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Governments need to push for more energy efficient end-use technologies

About 2.7 billion people do not have access to modern energy. Without it, they have little chance of achieving a decent living standard. Much more economic progress is needed to lift the living standards of the world's poor and to provide for the growing world population. This will substantially increase the demand for energy. This requires a fundamental transformation of the present global energy system. The system, as we know it, is responsible for most of the greenhouse gas (GHG) emissions responsible for climate change. Without a major shift to clean energy and greater energy efficiency, satisfying the additional energy demand will push climate change to catastrophically dangerous levels.

There are two main areas where the required shift must occur: (1) in the methods of supplying energy, and (2) in the technology with which energy is converted to heat, motion, lighting and other "end-uses". Solar or wind power and other energy sources that do not rely on fossil fuels are examples of the first. Energy efficient cars that use little to no fossil fuels are an example of the second. As discussed in the ***World Economic and Social Survey 2011*** (**WESS 2011**), strengthened public policies to accelerate technological change in end-use is critical both to meeting the global goals and development goals in poor countries.

Historically, technological shifts in end-use applications have driven supply-side transformations. But this is not the primary focus of policy makers today, who seem mainly concerned with energy supply, rather than end-use technologies. Development of green energy end-use technologies is also important for accelerating industrial development in developing countries.

More energy efficiency, less GHG emissions

Studies have shown that, across a wide range of potential futures, energy efficiency is expected to account for more than half (about 59 per cent) of all emission reductions from 2000 to 2100, compared to much lower contributions by renewables (18 per cent), nuclear power (9 per cent), fossil fuels (6 per cent) and other means (8 per cent). By far, the largest contribution is expected from end-use and service delivery efficiency improvements, possibly combined with caps on demand. If the conversion loss of each device in the global energy chain is reduced by one per cent—equivalent to about 33 exajoules (EJ), or 7 per cent of world primary energy supply—an amount almost equivalent to China's current energy consumption would be saved.

Indeed, with the right policies in place to induce much greater energy efficiency improvements, it is feasible to reduce the world's average primary energy use per capita from 71 gigajoules (GJ) in 2010 to 63 GJ in 2050, even if per capita income would triple over the same period.

Resetting priorities

In 2010, the lion's share of worldwide investments in research, development and demonstration (RD&D) and "market formation" (a term used by researchers in the field to refer to the technological diffusion stage characterized by declining unit costs) for the energy sector went into power and fuel supply. Only one fifth of the $50 billion spent was for end-use technologies and energy efficiency. Public spending in energy-related RD&D continues to be low in developed countries, less than 5 per cent of what governments invest in total RD&D. Today's level of spending for energy technology is well below that of the 1970s and early 1980s, even though overall RD&D budgets have doubled since the 1980s.

WESS 2011 highlights the importance of government support for new technologies in achieving commercial viability, by scaling up use to reduce unit costs. In 2010, only $5 billion was invested by public and private sectors to create markets for products using new technologies for energy end-use and efficiency in 2010 (**WESS 2011**, table II.1, p. 38). This is very little compared to the $150-180 billion of investments for electricity generation, transmission and distribution. Globally, government support for renewables is expected to quadruple between 2009 and 2035. However, no commensurate increase is planned for supporting the development of energy efficient end-use technologies.

Emerging economies are world leaders in terms of RD&D expenditure for energy technology, but also in their case most is spent on energy generation and, what is more, on fossil fuel-related technologies. Energy RD&D in Brazil, the Russian Federation, India, Mexico, China and South Africa reached $19 billion, more than the total public energy RD&D budgets of all developed countries combined, estimated at $12.7 billion (in PPP terms) (see table). This challenges the conventional wisdom that new energy technologies

Table

Public and private spending on energy-related RD&D in selected emerging economies and the United States of America, 2004-2008[a]

Millions of 2008 United States dollars at PPP							
	Fossil (including CCS)	*Nuclear (including fusion)*	*Electricity, transmission, distribution and storage*	*Renewable energy sources*	*Energy efficiency*	*Energy technologies (unspecified)*	***Total***
China	7 044	19	..	..	161	5 885	**14 772**
Brazil	1 246	8[b]	122[b]	46[b]	46[b]	196	**1 664**
Russian Federation	430	..	22[b]	14[b]	25[b]	553	**1 045**
India	800	965[b]	35[b]	57[b]	..	..	**1 857**
Mexico	140	32[b]	79[b]	..	263[c]	19[c]	**534**
South Africa	164	164	26[c]	7[c]	..	9[b]	**370**
Subtotal	**9 624**	**>1 187**	**>285**	**>124**	**>497**	**>6 662**	**>18 580**
United States	1 821	804	319[b]	699[b]	525[b]	2 510	**6 678**

Source: United Nations, *World Economic and Social Survey 2011: The Great Green Tehcnological Transformation*, (table II.2, p. 39).

a Most recent year available.
b Government only.
c Private sector only.

are developed in developed countries and then transferred to developing countries. Unfortunately, these energy RD&D portfolios are dominated by efforts to enhance supply, with more than half the resources invested in fossil-fuel technologies. Less than 3 per cent was dedicated to RD&D for energy efficiency and end-use. In fact, the focus on fossil-fuel technologies is even stronger than in developed countries although China and some other emerging economies have become world leaders in originating renewable energy patents.

Hence, the priorities do not seem to be where they should be. Much more public support is needed for innovation of end-use technologies with the highest potential energy savings, such as electric heaters, diesel engines, electric motors, biomass burners, gas burners and engines used in manufacturing plants.

Running to the top

Even though the private sector is investing significant resources in end-use technologies, it is far from sufficient to induce a technological transformation. Much greater public sector leadership will be needed. Governments will have to actively engage in creating a market for energy-efficient products, including through environmental regulation, minimum production quotas, public procurement policies, subsidies as well as risk-sharing policies. Such measures would stimulate private risk taking in greener end-use technologies.

Japan's *Top Runner Programme*, initiated in 1998, is a particularly creative and effective program to improve energy end-use efficiency. The idea of the programme is to use the most energy-efficient product on the market during the standard-setting process to establish the "Top Runner standard". All corresponding product manufacturers should then aim to meet that standard in the next stage. Energy efficiency standards are discussed and determined by the government and advisory committees comprising stakeholder representatives.

By 2009, the programme had been expanded to 21 products, accounting for more than 70 per cent of residential electricity use. The results of the programme have been impressive. For example, the energy efficiency of room air conditioners improved by 68 per cent, of refrigerators by 55 per cent, of TV receivers by 26 per cent, of computers by 99 per cent, of fluorescent lights by 78 per cent, of vending machines by 37 per cent, and of gasoline passenger cars by 23 per cent, representing enormous technical improvements on top of some of the most energy efficient technologies to start with.

As suggested in **WESS 2011**, a global programme could be considered following the rationale of Japan's Top Runner Programme. Such a programme would promote cooperation among countries, corporations, communities and individuals, in order to improve energy technology performance standards, especially on the end-use side. For developing countries it will be critical to receive support and flexibility to align actions taken under the programme with their industrial development policies and, more broadly, national development strategies. ■

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