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VISUALISING the "HIDDEN" FUEL of ENERGY EFFICIENCY

COMMENTARIES:
Günther Oettinger
Arthur Rosenfeld

VIEWS from INDUSTRY CHIEFS:
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Volkmar Denner, BOSCH


I, Lana Yahav
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ENERGY EFFICIENCY SIMPLY MAKES SENSE

By Maria van der Hoeven

Maria van der Hoeven is in her second year as Executive Director of the International Energy Agency, where she has worked to promote the Agency's effectiveness in global energy security. Before taking the helm of the IEA, she served as Minister of Economic Affairs for the Netherlands from February 2007 to October 2010, during which time she demonstrated leadership on energy policy at the national, regional and global levels.

What simple tool offers the entire world an extended energy supply, increased energy security, lower carbon emissions, cleaner air and extra time to mitigate climate change? Energy efficiency. What's more, higher efficiency can avoid infrastructure investment, cut energy bills, improve health, increase competitiveness and enhance consumer welfare – all while more than paying for itself.

The challenge is getting governments, industry and citizens to take the first steps towards making these savings in energy and money.

The IEA has long spearheaded a global move towards improved energy efficiency in buildings, appliances, transport and industry, as well as end-use applications such as lighting. That's because the core of our mandate is energy security – the uninterrupted availability of energy at an affordable price. Greater efficiency is a principal way to strengthen that security: it reduces reliance on energy supply, especially imports, for economic growth; mitigates threats to energy security from climate change; and lessens the global economy's exposure to disruptions in fossil fuel supply.

In short, energy efficiency makes sense.

The IEA has presented the 25 energy efficiency recommendations that identify best practice and policy approaches for our member countries to realise the full potential of energy efficiency. Every two years, the Agency reports on the gains made by member countries, and today we are working with a growing number of international organisations, including the European Bank for Reconstruction and Development, the Asian Development Bank and the German sustainable development co-operation services provider GIZ.

The opportunities of the "hidden" fuel of energy efficiency are many and rich. More than half of the potential savings in industry and a whopping 80% of opportunities in the buildings sector worldwide remain untouched. The 25 recommendations, if implemented fully by all 28 IEA members, would save USD 1 trillion in annual energy costs as well as deliver incalculable security benefits in terms of energy supply and environmental protection.

Achieving even a small fraction of those gains does not require new technological breakthroughs or ruinous capital outlays: the know-how exists, and the investments generate positive returns in fuel savings and increased economic growth. What is required is foresight, patience, changed habits and the removal of the barriers to implementation of measures that are economically viable. For instance, as the *World Energy Outlook 2012* demonstrates, investing less than USD 12 trillion in more energy-efficient technologies would not only quickly pay for itself through reduced energy costs, it would also increase cumulative economic output to 2035 by USD 18 trillion worldwide.

While current efforts come nowhere close to realising the full benefits that efficiency offers, some countries are taking big steps forward. Members of the European Union have pledged to cut energy demand by 20% by 2020, while Japan plans to trim 10% of its electricity consumption by 2030. China is committed to reducing the amount of energy needed for each unit of gross domestic product by 16% in the next two years. The United States has leapt to the forefront in transportation efficiency standards with new fuel economy rules that could more than halve vehicle fuel consumption.

Such transitions entail challenges for policy, and experience shows that government and the private sector must work together to achieve the sustainability goals that societies demand, learning what works and what does not, and following the right path to optimal deployment of technology. Looking forward, energy efficiency will play a vital role in the transition to the secure and sustainable energy future that we all seek. The most secure energy is the barrel or megawatt we never have to use.

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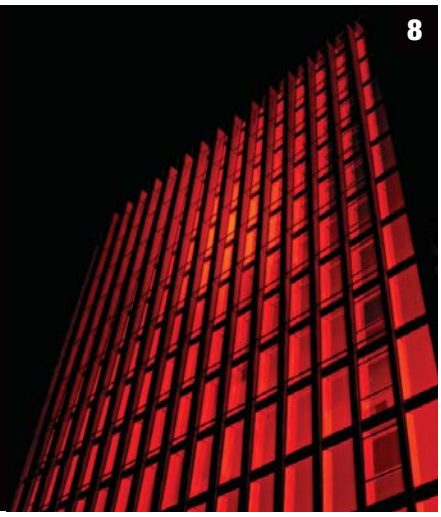

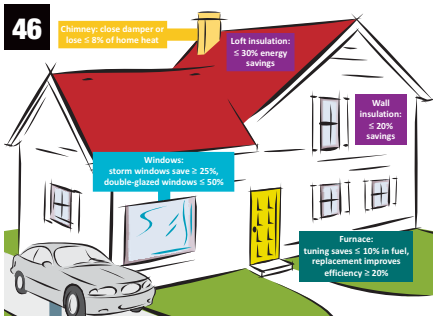

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ENERGY EFFICIENCY: TACKLING IT HEAD ON

By Günther Oettinger

Günther Oettinger has been European Commissioner for Energy since 2010, aiming to provide EU citizens and businesses with competitive and technologically advanced energy services; to make energy production, transport and consumption more sustainable; and to foster a secure energy supply, including through international relations. Before joining the Commission, he was Minister-President of Baden-Württemberg in Germany for five years.

The energy we use in industry, buildings, services or transport fuels our economy and our prosperity. Without improvements in energy efficiency, Europe would probably use four or more times as much energy today to produce the same GDP. Energy efficiency has created businesses and jobs and reduced waste, pollution and costs. It has been a good investment for our economy. Looking at the future, the need for more energy efficiency is glaring, as has been most recently highlighted by the International Energy Agency in its *World Energy Outlook 2012*.

The arguments in favour of energy efficiency are well known. One of the biggest energy resources we have, it is also the cheapest. It can reduce our dependence on imports and remove the need for costly new infrastructure. It can help keep European industry and jobs in Europe. There is no shortage of rhetoric in support of energy efficiency. So why are we not making more progress?

In March 2007, European Union member states agreed to a 20% target for reducing anticipated energy use by 2020. However, this general energy efficiency target was not enshrined into EU law. Instead, the European Commission has steered a large variety of policy instruments through the European Council. Most of these are now law and have resulted in major changes in areas such as buildings, cars, energy labels and eco-design for a wide range of products.

Resource efficiency is a flagship of the Europe 2020 programme as well as part of the EU economic policy for 2020, and it underpins the European Union's ambitions. Targeted financing has been put in place, such as the European Energy Efficiency Facility, as well as networks that include the Covenant of Mayors and sectorial targets such as in the new Energy Efficiency Directive.

As the European Union is not on track for the agreed efficiencies by 2020, this directive was adopted in 2012, bringing us nearer to our ambitious target. With full implementation due by 2014, the legislation should affect a wide range of areas: energy services, heat and power generation, buildings and public procurement. Each of these areas has significant unused potential for energy efficiency.

The new rules will benefit society as a whole. Public bodies will be required to renovate 3% of total floor area owned and occupied by the government every year – about twice the current EU renovation rate. Furthermore, energy distributors and/or designated energy retailers will be obliged to achieve new savings of 1.5% of annual energy sales averaged over the most recent three-year period. Suppliers will have to show that their actions made consumption less than it would otherwise have been. In other words, energy retailers will need to start selling energy efficiency. Businesses will benefit from the greater use of energy audits. Power and industrial plants will be required to recover waste heat, a step that will support more efficient co-generation, or combined heat and power.

It is clear, however, that we will need even more initiatives to achieve the 2020 target. Proper enforcement of existing rules is a must. We also need to communicate better with our citizens. More pro-active citizens mean more ambitious policies. To this end the European Commission has proposed additional funding for energy efficiency in the EU Structural Funds. Horizon 2020 and the Connect Europe Facility must give prominence to smart grids and cities. EU policy has highlighted resource efficiency in the transport sector.

In the latest *World Energy Outlook*, the IEA pushes for global action at all levels – political, industrial, social, legislative and financial – to improve world energy efficiency. That is right. Energy efficiency is an investment in our future. We cannot have sustainable, secure, competitive and affordable energy unless energy efficiency becomes part of our lifeblood. The European Union needs to remain at the forefront of these efforts.

WHITE ROOFS COOL WORLD EFFICIENTLY

By Arthur H. Rosenfeld

Arthur H. Rosenfeld fostered a number of critical energy efficiency breakthroughs at the Lawrence Berkeley National Laboratory in California. He has served as a senior adviser for the US Department of Energy and as Commissioner for the California Energy Commission. In February he received the US National Medal of Technology and Innovation for energy-efficient building technologies and related standards and policies; in 2011 Russia awarded him its Global Energy Prize.

I'm pleased to contribute to this *IEA Energy* issue on energy efficiency. Having devoted the past four decades of my career to energy efficiency, I can attest to the positive influence both of energy-efficient technologies and building and appliance standards that reduce energy consumption without compromising the quality of service.

My latest obsession is a campaign for white roofs in climates where summers are uncomfortably hot. White roofs not only reduce energy bills and dampen the urban heat island effect, but they also cool the world.

White roofs reduce heat load on buildings and cities ... and the world

On a clear day, a conventional dark roof can get 40°C to 50°C hotter than the outside air. A clean white roof, by comparison, runs only 5°C to 10°C warmer than the ambient air. This cooling from choosing a white roof over a dark one yields additive virtues. Well documented is the first – a cooler roof means that the space beneath the roof needs less electricity for air conditioning, saving money and avoiding emissions of CO_2 and other pollutants back at the power plant. Secondly, by reflecting more of the sun's energy back into space, white roofs cancel a small percentage of the heating effect from CO_2 that has already been emitted. This is called the "albedo effect", based on the Latin word for whiteness. As reflective arctic ice recedes rapidly, we need all the albedo we can get.

Together, these effects suggest that by installing a white roof to reduce a building's energy bill, you also contribute a free global cooling effect. Every 100 square metres of roof area that is white instead of black cancels the warming effect of 10 tonnes of CO_2 over the roof's lifetime (typically 20 years). With roofs accounting for roughly 25% of urban surface area and with cities occupying 1% to 2% of global land area, converting most flat roofs in warm cities to white would cancel warming from more than one gigatonne of CO_2 *per year* for the average lifetime of the roofs. In terms of emissions, it's equivalent to taking half the world's cars off the road for 20 years.

The role of standards and international co-ordination

As Energy Commissioner in California in 2003, I was shocked by the 30 000 deaths caused by the infamous heat wave that engulfed Europe that August. So by 2005, I succeeded in making cool roofs a mandatory component of our building code. While it is not cost-effective to replace a roof before the end of its service life and sloped roofs were exempted because they are an important architectural element of a home, we passed a mandate that as of 2007 all new or replacement flat roofs in the state must be white.

The California white roof message reached the national stage when my friend Steven Chu, in his first year as US Energy Secretary, adopted California's requirements for all Department of Energy buildings that pass a life-cycle cost-effectiveness test.

Then in 2010 he helped launch the Global Cool Cities Alliance (GCCA), a private-public partnership for the worldwide promotion of cool-city policies, and designated GCCA the operating agent of a voluntary international working group on cool roofs and pavements. Such hot countries as India, Japan, Mexico and South Africa have joined, and Brazil and China are actively studying the issue.

Implementation

The easiest way to implement white roofs is through building standards, enforced wherever they are life-cycle cost-effective. White roofs are an example of how the IEA can help its members – but also, and in particular, hot, fast-growing, developing countries.

For more information regarding cool roofs, visit the Lawrence Berkeley National Laboratory's Heat Island Group website at http://HeatIsland.LBL.gov. To learn more about the Global Cool Cities Alliance, see www.GlobalCoolCities.org and browse its technical implementation toolkit for cool roofs and pavements at www.CoolRoofToolkit.org. Finally, refer to www.ArtRosenfeld.org for recent presentations, papers, and pertinent resources by the author.

Arthur H. Rosenfeld: photo courtesy of Arthur H.Rosenfeld

A NEW LOOK AT ENERGY EFFICIENCY

WHAT MUST CHANGE

Energy efficiency aids economies and strengthens security. So why is it so underdeployed? Fundamental questions may lead to the answer.

By Robert Tromop

Robert Tromop heads the Energy Efficiency Unit of the Sustainable Energy Policy and Technology Directorate. Prior to joining the IEA, he managed the Monitoring and Research Team at the New Zealand Energy Efficiency and Conservation Authority.

Energy efficiency is neither visible nor easily measured. It improves competitiveness as well as security by expanding the provision of energy critical for growth and productive output.

But if it is such a critical driver of change, why is energy efficiency so often overlooked, why is it still the "hidden" fuel? What will it take to realise the potential? What are the right policies? Is there a silver bullet? I suggest that posing the following fundamental questions about the motivations and the willingness to adopt energy efficiency may better identify how to move beyond the current inertia.

Can we commit to full implementation of cost-effective measures available now?

It is four years since the Group of Eight leading industrialised nations committed to the IEA 25 Energy Efficiency Policy Recommendations. These remain the essential suite of policies, and we have made progress. But there is still work to do to scale up implementation to achieve the potential USD 1 trillion's worth of global energy demand reduction each year that the recommendations can deliver.

25 bright ideas

Sprinkled throughout news articles in this Feature Topic section on energy efficiency are the IEA 25 Bright Ideas. Everyday tips that mirror the IEA 25 Energy Efficiency Policy Recommendations for governments, the Bright Ideas also are divided into seven sectors, with recommendations for finance and regulation, buildings, appliances, lighting, transport, industry and utilities – but on an individual level.

The IEA publication *World Energy Outlook 2012* offers one of the few assessments of global energy efficiency potential, finding that it can contribute half of the change to energy usage necessary to limit the rise in global temperature. The book shows how that potential, both affordable and achievable, could also change global dependencies on oil.

But individual countries must take the first step – *i.e.* implementing the 25 Energy Efficiency Policy Recommendations – to enable global change.

Some are already doing so. In Japan's analysis of its future energy options, improved efficiency is responsible for meeting half of future energy needs. The Republic of Korea has reached similar conclusions, and the European Union Energy Efficiency Directive sets a challenging commitment for its member countries.

Will we let the real price of energy drive efficient energy systems?

If there is a silver bullet for energy efficiency, it is transparent energy prices in liberalised markets. Reflective market price signals, combined with prices for greenhouse gas emissions and local externalities, form the essential foundation for cost-effective demand-side options and new capacity, including renewables.

Not many countries have established energy markets where price signals accurately and completely reflect demand and generation perturbations to all players. Nordic countries led the way, adopting these essential drivers for energy efficiency alongside renewable energy, supply-side options and solutions to energy access.

In the past year, a number of countries have sought advice from the IEA on projected electricity shortages. The answer is technically easy: let price motivate the needed responses. But that deregulatory solution requires political fortitude to let market prices flow to reward the best investments.

Can we use energy efficiency to deliver socio-economic development as well as better use of resources?

To generate jobs, growth, security and resilience from energy efficiency requires defining and delivering that "hidden" fuel in social and economic terms. The IEA examines energy efficiency outcomes in terms of national economic impact through its Multiple Benefits project, finding more and better evidence of efficiency's economic value.

Will nations use their respective strengths in high-performing global collaboration?

Energy use has global implications for both emissions and resources, so global co-operation and commitment deserve strong merit. The accord at the 2010 climate meeting in Cancún, Mexico, created a fund to provide assistance to emerging economies as they seek ways to reduce greenhouse gases – solutions that include greater efficiency.

There are synergies from learning together, and some energy efficiency opportunities are impossible without global co-operation and commitment. For instance, international standards and joint efforts by committed governments working together drove significant advances in appliance and equipment efficiency (see the sidebar "Powering Down Gadgets").

Will we invest in the capacity building required to mainstream energy efficiency?

The United Nations Sustainable Energy for All goals set a global agenda for advancing efficiency, renewables and access to energy. But many of the countries that can expect to gain from these goals, and contribute to global energy and environmental objectives, lack the institutional, operational and market capacity to achieve them.

Governments must set up the governance and policy foundations for energy efficiency: ►

POWERING DOWN GADGETS

With more than 2 billion global citizens hooked into the Internet and more than 1.4 billion personal computers in use worldwide, the energy sector has a new leading consumer. Electricity consumption related to information communication technology is already more than 5% of total final global electricity consumption – 10% in the European Union – and could double by 2022, as the number of network-connected products tops 100 billion.

Many of those devices of the future will be smart appliances that hook into the Internet or are otherwise linked to a network.

Because they are part of a network, they need to stay "live" to receive and transmit data and so cannot be easily powered down to save energy. For instance, in the United States, more than 160 million television set-top boxes were consuming energy constantly in 2010. Even when no one is watching or recording a broadcast, nearly all such devices operate at close to full power as they maintain an active network connection, ready to receive and record programmes. In that one year, their standby consumption was the equivalent of the output of the largest nuclear power plant in the United States and cost their owners a total of USD 2 billion.

Similarly, cutting-edge appliances, from refrigerators to security systems, hook into networks that link a succession of machines to transmit everything from power consumption to grocery orders. As their network presence requires them to stay active, many connected appliances do not power down to a lower energy-consuming mode. Instead, like televisions before the IEA 1-watt initiative led to improvement, they use electricity full-tilt even when not delivering services. Already, the average home in the United States has four network-connected products, a number that is expected to quintuple by 2015, and smart appliances that can be operated remotely by cell phones are entering homes rapidly around the world, especially in the Republic of Korea and China.

A second IEA push to help gadgets rest

The IEA has been through this before. After manufacturers developed "instant-on" televisions in the late 1960s, the trend toward standby defaults in consumer electronics spread, and soon "inactive" machines were drawing 10% of total residential electricity consumption. A decade ago, televisions in homes around the world consumed significant electricity whether they were turned on or off. But in 1999 the Agency spearheaded the global "1-watt" initiative that led to the average new television's standby consumption falling from about 5 watts to 0.5 watt, saving energy for countries and money for consumers while keeping carbon from entering the atmosphere. Even as the number of such devices mushroomed, new low-power technologies reduced the share of the electricity used in standby modes.

But as more and different appliances are networked, machines that are now low-consumption will revert to high standby usage.

Different devices need tailored solutions

Reducing standby power use in networked devices requires solutions based on how each product functions within the network. A networked washing machine functions differently in standby from a desktop computer or a videogame console. And because consumers value features, functions and quick start-up times, manufacturers often lack incentives to increase efficiency. But there are successes in individual sectors. Because cell phone consumers want nonstop network access but also long battery life, producers have reduced power consumption when a phone is in standby mode.

To combat energy losses, in 2007 the IEA released its voluntary Guiding Principles of Energy Efficiency in Networked Products, and it will publish new policy guidance for governments and other stakeholders this year. Progress is under way. Already, the Republic of Korea has two mandatory programmes that set out targets for networked standby modes: the e-Standby Program and the Energy Efficiency Labelling Programme. In the United States, the voluntary programme Energy Star is starting to include provisions to measure and monitor networked standby modes in televisions and displays. The European Union has introduced a Code of Conduct on Energy Efficiency of Broadband Equipment and is amending regulations to include provisions ensuring that network-connected projects include power management features and that networked standby power consumption is reduced.

A networked refrigerator that stays online via Wi-Fi.

As more and more products are network-connected and the number of Internet-enabled services and applications surges, the quantity of information that is transferred and stored also grows rapidly. This has created yet another energy challenge: data centres' growing global energy consumption. In 2010, such facilities, which include server farms, used as much as 1.5% of electricity worldwide – approximately 2% in the United States – with consumption for centres and networks projected to grow 17% this year from 2012. Because customers expect immediate responses at each click of a mouse, technology companies argue that they cannot regularly shift inactive servers at their data centres to low-power standby mode, and so as much as 90% of the electricity drawn by data centres powers inactive devices.

With so many players involved, and such rapid development of digital systems, addressing network standby is proving to be one of the most challenging areas in energy efficiency. The IEA is working to develop global solutions with both the IEA Implementing Agreement for a Co-operating Programme on Efficient Electrical End-Use Equipment and the Super-efficient Equipment and Appliance Deployment programme, a Clean Energy Ministerial initiative.

– Vida Rozite, IEA

Should we put more faith in simple effective technology options, such as insulation, or in unproved technologies?

enabling frameworks (laws, strategies and action plans, funding mechanisms), stable institutional arrangements (implementing agencies, stakeholder engagement, public-private cooperation, international assistance) and coordinating mechanisms (targets, evaluation).

A multitude of private-sector players must put in place market supply lines, skills and services as well as financial investments.

Like countries, development organisations must collaborate on the basis of their individual strengths. The scale is global: the effort must reach the poorest of countries and include resourcing for the lifetime of the UN initiative, something like a Marshall Plan for sustainable energy and efficiency.

Will we reform energy subsidies to deliver better outcomes?

Much is made of the more than USD 500 billion in direct fossil-fuel subsidies worldwide – and the less direct forms of subsidy that may double that figure. Energy subsidies distort markets and disincentivise efficiency while using up limited government funds. Subsidies are usually developed to address access or entitlement barriers, and while often poorly implemented, are difficult to disengage from.

Instead, governments can look at how to transform energy subsidies so that more

HOW TO FINANCE EFFICIENCY BEST

All the best intentions in energy efficiency policy add up to nothing without financial support to bring the savings to life. Economic instruments, both carrots and sticks, are the linchpins that mobilise the financial muscle to fund policy measures, promoting and reinforcing energy performance regulations. Two recent IEA reports, available free, analyse the best ways governments and others can develop private and public financial instruments to encourage investment in energy efficiency.

Freeing up the money to make a difference

The first report, *Mobilising Investment in Energy Efficiency,* by Anuschka Hilke and Lisa Ryan, addresses the use of taxes, loans and grants, trading programmes, public procurement and research or infrastructure investment to shepherd financing to implement energy efficiency measures.

In general, economic instruments work best when part of a well-designed and coherent policy package. Though governments have mustered many of these economic instruments in efforts to improve energy efficiency, until now they have made little effort to evaluate how, and how well, the carrots and sticks work. Using the buildings sector as a prism, the report provides policy makers with advice on designing and selecting economic instruments to best fulfil their intended objectives within national contexts.

Using buildings to show the big picture

For instance, economic instruments work best when implemented with minimum energy performance standards or regulations and with measures to provide information and raise awareness among target audiences and those actually implementing the instruments.

Energy taxes are critical for investment in efficiency, as is the removal of energy price subsidies. Tax relief and grants can "sweeten" investment in efficiency that might otherwise not take place. However, they are likely to leverage only smaller investments.

Instead, governments need to use public funds and guarantees to provide access to finance as the energy efficiency market develops, encouraging larger investments that may be mandated through regulation. Then public-private financing instruments can be used to overcome market barriers and help people invest in energy efficiency measures.

Shifting investment to long-term gains

Most countries have few ambitious targets or eligibility requirements attached to economic instruments for increased efficiency in buildings. Instead, the focus tends to be on low-cost quick gains through equipment replacement, such as paying for new lighting or climate control, rather than delivering deeper retrofit of buildings by improving the building envelope or other large investments with significant if delayed paybacks.

But long-term investments in energy efficiency measures are low-risk and provide high returns to both investors and lenders. Policy makers can motivate investment in truly low-energy buildings by attaching strong energy performance

Insulation: © shutterstock.com

benefits flow to those who are targeted, and enable delivery of more sustainable energy outcomes. The first step is to objectively evaluate the positive and negative outcomes that subsidies are actually driving.

Will we invest a tiny amount of each nation's energy bill in understanding the driving forces of energy demand so we can develop effective strategies?

Anything as pervasive as energy use has many short- and long-term drivers, and a need for diverse implementers to cause change.

Cholera eradication, solutions to car safety and other public health issues require long-term policy responses of adaptation, synergised policies and ongoing evaluation and learning, starting with understanding the problem and its causes.

Effective energy efficiency requires that countries know better why and how consumer demand affects energy supply and how to most successfully adapt use to reduce that demand. Such improved analytical capacity will take time, money and supporting expertise.

Do we have the necessary willpower?

Technology is not going to bring energy efficiency by itself. Most energy-efficient technologies require supporting policies to accelerate their adoption. Fundamental challenges are often misunderstood, with simple effective technology options such as insulation undervalued while we place confidence in sophisticated future technologies yet to be assessed under real working conditions.

Instead, governments, businesses and citizens must learn how to create awareness as well as encourage new directions and motivation in human decision-making to deliver better social and economic outcomes from the use of energy.

GETTING STARTED

25 bright ideas

- Track your spending. Calculate your monthly power and fuel bills to track your energy costs. Then use the following ideas to become energy-wise and save money in the long term.
- Engage the whole family. Make time to talk with your family about how to reduce household energy use when cooking, washing, entertaining, commuting, etc.
- Shop wisely. When purchasing new devices for your home or office, ask salespeople about the most efficient items on the market. Better yet, research ahead of time and make informed decisions at the store.
- Take advantage of incentives. Contact your local government to find out about grants, tax rebates and other incentives that can help you to make an energy efficiency upgrade.
- Talk with your community. Spread the news about how to save energy to your friends and neighbours!

conditions to financial incentives, setting up rating criteria for investments and then assembling evidence that default rates for such loans are low. Best of all, they can institute complete cost-benefit assessments to monetise the multiple benefits of energy efficiency and increase the return on investment.

That is because public investments in energy-efficient buildings yield more than just energy savings: they also provide returns in the form of better health, economic development and energy security, to name just a few of those multiple benefits.

Saving on carbon emissions, too

One other critical benefit is reduced greenhouse gas emissions. Particularly in emerging economies, significant improvements in energy efficiency show the greatest potential of any single strategy to abate global emissions from the energy sector.

The second IEA report, *Plugging the Energy Efficiency Gap with Climate Finance*, by Lisa Ryan, Noral Selmet and Andre Aasrud, explains how emerging economies can use climate finance to scale up financing for energy efficiency but face a number of barriers, many of them also common to developed countries. These include weak capital markets; underdeveloped supply chains; low energy prices; lack of data and awareness; high transaction costs; inadequate governance capacity; lack of consensus on best practices; sovereign risk; and institutional fragility.

One solution is public climate finance flows from "north" to "south", currently running at an estimated USD 343 billion to USD 385 billion yearly. But very little of that money goes to energy efficiency. For instance, demand-side energy efficiency receives only 1% of credits from regular Clean Development Mechanism projects that finance sustainable development and emissions reductions.

Frameworks to stimulate demand

In low-income countries, public vehicles for financing, typically in the form of grants and subsidies, are essential to initial investments, the report finds, while in economies with more liquid capital markets, private investors need to be persuaded about the low risk and strong payback of projects through risk-guarantee mechanisms. Both types of countries must develop technical and regulatory support to create demand for energy efficiency and uptake.

One potential opportunity for financing energy efficiency in developing countries is the Green Climate Fund, the mechanism for international climate finance established at the 2010 global climate talks in Cancún, Mexico. Many of its procedures remain unfixed, which could allow it to be used to support cost-effective energy efficiency actions that also aid climate change mitigation and the growth of developing countries' economies.

Among the report's recommendations is the suggestion that energy efficiency have a specific share of funding in climate finance-funded projects in developing countries.

- Lisa Ryan, IEA

More Information: http://bit.ly/XxoPia *and* http://bit.ly/1272saN

MEGAWATTS VERSUS "NEGAWATTS"

WHERE LESS IS MORE

The best way to meet increases in energy demand might not be to supply more. But while efficiency improves security, hurdles abound.

By Melissa C. Lott

Melissa C. Lott is a US Department of Energy Presidential Management Fellow on loan to the IEA, where she leads thermal energy storage analysis for a roadmap on storage technology. She is also an author of Scientific American*'s "Plugged In" blog.*

Energy is a foundation of modern life and one of the key differentiators between healthy, wealthy societies and sick, poor ones. As populations grow and countries develop, the best option in meeting their rising energy demand lies in energy efficiency – getting the same for less energy or getting more from the same.

For the one in five people in the world who currently lack electricity in their homes and businesses, available and affordable energy resources are critical to their community's efforts to reduce poverty, improve public health and increase educational opportunities.

For those with energy access, supply security – ensuring that energy is consistently available and affordable – is an ongoing challenge.

The European Fuel Poverty and Energy Efficiency Project estimates that up to 125 million Europeans are fuel-poor, having to make the "eat or heat" decision during winter months. In Belgium, where nuclear power provides more than half of the electricity supplied, the country's power system came under significant strain late last year when safety concerns led to a months-long reactor shutdown. The American Society of Civil Engineers projects a USD 500 billion investment deficit for the ageing power grid in the United States, which increases energy reliability concerns.

But "negawatts" could reduce the pressure on supply infrastructure while maintaining adequate energy services for an improving quality of life. The negawatt is a theoretical unit of power saved – its name stems from a newspaper typo that Amory Lovins, the founder of the Rocky Mountain Institute and a dedicated energy efficiency supporter, decided to adopt for a 1989 keynote address at the Green Energy Conference in Montreal. There, he painted a picture of a more energy-efficient world, saying, "Imagine being able to save half the electricity for free and still get the same or better services!"

While the primary goal of energy efficiency initiatives is to reduce total energy consumption, negawatts can have benefits far beyond the kilowatt-hour. According to the United Nations Sustainable Energy for All initiative, "Energy efficiency – getting more from our existing resources – increases global resource productivity, supports economic growth and reduces costs for all citizens."

Individual, national and global benefits

According to the International Energy Agency analysts Lisa Ryan and Nina Campbell, the welfare benefits resulting from energy efficiency improvements can be broken down by level: individual, sectoral, national and global. For individuals and households, improving the efficiency of heating and cooling equipment can, for example, improve air quality within homes and offices. More effective temperature control and cleaner air can have significant positive impacts on public health.

Further, a more efficient customer can allow a utility to serve more people, increasing access to affordable energy supplies. On the supply side, efficiency can enable a shift from regional generation to greater amounts of local or even individual production. This can lead to reductions in transmission losses, while providing a local revenue stream.

More broadly, energy efficiency can make industries more competitive, resulting in job creation, more flexible government budgets and improved energy security. In China, efficiency has been a prominent objective for more than 30 years. The current Five-Year Plan targets a 16% cut in China's energy intensity

IT BEGINS AT HOME

25 bright ideas

- Ensure that your home meets modern energy standards. Walls, floors and ceilings should be insulated and windows glazed to maintain moderate temperatures and reduce noise.
- When building a new house, take the opportunity to include further energy-saving measures in the design. Building positioning, sun shading systems, window design, and integrated heating and cooling systems can naturally maximise home comfort and provide real low-cost energy savings.
- Take some simple steps to save energy in your existing home:
  - Check the temperature gauge on your central heating and hot water systems (19°C is a healthy temperature for your living and bedrooms; 60°C is sufficient for your water tank). If you don't have a thermostat, buy a thermometer at the pharmacy and regulate indoor temperature manually.
  - When temperatures are low outside:
  - keep your curtains closed at night to keep heat in; and
  - block gaps around doors and window panes to eliminate draft, but keep some background ventilation.
  - Have your water heater and heating pipes wrapped to minimise energy lost in transit – an insulation jacket on your hot water cylinder will pay for itself in two to three months.
- When renting or buying a home, look for a building energy label indicating high efficiency.
- Enjoy the best performance from your home and its energy systems:
  - Get your heating system serviced annually to improve safety, reliability and energy efficiency.
  - Consider replacing your old heating system or boiler with a modern, highly efficient heating system with good controls.
  - When replacing your windows, choose glazed windows and reflective glass to keep heat inside and cold out, or vice versa.

Melissa Lott; photo courtesy of Mary Lott

(the amount of energy required to produce one unit of gross domestic product, or GDP) by its conclusion in 2015.

On a global scale, increased efficiency can improve energy affordability and sustainable economic growth, in the process adding to global energy security. For example, according to the *World Energy Outlook 2012*, North America could become a net oil exporter by 2030. Under that scenario, the United States – which currently imports about 20% of its total energy requirements – will become essentially self-sufficient. This radical shift in historic trends is largely the result of rising oil, shale gas and bioenergy production. But it is also based on improved vehicle fuel efficiency standards that have been adopted in the United States.

Working around the rebound effect

For the optimist, energy efficiency is massively beneficial to all of society. According to an often-cited 2009 McKinsey & Co. analysis on energy efficiency in the United States, existing technologies and opportunities could significantly decrease the economy's energy intensity. And it could do so with a price of less than half that of a new natural gas power plant on a cost-per-unit energy basis. In India, ICF International reports a market potential of almost USD 10 billion for energy efficiency.

The pessimist can quickly respond that an inevitable rebound will kill estimated energy savings from efficiency projects. Further, most energy markets are set up to sell more energy, not to support end-user efficiency.

The "rebound" effect describes how, when an existing service becomes increasingly energy-efficient, society will often demand additional services that use up the savings. For instance, a 2012 study by the Massachusetts Institute of Technology economist Christopher Knittel found that the efficiency of American automotive engines rose 60% over the past three decades. But, three-quarters of the gain was eaten up by bigger, more powerful vehicle designs.

And utility companies' profits currently are linked to energy sales instead of specific energy services. In the absence of government policy, there is little reason for companies to increase spending for energy efficiency projects.

Some companies do make money from selling negawatts. Over the past 12 years, Chevron Energy Solutions has found ways to eliminate billions of dollars of energy waste in the public sector as an energy services company (ESCO). In Brazil, more than 70 ESCOs are working to eliminate energy waste, primarily through improved lighting technologies. But these organisations are the exception rather than the rule in the energy business.

There are examples of governments that have recognised and addressed this mismatch in incentives. The 1970s oil crises spurred Sweden to move towards alternative energy resources, including efficiency. Today, the country has set efficiency standards for everything from light bulbs to electric motors and has decreased its dependence on oil by more than 65%.

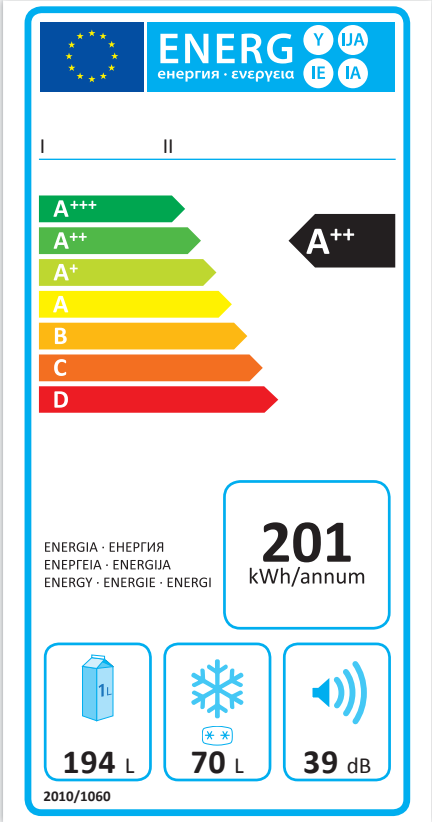
In Japan, energy efficiency is part of the national identity. In 2008, just before a meeting of the Group of Eight leading industrialised countries, then-Prime Minister Yasuo Fukuda proudly stated, "Superior technology and a national spirit of avoiding waste give Japan the world's most energy efficient structure." In the wake of the 2011 Fukushima Daiichi nuclear accident, efficiency mandates helped Japan to work through a difficult rebalancing of its national energy portfolio.

In the United States, California has realised impressive efficiency gains primarily through building codes implemented in the 1960s and 1970s. As a result of these and other policies, the state has recorded near-constant per-capita electricity use since 1973. This fact, known as the Rosenfeld Effect after the physicist Arthur H. Rosenfeld, demonstrates the potential for a large region to use efficiency to offset significant amounts of electricity demand growth.

In an attempt to extend the Rosenfeld Effect to other states, the 2009 American Recovery and Reinvestment Act focused heavily on efficiency – more than one-third of the USD 97 billion allocated to green energy was set aside for efficiency projects.

Moving forward, international efforts allow researchers and industry around the globe to share lessons learned. For instance, in a binational effort to decrease the amount of energy required to fuel India's growth, the United States-India Joint Clean Energy R&D Centre's Energy Efficiency of Buildings consortium develops ways to use information technology and building-control systems in commercial and high-rise residential buildings.

Such efforts can deliver energy savings by 2035 equivalent to nearly one-fifth of 2010 global demand, according to *World Energy Outlook 2012* analysis. As IEA Executive Director Maria van der Hoeven explained in announcing those findings, "Energy efficiency is just as important as unconstrained energy supply, and increased action on efficiency can serve as a unifying energy policy that brings multiple benefits."



Energy efficiency offers benefits locally and globally.

ROSENFELD'S MANY EFFECTS

The Rosenfeld Effect describes how per capita electricity use in California has been essentially flat since 1973, even as average use in the whole United States has grown by 50%. The effect is named for Arthur H. Rosenfeld, a pioneer of energy efficiency who entered the field during the oil crises of the 1970s, much like the IEA was born of that era's need for security of supply (see "Outside Perspective", page 7).

Rosenfeld is also the namesake of Rosenfeld's Law, which shows that the energy intensity – or the amount of energy needed to produce a unit of GDP – has declined by approximately 1% annually since 1845. And his name has been branded as an energy efficiency unit of measurement: one rosenfeld represents an energy savings of 3 billion kilowatt-hours per year, or the amount of power generated by one 500-megawatt coal-fired power plant.

Rosenfeld contributed to the development of efficiency technologies and software including DOE-2, a building analysis computer program that California incorporated into its Building Code in 1978.

25 WAYS TO USE LESS ENERGY

TAP A "HIDDEN" FUEL

The IEA 25 Energy Efficiency Policy Recommendations detail how to cut consumption and, if implemented now and fully, save USD 1 trillion a year.

By Sara Bryan Pasquier

Sara Bryan Pasquier joined the Energy Efficiency Unit in 2008. As programme manager, she oversees the IEA Energy Efficiency Policy Evaluation and Policy Pathway series. Her recent publications include Progress Implementing the IEA 25 Energy Efficiency Policy Recommendations.

Energy efficiency – the "hidden" fuel – provides all the benefits of a clean energy source, including improved energy security, environment, health and economic development. But its "hidden" nature raises very real obstacles for governments to improve it.

To help overcome these barriers and to tap the benefits of energy efficiency, energy ministers in 2005 asked the International Energy Agency to develop a concrete set of policy recommendations.

The final result – the IEA 25 Energy Efficiency Policy Recommendations – was completed in 2008 and, if implemented globally without delay, would save countries USD 1 trillion in energy and reduce annual CO_2 emissions by the equivalent of about 1.5 times recent annual emissions in the United States from the energy sector.

Downloaded more than 50 000 times from www.iea.org since their introduction, the recommendations were "translated" late last year into laypeople's language as the 25 Bright Ideas, recommendations that individual citizens – not just governments – can implement to make their daily lives more energy efficient. From early December, the IEA Facebook page and Twitter feed each day promoted one of the Bright Ideas, in time for New Year's resolutions.

Flagship approach to big savings

In the same way that the 25 Bright Ideas help citizens, the 25 Energy Efficiency Policy Recommendations make clear why governments need to take steps to overcome barriers to energy efficiency. These impediments include lack of access to capital for efficiency investments, insufficient information, indifference and the "principal-agent problem" – for instance, when a building's owner has no incentive to invest in efficiency because it is the tenant who will reap the benefits of lower bills and improved comfort.

The 25 recommendations are a package that leaders can adopt according to each country's needs and priorities. The wide-ranging suggestions, distributed across seven sectors, include policies to cost-effectively increase efficiency: use price signals, accelerate the introduction of new technologies, improve energy management in industry, and strengthen and enforce minimum energy performance standards (MEPS) for transport, appliances, equipment and building codes.

The IEA "brand" and dissemination capacity, along with the tried-and-true international expert-design process behind the policies,

GLOBALISING THE 25

As non-OECD countries' economies grow, their role and impact in tapping a major part of the world's energy efficiency potential become ever more significant. Apart from reducing both consumption and CO_2 emissions, energy efficiency helps countries maximise economic potential and social welfare and mitigate insecurity from stretched energy resources.

Through regional roundtables, the IEA helps emerging economies adapt the 25 Energy Efficiency Policy Recommendations to their area's needs so they can overcome the strong historical coupling between economic development and increased energy consumption.

At the roundtables, government and private-sector officials, along with regional energy efficiency organisations and multilateral development agencies, identify local needs as well as potential savings and barriers before assessing which of the IEA 25 recommendations need adaptation and how the local barriers can be overcome.

The first roundtable will focus on the South Eastern Mediterranean when representatives of seven countries meet in Jordan in April, thanks to funding from the European Bank for Reconstruction and Development, while the Asian Development Bank will host Southeast Asian representatives in May in Bangkok.

– Annabel Furstenau, IEA

GADGETS & GIGAWATTS

25 bright ideas

- When shopping for new appliances, look for energy rating and performance endorsement labels (*e.g.* Energy Star). Go for the top performing model; you will recuperate the cost through energy savings over the lifetime of the item!
- Get the best performance from your appliances:
  - Make sure your refrigerator and freezer have tight door seals, are positioned in a cool place, and are not blocked with frost – all of this will help them to function more efficiently.
  - Wait until your dishwasher and laundry machines are full before using them, and always use cold temperatures for lightly soiled items.
- Make easy energy savings by transforming your daily behaviour:
  - Apply the power-saving features in your computer or laptop. Always switch off the screen when you are done – "screen savers" do not save electricity!
  - Completely switch off appliances and entertainment systems when they are not in use. Remember, things that go "beep" in the night use huge amounts of energy.
  - When they are not in use, unplug appliances that don't need to stay connected to a network. Otherwise power will continue to travel through the cable.
  - Set your refrigerator at +5°C and your the freezer at -18°C. Use thick-bottomed pots and pans, put lids on your pots and keep the oven door closed. A conventional oven expends more energy heating up than it does staying hot – try to do all your cooking at once.

have made the recommendations many policy makers' first exposure to governments' role in scaling up efficiency.

Because of these advantages, IEA member countries pledged in 2008 to implement the recommendations, and evaluations in 2009 and 2011 found significant national efforts to meet that commitment.

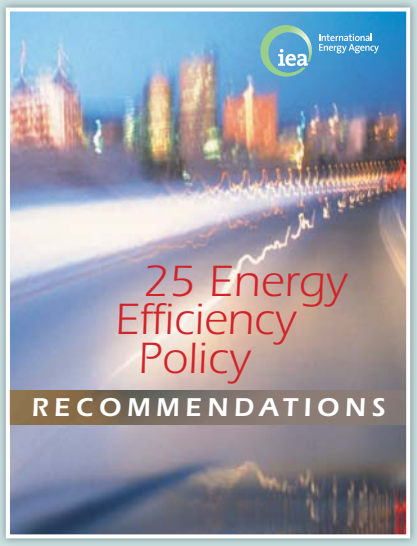
Before 2009 the transport sector lagged behind others in energy efficiency policy development. From 2009 on, policy makers made great strides, especially with regard to regulations for tyre-pressure monitoring systems, tyre-rolling resistance and labelling, CO_2 emissions standards for passenger cars, and policies to promote eco-driving and feedback instruments. In the buildings sector, many IEA member countries strengthened MEPs in building codes in 2009-11 and implemented building certification schemes. In the appliance and equipment sector, many governments expanded and toughened MEPs and implemented standby-power requirements. In industry, energy management and promotion of MEPs for motors have strengthened efficiency, while a number of countries implemented policies after 2008 that encourage energy utilities to facilitate cost-effective energy savings for end users.

Other means of delivering the message

The IEA also disseminates the recommendations through several outreach activities, including its Policy Pathway series of publications and its Training and Capacity-Building Programme. To urge efficiency gains in non-member countries, the recommendations have been translated and distributed in Chinese and Arabic.

But market structures vary dramatically by region, as do both opportunities and barriers to improving efficiency. So the IEA is starting a multiyear global project to tailor the recommendations to respond to the specific challenges and opportunities of several key regions, including South Eastern Mediterranean, Southeast Asia, South Asia, Latin America and Eastern Europe/Caspian.

The keys to realising the recommendations' benefits are developing, implementing and financing support mechanisms, including legislative frameworks, funding mechanisms, institutional arrangements and co-ordination bodies. Only when these governance institutions are in place can IEA member and non-member countries start to extract the full benefits of the "hidden" fuel of energy efficiency.



CROSS-SECTORAL

1. Reliable, timely and detailed data on energy end-uses, markets, technologies and efficiency opportunities in all sectors contribute to the development of effective efficiency strategies and policies.

2. Based on analysis of energy use, markets, technologies and efficiency opportunities, governments should formulate and regularly update strategies and action plans for improving energy efficiency.

3. Periodic review of regulations and subsidies ensures that retail energy prices reflect the full costs of energy supply and delivery, including environmental costs.

4. Facilitate private investment in efficiency by supporting capacity building, standardised measurement and verification protocols, private lending and technology research, development demonstration and deployment.

5. Enforce, evaluate and regularly update efficiency policies and measures in all sectors.

BUILDINGS

6. Apply energy codes and minimum energy performance standards (MEPS) to all new buildings and those undergoing renovation.

7. Support construction and marketing of buildings with net-zero energy consumption.

8. Improve existing buildings' efficiency, emphasising building envelopes and systems during renovations.

9. Require building energy performance labels or certificates.

10. Establish policies to improve the performance of critical building components, such as windows and heating, ventilating and cooling systems.

APPLIANCES AND EQUIPMENT

11. Adopt and regularly tighten mandatory MEPS and labels across the full spectrum of appliances and equipment.

12. Regularly update product test standards and measurement protocols.

13. Use incentives and other measures to support the introduction and uptake of new technologies and high-efficiency machinery.

LIGHTING

14. Phase out inefficient lighting products.

15. Require and promote improved lighting systems design and management.

TRANSPORT

16. Adopt and regularly update fuel-efficiency standards for road vehicles.

17. Use measures like labelling, incentives and taxes to boost vehicle efficiency and accelerate the market penetration of new efficient vehicle technologies.

18. Reduce the negative impact of components, such as tyres and air-conditioning systems, that are often excluded from vehicle fuel-efficiency testing and requirements.

19. Craft measures to increase the operational efficiency of vehicles, such as eco-driving, a central component of initiatives to improve efficiency and reduce CO_2 emissions.

20. Enable policies that increase the overall efficiency of national, regional and local transport systems and promote shifts of passengers and freight to more efficient modes.

INDUSTRY

21. Require large, energy-intensive industry, and encourage other industrial energy users, to conform to energy management protocols.

22. Adopt MEPS for electric motors and other categories of industrial equipment, and address barriers to the optimisation of efficiency in industrial systems and processes.

23. Implement specially designed policies and measures to promote efficiency in small and medium-sized enterprises.

24. To aid industrial efficiency, remove energy subsidies, internalise environmental costs, provide targeted incentives and assure ready access to financing.

ENERGY UTILITIES

25. Ensure that energy utilities support cost-effective, verifiable end-use efficiency improvements.

BEYOND JUST SAVING ENERGY

THE ADDED BONUSES

Beyond energy efficiency's obvious advantages are societal and personal benefits ranging from avoided infrastructure to higher property values.

By Nina Campbell

Nina Campbell, a New Zealand solicitor, works in the Environment and Climate Change Unit and has led workshops on the multiple benefits of energy efficiency. Her publications with the IEA include Evaluating the Co-Benefits of Low-Income Energy Efficiency Programmes.

Everyone knows that energy efficiency can reduce use of fossil fuels and emissions of greenhouse gases. But it affects societies in many other ways as well, in what the IEA calls the multiple benefits of energy efficiency.

IEA analysis suggests that these extra gains appear in five key categories: economy-wide impacts such as jobs creation and higher output, or health and well-being improvements; higher industrial productivity; lower infrastructure and operating costs for energy providers; increased property values; and lower public spending.

These five extra benefits are frequently overlooked, so the full value of energy efficiency is often underestimated. For instance, the US Environmental Protection Agency found that every dollar invested in energy efficiency increased a building's value by triple that amount.

In other cases, benefits come as an additional result of energy savings achieved – for example, avoided investment in infrastructure. Others flow from efficiency measures independently of energy savings themselves.

Studies show a range of employment effects from energy efficiency investment whose impacts average about 17 to 19 jobs generated for every EUR 1 million spent on efficiency interventions. These jobs result from the direct creation of posts as well as new employment further up the production chain as efficiency provides consumers new savings that they can spend, bolstering overall economic activity.

The benefit of such new spending may help to explain where the energy goes when reductions in consumption expected from an energy efficiency policy fall short – the "rebound" effect.

The rebound effect presents a challenge to the effectiveness of energy efficiency policy. Consumers often choose to reinvest savings to satisfy previously unmet energy needs. For example, after installing insulation, a household might decide to turn up the temperature on the thermostat. In cases like this, the rebound effect may be negative for energy savings but is positive for society in other ways – increasing the health and well-being of occupants of that house, not to mention their productivity in society. To understand the real impact of energy efficiency requires evaluating its impacts across sectors beyond fuel savings.

The five multiple benefits at a glance

Among the many ways energy efficiency contributes to better health are improved indoor temperatures, minimising damp and mould in homes, and reducing respiratory and other illnesses, particularly among children. In the developing world, the replacement of inefficient and highly polluting cookstoves could halve the incidence of child pneumonia.

Improvements in the energy efficiency of a home, car, power plant or other asset can increase its market value. "Green" buildings have higher rental and resale values, studies show, as well as better occupancy levels and lower operating expenses and capitalisation rates. As energy is a top operating cost in most offices, resale value can include the net present value of future energy savings from improvements.

The reduced demand for energy from efficiency limits brownouts or worse and also reduces the investments needed to install additional energy infrastructure to meet high demand. For energy providers, benefits range from improved service for customers to reduced operating costs and higher rates of bill payment.

In industry, efficiency not only raises profit through lower operating costs, it can also provide consistency and improvement in quality and output. Studies suggest that the multiple benefits in the overall industrial sector may be worth up to 2.5 times the value of energy savings.

Energy efficiency also offers positive macroeconomic impacts, encompassing a range of aggregate benefits for an economy. These include increases in gross domestic product, improved trade balance for fuel-importing countries, heightened national competitiveness – and the cumulative benefits of all other impacts. These macroeconomic gains are mainly indirect effects resulting from increased consumer spending and economy-wide investment in energy efficiency, as well as from lower energy expenditures, and are of particular importance during recessions.

More information: bit.ly/WSTfim

Energy efficiency does more than just save fuel.

LIGHT IT RIGHT

25 bright ideas

Love your efficient lamps! Compact fluorescent lamps use 80% less electricity and last up to ten times longer than traditional incandescent bulbs. When they expire, be sure to dispose of them at a designated collection point.

For systematic lighting savings:

- Turn off the lights when you leave a room!
- Use "task" lighting rather than whole-room lighting when only a small amount of light is required.
- Regularly clean light fittings, reflectors and lampshades – you will get more light from your clean lamps.

Light bulbs: © shutterstock.com

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UNCONVENTIONAL REVOLUTION, PART 2?

By Fatih Birol

Fatih Birol, the IEA Chief Economist, is responsible for the Agency's flagship World Energy Outlook, *which is recognized as the most authoritative annual source of strategic analysis of global energy markets. He is also the founder and chair of the IEA Energy Business Council, which provides a forum to enhance co-operation between the energy industry and energy policy makers.*

While energy efficiency has been an "epic failure" of energy policy making in most parts of the world, there are increasing signs that it is rising up the agenda. This could well represent a game-changer in the same way the boom in US oil and gas production is redefining the global energy map. After all, energy efficiency is just as important as energy supply – perhaps more so – in determining the nature of our economies.

Different countries have done different bits right. Australia has implemented effective industrial energy efficiency policies, as did India more recently. The European Union has enforced tight standards for cars. Japan has been successful with its Top Runner programme. We also are seeing welcome new measures: China is targeting a 16% reduction in energy intensity by 2015; the United States has adopted new vehicle fuel-economy standards; the European Union has committed to cut its energy demand by 20% in 2020; and Japan aims to reduce electricity consumption by 10% by 2030.

But even if progress is made towards meeting those targets, and additional policies are implemented elsewhere, two-thirds of the economic potential of energy efficiency would be left unused. This is unacceptable. In a world where 1.3 billion people remain without access to electricity, we cannot afford to see so much energy wasted.

So in the *World Energy Outlook 2012* (*WEO 2012*) we set out a blueprint for an energy-efficient world – the Efficient World Scenario – to examine what would happen if we pushed the efficiency button. The scenario makes no bold assumptions about technical breakthroughs, but instead shows what is possible simply by adopting existing technologies and practices that make economic sense.

The energy savings in 2035 equal nearly one-fifth of global demand in 2010. Oil demand is cut by 13 million barrels a day, or more than the production of Russia and Norway combined. Energy-related CO_2 emissions peak before 2020, buying precious time to pursue climate-change mitigation. Energy prices are suppressed and economic growth stimulated. Importantly, these efficiency gains do not diminish our quality of life or leave our economies worse off. Quite the contrary. It is not about making do with less, but doing more with less. And doing it better, much better.

But how do we actually push the efficiency button? First there needs to be government leadership. For too long, energy efficiency has been considered the low-hanging fruit that is ripe to be picked. And yet, it is not. Barriers need to be overcome. Governments are often in the best position to make this happen. One of the ways they can act is with accurate information – helping us measure and understand the costs and benefits. In essence, making the invisible concept of energy efficiency more visible.

Another way is to help make it affordable. Often the reason blocking energy efficiency is that the costs and benefits fall on different people. Either in a narrow sense, such as the landlord-tenant problem, or a broader sense, in that the costs are borne by an individual but the benefits accrue to the entire population. We need financing instruments that improve affordability and align incentives.

And we need to make energy efficiency the norm. There are soft ways of doing this, through information and communication campaigns to change behaviour. And there are harder ways, such as building codes and standards for household appliances and vehicles. Obviously, if you are going to introduce the standards, you also need to enforce them.

Thanks to the *WEO 2012* analysis, the benefits of improved energy efficiency are better understood than ever before. A few years ago, the *WEO* successfully foresaw the unconventional energy revolution now in full swing in the United States and gradually spreading elsewhere. Our latest edition made no such bold prediction – but it is my hope that we will see a second unconventional revolution, this time in energy efficiency. For that to take place we will need governments to raise their level of ambition and commit to putting a lot more energy into efficiency.

MANUFACTURING IMPROVEMENTS

INDUSTRIOUS GAINS

Industry uses one-third of global primary energy, but currently available technologies can cut its consumption by 20%. And that's just a start.

By Vida Rozite

Vida Rozite leads the IEA Energy Efficiency Unit's work on industrial energy efficiency and information technology-related energy use. Previously, she was a United Nations Industrial Development Organization consultant on sustainable development and a senior adviser at Nordic Energy Research.

Industrial energy intensity is improving around the world. But the sector can further cut its energy needs by about 20% through use of the best available technologies, never mind the further gains possible through technological advances and by optimising production and process techniques.

For instance, energy management systems can quickly save around 30% of energy at the enterprise or facility level, with continuous additional annual savings in the region of 2%. Even bigger cuts are possible through integrated approaches to management of energy resources and energy waste over the whole industrial production and consumption value chain.

Governments can promote systems-wide efficiency through zoning, planning and supporting optimised energy use among industrial companies and between them and other parts of communities. For example, district heating systems can use industrial waste heat, while industries can cascade heat within and between sites. Heat-cascading systems, in which waste heat from one industry is used by another, can halve energy requirements for industrial heat. Use of recycled materials can cut energy requirements by a factor of five or even more. For example, it takes 218 megajoules (MJ), including mining and transport, to produce a kilogramme of virgin aluminium; the corresponding figure for a kilogramme of recycled aluminium is just 28.8 MJ.

Industry can also drive energy savings in other sectors. Innovation and development in the chemicals and materials industry, for instance, can make possible much lighter vehicles, enabling radical improvements in fuel economy.

Motors offer big savings, as 70% of industrial electric consumption powers motor-driven systems. Replacing individual motors can save 3% to 5%, but optimising entire motor systems could cut consumption by 20% to 40%. IEA analysis indicates that global implementation of policy packages promoting energy-efficient motor systems could ensure savings in the magnitude of 2 800 terawatt-hours a year by 2030, equal to all current annual hydroelectricity production.

Improvement is critical, because industry uses a third of global primary energy. Growth in non-OECD countries, particularly China and India, led to a 31% increase in total industrial final energy use from 2000 to 2010. Over the coming decades, industrial output is expected to double or triple in most sectors, so modest improvements in energy efficiency will not suffice to stabilise or decrease industrial energy demand.

AT WORK

25 bright ideas

- Ask your office manager about the energy management plan for the building and the company.
- When old industrial motors fail, replace them with premium efficiency motors that have lower operational costs. Ensure that you use an appropriately sized motor – size matters and bigger is not always better!
- Consider other ways that your company could encourage better use of energy, for example, during the commute to work:
  - Offer public transport passes instead of free parking.
  - Propose office carpooling.
  - Provide secure bike racks and showers to encourage cycling.
  - Supply a shared office bicycle for short errands during the workday.
  - Improve the efficiency of your vehicle fleet.
- Establish a "best energy saver" award for the employee who comes up with the idea that saves the company the most energy.

CEMENTING A SECTOR'S GAINS

The cement sector offers significant opportunity for industrial energy efficiency. A new IEA study finds that simple steps could reduce the fast-growing Indian cement industry's future consumption by as much as the current annual energy use of Singapore or Bulgaria.

Societies consume more concrete by volume than anything other than water. Fortunately, new cement plants usually install the most recently developed technologies, which are typically the most energy efficient and so generally provide a cost advantage to the producer. A very wide range of technologies is available, and as a result the industry is phasing out inefficient long dry kilns and the wet production process.

Worldwide, cement factories can generate fuel by burning waste that otherwise would go to an incinerator. Such energy recovery reduces the cement plants' fossil-fuel consumption. Similarly, the production of pig iron generates slag, a nonferrous by-product similar in content to cement. Cement producers can use slag as a feedstock, and iron and steel manufacturers can provide it to them for little extra energy or cost aside from transportation.

India's cement industry, the second-largest in the world after China's, more than doubled output from 2000 to 2010 and is the country's third-largest energy consumer. Techniques detailed in the report by the IEA and the World Business Council for Sustainable Development would not only improve energy efficiency but also cut carbon emissions: they range from alternative fuels to waste heat recovery.

– Nathalie Trudeau, IEA

More Information: http://bit.ly/11Z4lr1

RULES THAT RAISE ENERGY SAVINGS

BUILDING CODES

Energy codes, the main policy instrument to cut buildings' consumption, must balance the many factors that influence energy demand.

By Yamina Saheb

Yamina Saheb, with 13 years of experience in buildings and appliances efficiency, joined the IEA Energy Efficiency and Environment Division in 2011 and heads the Sustainable Buildings Centre. Before, she was an energy efficiency analyst at IFRI (Institut français des relations internationales).

Buildings account for more than one-third of global final energy consumption, which doubled from 1971 to 2010. Natural gas plays a pivotal role, particularly for space heating and cooking, making the sector second in the use of fossil fuels after electricity generation.

The first step towards improved energy efficiency in the sector is well-designed and effectively implemented and enforced building energy codes.

The evolution of building energy codes

Historically building energy codes were prescriptive, setting requirements on permissible heat loss levels for windows, roofs or walls as well as minimum efficiency levels for heating, cooling and lighting equipment. Though the simplest way to set energy performance requirements, such codes deny designers flexibility to meet individual buildings' needs. A trade-off option, introduced in the 1980s, allows exchanges between, for example, the energy requirements of a building's shell and its heating and cooling equipment.

A building's energy consumption is shaped by a host of factors, so an advanced approach to energy savings – performance-based energy codes – considers a building as a single system and requires minimum energy performance for the entire structure, not just individual components. Thus, building energy codes must balance all factors that influence energy demand.

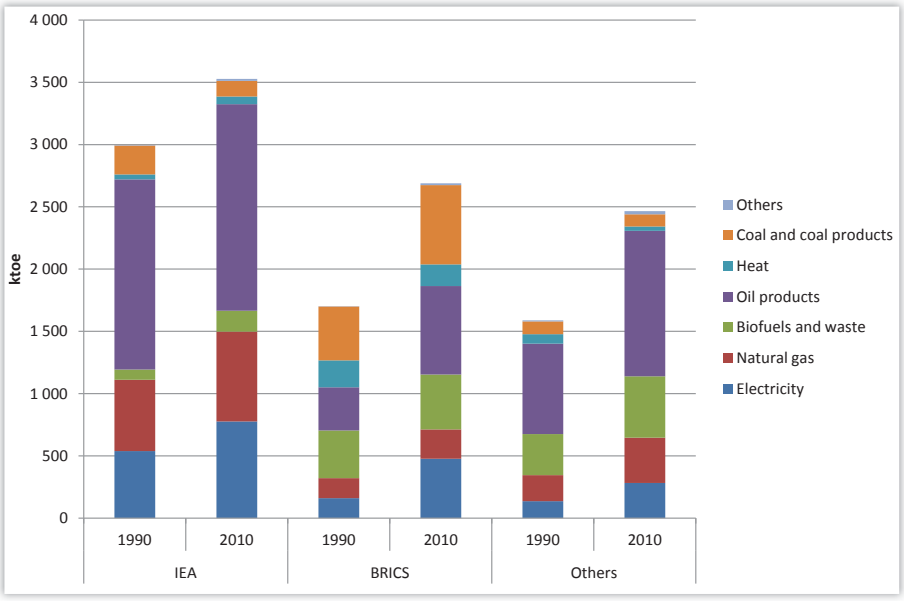
The performance-based policy approach requires an understanding of building science and sophisticated software to handle holistically the multiple factors that influence a building's energy use. These factors include its form and orientation, daylight, solar gains, shading, share of glazed areas, how much solar energy the shell can store passively, natural and mechanical ventilation, indoor comfort, internal loads from appliances and equipment, performance of different components and equipment, use of renewable energy sources, automatic controls and usage patterns, even the colours of the walls and roof.

The need for a broad policy package

The most effective policies go beyond just building codes to incorporate land-use policies – which affect neighbourhood energy and density as well as buildings' volume and orientation – and energy performance labelling programmes that inform consumers and property investors about the efficiency of individual appliances, insulation and other components. Good policies allow for local variances in building design and environmental and socio-economic conditions. Most importantly, they can adapt to evolving technologies and climate change.

Emerging economies offer great opportunities for implementation of best practice for new buildings, since more than half of their building stock expected for 2050 has yet to be constructed.

Toughest to improve are existing buildings – but they are particularly critical in IEA countries, where three-quarters of today's building stock will still be standing by 2050. On average, renovation takes place every 30 years for residential buildings and every 20 years for commercial buildings, and it is the only time owners usually even consider improving the shell or other major components. Worse, when investments, such as new appliances, are made on a product-by-product basis, rather than considering the building as a whole, they actually add to the lock-in effect of delayed improvement.



Buildings' energy use has grown worldwide since 1990, as measured in thousand tonnes of oil equivalent.

Many challenges to implementation

As notes *Building Energy Codes,* an upcoming Policy Pathway by the IEA and the United Nations Development Programme, building energy codes may benefit everyone from office workers to property owners to the global population, but challenges abound in their design and implementation. Barriers include setting requirements well below social optimal performance levels, to allow for a short payback period; the conflicting interests of the sector's multiple actors, such as the different financial priorities for property developers and renters; and limited resources for local governments to implement national codes.

The best way to implement a building energy codes policy, analysis for the Policy Pathway has shown, is for a governmental co-ordination body to ensure the development of training tools and compliance software and to give all stakeholders free access to them.

A BUILDING BLOCK FOR POLICY

THE BEEP DATABASE

The IEA Sustainable Buildings Centre's BEEP database helps policy makers and industry stakeholders analyse energy efficiency policies for the sector.

By Aurélien Saussay

Aurélien Saussay is an analyst in the IEA Energy Efficiency Unit, where he has contributed to a number of publications on the subject. He specialises in modelling, policy analysis and energy efficiency in the buildings sector, and is one of the lead designers of the BEEP database.

Buildings offer the largest single potential for energy savings. To help realise this opportunity, the IEA Sustainable Buildings Centre developed an online analytical tool: the Building Energy Efficiency Policies (BEEP) database.

The buildings sector is very diverse, featuring different segments that range from single-family houses to office buildings to hospitals. Each building is a complex system, and its energy consumption is shaped by interactions among design, environment, function, equipment, usage patterns and occupants' behaviour.

Three main policies deal with this complexity. Building energy codes are the main regulatory instrument to reduce demand, mostly by setting minimum requirements. Labelling programmes inform end-users. Finally, incentives promote improvements in the energy performance of new or existing buildings.

But with hundreds of pages of technical specifications, building energy codes can intimidate the most motivated reader. The ratings in labelling can be unclear. And the sheer quantity of incentive programmes in most countries (*e.g.* more than 1 500 across the United States alone) makes them difficult to analyse. Worse, key technical specifications that characterise each of these policies are often difficult to access and synthesise.

The BEEP database allows policy makers and industry stakeholders navigate this jungle by offering a comprehensive and detailed overview of the energy efficiency policy landscape. BEEP provides detailed information on more than 400 building energy codes, 200 labelling systems and 200 incentive programmes in a synthesised format for 34 countries: the 28 IEA member countries plus Brazil, China, India, Russia, South Africa and Tunisia.

Revealing gaps in existing policies

Building energy codes are the main policy to achieve savings in the sector. But to be effective, they must be mandatory and cover every segment of the sector. BEEP's tracking reveals that while most Group of 20 countries have codes, many of those codes are voluntary or do not cover all building types.

Even mandatory codes are only a starting point. To maximise savings, building energy codes must be performance-based, requiring a minimum energy performance standard for the building system as a whole. BEEP shows that as of last year, only three countries met these criteria for new buildings: Denmark, France and Tunisia. And Denmark was the only country meeting this requirement across all building types.

Database finds shortcomings in policies

IEA member countries have used energy efficiency incentive programmes for buildings widely over the past 40 years. But IEA analysis has shown that these policies do not deliver expected savings. BEEP data reveal that only about three in ten incentives are tied to measurable energy savings requirements, so the majority have no guarantee of effectiveness. Worse, even when measurable requirements are specified, the maximum mandated savings do not go beyond a 30% improvement over existing regulations – essentially the level of added efficiency already provided by technological progress.

An award-winning application

Since BEEP's debut in March 2012, more than 3 000 buildings energy efficiency experts around the world have used the database to learn from other countries' practices when updating their policies. In November 2012 in Monaco, BEEP received the 2012 Energy Efficiency Innovator Award from the Prince Albert II Foundation, Johnson Controls and the Climate Group.

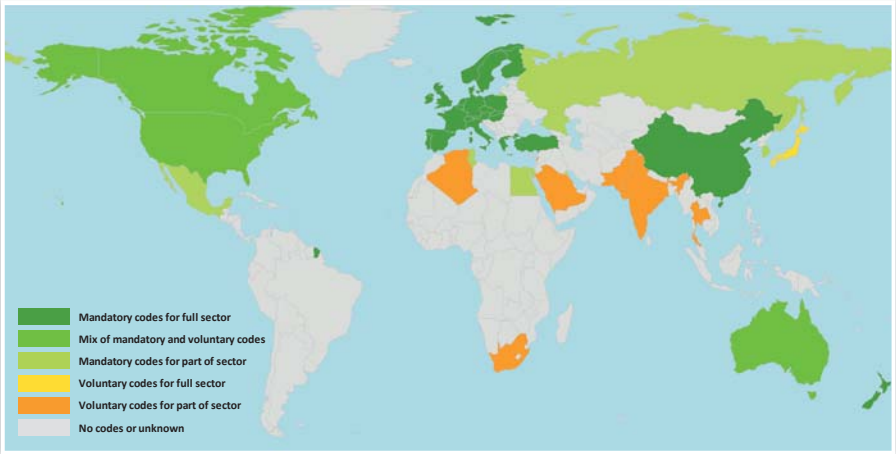
The IEA Sustainable Buildings Centre is expanding BEEP, and users will soon be able to analyse policies across multiple countries simultaneously and to browse an extensive library of energy efficiency papers and publications.

More information at:
www.sustainablebuildingscentre.org/pages/beep

RECRUIT YOUR ENERGY SUPPLIER

25 bright ideas

Ask your electricity provider about programmes to assist with home weatherisation, the installation of smart meters and the purchase of smarter appliances.



The stringency of building energy codes varies widely around the world.

DRIVING NEED FOR FUEL ECONOMY

IMPROVE MY RIDE

From better engines to smoother roads, current technology can cut vehicle fuel use significantly. But drivers and automakers need a push.

By François Cuenot

François Cuenot joined the IEA Energy Technology Perspectives transport team in 2009 and heads work on the Mobility Model that helps project fuel demand and associated emissions to 2050. He also leads IEA efforts in the Global Fuel Economy Initiative and the Sustainable Low Carbon Transport partnership.

Transport offers the easiest path for reducing oil dependency in theory: simple, readily available solutions promise a 30% to 50% improvement in fuel economy, depending on the country, while reducing carbon emissions by several gigatonnes of CO_2 each year.

Technologies now available to reduce fuel use include better engines and transmissions, improved aerodynamics and tyres, and more efficient auxiliary power systems such as lights, heating and air conditioning. By 2020, such advances promise a 15% gain in efficiency for new vehicles powered by conventional gasoline engines: 28% for diesels and 44% for full-hybrids, the US National Research Council says (versus a 2005 conventional gasoline vehicle). By 2035, down-sized gasoline- and diesel-engine vehicles should be nearly 50% more efficient than today, with hybrids nearly two-thirds more efficient.

But while auto manufacturers steadily deploy new technologies in vehicles, uptake for efficiency is slow, as with hybridisation, or the gains are used for purposes other than improving fuel economy, such as increased power.

Roadblocks to higher efficiency

Several market-related barriers reduce both manufacturers' and consumers' incentives for greater fuel economy.

To make informed decisions, consumers need to know about the efficiency of a vehicle. Trustworthy and widespread information about fuel economy requires labelling and ratings based on improved testing methods that reflect real-world driving conditions. Owners also must accept realistic discount rates for cars to correctly calculate repayment periods.

Low prices, and especially subsidies, for fuel limit efficient vehicles' economic return to individuals and companies, making it hard to justify any extra up-front cost. Similarly, uncertainty about oil prices can discourage buyers from purchasing more efficient vehicles.

These factors affect the payback period, with advanced gasoline engine and hybrid vehicles requiring a lengthy five-plus years. On a societal basis, however, fuel savings and forgone emissions over the average life of a car far exceed the cost of the new technology.

Educating drivers and equipping vehicles with gear-shift indicators and fuel-use displays can correct wasteful driving habits. Eco-driving measures can lift fuel economy by up to 10%. Smoother road surfaces can save up to another 10%, while better traffic flow reduces rolling resistance as well as stops and starts.

Implementing the right policies – now

In the prize-winning reports *Technology Roadmap: Fuel Economy for Road Vehicles* and *Policy Pathway: Improving the Fuel Economy of Road Vehicles*, the IEA tells how countries can encourage more efficient road transport. Some countries have long had programmes aimed at greater fuel economy, but such major OECD markets as the United States, Japan and the European Union only recently adopted strong measures. China, too, has adopted tough policies, but most other major emerging economies lack fuel economy standards, fiscal measures or even fuel economy labelling programmes.

Time is running out. It takes a government up to two years for the full analysis, stakeholder engagement and final rule-making required to plan and develop a policy. In addition, manufacturers need at least two years from the final development of the policy to respond with changes to their product plan; three to five years offer full flexibility for them to meet the requirements at a lower cost. Allowing the three to five years also permits tougher targets because manufacturers can react more effectively and improve the cost-effectiveness of their solutions.

The IEA recommends a ten-year horizon for regulation to give a clear signal for tighter standards coming in the future.

ON THE ROAD

25 bright ideas

- When buying or renting a car, examine fuel-economy labels and ask your salesperson about the most efficient models.
- Find out whether your government has a programme to promote high-efficiency vehicles, *e.g.* a tax deduction for more efficient vehicles.
- Get the most out of your car's non-engine components:
  - Try using vents to air the car, rather than fuel-hungry air-conditioning and window demisting systems. Use reflective windscreen shields to keep the sun out or heat in while your car is parked.
  - Check your tyre pressure. Even 0.5 bar below the manufacturer's recommended pressure will increase wear and tear, along with fuel consumption, by 2% to 3%.
  - When you buy tyres, look for labels showing low rolling resistance to ensure better gas mileage as well as a smoother ride.
  - Service your car regularly. A properly maintained car with good engine lubrication, wheel alignment and well-adjusted brakes will reduce your fuel consumption.
- Practise eco-driving to improve your gas mileage:
  - Avoid sharply accelerating your engine.
  - Maintain a steady speed and use higher gears.
  - Even if you only have to wait 30 seconds, it is more economical to switch off your car's engine and then restart it when necessary.
- Consider walking, riding a bike or taking public transport instead of driving, especially for short journeys.

More Information: http://bit.ly/X0IHV16

END-USE DATA, PLEASE

By Jean-Yves Garnier

Jean-Yves Garnier joined the IEA in 1995 and heads the Energy Data Centre. Before coming to the IEA, his career spanned over five years in Indonesia, three years in Ivory Coast, two years in Djibouti, two years in Berkeley and the rest in Paris, where he was in charge of National Energy Plans and energy-efficiency policy as well as building energy information systems.

Energy efficiency is high on the political agenda. There are many reasons for that. However, if the declaration and the intention are welcome, there is often a cruel lack of detailed data for policy makers to correctly appreciate the situation and consequently optimise policy and measures.

In the past, the standard in energy statistics was the energy balance, a convenient table for a first grasp of energy production, trade, stocks, transformation and consumption by fuels and sectors. While the balance allows policy makers to build a few useful indicators such as dependency and intensity, it is too limited to bring meaningful information in terms of energy efficiency, except maybe for the transformation sector (power plants, refineries, etc.).

Indeed, energy balances give data only at the sectoral level (such as transport, services or residential) and do not provide information on end uses (heating, lighting, appliances …) or on specific categories (*e.g.* trucks, cars or two-wheelers). Moreover, energy balances do not provide any activity data, which constitute the essential denominator of any useful energy efficiency indicator.

For instance, while a balance shows the residential sector's overall consumption, a more meaningful energy efficiency indicator would be the heating consumption per square metre or the average consumption per type of appliance; while a balance shows the overall consumption of the road transport sector, better indicators would include the average consumption per passenger-kilometre or per tonne-kilometre.

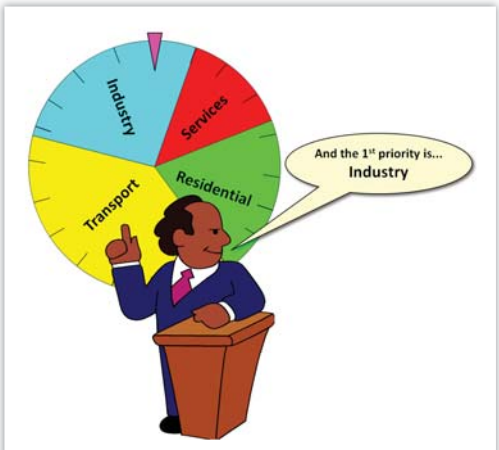
As a consequence, for energy policy makers to have the means to realise their ambitions, there is an urgent need to allocate the necessary resources for collecting more detailed data on both end-use consumption and activity. Such statistics are the basis for assembling indicators which are needed to assess the current situation, identify priority sectors, prepare appropriate measures and then monitor progress or failure.

Ministers of IEA member countries have understood the need and the urgency. In 2009, they agreed to a new annual questionnaire dedicated to energy efficiency. Since then, the IEA Secretariat has collected statistics on both end-uses and activity on an annual basis. The data are then used to assemble indicators which constitute the basis for many studies and analyses. This is certainly an important step forward but there are still major issues regarding missing data or data quality.

In line with the launch of the questionnaire, more and more countries have asked the IEA Secretariat for assistance on which indicators to build, what data to collect and – most importantly – how to collect these data. As the IEA assisted countries with basic energy statistics and balances when it published the *Energy Statistics Manual* with Eurostat, it is preparing a *Manual on Energy Statistics for Energy Efficiency Indicators*. The focus of this new manual will not be on data or indicators, but on what data to collect and how to collect consumption and activity data.

There are four main methodologies for collecting both consumption and activity data: surveys, modelling, measuring or metering, and administrative sources. For each of these, the manual will give examples of good practices in countries around the world; the book will present about 160 practices, equally distributed among the residential, services, industry and transport sectors.

There is an urgent need for more data, and we hope that the manual will help countries in launching more ambitious and optimised energy efficiency measures. As energy statistics are the basis for sound energy policy, they are also the basis for any sound energy efficiency policy.



Formulating proper action plans requires more than gambling.

IEA Key World Energy Statistics: use this QR or go to http://bit.ly/WeYGW1 for the app that puts the most critical energy data on your iPhone or iPad.

A BUSINESS LEADER SPEAKS

JEAN-PASCAL TRICOIRE

Schneider Electric's CEO and President shares how energy efficiency more than aids countries, companies and citizens – it also pays for itself quickly.

Our planet is facing an unprecedented energy challenge: even assuming that all recently introduced energy efficiency policies are implemented with full success, global primary energy demand is still expected to increase by 35% by 2035. This would have a dramatic impact on energy costs and energy security, competition for resources, access to energy for societies' poorest people, economic growth – and of course climate change.

Boosting energy efficiency in the major energy-consuming sectors of industry and buildings could help a country reduce its overall energy use by 15% to 25% – in effect significantly altering its energy mix and improving its energy security.

This is why we at Schneider Electric believe that the best watt is the negawatt, the one you save or don't use.

Energy efficiency is therefore essential. It matters for both new and mature economies; it matters for citizens, governments and companies. And for the first time in history, technology is able to provide cheap and efficient solutions, and generate a step change in the way we use energy.

Immediate return on investment

In mature countries, the biggest potential for energy efficiency is in the buildings sector, while in new economies the potential is both in buildings and industry.

Looking at industry, energy efficiency means significant savings on energy costs, and therefore increased competitiveness. It also means reducing the carbon footprint – a growing requirement of stakeholders, as well as a matter of regulatory compliance in many countries.

More generally, 60% of industry's electrical consumption is used by motors, one-third of which are pump or fan applications. Simply adding a speed drive to the motor results in dramatic savings: up to 50% for a fan – with payback within a year – and up to 30% for a pump – with payback within two years.

And this is just one simple solution. An integrated approach, looking at both processes and energy and based on dedicated software suites, can lead to significant additional savings.

Buildings are the single largest end-user of energy, and their demand for energy is forecast to grow by almost 30% by 2035. Buildings show the largest untapped potential for energy efficiency.

True, increasingly stringent regulations for new buildings mean overall more energy-efficient buildings – even if most such regulations tend to focus on just passive efficiency rather than combining it with active energy controls.

Still, 80% of potential savings are not addressed today!

There are two main reasons for that. The first is that buildings are very diverse: for example, there are old and new buildings; public and private ones; buildings owned by one person or company or by many; commercial, industrial or residential buildings. The second is that they have a very complex and fragmented value chain, involving energy suppliers, utilities, building operators, real-estate companies, owners, tenants, investors ... This makes implementation difficult, incentives split or at least non-targeted, and progress slow and hard to measure.

This being said, the IEA shows that the cumulative additional investments in energy efficiency between 2012 and 2035 would be more than offset by the energy bill savings they would deliver over the same time frame.

This is a payback that's hard to beat!

Schneider Electric's "active" technologies

A few years ago, passive energy efficiency (mostly insulation and double-glazing) was the only option for savings. Today, the convergence of the worlds of energy and information technology, the so-called Internet of things, is making intelligent energy – as well as smart

HOW THE IEA HELPS

IEA-Schneider Electric collaboration in the IEA Energy Business Council and through the *World Energy Outlook* combines the Agency's energy knowledge with Schneider Electric's technology expertise when it comes to testing future scenarios.

This collaborative work centres on the need for a new, pragmatic approach that combines policy, financing and technology

- For the policy part, energy efficiency should be included in the decision-making process of governments, companies and society. Efforts should be focused towards the sectors with the biggest potential – such as buildings.
- For the financing part, appropriate business models and financing instruments should be created – such as performance contracting.
- For the technology part, the most effective technologies – such as active controls – should be subsidised, and the least effective ones discouraged.

The focus on energy efficiency in the current *World Energy Outlook* should help unlock the potential of energy efficiency. And because energy efficiency requires continuous support, we at Schneider Electric hope that the next edition will show that significant progress has already been made.

Jean-Pascal Tricoire, ©Schneider Electric SA

Its energy management control room has helped Schneider Electric cut per-employee energy usage by 10%.

buildings, smart plants and even smart cities – an affordable reality. These new technologies enable what we at Schneider Electric call "active energy efficiency".

Active energy efficiency means optimising the entire energy cycle through active control.

A simple example is to automatically adjust meeting rooms' lighting and heating to occupancy – in effect adapting the building to the people in it, while improving users' comfort thanks to smarter control. Most places are unoccupied half of the time, so you can save a lot by simply switching off their equipment when not in use.

Active controls connect people to their environment, buildings, cities. They enable immediate efficiency and savings; they allow communities to share energy better, making sure people do not all consume energy at the same time, which generates inefficient and disruptive peaks of consumption; and they provide full transparency on performance, empowering people to change their behaviour.

Schneider Electric is one of the few companies to have taken a strong position in support of energy efficiency by developing competitive offers for all its strategic end-markets.

We provide products, systems, software and services that make energy safe, reliable, efficient, productive and green. This allows our customers to better manage energy in their homes, buildings, industrial facilities, data centres, electricity networks and urban infrastructures.

Efficiency starts within the company

Our own Schneider Energy Action programme aims at:

- achieving continuous reduction of electricity, gas and oil consumption;
- deploying our own hardware and software solutions across our sites; and
- raising employees' awareness of our latest energy efficiency offering.

We have published details of the energy consumption of 160 of our production and logistics sites every year since 2005. The data show that we have met the objective of reducing energy consumption by 15% since 2005, and we have a new objective to save a further 10% by 2014 through deployment of more complex solutions:

- connecting of all sites larger than 5 000 square metres to our energy-monitoring platform;
- implementing our Resource Advisor software, which makes it possible to access energy bills, check their accuracy, optimise supply contracts and save on unregulated markets; and
- deploying ISO 50001 certification on 20 sites and implementation of a global service contract in order to maintain the savings.

"HOMES" IS WHERE EFFICIENCY IS

The HOMES (Homes and buildings for Optimised Management of Energy and Services) project began in 2009 and was completed at the end of 2012. With a group of 13 research organisations from both the public and private sectors, Schneider Electric took a fresh look at significantly improving the energy performance of existing building stock. The project covered all steps of a development project: marketing, architecture specifications, technology research, prototype development, an assessment platform and communication.

HOMES covered three main areas of research:

- information systems that allow a building's stakeholders – owners, occupants, service providers, technicians, managers – to make decisions that optimise energy performance and drive behaviour change;
- tools and methods that allow the market to come up with an optimal design for the building, making long-term operation and maintenance more efficient; and
- optimisation of building and machinery performance via active controls – because one of the key lessons is that energy efficiency is closely linked to a building's actual use – *i.e.* to the activities going on inside. Buildings are where people live, work and play!

The results show that active energy efficiency solutions can yield energy savings ranging from 20% to 50% in existing buildings, with payback in two to five years.

All large facilities, including the Paris region Hive office park, link to the company's energy-monitoring platform.

International Energy Agency

www.worldenergyoutlook.org

WORLD ENERGY OUTLOOK

A new global energy landscape is emerging, resetting long-held expectations for our energy future. Incorporating these recent developments and world-class data and analysis, *WEO-2013* presents a full update of energy projections through 2035 and insights into what they mean for energy security, environmental sustainability and economic development. Oil, coal, natural gas, renewables and nuclear power are all covered, with more country-level detail than ever before.

This year's *WEO* also offers special insights into these topical issues:

- **Climate change and the energy sector**, highlighting the energy sector's key role in climate change mitigation, adaption strategies, and the potential "carbon bubble", which could leave energy assets stranded.
- **The prospects for energy in Brazil**, analysing how to meet the energy needs of a dynamic economy as well as the potential to develop the country's resource base, from renewables and biofuels to new offshore discoveries.
- **Prospects for oil supply, demand and trade**, including field-by-field analysis of decline rates, the global potential for light tight oil and the outlook for developments in refining.
- **The global spread of unconventional gas supply**, including the uptake of the IEA's "Golden Rules" to address public concerns about the associated environmental and social impacts.
- **The extent of fossil-fuel subsidies in the Middle East** and what their phase-out would do for oil export volumes and revenues.
- **Energy trends in Southeast Asia**, a region that is exerting a growing influence in the global energy system.

The *World Energy Outlook* is recognised as the most authoritative source of strategic analysis of global energy markets. It is regularly used as input for the development of government policies and business strategies and raises public awareness about the key energy challenges facing the world.

2013

RELEASE: 12 NOVEMBER

A BUSINESS LEADER SPEAKS

VOLKMAR DENNER

Technology and social momentum are key to energy efficiency, Robert Bosch GmbH's Chairman of the Board of Management says.

How the world can satisfy its hunger for energy in the decades to come is one of the most important questions of our time. Up to now, the global expansion of renewables and the future of electricity generation were much in the centre of the energy discussion. I propose to take a broader view. Improving energy efficiency and redesigning power generation must go hand in hand. According to the IEA, the share of global electricity supply provided by renewables could reach 30% by 2035. The remaining 70% will have to be met by conventional sources of energy. However, their supplies are finite, their costs are to rise and the impact of their use is climate-damaging.

Only by radically improving our track record in energy efficiency can we reduce energy consumption, secure supplies, lower the price tag on the deployment of renewables, reduce CO_2 emissions and cushion the rise in energy prices for consumers and businesses. Accordingly, as we progress towards an energy supply based on renewables, greater energy efficiency will play a key role. Not to focus on energy efficiency would be detrimental – for the environment, for industry, for consumers and for society as a whole. The costs associated with failure are high – the benefits associated with success are even higher: not only do societies and the environment profit from less energy being used, companies do as well.

We expect energy efficiency to be one of the major success factors for our future business at Bosch. In nearly all our business units, we are working on technologies and services which will help customers to be more energy-efficient than before. We have set up a new business sector, Energy & Building Technology, to maximise synergies and create new business opportunities. Bosch already generates more than 40% of its sales with technologies and products that protect the environment and conserve resources.

However, on a worldwide scale, things are not moving fast enough. By now, we are off track to achieve the 2°C target. According to the IEA, an efficiency strategy pursued vigorously worldwide would close the gap to achieve the 2°C target by half. IEA figures show the potentials – but societies are not yet on the right path.

What can our company contribution look like – as a global technology leader and as a corporate citizen?

First, I would like to explain that advanced technology is the cornerstone of any energy efficiency strategy. To shrink back from the "boundaries of growth" is not a solution. We have to work hard to develop and deploy relevant technologies in all fields of consumption. Bosch is determined to play a major role here.

Second, behaviour and attitudes of people are just as important. Therefore, energy efficiency has to gain a firm place at the centre of society. Otherwise, the widespread use of those advanced technologies will not take place. Industry can contribute here by leading by example. But politics has to play its role as well.

In the following, let me go in more detail with these two arguments:

First pillar: technology as basis for success

Advanced technology is a prerequisite for energy efficiency and a source of economic opportunity as well. Some examples from our four business sectors illustrate this.

Sustainable mobility: Transportation accounts for 28% of global energy demand. And the number of vehicles on the world's roads is set to rise. Thus, we need to use a wide range of technologies to improve efficiency and reduce CO_2 emissions. In the years to come, internal-combustion engines will make the greatest contribution to this. Use of technologies available today can achieve significant reductions in consumption and CO_2 emissions of internal combustion engines.

Nevertheless, the future belongs to electromobility. Bosch is involved here, too, with essential components such as electric motors, power electronics, energy-recovering braking systems, and battery systems. Fun to drive, comfort and affordability are decisive for the breakthrough of e-mobility products. With these, e-bikes have become a success in a short time.

With full electric vehicles we still have a long way to go. Therefore, innovative hybrid engines have to accompany us. Plug-in hybrids especially offer an excellent combination of pure electrical driving in urban areas and long-distance mobility in the same vehicle. As an alternative, hydraulic hybrid powertrains allow us to improve fuel consumption and reduce CO_2 emissions of mobile machinery, buses, and garbage-collection vehicles.

In the future, we want to take advantage of the benefits of hydraulic accumulators – robust energy storage devices that, since they require no battery, are comparatively inexpensive – in passenger cars as well and herewith contribute to fuel savings of up to 45% in urban traffic.

Efficient production technology: Like nearly all everyday products, cars and commercial vehicles have to be manufactured. And industry accounts for 32% of global energy consumption.

Let me give you a simple example, from the middle of the value-added chain, of how energy consumption can be reduced: folding presses are used to bend housings for appliances such as refrigerators and washing machines. Our Drive and Control Technology division has developed a "Rexroth for Energy Efficiency" programme, or 4EE for short, which allows industrial systems to be optimised by means of integrated energy system design, efficient components, energy recovery and storage, and energy on demand. After being redesigned on the basis of this methodology, a folding press consumes up to 44% less energy. We have to use this approach to address all processes in the value-added chain: in the case of the housings, from the production of the metal to the final spray of paint. ►

Volkmar Denner: © Robert Bosch GmbH

Efficient building technology and designs: Buildings account for 40% of today's global energy demand. For this reason, we need to improve the efficiency of existing buildings as well as to develop innovative designs for new ones.

With modern heating technology, hot-water boilers and control systems, we can already save a lot of energy. Especially in commercial buildings, we see huge possibilities by involving external service providers to offer overall management services. In particular, by creating Bosch Energy & Building Solutions, a new unit that specialises in integrated concepts for commercial buildings, we want to transform the experience we have gained with our own buildings into a business opportunity.

Pointing the way to the future, there is the energy-plus house, a house that creates more energy than it consumes. In a recent demonstration project we showed that such a house is both possible and affordable with present-day technology. Like in industry, we rely on integrated approaches which include new concepts for generating electricity and heat (such as photovoltaics and electric heat pumps), other efficient building technologies (such as those that ensure the best possible ventilation) and efficient A+++ class household appliances. And economical energy-storage devices can optimise occupants' power consumption even further, which is another reason for increasing research into battery technology.

Research and development: All these solutions are rooted in our research and development (R&D) work. With more than 40 000 researchers working at more than 80 locations worldwide, Bosch spends more than 45% of its R&D budget on technologies that protect the environment and conserve resources. In 2012, our R&D budget amounted to EUR 4.5 billion – more than 8% of our sales revenue. That year, we applied for more than 4 700 patents worldwide. This is strong evidence of our aim to drive innovation. This innovation mind-set is part of our Bosch DNA.

Taken together, we are confident that technologies we and others propose can make a significant contribution. However, technologies need to be adopted by societies, and they need a positive political framework.

Second pillar: creating social momentum

Energy efficiency has to gain a firm place at the centre of society. The IEA's latest *World Energy Outlook* says that efficiency solutions are not being promoted fast enough in the market to make a substantial contribution to affordability, climate protection and security of supply. Energy efficiency has to be an essential consideration in the many thousands of investment decisions made by companies and consumers every day. Only then will society reap the rewards of the efficient use of energy.

Everyone speaks about saving taxes, while scarcely anyone speaks with the same passion about saving energy. But this should be our objective. There have already been some steps in the right direction: besides progress in e-mobility, systems for labelling household appliances' power consumption are already being used successfully in Europe and there is debate about the need to modernise housing. And even debate about electricity prices has its positive side, since it means that energy efficiency is beginning to take on relevance for society.

Leading by example: To promote this process, Bosch – in the tradition of the company – has decided to lead by example. Bosch has set itself the target of reducing its relative CO_2 emissions by 20% by 2020 from their 2007 levels (related to our value-add). In all our business sectors, for example, we continuously analyse our building designs, manufacturing facilities, processes and machinery. Best practices are exchanged worldwide in an energy efficiency forum. The results are very promising. From 2007 to 2012, we reduced our relative CO_2 emissions by 15%. Emissions reductions of more than 30% have been possible in plants that have completed the implementation phase.

Pointing the way to the future: the energy-plus house generates more power than it consumes. Bosch recently demonstrated such a home built with present-day materials.

Energy-plus house: © Robert Bosch GmbH

Apart from the responsibility that industry itself is taking on, there is also a need for political action. It is positive that the European Union and Germany have set ambitious targets. By 2020, EU energy consumption is to be reduced by 20% compared with the forecast figure for 2020 derived from the "business-as-usual" scenario based on the "PRIMES" energy model. Germany has set itself the target of improving its energy efficiency by 2.1% per annum through 2050. In China as well, energy efficiency is on the political agenda: following a 21% reduction in energy intensity between 2005 and 2011, the country's current Five-Year Plan aims for a further 16% reduction by 2015. Many other regions of the world embrace strategies to enhance energy efficiency.

Sending the right political signals: To allow as many consumers as possible to make intelligent use of existing energy efficiency technologies, politics must create positive framework conditions. But the aim cannot be an all-embracing regime of energy efficiency regulations. Economic advantage is the most important driver of efficiency technologies. Efficiency solutions offer win-win situations – for companies and customers, since they save energy costs, and for the environment, since emissions are avoided.

An implementation strategy must remove the investment and political obstacles to energy efficiency. The essential obstacles are:

- Awareness of the problem: for many households and companies, energy costs are still not a sufficiently significant cost item compared with other expenses.
- Information asymmetry: decision makers frequently do not have enough information about energy consumption and energy-saving potential. To make things worse, energy efficiency measures call for an integrated approach – something in which neither companies nor private households have a lot of practical experience.
- Limited capital expenditure budgets: only in rare cases are investments in energy efficiency part of the "core business" of companies and consumers. Even if such spending makes economic sense, it may be excluded when other projects are competing for funds, even when the payback periods are short.
- No one-size-fits-all solutions: energy efficiency is a highly complex issue for politics, too. As far as political framework conditions are concerned, different approaches are needed for existing and new buildings, appliances and machinery. Moreover, the specific characteristics of every energy-using sector have to be taken into consideration.

E-bikes are already a success; electric vehicles will follow. Bosch is actively involved in e-mobility.

In order to address these obstacles, the following measures are of key importance:

1. Create transparency and improve education

The relevance of consumption and energy-saving potentials needs to be made far more transparent. In the European Union and Germany, an important step has been taken in the form of regulations for the introduction of energy audits and energy management systems. This also systematically cements energy and environmental issues in corporate policy.

For the decision on implementation measures, qualified information and advice are crucial. We have already developed such programmes in our Drive & Control Technology division. What the market still lacks, however, is strict, certifiable quality standards capable of creating the level of trust customers need when making investment decisions.

2. Set intelligent standards for key products

With its Ecodesign Directive, the European Union has created an important basis for efficiency standards for new products. With an ambitious programme to make these standards progressively stricter over a fixed period, important incentives will be created for efficiency in the commercial, industrial and private spheres. This approach should be used in the future for other standardisable products whose energy consumption can be reduced. Fair competition and maximum transparency for consumers are decisive.

3. Make use of innovative financing instruments

Wherever budgets are insufficient for such capital expenditure, thought should be given to innovative financing models such as public-private partnerships or contracting solutions. In small and medium-sized enterprises in particular, there is room for improvement. Moreover, the conditions for contracting must be optimised by enhancing the legal regulations for public- and private-sector clients. Another option might be publicly or privately initiated fund solutions that pay for themselves on the basis of the energy cost savings they make.

4. Paving the way for new services

One gap in today's market is the lack of services that make energy saving attractive. In adopting the Energy Efficiency Directive, and especially in allowing the option to introduce energy efficiency obligation schemes, the European Union has created a basis for closing this gap. If they are properly structured, such systems can create incentives for realising economic efficiency potential, and at the same time help the idea of energy efficiency take firm root in the mainstream.

The debate about ways and means of achieving more energy efficiency must become more intensive on all levels – in politics, industry, and society. The IEA will also play its part, with well-researched, comprehensive and regularly published data relating to all significant energy indicators worldwide. Its publications draw more attention worldwide to the subject of energy efficiency. One successful example is the *World Energy Outlook 2012*. The energy efficiency scenario it presented for the first time brought the issue back to where it belongs: at the heart of the energy debate.

Electric bike: © Robert Bosch GmbH

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FOCUS

ASIA: THE NEW HUB FOR OIL REFINING?

By Toril Bosoni

Toril Bosoni joined the IEA in 2001 and is in charge of the refining and product supply analysis in the Agency's monthly Oil Market Report *and the annual* Medium-Term Oil Market Report. *Before, she handled oil and gas statistics with extensive work on biofuels and on trade and demand modelling.*

The global map for refining is being ripped up and redrawn as the main players of yesteryear – OECD countries – yield before a surge in new refining capacity in Asia and the Middle East. The shift in refining presence reflects the overarching story of how non-OECD oil demand could overtake OECD demand within a year. But it also brings increased product exports, creating capacity surpluses in developed countries above those resulting only from structurally declining demand. Imbalances in product demand growth, heavily biased towards distillates, are expanding trade opportunities for oil products, to the benefit of the new refiners.

The two biggest players in the refining boom are China and India, whose significant expansion in capacity is a major, if underreported, component of their surging economies and their growing export muscle regionally and globally. The IEA forecasts that China will increase its refining capacity by as much as 2.9 million barrels a day (mb/d) over the next five years, but other observers, including the Chinese oil giant PetroChina, see growth of as much as 5 mb/d to 15 mb/d by 2015. Meanwhile, Indian capacity has already increased by almost 50% in the last five years, adding 400 000 barrels a day (400 kb/d) of capacity in 2012 alone to approach 5 mb/d, with even more growth scheduled for 2013.

Slowdown lifts China's export options

Domestic demand is rising sharply in both countries, but a late-2012 surge notwithstanding, the medium-term outlook for Chinese demand has eased on signs of a slowing economy. As a result, China could develop surplus processing capacity, allowing it to export refined products to neighbouring countries and further afield to rival India as an exporting leader in the region. India already posted record exports last year, mainly within Asia but also as far away as Europe and Latin America.

While India has become firmly entrenched as an exporter because of private companies that are allowed to sell internationally at market prices, China is just getting started. It exported less than 50 kb/d net of gasoline and similar products last year, while not producing more than it needed to meet domestic demand for middle distillates such as kerosene or diesel. And the country averaged net imports of 250 kb/d of fuel oil. Beijing only recently granted the first foreign-financed project permission to buy and sell oil products for export.

But with Asian demand surging and China adding capacity in the famously cyclical refining sector, the country is on track to become not only a regional exporter but a global one as well. If it imported crude oil for refining at the expense of other, less competitive, regions, it could in theory produce a surplus of 1.2 mb/d of products as of 2017. Potentially building up to that, Chinese firms are already increasing their use and ownership of independent storage facilities in European and Caribbean ports, as well as in Asia. While the potential is there, in reality expansion plans are more likely to be delayed to more closely match internal product demand. That was already seen in 2012, when project deadlines were allowed to slip because of lower demand growth.

Indian exports are already in many of those ports, as the country accounted for nearly half of last year's global increase in crude oil processing. Total product exports from India reached 1.5 mb/d in 2012, according to a government monitor, with diesel and gasoline accounting for 39% and 25% of the total, respectively.

Vying with Middle East and United States

But even as India and China push forward at the expense of OECD refineries, they face their own rising competitors: new large and sophisticated facilities are being commissioned in the Middle East, whose competitive advantages include lower shipping costs, particularly for European markets. Saudi Arabia's 400 kb/d Jubail refinery is due to start up soon, followed by other large projects in the United Arab Emirates and elsewhere in Saudi Arabia over the period of 2014 to 2017.

Finally, product exports from the United States continue to increase on the back of surging North American oil production, further boosting international supply.

As its oil-processing capacity grows, China can become a regional rival to India in exports of distillates.

Oil refinery: © shutterstock.com

EUROPEAN GAS: A LOST DECADE?

By Anne-Sophie Corbeau

Anne-Sophie Corbeau is an IEA Senior Gas Analyst. She previously worked at Cambridge Energy Research Associates, focusing on European gas markets, and in Peugeot's fuel cell and hydrogen department. She studied engineering in France and Germany.

Like an athlete striving to re-attain past glories, European gas companies, along with their suppliers, look at domestic consumption and wonder, "When will it return to the record level of 2010?"

European OECD member countries consumed 570 billion cubic metres (bcm) that year, an 8% gain that more than wiped out the 6% drop in 2009 caused by the economic crisis.

But, as the IEA warned in the *Medium-Term Oil and Gas Market Report 2011*, that dramatic increase was an illusion, with half of the gain driven by a particularly cold winter. The milder 2011, along with anaemic economic growth and higher gas prices, indeed saw a 9% decline in demand. Neither the economic nor the pricing environment improved in 2012, and demand seemed set to decline by 3%, getting close to the 500 bcm mark. Seasonally-adjusted gas consumption has actually lost ten years of gains, and a few countries, such as the United Kingdom, are back to levels unseen since 1995.

Only five years ago, most scenarios assumed that European gas demand would be well above 600 bcm in 2015 and around 700 bcm by 2030, driven by the power sector. Gas-fired plants were to benefit from their lower CO_2 emissions compared with coal and their complementarity with renewables. Only scenarios featuring a strong increase of nuclear, renewable energy or both, plus drastic improvements in energy efficiency, were expected to dampen or reverse this growth track, and even then only in the long term (post-2020).

Delving into the details to find the cause

The economic crisis, persistent high gas prices and the still-unabated growth of renewable energy completely changed this outlook, and some analysts consider a recovery to 2010 levels by the end of this decade quite optimistic. But we should be careful about "over-negativising" the overall prospects for gas and instead analyse sectors individually.

The residential/commercial sector, the backbone of European gas consumption with 38% to 40% share of the market, looks unlikely to make huge gains, given only modest population growth and governmental efforts to incentivise energy efficiency in existing and new houses. Moreover, increasing prices in most countries are prompting users to lower thermostats whenever they can. Unless the European climate gets much colder – are we not worried about global warming – there is little hope for major gains in this sector. Instead, companies are counting on a stabilisation.

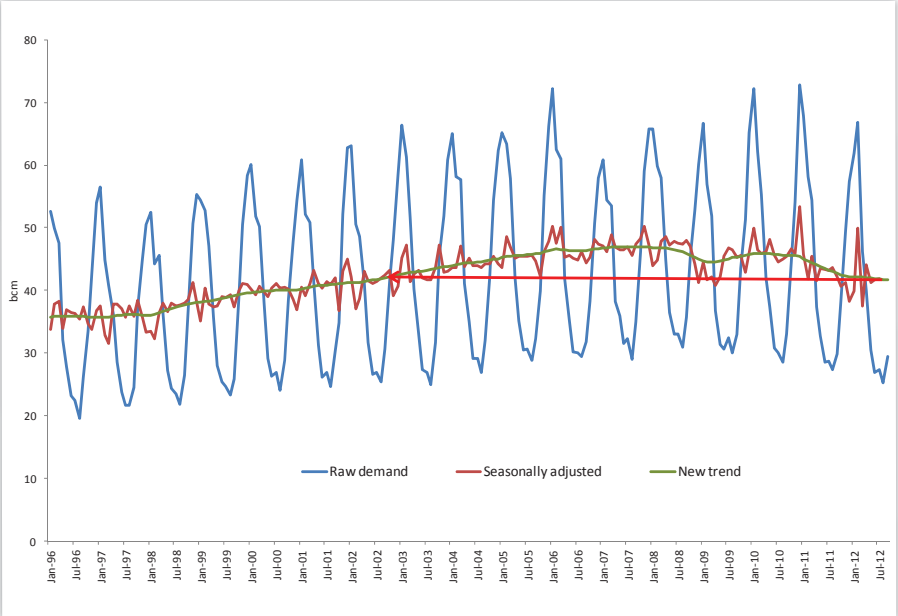
Industry has never quite recovered from the economic crisis. Indices on production in manufacturing are below their 2007 levels in most European countries, which translates into lower energy consumption. Another blow originates from North America, where wholesale gas prices are one-third to one-quarter of the rates in Europe, giving fertilisers and chemicals industries there an unprecedented advantage. Only an improved economic outlook or much lower gas prices would trigger a recovery in this sector, and both look relatively unlikely in the medium term.

Power generation is where much hope lies, even if it was the major driver for the recent sharp drop in demand. Gas-fired plants are suffering not only from low growth in electricity demand (with Turkey alone providing two-thirds of the initial increase in 2012), but also continued strong growth of renewables, including an almost 30% increase over the first nine months of 2012, and a lack of competitiveness against coal-fired plants. Ironically, the United States, where low gas prices are prompting a switch from coal, is exporting cheap coal and triggering a golden age of coal in Europe, despite the Emission Trading Scheme's price for carbon.

Decommissionings may power a recovery

But additional nuclear plants will be decommissioned by the end of the decade as well as many coal-fired plants after 2015 under the European Union's 2001 Large Combustion Plants Directive. To what extent this will drive an increase in gas demand depends on how the gap between power demand and renewables generation will be filled. Gas was once seen as the fuel of choice, then the default fuel, but now power producers are reluctant to invest in gas-fired plants if those are to run only a few hundred hours each year as complements to other, variable energy sources, instead of the 4 000 hours in previous economic models. Additionally, the question of dispatch between gas- and coal-fired plants will hinge on the delicate balance of future coal, gas and CO_2 prices.

The uncertainties are considerable for those investing all along the gas value chain – and therefore for future security of supply.



As shown by the bright-red horizontal arrow, European gas demand ended the past decade virtually unchanged.

THE RE-GREENING OF OPEN-PIT MINES

By Carlos Fernández Alvarez

Carlos Fernández Alvarez joined the IEA in 2010 with more than 20 years of experience in the energy sector. He began as a consultant for electricity producers, focused on system modelling and nuclear plant safety assessments, before joining the Spanish government.

Open-pit mines will not disappear soon, no more than coal usage will. From Mozambique to the west of the United States, companies are using open-pit mining as a low-cost way to recover the fastest-growing energy source. At 28% of total primary energy consumption, coal is second only to oil as a fuel, and the gap is shrinking quickly.

A new approach to re-greening open-pit sites allows companies to use their powerful operating equipment during the mining to repurpose the landscape more cheaply and effectively than past efforts to restore the deeply scarred areas to their pre-mining states.

Open-pit mining involves the removal of so much coal and other materials that returning a mined area to its original state has proved virtually impossible, no matter what the technical and financial resources invested. Instead, companies increasingly are leveraging their operations' economic and technical capacities to repurpose an affected site and its surroundings into a different post-mining area that is often more useful to nearby communities than was the space before extraction.

To limit cost, a company must develop its plan before mining starts, as the shaping of the land affects operations. Timing the mining machinery's work with the grooming in mind significantly reduces the effect on expenses.

Examples on three continents

One open-pit mine that was repurposed with environmental concerns in mind is ENDESA's As Pontes mine in Spain, which produced 261 million tonnes of brown coal from 1976 to 2008, displacing 697 million cubic metres of earth in the process. As detailed in an unpublished paper by Miguel Colomo, former Director of Mining at ENDESA, reclamation efforts both during and after the mining left the region with a forest on a 1 150-hectare hill, with roads and drainage that facilitate ranching, forestry, hunting and tourism. The void created by the mining was turned into a 1 200-hectare lake.

"Early and comprehensive planning of environmental works in open-pit mining helps to better structure mining tasks, and hence it allows achieving high-quality standards without large extra costs," Colomo explained.

In another example, Peabody in 2010 completed a coal-mine restoration project in the northern steppes of Mongolia, transforming the former open-cut Ereen Mine into a pastureland for local livestock and building a new community designed for the region's climate. According to the company, the restored land is four times as productive as adjacent native grazing land, and it includes a source for drinking water that previously was hard to come by.

In Australia, Xstrata Coal is rehabilitating sections of Ravensworth State Forest for the closure of the Mount Owen mine, intending to leave a native woodland five times larger than the site's forested area before mining began. University of Newcastle specialists are co-operating with Xstrata to restore native plant and animal life in the area, which will cover 1 774 hectares.

Open-pit mining removes so much material that restoring the space to its virgin state is virtually impossible.

Coal pit: © Shutterstock.com

CCS IS BEST CURE FOR CARBON HABIT

By Juho Lipponen

Juho Lipponen joined the IEA in 2010 as Head of the Carbon Capture and Storage Technology Unit. Previously he was Head of the Energy Policy and Power Production Unit at EURELECTRIC, the European power industry federation based in Brussels.

Despite all the attention given to renewable energy, fossil fuels still produce about four-fifths of the energy consumed worldwide. And there is only one way to burn fossil fuels without adding more CO_2 to the atmosphere: carbon capture and storage (CCS). But high cost and simultaneous lack of incentive policies are delaying deployment of this element critical to limiting climate change.

Fossil fuels not only met 81% of total energy demand as of 2009 but also made up 85% of increased global energy demand in the past ten years. Even in the ambitious IEA scenario to hold average temperature rise to 2°C, fossil fuels make up 45% of global primary energy demand.

Therefore, much of the emissions from that remaining use of fossil fuels must be stored in deep geological formations. The technology exists to capture the emissions from industrial activities and power plants. But CCS does not come for free: besides the cost of locating and developing a storage site and preparing the infrastructure to pipe the CO_2 there, equipment and energy are required to capture and compress CO_2 from various flue gas streams, significantly increasing operating costs at the capture site.

As a first step, governments need to systematically assess CCS's role in their energy futures. Industry and governments must increase efforts in large-scale demonstration; governments also should use active policies to speed storage site screening and development so that storage itself does not become an impediment to deployment.

But perhaps the most critically important short-term issue is to develop practical incentive policies, with successful policies for renewable energy potentially serving as models for CCS deployment. Despite many countries' slow adoption of CCS, a host of industries have tested and proved the needed technologies over several decades. The IEA is currently revising its CCS roadmap: the update should be available by this May.

HOW NUCLEAR CAN COST LESS

A BUYER'S MARKET

When some countries retreated on nuclear power in the 1980s, others that did not, especially Korea, benefitted. Who might gain now?

By Ron Cameron

Ron Cameron is Head of the Nuclear Development Division at the OECD Nuclear Energy Agency. He has more than 30 years of experience in nuclear science and technology in the United Kingdom and Australia, as well as with the International Atomic Energy Agency.

Nuclear power generation can enhance energy security while producing electricity without emitting greenhouse gases during operation. But it has fluctuating support in many IEA member countries and can quickly fall out of favour with the public and politicians if an accident occurs anywhere in the world. When that happens, countries that adopt or continue with nuclear power find themselves in a buyer's market that not only can result in discounts on the significant price of plants, but also bring technology transfer and facilitate the development and retention of a skilled workforce.

Global reconsideration of nuclear power after three major radiation releases on three continents – Three Mile Island in 1979, Chernobyl in 1986 and Fukushima Daiichi in 2011 – led to cut-backs in the industry, with construction halted and engineers and technicians turning to other work. The United States pulled back on nuclear power after Three Mile Island; most recently, Germany and Belgium turned their backs on the technology and France is debating the reduction of the share of nuclear power in its electricity production.

But countries that went against the trend in the past were able to take advantage of overcapacity in the global nuclear industry in the 1980s to build nuclear power plants and industries at relatively low cost. Those that also arranged technology transfers got a chance to foster a domestic industry and give opportunities to talented personnel.

How Korea profited from others' reluctance

One example is the Republic of Korea, whose commitment to nuclear power and demand for initial imports of nuclear technology were greatly aided by the depression of the world's nuclear industry in the 1980s. Korea's 23 nuclear power plants provide 29% of the country's electricity, with five more under construction and six others planned, making it the fifth-largest nuclear country in the world. These plants have impressive records of being built on time and within budget, with some of the shortest construction times in the world. As the country has very limited energy resources beneath the ground, nuclear power is its cheapest source of electricity, gaining in support since the 1970s. As the IEA explained in its recent analysis, *Energy Policies of IEA Countries: Republic of Korea*, "Given its lack of other indigenous resources, the choice by Korea to pursue nuclear energy is a pragmatic and economically efficient approach."

Korea's first nuclear power plant was an imported reactor operated using non-domestic services and support, and its early plants were mainly built through turn-key contracts (where everything is put together by the supplier and sold as a complete package) that allowed limited use of local labour or construction materials. But in 1985 the government decided to push for domestic companies to handle civil engineering and design, construction and plant engineering, even project management.

That move gathered momentum as many other countries pulled back on nuclear power following Chernobyl, allowing Korea to continue to negotiate technology transfers with foreign suppliers under favourable conditions, including deals that allowed the development of national participation in projects. For instance, Korea reached licensing arrangements with foreign suppliers to construct purpose-built factories to manufacture heavy and specialised nuclear components. Starting with the construction of the third and fourth Yonggwang reactors in 1989, domestic companies became the prime project contractors, with foreign subcontractors providing only limited technological input.

Korea decided early on to develop a domestic industry to build and operate its nuclear power facilities.

A steady course, and picking up speed

Drops in support for nuclear power in other countries also helped Korea attract back native nuclear scientists and engineers working abroad, who then took on key roles in the local development of nuclear power technology.

The Ministry of Education, Science and Technology started the Brain Korea 21st Century programme in 1999 and provided nuclear education and training grants

of USD 100 000 to each of the country's eight nuclear engineering departments. The Ministry of Knowledge Economy (MKE) established manpower development programmes for industries and universities related to electricity, with support extended from basic or applied science and engineering research to broader university programmes allowing diversified research.

The Korean nuclear industry now not only has a fully domestic capability but also has developed an international nuclear power business. It won its first overseas contracts in 2009 to build four plants in the United Arab Emirates and a research reactor in Jordan. In 2010, the MKE set a goal of USD 400 billion in exports of nuclear power plants by 2030, saying that for the country, "Nuclear power-related business will be the most profitable market after automobiles, semiconductors and shipbuilding."

National promotion of nuclear power in Asia

Korea's nuclear technology self-reliance programme has involved strong government efforts to marshal both physical and human resources. It has also required support from citizens, with the majority supporting the policy. But immediately after the Fukushima accident, public approval plummeted to its lowest level in 15 years, with some polls finding up to two-thirds of citizens opposed to new plant construction. Large numbers expressed concerns about storage of nuclear materials well before 2011, but Korea was successful in finding a host community for a new radioactive waste repository. Since the Fukushima accident, the Korean government has been very proactive in public engagement in order to maintain support for its policies, which remain a high priority after a scandal involving materials and documentation for some plants. Consistent with one of the recommendations in the IEA review, the government set up the Nuclear Safety and Security Commission, an independent presidential panel that is responsible for safety regulation.

Korea's strong support of nuclear power stands in contrast to that of some other IEA member countries, though it fits with the approach of non-member Asian countries in need of dependable and plentiful electricity supply, particularly China and India. In the past two years, those two countries have gained the potential advantage of pitting international developers and operators of plants against one another in negotiations, after years in which the nuclear industry was expecting growth and, in anticipation of that, new business expanded its capacity and workforce.

European neighbours diverge

Some European countries, too, stand to benefit from cut-backs among their neighbours on nuclear power. While Switzerland and Belgium have pulled back on plans for new construction, essentially moving to a gradual denuclearisation, and Sweden is not expanding its programme, Finland and the Czech Republic are pushing ahead, with the former having one new reactor under construction and another planned. They may profit from the buyer's market in new technologies and availability of skilled operators. The Slovak Republic, Ukraine and especially Russia continue to expand their nuclear energy programmes, though not at the same scale as the more than two dozen plants listed as under construction in China. The United Kingdom is also pursuing new reactors, although, being a liberalised market, it has had to be more proactive in providing an appropriate environment for investors, and thus the road to new construction has been more difficult.

Countries now moving forward on nuclear energy do not have all of the bargaining advantages of nearly three decades ago. Besides public concerns about safety that chilled international development, the industry then was also buffeted by low global oil prices. Not only are those prices much higher today, but increased Japanese demand for oil to replace nuclear generation of power following the Fukushima accident tightened the market, unlike in the 1980s, while demand for energy remains strong in many countries.

But in its assessment of Korea's energy policies, the IEA described the country's performance in nuclear power as an excellent example for other countries, highlighting its significant scientific and technological development through domestic research and international co-operation. The government continues to urge public acceptance for further development of nuclear power by emphasising its role in energy security and its delivery of large quantities of energy without releasing environmental pollutants and greenhouse gases. In advice that could apply to other countries as well, the IEA urged the government to make clear to its public the costs involved in not proceeding with the country's nuclear programme, so they are aware of the full impacts of any decision to choose a different course.

> COUNTRIES THAT DID NOT HALT THEIR NUCLEAR PROGRAMMES IN THE 1980s COULD NEGOTIATE NOT ONLY FAVOURABLE FINANCIAL TERMS BUT ALSO TECHNOLOGY TRANSFERS.

A nuclear plant under construction in China, which can leverage competition among international developers.

TEST-DRIVING ELECTRIC VEHICLES

CITIES AS LIVING LABS

The first lessons learned about electric cars are streaming in from cities, underscoring the importance of urban experiences for deployment.

By Tali Trigg

Tali Trigg became an IEA Energy Analyst in 2010. He specialises in transportation technology policy, with an emphasis on smart growth, electric vehicles (spearheading the Agency's work on the Electric Vehicles Initiative) and bus rapid transit.

Electric cars entered the mass market just two years ago, giving IEA and other analysts their first looks at what works and what doesn't. Most of the data has come from cities, where short commutes and innovative municipal programmes allow consumers and governments alike to test out the vehicles, using car-sharing and infrastructure advantages as well as pricing and parking incentives to determine the most promising means to encourage use of pollutant- and emissions-free vehicles.

Electric vehicles (EVs) are a critical element of the IEA long-term scenario for decarbonised transportation. To limit CO_2 emissions sufficiently to curb average global temperature rise to 2°C, the IEA foresees that half of all passenger light-duty vehicles worldwide must be run on electricity by 2050. An interim target, crucial for accomplishing mass-market deployment, calls for 20 million EVs on the road by 2020, a far cry from the approximately 100 000 now in OECD countries. The bulk of that transitional growth must come in urban cores, or city centres.

The IEA, along with partners that include the Clean Energy Ministerial, released the *EV City Casebook: A Look at the Global Electric Vehicle Movement* last year, documenting urban programmes that encourage use of EVs. The book detailed efforts in 16 cities and regions, in nine countries across three continents. The cars in these areas made up nearly a third of the current worldwide fleet of passenger light-duty EVs.

These 16 programmes, and others, take different approaches. Some provide EVs for mass transit or taxis, others offer short-rent individual cars, and still others subsidise vehicle purchases directly. Most offer incentives for use, such as discounts for parking or tolls. Nearly all facilitate recharging through financial assistance or stations, or both, and use various technologies to create information traffic systems. Infrastructural benefits such as priority parking are made prominent, to encourage use.

The experiences of Casebook and other cities are the first step in rapid-response analysis to glean best practices and how to overcome challenges so as to enable wider vehicle electrification.

Barcelona, motorbike heaven, goes electric

Barcelona is second only to Rome in the use of motorbikes for personal mobility. But the vehicles in Barcelona are cleaner since the 2011 introduction of the city's Mobecpoint charging stations for electric motorcycles.

The stations allow free charging at hotels and on university campuses to encourage use of emission-free motorbikes as well as electric bicycles.

This year Barcelona has four fast-charging stations, with four others under development, and more than 260 slow-charging stations for the city's nearly 300 public and almost 250 private EVs, 70% of which are motorbikes.

A principal source of the electric motorbikes in the city is the Catalan producer Volta, whose first model, the Volta BCN, is named after Barcelona.

The Italian design house Pininfarina shaped the Autolib' cars that 60 000-plus subscribers share around Paris.

Amsterdam: studded with charging stations

Amsterdam has the ambitious goal of using electricity from renewables to power every kilometre driven within the city by 2040. It plans for electric boats to ply its canals, while only EVs will be on its roads, reducing noise, improving air quality and limiting carbon emissions.

To reach that goal, the city has installed 500 charging stations, the most per capita in the world, and expects to have 1 000 by the end of the year. They are there to serve the 10 000 EVs the city expects on its roads by 2015, half of the national target for that year. The electricity is provided free to owners of EVs, and renewable energy is used whenever possible. December 2012 saw EVs draw a record 115 000 megawatts, equal to nearly 600 000 km of driving.

To increase EV ownership, Amsterdam has set aside EUR 8.6 million for subsidies to encourage heavy users of vehicles in the cities, such as taxi and delivery companies, to switch fuels, offering reimbursement of up to 50% of the additional cost of buying an electric vehicle over a comparable one with an internal-combustion engine. The city programme is in addition to national tax advantages for buyers of EVs.

EVs by the hour in the City of Lights

Paris inaugurated Autolib' in December 2011. The most ambitious electric-car-sharing project in the world, the programme offers 1 740 cars at

any of 745 charging stations, each with space for at least three vehicles, with plans to eventually expand to 3 000 cars and 1 050 stations.

Autolib' is modelled on the French capital's successful public-private bicycle-sharing programme called Vélib', introduced in 2007 and since emulated in cities from Barcelona to Mexico City to Guangzhou, China.

In little more than a year, more than 60 000 people have signed up for Autolib', whose auto fleet has nearly sextupled in size. Drivers have used an Autolib' car for 646 000 trips around the Paris area, with guaranteed parking at the end of the drive. Those same trips with comparable fossil-fuelled cars would have emitted 1 300 metric tonnes of CO_2, an amount that Autolib' calculates is equivalent to the annual absorption of 260 000 trees.

The average Autolib' trip lasts 42 minutes, with the longest rentals running about three hours. Subscriptions range from annual to just 24 hours, with rental fees of EUR 4 to EUR 7 per half-hour.

With a look by the Italian vehicle design house Pininfarina, the four-seater Autolib' cars are distinctive because they are unpainted, which reduces their weight and their cost. Each car runs on a lithium metal polymer battery that weighs 300 kilogrammes and can power the car for 250 kilometres (km) of city driving.

"Our test lab is real life," said Didier Marginèdes, a lead researcher at Bolloré, the company that operates Autolib'. In Paris, "We have indeed more than 2 000 batteries and cars running every day in any condition, which makes it a unique place for testing batteries, cars and car-sharing service in real life."

Hangzhou, China, is building a fleet of 800 electric taxis that use interchangeable batteries.

Hail an electric taxi in Hangzhou, China

Hangzhou was not the first Chinese city to use electric taxis – Shenzhen started its programme six months earlier, in June 2010 – but the Zhejiang Province capital has gone from 30 taxis in early 2011 to 230 zero-emissions cabs as part of its long-term goal of a fleet of 800 electric taxis. Hangzhou has 620 charging stations serving both taxis and private vehicles, plus 12 battery-swap stations and 50 more under construction.

The taxis are bright yellow, advertising their electric nature boldly. Built by two companies, one of which is part-owned by investor Warren Buffett's company Berkshire Hathaway, they serve the city centre only because they cannot travel more than 100 km before swapping batteries. Exchanging batteries keeps the vehicles on the roads longer and reduces the number of charging stations needed around the city.

The programme was suspended briefly in 2012 when a taxi caught fire after a collision, but after the city completed an inquiry to its satisfaction, it redoubled its support of the taxis.

EVs are also available for private rental at Hangzhou transportation hubs including the airport, railway stations and commercial centres. Across China, the government urges cities to provide discount parking, charging and road fees for EVs.

Oslo leads country with most EVs per capita

More than 10 000 EVs are on the road in Norway, the most per capita of any country in the world. The bulk of them are in Oslo, where they are exempt from congestion, parking and toll charges and are allowed to use traffic-free bus lanes.

EVs are also not subject to value-added and import taxes as well as initial registration fees. Norway, despite being a major oil producer, taxes non-electric cars heavily, so the exemptions greatly reduce the price premium for an EV over an internal-combustion engine vehicle. EVs have been on sale in Norway since 2000, and a national organisation represents owners and their interests, resulting in more than 4 200 charging stations, including above the Arctic Circle.

In Oslo, home to nearly a quarter of all Norwegians, a programme offers grants for setting up charging stations in commercial and residential buildings. EVs have dedicated and free parking spaces, though time limits apply. Local ferries carry the cars for free.

With all these perks to EV ownership, Norway has the world's highest market share for EVs, reaching 5.2% of new-car sales last year. The many non-financial incentives support adoption of EVs in their nascent development phase.

WHAT DO YOU THINK?

What must be done to achieve significant progress in energy efficiency?

One respondent chosen at random will win a free copy of the World Energy Outlook 2012*.*

Share your thoughts and submit your raffle entry by 31 May 2013 at: http://svy.mk/ieaEnergySurvey

FROM OUR LAST ISSUE:

The winner of the previous raffle for a copy of the Medium-Term Oil Market Report 2012 *is Ajibola Oyelade of Abuja, Nigeria.*

4°C IN DAVOS

By Fatih Birol

Fatih Birol, Chief Economist of the IEA, has been named by Forbes Magazine *as one of the world's most powerful people in terms of influence on the global energy scene and is the Chairman of the World Economic Forum's Energy Advisory Board. He was awarded the Order of Merit of the Italian Republic in 2012. In 2009, alongside awards from the Dutch and Polish governments, he received the German Federal Cross of Merit. He was awarded the Golden Honour Medal of Austria in 2007 and was made a Chevalier dans l'Ordre des palmes académiques by France in 2006.*

Once a year Davos becomes a frenzied focal point for the world's political and business leaders. They engage in intense debate intended to shape the global agenda, and my experience over almost a decade is that Davos is an invaluable barometer of opinion among international decision makers.

In the past, I have regularly discussed climate change with attendees and been reassured by how their attitudes chimed with the weight of scientific evidence – namely, that the world needs to focus clearly on limiting global temperature rise to no more than 2°C. This year my confidence was rather shaken. While there were laudable exceptions, a new contingent had become visible that, either by implicit agreement or reluctant resignation, seemed ready to accept a 4°C climate trajectory.

The facts do not justify such a shift, and it is important that such voices do not evolve into a creeping consensus. The central scenario in the *World Energy Outlook* (*WEO*) does indeed show that the world is on a climate trajectory closer to 4°C, but it is presented as a reason to raise our ambitions to meet the 2°C target rather than as an excuse to lower our expectations.

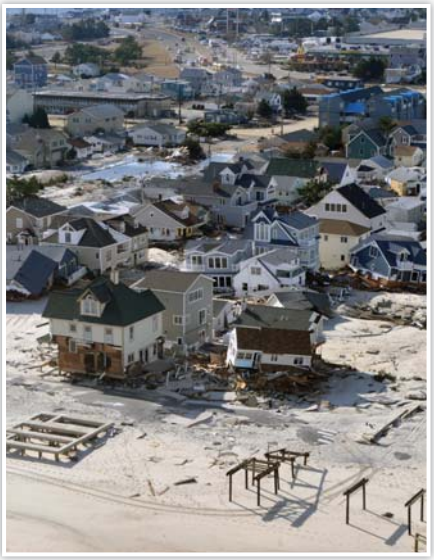
Several studies find that in a world where the average global temperature increases by 4°C, the most marked warming will be over land and actually range from 4°C to 10°C. The past decade already featured an exceptional number of extreme heat waves, from Europe in 2003 to Australia early this year. According to almost unanimously accepted scientific research, in a 4°C world such events would become increasingly common. Food production would be negatively affected, droughts much more widespread, and sea levels would rise, increasing coastal flooding, especially in developing countries.

The energy sector is the single largest source of global CO_2 emissions and, in 2011, these increased by more than 3% to yet another record high of more than 31 gigatonnes. In fact, the *WEO 2012* revealed that unless there is more action to reduce greenhouse gases, the energy infrastructure existing by 2017 will lock in all the emissions allowable under a 2°C trajectory. The energy sector is also vulnerable to extreme weather events. We have already seen the negative impact of droughts on hydropower (such as in Brazil) and of hurricanes on electricity infrastructure (such as in New York) and on offshore oil and gas production.

The body of climate evidence and analysis should provoke a sense of urgency, but there are worryingly few signs of decisive action. We still have not agreed on a much-needed global agreement to cut greenhouse gas emissions. The renewable energy sector, such an important part of any solution to climate change, is growing but not quickly enough. Many renewable energy companies are showing significant signs of strain, while many governments have been reviewing critically their levels of support. Subsidies that encourage the wasteful consumption of fossil fuels also handicap action on climate change, and yet their value jumped by nearly 30% in 2011. These subsidies – valued at more than USD 520 billion worldwide – represent an implicit incentive to emit CO_2 equivalent to USD 110 per tonne. By comparison, the carbon price in the European Union currently trades below USD 7.

The energy sector has a crucial role in making meaningful progress on climate change. We need an energy agenda that embraces new solutions and sets out immediate action, keeping the door to 2°C open, as well as vital elements that can be included in a future global climate deal that delivers longer-term sustainability.

We will bring all of these issues and more into the spotlight on 10 June, when the IEA publishes the *WEO* special report *Redrawing the Energy-Climate Map*. It is my hope that this report will help bring the temperature in Davos back to 2°C next year.



Expect more superstorms like Sandy in a 4°C world.

New Jersey shore; photo by jim.greenhill on Flickr, http://creativecommons.org/licenses/by/2.0/legalcode

ENERGY INDEPENDENCE'S OTHER HALF

SAVING FUEL AND CO_2

Cutting US energy imports requires not just more oil output but also improved efficiency. One step is a tough new vehicle emissions standard.

By Laura Cozzi

Laura Cozzi heads the IEA Energy Modelling Unit that is in charge of producing the World Energy Outlook. *A contributor to several editions, she was responsible for the* WEO 2012*'s energy efficiency and climate analysis. Before joining the IEA, she worked for the Italian oil company Eni.*

Newspaper headlines cried, "The United States is moving towards energy independence," upon the release last November of the latest *World Energy Outlook*. To explain this hallmark change in the energy landscape, most reports focused on the increase in unconventional oil production that has reversed the country's decade-long downward trend in output. Only a few reported on an equally important side of the story: energy efficiency measures.

According to the *World Energy Outlook 2012*, the United States imports 9.5 million barrels a day (mb/d) of oil but by 2025 is expected to import less than half as much, *i.e.* 4.5 mb/d. The increase in unconventional oil production accounts for 55% of this drop, but the rest must come from energy efficiency measures.

Improved mileage trims CO_2 emissions

Last year the Obama administration set new standards for the Corporate Average Fuel Economy (CAFE) regulation that require the average CO_2 emissions for cars and light trucks made in 2025 to be about half of the average for such vehicles produced in 2010. CAFE would reduce 2025 energy-related CO_2 emissions in the entire transport sector by 12% from today, avoiding 200 million tonnes, or more than Venezuela's total emissions in 2010.

Auto manufacturers can reach the CO_2 emissions standard by improving fuel economy or by adopting less carbon-intensive fuels. To meet the CO_2 standard in 2025 exclusively through better fuel economy, the average vehicle would have to travel 54.5 miles per gallon (mpg) of fuel, or 4.3 litres per 100 kilometres, a significant gain for US energy security. In 2012, the average fuel economy of all vehicles sold in the United States was 23.8 mpg, or 9.9 litres per 100 kilometres, according to the University of Michigan Eco-Driving Index – nearly 11% more efficient than the fleet sold in 2008. Per-driver US emissions as of October 2012 were a record 21% lower than five years earlier, reflecting less driving as well as more efficient vehicles.

Upfront cost and long-term savings

Other long-term emissions and fuel economy standards are in the pipeline, including in the European Union and Japan. But such regulations are not always easily enacted.

One problem is that increased vehicle efficiency comes at an additional upfront cost for car buyers.

The US Environmental Protection Agency estimates that the new CAFE standards will increase the cost of a vehicle by an average of USD 1 800 in 2025, though the exact figure is difficult to assess. At current fuel prices, that upfront investment would be paid back in about three years, saving consumers money over the remaining lifetime of the car.

Not all consumers will be able to afford the additional upfront cost, so car manufacturers fear being penalised by the new regulation. Access to affordable credit will be of paramount importance. Also critical is that domestic fuel prices do not drop too much from current levels, as that would make the payback period too long. Low fuel prices also incentivise drivers to use their cars more, eating up part of the expected savings in oil demand and CO_2 emissions.

Rules such as CAFE are only a first step

After having been considered a laggard for many years, the new CAFE standards put the United States in the forefront of energy efficiency policies and will allow the country's economy to produce one unit of gross domestic product with only 60% of the oil it uses today.

Innovation and job creation in Detroit will matter as much as innovation in North Dakota – one of the boom regions for unconventional oil – in securing the United States a healthy energy system and economy going forward.

But as the *World Energy Outlook 2012* shows, CAFE is only a first step towards a more sustainable path, as full implementation of the new standards as well as other regulations currently under consideration around the globe would tap less than one-third of economically viable efficiency measures worldwide.

Significantly better fuel efficiency is one way vehicles can meet the new CAFE standards on lower emissions.

US traffic: © GraphicObsession.

RENEWABLES IN AN OIL PATCH

A NEW SOLAR CENTRE

The Middle East and North Africa have a new resource in renewable energy. As the region captures solar power, it is also embracing energy efficiency.

By Christopher Segar

Christopher Segar joined the IEA in 2008 after a career in the British Foreign Service. In the Office of Global Energy Policy, he monitors the Middle East and North Africa, and he has represented the IEA on the Executive Board of the International Energy Forum in Riyadh.

Much of the Middle East and North Africa abounds with oil and gas, but lately another form of energy has been catching on there: renewables.

The region with the globe's largest oil reserves is also home to the International Renewable Energy Agency (IRENA) in Abu Dhabi as well as some of the most ambitious solar energy projects in the world. Jordan, Kuwait, Qatar and the United Arab Emirates have all adopted targets for renewable energy.

Given the abundant sunshine in the region, the focus is on solar power, offering a new, cleaner energy that will bring more jobs and a resource that will never dry up.

Besides their plentiful solar resources, the countries' strong incentives to make the switch include the need to maintain levels of oil exports even as domestic demand for electricity surges. Today, much of the region's power generation comes from oil. Economic expansion and even faster population growth have produced strong and continuous increases in regional energy demand, taxing electricity generation systems.

The region's minimal cloud cover and the declining cost of solar systems compared with the high price of oil mean that even oil exporters have a strong incentive to shift towards solar power, especially given the high opportunity costs of using the oil domestically.

Saudi Arabia, home to almost one-fifth of the world's proven oil reserves, has pledged nearly USD 110 billion to shift its electricity grid to solar energy, and it plans to have its first utility-scale solar plant running by 2015. Prince Turki al-Faisal al-Saud said in Brazil last year, when he was 67, "I would like to see Saudi Arabia using 100% renewable energy within my lifetime."

Jordan recently adopted feed-in tariffs for a portfolio of renewable technologies, while Qatar has set a goal of 1 800 megawatts (MW) in solar power by 2018, with 200 MW tendered, committing USD 10 billion to achieve its target.

Desert sunshine makes energy and water

In an area where solar systems can produce consistent power over long periods of the year, they can also be used to produce water. Using solar power for desalination of water is particularly suitable for a region such as the Middle East. Saudi Arabia already runs the world's largest desalination programme. Unlike the electricity produced, which needs to find a home on the grid, the water created through use of solar power can be stored easily. And solar desalination is ideal for providing both energy and drinking water in remote areas where grid access is difficult or expensive.

What's more, the IEA notes the opportunities for countries in the region to start exporting a new form of energy in addition to fossil fuels.

The IEA is collaborating with the R20 Regions of Climate Action, a group of national and subnational governments, to help Morocco become a solar energy hub, with an eye toward expanding energy access domestically and eventually exporting power around the Mediterranean Basin.

"It seems odd to advocate solar and wind power in an area which holds 50% of the world's crude oil and 40% of its gas," IEA Executive Director Maria van der Hoeven explained on a visit this year to the region. "But even the world's biggest oil and gas exporters have an interest in diversifying their energy portfolio. International cooperation, in particular the sharing of best practice, can be very helpful in achieving this objective."

Sharing information is the key

The IEA is working with countries in the region as well as IRENA to foster this realignment of energy policies and dependency. The Agency has already expanded collaboration with IRENA on a renewable energy policy database and the assessment of renewable energy technology costs. Now it is looking at collaborating with IRENA, the United Nations Environment Programme and the REN21 renewable energy policy network in the forthcoming *Global Renewable Economics Report*, which aims at assessing

A solar installation in Morocco: the IEA is working with other agencies to help the nation become a solar energy hub.

Ain Beni Mator installation: © OECD/IEA, 2013

the macroeconomic impacts of the deployment of renewables.

Countries in the region are taking note of how renewable energy provides economic benefits and energy security beyond increasing electricity output.

Renewables can significantly reduce import payment bills, which concern even leading oil exporters, while smaller countries in the region that do not export oil or gas otherwise face ever-rising bills for energy supplies.

For all of North Africa and the Middle East, a portfolio of renewable energy provides a greater level of energy diversity, whether or not an individual country has its own oil or gas supplies. That diversity also provides a more modular and distributed supply, less prone to simultaneous interruption – from technical or human faults or extreme weather events. Lastly, modular solutions can meet rising energy demand across sparsely populated parts of the region without requiring expensive expansion of the domestic grid.

Deploying new technologies for renewables can also bolster the region's economy. The shift can encourage foreign investment not only in power systems but in the renewable energy industries themselves, and it can include technology transfer. Thus it benefits both regional development and employment.

Optimising the performance of solar power systems in high temperatures and dusty conditions requires specific technical approaches. A number of countries in the region, in particular Saudi Arabia, the United Arab Emirates, Kuwait and Qatar, are investing significant research time and funds in those approaches, providing the basis for a higher level of international collaboration.

The other "new energy" for the region

Energy efficiency is another means to significantly improve the region's socioeconomic conditions, as buildings in particular can be improved quickly, freeing up savings for investment to create businesses and jobs. The region has a rapid replacement rate for housing stock compared with other parts of the world, spurred by government housing programmes in a number of countries to address population growth and social welfare. As a result, energy efficiency can produce benefits more quickly than elsewhere.

For example in Saudi Arabia, the building sector alone consumes 80% of electricity supply, and 70% of that is used for air conditioning. Applying thermal insulation is estimated to cost no more than 5% of a building's total value. The Saudi government has announced the introduction of new standards for air conditioning units, both imports and locally produced systems.

Construction in Dubai. The region's rapid turnover of building stock offers big opportunities in energy efficiency.

As already required by Saudi Arabia since 2010, new labelling requirements for energy (and water) efficiency took effect this year in the United Arab Emirates.

> IN COUNTRIES WITH NET ENERGY EXPORTS, HIGH CONSUMPTION SUBSIDIES CAN ERODE EXPORT AVAILABILITY OVER THE LONGER TERM, REDUCING EARNINGS.

Morocco is working with the United Nations Development Program; its efficiency efforts include a building code drafted in 2009 that is contributing to policies aimed at saving 12% of energy by 2020 and 15% by 2030 compared with business-as-usual policies. The opportunities for efficiency are bolstered by Morocco's forecast of nearly one million new homes built by 2020.

Breaking free of fossil-fuel subsidies

Energy demand is fueled by the region's strong economic and population growth as well as urbanisation. But low prices also contribute to the increase in domestic consumption of oil. One critical step towards reducing regional reliance on fossil fuels is moving away from subsidies that encourage the burning of the currently plentiful but finite oil and gas supplies.

Subsidies inflate demand, distort economies and reduce incentives to improve efficiency, plus they encourage carbon emissions by keeping the price of fossil fuels far lower than that of renewable energy.

With persistently high energy prices in recent years, subsidies have become an unsustainable financial burden for many net-importing countries. But even in net-exporting countries, the high consumption fostered by subsidies can erode export availability over the longer term, thus reducing foreign currency earnings, and also create a burden on public budgets.

The Middle East and North Africa are hardly alone in relying heavily on fossil fuel subsidies. The IEA estimates that such subsidies totalled USD 523 billion in 2011 worldwide. Although some governments in the Middle East and North Africa more recently let their domestic fuel prices rise, in 2011 the region contributed to a nearly 30% global increase in fossil-fuel subsidies, the IEA estimates.

The IEA flagship publication *World Energy Outlook 2012* provides guidelines on easing subsidies in a manner that seeks to avoid price shocks and provide greater assistance to less wealthy citizens, addressing issues that otherwise can make the lifting of subsidies unpopular.

NORKUN SITTHIPHONG

NORKUN SITTHIPHONG, THE PERMANENT SECRETARY OF THE THAI MINISTRY OF ENERGY FOR TEN YEARS, SPOKE WITH *IEA ENERGY* ABOUT HIS COUNTRY'S GROWING CO-ORDINATION WITH THE AGENCY. FROM EXERCISES TO IMPROVE ENERGY SECURITY TO EFFORTS TO DIVERSIFY FUELS, THAILAND IS A LEADER IN DEVELOPING SOUND ENERGY POLICY, WORKING WITH BOTH THE IEA AND FELLOW MEMBERS OF THE ASSOCIATION OF SOUTHEAST ASIAN NATIONS.

What does Thailand seek in its co-operation with the IEA on oil security and other bilateral work programmes?

Thailand aims to enhance its energy security by developing an emergency response system in time for an energy crisis, and the IEA has been helping us to increase our knowledge, and our preparedness for this mission. I, myself, participated in the IEA Emergency Response Exercise in Paris. Over time, we have learned so much about energy emergency response, and this has helped us develop our own system.

The important milestone was the Energy Response Assessment (ERA) in which the IEA favourably evaluated Thailand's own energy emergency response system in September 2010. The ERA recommendations, such as policy on the Strategic Petroleum Reserve, have been adopted for implementation.

How else has Thailand's relationship with the IEA grown?

Thailand and the IEA have also developed co-operation in other areas, such as energy modelling and capacity building. Thailand is contributing to the *World Energy Outlook 2013*, which will include a special section on ASEAN. The *World Energy Outlook* is an influential report that shapes the world's energy sector, and we are proud to play a part in it. Last November, the IEA launched the *World Energy Outlook 2012* in Bangkok, marking yet another step forward in our co-operation.

In addition, for the past few years, representatives from Thailand have joined the IEA Energy Training Week, which benefits Thailand's human resource development.

How does the IEA-Thai relationship help Southeast Asia build energy security?

Thailand can certainly share experience from working with the IEA with our ASEAN colleagues.

The ASEAN region is a net importer of crude oil. Hence, we are working to make operational the ASEAN Petroleum Security Agreement (APSA). In this regard, the IEA can support ASEAN in the development of emergency response and energy security enhancement, especially the Co-ordinated Emergency Response Measures Mechanism under APSA.

Thailand leads the ASEAN programme on energy efficiency. How is your country moving ahead on realising energy efficiency targets?

We have a plan for long-term energy efficiency. The 20-year energy conservation plan has set the target of reducing energy intensity by 25% by 2030, outlining measures in the short, medium and long term. Those measures include financial incentives from tax deductions, investment grants and revolving funds. We also put in place necessary regulations such as building energy codes, energy efficiency standards and labelling.

Furthermore, we realise that public awareness is the key contribution to energy saving: we have implemented various campaigns to make energy conservation part of the culture for Thai people.

What are Thailand's ambitions for renewable energy?

Thailand aims to achieve its renewable energy target of 25% of final energy consumption by 2021. This Alternative Energy Development Plan outlines a ten-year roadmap of renewable energy development in all categories, including electricity, heat and biofuels. Necessary measures are in place for the promotion of renewable energy, such as financial incentives, rules and regulations.

With the country's large agricultural base, the appropriate types of renewables can be created to integrate with agro-industrial development. Incentives such as the "adder" (a premium for electricity generation from renewables) and/or feed-in-tariffs are prescribed.

We also promote distributed green generation at the local level to accelerate both community economic growth and renewable energy development.

How is Thailand balancing the need for food and energy as it adopts significant use of biofuels?

Thanks to Thailand's large agricultural sector, we manage to utilise our abundant crop supply by placing food as a first priority. The surplus from food is for energy and other uses.

One important step for biofuels development is to increase the agricultural product yield from existing farmland. In addition, we have worked continuously to use advanced technology to develop next-generation biofuels using the non-food crop.

Norkun Sitthiphong; photo courtesy of the Ministry of Energy, Kingdom of Thailand.

IEA IN ACTION

Launch of Sweden policies review | State Secretary Daniel Johansson, IEA Executive Director Maria van der Hoeven | Stockholm

Outstanding Low Carbon Publication Award
Low Carbon Vehicle Partnership | London

Energy Supply Technology Head Markus Wråke
Nordic ETP launch | Oslo

IEA Chief Economist Fatih Birol
World Economic Forum | Davos

Energy Efficiency Innovator Award for the IEA BEEP database
Euro-Mediterranean Energy Efficiency Forum | Monaco

IDR Sweden launch: photo courtesy of the Swedish Ministry of Enterprise, Energy and Communications; *Nordic ETP* launch: Nordic Energy Research, all rights reserved; Fatih Birol at World Economic Forum: © World Economic Forum; Fuel economy publications award: photo courtesy of LowCVP; BEEP award: © Johnson Controls International SA/NV

ENERGETIC READING

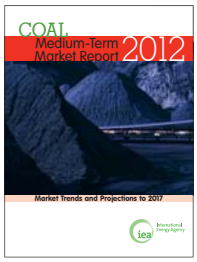
ENERGY POLICIES OF IEA COUNTRIES: GERMANY – 2013

Language: English; **Release:** available soon
Price: €75; **ISBN:** 9789264190757

The IEA assesses the energy policies of each member country every five years, providing a careful analysis of all aspects of the country's import, export, production, use and storage of every relevant form of energy, followed by recommendations of best practice. Few country reviews have been as anticipated as the Agency's forthcoming assessment of Germany's energy policies. Germany faces difficult decisions given its heavy and intermittent output of renewable energy and its resolve to stop relying on nuclear power. The review will assess how the country can best reconcile its intentions, meet its energy needs and interact with neighbours with whom it trades energy.

MEDIUM-TERM COAL MARKET REPORT 2012

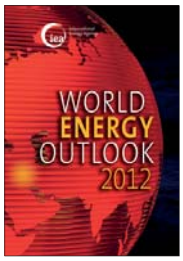
Language: English; **Release:** available now
Pages: 148; **Price:** €100; **ISBN:** 978-92-64-17795-6



The international coal market is experiencing dynamic changes. In 2011, China alone accounted for more than three-quarters of incremental coal production. The country overtook Japan as the largest importer of coal, while Indonesia passed Australia as the top exporter on a tonnage basis. Low gas prices associated with the shale gas revolution caused a marked decrease in coal use in the United States, which sent its excess to Europe, causing an oversupply there. *Medium-Term Coal Market Report 2012* provides IEA forecasts on coal markets through 2017, as well as an in-depth analysis of these and other recent developments in global coal demand, supply and trade.

WORLD ENERGY OUTLOOK 2012

Language: English; **Release:** available now
Pages: 690; **Price:** €150; **ISBN:** 978-92-64-18084-0



The global energy map is changing in dramatic fashion, according to the latest edition of the *World Energy Outlook*, the IEA flagship annual report. With more than 12 000 copies already sold, this must-read's central scenario tells decision makers in both industry and government how the United States by 2035 can become almost self-sufficient in energy in net terms – which would accelerate a huge shift in the international oil trade, resulting in almost 90% of Middle Eastern oil exports going to Asia. Amid changing regional dynamics, global energy demand will push ever higher, with the central scenario seeing more than one-third growth to 2035.

ENERGY POLICIES OF IEA COUNTRIES: SWEDEN – 2013

Language: English; **Release:** available now
Pages: 175; **Price:** €75; **ISBN:** 978-92-64-19073-3

Sweden already has an almost carbon-free electricity supply and has phased out oil use in residential and power sectors. It is increasingly integrated within the Nordic and Baltic electricity markets, and its joint renewable electricity certificate market with Norway offers a unique model for other countries. Now Sweden must take concrete steps to realise its vision of a fossil-fuel-independent vehicle fleet by 2030 and no net greenhouse-gas emissions by 2050. The country's lead in smart grids is an asset, but its energy-intensity level is high, which requires greater efficiency in industry, buildings, heat and transport. This review analyses the energy-policy challenges currently facing Sweden, and provides studies and recommendations for each sector.

CALENDAR

March
26-28 Pacific Energy Summit, Auckland, http://bit.ly/i-pes

April
4 International Oil Summit, Paris, http://bit.ly/iea-ios
11-13 Lech Energy Forum Lech, Austria
17-18 Clean Energy Ministerial, New Delhi, http://bit.ly/iea-cem

May
14 Launch of *Medium-Term Oil Market Report*, Paris
23 Launch of *Energy Policies of Finland*, Helsinki
22 Third Vienna Energy Forum, Vienna, http://bit.ly/iea-unido
27-31 OECD Ministerial, Paris

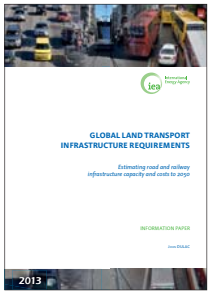
June
10 Launch of *WEO Zero-cost options climate excerpt*, London
10-13 Conference of Montreal Meeting, Montreal http://bit.ly/iea-mon
20-22 International Energy Week, Saint Petersburg
25-26 Launch of *Medium-Term Renewable Energy Report* at Renewable Energy Finance Forum, New York http://bit.ly/iea-reffws

November
12 Launch of *World Energy Outlook 2013*, London
19-20 IEA Ministerial Meeting, Paris

IEA ENERGY FEATURED RESEARCH

GLOBAL LAND TRANSPORT INFRASTRUCTURE REQUIREMENTS

Author: John Dulac



Over the next four decades, global passenger and freight travel is expected to double over 2010 levels. Non-OECD regions will account for nearly 90% of this increase.

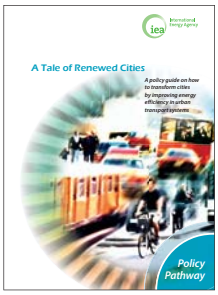
All this new traffic will require huge investment in transport infrastructure, with nearly 25 million new kilometres (km) of paved road lanes and 335 000 new km of new rail track, 60% more than the kilometres existing as of 2010. The cars on those roads will park in the up to 77 000 square kilometres (km^2) of new parking spaces. All told, road, rail and parking infrastructure as of 2050 will cover at least 250 000 km^2 – roughly the size of the United Kingdom. Non-OECD expenditures on land transport infrastructure are expected to surpass OECD levels by 2030, and by 2050 be nearly 20% higher.

But countries can reduce this gargantuan growth and the investment it requires. *Global Land Transport Infrastructure Requirements* details how shifting some road passenger and freight travel – to, say, bus or rail – or eliminating the need for it altogether – such as through changes in land use – can reduce vehicle kilometres of travel by nearly 23% in 2050, decreasing roadway additions by more than 10 million km of paved lanes and avoiding nearly 27 000 km^2 of new parking space.

Rail additions would rise under the infrastructure scenario in this *IEA Energy* Featured Insight by close to 200 000 km of track, including nearly 90 000 km of additional high-speed rail, while bus-rapid transit networks would expand by ten times the amount expected in business-as-usual projections. Despite this investment, the cumulative global savings to 2050 in transport infrastructure spending nears USD 20 trillion.

A TALE OF RENEWED CITIES

Authors: Sara Bryan Pasquier and John Dulac



Transport currently accounts for half of global oil consumption and nearly 20% of world energy use, of which around 40% is for urban transport alone. The International Energy Agency expects urban transport energy consumption to double by 2050, despite ongoing improvements in vehicle technology and fuel economy.

These numbers demand urgent energy efficiency policy attention to mitigate associated noise, air pollution, congestion, climate and economic impacts, which cost countries huge sums annually.

The IEA *Policy Pathway on Energy Efficiency in Urban Transport Systems* provides policy advice to local and national governments as well as the private sector on improving urban transport systems' energy efficiency. Its policy suggestions can be grouped into three broad categories: those that allow travel to be avoided; those that shift travel to more efficient modes; and those that improve the efficiency of vehicle and fuel technologies.

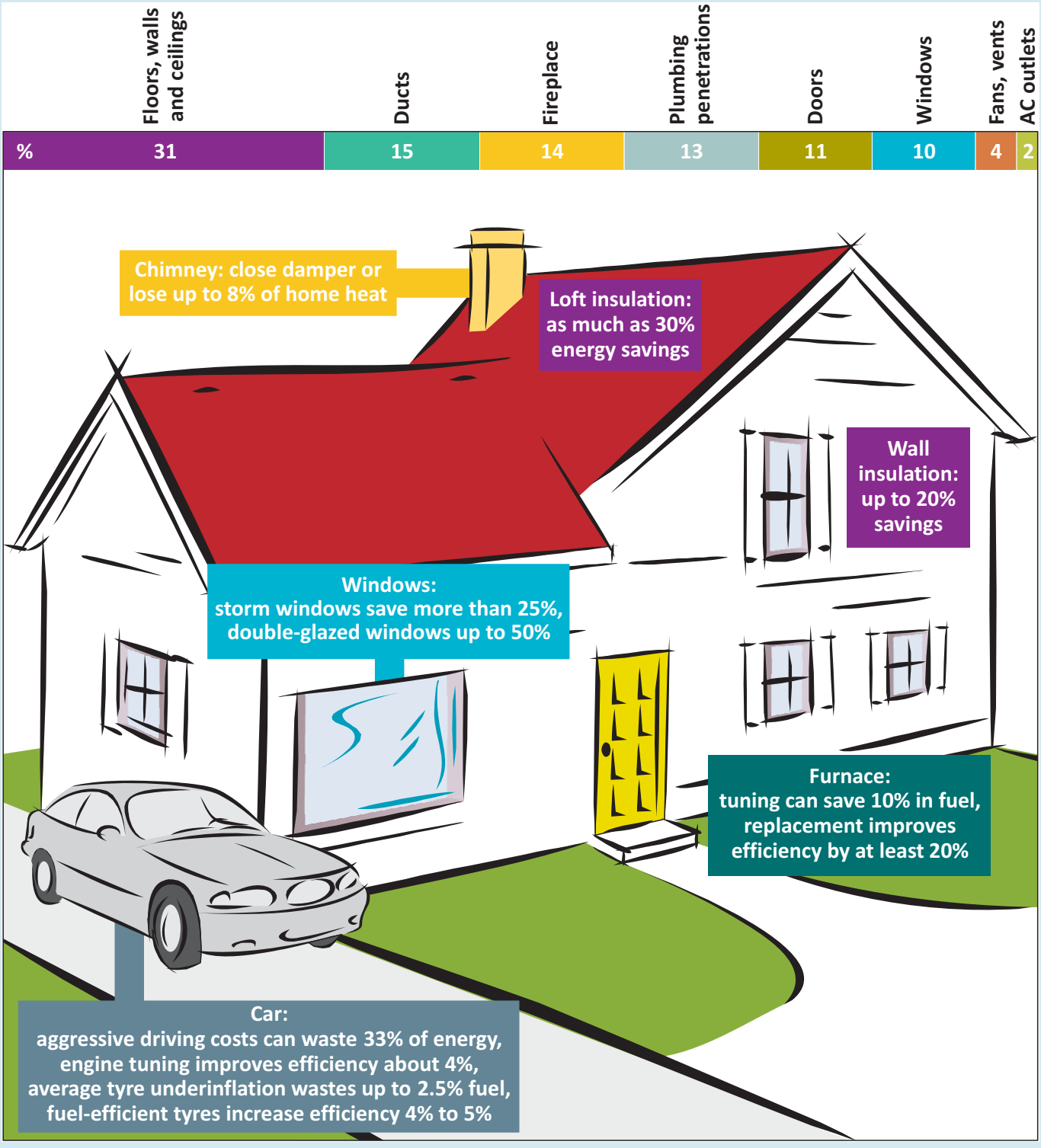
The IEA estimates that by 2050, the "avoid, shift and improve" approach offers the potential to lower total global expenditures on vehicles, fuels and transport infrastructure by as much as USD 70 trillion.

This Policy Pathway highlights holistic approaches to improving urban transport systems that are already being implemented in Seoul, Belgrade and New York City. Based on these three and other case studies, the report proposes ten critical steps for developing, implementing and evaluating key urban transport system policies.

Read or download this publication at
http://bit.ly/12b62Rr

Read this publication soon at
www.iea.org

HOW WE WASTE ENERGY, AND HOW TO CUT OUR LOSSES



Graphic: © OECD/IEA, 2013, illustration by Bertrand Sadin.
Data sources: Air infiltration: US Department of Energy. Home improvements: IEA, Victoria (Australia) Sustainable Energy Authority; California Energy Commission; New Zealand Energy Efficiency and Conservation Authority; Sustainable Energy Authority of Ireland; Thisoldhouse.com; US Department of Energy.

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 28 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency's aims include the following objectives:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

IEA member countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Korea (Republic of)
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

The European Commission also participates in the work of the IEA.

International Energy Agency

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www.iea.org

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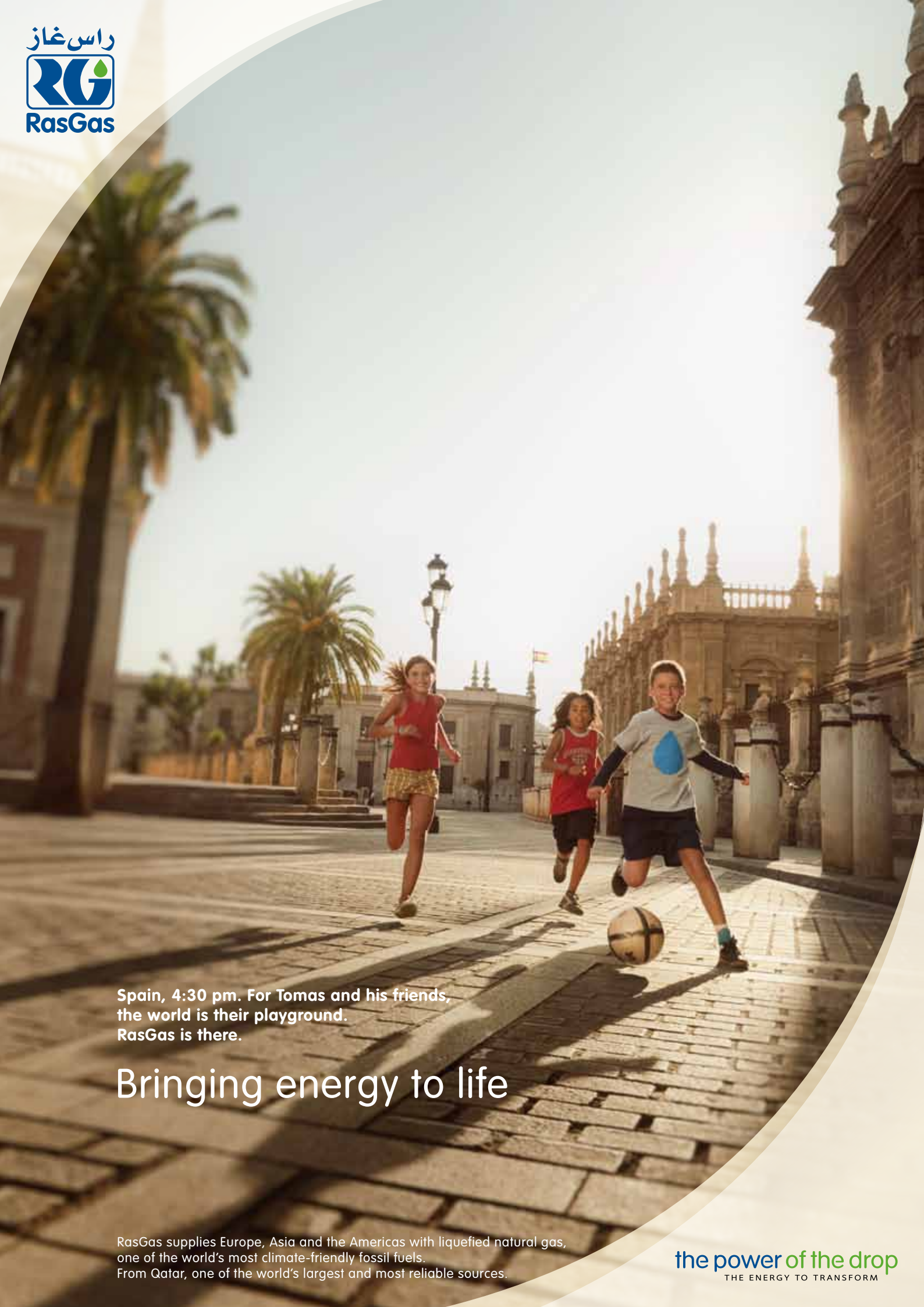

**Spain, 4:30 pm. For Tomas and his friends,
the world is their playground.
RasGas is there.**

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RasGas supplies Europe, Asia and the Americas with liquefied natural gas,
one of the world's most climate-friendly fossil fuels.
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