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**Wuppertal Institute for  
Climate, Environment and  
Energy**

# **Towards Sustainable Energy Systems: Integrating Renewable Energy and Energy Efficiency is the Key**



**Discussion Paper  
for the International Conference  
'Renewables 2004'**

Prepared by the  
Wuppertal Institute for Climate Environment Energy  
in the Science Centre North Rhine-Westphalia  
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# Executive Summary

## The Issue

Delivering affordable energy services from low-risk energy sources to the poor and raising the living standards for a growing world population is the ultimate goal of sustainable energy systems. Humankind has good prospects for reaching these ambitious goals by combining the inherent benefits of energy end-use efficiency with those of renewable energies. If *the demand side* is optimised through energy end-use efficiency, the increase of energy demand and costs can be kept much lower than with a “business as usual” strategy. The energy costs saved can be invested to accelerate the market introduction of the still expensive but in the long run more sustainable supply from renewable energies. Neither just shifting from traditional energy supplies to renewable energies nor investing only in energy end-use efficiency while neglecting the need to diversify the energy supply by renewable energies and cogeneration of heat and power can do the job alone: Integrating efficiency with renewable energies is the key to sustainable energy systems!

In the context of the International Conference Renewables2004 and its follow-up activities, this discussion paper has the objectives of *emphasising* integrated policies and management practices of energy efficiency and renewable energies and stimulating the debate on the removal of barriers and on international implementation strategies.

## The Challenge

*Today's patterns and trends* in overall energy demand and supply *are not sustainable*, neither in industrialised nor in developing countries. This can only change if the inherent benefits of efficiency and renewable energies are harvested through integrated strategies.

- Around 2 billion people still lack access to modern and affordable energy services, while the poor often pay the highest prices for energy sources.
- Many market and structural barriers are hindering both energy end-use efficiency and renewable energies, and especially their integrated use both at project and national strategy levels. Without a new policy approach of barrier removal, long-term, least-cost solutions for sustainable development will not be attained.
- Under business-as-usual projections, world primary energy demand is expected to at least double by 2050, with high investment costs and emissions and threatening risks of climate change, nuclear disasters and geostrategic conflicts on oil and gas.

## The Solution

Both energy end-use efficiency and renewable energies can reduce demand for risk-loaded fossil and nuclear energies, but *only if they are combined will they enable an affordable and risk-minimising path to sustainable energy systems*.

- Scenario analyses based on proven technologies and good policy practices show that energy efficiency in end use and supply can stabilise world primary energy demand by 2050. This enables renewable energies to provide 50 % of the remaining demand, thereby reducing world CO<sub>2</sub> emissions by 50 % compared to today's levels, while raising living standards and alleviating poverty in the South (Lovins/Hennicke 1999; IPCC/WBGU 2003).

- Framework conditions, institutional settings, incentive structures and the motivation of actors in developing and industrialised countries are all too often still oriented on traditional fossil and nuclear energy supplies. As far as the benefits of renewable energies are acknowledged by diversifying the energy supply, this strategy will be the more promising the more it is combined with energy efficiency.
- In all sectors (e.g. production, buildings, transportation, irrigation, households), a large but untapped cost-effective energy saving potential (between 25 and 85%) has been demonstrated (see Figure 2 below; WEA 2000). Using advanced efficiency technologies, innovative management methodologies (e.g. Demand-Side Management) and a bundle of proven policies and measures, barriers to least-cost energy services can be removed with low transaction costs.
- The net cost savings from energy efficiency can be used to accelerate market introduction and to “buy down” the initially higher cost of renewable energies. This is the case both from a macroeconomic perspective and for specific projects. In sum, it enables cost reductions through mass production and learning effects, making renewable energies more rapidly competitive with fossil and nuclear energies.
- Thus the integration of energy end-use efficiency and renewable energies creates more favourable conditions to reduce the demand for energy imports, to improve security of supply of energy services, to create local jobs and income, to raise living standards and thus to contribute to poverty alleviation.

## The Implementation

In developed as well as in developing countries, an effective *policy of integrating energy efficiency and renewable energies* requires:

- a change in basic concepts, methodologies and decision-making criteria in the energy sector: delivering least-cost energy services and substituting risk-prone energies by renewable energies should be given top priority;
- an energy policy aimed at reducing subsidisation and internalising external costs by introducing energy taxes step by step, so that, in the end, prices reflect the true societal costs;
- an appropriate combination of policy instruments aiming at encouraging cost-effective energy efficiency on the demand side;
- an appropriate combination of policy instruments supporting a broad implementation of renewable energies and combining the inherent benefits of efficiency and renewable energies;
- a supportive framework for the integration of energy end-use efficiency, co-/tri-generation of heat/cold and power, and renewable energies;
  - at macro level by including these three resources in overall national strategies and programmes and their evaluation — a process that should involve concrete and quantitative policy targets, based on an analysis of technologies, potentials, markets, and barriers, using methodologies of integrated resource and cost assessment;
  - at micro level by the implementation of motivation, information and training programmes (transfer of know-how, capacity building), economic incentives, financial instruments and a supportive legal framework for new actors in the market offering integrated energy efficiency and renewable energy solutions.

The general guideline should be to integrate energy efficiency components into renewable energy projects and develop least-cost implementation strategies for combined energy efficiency plus renewable energy options. Packages of policy instruments and measures must, of course, be *adapted* to a country’s specific natural, cultural and institutional circumstances.

Today, actors of *international technical and financial co-operation* usually support *either* efficiency or renewable options. In the future, support should focus much more on integrated energy policies and measures by

- supporting capacity building for integrated policy assessment and formulation, and knowledge management for good practice in integrated policies and projects;
- supporting integrated resource and least-cost assessment studies as a basis for political medium and long-term decisions;
- tailor-made implementation strategies taking into account the country-specific situation and developed in close consultation with all relevant stakeholders;
- inclusion of a positive framework for energy end-use efficiency programmes and services in energy sector reform and regulation;
- establishing or strengthening of advisory and implementation structures in the partner countries.

Furthermore, national and international *development agencies and banks* should change their guidelines and project concepts so that they fund and implement more and more *integrated projects* instead of projects targeting either renewable energies or energy efficiency. This includes developing more integrated projects eligible for CDM and Joint Implementation (JI). It will also be a task, e.g., for the GEF and for the World Bank's planned Consultative Group on renewable energies.

## Recommendations for next steps

Enormous potentials for energy end-use efficiency and for combining it with renewable energies exist as well as good practice examples of an integrated policy and integrated projects. The opportunity of Renewables2004 and its follow-up activities should be taken to *reach agreement*

- to make sustainable energy systems integrating energy efficiency and renewable energies an important subject for the discussion and implementation in the follow-up process and also in the WSSD follow-up;
- on rapidly intensifying international transfer — 'South-South' as well as 'North-South' — of know-how on the potentials, methods, programmes, and policies of energy end-use efficiency and their combination with renewable energies both at strategic level (national energy policy) and in practical implementation for buildings, factories, transport systems and all other investments in energy-using infrastructure and equipment, particularly if they are subjects of co-operation projects;
- on how such international know-how transfer should best be organised (e.g. through a co-ordinated knowledge management network);
- to devote a strongly increasing amount of resources and possible special programmes to energy end-use efficiency, renewable energies, and their combination with each other;
- that development agencies and banks should change their guidelines and practices to promote the use of energy efficiency and renewable energies and particularly their integration in each project and
- to make more projects that integrate renewable energy and energy efficiency eligible for CDM and JI, and to promote these types of project in particular.

Furthermore, all actors of international technical and financial institutions should co-operate more closely in the support and the implementation of national sustainable energy policy strategy integrating energy efficiency on the demand side with supply-side efficiency and renewable energies.

## The Issue in the context of Renewables2004

It is the main objective of the International Conference for Renewable Energies — *Renewables2004* — to prepare the ground for a global expansion of renewable energies, integrated into a broader strategy to create a highly efficient and sustainable energy future. The conference will also address key challenges in sustainable development such as access to affordable energy services for the poor and the protection of the global climate.

In the context of *Renewables2004* and its follow-up activities, this discussion paper has the objectives

- (1) of emphasising that renewable energies must indeed be *integrated* into a broader strategy connected in particular *with energy end-use efficiency* (also referred to as rational energy use) to create a highly efficient and sustainable energy future. We stress the fact that it is good policy to optimise the demand-side through energy end-use efficiency and invest the energy costs saved in the development of renewable energies, instead of just shifting from traditional sources of energy supply to renewable energies;
- (2) of demonstrating that the inherent *benefits of renewable energies* can be *maximised* and their main shortcoming, the still comparatively high costs, can be minimised, if the market introduction of renewable energies is combined with a more efficient use of energy. As an example, distributed power systems using renewable energies can reduce system costs (e.g. for transmission and distribution) if the electricity is used in a more efficient way at the same time. On the other hand, focusing only on supply-side investments, e.g. to create national wind power markets in a developing country, can hardly be justified with economic arguments as long as it is more cost-effective to invest into the efficient use of electricity to reduce the growth rate of electricity consumption;
- (3) of presenting *recommendations* for policymakers and stakeholders on *instruments and strategies* for achieving such an *integration* between energy end-use efficiency and renewable energies. These recommendations concern both the policy and the project level, and in particular the international *technical and financial* co-operation between industrialised and developing countries;
- (4) of identifying *open questions regarding the concrete implementation* of combining energy end-use efficiency with renewable energies at policy and project levels.

# The Challenge: Affordable and sustainable energy services for all

Today's patterns and trends in overall energy demand and supply are not sustainable, neither in industrialised nor in developing countries. It is likely that geostrategic conflicts on oil and gas, climate change, and nuclear risks will increase and reinforce each other unless energy policies and priorities change fundamentally.

According to representative business as usual projections (e.g. WEC 1999), world primary energy demand will double by 2050, causing an acceleration in global warming and requiring 16,000 billion US\$ of investment, 10,000 billion US\$ of which will be in power plants and networks, by 2030 (WEC 1999; IEA 2003), while still leaving hundreds of millions of people in developing countries without access to modern energies and basic energy services.

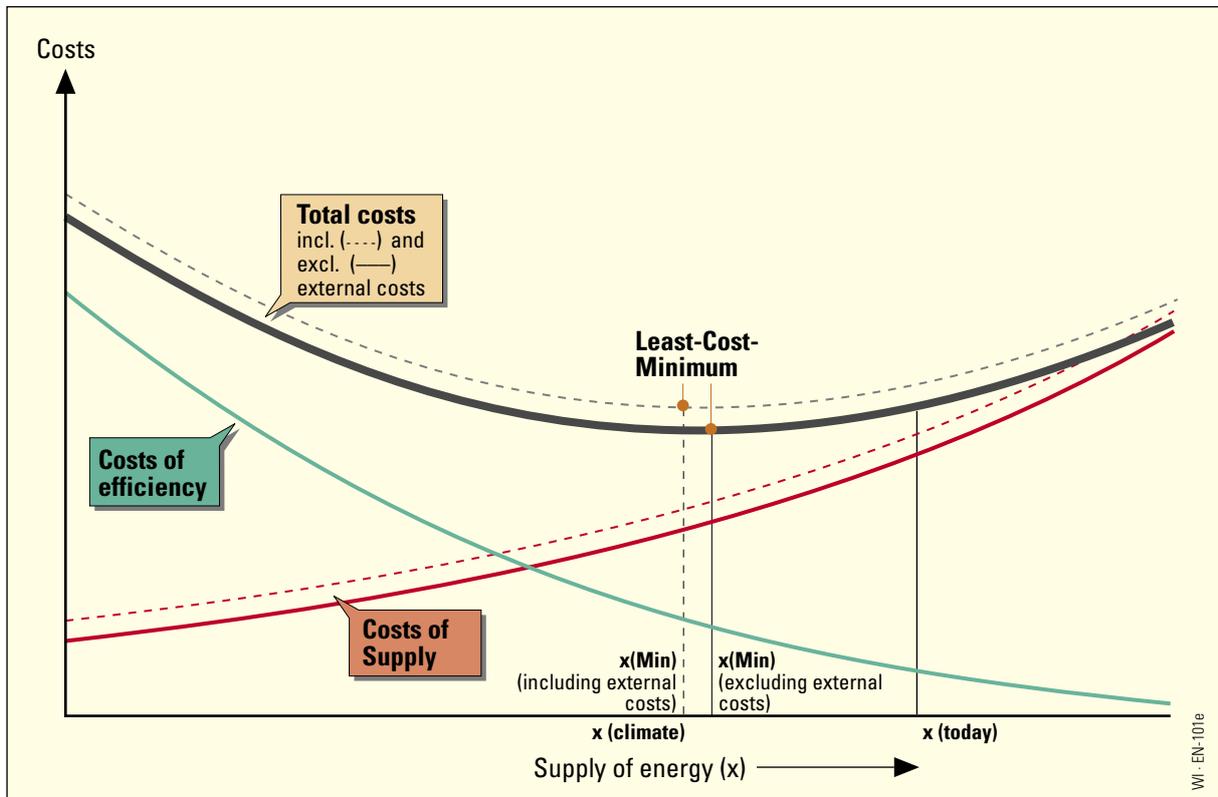
However, these unsustainable policies and trends can be changed, as has been demonstrated by long-term scenario analyses of sustainable energy systems (IPCC 2001, Enquete Commission 2002, WBGU 2003). One important lesson can be learnt from these studies: Only renewable energies combined with energy efficiency will suffice to solve the economic, social and ecological problems, and only if their synergies and complementary benefits are used in a much more systematic and integrated manner than today. It is the comparative advantage of advanced energy end-use efficiency to avoid energy-cost-intensive structures and lost opportunities in buildings, production processes and infrastructures on the demand side. These cost benefits can partly offset the still high prices of renewable energies at their market introduction stage. On the other hand, renewable energies offer promising long-run options for security of supply of energy services, income generation, rural electrification and poverty alleviation, which can only be realised if the energy bills are kept low and affordable for the poor by the efficient use of energy. This holds true for rural electrification, but also for investments into larger power plants based on renewable energies, like offshore wind parks or solar thermal power plants.

Promising steps forward, good practice and success stories based on best available technologies (e.g. for end use energy efficiency, co-/tri-generation of heat/cold and power (CHP) and renewable energies), have been demonstrated in many countries. Innovative framework conditions have been institutionalised to create markets for energy services and "green" energy supply.

What consumers really need are useful energy services such as cooking, heating and cooling, light, communication, power and motion. The use of energy is only a means to this end. Energy must, therefore, always be used in packages with specific technical equipment to provide the desired service — and this technical equipment can be inefficient or efficient. Therefore, in economic terms, it is not cheap kilowatt-hours that are often produced with high environmental, societal or health risks, but packages of efficient equipment and energy at least societal costs (including external costs) that should be the ultimate goal to satisfy the needs of the customers. When the external costs of fossil and nuclear energy are "internalised" by investing in more expensive renewable energies, the least-cost optimum for the provision of energy services is economically connected with the more efficient final use of energy (see Figure 1). In other words, extra investment for renewable energies has the same economic effect as an energy tax but leads to immediate emission reductions. And in both cases, it becomes even more cost-effective to save energy, and the least-cost minimum is at a lower level of energy consumption than without the "internalisation" of external costs.

Since the average level of energy use is unsustainably high in the North and many sectors of the South, there is also a dichotomy of energy waste — both in industrialised countries and in developing countries' cities and industries — and of energy poverty of the urban poor and in rural areas. This dichotomy is, however, also a point of departure in solving the problem. To say "the poor cannot save energy" is not even true for people who have no access to modern, grid-connected energies. In fact, the poor often pay the highest prices for energy sources (WEC 1999, 2001). When they use traditional biomass, kerosene or electricity from solar home systems, this should be done as efficiently as possible for economic and environmental reasons. In other sectors of developing economies (e.g. industry, buildings, transportation), energy efficiency should be an imperative too. The energy-saving potentials tend to be even higher than in industrialised countries, and because of this inefficient use of energy, the societal costs for energy

**Figure 1: The economic optimum of the total costs for energy services as a result of the substitutional competition ("trade-off") between energy supply and energy efficiency**



services in many developing countries are far too high. Therefore the high increase rates of energy demand in many developing countries can be reduced by investing into energy end-use efficiency, and often this option is much more cost effective than investing into additional energy supply.

There are many opportunities for renewable energy technologies — especially in combination with energy efficiency measures — to provide local benefits, and experience to date supports the conclusion that increased attention to and investment in renewable energy for productive uses would produce important benefits for the rural poor. A GEF review of thirty climate change projects has shown that local benefits are predominantly income and employment opportunities, legal and policy changes to enable increased access to new technologies at local levels, improved access to information and human capital training and skills transfer (GEF 2003). These local benefits can be enhanced when energy bills can be kept low by using the relatively expensive electricity, heat or cold from renewable energies in highly efficient technologies. But it should be stressed that local benefits — especially from combining renewables with efficiency — should be given more attention in project design and evaluation procedures. The evidence from available documents is that projects do not systematically target or measure a broad range of livelihood benefits, particularly in health and education. While most projects lack monitoring and evaluation procedures to enable them to specify income and employment benefits, a clear potential to combine poverty reduction with improved environmental management has been demonstrated. Project reporting practices have focused on outputs (e.g. number of installed solar home systems) rather than on outcomes/ impacts at community level. However, a cross-sectoral approach is important to integrate renewable energies and energy efficiency measures with activities in the agriculture, education, health, water, and rural development sectors.

Figure 2: Energy end-use efficiency potentials in developing countries

<b>Agriculture</b>			<b>Transportation</b>	
<b>Tractors</b>	up to	35 %	<b>Persons and goods</b>	10 - 35 %
<b>Irrigation</b>	up to	85 %	<b>Industry</b>	
<b>Soil cultivation</b>	up to	70 %		
<b>Buildings</b>			<b>Steel; Cement; Chemicals</b>	25 - 50 %
<b>Industry, Production</b>		50 - 60 %	<b>Pulp and Paper; Oil</b>	30 - 40 %
<b>Private</b>		50 - 70 %	<b>Steam; Electric Motors &amp; Drives</b>	20 - 50 %

Source: WEA, 2000

Energy intensive industries (cement, steel, paper):

Share of energy costs up to 20 - 30 % of total production costs

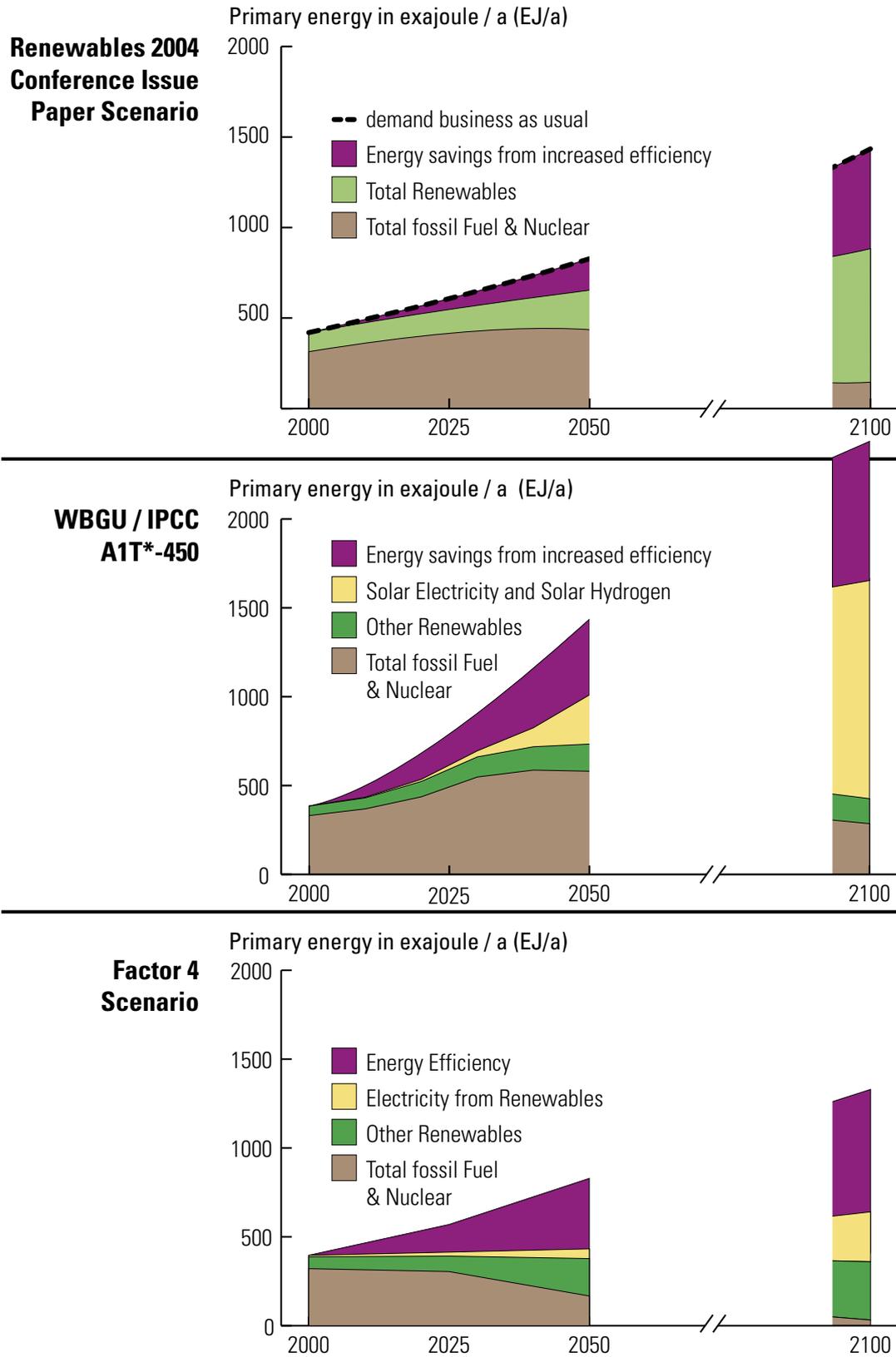
➡ Energy efficiency is the key for cost reduction !

➡ General barrier: subsidized energy prices !

There is an enormous cost-effectiveness potential for energy efficiency in energy end use and supply that can be swiftly realised by the reduction of market barriers to reduce transaction costs (cf. Chapter 4; Figure 2). For example, refrigerators sold on the EU market now use a third less energy than those sold in 1992 (Waide 2000), and the most efficient models even save two thirds for the same cooling service. Homes and office buildings with the same or higher comfort compared to traditional buildings have been built at moderate extra costs which require no, or virtually no, energy for heating or cooling in most of Europe's climates (Schnieders 2003). Optimisation of pumping systems can yield savings of up to 85%.

However, on a world-wide scale, this potential alone will not be sufficient to halve greenhouse gas emissions by 2050 while enabling a sustainable development and the necessary increase of energy services to improve living standards and to alleviate poverty. World-wide scenario analyses demonstrate that improving energy efficiency for 50 years by about 2 % p.a. (compared to about 1% p.a. in the past) could offset the increase in world primary energy demand by 2050, but — without fostering the market introduction of renewable energies at the same time — would not suffice to cut fossil energy demand and CO<sub>2</sub> emissions by half, as would be required to stabilise the world's climate (cf. Box on the next two pages).

Figure 3: Comparison of three sustainable world energy system scenarios



The starting point of the presentation given here is the scenario provided in the Renewables2004 Conference Issue Paper (CIP). It is contrasted with two other scenarios, the first of which is the “exemplary transformation path” developed by IIASA according to IPCC definition standards on behalf of the German WBGU (2003). The second one, the “Factor-4 path”, has been developed by the Wuppertal Institute and was originally published in Lovins/Hennicke (1999).

With a view to developments over the coming 100 years, these three scenarios bear two main differences as well as one common feature, the latter being the downward motion of fossil and nuclear fuels over the century, not only in relative but also in absolute terms. This is the implication of the (assumed) targets for climate protection and risk minimisation.

The first obvious main difference is the different amount of primary energy, which is assumed to be necessary to feed economic growth. Here, the WBGU scenario has a much higher energy demand than other two, leading to a higher residual contribution of fossil and nuclear fuels despite a tremendous development of renewables, with its corresponding high investments. In fact, the WBGU scenario needs to introduce costly carbon sequestration before 2050 to achieve the necessary reduction of global CO<sub>2</sub> emissions by half by 2050.

The second main difference is the contribution of energy efficiency. Here, both the CIP and the WBGU scenarios assume a much more moderate contribution than the Factor 4 scenario. The latter is built upon a bottom-up approach assuming an ambitious dissemination strategy for all existing most advanced efficiency technologies all over the world in 50 years, using the same regional differentiation and assumptions on the main drivers (population and economic growth) as the WEC B scenario. With these major assumptions it demonstrates the possibility of stabilising world primary energy demand by 2050 and halving the use of fossil fuels by increasing energy efficiency improvements from the historical rate of 1 % per year up to 2 % per year for the next 50 years. In contrast, the WBGU scenario only assumes an increase from 1 % to 1.6 % per year. The CIP scenario also has relatively low gains from energy efficiency in the next decades. These efficiency assumptions must be evaluated in the light of the Houston Statement of the WEC (1998): “Increased efficiency in the end use of energy offers the most immediate, largest and most cost-effective opportunity to reduce consumption and environmental degradation ...”

On the other hand, a diversification of the energy supply will not suffice to solve that sustainability dilemma either. Strategies relying on large energy supply infrastructures are too expensive and risk-prone, and their benefits for developing countries in terms of poverty alleviation, added value, and employment are quite small.

Nor will the so-called new energy carriers or options (hydrogen, “Cleanest Coal”, CO<sub>2</sub> sequestration and storage) provide complete remedy. Many technical, ecological and cost problems are not solved, so that it will take decades before they are fully developed, and they will only have limited application, particularly in developing countries, due their high costs.

A comprehensive and accelerated use of renewable energy sources is part of the solution for more sustainable energy systems. Raising the share of renewable energies in the energy systems in the North and the South within the next decades is a prerequisite for sustainable development. Scenarios show that even very ambitious market introduction strategies of renewable energies are not sufficient for climate mitigation and that 60 to 75 % of the necessary CO<sub>2</sub> reductions have to be contributed by efficiency within the next decades. (Enquete Commission 2002). In addition, bringing down the costs of renewable energies by technological and societal learning effects takes time. Therefore, supplying energy from precious renewable sources that is later wasted in inefficient buildings, industries, appliances, and cars will soon face limits of financing, nature, and social acceptance.

## The Solution: Integrating renewable energy and energy efficiency

The most promising way towards a sustainable energy system is, therefore, to integrate energy efficiency and renewable energies as much as possible and economically benign at project, regional and national level. Such integration will improve security of supply, minimise risk, keep the energy bills lower and thus enhance the ability to finance the necessary investments.

An integrated approach using a combination of energy efficiency and renewable energies adapted to a nation's natural, economic, and social conditions is crucial to delivering energy services at least costs, both for the national economy and for the individual household, building, or company.

Scenario analyses show that the overall long-term total system costs of energy with high shares of renewable energy in combination with increased energy efficiency will probably be about the same as those of business-as-usual scenarios. However, it must be noted that up to 2020 there will probably be a cost differential arising from fostering the market introduction of renewable energy sources, until the costs can be reduced through learning and mass production effects. This higher investment for a transition to a renewable energy system must be seen in conjunction with the local and global benefits renewable energies offer to society. One important global benefit is conflict prevention and security of supply of energy services; in particular, this benefit can be maximised when renewable energies are combined with energy efficiency.

Therefore, a drastic reduction of energy waste and energy costs in the cities and industries in developing countries is an important option to relieve the lack of energy services and to generate the national funds for the electrification in rural areas. For example, energy supply is often subsidised while there is not enough money to invest in the capacity additions required for economic growth and inefficient use of 'cheap' energy eats up financial resources. The strategy should be a gradual reduction of subsidies and adaptation of the energy prices to the full societal costs, while using a part of the extra income to fund energy efficiency programmes. Chapter 4 provides more detail on energy efficiency policies. The total bill (energy consumption times price) of consumers can thus be kept at about the same level as otherwise, but the nation will save money on energy imports and investments in urban energy supply. This money can be used to invest in rural energy supply, integrating energy-efficient end-use equipment (e.g. compact fluorescent lamps, efficient refrigerators, cookers (Grupp 2003), or TVs) from the beginning.

Creating a fair, level playing field for energy end-use efficiency in the energy markets through intensified competition with energy supply offers great opportunities for developing countries in particular. A growing level of energy services (living space, appliances, GDP) can be decoupled from energy inputs with lower societal costs if energy-efficient technology for the conversion and use of energy is integrated into the development process from the beginning.

Developing countries could thus actually leap-frog some of the outdated technology patterns of the developed world by using modern and most advanced energy-efficient technologies (e.g. for appliances, ICT technologies, efficient production processes or buildings). But leap-frogging only to renewable energies "from the North to the South" is not a sustainable strategy. Instead, "systems solutions" — integrating renewable energies with energy efficiency — are the most technically advanced and economically benign options. And even leap-frogging "from the South to the North" may be important in the future: While industrialised countries can afford to use expensive renewable energies within inefficient energy use patterns, developing countries should take the lead in minimising energy bills by allocating scarce capital to highly cost-effective and efficient technologies and system solutions.

A country's, a region's, or a city's total energy bill can thus remain affordable even with an increased use of renewable energy sources that require a higher level of investment provided that unnecessary waste of energy and money is stopped in other parts of the economy. Implementing the cost-effective potentials of energy efficiency can be used within an integrated national energy strategy to buy down the cost of renewable energies, benefiting from learning curve effects.

There are large potentials, and successful examples of integrated energy efficiency and renewable energy solutions do exist, but the integrated approach to thinking and design is still unfamiliar to many project developers, investors, and financiers that are used to approach projects either from the energy supply or the energy demand side; a multitude of further market barriers and frequently weak or lacking market players, such as energy service companies or energy agencies, require special forms of public support, communication, know-how transfer, and capacity building.

A favourable policy framework, motivated players (e.g. energy service companies), and adequate incentive structures are key. Energy policy must create a level playing field to stimulate competition between options of energy supply and of demand-side energy efficiency that provide the same level of energy services.

It is not the upfront price, but the total cost over the whole life cycle of an energy systems solution that is decisive for profitable investment decisions. Even if the investment costs of advanced technologies are higher at the beginning, the life-cycle costs (including running costs e.g. for power, maintenance and waste disposal), especially for efficient end-use technologies, are often cheaper compared to conventional technologies.

Therefore, the policy and regulatory framework must create supportive incentive structures, raise awareness for life-cycle cost (LCC) analysis and enable good practice projects and innovations to become the market standard. Innovative procedures of finance and for pre-financing efficient end-use equipment and renewables (e.g. energy service companies, micro credits, third party financing, BOT) are decisive in scaling up markets for energy services. The next chapter will provide more detail on this.

# The Implementation: policy options and strategies for strengthening energy efficiency and renewable energy markets

## National policy

Although significant economical opportunities to save energy costs exist, these *profitable potentials* are not realised due to various reasons and market barriers. Energy-efficient solutions often need a higher up-front investment than less efficient ones. Furthermore, awareness of the respective energy efficiency potential, special information and knowledge is needed in order to identify and apply energy-efficient technologies. This is often a problem for end-users and leaves them no choice but to apply the simplest, most inefficient technologies. Moreover, further *barriers* to energy efficiency on the demand side exist, in liberalised (restructured) markets as well as in non-liberalised markets with private or state-owned monopolies. Similar and other barriers hinder the diffusion and broad implementation of renewable energies. Finally, cost-effective solutions integrating energy efficiency measures and renewable energies in order to achieve their mutual benefits are hardly known to most market actors.

Therefore, it is the *task of energy policy* to reduce the many barriers to a sustainable, energy-efficient and cost-effective (least-cost) provision of energy services in order to *make energy efficiency and the integration of energy efficiency and renewable energies easy* for all market actors.

Policy has to ensure a *fair, level playing field* for competition between energy supply on one side and efficient final use of energy on the other as a base for *target-oriented reforms* of the energy sector towards a sustainable and competitive energy system. Appropriate policy interventions are needed in order to create a *supportive framework* and suitable *economic incentives* for the increase needed in energy efficiency and renewable energies. Policy instruments should thereby address *existing actors* and make it possible for *new actors* to enter the market, for example, public-private-partnerships, energy service companies, producers and project-executing organisations in the field of renewable energies and energy efficient technologies, integrating planners and architects in the building area.

*Recommendations for good policy* to promote the development of *renewable energies* are provided in an official paper for *Renewables2004*. We therefore provide some recommendations for policy to promote *energy end-use efficiency* here as a complement before focusing on the integration of both. This complement is necessary for the institutional settings of most OECD countries as well. Because of specific psychological barriers and market/policy failures, energy end-use efficiency seems to be “the forgotten pillar” of energy policies. This observation can be explained e.g. by the fact that energy efficiency options often

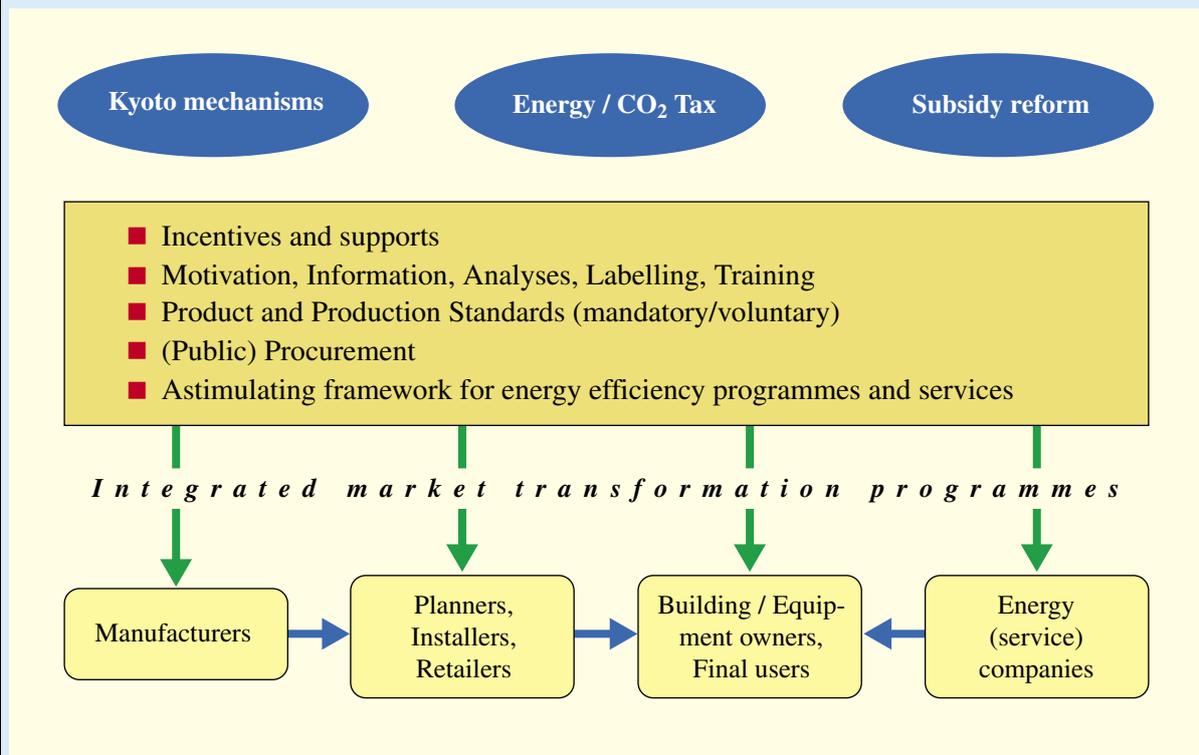
- are very diversified and supplied/used by a huge variety of actors, so that market transparency is low,
- lack a strong public lobby and the appeal of the “solar age”,
- cannot easily be visualised or demonstrated, but can only be measured and
- are perceived to be low-interest products.

An effective policy of integrating energy efficiency and renewable energies requires

- a change in basic concepts, methodologies and decision-making criteria in the energy sector: delivering least-cost energy services and substituting risk-prone energies with renewable energies should be given top priority;
- an energy policy aimed at reducing subsidisation and internalising external costs by introducing energy taxes step by step so that, in the end, prices reflect the true societal costs;

An effective *energy efficiency policy* requires a *combination* of more information, practical guidance, regulation, and financing support (“the sticks, the carrots, and the tambourines”). Figure 4 shows the basic package, which has to be adapted to the markets for energy-efficient buildings and equipment. Suding (2004) offers a good example of the analysis of actors in the market chain, barriers and incentives they face, and the appropriate policy mix to make action in favour of increased energy efficiency feasible, rewarding, and easy, for the example of the urban construction sector in China. Many of these policy instruments can also be adapted for the promotion of renewable energies, and for the integration of renewable energies and energy efficiency at project level.

**Figure 4: Innovative Energy Efficiency Policy – the Basic Package**



The basic task of energy policy is to ensure that *prices reflect the true societal costs* of energy by reducing subsidisation and introducing energy taxes, which reflect external costs. To evaluate the cost-benefit-relations between the supply and the saving of energy it is e.g. necessary not to compare subsidised electricity prices but the total systems costs (i.e., production, transmission, distribution, reserve capacity cost etc., including subsidies from the public budget) with the marginal costs of saving energy. Emissions trading, CDM or JI are additional general instruments that should support an increase in energy efficiency and its integration with renewable energies.

While most of the *specific instruments* listed in the box in Figure 4 directly address the final customer or the technology providers, energy policy can and should also involve energy service companies (ESCOS and other companies and agencies) as a *professional intermediary*. This is true regardless of whether the energy markets are open to competition or not. Such a professional intermediary role is needed between providers and customers of energy-efficient end-use solutions to overcome the multitude of barriers to end-use energy efficiency, and to reduce the transaction costs for energy efficiency measures. This will multiply the effects of economic and legislative instruments such as energy taxes, minimum energy efficiency standards and labelling.

Several *good-practice examples* from industrial, newly industrialised and developing countries exist that demonstrate how a supportive framework with adequate policy instruments can increase energy efficiency on the demand-side and its economic, social and environmental benefits, for example in Denmark (the Danish Electricity Saving Trust financing innovative energy efficiency programmes), in Germany (the German building code), in Japan (Top runner programme), in Thailand (e.g. energy labels for appliances) or in India (e.g. the new Energy Conservation Act) (cf., for example, Wuppertal Institute 2002, Wuppertal Institute 2003, Kaupp 2004, <http://www.e-parl.net/energy/index.htm>).

- an appropriate combination of policy instruments aiming at encouraging cost-effective energy efficiency on the demand side;
- an appropriate combination of policy instruments supporting a broad implementation of renewable energies and combining the inherent benefits of efficiency and renewable energies;
- a supportive framework for the integration of energy end-use efficiency, co-/tri-generation of heat/cold and power, and renewable energies
  - at macro level by including these three resources in overall national strategies and programmes and their evaluation. This process should involve concrete and quantitative policy targets, based on an analysis of technologies, potentials, markets, and barriers, using methodologies of integrated resource and cost assessment;
  - at micro level by the implementation of motivation, information and training programmes (transfer of know-how, capacity building), economic incentives, financial instruments and a supportive legal framework for new actors in the market offering integrated energy efficiency and renewable energy solutions.

Such a package of policy instruments and measures must, of course, be adapted to the specific natural, cultural and institutional circumstances in a country in order to reach a favourable mix of energy efficiency and renewable energy activities.

In conclusion, enormous potentials and good practice examples of integrating energy efficiency and renewable energies exist. However, policy makers, project executing organisations, investors and financiers are not used to the integrated thinking and planning of both elements, and to an integrated assessment of supply-side and demand-side options over their lifetime in general (least-life cycle cost thinking). A first step to increase awareness for the integration and the mutual benefits of both elements of a sustainable energy system would be to demand the integration of an energy saving component in as many renewable energy projects as possible as part of a capacity building process.

## Multilateral co-operation

New bilateral or multilateral alliances between industrialised, newly industrialised and developing countries could foster the integration of energy efficiency and renewable energies. International financial and technical co-operation should aim for the integration of energy efficiency or demand-side management measures in as many renewable energy projects and national energy strategies as possible. This will, at the same time, trigger an awareness-raising and capacity-building process. The GEF and the Implementing Agencies (World Bank, UNDP, UNEP) should take the lead in supporting new alliances for integrated “Efficiency-Renewables-Projects” (ERP) and strategies between the private sector and other stakeholders and between developed and developing countries.

All actors of international technical and financial co-operation should *support an integrated national energy policy strategy* by

- supporting capacity building for integrated policy assessment and formulation and knowledge management for good practice in integrated policies and projects;
- supporting integrated resource and least costs assessment studies as a basis for political medium and long term decisions;
- tailor-made implementation strategies taking into account the country-specific situation and developed in close consultation with all relevant stake holders
- inclusion of a positive framework for energy end-use efficiency programmes and services in energy sector reform and regulation.
- establishing or strengthening of advisory and implementation structures in the partner countries

Support for the integration of energy end-use efficiency and renewable energies at the project level is above all a subject for *technical and financial assistance agencies*. They should change their guidelines and practices so that they fund and implement more and more integrated projects instead of projects targeting either renewable energies or energy efficiency. Integration can be promoted starting from both sides, through advice and practical support to project partners in the developing world.

Guidelines could even stipulate that financial assistance to grid-connected renewable energy projects will only be granted if the host country government or the energy company invests to save the same amount of energy through energy end-use efficiency or through reduction of grid losses, as will be produced by the renewable energy generator.

The same recommendations hold for the *GEF and the implementing agencies*.

The design and results of successful policies for advancing energy efficiency and renewable energy from a variety of old and newly industrialised and developing countries can be used to spur adaptation and adoption of such policy approaches. A *knowledge management system* should be established to monitor projects and policies and assess innovative developments and the results of adaptive research so that these can be accessed on a world-wide scale and used for dissemination, replication, expansion and emulation of good practice. For this purpose, it may be worth considering a Knowledge Diffusion Network with a *co-ordinating unit* (e.g. the new Consultative Group on renewable energies at the World Bank) in co-operation with the monitoring and evaluation departments of the “GEF family”. This network would identify, systematise and publish relevant information related to lessons learned from successes and failures of projects and of good practice for scaling up and for market aggregation (“good policies”). A handbook for specific target groups (e.g. project developers) needs to be developed and updated every two years which provides high profile and authorised data on key technologies (supply and demand side), costs, financing, standard specifications, typical applications, list of relevant addresses etc.. (cf. TERI, 2004)

*International development banks* should also play an important role by supporting integrated projects in particular via information, inclusion in their own strategies and financing schemes. Although both elements are already part of some programmes financed by international development banks (e. g., the REEP programme by the ADB; cf. ADB 2003), concrete projects integrating energy efficiency and renewable energy measures are still rare.

Furthermore, *international NGOs, networks and initiatives* (e. g., e-parliament, REEEP, WSSD, etc.) should support integrated thinking, planning and implementation by dissemination of information, integrated strategies of their own and respective recommendations to policymakers.

Integrated projects offer new prospects for an *increased trade* of energy efficiency and renewable energy technologies and services (such as design, operation, and finance for projects), which could lead to a mutual process of achieving economies of scale and scope and initiating learning processes. Policy instruments promoting trade by collecting and filing suitable country information (e. g., preparatory market research), trans-national co-operation media-

tion, credit insurance (credit risk prevention, compensation for losses due to buyer insolvency), financing of trade receivables (factoring, securitisation), trade debt collection and other services (e. g., export credit insurance, surety bonds, etc.) should support international trade in these technologies and integrated international projects. For example, such projects should be explicitly mentioned in the environmental guidelines for *export credit guarantees* by a country, thereby overcoming the traditional differentiation of projects by sector within these guidelines (cf. Euler Hermes 2001 for the German guidelines).

As additional instruments, *CDM and JI* should be used to support concrete project integration of energy efficiency and renewable energy measures. Criteria for the eligibility of such projects must be developed. Then again, advice, support and guidelines to potential investors could promote such integration. Host countries could encourage or even require that JI/CDM investments into grid-connected renewable energy projects are only admitted if the investors will save the same amount of energy through end-use energy efficiency or through reduction of grid losses, as will be produced by the renewable energy generator. Of course, the host country must then allow cost recovery and a reasonable return for these extra investments from the saved energy costs via payments from the energy company as well.

## Recommendations for next steps

Enormous potentials for energy end-use efficiency and for combining it with renewable energies exist as well as good practice examples of an integrated policy and integrated projects. The opportunity of Renewables2004 and its follow-up activities should be taken to reach agreement

- to make sustainable energy systems integrating energy efficiency and renewable energies an important subject for the discussion and implementation in the follow-up process and also in the WSSD follow-up;
- on rapidly intensifying international transfer — ‘South-South’ as well as ‘North-South’ — of know-how on the potentials, methods, programmes, and policies of energy end-use efficiency and their combination with renewable energies both at strategic level (national energy policy) and in practical implementation for buildings, factories, transport systems and all other investments in energy-using infrastructure and equipment, particularly if they are subjects of co-operation projects;
- on how such international know-how transfer should best be organised (e.g. through a co-ordinated knowledge management network);
- to devote a strongly increasing amount of resources and possible special programmes to energy end-use efficiency, renewable energies, and their combination with each other;
- that development agencies and banks should change their guidelines and practices to promote the use of energy efficiency and renewable energies and particularly their integration in each project and
- to make more projects that integrate renewable energy and energy efficiency eligible for CDM and JI, and to promote these types of project in particular.

Furthermore, all actors of international technical and financial institutions should closer co-operate in the support and the implementation of national sustainable energy policy strategy integrating energy efficiency on the demand side with supply-side efficiency and renewable energies.

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