

Renewable Energy Knowledge Base: Global Markets, Investments, and Policies

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WCRE 2nd World Renewable Energy Forum

Bonn, Germany
May 29-31, 2004

NATIONAL NEWS STORY

Man walks NZ to clear mind

10 April 2004

By CHALPAT SONTI

The Southland Times

Most people like a stroll around the block to relieve stress – Eric Martinot decided to walk the length of New Zealand.

The 41-year-old Washington DC renewable energy expert arrived in Bluff on Thursday, about six months after setting out from Cape Reinga.

He said the reason for his walk was simple. "I was due for a break – there is a lot of stress in my job and I decided to take six months off and clear and rest my mind."

[story continued; see link on www.martinot.info/nztrek]



Renewable Energy Knowledge Base

Indicators, experience, and lessons used to inform strategy, decision-making, and awareness about renewable energy

A. Market Indicators

- installed capacities
- number of people/households served by application
- market volume, standards, participants, costs, resources, etc.

B. Case Studies and Lessons

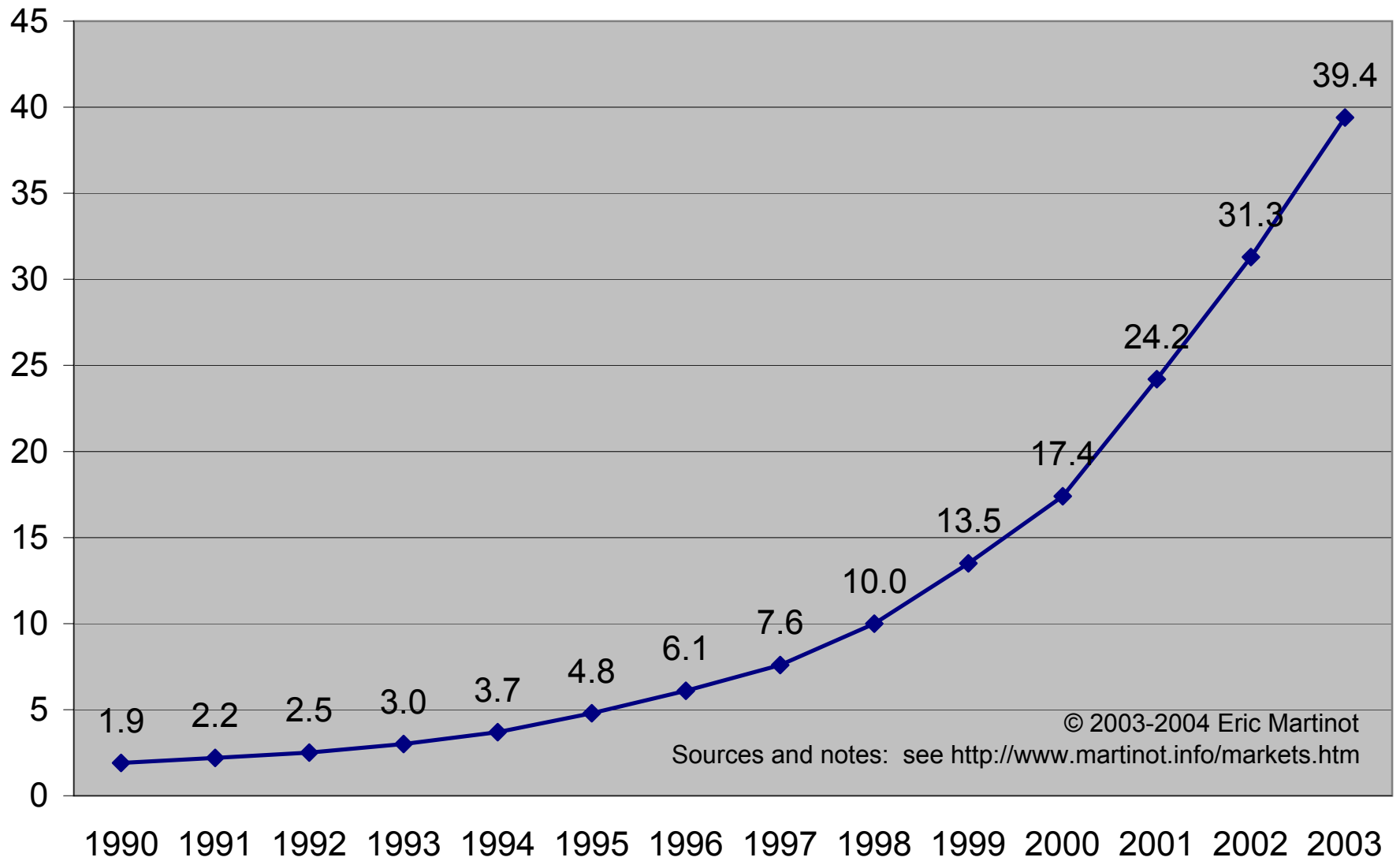
- market facilitation programs
- investment projects
- business model innovation and testing

C. Policy Impacts and Lessons

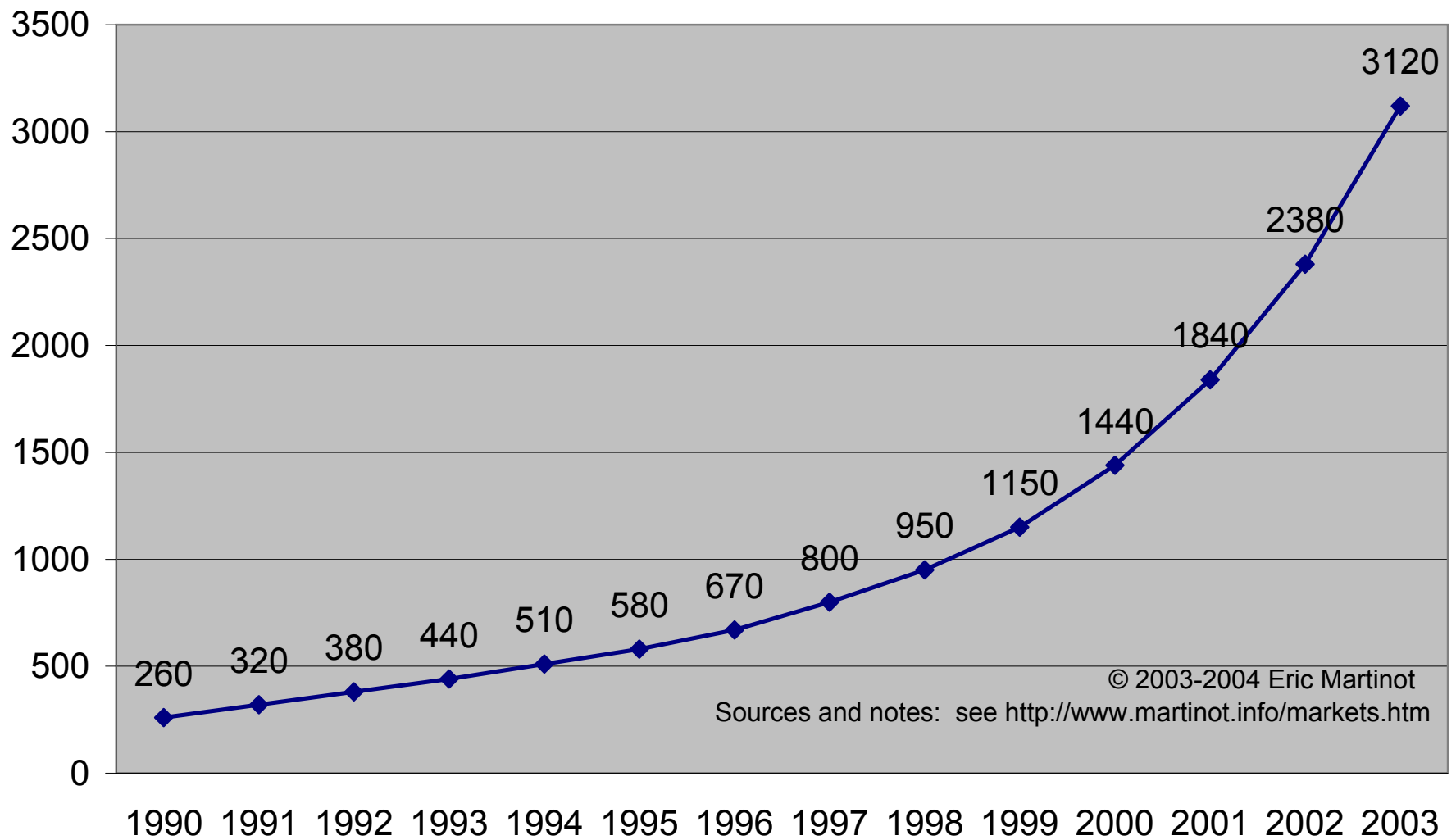
- policy and context descriptions
- analyses of impacts and guidance for future policy

D. Sources of Information

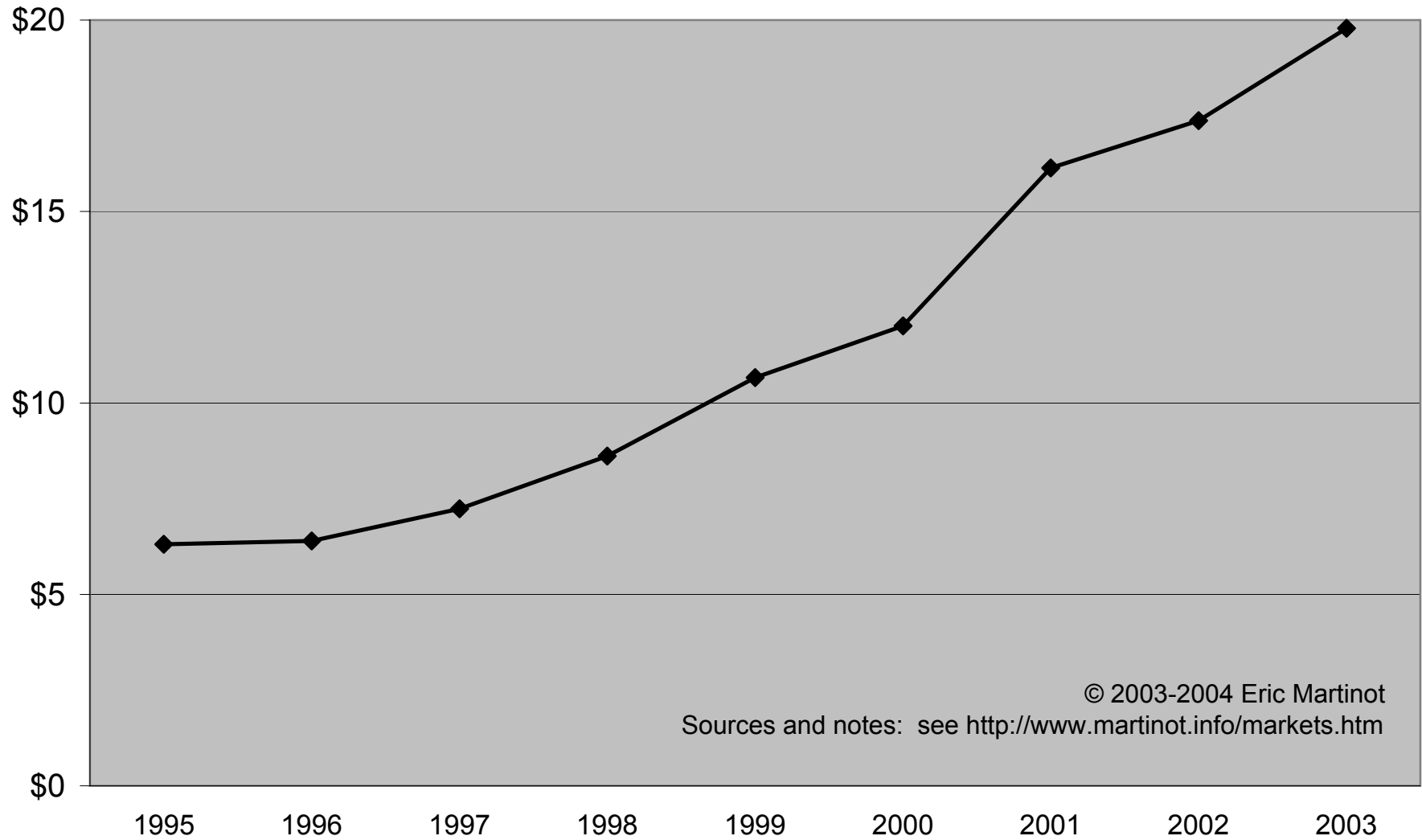
Wind Power Capacity World Total, 1990-2003 (GW)



Solar Photovoltaic Capacity World Total, 1990-2003 (MW)



Annual Investment in Renewable Energy World Total, 1995-2003 (\$ billion)



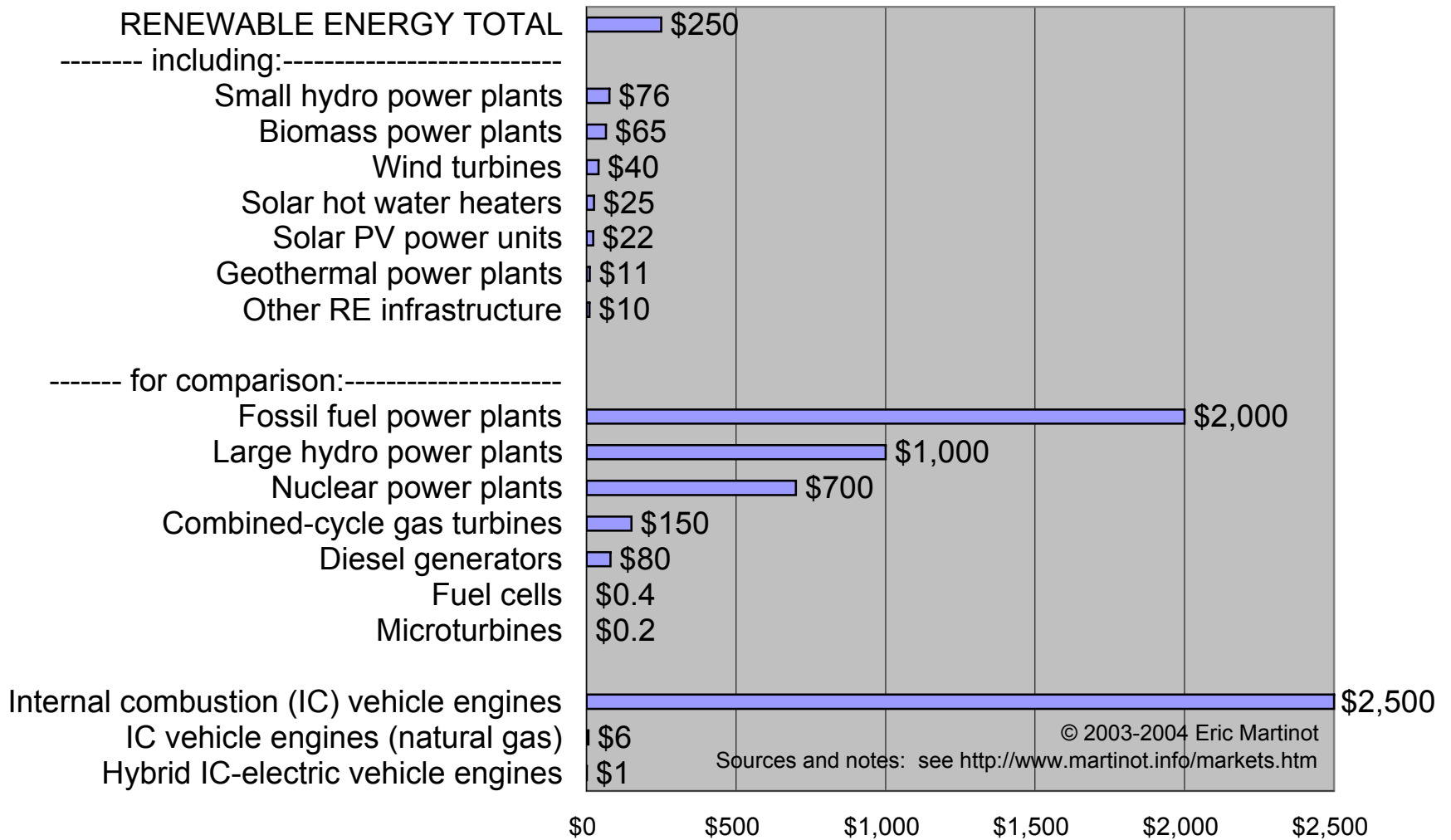
Renewable Grid-Based Electricity Generation Capacity

Installed as of 2000 (megawatts)

Technology	World -- all countries	Developing countries
Small hydropower	43,000	25,000
Biomass power	32,000	17,000
Wind power	18,000	1,700
Geothermal power	8,500	3,900
Solar thermal power	350	0
Solar photovoltaic power (grid)	250	0
Total renewable power capacity	102,000	48,000
<i>For comparison:</i>		
Large hydropower	680,000	260,000
Total electric power capacity	3,400,000	1,500,000

© 2003 Eric Martinot. Source: "Renewable Energy Markets in Developing Countries," E. Martinot, A. Chaurey, D. Lew, J. Moreira, N. Wamukonya, *Annual Review of Energy and the Environment* 27: 309-348 (2002), available at www.martinot.info/re_publications.htm.

"Replacement Value" of Existing Renewable Energy Capacity and Comparison with Value of Selected Energy Infrastructure World Total (\$ billion)



Renewable Energy Markets in Developing Countries

Application	Indicators of Existing Installations and Markets (as of 2000)
1. Rural residential and community lighting, TV, radio, and telephony	<p>Over 50 million households are served by small-hydro village-scale mini-grids</p> <p>10 million households get lighting from biogas</p> <p>1.1 million households have solar PV home systems or solar lanterns</p> <p>10,000 households are served by solar/wind/diesel hybrid mini-grids</p>
2. Rural small industry, agriculture, and other productive uses	<p>Up to 1 million water pumps are driven by wind turbines and over 20,000 water pumps are powered by solar PV</p> <p>Up to 60,000 small enterprises are powered by small-hydro village-scale mini-grids</p> <p>Thousands of communities receive drinking water from solar PV-powered purifiers/pumps</p>
3. Grid-based bulk power	<p>48,000 MW installed capacity produces 130,000 GWh/year (mostly small hydro and biomass, with some geothermal and wind)</p> <p>More than 25 countries have regulatory frameworks for independent power producers</p>
4. Residential/commercial cooking and hot water	<p>220 million households have more-efficient biomass stoves</p> <p>10 million households have solar hot water systems</p> <p>800,000 households have solar cookers</p>
5. Transport fuels	<p>14 billion liters per year ethanol vehicle fuel produced from biomass</p> <p>180 million people live in countries mandating mixing of ethanol with gasoline</p>

Developing Country Indicators: Rural Residential and Community Lighting, TV, and Telephony

*400 million households—a third of the world's population—
do not have access to electricity!*

- Over 50 million households served by small-hydro village-scale mini-grids
- 10 million households get lighting from biogas
- 1.1 million households have “solar home systems” or solar lanterns
- Over 200,000 households served by household-scale wind power
- 10,000 households served by solar/wind/diesel hybrid mini-grids



Developing Country Indicators: Rural Small Industry, Agriculture, and Other Productive Uses

“Productive uses” are those which increase incomes or provide social services beyond home lighting and entertainment

- Up to 1 million water pumps driven by wind turbines and up to 20,000 water pumps powered by solar PV
- Up to 60,000 small enterprises powered by small-hydro village-scale mini-grids
- Thousands of communities receive drinking water from solar PV-powered purifiers/pumps



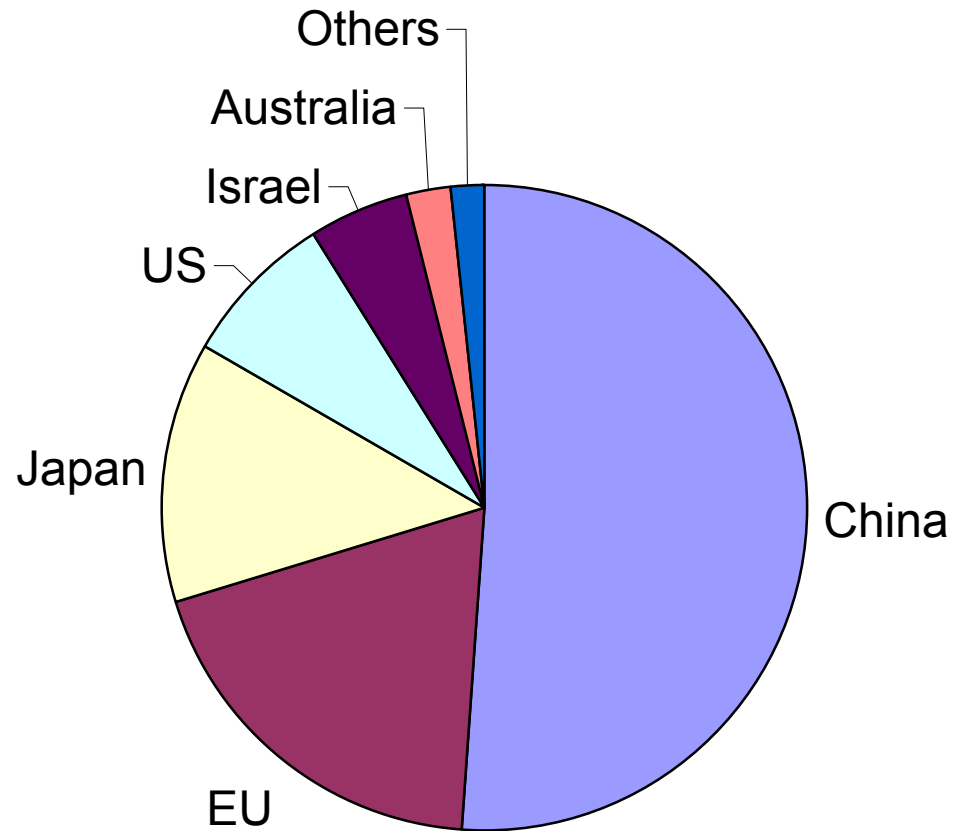
Developing Country Indicators: Residential/Commercial Cooking and Hot Water

Traditional biomass use — wood, crop wastes, dung, and charcoal — provides 30-45% of primary energy supply in many developing countries

- 220 million households have more-efficient biomass stoves
- 10 million households have solar hot water systems
- 800,000 households have solar cookers



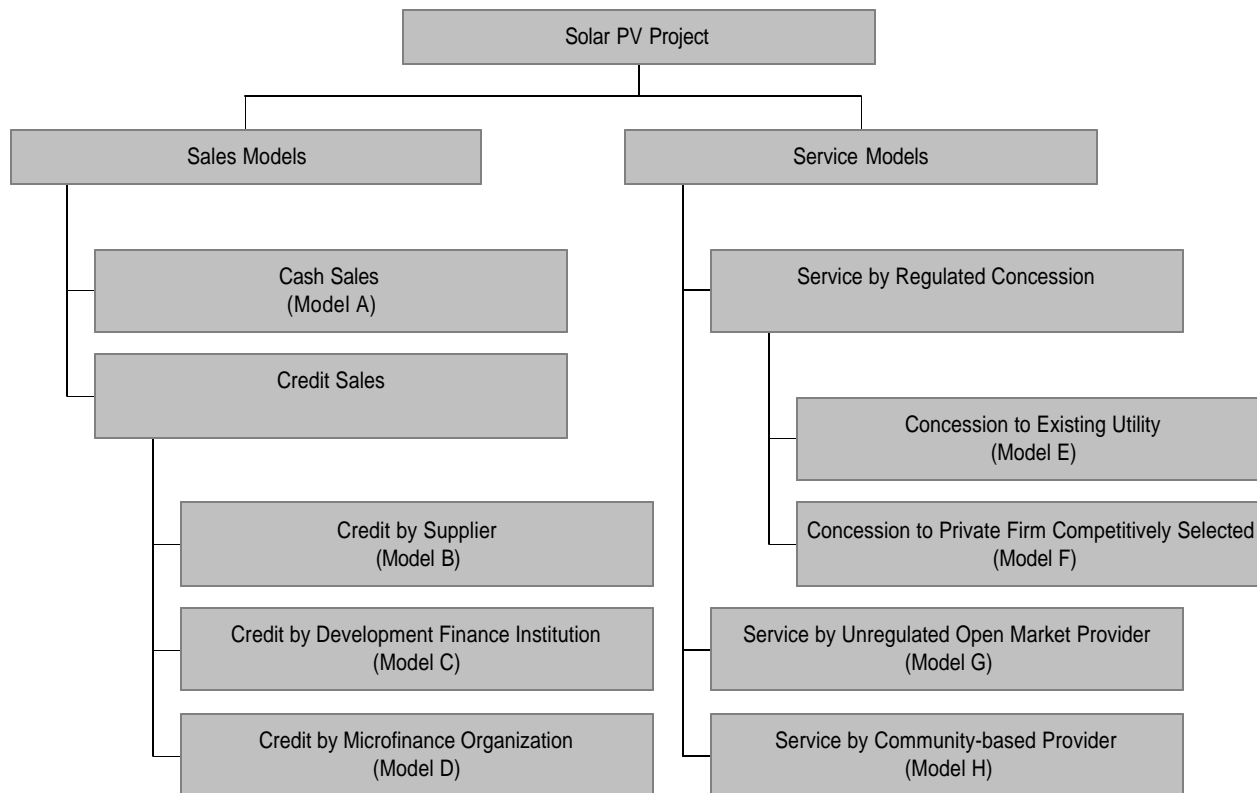
Existing Solar Hot Water Capacity, 2001
(total 62 million square meters)



Solar Home Systems Business Models

GEF projects test a variety of sales and service models

Typology of GEF-supported Solar PV Projects



Solar Home Systems in Sri Lanka (World Bank/GEF)

A promising example of rural microcredit and private/NGO partnership

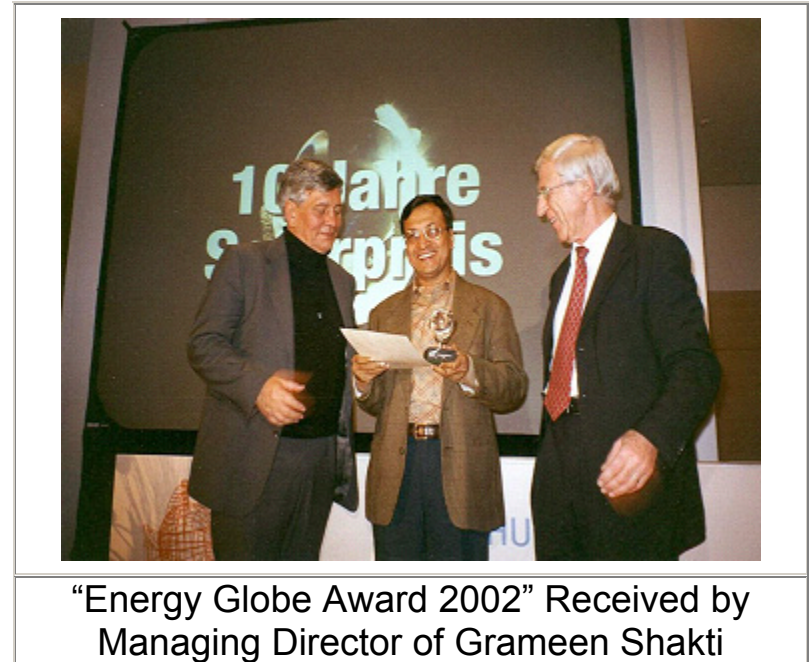
- Local dealers assemble, sell and service systems, using business financing from commercial banks through the project
- Dealers find marketing time-consuming and costly
- Initial attempts at dealer-supplied consumer credit failed
- Consumer credit provided through local microfinance organization (in partnership with dealers)
- Sales by 2002 exceeded 20,000 systems
- Main problem: creditworthiness of microfinance organizations questioned; so far only one has qualified
- Two events indirectly influenced: Shell Renewables entered the Sri Lanka PV market and a nationwide department store chain began to sell PV systems



Solar Home Systems in Bangladesh (IFC/GEF)

The only working example of dealer-supplied credit in the GEF portfolio

- Dealer selling systems without any subsidies
- Dealer credit, not microcredit!
- 3-year consumer credit possible because of IFC/GEF Small and Medium Scale Enterprise loan; before, only 1-year consumer credit was possible
- 3-year credit greatly increased demand relative to 1-year credit
- Marketing costs are high, must be paid from borrowed capital, and delay profitability by several years
- 20,000 systems installed by 2003



Grid-Based Wind and Small Hydro Power in India (World Bank/GEF)

*Financier acceptance, confidence, and willingness are key
(and big tax breaks don't hurt either)*

- Directly financed 40 MW of wind and 65 MW of mini-hydro installations.
- Strengthened the capabilities of the India Renewable Energy Development Agency (IREDA) to promote and finance private investments; subsequently more than 270 MW of wind projects were financed through IREDA in 1990s.
- Raised awareness among investors and banking institutions of viability of wind power technology—many financial institutions began to offer financing
- Investment tax policies resulted in more than 1,000 MW of wind power
- Dozens of domestic wind turbine manufacturers emerged, many joint ventures with foreign firms
- Sufficient experience and growing wind industry needed to work out technical and operational difficulties and produce superior wind farm performance



Small Hydro in Sri Lanka (World Bank/GEF)

New but flawed independent power producer framework

- Established private independent power producers and “non-negotiable transparent power tariffs”
- Tariffs were set at 5 cents/kWh in 1997-98 and industry flourished: 25 MW installed with World Bank financing through local commercial banks
- But....tariffs were based on short-run avoided cost, so with decline in oil prices in 1998-99, tariffs went to 3.5 cents/kWh in 1999 and installations stopped (and industry confidence collapsed)
- Industry rebounded by 2002, with tariff back above 5 cents/kWh, and total installed exceeded 32 MW
- Tariff scheme finally changed to incorporate multi-year averaging to reduce tariff fluctuation



Emerging Lessons: Impacts on Rural Development

After decades of work, we still know very little about the development impacts of renewable energy!

- Social benefits and quality of life, rather than income and economic benefits, have driven markets for renewable energy in rural areas
- Experience with “productive uses” of renewable energy is still in its infancy and deserves much greater attention from donors, development agencies, and governments
- Economic benefits from renewables are more likely in rural areas that can incorporate the additional energy dimension into existing development activities for water, health, education, agriculture, and entrepreneurship
- Published studies of income generation and economic benefits from renewable energy are still limited and call for further research

Emerging Lessons: Affordability, Consumer Credit, and Rentals

Can households “afford” to buy renewable energy based on savings of avoided kerosene, candles, and battery purchases?

- Historically, affordability of rural energy has been addressed through government subsidies, donor programs, and private cash sales of small systems
- New approaches to affordability are emerging, including vendor-supplied credit, microcredit, and rental models, but are still largely untested
- Credit risk is a serious concern of both financiers and dealers and makes credit sales challenging
- Lower income rural households will need long-term credit or rental options
- Even with credit or rentals, lower incomes groups will only benefit with targeted policies, including subsidy policies, justified by development goals

Emerging Lessons: Equipment Subsidies and Market Distortions

Donors are still undermining markets with capital cost subsidies and donated equipment

- Subsidies are unlikely to lead to sustainable markets unless they explicitly create the conditions whereby they are no longer needed (i.e., “smart” subsidies)
- Subsidies can undermine private investments and business in new markets and should be applied with attention to private-sector conditions in a particular market
- Subsidies can be used effectively to build up initial market volume, local expertise, user awareness, appropriate technology adaptation, quality standards, and entrepreneurial activities
- Subsidies are more effective when tied to operating performance rather than investment
- Continuing subsidies may always be needed for poorer segments of the population

Emerging Lessons: Enterprise Development, Financing, Viability

The track record of donor programs is poor in creating and sustaining rural enterprises for delivering renewable energy services

- A few donor programs have effectively assisted rural renewable energy-based enterprises to build a sustainable and viable business
- Rural energy enterprises face a high-risk, low-margin business with high transaction costs
- Commercial banks and financial intermediaries are key decision makers, who must understand the technologies and manage risks
- Demonstration of viable business models that eventually show sustained profits for the enterprise is key to achieving market sustainability

Emerging Lessons: Policies/Financing for Private Power Producers

Many developing countries have regulatory frameworks for independent power producers, but still lack specific renewable energy policies

- Policies that promote production-based incentives rather than investment-based incentives are more likely to spur industry performance and sustainability
- Power-sector regulatory policies for renewable energy should support ipp frameworks that provide incentives and long-term stable tariffs for private power producers
- Regulators need skills to understand the complex array of policy, regulatory, technical, financing, and organizational factors that influence whether renewable energy producers are viable
- Financing for renewable power projects is crucial but elusive

Emerging Lessons: Market Facilitation Organizations (MFOs)

Traditionally industry associations, a new generation of MFOs has emerged for renewable energy, including business-oriented NGOs

- MFOs can be powerful market stimulants but very few exist
- Public-private MFOs most likely need full public funding to begin, but eventually can become partly self-supporting through private contracts
- Very few people are thinking about the power of MFOs to stimulate renewable energy market development

Promote “Productive Uses” of Renewable Energy in Rural Areas

Beyond improving quality of life with lighting and TV, productive uses increase incomes and expand development benefits

General Categories:

Agriculture: water pumping, drip irrigation, crop drying, electric livestock fences

Health: drinking water, "telemedicine", vaccine refrigeration, medical equipment power

Education: distance education, internet, school lighting, computer training

Commercial services: telephony, commercial communications, fax, internet, Xerox

Small industry: craft tools, retail lighting, sewing, grinding, freezing

Specific Examples:

Drinking water purification and pumping with solar PV

Village mini-grids based on renewable energy powering local small industries

"Telecenters" for teacher training, distance education, distance medicine, entertainment, and commercial services

Policies for Incorporating Renewable Energy with Restructuring

Experience and lessons with what works still emerging

- Frameworks for independent power producers, including transparent and stable tariffs and long-term contracts
- Reduced subsidies to fossil-fuels and nuclear power
- Open access to transmission with transparent wheeling policies
- Comparable environmental standards for all generators
- Renewable energy portfolio standards (RPS)
- Mandatory purchases of renewable-energy-based power at fixed price (EFL)
- Competitively-bid renewable-energy-resource obligations (NFFO)
- ‘System benefits charges’ (per-kWh levy) to fund public clean energy programs
- Institutional frameworks for green power sales and green certificates

Policy Impacts: Some Examples

Policy	Results
Brazil “ProAlcool” ethanol program	Over 40% of automobile fuel consumption is ethanol and 18 billion liters of ethanol are produced annually.
China township electrification program	1000 townships electrified with solar, wind, small hydro in just 20 months (2001-2003) – nearly 1 million people.
Germany electricity feed-in laws	Wind power capacity went from virtually zero in early 1990s to 14,000 MW by 2003.
Germany 100,000 roofs program	Over 300 MWp PV installed from 2000 to 2003, representing about 70,000 roofs.
India tax and tariff policies for wind	Wind power capacity went from 50 MW to 2,000 MW from 1995 to 2003.
Japan Sunshine program	Added over 110,000 solar homes from 1994 to 2002, more than 400 MWp
Netherlands pollution tax / green exemption	Over 1 million households signed up as green power customers in first year.
U.S. production tax credits for wind	Wind power capacity reached 6,300 MW by 2003, with 1,700 MW installed in 2003 alone.

Knowledge Base Input and Output

Synthesis of global experience and lessons tied to a network to share knowledge with practitioners and decision-makers

Information collection → Knowledge synthesis and storage → Decision and strategy support

From:

- Businesses
- Research centers
- Multilateral/bilateral agencies

1. Market indicators
 - installed base
 - volume
 - participants
 - standards
 - costs
 - resources
2. Case studies & lessons
 - business models
 - investments
 - market facilitation
3. Policy impacts & lessons
4. Information sources

Documents and “help desk” custom targeted to:

- Businesses
- Investors/banks
- Policy makers
- Multilateral/bilateral agencies
- Public advocates/NGOs

Photo credits (in order of appearance):

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