Tables & Figures

Table 6.1. Greenhouse gas emissions reduction potential for residential and commercial sectors

Country/ region	Study reference	DR	Type of potential	Mitigation scenarios	Potential		Most promising measures (lowest cost)	Most promising measures (size of potential)	Other Important notes
					Mln t	%BL			
Studies considering Demand Side Measures only									
EU-15	Joosen and Blok 2001	4%	Economic	The most important 32 options in terms of reduction, new and retrofit buildings are considered	314	21%	1.TV and video (Improved energy efficiency); 2.Efficient refrigerators and freezers; 3.Lighting Best Practice.	1.Retrofit houses: highly insulated windows, 2.Building Energy Management Systems: space heating and cooling, 3.Retrofit houses: wall insulation.	3. GHG recalculated into CO2eq.; 4.Frozen efficiency BL; 6. TY 2010.
USA	Koomey et al 2001	7%	Economic	End-use demand side options, measures and programs.	898	37%	N.A. (The study did not examine a GHG potential supply cost curve).	1.Lighting, 2.Appliances.	3.CO2eq (initially Carbon); 5.BY 1997.
India	Reddy and Balachandra 2005	N.a.	Economic	Lighting and water heating & cooking programs only	85	n.a.	1.Efficient packages of lighting (proportion of Incadescents, fluorescent tubes and CFLs), 2.Efficient kerosene stoves, 3.Efficient wood stoves.	1.Efficient wood stoves, 2.Efficient packages of lighting (proportion of Incadescents, fluorescent tubes and CFLs), 3.Efficient kerosene stoves.	3. GHG recalculated into CO2eq.; 5.BY 2000; 6.TY 2010; 8. Households only.
China	ERI and NDRC 2004	N.a.	Enhanced market	Key policy measures including standardization, energy price reforms, promotion of energy efficiency projects, and others.	422	23%	N.a. (The study estimated the total available potential not taking into account its abatement cost)	Building energy conservation and lowest efficiency standards, heat price reform, appliance labeling, promotion of projects such as Green Lights.	3.CO2eq (initially Carbon); 4.BAU constrained by market competition, cost or resources. 5.BY 2000.
New EU Member States (Hu, Sk, Sl, Est, Lv, Lt, Po, Cz)	Petersdorff et al 2005	N.a.	Economic	New construction and practice: including DH improvements, certificates to enhance of energy retrofit, retrofit programs, and others.	26	-	1.Roof insulation, 2.Wall insulation, 3.Floor insulation.	1.Replacement of windows, 2.Wall insulation, 3.Roof insulation.	3. GHG recalculated into CO2eq.; 5.BY.2006; 6.TY 2015.
Republic of Korea	ADB 1998d	8.5%	Technical	Nine options are considered: boilers, water systems, air conditioners, lights, motors, inverter, refrigerators, insulation.	36	31%	1.Condensing boiler, 2.Insulation&Solar hot water systems, 3.Efficient air-conditioning.	1.CFLs&electronic ballast, 2.Inverter and efficient motors, 3.Solar water systems & Insulation	3.GHG recalculated into CO2eq.; 5.BY1995; 8. All buildings including industrial.
Equador	FEDEMA 1999	10%	Technical	Six end-uses are considered: cooking, water heating, refrigerators,	9	64%	1.Lighting (shift to higher-efficiency incadescents or CFLs), 2.Fuel	1.Fuel switch in stoves & water heating & air conditioning in the service sector,	5.BY 1995; 6.TY 2030.

				lighting, air conditioning, heating and other uses.			switch in stoves, water heating, air conditioning in rural areas and then in the service sector.	2.More efficient refrigerators, 3.Lighting (shift to higher-efficiency incadescents or CFLs).	
Thailand	ADB 1998c	10%	Technical	Three technological programs: lighting, refrigerator, and air-conditioning.	15	31%	1.Lighting (shift to fluorescents), 2.Efficient refrigerators (insulation and compressors), 3.Efficient air-conditioning.	1.Efficient air-conditioning, 2.Efficient refrigerators (insulation and compressors), 3.Lighting (shift to fluorescents).	3.GHG recalculated into CO2eq.; 5.BY 1995; 8. R only.
Pakistan	ADB 1998k	8%	Technical	Five measures only: lights, fans, refrigerators, water heaters, building design.	7	18%	1.Shift to CFLs and other fluorescents, 2.Ceiling fans, 3.More efficient refrigerators.	1.Ceiling fans, 2.Shift to CFLs and other fluorescents, 3.Building design (roof insulation, natural ventilation).	3.GHG recalculated into CO2eq.; 5.BY 1991.
Indonesia	APEIS 2004	5%	Economic	Nine technological options: energy efficient appliances, lights, water heating, insulation, and others.	14	25%	Efficient gas heater, efficient kerosene heater, efficient gas water heater, shift to fluorescents from incandescents, efficient air conditioners (not ranked).	1.Efficient refrigerators, 2.Wall insulation, 3.Efficient electric water heater.	4.Frozen efficiency BL; 5.BY 2000; 8.R sector.
Australia					9	19%			
New Zealand					0.3	17%			
Canada					11	14%			
Russia					204	18%			
Argentine					4	22%			
Brazil					5	41%			
Myanmar	ADB 1998g	10%	Technical	Some of possible mitigation options: CFLs, efficient air conditioners, cook stoves, improved kerosene lamps, co-generation.	0.5	68%	1.Biomass cook stoves, 2.Improved kerosene lamps, 3.CFLs.	1.Biomass cook stoves, 2.LPG cook stoves, 3.Co-generation.	3. GHG recalculated into CO2eq.; 9.Potential is calculated taking into account that proportion among sectoral emissions is constant during 1990-2020 (4%)
Estonia	ESE, SEITC 1999	6%	Technical	Four insulation measures	0.4	3% of the whole economy emissions	1.New insulation into houses, 2.Additional attic insulation, 3.Third pane for windows.	1.New insulation into houses, 2.Third pane for windows, 3.Additional attic insulation.	3. GHG recalculated into CO2eq.; 5. BY 1995; 6.TY 2025.
Botswana	MMEWA 1999	6%	Technical	Five options: efficient lighting, prepayment meters, geyser time switches, solar home system, solar geyser.	0.9	14% of energy sector emissions	1.Lighting, 2.Prepayment electricity meters, 3.Geyser time switches.	1.Geyser time switches, 2.Prepayment electricity meters, 3.Lighting.	3. GHG recalculated into CO2eq.; 5.BY 1994/95; 6.TY 2030; 8.R only.
Studies considering both supply and demand side measures									
South Africa	De Villers and Matibe 2000	6%	Technical	Very comprehensive range of 15 technological options and measures	9	99%	1.Efficient use of hot water, 2.Lighting practices, 3.CFLs.	1.Hybrid solar water heaters, 2.Appliances labeling and standards OR Shift from electricity to gas space heating OR Insulation of geysers	3. GHG recalculated into CO2eq.; 7.TY 2030; 8. R only 9.Other important notes:

									Calculations from cumulative data over the period.
UK	Johnston et al 2005	N.a.	Technical	Shift to use of renewables and carbon efficient fossil generation technologies, changes in 4 end-use categories, the number of characteristics of buildings.	46	36%	N.a. (The study considered technological possibility not taking into account cost component).	1.Lights and appliances, 2.Space heating, 3.Water heating.	5.BY 1996; 6.TY 2030; 8.R only.
Greece	Mirasgedis et al 2003	6%	Technical	Fourteen technological options: fuel switch, controls, insulation, lights, air conditioning, and others.	13	53%	1.Replacement of old central heating boilers, 2.Use of roof ventilators, 3. Replacement of old air conditioners.	1.Building shell (especially wall and roof insulation, sealing of openings), 2.Lighting&water heating, 3.Space heating systems.	4.Frozen efficiency BL; 5.BY 2000; 6.TY 2010; 8. R only.
Hungary	Urge-Vorsatz and Szlavik 1999	3-5%	Technical	41 technological options and measures (building envelope, space heating, hot water supply, ventilation, awareness, lighting, appliances).	31	63%	1.Central heating (fuel switch from coal/oil to natural gas), 2.Hot water (flow controllers on faucets and shower heads), 3.District heating (utilization of wastes, improved controls, energy efficiency of boiler plants).	1.Building insulation (windows), 2.Replacement of luminaries and controls & procurement of efficient appliances, 3.Distrcit heating (up-to-date cogeneration into existing one or heating only).	3. GHG recalculated into CO2eq.; 6. TY 2030.

Notes specify those parameters which are different from (the number of a note is the number of the model parameter):
1. Discount Rate (DR) belongs to the interval [3%; 10%]
2. All Models are Bottom-up (BU) (exceptions are Top-down (TD))
3. All models consider CO_2
4. Baseline (BL) is Business as Usual Scenario (BAU) or similar
5. Base year (BY) is 1990
6. Target year (TY) is 2020
7. Costs covered: cost of incremental reduction, abatement costs, costs of avoided or saved or mitigated CO_2, marginal costs
8. Estimations are made for Residential (R) and commercial (C) sectors in sum
9. Other important notes

Table 6.2. Typology of policy instruments available for GHG emission limitation in buildings (reference to be completed)

Control and regulatory mechanisms	**Fiscal instruments and incentives**	**Economic and market-based mechanisms**	**Support, information and voluntary action**
➢ 'Direct' regulation: technology standards, performance standards, building codes, emission standards, permits, bans, usage restrictions; ➢ public budgeting and public procurement rules; ➢ Obligations to achieve certain outcomes: energy saving quotas, spending on energy efficiency; ➢ Revenue regulation and billing regulation; ➢ demand-side management.	➢ Taxation; ➢ Recycling energy tax revenue; ➢ Tax exemptions and reductions; ➢ Cost recovery mechanisms for energy efficiency programs; ➢ Public benefit charges; ➢ Capital subsidies, grants and rebates, low-interest loans, lower interest rates, and loan guarantees.	➢ energy performance contracting; ➢ energy outsourcing; ➢ co-operative procurement for energy efficient appliances and equipment; ➢ emission trading schemes (cap-and-trade, baseline-and-credit); ➢ tradable green and white certificates;	➢ Energy performance labeling and certification (appliances, cars, buildings); ➢ Awareness raising campaigns, education and training; ➢ Energy audit programs; ➢ Communicating pricing and other information for energy efficiency; ➢ Energy efficiency branding; ➢ Voluntary agreements (a.k.a. negotiated agreements).

Table 6.3. *Subsidy rates and impact of the removal of energy subsidies in the energy economy of several countries (**IEA (International Energy Agency)**, 1999).*

Country	Average rate of subsidy removed? (% of market price)	Annual economic efficiency gain (% of GDP)	Reduction in energy consumption (%)	Reduction in CO_2 emissions (%)
China	11	0.4	9	13
Russia	33	1.5	18	17
India	14	0.3	7	14
Indonesia	28	0.2	7	11
Iran	80	2.2	48	49
South Africa	6	0.1	6	8
Venezuela	58	1.2	25	26
Kazakhstan	18	1.0	19	23
Total selected countries	21	0.7	13	16
Total world	n.a.	n.a.	3.5	4.6

Table 6.4. *Selection of financial support measures for sustainable energy measure in buildings, in several OECD countries (**IEA (International Energy Agency)**, 2004c).*

Country	Program Title	Type of fiscal measure	Techniques	Size of incentive
Austria	Federal Environment Fund	Subsidy	- biomass and biogas district heating - energy efficiency measures - thermal renovation of entrepreneurial buildings	
Belgium	Tax Reductions for Home Improvements - Federal	Tax reduction	- replacement of old boilers by new condensation boilers - installation of double glazing, roof insulation, the installation of a central heating regulator, plus energy audits	- 15% deduction rate - 40% deduction rate
Belgium	Subsidies to Improve Energy Efficiency in Buildings - Wallonia & Brussels-Capital	Subsidy	- energy audits in buildings - energy efficiency improvements low-income households	- 50% of the cost - maximum 1850 US dollar per household
Canada	Commercial Building Incentive Program (Extension)	Subsidy	- new commercial and institutional buildings that are designed to be at least 25% more energy-efficient than the building standard	- 42.000 US dollar per building
Canada	EnerGuide for Houses Retrofit Incentive	Subsidy	- personal energy evaluations and retrofit plans to homeowners to encourage them to implement energy efficiency retrofits	- 105 US dollar of evaluation costs between 155 and 230 US dollar
Canada	Energy Innovators Plus (Extension)	Subsidy	- energy efficiency retrofits of commercial and institutional buildings - refrigeration and equipment	
Canada	Power Smart New Home Program in British Columbia	Subsidy	- energy efficient technologies in new homes	
France	Tax credit in favor of high efficiency natural gas boilers	Tax reduction	- high efficient natural gas boilers	
France	Extension of Tax Credit for Large Collective Equipment, Renewable Energy Equipment, Thermal Insulation and Heating Regulation Equipment	Tax reduction	- thermal insulation and regulation material	
Germany	CO2 Building Modernisation Program	Preferential loans	- raise energy efficiency of 30000 units of existing stock of residential buildings	
Germany	Renewable Energy Promotion Programme	Subsidy	- thermal solar collectors - energy conservation measures	
Ireland	House of Tomorrow Programme	Subsidy	- research, development and demonstration projects to achieve more sustainable energy in new and existing houses	
Japan	Home Energy Management System, Building Energy Management System	Subsidy	- energy management systems in homes and buildings	
The Netherlands	Energy Premium Regulation	Subsidy	- energy conservation measures and purchase of energy efficient appliances by households	for example 100 US dollar for high efficient washing machine, refrigerator and 45 US dollar for a high efficient condensing boiler
United Kingdom	Energy Efficiency Commitment	Subsidy	- domestic energy efficient improvements, insulation, energy efficient boilers, appliances and lights bulbs (focus on low-income consumers)	
United States	Grants to Improve Energy Efficiency of Low-Income Households - Weatherization Assistance Program 2001	Subsidy	- energy efficient services for low income households that include installing insulation and ventilation fans, sealing ducts, adding weatherstripping, and insulating water heater systems	
United States	Tax Incentive Package - Federal Level	Tax reduction	- energy efficient new homes - energy-efficient products	- 1,000 to 2,000 US dollar - 20% tax credit
United States	Energy Savings Performance Contracts (ESPCs)	Preferential funds	- new energy efficient equipment	- up front costs

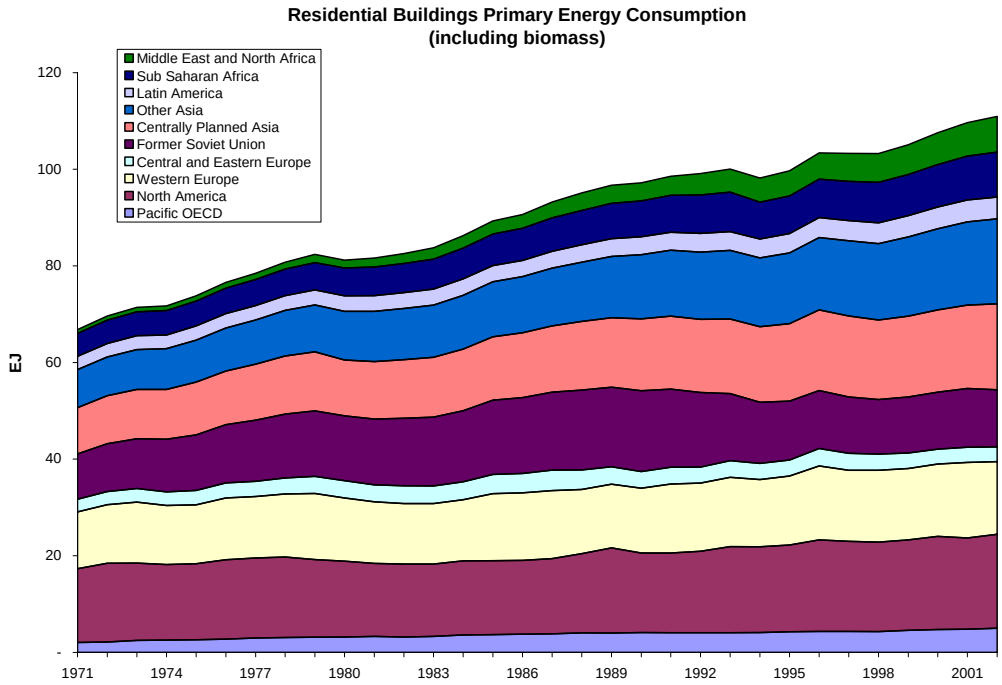

Figure 6.1. *Primary Energy Consumption in Residential Buildings (including biomass), 1971-2002. Source: (Price et al., 2005).*

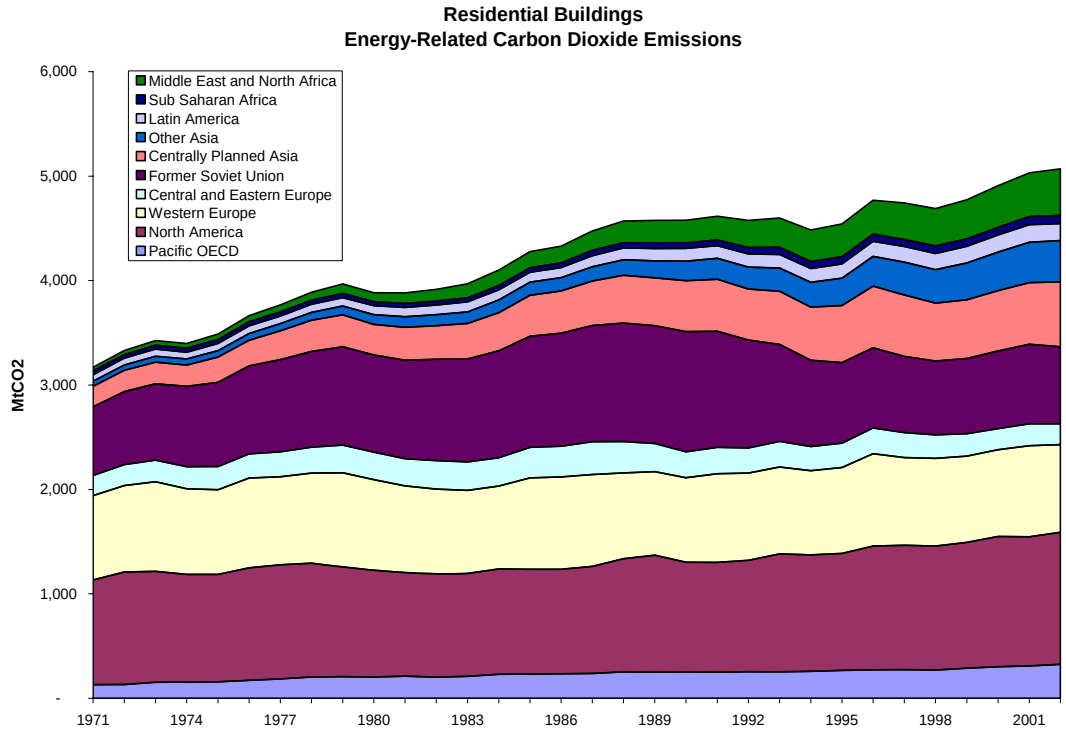

Figure 6.2. *Energy-Related Carbon Dioxide Emissions from Residential Buildings (including biomass), 1971-2002. Source: (Price et al., 2005).*

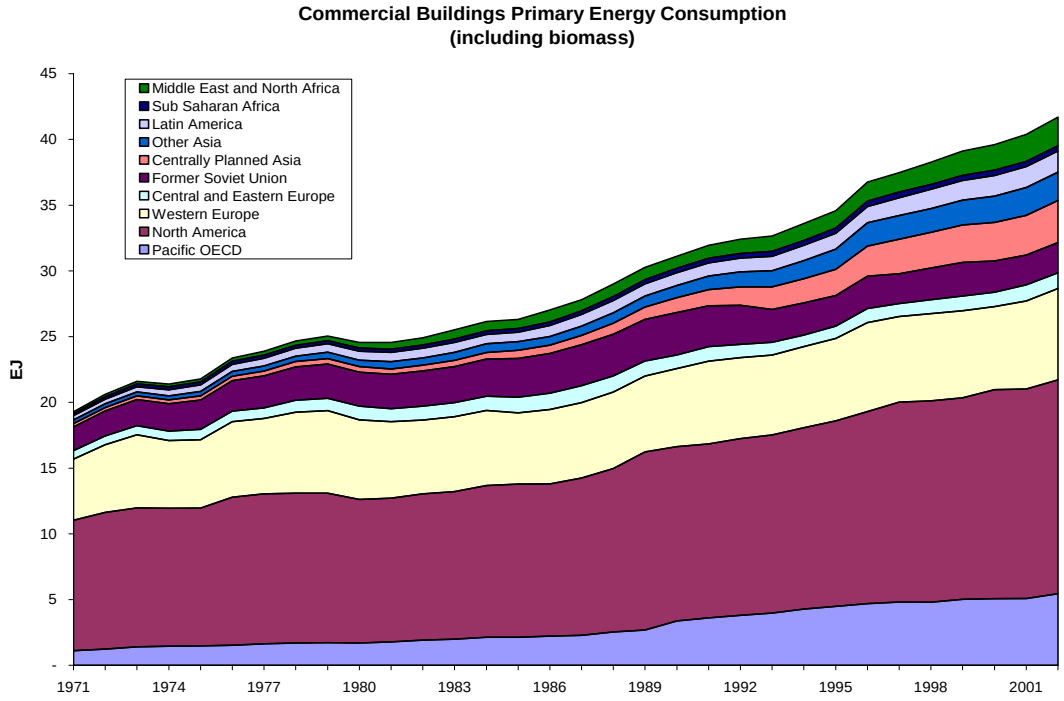

Figure 6.3. *Primary Energy Consumption in Commercial Buildings (including biomass), 1971-2002. Source: (Price et al., 2005).*

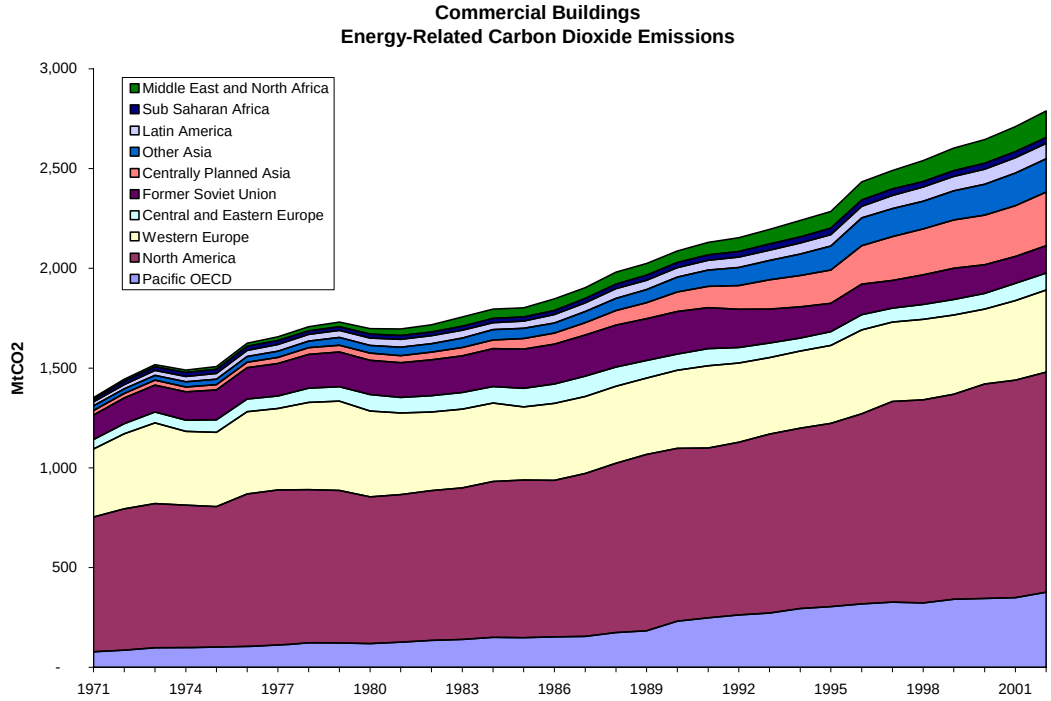

Figure 6.4. *Energy-Related Carbon Dioxide Emissions from Commercial Buildings (including biomass), 1971-2002. Source: (Price et al., 2005).*

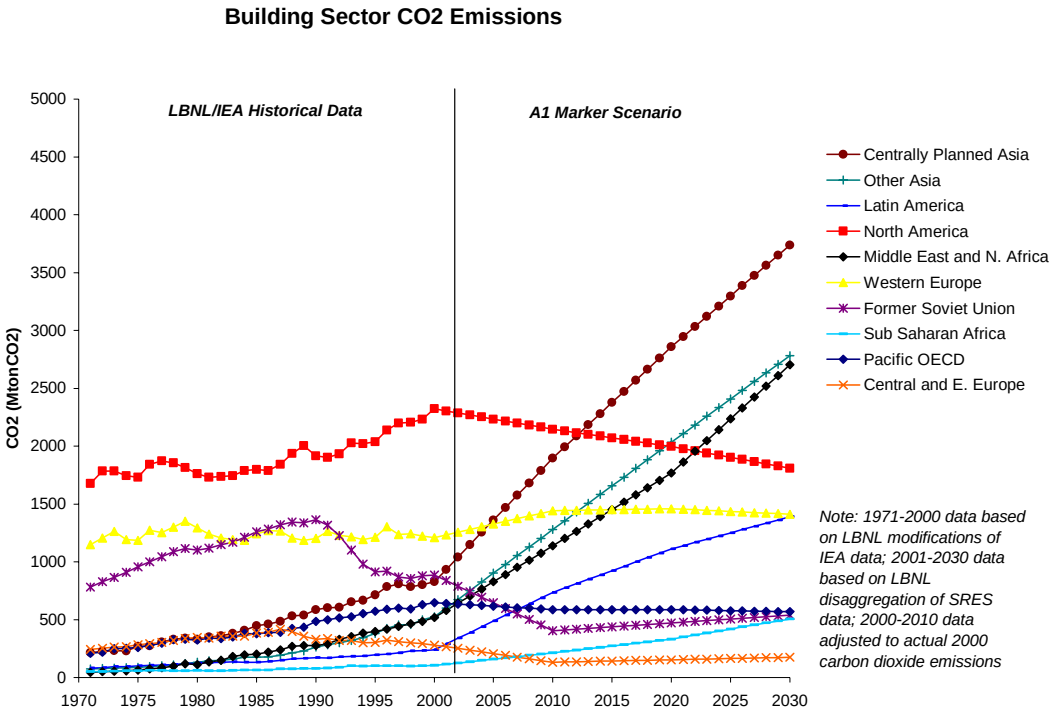

Figure 6.5. *Projected Residential Sector Energy-Related CO_2 Emissions, A1 Scenario (Price et al., 2005a).*

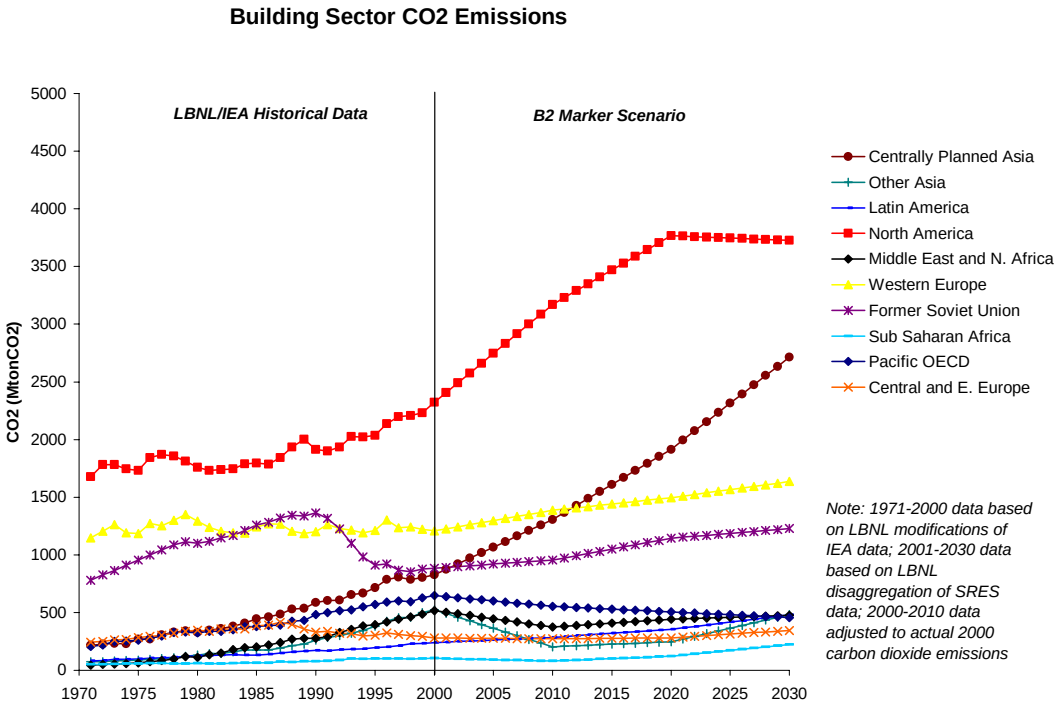

Figure 6.6. *Projected Residential Sector Energy-Related CO_2 Emissions, B2 Scenario (Price et al., 2005a).*

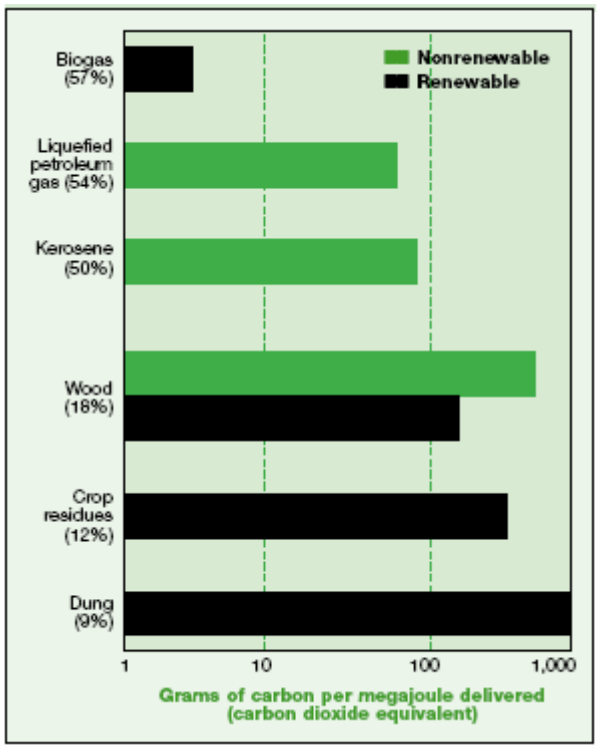

Figure 6.7*. Greenhouse gas emissions from household fuels*
Note: includes warming potential from all GHGs emitted: CO_2, CH4, CO, non-methane hydrocarbons, and nitrous oxide. Weighted by stove distribution in India. Numbers in parentheses are average stove energy efficiency.
Source: Goldemberg et al. 2000

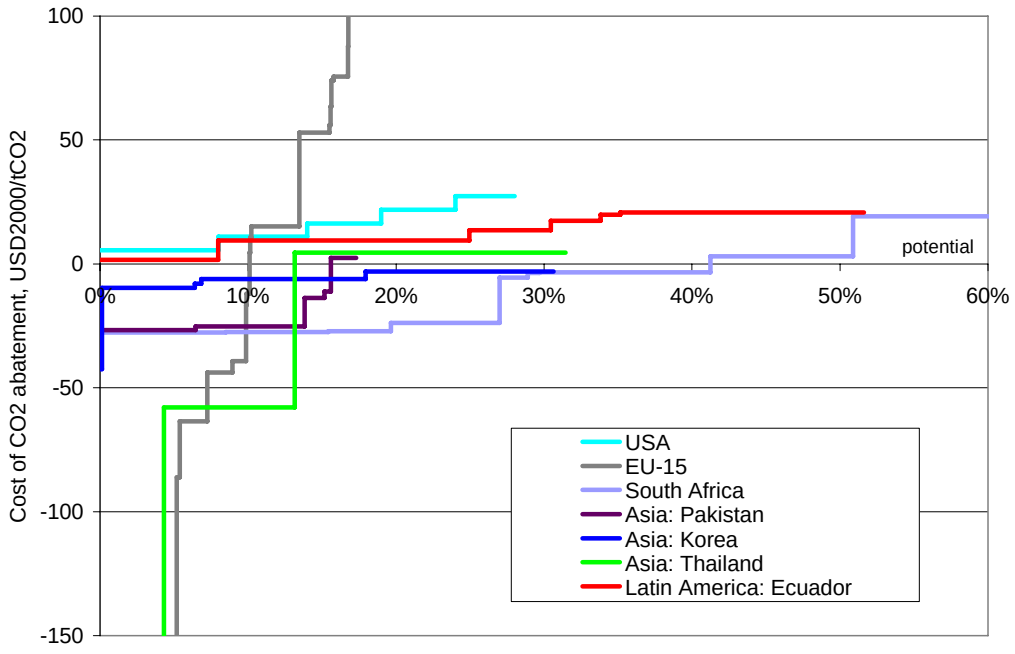

Figure 6.8. *Supply curves of conserved CO_2 for commercial and residential sector in 2020* for different world regions.*

**Except for Ecuador and South Africa, for which the target year is 2030.*

Notes: *Each step on the curve represents a type of measure, such as improved lighting or added insulation. The length of a step on the "X" axis shows the abatement potential represented by the measure, while the cost of the measure is indicated by the value of the step on the "Y" axis. Negative values indicate that the measure has a net benefit instead of net cost (e.g., due to avoided energy costs in the case of an energy efficiency measure).*

Source: Joosen and Blok 2001, Newell and Pizer 2005, ADB 1998a, ADB 1998b, ADB 1998c, De Villers and Matibe 2000, FEDEMA 1999.

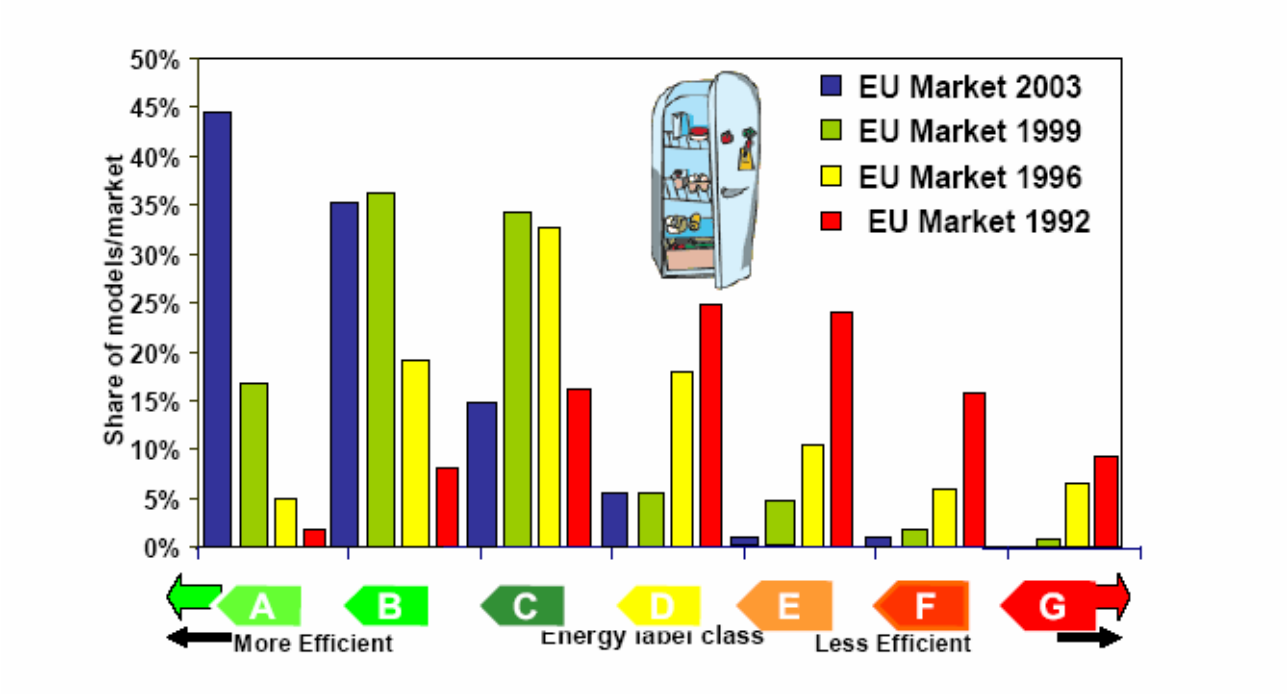

Figure 6.9. The Impact of the EU Appliance Label on the Market of Cold Appliances

Source: Data for 1992-99 are from (IEA, 2003). Data for 2003 are from (Soregaroli, 2003)

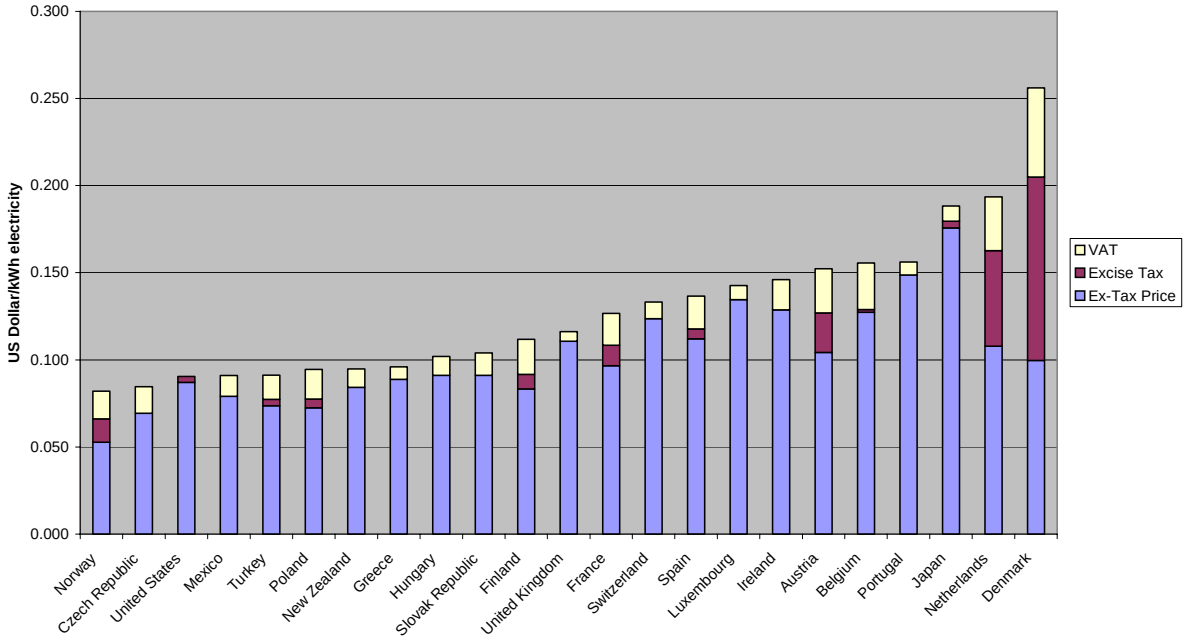

Figure 6.10. *Electricity price for households in 2003 (**IEA (International Energy Agency)**, 2004c)*

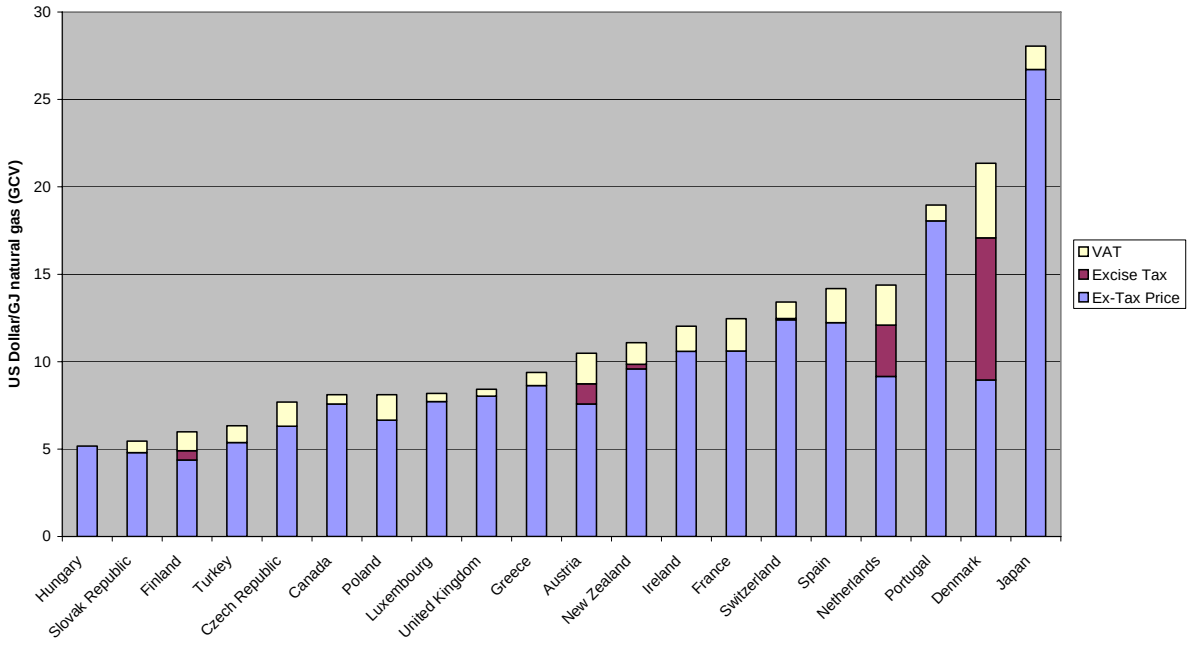

Figure 6.11. *Natural gas prices for households in 2003 (**IEA (International Energy Agency)**, 2004c)*

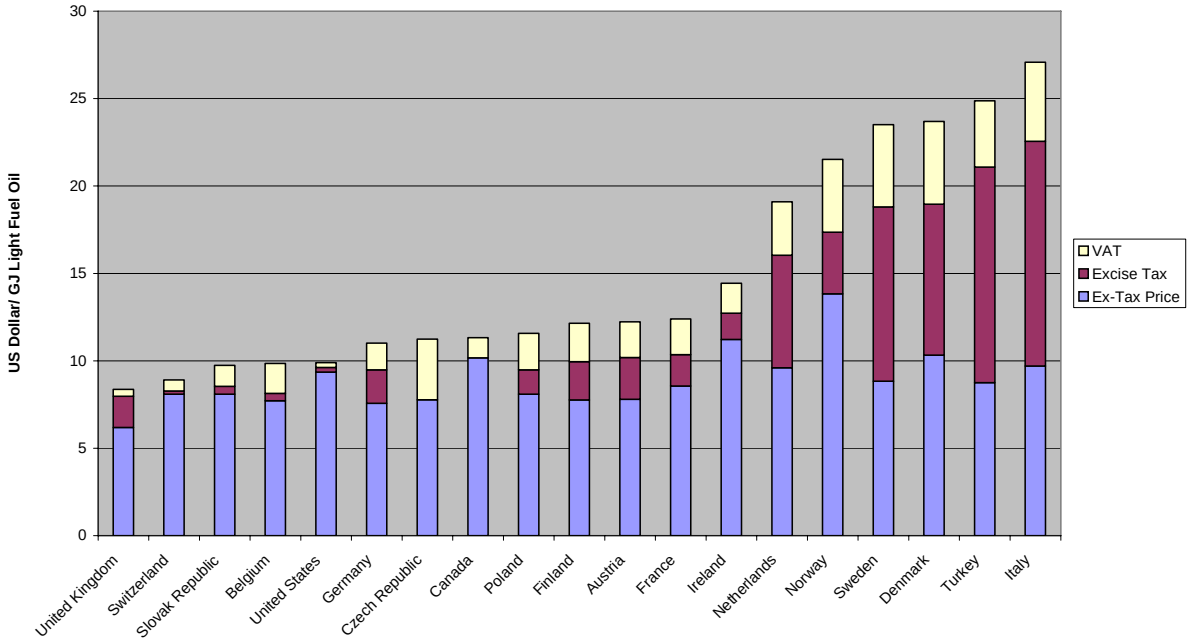

Figure 6.12. *Light fuel prices for households in 2003 (**IEA (International Energy Agency)**, 2004c)*

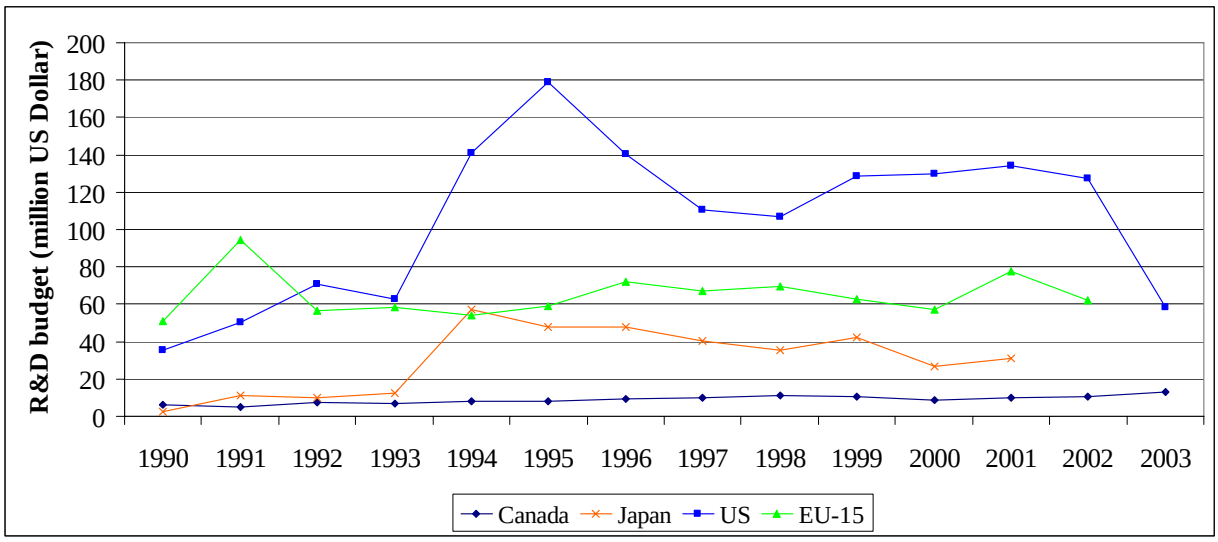

Figure 6.13. *Annual budget for R&D in energy conservation in the residential and commercial sectors for the period 1990-2003 (**IEA** 2004c). The data series are not complete for several countries in the IEA RD&D database and the reliability of data is uncertain.*