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THE BENEFITS OF ENERGY EFFICIENCY – WHY WAIT?

The benefits of energy efficiency go well beyond reducing greenhouse gas emissions. Energy efficiency will lead to massive global cost savings. Energy efficiency improvement can play an important role in reviving economic growth and put the world on a sustainable development pathway.

A report brought together by Ecofys, commissioned by Philips
for the United Nations Climate Change Conference
Doha, Qatar, 26 November – 7 December 2012.

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Utrecht/Eindhoven, The Netherlands, November 2012

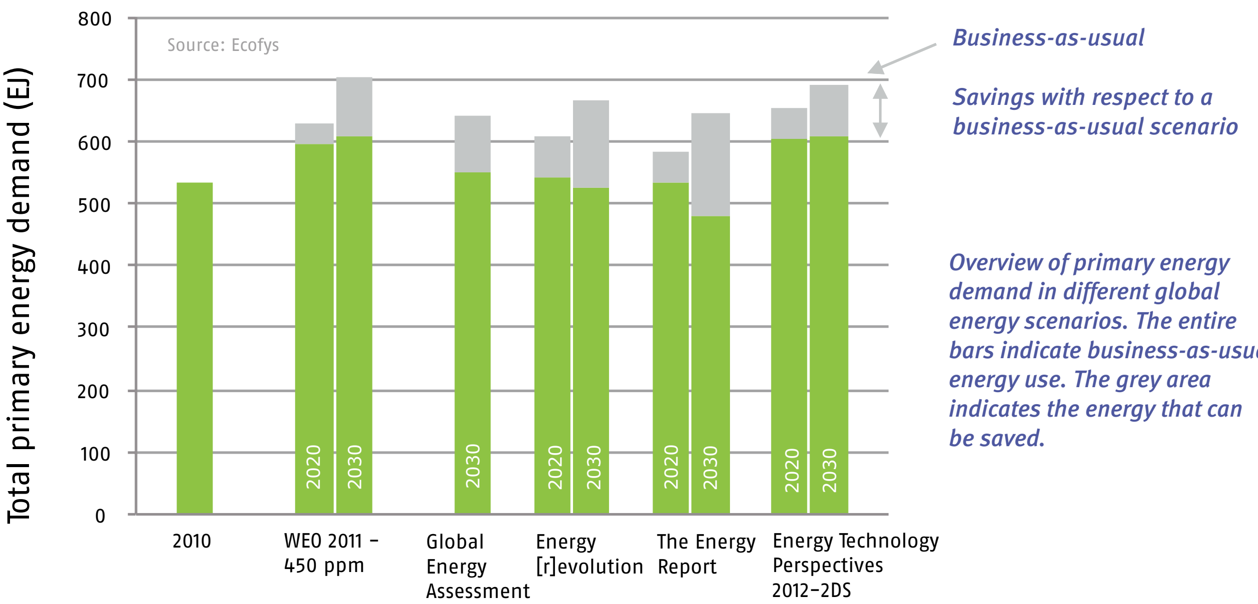
The benefits of energy efficiency – why wait?

Improving energy efficiency globally leads to many benefits. First and foremost, improved energy efficiency of equipment, buildings, vehicles and industrial processes will lead to a reduction of the use of electricity, heat and fuels. This will save large amounts of money. Moreover, benefits exist for employment, climate change abatement and the overall sustainability of our energy system.

The aim of this report is to estimate the scale of these benefits, based on assessments from the world's most authoritative organizations in this field. In addition, we provide some indications on how even greater improvements in energy efficiency could be stimulated.

In 2020, energy efficiency can save up to 10% of primary energy compared to a business-as-usual development pathway. In 2030, this increases to 20%.

- Potential savings in global primary energy use range between 35 and 65 EJ in 2020 and between 65 and 140 EJ in 2030 for the various scenarios[I].
- We can nearly offset the global growth of energy use caused by increasing economic activity.



Overview of primary energy demand in different global energy scenarios. The entire bars indicate business-as-usual energy use. The grey area indicates the energy that can be saved.

Energy efficiency will save on our operational costs: it can reduce global fuel bills by 1900 billion US$ per year in 2020 and by 3100 billion US$ in 2030.

- Improved energy efficiency will obviously lead to a decrease of energy costs. Saving electricity, heat and fuels will lead to reduced expenditures on coal, oil and natural gas amounting to 700 billion US$ by 2020 and 1700 billion US$ by 2030[II].
- In addition, a reduction of global energy demand will have a decreasing impact on global energy prices, reducing energy costs even further. These indirect energy cost savings will exceed direct cost savings in 2020. Decreased fuel prices will lead to an additional decrease of the global energy bill by 1200 billion US$ by 2020 and 1400 billion US$ by 2030[III].

Energy efficiency will also save on capital costs. For example, energy efficiency improvement can economize 1250 – 2500 billion US$ in capital investments in power production infrastructure by 2030.

- The implementation of energy efficient LED lighting alone could reduce current electricity demand with nearly 1300 TWh, i.e. the construction of 640 medium-sized power plants can be avoided[IV].
- Improving efficiency of electricity use with an additional 1-2% per year will reduce electricity demand with more than 5,000 to 10,000 TWh by 2030, which is the equivalent production of 2,500 to 5,000 medium sized power plants. The associated capital investments economized total over 1,250 – 2,500 billion US$, leading to substantial relief for budgets in many countries in the world[V].

Investing in energy efficiency can create more than six million jobs by 2020.

- While investing in coal-fired power plants creates about 110 jobs per TWh of electricity generated, energy efficiency measures could create 380 jobs per TWh electricity saved[VI].
- Improved energy efficiency has direct and indirect impacts on employment. Jobs are created directly in manufacturing and installing efficient equipment, insulating buildings etc. But there is also an indirect effect: energy efficiency saves costs and frees up money for other consumption and investment[VII]. Both effects together lead to an estimated employment effect of over six million globally[VIII].

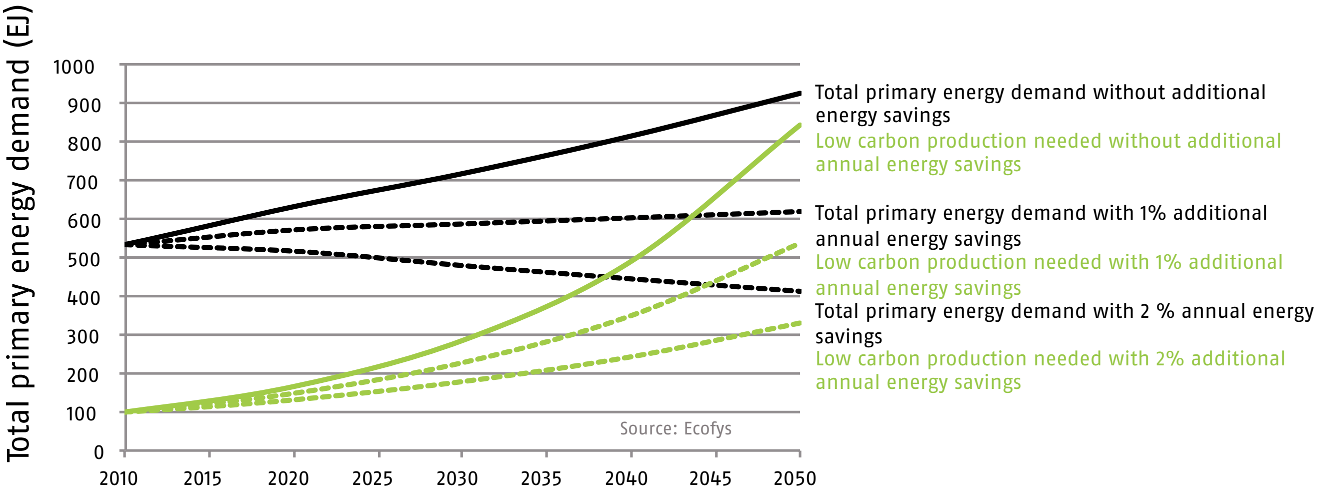
Energy efficiency can bridge a substantial part of the greenhouse gas emissions gap by 2020.

- The "emissions gap" to be bridged in 2020 between a "business-as-usual" development pathway and a pathway compatible with a maximum temperature increase of 2 °C is 14 billion tonnes CO_2e[IX].
- Energy efficiency improvement can avoid 5 billion tonnes CO_2e of annual greenhouse gas emissions by 2020, which is more than one third of the estimated gap[X].

Energy efficiency makes the long-term transition to a sustainable energy system much easier.

To achieve a greenhouse gas emissions pathway compatible with a maximum temperature increase of 2 °C, substantial reductions of greenhouse gas emissions are necessary, e.g. by attaining a reduction of 80% of current emissions by 2050[XI]. Such deep emission reductions can be achieved with much less effort if energy efficiency is improved substantially. This is illustrated in the figure below[XII].

- Without energy efficiency improvements beyond business-as-usual, more than 700 EJ of low carbon primary energy production has to be added by 2050.
- In case of an additional energy efficiency improvement of 2% annually, this amount is reduced to 230 EJ of low carbon primary energy production.



Overview of the development of primary energy demand for different rates of energy efficiency improvement. The green lines indicate the low-carbon energy production that is needed if we want to reduce greenhouse gas emissions by 80% (relative to current emissions) by 2050.

The road ahead

While improving energy efficiency obviously has many benefits, the progress over the last decade of energy efficiency is still limited compared to its potential[XIII]. To take energy efficiency to the next level, action is needed.

The role of governments: standards and prices

National governments can play a key role. First of all they can set standards for energy efficiency. Many governments have already set standards for energy efficiency, enhancing the overall performance of the subjected appliances:

- In the past decade, the fuel economy of new passenger cars has typically improved by 15 to 35 % in many regions in the world[XIV].
- Many countries (for example EU27, US and China) have already effectively banned incandescent lamps or announced a ban, guiding the market to go for alternatives with up to 80% lower electricity consumption[XV].
- Electrical appliances, like refrigerators and washing machines have strongly improved their energy performance[XVI].

Secondly, energy prices should reflect the real costs of energy. The International Energy Agency has consistently made the argument that global energy subsidies are high and removal of these subsidies is pivotal in the transition to a sustainable and efficient energy system[XVII]. In addition, internalization of external costs (e.g. through emission trading systems and energy taxation) is needed to take into account damage incurred by the use of energy carriers.

Reducing subsidies and internalizing external costs will stimulate energy users to invest in energy efficiency.

Bottom-up initiatives

While governments play a key role in creating the right boundary conditions for energy efficiency, the measures eventually have to be adopted by end-users: in companies, households, and other organizations. Apart from governmental action, the different sectors themselves can contribute to energy efficiency and undertake actions. So how can these so-called bottom-up activities be accomplished? In a recent paper, Blok et al.[XVIII] have shown that a combination of 21 global initiatives could virtually bridge a 10 billion tonne CO_2e greenhouse gas emissions gap by 2020, of which an estimated 5 billion tonne CO_2e is related to energy efficiency.

In the area of energy efficiency such initiatives could include:

- An initiative focused on efficient heating and cooling of buildings, through an increased retrofit rate for existing buildings and nearly zero-energy approaches for new buildings.
- A global phase out of inefficient lighting and efforts to apply the most efficient technology (which is nowadays LED technology).
- An initiative to rapidly step up energy performance for electrical appliances and fuel economy of cars and trucks, e.g. by setting up sector-specific agreements on efficiency standards.

In addition, more generic initiatives include important energy efficiency components:

- Cities could reduce their greenhouse gas emissions, including energy efficiency improvement in buildings and transport systems.
- The Top-1000 greenhouse gas emitting companies could launch an initiative to reduce their emissions, among others through process energy efficiency improvements.
- In addition, companies could launch supply chain initiatives in order to stimulate their suppliers to improve energy efficiency and at the same time reduce costs.
- A global campaign for citizens with high greenhouse gas emissions to voluntarily offset their emissions through energy efficiency and other projects.

All initiatives have important additional benefits, like reducing costs, improving competitiveness, stimulating the local economy, creating jobs, reducing local air pollution and improving health.

Embracing and stimulating such initiatives are, in addition to the regular UNFCCC process, important means to lead the world to greater energy efficiency and staying within the 2 °C limit for climate change.

Methodology, assumptions & references

[I] The following global energy scenarios were considered:

- *World Energy Outlook (WEO) 2011 – 450 ppm (IEA, 2011). The associated BAU (business-as-usual) scenario is the Current Policy Scenario.*
- *Energy [r]evolution 2012 (Greenpeace, 2012), in this study the associated BAU scenario was based on the Current Policy Scenario of the WEO 2011.*
- *Global Energy Assessment (GEA, 2012), where we compare the 'GEA-Efficiency' scenario with the 'GEA-Supply' as scenario. The GEA does not provide a BAU scenario and we compare a scenario focused on supply transformation to a scenario that focuses on efficiency improvements. See chapter 17 of the GEA.*
- *The Energy Report (WWF/Ecofys, 2011). This analysis and scenario is based on final energy demand, figures presented here are estimations of the corresponding primary energy supply. In this scenario, primary energy demand excludes non-energy use, which was 33 EJ in 2010.*
- *Energy Technology Perspectives (ETP) 2012 – D2S (IEA, 2012) the associated BAU scenario was the 6DS Scenario in the same ETP.*

To obtain the energy savings, we subtract the total primary energy supply (TPES) in the ambitious scenarios from the TPES of the BAU scenario. In the convention applied by international statistics, for wind and solar energy the primary energy supply is taken to be equal to their final energy production, consequently an increase in electricity production from wind and solar PV will save primary energy as well. These 'renewable energy based savings' are excluded in the cost savings presented here. We do this by calculating the renewable energy based savings based on the conversion efficiencies in the BAU scenarios and subtracted those from the total savings in order to arrive at the 'efficiency based savings'. In the Energy [r]evolution scenario, the highest TPES saving is achieved by energy efficiency improvements: 65 EJ in 2020 and 140 EJ in 2030. These numbers are used for the further analysis.

IEA, 2011. World Energy Outlook 2011. International Energy Agency (IEA), Paris

IEA, 2012. Energy Technology Perspectives 2012. International Energy Agency (IEA), Paris

GEA, 2012. Global Energy Assessment – Toward a Sustainable Future, Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg.

Greenpeace/GWEC/EREC, 2012. Energy [r]evolution – A sustainable World Energy Outlook. Greenpeace International, Amsterdam, Global Wind Energy Council (GWEC), Brussels & European Renewable Energy Council (EREC), Brussels.

WWF/Ecofys, 2011. The Energy Report – 100% Renewable Energy by 2050. WWF International, Gland

[II] Here, we assume energy savings are at the expense of fossil fuels and we start with the abovementioned 64 EJ and 140 EJ savings in 2020, respectively 2030. The energy prices in the BAU scenario are taken from WEO 2011 – Current Policies Scenario. The saved amount of fossil fuels is multiplied with the energy prices in the BAU scenario to obtain the cost savings from reduced consumption.

[III]To calculate the decrease in energy prices, we start with the prices in the BAU case (see previous note) as well as the prices in the WEO 2011 – 450 ppm scenario. From these prices and the consumption of coal, oil and natural gas in the two scenarios, we obtain a relation between fuel consumption and energy prices, which we assume to be linear (within the studied demand range). With this relation and the difference in energy consumption, the energy prices in the ambitious scenario and the difference with the BAU prices are calculated. The remaining consumption of fossil fuels in the ambitious scenario is multiplied with the difference (with the BAU scenario) in fuel prices to obtain the energy cost savings from the reduced fuel prices.

[IV] Philips, 2012. The LED lighting revolution A summary of the global savings potential - May 2012

[V] We applied the efficiency improvements to the electricity consumption in the WEO-2011-Current Policy Scenario and assumed the same power plant as in endnote iv. Costs are based on the average of an advanced pulverized coal power plant and a combined cycle gas turbine (steam extraction), as indicated in: Energinet/ENS, 2012. Technology Data for Energy Plants. Energynet/Energi Styrelsen, Copenhagen

[VI] ACEEE, 2011. Appliance and Equipment Efficiency Standards: A Moneymaker and Job Creator. American Council for an Energy-Efficient Economy (ACEEE), Washington

Engel and Kammen, 2009. Green Jobs and the Clean Energy Economy. Copenhagen Climate Council, Copenhagen

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[VII] ACEEE, 2011. Appliance and Equipment Efficiency Standards: A Moneymaker and Job Creator. American Council for an Energy-Efficient Economy (ACEEE), Washington

[VIII] Estimations on energy efficiency job benefits are based on data from ACEEE (2008), ACEEE (2011) and Ecofys (2011). Ecofys (2011) is based on the work of ACEEE (2011). ACEEE (2011) estimates a net increase of about 6 jobs per million US$ saved. This would translate to about 60,000 jobs per EJ of saved energy. The job benefits in Ecofys (2012) were estimated to be higher, because of higher energy prices in the EU result in larger energy bill savings and thus potentially more indirect job creation. In our estimate, we took the average of these two studies: 95,000 jobs per EJ saved. Multiplying this with the energy savings of 64 EJ in 2020 results in 6 million jobs.
ACEEE, 2008. American Council for an Energy-Efficient Economy. American Council for an Energy-Efficient Economy (ACEEE), Washington
ACEEE, 2011. Appliance and Equipment Efficiency Standards: A Moneymaker and Job Creator. American Council for an Energy-Efficient Economy (ACEEE), Washington
Ecofys, 2012. Economic benefits of the EU Ecodesign Directive - Improving European economies. Commissioned by Natuur & Milieu.

[IX] The gap is the difference between the business-as-usual emissions in 2020 and the level of emissions that should not be exceeded to have a fair chance (<50%) to keep the global temperature increase below 2 °C.
UNEP, 2012. The Emissions Gap Report 2012 - A UNEP Synthesis Report. United Nations Environment Programme (UNEP), Nairobi

[X]In our estimations, we only account for those reductions that can be attributed to energy efficiency improvements; emission reductions that can be attributed to the deployment of low carbon technologies are excluded.

[XI] Höhne, N., Ellermann, C., De Vos, R., 2009. Emission pathways towards 2°C. Ecofys, Utrecht by order of the Nordic COP 15 Group.

[XII] In this exercise, the starting point was a reduction of 80% of the fossil fuel consumption by 2050, relative to present day. We assume the shares of each fuel in the fuel mix to be unchanged, so this fossil fuel reduction corresponds to an emission reduction of 80%. Next, we define a BAU demand by extrapolating the total primary energy demand from the WEO-2011 – Current policy scenario until 2050, using the growth rates in the period 2020-2030. The difference between the total primary demand and the remaining fossil supply has to be covered with new low carbon energy production. Low carbon energy includes hydropower, nuclear power, biomass and other renewable sources. Until 2050, we then assume the new low carbon energy supply to grow exponentially and this growth also determines the pace of the reduction in fossil fuel demand. We calculated the required new low carbon energy production in the BAU scenario and in the cases where the energy efficiency improves with 1% and 2% annually (from 2010). The deviation of the total primary energy demand (in the higher efficiency cases) from the BAU thus grows with 1% and 2% per year from 2010 onwards.

[XIII] IEA, 2012. Energy Technology Perspectives 2012. International Energy Agency (IEA), Paris

[XIV] IEA, 2012b. Tracking Clean Energy Progress, International Energy Agency (2012), Paris

[XV] See the Global Policy Map of en.lighten: http://www.enlighten-initiative.org/portal/CountrySupport/GlobalPolicyMap/tabid/104292/Default.aspx

[XVI] Siderius, H.-P., Jeffcot, S., Blok, K., 2012. International benchmarking: supplying the information for product efficiency policy makers, Energy Policy, 45 (2012) 389–398

[XVII] Most recently this was done in: IEA, 2012c. World Energy Outlook 2012, International Energy Agency (IEA), Paris

[XVIII] K. Blok, N. Hoehne, C.J. van der Leun and N. Harrison: Bridging the Greenhouse Gas Emissions Gap, Nature Climate Change, 17 June 2012

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Ecofys – Experts in Energy

Established in 1984 with the mission of achieving "sustainable energy for everyone", Ecofys has become the leading expert in renewable energy, energy & carbon efficiency, energy systems & markets as well as energy & climate policies. The unique synergy between those areas of expertise is the key to its success. Ecofys creates smart, effective, practical and sustainable solutions for and with public and corporate clients all over the world. With offices in Belgium, the Netherlands, Germany, the United Kingdom, China and the US, Ecofys employs over 250 experts dedicated to solving energy and climate challenges.

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