APEC ENERGY CONSUMPTION TRENDS: A DECOMPOSITION ANALYSIS

Elvira Torres Gelindon, Senior Researcher, Asia Pacific Energy Research Centre (APERC), (+81)3-5144 8543,
gelindon@aperc.ieej.or.jp

Overview

Asia-Pacific Economic Cooperation (APEC) is a dynamic region in which diverse economies have agreed to work together to support sustainable economic growth and prosperity. Over the past decade, many APEC economies have experienced rapid economic growth alongside rising population, which drives up individual and collective energy demand requirements. The region has a prominent role in shaping the global energy sector, accounting for 57% of global final energy demand in 2016 (APERC, 2019). In this regard, APEC aspires to reduce its aggregate energy intensity by 45% percent by 2035 with 2005 as base year. The APEC Energy Working Group (EWG) has been monitoring the progress of energy intensity over the years using final energy consumption per GDP as the common measure, and has noted considerable progress towards the energy intensity reduction target. Nevertheless, the analysis is not a complete picture of what is driving the reduction as energy consumption trends may be explained by several factors beyond energy efficiency improvement. Changes in final energy consumption can be explained better by a) activity effect—changes in the scale of economic activity; b) structural effect—changes in the relative importance of sectors with different energy intensities, c) intensity effect—changes in the productivity of energy use and d) weather effect—changes in weather patterns (especially for residential). Hence, this paper seeks to identify the main factors that have driven the decline in energy intensity in APEC region since 2005 using decomposition methodology (Ang, 2016). This method allows us to separate structural shifts, understanding better true trends in energy consumption as well as trends in economic activity that influence energy consumption in the region.

Methods

- The final energy consumption (FEC) data in thousand tonnes of oil equivalent (ktoe) used in the analysis were from the EGEDA (APEC) database. FEC consists of the industry, services and agriculture sectors only as these sectors have the equivalent measure of the level of activity of energy consumption associated with gross value added (GVA).

- To conduct energy decomposition, activity data are also needed, in this case the GVA in constant 2010 US dollar taken from World Bank Indicators were used. Note that while GVA represents the level of activity associated with the energy sectors mentioned, it is not a good proxy to measure activity in other sectors such as the transport or residential. The transport consumption is not comparable to the GVA of the transport sector since the energy use attributed to transportation is part of the companies and activities included in all economic sectors while energy consumption in the domestic sector is not directly related to any concrete production process (Marrero and Ramos-Real). These two sectors can be analysed with other more related indicators such as passenger-km travel and number of vehicles (transport), floor area and weather effect (residential), etc. It is of note also that the GVA of Chinese Taipei (DGBAS, 2019) was taken from its National Statistics office in the local currency unit and converted into constant 2010 USD.

- Decomposition method represented by Logarithmic Mean Divisia Index (LMDI)-I Formula by B.W. Ang: $\Delta E_{tot}=E^T- E^0=\Delta E_{act}+ \Delta E_{str}+\Delta E_{int}$ where ΔE_{tot} represents change in energy consumption, ΔE_{act} change in consumption due to activity, ΔE_{str} due to change in structure and ΔE_{int} due to intensity effect. A positive **activity effect** means GVA grows because of additional energy demand from increased economic activity. Relatedly, the activity effect is negative during economic recession. A positive **structural effect** means that the share of GVA corresponding to energy intensive sectors increases relative to the GVA of less intensive ones. And lastly, the **intensity effect**, represented by the ratio of final energy consumption to GVA, accounts for changes in total energy consumption due to technology improvements, policy effects and other factors (Economidou, 2017).
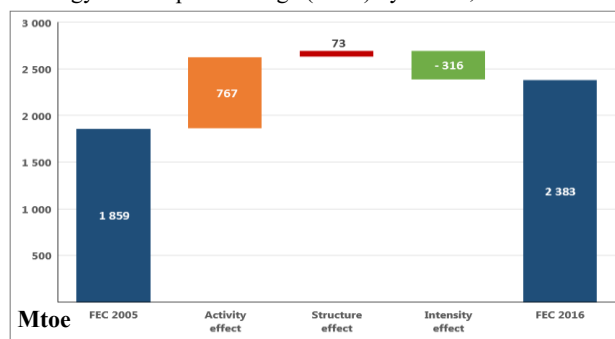
Results

Final energy consumption (FEC) grew at a compound annual growth rate (CAGR) of 2.3% between 2005-16. Among the three sectors analysed, the industry sector dominated the total consumption in APEC with more than a 70% share followed by the service sector (18%) then lastly agriculture (4%). The economic ranking, however is slightly different when we look at GVA. APEC's GVA grew at a 3.4% CAGR over the same period, with the service sector comprising the biggest share at 66% followed by industry (30%) then agriculture (3%). While shares of GVA represent the relative size of each sector in the economy, the final consumption shares highlight the region's energy

needs for the respective demand sector. And as mentioned earlier, the sectoral composition of economy is critical in determining the region's energy consumption trends as well as energy intensity trends.

By decomposition, Figure 1 shows that the activity effect ramped up the FEC by 41% (767 Mtoe) to 2 383 Mtoe in 2016 compared with 2005 (1 859 Mtoe). The structural effect although insignificant, contributed a 4% (72 Mtoe) increase in FEC while the intensity effect was the strongest factor, offsetting increases in FEC by 17% (-315 Mtoe). If energy intensity reduction did not come into play, FEC would have increased by 839 Mtoe in 2016 from the 2005 level because of economic growth during this period. Meanwhile, Figure 2 shows the yearly results of decomposition: total change in FEC relative to 2005 and the effects shown in percentages in terms of decomposed indicators in 2005. For example, the total effect value of 128% means a 28% increase in FEC compared with the 2005 consumption level. The activity effect of 141% and structural effect of 104%, represented 41% and 4% increases, respectively in FEC compared with 2005 that would have been observed had there been no intensity reduction. It is fairly obvious that since 2005, reduction in energy intensity has led to offsetting the increase in FEC brought about by activity and structural effects.

Figure 1 ● Decomposition of changes in APEC final energy consumption change (Mtoe) by LMDI, 2005-16

Sources, FEC (EGEDA) and GVA (WB and DGBAS)

Figure 2 ● Yearly Additive Decomposition results, 2005-16 (% in terms of 2005 consumption levels)
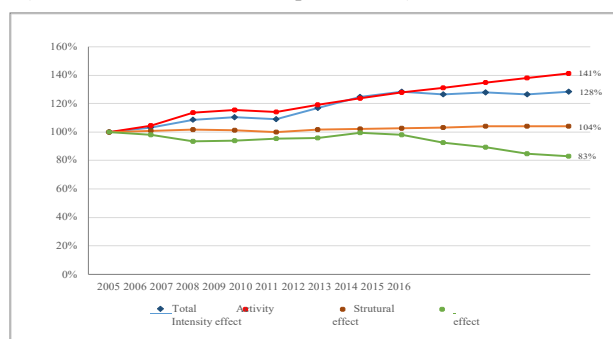
Sources, FEC (EGEDA) and GVA (WB and DGBAS)

Conclusions

By decomposition, it can be said that the intensity effect played a significant role in offsetting the increases in final energy consumption brought about by the rapid growth (activity) of APEC region. While the structural effect is positive, it reflected minimal year-on-year increases in APEC final energy consumption. To better understand the other factors affecting energy consumption trends in APEC, decomposition of a more detailed disaggregation of energy consumption and related indicators should be further analysed.

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