			
United States	0.1	2.6	0.1	2.6	1.8			
Australia	0.2	1.6	0.2	1.8	1.3			
India	0.5	1.3	0.6	1.8	1.2			
Jordan	—	—	—	0.7	0.5			
(other countries)	< 1	< 2	< 1	< 3	< 2			
World Total	19	126	25	150	105			



Source: Renewable Energy Policy Network

Note: Figures do not include swimming pool heating (unglazed collectors). Global estimate for 2007 is 24 GWth added, 128 GWth cumulative. Existing figures include allowances for retirements. By accepted convention, 1 million square meters = 0.7 GWth. Source: See Endnote 12.



Renewable Energy: Biofuels

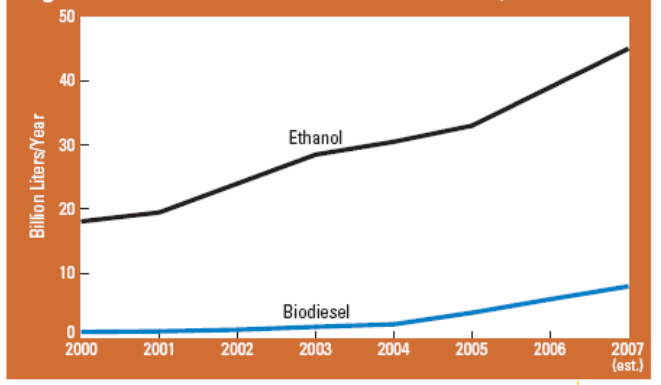
- Production of biofuels (ethanol and biodiesel) exceeded an estimated 53 billion liters in 2007, an 43% increase from 2005.
- Ethanol production in 2007 represented about 4% of the 1,300 billion liters of gasoline consumed globally.

Table R6. Biofuels Production, Top 15 Countries plus EU, 2006

Country	Fuel ethanol	Biodiesel
billion liters		
1. United States	18.3	0.85
2. Brazil	17.5	0.07
3. Germany	0.5	2.80
4. China	1.0	0.07
5. France	0.25	0.63
6. Italy	0.13	0.57
7. Spain	0.40	0.14
8. India	0.30	0.03
9. Canada	0.20	0.05
9. Poland	0.12	0.13
9. Czech Republic	0.02	0.15
9. Colombia	0.20	0.06
13. Sweden	0.14	—
13. Malaysia	—	0.14
15. United Kingdom	—	0.11
EU Total	1.6	4.5
World Total	39	6

Note: Numbers for fuel ethanol only; total ethanol production figures will be significantly higher. Table ranking by total biofuels. Source: See Endnotes 15 and 17.

Figure 10. Ethanol and Biodiesel Production, 2000–2007

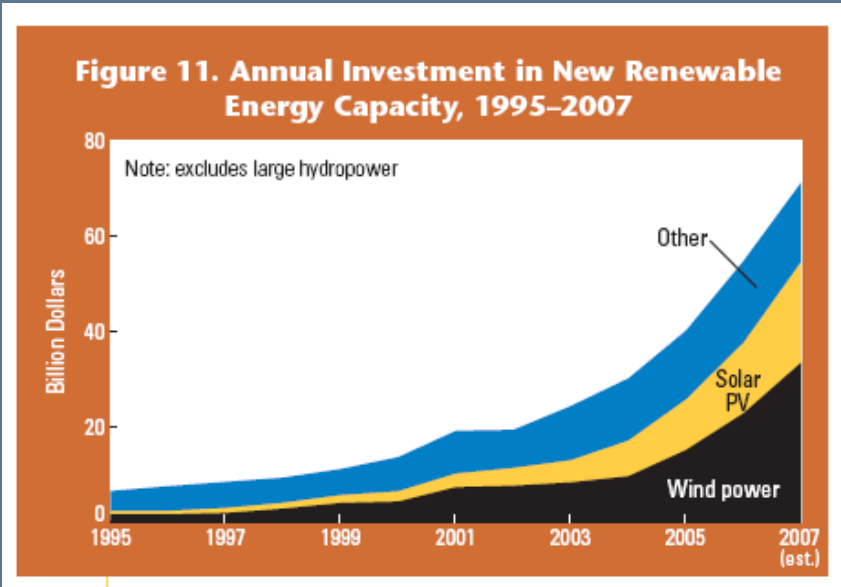


Source: Renewable Energy Policy Network



Renewable Energy: Investment

- An estimated \$71 billion was invested in new renewable energy capacity worldwide in 2007, up from \$55 billion in 2006 and \$40 billion in 2005.
- Altogether, clean-energy companies raised about \$10 billion in 2006 via public stock markets, almost double the 2005 amount.
- The 140 highest-valued publicly traded renewable energy companies yields a combined market capitalization of over \$100 billion.



Source: Renewable Energy Policy Network

3rd Quarter 2007 Performance of Leading Clean Energy Companies				
Name	Country	Primary Sector	Main Market	% Change
First Solar	US	Renewable-Solar	NASDAQ-GM	101%
Suntech Power Holding Co Ltd	China	Renewable-Solar	New York	98%
Schmack Biogas AG	Germany	Renewable-Biofuels, Biomass & Waste-to-Energy	XETRA	66%
Sunpower Corp	US	Renewable-Solar	NASDAQ-GM	50%
Evergreen Solar Inc	US	Renewable-Solar	NASDAQ-GM	47%
Q-Cells AG	Germany	Renewable-Solar	XETRA	34%
JA Solar Holdings Co. Ltd.	China	Renewable-Solar	NASDAQ-GM	32%
MEMC Electronic Material Inc	US	Renewable-Solar	New York	32%
Suzlon Energy Ltd	India	Renewable-Wind	Mumbai	31%
Techem	Germany	Demand-Side Energy Saving	XETRA	28%

Source: Renewable Energy Focus – Jan/Feb 2008



Renewable Energy: Leading Developments in 2007

- General Electric posted annual wind power revenues of \$4.5 billion from its booming wind business in 2007.
- Google launched its R<C initiative, backed by \$100 million, aimed at making renewable energy cost competitive with coal within years, not decades.
- MEMC, the semiconductor giant, announced solar-grade-silicon wafer supply agreements worth a projected \$12 billion to the company over a ten-year period.
- PG&E doubled its commitments to concentrating solar power (CSP) plants to 2,000 MW and FPL Group announced plans to invest \$1.5 billion in new CSP projects.
- Royal Dutch Shell will construct a pilot facility in Hawaii to grow marine algae for conversion into biofuel





Renewable Energy: Policy

- By 2007, at least 64 countries had a national target for renewable energy supply, including all 27 European Union countries.
- EU-wide target of 20 percent of final energy by 2020
- Chinese target of 15 percent of primary energy by 2020

Table R8. Share of Electricity from Renewables, Existing in 2006 and Targets

Country/region	Existing share (2006)	Future target	Country/region	Existing share (2006)	Future target
World	18%	—			
EU-25	14%	21% by 2010			
Selected EU Countries			Other Developed/OECD Countries		
Austria	62%	78% by 2010	Australia	7.9%	—
Belgium	2.8%	6.0% by 2010	Canada	59%	—
Czech Republic	4.2%	8.0% by 2010	Israel	—	5% by 2016
Denmark	26%	29% by 2010	Japan*	0.4%	1.63% by 2014
Finland	29%	31.5% by 2010	Korea	1.0%	7% by 2010
France	10.9%	21% by 2010	Mexico	16%	—
Germany	11.5%	12.5% by 2010	New Zealand	65%	90% by 2025
Greece	13%	20.1% by 2010	Switzerland	52%	—
Hungary	4.4%	3.6% by 2010	United States	9.2%	—
Ireland	10%	13.2% by 2010	Developing Countries		
Italy	16%	25% by 2010	Argentina*	1.3%	8% by 2016
Luxembourg	6.9%	5.7% by 2010	Brazil*	5%	—
Netherlands	8.2%	9.0% by 2010	China	17%	—
Poland	2.6%	7.5% by 2010	Egypt	15%	20% by 2020
Portugal	32%	45% by 2010	India	4%	—
Slovak Republic	14%	31% by 2010	Malaysia	—	5% by 2005
Spain	19%	29.4% by 2010	Morocco	10%	20% by 2012
Sweden	49%	60% by 2010	Nigeria	—	7% by 2025
United Kingdom	4.1%	10% by 2010	Pakistan	—	10% by 2015
			Thailand	7%	—

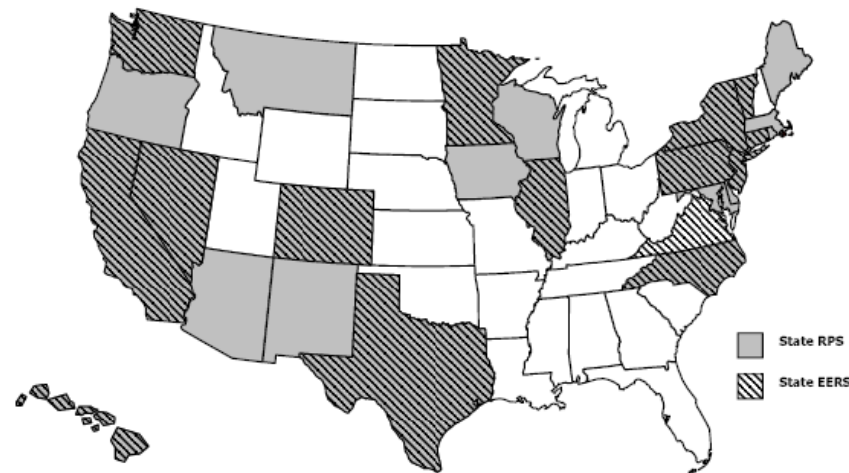
Source: Renewable Energy Policy Network



Renewable Energy & Energy Efficiency: Policy

- At least 44 states, provinces, and countries have enacted renewable portfolio standards (RPS), also called renewable obligations or quota policies.
- 29 U.S. states and 9 Canadian provinces have targets based on RPS or policy goals, and many of these include energy efficiency standards.

States with EERS and RES Activity



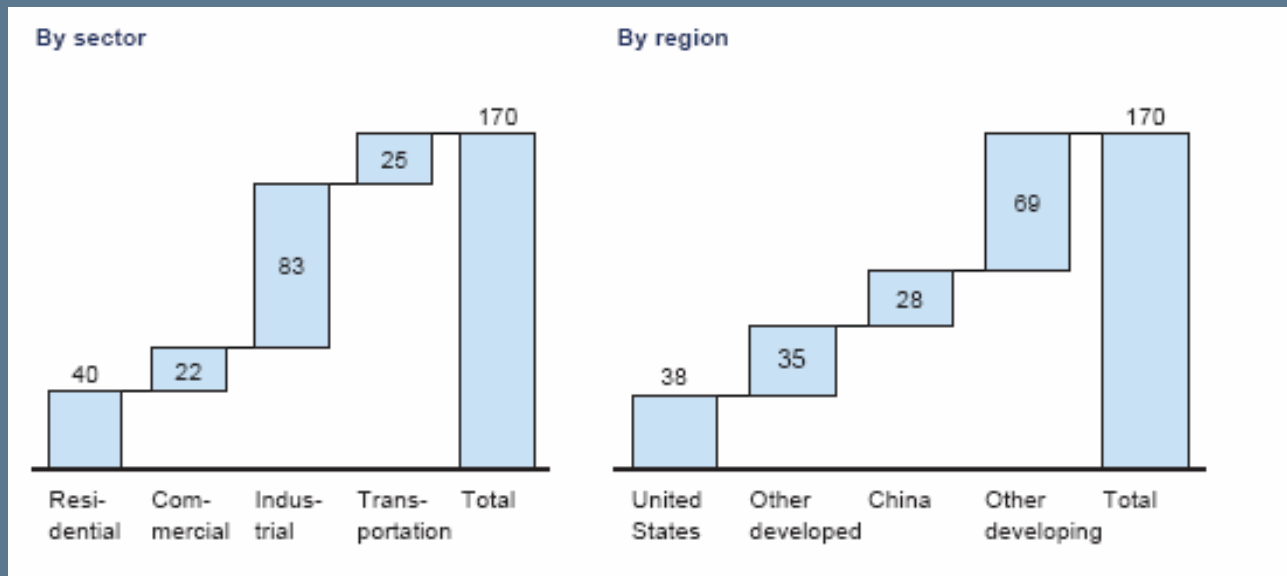
Note: New Jersey and New York have pending EERS requirements.
Source: ACEEE 2007. <http://www.aceee.org/energy/state/2pgEERS.pdf>





Energy Efficiency: Opportunities

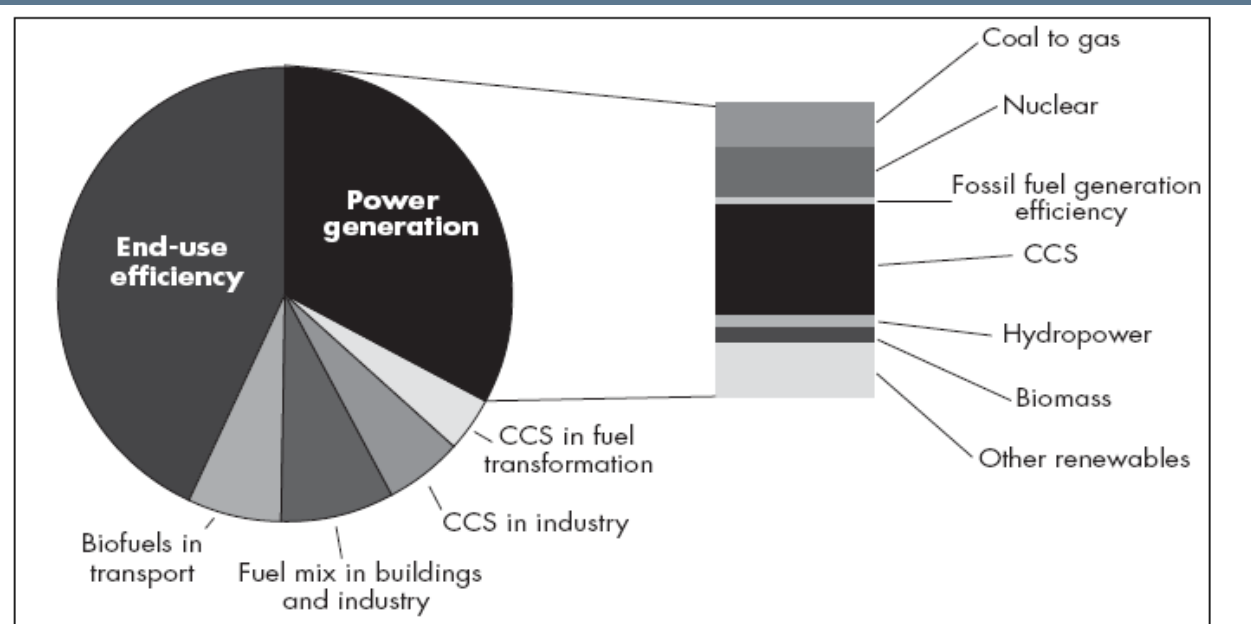
- McKinsey has identified energy efficiency project opportunities that would reduce world energy demand by 170 QBTU in 2020
 - 4 sectors: industrial, commercial, residential, transportation
 - Projects with average IRR 17% are targeted
 - \$170 billion investment annually is required
- By Sector, most opportunities are industrial
- Developing countries represent 57% of the opportunities
 - Low efficiency
 - Low labor cost





Energy Efficiency: The Opportunity of Programmatic CDM

- End-use energy efficiency has huge potential for climate change mitigation. According to IEA, end-use energy efficiency represents about 45% of GHG reduction potential in 2050
- However, compared to supply-side energy efficiency, end-use is less concentrated and smaller in unit size. Therefore, it is often not cost effective for project-based CDM

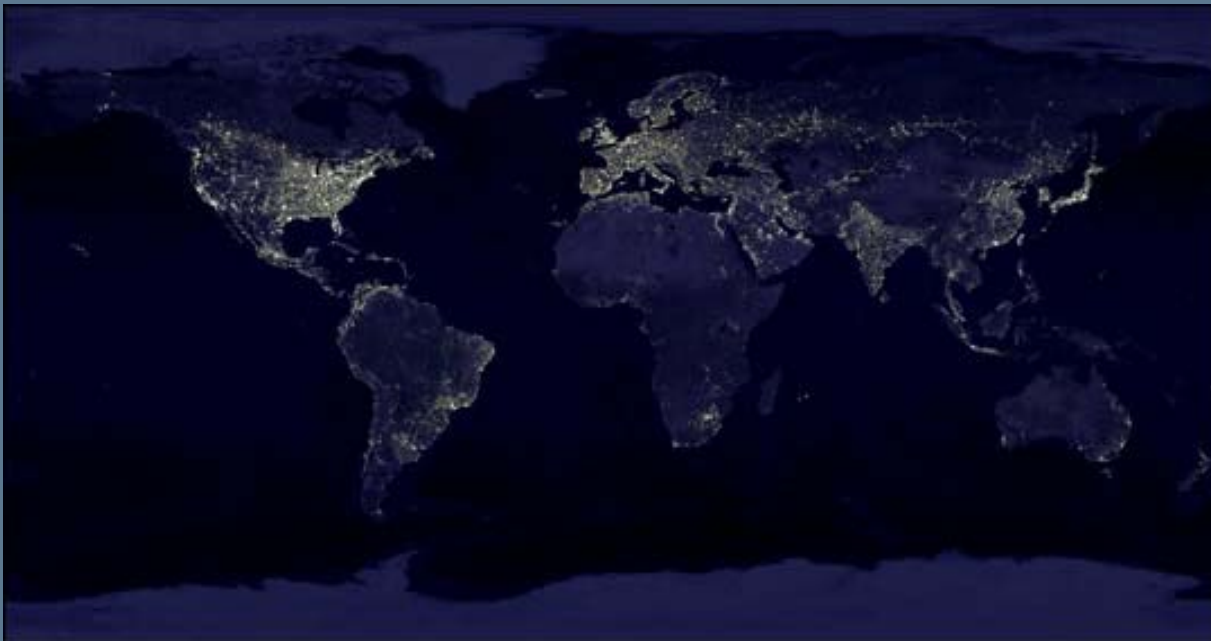


Source: IEA Energy Technology Perspectives 2006.



Energy Efficiency: Programmatic CDM & CFLs

- Replacing one 60W incandescent bulbs with a 15W CFL equivalent for a year could (assuming 1500 h operation and a grid emission factor of 0.8kg CO₂/kWh)
 - Save 67 kWh electricity
 - Avoid 54 kg CO₂ emission



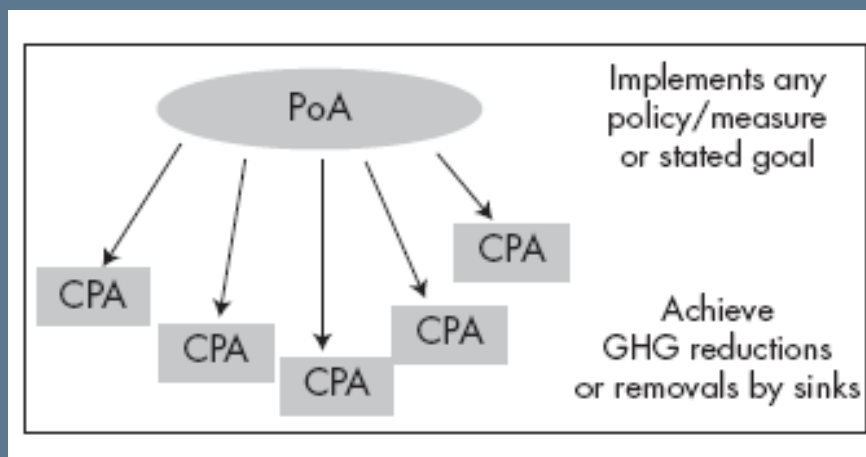
23 industrialized countries consume half the world's total lighting energy use

Source: NASA
Year: 2000



Energy Efficiency: Programmatic CDM Structure

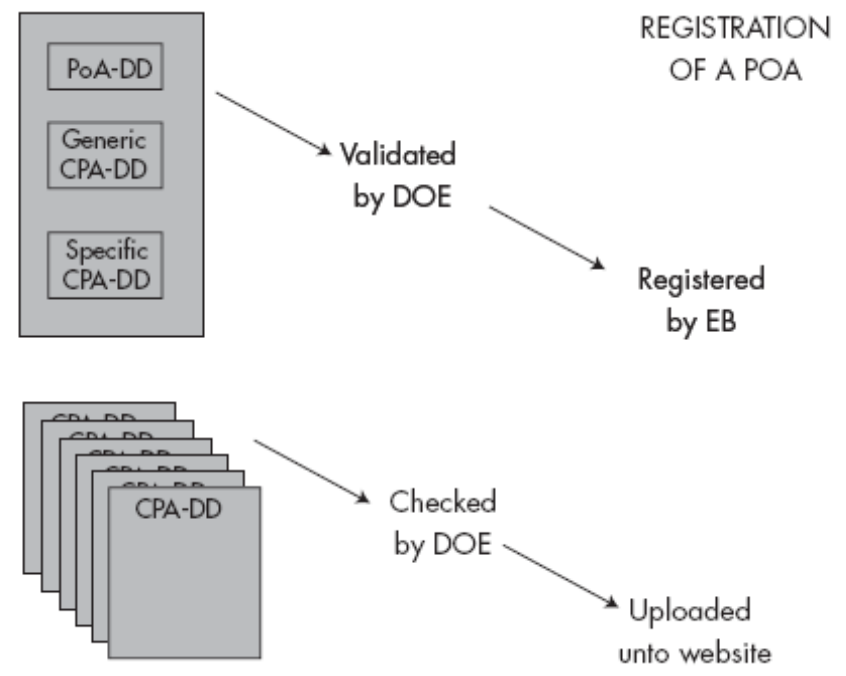
- Programmatic CDM provides a strong tool for financing CFL and can be integrated into existing energy efficiency policies
- Programmatic CDM:
 - **Program of Activities (PoA):** a “voluntary coordinated action by a private or public entity which implements any voluntary or mandatory policy/measure or stated goal which leads to GHG emission reductions”
 - **CDM Project Activities (CPA) :** Detailed project design on how GHG emission reduction will be achieved





Energy Efficiency: Programmatic CDM Implementation

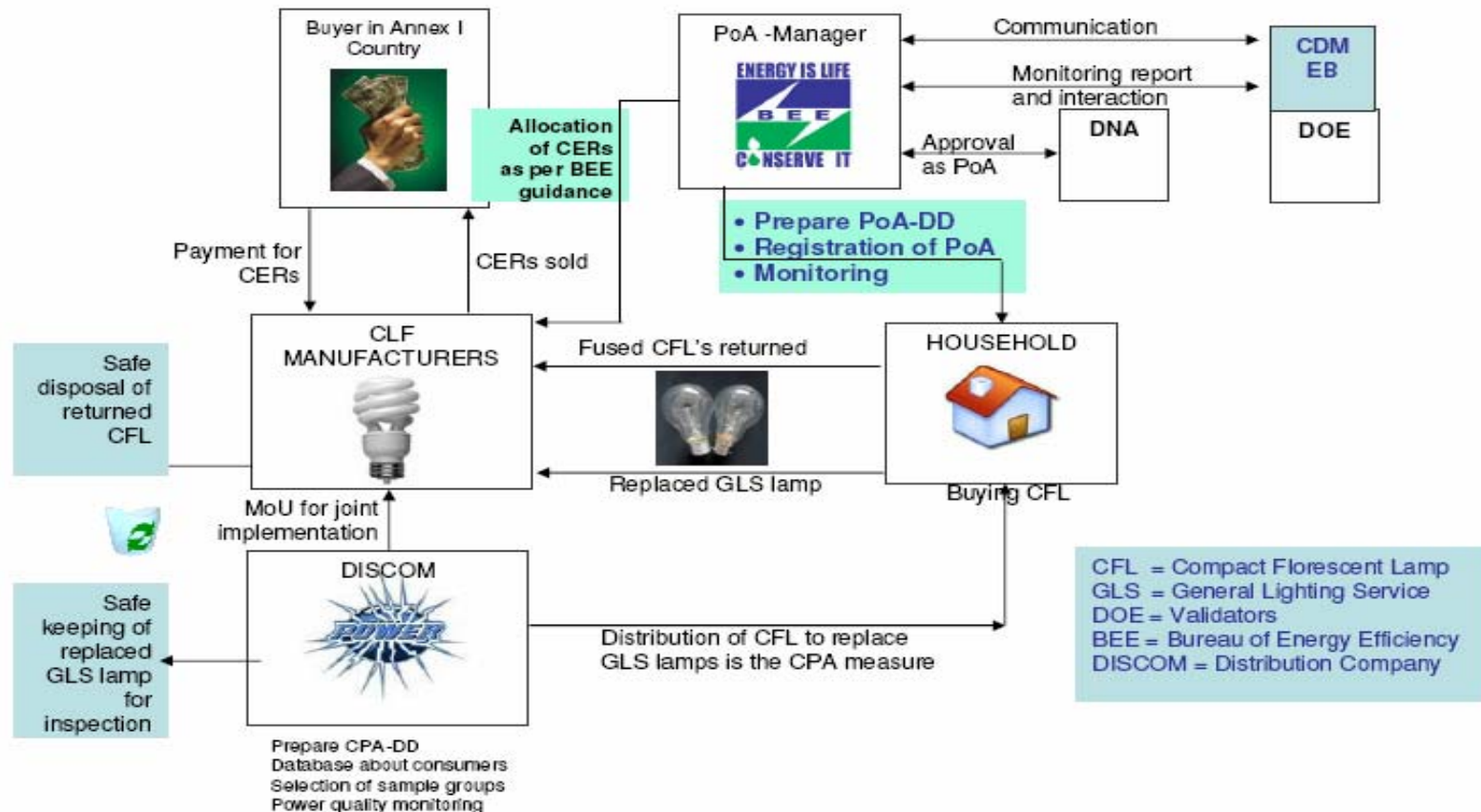
- PoA could be a national policy or a private initiative to promote CFL (and other EE technologies) in long-term
- CPAs would be developed when specific regions decided to start the action
- More flexible and efficient compared to traditional project-based CDM since new CPAs do not have to go through an independent validation/registration process





Energy Efficiency: Bureau of Energy Efficiency in India

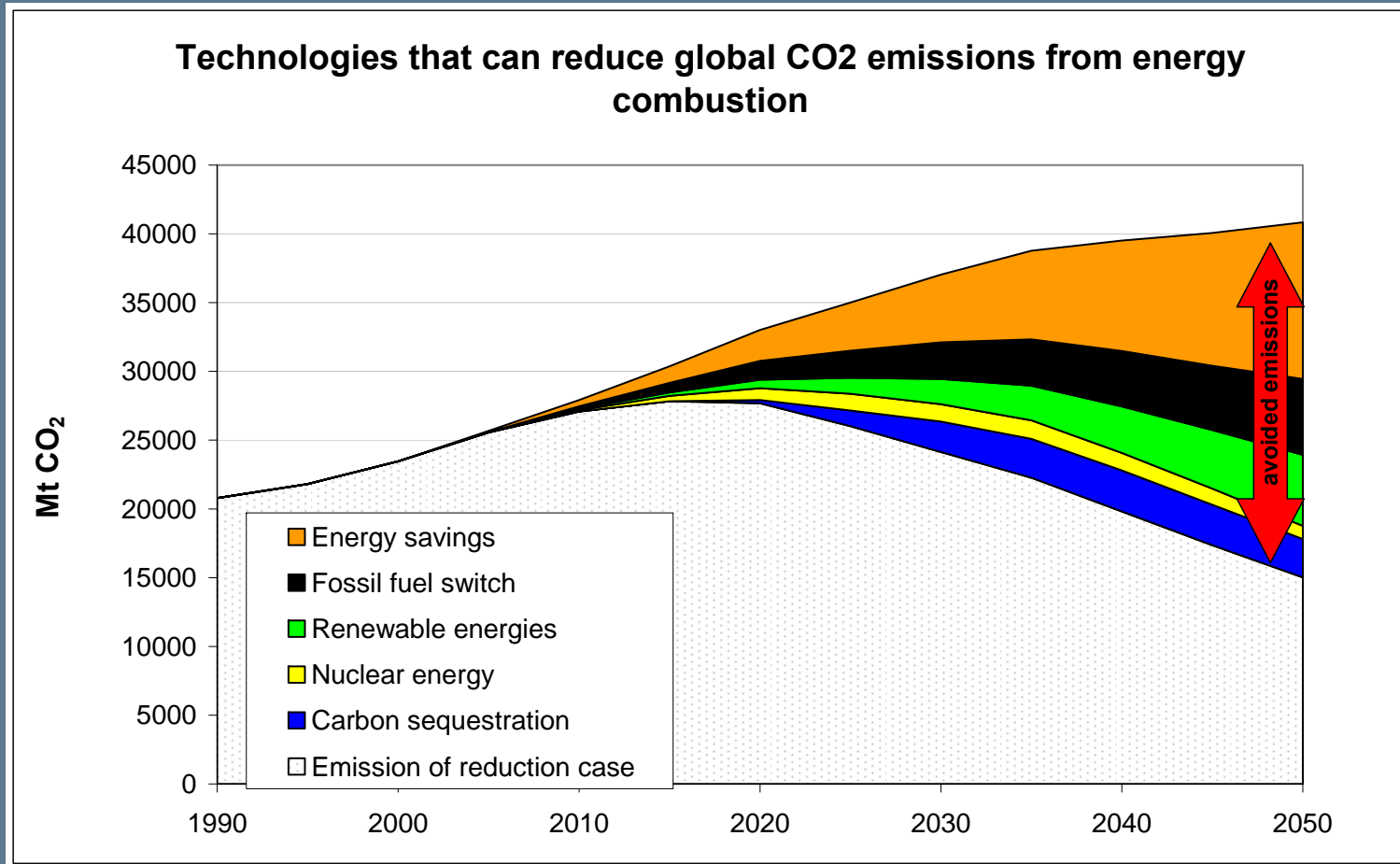
Programme Landscape under CDM Methodology



Source: Bureau of Energy Efficiency of India



Global GHG Emissions: Dramatic reductions will require a suite of technological solutions





US Climate Change Legislation: Lieberman-Warner

➤ Most CO₂ reductions will need to come from the electric sector through a combination of demand side efficiency improvements, renewable energy use and carbon capture and sequestration.

