part VI

Policies and Actions to Promote Energy for Sustainable Development

Part VI identifies key strategies and policies for globally achieving both economic growth and sustainable development. The needed actions include:

- Encouraging greater international co-operation in areas such as technology procurement, harmonisation of environmental taxes and emissions trading, and energy efficiency standards for equipment and products.
- Adopting policies and mechanisms to increase access to energy services through modern fuels and electricity for the two billion people without such access.
- Building capacity among all stakeholders, especially in the public sector, to address issues related to energy for sustainable development.
- Removing obstacles and providing incentives to encourage greater energy efficiency and the development and/or diffusion of new technologies – steps which can increase energy services more economically than improvements in generation or distribution.
- Advancing innovation, with balanced emphasis on all steps of the innovation chain.
- Creating market framework conditions (including continued market reform, consistent regulatory measures, and targeted policies) to encourage competitiveness in energy markets, to reduce total cost of energy services to end-users, and to protect important public benefits.
  - Cost-based prices, including phasing out all forms of permanent subsidies for fossil fuels and nuclear power and internalising external

environmental and health costs and benefits.

- **Removing obstacles and providing incentives, as needed, with "sunset" clauses, to encourage greater energy efficiency and the development and/or diffusion to wider markets of new technologies for energy for sustainable development.**
- **Reversing the trend of declining official development assistance and foreign direct investments, especially as related to energy for sustainable development.**

The challenge of energy for sustainable development will require a concerted effort on the part of international organisations, national governments, the energy community, civil society, the private sector, and individuals. Whatever difficulties are associated with taking appropriate action, they are small compared to what is at stake. Because humankind is in a dynamic and critical period of economic, technological, demographic, and structural transition, and because energy systems take decades to change, the time to act is now.

The Context for Sustainable Energy

Energy developments will affect and be affected by major global transformations occurring at the beginning of this new millennium. For instance, though world population continues to grow rapidly, for the first time in history, the number of people being added each year is less than the year before, and more people are living in urban than rural settings. Other major trends that set the stage for sustainable energy policies include:

Increasing Globalisation. Trade barriers have been reduced in recent years and world trade is growing rapidly. The global economy is steadily becoming more integrated through mergers, acquisitions, joint ventures, and the expansion of multinational companies. Multinational companies are playing an increasing role in fossil fuel production and distribution, gas and electric systems, and manufacturing of energy end-use technologies. As companies and markets become more international, policy interventions will require co-ordinated action and harmonisation in order to be more effective.

Shifting Governmental Responsibilities. The fact that market forces extend beyond national borders has made it more difficult for governments to raise taxes and still stay competitive globally. Government activities are increasingly moving toward regulation and oversight to ensure that markets work efficiently and advance social benefits.

Restructuring and Liberalising Energy Markets. All over the world, the allocation of materials and human and financial resources, as well as the selection of products and technologies, are increasingly done by private actors and, at least partially, as a function of market conditions. Many nations are corporatising or privatising formerly government-owned utilities and petroleum and natural gas companies, and introducing competition and new regulatory frameworks, in part to increase efficiency and attract private capital to the energy sector. Government oversight is essential to protect public benefits in a market-driven energy sector.

The Emerging Information Technology Revolution. The microelectronics revolution and its various ramifications are well known. The economic and structural transformations from the information age are likely to have far-reaching and difficult-to-predict structural consequences. The Internet and related information technologies also offer tremendous potential in terms of technology transfer, capacity building, and awareness raising.

Increased Public Participation in Decision Making. The freer flow of information and increasing globalisation has been accompanied by a wave of democratisation. Throughout the world, large numbers of people without economic power are gaining political power. Local groups are becoming more involved in the decision-making process and affecting public policy formulation. Women are becoming more active in the political process.

These trends are likely to provide a growing impetus to keep sustainable development high on the political agenda and energy as an important ingredient to that goal.

A Policy Framework to Promote Energy for Sustainable Development[17]

The WEA scenarios exercise shows that, although energy *can* contribute to sustainable development, *whether and how well* it does depends on a range of factors. These include access to information and technologies, the availability of finance and supporting institutions, attitudes and behaviours, and – in particular – policies and policy frameworks that encourage change in the desired direction. Current approaches to energy development,

17. This section draws on Johansson and Goldemberg (2002).

and the current rate of change, are not compatible with key elements of sustainable development. The following are some general principles for decision makers and programme designers to use as a framework when formulating strategies and policies for energy for sustainable development.

Encourage Greater Co-operation at the International Level. The ongoing process of globalisation means that ideas, finances, and energy are freer to flow from one country to another. Productive ways of moving forward might include combining national efforts, for example, in the procurement of renewable energy technologies. Other options include international harmonisation of environmental taxes and emissions trading, particularly among developed countries, and energy efficiency standards of equipment and products.

Concerted action is needed in the energy field to implement the various international agreements that have been reached in recent years. These include major international conventions that emerged from UNCED (particularly the United Nations Framework Convention on Climate Change), the major United Nations conferences of the 1990s, and the World Summit on Sustainable Development.

Important developments in setting goals and quantitative targets for renewable energy have occurred at the regional level. Examples of significant efforts include:

- The European Union Member States have agreed on renewable energy targets, increasing the share of renewable primary energy from 6 percent in 1995 to 12 per cent by 2010, and increasing the proportion of electricity generated from renewable sources from 14 percent in 1997 to 22 per cent in 2010.
- The Latin American and Caribbean Initiative, signed in May 2002 in São Paulo, included a target of 10 percent renewable energy by 2010. As a whole, this region had 24.4 percent of energy use as renewables in 2002, but that includes 15.6 percent in the form of combustible renewables and waste, which in most countries is not renewable (see footnote 5). Most of the Caribbean countries and a few in Latin America were below the 10 percent mark in 2002.

The Carbon Sequestration Leadership Forum is a co-operative effort by governments and the private sector to address the issue of carbon capture and storage (Box 6).

Make Modern Energy Carriers Affordable for Rural Consumers. Rural areas need affordable energy to meet basic needs. This affordability may, at least initially, require subsidies to be reduced over time. One option is to target the subsidies to the neediest consumers. Another option is to introduce market efficiencies and extend the smallest subsidy needed to achieve social objectives. Indeed, the subsidy may be provided as an integral part of a new social contract: energy providers meet rural energy needs by providing low-cost services while highly competitive conditions are simultaneously created in the energy sector (a key element of energy reforms).

One way to finance the needed subsidies would be to complement the creation of competitive markets with the establishment of a public benefits fund generated by wire and pipe charges on electricity and gas providers that cannot be passed on to consumers. Such funds have been adopted or are under consideration in several countries as a means of protecting public benefits under competitive market conditions. Other options include carefully designed economic incentives, perhaps using tax regimes.

Specifically, some of these revenues could be used to subsidise the poorest households until they are able to work themselves out of poverty. This strategy could

BOX 6. THE CARBON SEQUESTRATION LEADERSHIP FORUM

The Carbon Sequestration Leadership Forum (CSLF) is a co-operative effort of several countries and large companies organised in 2003 to stimulate work on carbon sequestration, that is, the capture and storage of carbon emitted in the form of CO_2 from large power plants and other installations burning fossil fuels. The basic premises of its work are the following:

- Sequestration complements energy efficiency and other forms of carbon-free energy, as part of a portfolio response to managing greenhouse gas emission.
- Industry supports a globally co-ordinated sequestration program through the CSLF and notes the following key requirements needed to ensure success: build substantial trust with the public, expand the CSLF's country membership, and facilitate opportunities for collaboration among industry, government, academia, and other important stakeholders.
- Sequestration is critical to the production of hydrogen from fossil fuels without CO_2 emissions, possibly paving the way to a hydrogen-based economy.

To that effect, the Forum supports:

- Moving large-scale sequestration demonstration projects forward as rapidly as possible to provide society with technically, economically, and socially viable options for carbon-neutral energy.
- Developing a flexible portfolio of sequestration techniques that focuses on geological sequestration, yet includes other approaches such as terrestrial sequestration, including re-injection in coal mines, oil fields, and the oceans.

Countries are pursuing sequestration in various ways. The European Union, for example, has set the following targets for its work on sequestration: reducing the cost of CO_2 capture from 50-60 Euros to 20-30 Euros per tonne of CO_2 captured; achieving capture rates above 90 percent; and assessing the reliability and long-term stability of sequestration.

The most critical targets for capacity development in the energy sector world-wide are macro-planners, energy policymakers, and new regulatory agencies.

be made entirely consistent with a shift to greater reliance on market forces to efficiently allocate resources. For example, a rural energy concession could be created to bring adequate energy services at a set price to a particular rural area. If the concession were awarded competitively, market forces would find the least costly mix of energy technologies with the least amount of subsidy to satisfy the concessionaire's obligation to provide affordable energy services to all. The task of supplying energy to the large, currently unserved rural population is one of the most daunting problems faced today in many developing countries and the sample solutions cited here do not exhaust the measures being developed world-wide.

Develop Capacity. Capacity development can be understood as the process of creating, mobilising, and converting skills/ expertise, institutions, and contexts to achieve specific desired socio-economic outcomes, such as using energy as an instrument for sustainable development. Capacity development is a long-term process that must be achieved through activities at the individual, institutional, and systemic level. The public sector, both at national and local levels, is the key target and recipient of capacity development.

All of the policy actions proposed here depend on human skills and knowledge, as well as institutional and government support. The most critical targets for capacity development in the energy sector are macro-planners, energy policymakers, and new regulatory agencies. The ongoing process of energy sector reform, utility restructuring, corporatisation, and re-regulation demands regulators who can keep up with quickly changing conditions – and this applies equally to industrialised and developing countries. The objectives of market reform, in terms of economic optimisation and social improvement, cannot be reached unless effective regulatory capacities exist to direct the functioning of the market. Capacity development should be a priority in new policy frameworks, and funding for capacity improvements should be part of domestic energy planning and development co-operation. Thus attention to capacity should be considered a crucial and crosscutting element of all development co-operation and energy sector programmes. Special attention needs to be given to the multi-sectoral capacity needs of rural areas.

Improve End-Use Energy Efficiency. Enhancement of end-use equipment can generally provide energy services more economically than improvements in generation or distribution. In addition to reducing externalities associated with energy use, improvements in energy efficiency can stimulate new industries in energy-saving goods and services.

For a number of reasons, the technical and economic potential of energy efficiency improvements has been under-realised. Numerous technical options and players could be involved in achieving higher end-use efficiency. Improving the energy efficiency of an economy is a decentralised, dispersed activity, with limited visibility, making it a less attractive cause for politicians, the media, or individuals looking for recognition and acknowledgement. In addition, significant barriers – primarily market imperfections that could be overcome by targeted policy instruments – prevent the realisation of greater end-use efficiencies. The barriers include:

- lack of adequate information, technical knowledge, and training;
- uncertainties about the performance of investments in new and energy-efficient technologies;
- lack of adequate capital or financing possibilities;
- high initial and perceived costs of more efficient technologies;
- high transaction costs (for searching and assessing information and for training);
- lack of incentives for careful maintenance;
- the differential benefits to the user relative to the investor (for example, when energy bills are paid by the renter, the property owner may have no incentive to invest in technology);
- external costs of energy use not included in energy prices;
- patterns and habits of consumers, operators, and decision makers, which may be influenced by many factors, including ideas of social prestige and professional norms;
- lack of attention to R&D investments in energy efficiency improvements.

Realising cost-effective energy efficiency potentials will be beneficial not only for the individual energy consumer but also for the economy as a whole.

Pricing energy correctly is important, but by itself is not sufficient to overcome the significant barriers to efficiency improvements. Energy efficiency policies that use direct or indirect price mechanisms (such as the removal of subsidies and the incorporation of externalities) are effective in lowering consumption trends in price-sensitive sectors and applications. But even without changing the overall price environment, energy efficiency policies should be pursued to address market failures. For example, energy service companies, which typically contract for a given level of energy services, can overcome some of these barriers because they have the incentive and expertise to find the least costly, most energy-efficient mix of options. Public sector procurement policies can be helpful for similar reasons.

Specific policy instruments can target different players – from consumers and builders to car manufacturers, urban planners, and industrial designers and engineers. Some of the approaches that have been effective in various contexts include energy efficiency standards and labelling, low-interest loans to cover investments in energy improvements, large-scale procurement that incorporates energy-efficiency requirements in the bidding process, educational campaigns, tradable certificates for energy efficiency improvements, tax incentives, and voluntary agreements. For larger public entities or private enterprises, integrated resource planning can be used to identify the least-cost options of meeting the need for energy services, looking at both supply and demand issues.

Encourage Energy Innovations. Energy innovations face barriers all along the energy innovation chain (from research and development, to demonstration projects, to cost buy-down, to widespread diffusion). Some of these barriers reflect market imperfections; some reflect inadequacies in the public sector domain; and some reflect differences of view about needs, corporate priorities, relevant time horizons, and reasonable costs. The amount of public support needed to overcome such barriers will vary from one technology to the next, depending on its maturity and market potential. Obstacles to technology diffusion, for example, may need to be given higher priority than barriers to innovation. Direct government support is more likely to be needed for radically new technologies than for incremental advances where the private sector functions relatively effectively.

Interventions should aim at helping the most promising energy innovations surmount bottlenecks wherever they occur in the innovation chain – a complex, interactive system requiring networks of innovation, knowledge sharing, and demand "pull" as well as supply "push". Over the past two decades, countries

TABLE 9. THE ENERGY INNOVATION CHAIN: BARRIERS AND POLICY OPTIONS

	Research and Development (laboratory)	Demonstration (pilot projects)	Diffusion	
			Early deployment (technology cost buy-down)	Widespread dissemination (overcoming institutional barriers and increasing investment)
Key barriers	■ Governments consider R&D funding problematic ■ Private firms cannot appropriate full benefits of their R&D investments	■ Governments consider allocating funds for demonstration projects difficult ■ Difficult for private sector to capture benefits ■ Technological risks ■ High capital costs	■ Financing for incremental cost reduction (which can be substantial) ■ Uncertainties relating to potential for cost reduction ■ Environmental and other social costs not fully internalised	■ Weaknesses in investment, savings, and legal institutions and processes ■ Subsidies to conventional technologies and lack of competition ■ Prices for competing technologies exclude externalities ■ Weaknesses in retail supply, financing, and service ■ Lack of information for consumers and inertia ■ Environmental and other social costs not fully internalised
Policy options to address barriers	■ Formulating research priorities ■ Direct public funding ■ Tax incentives ■ Technology forcing standards ■ Stimulating networks and collaborative R&D partnerships	■ Direct support for demonstration projects ■ Tax incentives ■ Low-cost or guaranteed loans ■ Temporary price guarantees for energy products of demonstration projects	■ Temporary subsidies ■ Tax incentives ■ Government procurement ■ Voluntary agreements ■ Favourable pay-back tariffs ■ Competitive market transformation initiatives	■ Phasing out subsidies to established energy technologies ■ Measures to promote competition ■ Full costing of externalities in energy prices ■ "Green" labelling and marketing ■ Concessions and other market-aggregating mechanism ■ Innovative retail financing and consumer credit schemes ■ Clean Development Mechanism

Source: Adapted from President's Council of Advisors on Science and Technology (PCAST), Powerful Partnerships: The Federal Role in International Cooperation on Energy Innovation *(Washington, DC: PCAST, 1999).*

TABLE 10. REPORTED* INDUSTRIAL-COUNTRY PUBLIC SECTOR SPENDING ON ENERGY RD&D

	1975	1980	1985	1990	1995	1998
Energy conservation	321	974	747	534	1,069	1,134
Fossil fuels	603	2,570	1,461	1,776	902	565
Oil and gas	143	552	442	345	406	282
Coal	460	2,018	1,018	1,431	496	283
Renewable energy	206	1,941	845	564	681	652
Solar PV	24	391	242	192	236	237
Other solar options	49	669	158	96	98	62
Wind	7	185	144	92	112	95
Biomass	6	142	163	82	139	173
Geothermal	116	430	125	89	79	65
Others	4	124	13	13	17	20
Nuclear energy	5,434	7,839	7,798	4,905	4,052	3,590
Nuclear fission	4,823	6,635	6,363	3,864	3,091	2,838
Nuclear fusion	611	1,204	1,435	1,041	961	752
Power and storage technologies	140	432	269	250	317	360
Other technologies/ other energy research	836	1,192	809	957	1,126	1,112
Total	7,540	14,949	11,927	8,986	8,146	7,413

* IEA total reported countries, in US$ millions (2002 prices and exchange rates)

Source: IEA, 2003; see http://library.iea.org/rdd/eng/TableViewer/wdsdim/dimensionp.asp

have experimented with a growing number of policy instruments – from target setting and procurement policies to green labelling and fiscal incentives. Table 9 summarises some of the barriers to, and policy options for, energy innovation.

After a steep increase in the 1970s related to the oil crises in these years, public expenditure for energy research, development, and demonstration (RD&D) has been falling steadily in industrial countries, from US$15 billion in 1980 to about US$7 billion in 2000. Of this amount, in 2000, about 8 percent was on renewables, 6 percent on fossil fuels, 18 percent on energy efficiency, 47 percent on nuclear energy, and 20 percent on other items (Table 10). About two third of the decline occurred in the United States. Major declines also happened in Germany, the United Kingdom, and Italy. Public spending on energy RD&D remained stable or increased in Japan, Switzerland, Denmark, and Finland.

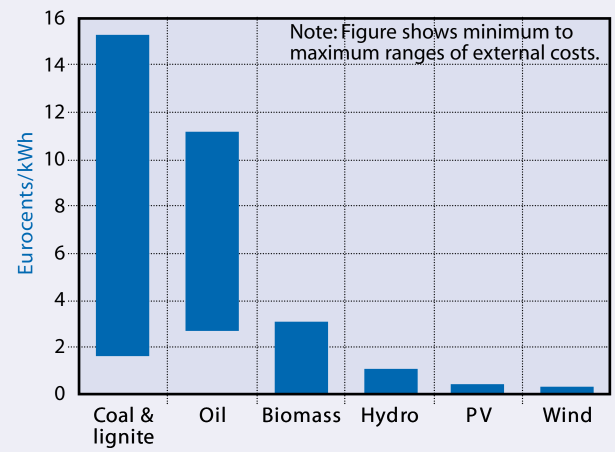
Making Markets Work Better. Throughout the world, markets are playing a larger role in energy investment decision making and in the determination of energy prices. When they are functioning well, markets sustain the pressure on competing producers to find productivity gains, which creates a continuous force for technological change that improves the efficiency with which resources are converted into valued goods and services. However, market-based approaches are no panacea – especially in the energy sector, where significant market imperfections require attention and oversight. In many countries, markets barely function. Huge populations of both city dwellers and rural families are excluded from markets by extreme poverty. The following policies can improve the functioning of energy markets.

Price energy correctly. Prices should cover all costs and needed investments, and thus ensure adequate revenue for the company or agency providing the energy. Earned revenues should cover operating and capital costs, including investment in system expansion where warranted (this may be difficult to achieve in many developing countries). Rates should also take account of differences between the marginal and the average costs of providing goods and services. However, while pricing reform can lead to economic efficiency, it is important not to pursue such reforms without regard to other sustainability objectives. Changes in tariff design can lead to substantial shifts in the revenue requirements from different consumer groups, so these distributional effects may need to be offset with some form of compensation or softened by a lengthy transition period.

Where well-functioning markets do exist, policies should attempt to ensure that competitors are playing on a level field. Two measures are particularly critical in this regard: removing subsidies and accounting for social costs or externalities.

Restructure subsidies to support sustainable development. Global subsidies to conventional energy amount to about US$250 billion per year. They represent a substantial market distortion, discourage new entrants into the market, and undermine the pursuit of energy efficiency (Box 7). Although subsidies may have a role to play in providing the poorest of the poor access to modern energy, few of the subsidies now in place serve this purpose. There are some notable exceptions; for example, South Africa used cross-subsidies to double the proportion of its population with access to electricity in the 1990s. Similarly, temporary subsidies can help to reduce the cost of new entrants into the market such as

FIGURE 16. EXTERNAL COSTS FOR ELECTRICITY PRODUCTION IN THE EUROPEAN UNION, BY SOURCE



Source: Data from the European Commission – ExternE Programme (European Union 5th Research and Technological Development Framework Programme).

BOX 7. COST OF ENERGY SUBSIDIES

Subsidies comprise all measures that keep prices for consumers below market level or keep prices for producers above market level or that reduce costs for consumers and producers by giving direct or indirect support. Energy subsides comprise a wide variety of public interventions:

- direct grants to cover losses of coal mines or domestic purchase obligations for coal
- support to low-income households to purchase fuels for heating and cooling
- all sorts of tax breaks for energy users, including lower value added tax (VAT) rates low-interest loans, and allowing public energy companies to earn a lower-than-market rate of return
- R&D support for nuclear fusion programs
- deficit payments to miner pension funds to compensate for the costs of Black Lung Disease and early retirement
- end-user energy prices at rates below market level
- a recent phenomenon, the non-payment of tax bills and bail out operations of public companies.

Much of this energy support is not directly visible but is hidden in public and economic structures. In total, energy subsidies currently amount to over $US240 billion per year. Nearly two thirds of all subsidies flow to fossil fuels (coal, oil, and gas). In fact, since power generation usually involves burning fossil fuels, adding subsidies for electricity further raises the share to over 80 per cent.

COST OF ENERGY SUBSIDIES, BY SOURCE, 1995-98 (US$ BILLION/YR)

	OECD Countries	Non-OECD Countries	Total
Coal	30	23	53
Oil	19	33	52
Gas	8	38	46
All fossil fuels	***57***	***94***	***151***
Electricity	a	48	48
Nuclear	16	nil	16
Renewable and end-use	9	nil	9
Non-payments and bailout[b]	0	20	20
Total	82	162	244
Per capita ($US)	88	35	44

a) Subsidies for electricity in OECD countries are included in fossil fuel subsidies, by energy source.
b) Subsidies from non-payments and bail out operations are not included in data by energy source.

Sources: André de Moor, "Towards a Grand Deal on Subsidies and Climate Change", Natural Resources Forum *25, no. 2 (May 2001); Cees van Beers and André de Moor,* Public Subsidies and Policies Failures: How Subsidies Distort the Natural Environment Equity and Trade and How to Reform Them *(Cheltenham, UK: Edward Elgar Publishers, 2001).*

wind, photovoltaics, etc. Figure 14 shows declining costs as cumulative investments in new energy sources grow.

Modest, time-limited subsidies – sometimes in the form of small amounts of electricity to satisfy households' needs – may be justified for social and environmental objectives. However, substantial subsidies are both unsustainable financially and harmful to economic growth because resources are not used efficiently. Moreover, they often do not go to the people whom they are ostensibly designed to help. Generally, subsidies to cover capital improvements rather than operating costs are most effective. Subsidies may also be used to promote technological advances and organisational learning. However, they are unlikely to lead to sustainable markets unless they create conditions whereby they are no longer needed.

Address externalities. In the absence of intervention, markets fail to address the substantial negative side effects of conventional energy use. External costs can be as large as or larger than the market. Figure 16 shows the external costs associated with various kinds of electricity production; for coal, for example, the external costs range from 2-15 eurocents per kWh; market costs for power generation are typically 3-10 eurocents per kWh. In some cases, such as certain effects of unmitigated climate change, it has been argued that the external costs are essentially "infinite", much larger than the costs of mitigation. If such costs are not reflected in the market conditions seen by investors, optimal decisions will not be made in the marketplace.

As more attention has focused on external social and environmental costs, a variety of instruments and approaches have been devised to improve the functioning of markets, either through restrictions or through prices. A general term for the analysis behind such policies is social costs, which is defined as the combination of private financial costs (those capital and operating costs normally seen in the market) with uncompensated negative externality costs.

One way to improve market functioning is through information, labelling, and pricing policies to change

BOX 8. THE TEXAS RENEWABLES PORTFOLIO STANDARD

Under the Renewables Portfolio Standard (RPS) in Texas, retail electricity suppliers are required to include a specified percentage of renewables in their generation portfolio. Annual renewable-energy generation targets back the policy. Texas state authorities have set targets to increase the amount of energy generated by renewables to 2,880 MW by 2009, including 2,000 MW from "new renewables" (i.e., modern biofuels, wind, solar, small-scale hydropower, marine, and geothermal energy). Wind energy currently dominates the installed capacity of renewables, with supply costs of around 4.7 cents/kWh (of which 1.7 cent/kWh is covered by a federal production tax credit).

Projections show that the first-year target of 400 MW of new capacity to be installed by 2003 will be exceeded significantly. Several factors are contributing to the policy's success: clear renewable energy targets, clear eligibility of what qualifies as a renewable resource project, stringent non-compliance penalties, a Tradable Renewable Energy Certificate system that encourages flexibility and minimises costs, and a dedicated regulatory commission that fully involved numerous stakeholders during the detailed design of the policy. A major lesson from Texas is that, although new and relatively untested as a policy tool, the RPS, in combination with tax credits, has the potential to cost-effectively support the establishment of a robust renewable energy market.

Source: G8 Task Force on Renewable Energy, Final Report, June 2001.

consumer behaviour to favour "greener" products. Governments may take a more dominant role by, for example, specifying emission levels or efficiency standards. A number of emerging hybrid policies, such as renewable portfolio standards and certificate markets, so-called cap and trade policies, combine the efficacy of regulatory approaches with the flexibility and cost-effectiveness associated with market-oriented pricing policies. One example of green certificate markets, or renewable portfolio standards, is shown in Box 8. Another example of the power of incentives and predictable market conditions is the approach taken by the German Renewable Energy Law (Box 9).

Re-Regulate Liberalised Electricity Markets. When markets work well, competition can drive down costs and open up opportunities for new players. Liberalisation by itself, however, will not protect or enhance public benefits. Moreover, oligopolies may replace monopolies, with limited benefits to consumers. Thus regulation is even more critical in a liberalised energy sector, and a regulatory framework should be established before energy corporations are privatised. Someone must have responsibility for ensuring system adequacy and reliability. The California and Brazil experiences, as well as the recent blackouts in London and along the North American eastern seaboard, provide examples of the seriousness of adopting wrong policies in a liberalised setting (Box 10). Clearly a strong leadership role for public policy and institutions is essential.

BOX 9. GERMAN RENEWABLE ENERGY SOURCES ACT

Germany's Renewable Energy Sources Act was passed in 2000 to establish a framework for doubling the market share of renewable energy sources by 2010. The mechanism of a set feed-in price for electricity delivered to the power grid was adopted to promote technological progress and achieve decreasing cost of the electricity-producing technologies; this decreasing adaptation was not part of the preceding Electricity Feed-In Act of 1991. Spain adopted a similar law in 1998.

The German law sets specific maximum prices paid by the distribution companies. The increased cost is passed on to all electricity consumers for each individual renewable energy technology, based on its annually decreasing real cost. The aim of the tariffs is to initiate a self-sustaining market for renewables and to create a critical mass through a large-scale market introduction programme. The incentives, in the form of a guaranteed market and higher set tariffs, thus create an artificial competition between emerging renewable technologies and conventional ones. These incentives are revised downwards periodically, decreasing 55 percent between 1991 and 2003 from 18.4 cents/kWh to 8.33 cents/kWh. As a result of this law, Germany today has the largest installed wind capacity in the world (mid-2003: around 12.5 GW).

In 2002, Brazil adopted a law to promote adoption of wind energy, photovoltaics, small hydro, and biomass. The law was designed to protect the national interest where the market alone cannot; its goal is to have renewable forms of energy providing 3000 MW, approximately 5 percent of all electricity consumption, by 2006.

A key lesson learned is that such laws lead to reductions in cost as production increases, as indicated in Figure 14. As cumulative investment in new capacity grows, the cost per unit comes down.

The challenges of sustainability are major ones. At the same time, there are hopeful signs. Clearly, energy can serve as a powerful tool for sustainable development. The Assessment shows that there are indeed combinations of resources and technologies that are capable of meeting most, if not all, of the sustainability changes simultaneously. The finding that there are measures related to energy that help address several major issues at the same time is highly significant, as it should add support for those measures from different groups in society. The decisive issues are not technology or resource scarcity, but the institutions, rules, and regulations needed to make markets work in support of energy for sustainable development.

Some governments and corporations have already demonstrated that policies and measures to promote energy solutions conducive to sustainable development work. The renewed focus and broad agreements on energy in the Johannesburg Plan of Implementation and at the eighteenth World Energy Congress are promising. The formation of many partnerships on energy between stakeholders at WSSD is another encouraging sign. A sustainable future in which energy plays a major positive role in supporting human well being is possible! ■

A sustainable future in which energy plays a major positive role in supporting human well being is possible!

BOX 10. ELECTRICITY CRISIS IN CALIFORNIA AND BRAZIL

Beginning in the summer of 2000, California suffered an electricity crisis that has caused many to doubt the wisdom of efforts to introduce customer choice into electric power markets or even of major restructuring of electricity systems. Other countries such as Brazil have also experienced problems of supply availability, and of extreme price volatility in electric power markets, as a result of efforts to privatise state-owned enterprises. In both countries, the crisis consisted of frequent blackouts and/or blackout warnings, and extraordinary volatility in wholesale prices.

From the standpoint of sustainability, the California crisis teaches a number of important lessons. First, California adopted a market design that did not value efficiency and load management appropriately. The dismantling of the regulated monopoly structure in California in the 1990s was accompanied by a significant drop in spending on energy efficiency, which cost California an estimated 1,100 MW in energy savings by 2000. This drop occurred because utilities, with state approval, reduced spending on energy efficiency in anticipation of retail competition, thereby departing from the historic California policy of taking into account both the market barriers to and the societal benefits from energy efficiency.

Second, the restructured California market did not permit energy efficiency and load management to participate on equal terms with new supplies. This flawed market design left the California Independent System Operator paying ten times more to buy power than customers would have been charged to save the same amount. The market mechanisms and metering devices necessary to allow the demand side of the market to respond to price signals are still being implemented.

Third, in anticipation of lowered prices from conventional sources in the new "market", California utilities in 1995 persuaded the Federal Energy Regulatory Commission to override a state requirement that they purchase 1,400 MW from renewable sources over the next few years. These renewable resources, together with improved energy efficiency, would have substantially mitigated the crisis.

Fourth, California citizens responded dramatically and successfully to the crisis by reducing their consumption by some 6 percent in the first half of 2001, showing the contribution that energy conservation can make in a crisis even when few advance planning and price incentives have been developed. The measures taken included intensive public information, rate incentives, and incentives for more efficient appliances, as well as an extensive conservation program by the state government itself. By underestimating the extent of the efficiency response and signing long-term contracts to ward off an extended crisis, California is now committed to paying apparently excessive prices for power that customers turn out not really to need, at least at the price they must pay for it.

Fifth, California has learned the need for continued state involvement in power supply management in order to assure that values the short-term market tends to ignore – such as reliability, price predictability, environmental impact, and the furtherance of renewable energy – are reflected in power procurement decisions.

More than 90 percent of Brazil's electricity comes from hydroelectricity. From 1995 on, as a result of increasing international interest rates and the declining investment capacity of the state, the Brazilian government initiated a process of privatising and liberalising the electricity market. Despite high expectations, investments in new electricity generation did not follow increased consumption. A modest rate of precipitation in the first months of 2001 caused a serious electricity shortage; in response, the government imposed a compulsory 20 percent cut for almost all electricity consumption that lasted almost a full year, to April 2002.

Source: P. Bradford in Goldemberg and Johansson, 2002, pp. 92–94