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King Abdullah Petroleum Studies and Research Center

Workshop Policy Brief

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Energy productivity: aligning global agendas

Summary for policymakers

The well-established link between economic growth and energy usage presents a conundrum for policymakers that can be resolved by focusing on energy productivity to promote greater societal welfare. Energy productivity focuses attention on how energy resources can be put to their best use, augmenting scarce energy resources, and how energy efficiency can lift economic growth.

Energy productivity appears to be a poorly understood concept, but it holds the key to one of the greatest reservoirs for increasing wealth and welfare available to the world. It is a concept tied intimately to energy efficiency - the amount of output (e.g. tons of steel or lumens emitted etc.) per unit of energy input. However, at the sector, national, or global level, this efficiency can be measured as energy productivity: the economic output (e.g. GDP or value added) per unit of energy input.

It can be argued that, over the last 40 years, energy efficiency has provided more energy than virtually any other energy source. Yet, until recently, it has not commonly been thought of as a fuel, and has been overlooked by politicians, businesses, and economic modelers in favor of supply-side expansion. The problem with energy efficiency as an organizing narrative for policymakers is that it is often framed as a way of reducing energy demand. Empirically, energy demand continues to rise outside of recessions, so energy efficiency is seen by some as somehow failing, at least at the national level. Furthermore, the rebound effect (where greater efficiency frees up resources to consume more of the more efficient item, or consume more of something else) is seen as a problem.

Recasting energy efficiency as energy productivity could change this by focusing on getting more value for each unit of energy consumed. This helps align the often competing agendas of alleviating poverty and enhancing welfare versus protecting the environment at the local and global level. With a small but growing number of countries adopting or debating using energy productivity as an energy policy goal, there may also be potential to create new consensus in international climate negotiations for a more prosperous, safer, and cleaner world.

This brief provides some answers to the following questions for policymakers:

- Why energy productivity rather than energy efficiency?
- How large is the potential to improve energy productivity?
- How do you measure and track energy productivity to benchmark the performance of nations?
- Why don't people invest in profitable opportunities to increase energy productivity?
- What is the finance sector doing to tap into energy productivity's potential?
- Why is energy productivity a particular issue for the Middle East?
- What can policymakers do?

It concludes that setting energy productivity targets at the national or sector level (GDP per energy use unit); and/or energy efficiency targets at the process and product level may help form the foundation for greater consensus around how to meet international energy, economic, and environmental objectives.

About KAPSARC

The King Abdullah Petroleum Studies and Research Center (KAPSARC) is an independent, non-profit research institution dedicated to researching energy economics, policy, technology, and the environment across all types of energy. KAPSARC's mandate is to advance the understanding of energy challenges and opportunities facing the world today and tomorrow, through unbiased, independent, and high-caliber research for the benefit of society. KAPSARC is located in Riyadh, Saudi Arabia.

Legal notice

Background to the workshop

In April 2014, KAPSARC held a workshop in Riyadh to discuss the role improved international cooperation on energy productivity can play in enhancing global benefits from energy use. Energy productivity also has special importance for the Middle East. The Minister for Petroleum and Minerals of Saudi Arabia, Ali Al-Naimi, in an interview with local media in November 2012 spoke of the need to reduce wasted energy resources and increase value in the economy, noting that it takes more than double the world average amount of energy to generate $1000 of GDP in the Kingdom. The workshop gathered international experts from academia, business and government to discuss the issues around energy productivity at the international level. KAPSARC also prepared several research notes to frame discussions at the workshop which are available on our website.

Why energy productivity rather than energy efficiency?

Improving energy efficiency is almost universally recognized as a way to boost economic growth, strengthen energy security, and lower greenhouse gas emissions. At a personal level, energy efficiency also makes people's lives better. It can deliver better services in terms of comfort, visibility, mobility, information processing, and entertainment. It can also provide attractive investment returns. However, energy efficiency as an organizing narrative has proved to be a weak vehicle for communicating its profound benefits to society. Energy efficiency is normally discussed as a means of reducing energy consumption and, by that measure, is seen to fail in the eyes of many because economic growth is almost invariably accompanied by rising energy demand.

Recasting the energy efficiency agenda as an energy productivity agenda has multiple benefits:

- By including economic growth it brings in a wider social welfare angle, such as establishing access to energy services;
- It incorporates energy efficiency into an agenda where the rebound effect is not seen as a negative;
- It can be used to measure energy efficiency at the regional and national level and, thus, provide an indication of whether specific policy actions are achieving their intended aggregate outcomes;
- It can bridge the gap between debates over "carbon-constraints" and "growth-constraints". Climate negotiations over the last two decades have highlighted the difficulty of achieving consensus if governments use the approach of binding absolute emissions caps; and, in any case,
- Who could argue against boosting productivity since the opposite is, by definition, energy waste?

How large is the potential to improve energy productivity?

Energy efficiency is perhaps the world's greatest single energy resource, but few people are aware of this, or even have a clear idea of exactly what it is.

In its 2013 Energy Efficiency Market Report, the IEA showed the importance of falling energy intensity, by calculating if 11 IEA countries had produced their 2010 GDP at the 1974 delivered energy intensities, they would have used 65 per cent more energy than they did. In fact, they make the point that energy productivity has helped fuel over half of the world's growth since the 1970s.

Of course, not all the increased energy productivity (reduced intensity) is due to increasing efficiency. Technical improvements in things like lighting, household appliances, vehicles, and industrial processes count for only about half of these gains.

The rest are a result of structural shifts in these 11 economies away from heavy industry towards services.

The effects of structural change in the economy highlights the critical importance of incorporating an assessment of the energy embodied in the trade of goods and services into evaluations of a country's energy efficiency. If a country has become efficient as a result of importing steel and cement and other energy intensive goods from another country, then there is an argument that some or all of the energy associated with that country's imports should be attributed to the consuming country - the one importing, not the one where those energy intensive goods are produced.

The IEA's Energy Efficiency Market Report, also estimated that in 2011 the world invested up to USD$300 billion in energy efficiency. This was about as much as was invested in fossil fuel power generation. While this was a systematic account, it almost certainly underestimated the total investment, as energy efficiency as an asset class has never before really been identified. Even so, it revealed that even though investors are already funding a huge quantity of energy productivity enhancing investments, energy efficiency is still the unsung hero of energy policy. It needs a makeover.

There is also a feeling that significant investments in energy efficiency are going unfunded, not so much due to the lack of their economic feasibility, but due to non-price barriers, such as technical capability to identify and execute large scale investments (such as energy efficient street lighting at the municipal level), and the problem of aggregating thousands of small efficiency actions into investment products that deliver a financial return to large investors. A range of other barriers at the micro level have also been identified.

New frameworks are required that can help individuals and investors navigate these market barriers; and thus realize energy efficiency's full potential. A movement is building which recognizes the powerful logic of energy productivity as a key metric for measuring progress and promoting greater action on energy efficiency. Leading economies such as the United States and Germany have already adopted energy productivity goals and others are discussing it. Could this movement form the seed for improved cooperation and target setting at the international level too?

How do you measure and track energy productivity to benchmark the performance of nations?

The United National Sustainable Energy for All (SE4ALL) initiative has a goal of doubling the annual rate of energy efficiency improvement by 2030. This is a laudable goal, but how will it be measured?

- **Product level:** Technological objects such as light bulbs, cars, refrigerators, and air conditioners can all be given a measure according to the amount of output (e.g. light, miles travelled, temperature cooled or warmed) produced from a given amount of inputs (e.g. electricity in kwh). Even some industrial plants and processes can be categorized in this way, such as the efficiency of power plants, or steel processes. This has a high level of clarity, but it is difficult to generalize from product or process performance to get a sense for energy efficiency in the broader economy.
- **Sector level:** Industrial sectors can be rated according to the amount of economic output produced from energy inputs. For example, the efficiency of coal fired power plants, steel or aluminum manufacturing, or cement can be given by output produced (electricity, steel ingots, or

tons of cement etc.) from a certain amount of energy inputs measured in tons of oil or coal equivalent. The efficiency of the transport and building sectors as a whole can also be indicated this way as energy use per size of household or for a class of vehicles per unit of distance travelled.

- **National level**: Energy efficiency has historically been measured by the use of energy intensity (energy inputs in tons of oil or coal equivalent) required to produce a certain amount of GDP. However, the use of energy productivity (GDP produced from a certain quantify of energy) is beginning to be adopted.
- **Global level:** Energy efficiency can be measured by either energy productivity or intensity at the global level.

The structural effects that allow nations to make improvements, but possibly at the expense of their trading partners, are not the only challenge in measuring progress. In a large country, the efficiency of products and processes can be influenced by geographic factors, such as temperature. Demand for certain energy services such as heating and cooling, or water desalination, will mean that some countries use more energy relative to the amount of GDP. This will lift their energy intensity, or lower their productivity. A particularly cold winter or hot summer will lift demand for heating and cooling, and thus energy consumption relative to GDP causing a drop in productivity (rise in intensity). However, the economy has clearly not become less efficient.

Such effects can be controlled for through normalizing energy productivity for factors such as climatic conditions and water availability. In the case of assessing structural effects, it is possible to adjust energy consumption according to the embodied energy in traded goods and services. There are also different ways of normalizing energy use across countries, including using a per capita measure, or by using different exchange rate conversion methodologies for GDP.

The American Council for an Energy-Efficient Economy's 2014 International Energy Efficiency Scorecard, provides an initial step at making such comparisons for a set of 16 countries and across different metrics and measures. Future research could build on this, broadening its scope in terms of countries covered and using more sophisticated normalization techniques.

Another way to avoid the distortions is to compare countries using physical intensities or productivities, such as the energy or electricity used per square meter of floor space per degree day, or to provide a liter of water; or move a ton of freight across a mile of distance. Such comparisons are real, comparable and meaningful. However, by taking GDP out of the equation a wider set of social benefits is taken out of consideration, and individual physical intensities cannot be aggregated across sectors to give a national level of efficiency.

Why don't people invest in profitable energy productivity actions?

Even when the benefits of energy efficiency or productivity have been identified, its gains versus its costs are a keenly debated topic. Some cast a skeptical eye over the win-win situations that energy efficiency evangelists make. Nowhere is this more apparent than with respect to the energy efficiency paradox, which describes the issue that if profitable investments exist for energy efficiency why don't people make them? Why are special incentives necessary? Skeptics might say, "so what if its potential is huge. If money is better spent on other things, like going on a holiday, rather than investing in a new boiler, then it is best to leave it to the individual or market to decide."

A host of behavioral, informational, contractual, and supply-chain impediments have been highlighted as reasons for a less than expected uptake of the energy efficiency actions. So, why don't people invest in profitable energy productivity actions?

- **Sunk cost effects:** In theory people should not take sunk costs into account when making investment decisions, but in practice they do. This means society can get locked into inefficient infrastructure once an investment is made, even though it would make economic sense to switch to an alternative.
- **Valuing time inconsistently and impatience:** People value the present more than they value the future. This is one reason why economists use discount rates in evaluating projects. However, some people discount the future so heavily that investments that make payoffs in the long-term are forsaken for short-term benefit. Many energy efficiency investments fall into this category, with relatively high upfront costs, but delivering lower operating costs over the longer term.
- **Lack of clear goals:** Goal setting has been found to help overcome status quo and set a reference point to measure performance against.
- **Lack of time, knowledge and expertise:** The information and technical requirements for undertaking energy efficiency actions can be high.
- **The costs:** Although many energy efficiency projects offer positive net present values over the lifetime of the investment, they can be expensive up front. Businesses might look at the opportunity cost of this and decided the money is better spent on other strategic goals, such as capturing greater market share, than minimizing operating costs.
- **Split incentives:** The benefits of energy efficiency in buildings go to the occupier, while the expense accrues most often to the owner. If they are not the same person or organization, this often results in cheap, low efficiency buildings.
- **Lack of "cutting the ribbon" opportunities**: Unlike many supply-side projects, like a solar plant, for example, there is often no ribbon to cut at official opening ceremonies. Photo opportunities with energy efficiency infrastructure make for dull news even with the most charismatic of celebrities and politicians. At the household level, people are more likely to gain social status from solar panels on the roof than for energy efficient appliances or some really good insulation.

It has also not helped that energy efficiency has most often been talked about in terms of reducing energy consumption rather than emphasizing the positive effect it can have on economic growth. People are generally put off when they are told they have to make do with less of something, like being told to turn off the lights by their mother, even if it is the right thing to do. Energy productivity on the other hand, de-emphasizes the energy conservation dimension and places focus more clearly on how more can be done, not less, with the same resources.

Following on from this, an important area of research is to quantify the effect on GDP of different energy efficiency actions and investments and highlight this to policymakers.

What is the finance sector doing to tap energy productivity's potential?

Recognition of energy efficiency as an asset class is growing, but is a long way from becoming a significant reality. Nevertheless, innovation in energy efficiency financing methods such as Property Assessed Clean Energy (PACE), On-Bill Repayment (OBR) and new contract forms such as Efficiency Services Agreements (ESAs) demonstrate

the increasing interest from financiers. Many countries, including the United Kingdom, Ireland, Singapore, and the United Arab Emirates, have launched, or are launching, energy efficiency financing programs. Led by the multilateral development banks, several large financial institutions have started activities around energy efficiency financing.

There are several national and international initiatives around energy efficiency financing. One risk is that these initiatives compete, rather than create a harmonized environment for the financing of energy efficiency projects that allows resources to flow to the best investments. Major initiatives include:

- **The Investor Confidence Project (ICP):** This US based project has been created by the Environmental Defense Fund. It is creating a set of protocols for developing energy efficiency projects in a standardized way in order to build confidence in projects and reduce transaction costs. This will support the development of a secondary market in energy efficiency financing, such as the use of Debt Capital Markets (bonds), which would provide large institutional investors with a mechanism to access energy efficiency projects. Informed by this experience, there is growing momentum for a European ICP based on the same generalized process, but using European technical standards.
- **The International Energy Efficiency Financing Protocol (IEEFP):** is an initiative created by the Efficiency Valuation Organization, the organization behind the International Performance Measurement and Verification Protocol. It was designed to support the Energy Performance Contracting model, which can be used by energy efficiency project promoters to access third party capital.
- **Open data on energy efficiency:** Cities in the United States such as New York and Chicago have embraced the idea of building owners having to publish their energy consumption data on open data platforms. The United States Department of Energy is supporting the Standard Energy Efficiency Data Platform to broaden this approach. Online, energy consumption platforms are also allowing households and businesses to track energy efficiency performance real time. One example is http://facilities.ucdavis.edu/Dashboard/Total_Electric/ which shows the University of California's campus wide and building specific electricity use. Similar tools are also available at the economy-wide level, for example http://www.gridwatch.templar.co.uk/.

As energy efficiency starts to attract more and more interest from those in the finance sector, the movement towards a set of standards around project development will gather momentum. This is could be analogous to the oil and gas industry where a set of globally recognized standards around the definition of reserves was developed and supported by professional bodies, such as the Society of Petroleum Engineers, the American Association of Petroleum Geologists, the World Petroleum Council, and the Society of Petroleum Evaluation Engineers. The same work is underway for energy efficiency, but currently lacks the resources and coordination that was marshalled by the oil and gas industry. Collaboration towards this goal would be a boost to maximizing the global benefits from energy use.

Why is energy productivity a particular issue in the Middle East?

Total primary energy consumption in the Middle East region steadily increased during the last decade, with an average growth rate of around 6.3% from 2001-2010, and a notable acceleration in the last 5 years. In addition, the region consumed 36% of its

total primary energy production to meet its local energy needs in 2010, compared to only 25% in 2000. These energy consumption trends are expected to worsen in the absence of corrective measures, and would lead to an alarming situation where local consumption crowds out exports. For the net energy exporting countries, total energy exports represented 3.8 times their energy consumption in 2001. Ten years later, in 2010, total energy exports represented only 1.9 times their energy consumption.

For countries with economies relying on revenues from fossil fuel exports, a substantial reduction in hydrocarbon products destined for export can result in a corresponding reduction in potential government revenues. This is a major risk to the on-going development of these countries, as their income is greatly buttressed by oil and gas export revenues. It could also be a significant risk to global energy markets as well, where increased energy prices can, in turn, slow growth in other regions.

The Middle East is one of the only regions in the world where energy productivity is getting worse, and most countries are far below international benchmarks of energy efficiency. For example, average power plant efficiency is currently about 35% compared to a typical efficiency of 55% for combined cycle plants. This highlights the opportunity from switching to higher efficiency plants for new power stations. Greater promotion of cogeneration, or even tri-generation where feasible, could lead to overall efficiencies of over 75% in power generation. Distribution and transportation losses are another area where the region lags behind international benchmarks, with average losses of about 12% overall, and losses of over 20% in some countries. This compares with 5% to 8% in most developed countries.

What can policymakers do?

Despite its potential, there is a strong perception among experts that energy efficiency is overlooked relative to supply side solutions to energy policy challenges. What is needed is an amplifier capable of communicating the energy efficiency message as well as policy pathways which provide the institutional framework to support efficiency investments. This would help make energy efficiency part of the everyday management of businesses and households. Energy productivity could be such an amplifier.

The United States and Germany have adopted energy productivity targets, and such targets are being discussed in other countries as a way to catalyze energy efficiency actions and initiatives. The Alliance to Save Energy is also active in globalizing its successful campaign in the United States to get more governments to commit to doubling energy productivity by 2030. An Australian Alliance to Save Energy and a European Alliance to Save Energy have been formed to contribute towards this aim by bringing together key business and NGO groups and forming bipartisan coalitions in support of energy productivity in these countries.

In the Middle-East, the United Nations Economic and Social Commission for West Asia (UNESCWA) and the Regional Center for Renewable Energy and Energy Efficiency (RCREEE) are two important organizations working to highlight investment pathways towards greater energy efficiency. As part of this framework, individual nations are developing and implementing National Energy Efficiency Action Plans, and work is underway to assess investment pathways for sustainable development and climate mitigation.

The Saudi Arabian Energy Efficiency Council (SEEC) and the Electricity and Cogeneration Regulatory Authority (ECRA) are also playing important roles in building the institutional frameworks to support energy efficiency actions within the Kingdom.

Globally, an increasing number of initiatives addressing energy efficiency include the already mentioned United Nations Sustainable Energy for All initiative (SE4ALL), the Clean Energy Ministerial (CEM), the Super-Efficient Equipment and Appliance Deployment Initiative (SEAD), the International Energy Agency's Efficient Electrical End-Use Equipment (4E) initiative, and the International Partnership for Energy Efficiency Cooperation (IPEEC), to name a few.

SE4ALL has Regional Hubs in Africa (through the African Development Bank), in Asia (through the Asian Development Bank), and in Latin America (through the Inter-American Development Bank) in addition to its two Thematic Hubs: Energy Efficiency at the UNEP Risø Centre, in Copenhagen, and Renewable Energy at IRENA, in Bonn and Abu Dhabi. The World Bank also acts as a Knowledge Hub to SE4ALL.

The 21st session of the Conference of Parties to the UNFCCC will take place in December 2015, in Paris, France, in order to secure an international post -2020 climate action agreement. Energy efficiency is an important contributor to the ongoing UNFCCC discussions, given the significant untapped potential it represents to deliver energy savings. According to the IEA, targeted energy efficiency measures could reduce global energy-related emissions by 1.5 Gt in 2020 and significantly more over the next decades. 60% of potential reductions are in the building sector, other key sectors include transport, street lighting and industry.

To drive action and commitments, an Energy Efficiency Global Coalition and Accelerator Platform has been proposed under the SE4All. This could help define the common elements of each of accelerators in each sector, such as governance, performance metrics, reporting requirements, commitment management, policies, resources and tools as well as public and private-sector financial support. The individual accelerators will focus on specific energy efficiency sectors and include, for instance buildings, lighting, motors, municipal, district energy, industrial motors, and transportation.

Action on energy efficiency is also being debated at the G20 level under the leadership of the Australian Presidency which culminates in Brisbane this year on November 14. While a mandate for energy efficiency actions within this forum is yet to achieve unanimous support, there is potential for this leading group of economies to articulate targets for follow-up by governments on energy productivity in the building, industrial and transport sectors.

Using such international forums can be an important way for countries to foster an international sense of community and a way of informally holding each other to account among peers. One thing that governments can do to support the aims of such initiatives underway would be to set energy productivity targets at the national or sector level (GDP per energy use unit); and/or energy productivity targets at the process and product level. This would be particularly useful, especially if energy efficiency targets are not already articulated. Such targets could then help form the basis of a bid for greater consensus around how to meet international energy, economic and environmental objectives.

Setting such targets, however, is complicated by the offshoring of energy intensive industries to other countries, an issue that can be resolved by adopting the embodied energy approach highlighted in this briefing.

About the workshop

KAPSARC convened a workshop in Riyadh in April 2014 to discuss the emerging agenda around energy productivity. Energy productivity is a concept that brings together issues around energy efficiency, economic growth and environmental performance. The workshop also focused on the important role of international trade in influencing global energy productivity, and methodologies to compare countries taking into account uncontrollable factors such as climate and water availability. The workshop was held under the Chatham House Rule, or capturing the discussion under a non-attribution basis. Presenters prepared several research notes to help seed discussion. KAPSARC's own presentations are available on the www.kapsarc.org

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