Policies to Change the World

Energy Sufficiency – Eight Policies towards the Sustainable Use of Energy

World Future Council

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Introduction

The fossil fuel age is facing serious challenges. Based on an energy mix comprising 85 % fossil fuels, the current energy consumption patterns of the developed world – coupled with increasing consumption by emerging countries – are accelerating the climate change crisis. Moreover, fossil resources are diminishing fast and energy shortages, economic instability and geostrategic disputes will only increase. These problems threaten the living conditions of future generations. Today, we may still be able to solve the energy and climate crisis, but the window of opportunity is closing fast. Fatih Birol, chief economist of the International Energy Agency (IEA), warned "we have to leave oil, before oil leaves us" (Guardian, 3 August 2009).

The World Future Council (WFC) places the interests of future generations at the heart of policy making. In the energy sector, the WFC has promoted feed-in tariff legislation for the accelerated deployment of renewable energy. If dangerous climate change and other crises are to be avoided, however, CO_2 emissions must still be reduced faster than can be achieved by replacing fossil fuels with renewables. The transition gap between now and a secure renewable energy future can only be bridged if we reduce our energy consumption to sufficient levels through improved efficiency and conservation.

The Climate Change Crisis

The Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC AR4, 2007) underlined the scientific consensus that climate change is real, man-made and accelerating at a dangerous pace. Within this century, in a business as usual scenario, temperature increases of up to 6°C above pre-industrial times will disrupt the global environment severely, causing massive movements of population, global conflicts and severe dislocation (Stern, 2009, p. 8). We are already experiencing increased incidence of extreme weather events, higher species extinction rates and a rapid melting of the Arctic ice shelf; sudden changes could become dramatic with irreversible effects. Burning of fossil fuels for energy generation is the major factor in global warming, accounting for more than half of total anthropogenic greenhouse gas emissions (IPCC AR4, 2007).

6 good reasons for energy sufficiency:

- Climate stability
- Energy security
- Cleaner air
- Lower energy costs
- Fair and just access to energy
- New economic opportunities

This booklet introduces the principle of energy sufficiency and explains why only efficiency and conservation can achieve the more ambitious energy reduction scenarios. It presents eight proven and effective policies to help reduce worldwide energy consumption:

- Energy audits for existing buildings
- Phasing out of incandescent light bulbs
- Energy performance contracting
- Incentivising combined heat/cooling energy and power
- The 'Top Runner' programme
- Carbon-negative cooking
- Smart metering
- Area road pricing

Naturally, these policies represent but a fraction of the many options available; their inclusion is based on the criteria of effectiveness and feasibility. In addition, the choice of policies covers different modes (regulatory, incentive mechanisms and information policies) and sectors (buildings, appliances, energy supply and transport). Each policy is supported by a brief case study showing that the relevant legislation can and does work.

This booklet aims to give legislators, decision makers and other stakeholders a compact digest of facts, arguments and a range of policy suggestions for reducing energy consumption. It cannot answer all questions pertaining to energy sufficiency, but it is intended as a useful summary of successful policies for a secure energy future.

The 'other' solution: Feed-in tariffs for renewable energy

The switch to renewable energy can solve the current problems of climate change, energy security and energy dependency. Global renewable energy resources could theoretically supply about 3,000 times our current global energy needs (Greenpeace/EREC, 2007, p. 60). Renewable energy is the fastest-growing sector in global power production and reached an estimated 280 gigawatts (GW) worldwide in 2007, an increase of 75% over 2004. Feed-in tariffs – a legal obligation on utilities to buy electricity from renewable sources at a premium rate – are widely regarded as the best policy mechanism for accelerating the deployment of renewable energies ultimately leading to a decentralised and secure energy future. They provide economic benefits as well – in 2008, Germany's renewable energy industry had a turnover of 24.6 bn euros and employed 280,000 people.

What is energy sufficiency?

In order to reach a real turning point in the patterns of our energy consumption, we have to address the issue from several angles. The developed world needs to radically cut its energy consumption, while the efficiency of energy services must also continuously improve as new technologies are deployed. At the same time, equitable access to energy for those 1.6 billion people who lack proper energy supplies must be facilitated as a matter of urgency.

The concept of *energy sufficiency* combines the technical aspects of increasing energy efficiency with the notion of 'having enough' energy – in terms of sustaining development and improving quality of life, comfort and wellbeing. New technologies alone cannot deliver the carbon cuts demanded by climate science in sufficient time. The cheapest and most rapidly deployable solution is for the developed world to consume less. This also starts us down the road of energy equality – the shift of energy use from North to South which is long overdue.

By contrast, the notion of *energy efficiency* relates solely to delivering energy services more efficiently, without changing energy consumption patterns to limit overall demand.

The 2000-Watt Society

There is much evidence that it is necessary to define overall limits on energy use – both in terms of 'what is sufficient for us' and in terms of what is good for the planet. To this end, Switzerland's 2000-Watt Society initiative proposed that each person in the developed world should cut their overall rate of energy use to no more than 2,000 watts by the year 2050. The concept can be scaled up from personal or household energy use to collective energy use by society as a whole.

2,000 watts is equivalent to average per capita consumption in Switzerland in 1960, and corresponds approximately to the current average rate of total energy use worldwide. By comparison, current averages are around 6,000 watts in Western Europe, 12,000 watts in the United States, 1,500 watts in China, 1,000 watts in India, and only 300 watts in Bangladesh.

How much energy do we consume?

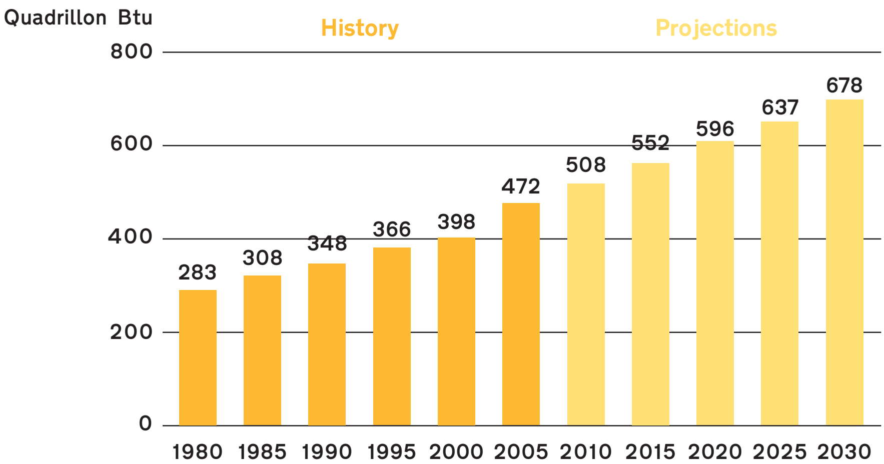
According to projections from the U.S. Energy Information Administration (EIA), the world's consumption of marketed energy is forecast to increase by 44 % from 2006 to 2030. In the 'business-as-usual' scenario, the EIA predicts that the world's energy consumption will rise by an average of 1.5 % per year (EIA, 2009, p. 7).

Why is consumption still increasing despite efficiency gains?

Population and economic growth will be the main drivers of increased energy demand for decades to come. For example, despite continuing improvements in average vehicle fuel efficiency, the sheer growth of the number of cars worldwide – from an estimated 650 million in 2005 to about 1.4 billion by 2030 – is expected to continue to push up total oil use for transport purposes.

Most of the overall increase – an estimated 85 % (McKinsey, 2008, p. 9) – will come from the developing world where access to affordable energy is needed to tackle poverty, raise living standards and power economic development. The World Energy Outlook (2008) of the IEA predicts China and India will account for over half of incremental energy demand by 2030.

World Market Energy Consumption, 1980–2030



"We assume that high quality life and satisfaction based on the two pillars of efficiency and sufficiency can be achieved even for a world of seven or more billion people."

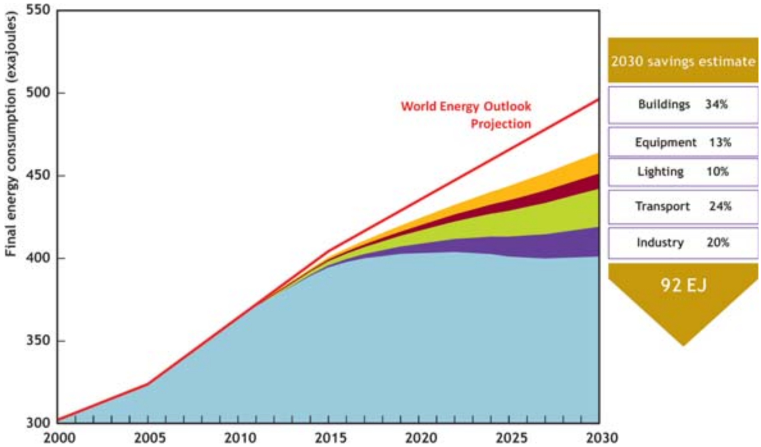
Ernst Ulrich von Weizsäcker,
Co-Chair of the International Panel for Sustainable Resource Management and Honorary Councillor of the WFC, et. al. in 'Factor Five' (Earthscan, London, 2009).

But why is growth still inextricably interlinked with increased energy use and more CO_2 emissions, even though it is widely acknowledged that this will accelerate climate change? The answer lies in the failure of markets to reflect the real costs of fossil fuel use. These costs (5–20 % of GDP; Stern, 2006, p. 143) are borne not by the producers or emitters of fossil fuel and fossil fuel-dependent products, but by those who suffer from the effects of climate change, in particular the poor and the future generations. The prices indicate that the incentives are wrong, leading to inefficiency and waste (Stern, 2009, p. 11). If, for example, energy costs in the office space market in London amount to only 1–2 % of rental costs (Guertler, Kaplan and Pett, 2005), tenants and owners do not have any incentive to invest in energy-saving measures.

Another barrier is known as the 'rebound factor', which refers to the fact that human beings tend to use more energy and buy more appliances, as more efficient appliances allow them to keep their energy bill stable. This situation is sustained by many industries, which 'invest' energy efficiency gains in more powerful appliances with more features. For example, today's refrigerators use about a quarter of the energy of 1972 models of the same size, but they are also likely to be twice or three times the size of 1970s models.

Barriers to energy sufficiency:

- Mantra of economic growth
- The rebound factor
- Wrong incentives
- Externalisation of costs involved in energy consumption
- Higher short-term investment costs
- Lack of information on saving potential
- Carelessness and lack of awareness



Moreover, market and behavioural imperfections often lead to increased energy consumption even when energy saving could be the more economical option. Initial investment costs for energy-efficient equipment are usually higher than the costs of the less efficient alternative. Even though the former products often have a longer lifetime and pay off after a couple of years, many studies show that end-users still tend to purchase less efficient products because of their financial inability to make a large investment or a lack of awareness of the problems related to energy consumption.

How much energy can we save?

Numerous reports have estimated the enormous potential of energy efficiency and energy conservation. Based on the 2008 World Energy Outlook (WEO) reference scenario, the IEA calculated that energy efficiency policies could significantly restrict growth in global energy consumption, preventing 92 exajoules of energy use by 2030.

Many would argue that these predictions are too conservative and that, with increased investments and more aggressive policies, savings could be even greater. According to a study by the German Aerospace Centre (DLR) carried out by the European Renewable Energy Council (EREC) and Greenpeace (2007), a 47 % reduction in worldwide final energy demand could be achieved by 2050 if the more ambitious of two low-energy-demand scenarios were applied. Several other studies have already calculated less frugal models of energy conservation which would help to ensure people use energy more sustainably.

How much will it cost?

Projects such as 'Factor Five' and the '2000-Watt Society' show that drastic improvements in energy efficiency are perfectly feasible.

Factor Five

When first published in 1997, *'Factor Four: Doubling Wealth, Halving Resource Use'* by efficiency pioneers Ernst von Weizsäcker (WFC Honorary Councillor), Amory Lovins and L. Hunter Lovins demonstrated how technical innovation could cut resource use in half while doubling wealth. The 2009 follow-up *'Factor Five'* examines the past 15 years of innovation in industry, technical innovation and policy. It shows how to achieve greater factor five or 80%+ improvements in resource and energy productivity and how to roll them out on a global scale to retool our economic system and massively boost wealth for billions of people.

In its G8 report, the UN Foundation calculated that doubling the rate of energy efficiency improvements (to 2.5%) would cost US$ 3.2 trillion, but would avoid US$ 3 trillion in supply investments and reduce consumer energy bills by around US$ 500 bn/annum by 2030 (UN Foundation, 2007, p. 14). For the US, a recent McKinsey study found that a holistic energy efficiency approach would yield gross energy savings in excess of US$ 1.2 trillion, more than double the US$ 520 billion that the authors deemed to be required until 2020 for upfront investment costs (McKinsey, 2009). These calculations do not include additional savings due to climate change mitigation.

The positive side of these investments is that they can become drivers of the economy. The energy efficiency sector provides for a wide range of new jobs and income opportunities including (among many others) advisors, auditors and constructors, engineers, building inspectors, scientists and researchers. It has been forecast that, by 2030 – in an 'aggressive scenario' – one out of every four (i.e. 37 million) workers in the US could be working in renewable energy and energy efficiency industries which could be worth up to US$ 4.3 trillion in revenue (ASES, 2007).

Policies towards Energy Sufficiency

Worldwide, hundreds of energy efficiency and sufficiency policies have already been implemented and have proven generally successful (IEA database at http://www.iea.org/textbase/pm/index_effi.asp). However, in order to reverse the steady increase in energy consumption, policy-makers around the world need to do much more. They must adopt comprehensive policies which tackle market imperfections and consumer ignorance. There is no one-size-fits-all solution. Instead, each country has to draw up a package of measures, tailored to its particular economic, political and social situation, aimed at overcoming barriers and imperfections. Regardless of these circumstances, the overall level of ambition must be strong and equitable (Stern, 2009, p. 105).

This task implies that a country's policies must address the problem at different levels to ensure that the relevant policy is effectively planned, enacted, implemented, financed, accepted and enforced. It must be possible to monitor, verify and report the desired outcomes of these policies.

The different policy approaches can be categorised by the level of state intervention. Often, certain features of each category must be applied to ensure a substantial effect.

"I would like to call for global collaboration on energy efficiency, renewable energy and sharing the earth's resources with equity."

C.S. Kiang, Founding Dean, College of Environmental Sciences, Beijing, and WFC Councillor

- **Regulatory** approaches entail direct state intervention by permitting or prohibiting certain features of products, technologies or activities. In this way the effectiveness of the policy can be maximised, provided that adequate enforcement mechanisms are in place.

- **Incentive mechanisms** can be either positive or negative, and they mostly consist of financial incentives. Examples are taxes, tax credits, preferential tariffs, subsidies and trading schemes. Lawmakers can regulate the level of effectiveness by adjusting the scale of the incentive.

- **Education and information** policies are aimed at educating users so that, being informed about the advantages and aware of the risks and problems associated with energy consumption, they can consciously choose to consume less energy. The incentive lies in conveying an understanding of the impacts on consumer behaviour: reduced costs, a healthier environment and lower CO_2 emissions, for example.

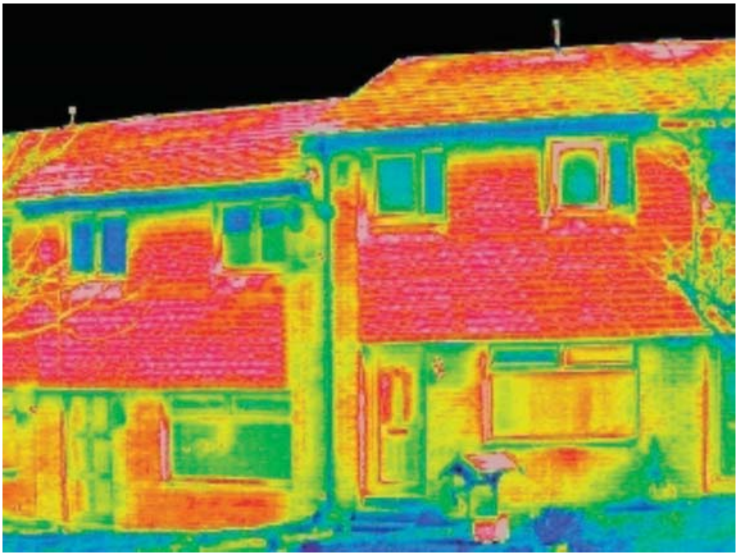
The following pages offer examples of proven energy policies that can help make a difference.

Energy Audits for Existing Buildings

Buildings account for 30–40 % of the world's energy consumption. The IPCC AR4 found that the global potential for cost-effective reductions in projected baseline emissions by 2020 amounts to 29 % in the residential and commercial sector (giving it the highest potential of all the sectors studied). They considered that substantial reductions in CO_2 emissions were possible "using existing, mature technologies for energy efficiency that already exist widely and that have been successfully used". In any given year, only 1 % of buildings are newly constructed. This makes existing buildings the biggest energy consumer of all the sectors, and effective policies which address the energy performance of existing buildings are crucial.

Policies must be designed in accordance with the local climate and in line with the specific construction and condition of each building. In addition to local standards, surveying every building individually can pinpoint the measures available for its optimisation.

The tool by which individual stocktaking of this nature can be achieved is a mandatory energy audit, the aim of which is to detect inefficiencies. It should be carried out by state-certified energy specialists. Audits will provide owners with technical and financial information about measures to reduce the energy consumption of their buildings. At best, the policy should make it compulsory to implement the audit recommendations, when they are evidently cost-effective. Placing audits and the implementation of their findings on a mandatory basis promises to be a useful policy, since audits provide information and clear guidelines on how to take action, but are often not acted upon if voluntary. Moreover, an extensive audit programme will raise general awareness of energy efficiency and create jobs for auditors and engineers and other workers in the building industry who implement the recommendations.



Key features of the policy

- Time period for mandatory audits
- Threshold size of buildings for which audit is mandatory
- Financial assistance for conducting audit
- Mandatory follow-up actions based on audit recommendations
- Financial assistance for follow-up measures
- Enforcement mechanisms

Key benefits of the policy

- Immense savings potential
- Cost savings for property owner
- Stimulus to behaviour change through education and awareness raising
- Individually tailored solutions for each building
- Job and business creation

Case Study: New York

According to a new State building law due to enter into force in 2013, the owners of tens of thousands of New York City's buildings larger than 50,000 square feet will be required to conduct energy audits and carry out energy efficiency retrofits. These audits will be mandatory on a once-a-decade basis and require retrofits that are deemed cost-effective, which is defined as a five-year payback period. Building owners would have control over what retrofits they choose to implement and could forego efficiency investments that are too costly.

Phasing Out Incandescent Lighting

Instead of incandescent light bulbs, more efficient technologies such as compact fluorescent lamps (CFLs) and light-emitting diode (LED) lamps can be used for lighting. Lighting can account for up to 20 % of a household's electricity consumption. The most efficient light bulbs consume 80 % less electricity than incandescent light bulbs. If all incandescent lamps worldwide were replaced by CFLs, CO_2 emissions totalling around 2,880 petrajoules and 470 Mt could be saved in 2010, rising to 700 Mt CO_2 in 2030 (IEA/AEF, 2008). Total household electricity consumption could be reduced by 10–15 % in industrialised countries. In addition, CFLs last up to 10 times longer than incandescent light bulbs, greatly reducing waste in the life cycle compared with incandescent bulbs. Even though CFLs still are more expensive than equivalent incandescent light bulbs, their durability and reduced energy costs make them cost-effective for the consumer after several hundred hours of use.

One drawback of CFLs is that they each contain about 4 milligrams of mercury, necessitating special recycling and – if broken – careful treatment. However, the amount of mercury used is still significantly lower than the mercury emissions of a coal plant to produce the electricity to light an incandescent light bulb (Worldwatch Institute, 2009).

Given the overwhelming economic and environmental benefits of new lighting technologies in comparison with incandescent bulbs, the best policy in this area is a command-and-control approach that prohibits energy inefficient lighting after a certain phase-out period. Whereas California and Australia have introduced minimum performance standards for lighting products, which effectively prohibit the most energy inefficient light bulbs, Cuba, Argentina, Venezuela, the Philippines, Switzerland and the European

Union have passed legislation to phase out the sale of incandescent light bulbs. The former approach has the advantage of being technology neutral, but it must ensure that the minimum standard is sufficiently stringent and effective. Setting a suitably long time period for the switchover (i. e. 2–5 years), in conjunction with provision for certain exceptions or special-purpose light bulbs, should ease the transition. In addition, the ban should go hand in hand with financial support for consumers who cannot afford the higher purchase costs of CFLs or LED lamps.

Key features of the policy

- Minimum performance standard for lighting above 25 lumens per watt
- Phase-out period of 2–5 years
- Recycling strategy for CFLs
- Financial assistance for citizens with limited economic resources

Key benefits of the policy

- High CO_2 mitigation potential
- High feasibility due to transition in industry
- Low investment costs for new technology
- High life-cycle cost savings for consumers

Case Study: Philippines

In 2008, the Philippines announced the phase-out of incandescent bulbs by 2010. The Asian Development Bank provided a $ 30 million loan enabling 13 million light bulbs to be given away and so mitigate the financial impact of changing to CFL bulbs. The switch will cut household lighting costs by as much as 80 % and will reduce the Philippines' annual greenhouse gas emissions by 2.2 million tons from 2010.

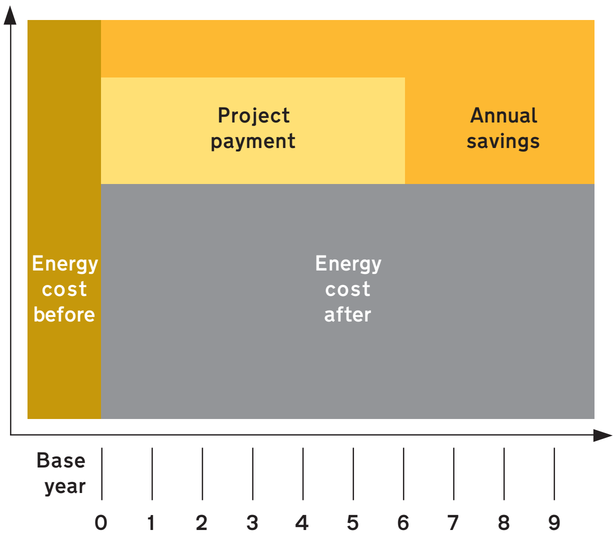
Case Study: Ghana

In order to tackle the country's power crisis, the Ghanaian government replaced six million incandescent lamps with the same number of CFLs free of charge. This way, the construction of new power generation capacity of 200–240 MW was avoided. Some 1,200 MWh hours were saved every day, amounting to 480 GWh per year. Peak electricity demand was reduced by 200 MW, thus stabilising the electricity grid. In addition, the use of expensive diesel and thermal generators was reduced. The government decided that it was far cheaper and faster to reduce electricity consumption by distributing CFLs free of charge than to construct one or two new power plants. Ghana was the first African country to take such action. The government's interim report shows that, by applying this measure, Ghana is saving US $ 3.3 million per month and US $ 39.5 million per year (assuming an oil price of US $ 120/bbl). The country is also saving 105,000 tons of CO_2 every year.

Energy Performance Contracting

Energy performance contracting is a market-oriented mechanism for overcoming the major barriers (i. e. investment costs) to delivering energy efficiency improvements in the building sector. Energy performance contracting can be used in any facility in which energy is used, including all types of buildings and industrial processes.

A contract is agreed with an energy service company (ESCO) to improve the energy efficiency of a building, with the cost savings paying for the capital investment required to make the improvements. Under the performance contract, an ESCO will examine a building, evaluate the level of energy savings that could be delivered, and offer to implement the project, assuring guaranteed savings agreed over a fixed term. The ESCO will then monitor performance and maintain the system to ensure that energy savings are achieved during the payback period. Provided that the energy services will create a net benefit for society, additional state funds can serve as a financial backup, especially for smaller ESCOs. Private-public initiatives are also an option.



ESCOs have been successful in many countries including the US, Canada, the Philippines, South Korea and various European states. A key factor in overcoming the barriers to their success and market development is the active role of government or local authorities as a customer, information provider, and promoter of ESCOs. Energy efficiency project appraisal, training, and designing specialised financial products are other measures by which the uptake of ESCOs can be accelerated.

Key features of the policy

- Implementation of standards for performance measurement
- Provision of information on and assistance to ESCOs
- Engaging in public-private partnerships
- Financial incentives, such as income tax rebates on payments made to ESCOs

Key benefits of the policy

- Reduced energy consumption and energy operating costs
- New business and job opportunities in finance and engineering
- Best market model for overcoming financial barriers to energy efficiency investment

Case Study: Berlin

The Berlin Energy Agency (BEA), founded in 1992 by the State of Berlin, is a public-private partnership (PPP). The BEA's mandate is the active detection of energy saving potential in industry and commerce, service companies, housing agencies and public institutions. The BEA has launched an energy saving partnership with the aim of bringing together building owners and ESCOs, and joining their negotiation process in order to agree on energy performance contracting to retrofit public and private buildings. The BEA organises tenders for pools of buildings. ESCOs filing a tender will have to guarantee energy savings by employing efficient and innovative technologies, such as CHP, heating control systems, or thermal insulation.

Within this programme, ESCOs have invested at least € 40 million in energy efficient equipment such as light fittings, energy control systems, and insulation in over 1,400 buildings.

In terms of savings, this amounts to € 10,164,848 and 60,000 t CO_2/year, or 26 % of the energy bills.

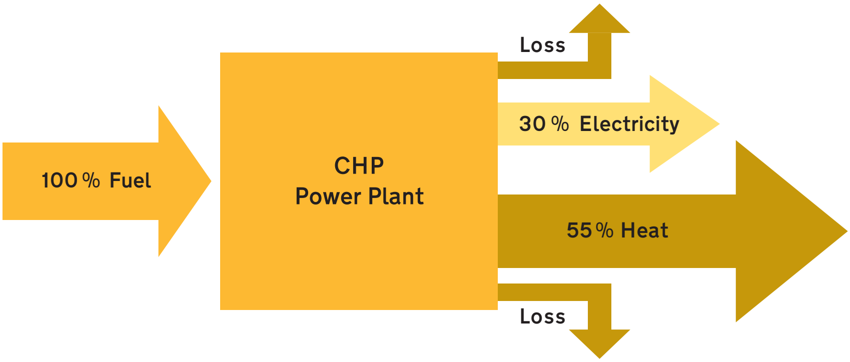
Incentivising Combined Heat/Cooling Energy and Power

CHP is the combined production of heat/cooling energy and power (i. e. electricity) in a single process. The heat produced during power generation is recovered, usually in a heat recovery boiler, and can be used to raise steam for a number of industrial processes, as well as to provide hot water for space heating (co-generation) and cooling (tri-generation).

Because CHP systems make extensive use of the heat produced during the electricity generation process, they can achieve overall efficiencies in excess of 70 % (and up to 90 %). In contrast, the efficiency of conventional coal-fired and gas-fired power stations is mostly below 40 %. CHP systems are most effectively installed onsite or in conjunction with centralised district heating systems for larger areas. CHPs are most valuable in urban areas.

With CHP currently accounting for only 7 % of world power generation, vast potential gains can be made both in energy and financial savings. According to the IEA, CHP could reduce GHG emissions by 10 % by 2030 and costs in the power sector by US $ 795 bn. In Europe, several countries – Denmark, Sweden, Finland and the Netherlands – already generate more than one third of their power using CHP.

A wide variety of policies are used to accelerate the transition from conventional condensing power generation to CHP technology. Two policy tools have proven effective – particularly in combination – in the implementation of CHP technology. Firstly, governments encourage investment in CHP plants by setting preferential prices for electricity from CHP plants (feed-in tariffs). Tariffs may vary by the size and energy source of the CHP plant. Secondly, urban planning policies are used to establish district heating and cooling networks.



Key features of CHP policies

- Assessment of local conditions, potentials and barriers for CHP
- Use of FITs for grid-delivered electricity from efficient, non-coal-fired CHP plants
- Utilisation of urban planning policies to prepare regional heating/cooling networks
- Dissemination of information, including R&D

Key benefits of CHP policies

- Deployment of CHP reduces waste of energy
- Savings in operating costs
- FITs provide effective investment incentive

Case Study: Denmark

In Denmark, CHP accounts for more than 50 % of electricity production, making this country the world leader in CHP use. The high coverage is the result of 35 years of continuous, sustained national and local policies. After the first oil crisis in the 1970s, the Danish government introduced a comprehensive heat planning system which identified areas suitable for district heating, these being connected to large-scale central CHP stations. Both cities and smaller communities were connected by heat transmission pipelines. Today, Denmark's ten largest cities have district heating systems where more than 95 % of the heat is produced in CHP plants. Outside the larger cities, small-scale CHP has been supported by heat supply planning, by close regulation of size, location and choice of CHP fuel and technology, and by economic incentives in taxation, subsidies and electricity tariffs. Investments of € 1.5 bn have led to CO_2 emission reductions of 4 Mt/a (Hammar, 1999).

The 'Top Runner' Programme

Transport, home appliances (in particular information & communications technology) are currently the world's fastest growing energy users (Worldwatch Institute, 2004), which makes it imperative to increase the energy efficiency of new versions of these products and their production processes. An especially innovative policy to continually drive efficiency improvements is the 'Top Runner' programme in Japan. This policy specifically targets the 'use phase' of energy-using equipment through market transformation.

Japanese Top Runner poster

This initiative is a regulatory policy instrument directed at manufacturers and importers of energy-consuming devices. It is a dynamic policy programme, constantly undergoing revisions which allow flexibility in deciding its scope (i. e. the range of product groups such as TVs, DVD players, categories of car), and level (i. e. the targets set for each product range).

The scheme works as follows: products are assigned to categories, and if a category meets certain criteria (products that are commonly used, require energy supply, and/or have potential for efficiency improvement), it can be included in the Top Runner programme. When a manufacturer produces an appliance with the best energy efficiency performance (during the use phase) within its Top Runner category, all other appliances are required to reach that level within an agreed time scale. If the required level is achieved or surpassed before the deadline, the process can start again, and the cycle continues. If manufacturers or importers do not meet the targets, the government makes recommendations, which can be enforced in the event of further non-compliance. What distinguishes Top Runner from other regulatory standard setting programmes is the process and active engagement of all relevant actors at the target value and timescale-setting stage. In this way importers and manufacturers buy into the scheme, share the regulatory burden, and are incentivised to make improvements beyond the agreed targets.

Key features of the Top Runner policy

- Targets product categories with the highest energy impact
- Dynamic scope and level
- Involvement of industry and private players
- Evaluation through weighted average method
- Combination with labelling and retailer assistance programme
- Governments must choose 'Top Runner' products in their procurement process
- In case of non-compliance, recommendations and enforcement by government is necessary

Key benefits of the Top Runner policy

- Transforms markets and raises public awareness
- Regulatory burden is shared as industry is part of process
- Incentivises continual improvement beyond the agreed targets and encourages competition
- Creates a culture of R&D and rapid market deployment
- Flexible, adaptable and responsive to technology or market changes

Case Study: Japan

At its launch in 1999, 11 products (air conditioners, fluorescent lights, television sets, copying machines, computers, magnetic disk units, video cassette recorders, passenger vehicles, freight vehicles, electric refrigerators and electric freezers) were originally included in the programme. It now includes 21 product groups, following the addition of space heaters, gas cooking appliances, gas-burning water heaters, oil-burning water heaters, electric toilet seats, vending machines and transformers (moulded), micro-waves, computer and DVD players.

So far, the policy appears to have worked well, and efficiency levels for each product category have seen improvements that exceeded the initial expectations. An added benefit of the programme is felt by consumers, in that their electricity bills are lower. The Top Runner scheme is expected to continue to generate major energy savings and to contribute considerably – estimates vary between 16 and 25 % – towards the achievement of Japanese CO_2 reduction targets for 2010.

Carbon-Negative Cooking

Developing countries consume little energy compared with developed nations; however, over 50 % of the energy they do use goes into cooking food. The average rural family spends 20 % or more of its income purchasing wood or charcoal for cooking, and 1.5 billion people still cook over open fires. As well as consuming wood, this process emits CO_2, CO, benzenes, aldehydes and other particles which constitute health risks. With certain innovative cooking stoves that employ pyrolysis, based on simple new technologies, rural families could cook food using crop residues and other biomass fuels without releasing CO_2 and other dangerous emissions. The biomass is burnt in a low-oxygen environment, so that emissions are largely restricted to hydrogen and water vapour. As a by-product, charcoal (or 'biochar') is generated. When biochar is added to soils, their fertility is enhanced, boosting agricultural productivity. A further benefit arises because biochar, which contains 70 %–80 % carbon, remains in soils for very long periods of time, storing carbon and helping to tackle climate change. It is a very stable and permanent form of carbon sequestration and storage.

Such stoves can save up to 40 % of the wood fuel normally consumed in open fires, and 25–35 % of the fuel consumed in typical traditional stoves. Advocates calculate that biochar applications to soil could remove several billion tonnes of carbon from the atmosphere each year (Lehmann, Joseph, 2009).

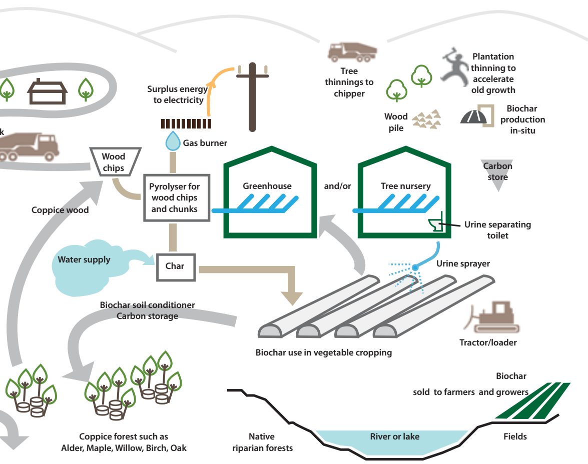
Although the production costs of pyrolysis cooking stoves are modest (at between € 10 and € 20), this still makes them unaffordable for most of the target market. National and regional governments must, therefore, support the local production, distribution and installation of biochar cooking stoves. In addition, there needs to be adequate instruction on the correct methods of using the stove and the resulting biochar.

Key features of the policy

- Start-up assistance and training of local manufacturers of biochar stoves
- Free distribution of biochar stoves to rural populations
- Instructions on how to use stove and biochar
- Informing rural population about biochar benefits

Key benefits of the policy

- Facilitates access to a cheap and healthy cooking method
- CO_2 reduction through carbon sequestration
- Conservation of wood
- Stimulus to local manufacturers



Case Study: Terra Preta

Though the idea of using biochar for climate change mitigation is relatively new, its origins extend back to the pre-Columbian era, when humans first made *terra preta* — meaning 'dark earth' in Portuguese — soils in the central Amazon basin. According to archaeologists, the rich, black and fertile *terra preta* was created by adding a mixture of bone, manure and charcoal to the otherwise relatively infertile soil over many years. The charcoal – believed to be the key ingredient – is 70 times more concentrated in *terra preta* than in surrounding soils and is formed by heating biomass in an oxygen-poor or oxygen-free environment. Some of the charcoal in Amazon *terra preta* soils has persisted for thousands of years, originating from people's first use of this practice. Its persistence has attracted the attention of research scientists who believe that it could be used to lock away carbon for a similarly long time in the future, keeping it out of the atmosphere where it acts as a greenhouse gas (from Kleiner, 2009).

Smart Metering

The smart meter is a two-way communication system which, via a display, provides precise real-time information on energy use in a building. It also sends the data back to the energy supplier. It helps decision makers, building managers and individual households, who are ill-informed about electricity consumption patterns (i. e. where, when and how much energy they use) and electricity-saving potential.

Smart meters have been proven to help cut energy consumption in buildings. By providing accurate real-time information to energy users (including private, organisational and industrial users) it empowers them to make evidence-based choices about how and why they use energy, resulting in reduced usage and cost savings. Research published in Finland (Capgemini et al, 2008) found that in-house displays brought average energy savings of 10.3 %. Energy sufficiency requires society to re-think how energy is used, and homes equipped with smart meters are an ideal place for this process to start. This could eventually lead to household energy budgets along the lines of the 2000-Watt Society model.

Governments should adopt a policy to install smart meters in all buildings within a given timetable. The installation costs can be split between electricity suppliers and customers. Electricity suppliers will make significant savings (see text box) and customers will retain ownership of the meters through joint payments. In the first instance, the supply companies will pay the upfront costs and recover their investment through billing in following years.

Smart meter technology is constantly evolving, but there are basic features that should be included in any metering policy, such as real-time digital displays showing energy use in standard units, cost in terms of actual rate use, daily total, and carbon emission. More detailed information (e. g. longer-term trends) could also be relayed to consumers through their energy bills. Information and technical standards should be agreed in consultation with consumer groups, academic and technical experts, and the electrical industry. Supporting these policies with information campaigns and advice services will maximise the impact of smart meters.

Key features of the policy

- Shared installation costs spread over time
- Regulated common design features (information displays and installation hardware)
- Installation timetable
- Legislation on meter ownership, access to data, and transfer rights with changes to electricity supplier
- Indication of maximum energy budgets per day/month/year

Key benefits of the policy

- Reduces energy use and carbon emissions
- Promotes behaviour change and empowers individuals through knowledge and information
- More accurate bills save money for both consumers and suppliers
- Paves the way for demand response management and variable tariff rates
- A building block for the introduction of smart grids

Case Study: Italy

The world's first large-scale smart metering programme was launched by the Italian utility ENEL in the 1990s. Between 2000 and 2005, ENEL deployed smart meters to its entire customer base. The cost of replacing 30 million electromechanical meters with electronic AMR devices and of establishing a new information and communication infrastructure (based on PLC technology) was about € 2 billion. ENEL's main objective was to reduce 'non-technical losses' (i.e. theft) and to be able to effectively control contracted power (which was not feasible with the previous electro-mechanical meters). According to ENEL's business plan, the associated savings of € 500 million per year justified the large investment and had a pay-back period of less than five years.

Area Road Pricing

Transport emissions are one of the fastest-growing sources of greenhouse gases, particularly in developing countries. In populated areas, traffic congestion is a huge issue and not only causes greenhouse gas emissions but also increases other pollution problems, damages property, leads to lost time and is detrimental to the overall standard of living. For example, the cost of congestion is estimated at between £20 and £30 billion per year in Britain (Goodwin, 2004, p. 2) and 4.4% of GDP in Korea. Road space in populated areas becomes a scarce commodity, which should be shared in a sustainable and fair way. At the same time, modes of transport should be shifted to low-carbon options, such as public transport, cycling and walking.

Area road pricing schemes (also referred to as congestion charging) are effective and equitable policies to work towards these objectives. The general idea is to levy a charge on motor vehicles if they enter a restricted area with high traffic volumes (such as a city centre). Thanks to modern technologies, these charges can be levied electronically and drivers with in-vehicle units do not have to stop at entry points. Technology also allows the introduction of different rates depending on peak and off-peak hours and the vehicle's relative emissions. In Singapore, the electronic system adjusts rates as frequently as three times a month with a punitively high charge for the peak 30 minutes each day. Exemptions or preferential rates for fuel and CO_2-efficient cars can be integrated, but must be based on objective criteria (e. g. CO_2 emissions) and not on specific technologies (e. g. hybrid car).

The scheme must be complemented with a well-functioning public-transport network and an effective enforcement system. Moreover, the income from the scheme should be allotted to alternative low-carbon transport modes. The revenues can be used to create cycle and bus lanes, subsidise public-transport fares or establish public bike rental schemes. In this way, car drivers are not merely burdened with another charge; the public are also offered healthier and cleaner alternatives.

Key features of the policy

- Levying of charges on motor vehicles in dense traffic area
- Different rates of levies based on time of use and emissions of vehicle
- Earmarking of revenues for improvement of public-transport and cycling infrastructure

Key benefits of the policy

- Problem-oriented traffic reduction
- Switch to low-carbon transport modes or off-peak hours
- Reductions in CO_2 emissions, pollution, noise, time loss, etc. leads to improved overall living standards in cities

Case Study: London

In 2003, former London Mayor Ken Livingstone announced his intention to introduce congestion charging in London's city centre. His view was that all Londoners would benefit from lower pollution levels, while faster-flowing traffic would make bus journeys more predictable and encourage people to use buses. The initial charge of £5 per day has been raised to £8 per day; exceptions exist, inter alia, for hybrids and electric cars.
Despite initial widespread opposition, traffic levels have been cut significantly in the congestion zone. Vehicle hours saved per day are estimated at 36,800 hours. In the zone area, the distances travelled on charging days have been reduced by almost 20%. Total annual petrol savings amount to 50 million litres. £210 million in revenue is generated each year, whereas the equivalent annual costs – if investments are depreciated over 10 years – are put at only £25 million (Evans, 2007).

Conclusion

Many of these policy proposals have been implemented successfully in various countries. However, these countries are outnumbered by those that have not taken up the opportunity of adopting policies such as these. What this booklet shows is that policymakers do not have to reinvent the wheel when it comes to facilitating access to affordable and efficient energy services, but can implement tried-and-tested examples and find feasible tools to reduce energy consumption and CO_2 emissions.

These examples show that energy sufficiency is a global issue that has been addressed in a number of ways by policy-makers and governments around the world. Not all the policies will be suitable for every region, but each country should be able to select a few of the ones presented here and apply different design options to tailor the policy to local needs.

If a given policy is to be successfully adopted and implemented, it is important to ensure the broadest possible involvement on the part of different levels of government, civil society, business, academics and other stakeholders. As with every bold policy move, however, not everyone will be in favour. Policymakers should maintain their resolve to do what is right for their country or community, even in the face of opposition from certain interest groups. The long-term consequences of not taking action, to the detriment of future generations, need to be highlighted. Nevertheless, the policies presented here do offer enough advantages to the present generation to persuade us to act. We hope this booklet provides the advice, examples and arguments required to help initiate this legislative process.

More information and examples can be found at our Policy Action Climate Toolkit (PACT) website: **www.onlinepact.org**

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References

ASES, 2007. American Solar Energy Society, Defining, Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century.

Capgemini et al, 2008. European Energy Markets Observation 2008.

Challen, 2009. Too little, too late – the politics of climate change, Hove.

Darby, 2007. Enough is as good as a Feast – Sufficiency as a Policy. ECEE 2007 Summer Study, p. 111–119.

Friedmann, 2008. Hot, Flat and Crowded. London.

Goodwin, 2004. The economic costs of road traffic congestion. Discussion paper. The Rail Freight Group, London, UK.

Energy Information Administration, 2009. International Energy Outlook 2009. May 2009, Washington D.C. Available at: www.eia.doe.gov/oiaf/ieo/index.html (last visited 24 July 2009).

Evans, 2007. Central London Congestion Charging Scheme: ex-post evaluation of the quantified impacts of the original scheme. Available at http://www.tfl.gov.uk/assets/downloads/Ex-post-evaluation-of-quantified-impacts-of-original-scheme-07-June.pdf (last visited 16 July 2009).

Gege (ed.), 2008. Das große Energie- und CO_2-Sparbuch. 1001 Tipps für Haus, Garten, Büro und Freizeit. Hamburg: B.A.U.M., 2008.

Girardet, Mendonça, 2009. A Renewable World. A Report to the World Future Council. Foxhole 2009.

Greenpeace, European Renewable Energy Council (EREC), 2007. Energy [r]evolution. Available at: http://www.energyblueprint.info/fileadmin/media/documents/energy_revolution.pdf (last visited 2 September 2009).

Guertler, Kaplan and Pett, 2005. Valuing low energy offices – the essential step for the success of the Energy Performance of Buildings Directive. Proceedings of the 2005 ECEEE Summer Study, Mandelieu, May 30 – June 3, Stockholm.

Hammar, 1999. The case of CHP in Denmark – and perspectives to other countries. OECD workshop September 1999. Available at http://www.oecd.org/dataoecd/30/59/2045811.pdf (last visited 2 September 2009).

Hamrin et al, 2007. Review of renewable energy in global scenarios.

IEA, 2003. Creating Markets for Energy Technology, Paris.

IEA, 2009. World Energy Outlook 2008, Executive Summary, Paris.

IEA/AEF, 2008. Promoting Energy Efficiency Investments. Case Studies in the residential sector, Paris.

IPCC AR4, 2007. Technical Summary. In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O. R. Davidson, P. R. Bosch, R. Dave, L. A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Jowit, Wintour, 2008. "Cost of tackling global climate change has doubled, warns Stern", in The Guardian, June 26, 2008.

Lehmann, Joseph (eds.), 2009. Biochar for Environmental Management. London, March 2009.

McKinsey & Company, 2008: Fuelling sustainable development – the energy productivity solution. Available at http://www.mckinsey.com/mgi/publications/fueling_sustainable_ development.asp (last visited 2 September 2009).

McKinsey & Company, 2009. Unlocking Energy Efficiency in the U.S. Economy. McKinsey Global Energy and Materials, July 2009. Available at www.mckinsey.com/USenergyefficiency (last visited 14 August 2009).

Kleiner, 2009. The bright prospect of biochar. Nature Reports Climate Change, 21 May 2009.

Kutscher (ed.), 2007. Tackling Climate Change in the U.S.: Potential Carbon Emissions Reductions from Energy Efficiency and Renewable Energy by 2030 (Washington, DC: American Solar Energy Society, 2007), pp. 3, 10, 34–35.

Nordqvist, 2006. Evaluation of Japan's Top Runner programme. Within the framework of the AID-EE project, July 2006.

Santa Barbara, 2009. Can Biochar save the World? Peace Magazine Apr–June 2009, p. 8. Available at http://archive.peacemagazine.org/v25n2p08.htm (last visited 2 September 2009).

Sorensen, 2008. Seven Wonders for a Cool Planet, by Eric Sorensen and the Sightline Institute (Sierra Club Books, May 2008).

Spratt & Sutton, 2008. Climate code red: the case for emergency action. Carlton North.

Stern, 2006. The Economics of Climate Change – The Stern Review, Cambridge.

Stern, 2009. A Blueprint for a Safer Planet, London.

Taipale (ed.), 2007. Buildings for a Better Future. Best Policy Practices. Marrakech Task Force on Sustainable Buildings and Construction, Ministry of the Environment of Finland.

United Nations Foundation, 2007. Realizing the Potential of Energy Efficiency. Targets, Policies, and Measures for G8 Countries, Expert Report.

Von Weizsäcker, Hargroves, Smith, Desha and Stasinopoulos, 2009. Factor Five – Transforming the Global Economy through 80 % Improvements in Resource Productivity. London, upcoming in November 2009.

World Energy Council, 2008. Energy Efficiency Policies around the World: Review and Evaluation.

Worldwatch Institute, 2004. The State of the World 2004. Available at http://www.worldwatch.org/node/1043 (last visited 2 September 2009).

Worldwatch Institute, 2009, Lighting an Efficient Future, Minus the Mercury. http://www.worldwatch.org/node/5757 (last visited 24 August 2009).

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Energy sufficiency aims to deliver energy services more efficiently, while also changing energy consumption behaviour to reduce overall demand. At the same time, equitable access to energy must be facilitated as a matter of urgency.

This booklet presents eight proven and effective policies to help make the world more energy sufficient:

- Energy audits for existing buildings
- Phasing out incandescent light bulbs
- Energy performance contracting
- Incentivising combined heat/cooling energy and power
- The 'Top Runner' programme
- Carbon-negative cooking
- Smart metering
- Area road pricing