

Measuring Underlying Energy Efficiency in the GCC Region

BY SHAHAD ALARENAN, ANWAR GASIM, LESTER HUNT, AND ABDEL RAHMAN MUHSEN

Energy consumption in the six Gulf Cooperation Council (GCC) countries – Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE – has grown rapidly over the last several decades. With low administered energy prices, rapid population growth, and extensive economic development, final energy consumption across the GCC countries increased by an average of 6.8% per annum between 2004 and 2014 – almost four times faster than the global average. Energy efficiency carries the potential to mitigate such growth in energy demand, putting the GCC countries on a more sustainable pathway. However, there is a lack of hard evidence about energy efficiency for the GCC countries. We therefore undertake a benchmarking exercise to shed light on the relative energy efficiency position of the six GCC countries over the period 2004 to 2014 for residential electricity, transportation gasoline, and manufacturing aggregate energy.

Many believe that there have been limited, if any, improvements in energy efficiency in the GCC region, which would not be surprising given the low administered energy prices enjoyed by consumers for decades. In an environment of low energy prices, efficiency policies can play a big role. When consumers lack the incentive to invest in energy efficiency, policies such as minimum energy efficiency standards can drive up energy efficiency levels. Countries in the GCC however have launched a limited number of energy efficiency policies over the last several decades. Nevertheless, policymakers in the GCC have recently shown greater interest in energy efficiency, establishing several comprehensive initiatives across the region such as the Saudi Energy Efficiency Program. Hence the need for more evidence about the energy efficiency performance of the GCC countries.

Energy efficiency itself is very difficult to measure. This makes it difficult to track progress. Because of these difficulties, analysts often use simpler, indirect indicators to track progress in energy efficiency. For households, consumption per capita is often used. A fall in electricity consumption per capita is often believed to be associated with energy efficiency improvements. Davis (2017) for example explores the fall in residential electricity consumption per capita in the US and suggests that the recent uptake of energy efficient lighting is likely responsible for the fall. For firms, energy intensity (or its inverse, energy productivity) is often used. A fall in energy intensity is often associated with improvements in efficiency. The IEA (2017) for example combines decomposition analysis with energy intensity indicators to isolate the effect of energy efficiency, but even with decomposition the result likely captures much more than just energy efficiency. As Filippini and Hunt (2011 and 2015) argue, such indirect indicators can

increase or decrease because of many different factors that are unrelated to energy efficiency. Filippini and Hunt (2011) therefore advocate attempting to control for such factors by estimating energy efficiency using frontier analysis.

There are various approaches for conducting frontier analysis, which can be either parametric or non-parametric. Corrected Ordinary Least Squares (COLS) and Stochastic Frontier Analysis are among the most commonly used parametric approaches. For our benchmarking analysis, using a newly constructed dataset, we adopt a parametric approach by estimating econometrically an Energy Demand Function (EDF). According to Filippini and Hunt (2015), the EDF can be used to capture economic inefficiency (both allocative and technical). Furthermore, we apply COLS to the estimated EDFs to measure underlying energy efficiency given our relatively small dataset for the six GCC countries.

Applying COLS to the residential electricity sector in the GCC suggests that between 2004 and 2014 estimated underlying energy efficiency improved in Kuwait, Bahrain, and Saudi Arabia by 18%, 11%, and 10%, respectively, while it deteriorated in Qatar, Oman, and the UAE by 34%, 15%, and 4%, respectively (see Figure 1A). For the gasoline road transport sector, estimated underlying energy efficiency improved in Bahrain, Kuwait, Qatar, and Saudi Arabia by 21%, 17%, 7% and 7%, respectively, while it deteriorated in Oman and the UAE by 47% and 33%, respectively (see Figure 1B). For manufacturing aggregate energy, estimated underlying energy efficiency improved in Saudi Arabia and Bahrain by 31% and 6%, respectively, while it deteriorated in Oman, UAE, Kuwait, and Qatar by 77%, 39%, 18%, and 8%, respectively (see Figure 1C). In summary, the results suggest that there are some relatively large energy inefficiencies in the GCC and that there have been as many deteriorations as improvements. These results validate some of the widely held beliefs around energy efficiency in the GCC and show that there remains great potential for energy efficiency in the region.

Comparing the estimates of underlying energy efficiency to indirect indicators such as energy intensity and energy consumption per capita reveals that: 1) Indirect indicators are generally good at tracking progress in energy efficiency, but are not always perfect at doing so. 2) Indirect indicators are less useful at comparing and ranking countries in terms of

Shahad Alarenan, Anwar A Gasim, and Abdelrahman Muhsen are researchers at the King Abdullah Petroleum Studies and Research Center (KAPSARC), Riyadh, Saudi Arabia; **Lester C Hunt** is at the University of Portsmouth, UK and a visiting researcher at KAPSARC. Corresponding author: Anwar A Gasim, anwar.gasim@kapsarc.org

energy efficiency – the relative rankings in estimated underlying energy efficiency differ considerably from the relative rankings in energy intensity for example.

The evolution of energy demand in the GCC region over the next several decades is likely to be considerably different to the patterns witnessed in the past. GCC countries have recently started to use both prices and policy to encourage greater energy efficiency. In late 2015, Saudi Arabia for example announced comprehensive increases in energy prices across the residential, transport, and industrial sectors. Saudi Arabia then implemented a second wave of energy price increases roughly two years later. The UAE has also been a leader in energy price reform, as it was the first to implement significant gasoline and diesel price increases. Almost all GCC countries have recently attempted to reform energy prices, although the scale and degree of price reform differ between them. Most GCC countries are also relying on energy efficiency policies, as they have started to develop and update their standards for appliances. Such a two-pronged approach that utilizes both energy prices and policies will likely yield considerable improvements in energy efficiency. Thus, unlike the estimated energy efficiency trends for the period 2004-2014, the trends over the next decade or two are likely to be very different, with the potential for rapidly improving energy efficiency. This in turn will support more sustainable growth pathways for the GCC countries.

References

Davis, L., 2017. Evidence of a Decline in Electricity Use by U.S. Households. *Economics Bulletin*, 2017, 37(2), 1098-1105.

IEA, 2017. Energy Efficiency Market Report 2017. International Energy Agency, France.

Filippini, M. and Hunt L.C., 2011. Energy demand and energy efficiency in the OECD countries: a stochastic demand frontier approach. *The Energy Journal*, Vol. 32, No. 2, pp. 59-80.

Filippini, M. and Hunt L.C., 2015. Measurement of energy efficiency based on economic foundations. *Energy Economics*, Vol. 52, pp. S5-S16.



Figure 1. Estimated underlying energy efficiency for the GCC countries.

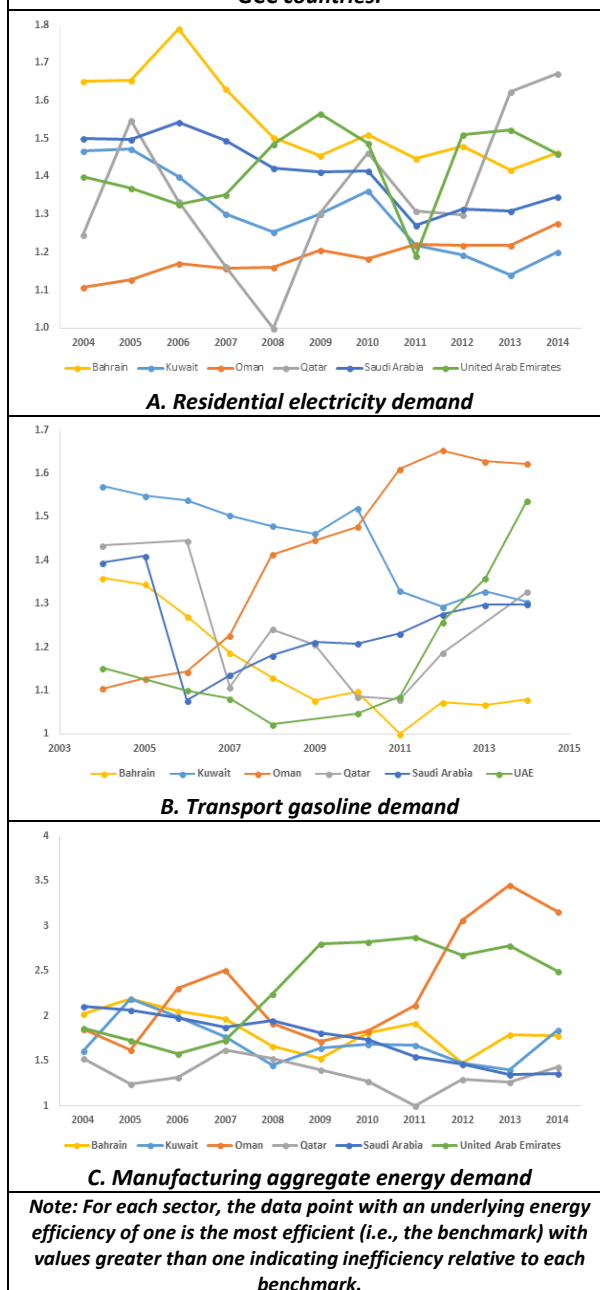


Figure 1. Estimated underlying energy efficiency for the GCC countries.

