Guatemala: a country that runs on fuelwood

Table of Contents

Introduction

This series of Synthesis Reports on the Guatemalan System of Environmental and Economic Accounts is the result of an effort to make its findings available to a broader non-Spanish speaking audience. The System includes information on energy, forests, water, ecosystems, waste, subsoil resources, fisheries, and environmental expenditure.

The Synthesis Reports summarize three documents that were published in 2009 for each of the accounts--one methodological, one of results, and one more informational--by the Central Bank of Guatemala and Rafael Landívar University. We feel that even if a few years have gone by and the numbers have evolved, key insights that were made possible by the accounts regarding the relationship between the environment and the economy in Guatemala will be everlasting.

Rather than translating these documents verbatim, we opted to slightly rewrite and reorganize their information having a general English reader in mind. This resulted in more concise documents with less of an academic tone, which policy makers and the general public will appreciate.

We also tried to make them more suitable for the different ways in which people consume information. For that reason, each of the reports can be read online, downloaded as an e-book or PDF, or acquired in printed format.

Energy, the environment, and the Guatemalan economy in a nutshell

[**This text accompanies the Figure with the diagram.**]

Nature provides the Guatemalan economy with coal, wind, hydraulic and geothermal power, fuelwood, sugar cane bagasse, and crude oil, among others. These are called "primary sources" of energy because they are usable in its natural form to some extent. We can take advantage of them locally or we can import them from the rest of the world. However, most of the economy's productive processes cannot take advantage of these sources in their raw form, and so they are transformed into what we call secondary sources of energy. Examples of this type of energy include the various types of gasolines and diesel fuel, liquefied petroleum gas, and electricity.

Different industries, or economic activities, use both primary and secondary energy sources as inputs in their production processes. Households, in turn, use them to satisfy domestic needs like cooking, powering of devices, heating or cooling, among others. One special industry uses large amounts of various types of primary and secondary sources to produce electricity, which is then used universally by everyone else in the economy.

Finally, from the combustion, or simply burning, of some these energy products, industries emit various gases that go up into the atmosphere. Some of these are known as greenhouse gases and in our accounting efforts we have tracked carbon dioxide (CO2), nitrous oxide (N2O), and methane (CH4).

Executive summary

- In 2006, Guatemala consumed 483,947.3 terajoules (TJ) of energy in all its forms.
- Households accounted for about 46% of all energy consumption. Their main sources of energy were fuelwood, gasoline, and electricity.
- The generation of electricity, as an industry, used around 13% of energy of all types; an equivalent of 61,594.2 TJ.
- Of all economic industries, the production of electricity is the largest individual consumer of energy.
- Among industries with high levels of energy consumption, we can also find the Manufacture of bread, with 3.6% of total consumption, transportation (3.5%), other manufactures of grain mill products (3.3%); manufacture of cement, lime and plaster (2.6%); wholesale and retail trade (2.4%); manufacture of refractory ceramic products (2.2%); restaurants, bars and canteens (1.1%); manufacture of sugar (1%); and the manufacture of soap and detergents (1%).
- Guatemala exported 32,922 TJ of energy, 99% of which represents crude oil exports and the remaining 1% corresponds to electricity.
- As a result of the combustion of energy products, the Guatemalan economy emitted a total of 45.6 million CO_2 tons equivalent.

- The main 5 carbon dioxide emitters among economic industries generated a total of 11.6 million CO_2 tons equivalent (this excludes households). This is equivalent to 64% of all 129 industries studied.
- Households emitted 27.5 million CO_2 tons equivalent.
- The production of electricity emits more than 5.7 million tons equivalent of CO_2 due to the fact that it is the largest individual consumer of fossil fuels. After households, it is the largest emitter.
- The production of electricity required 14.2 terajoules to generate each million quetzales of newly added wealth during that year, in contrast with most manufactures that average 2.9 TJ to achieve the same, or wholesale and retail activities which barely reach 1 TJ.

Main findings

Flows from the environment to the economy

Between 2001 and 2006, the Guatemalan economy used several types of energy resources directly from the environment in order to satisfy both the needs of production and those of final consumption. Water's potential energy and thermal energy from volcanic activity were key resources in the production of electricity. The country also extracted crude oil and natural gas in some regions, which were destined almost exclusively for the export market. Guatemalans also imported coal from other countries mainly for the production of electricity. Nevertheless, in Guatemala the biggest source of energy obtained directly from the environment was biomass in the form of fuelwood for domestic use and sugarcane bagasse, mainly used as an input in the production of electricity.

The table below shows the relative structure of primary energy sources for Guatemala in terajoules (TJ). It is evident that biomass is extremely important for the country, with a use share of around 83% of all primary energy sources. And within that category it is evident that fuelwood powers household activities with 224,227.3 TJ or 90% of that biomass. The second most important source of primary energy is coal, which is used mainly for the production of electricity and is mostly imported. Hydro and geothermal energy are also important for the country with around 20,534 TJ used in the year 2006. Even if oil production in the country is important as a source of foreign income, its direct use in Guatemala is minimal, with a share of about 1% of primary resources.

[Table 8, p. 30 AD, Primary energy]

Energy within the economy

A total of 483,947.3 TJ[1] of energy in all its forms was available to the Guatemalan economy in 2006. That energy was used as inputs in the production of goods and services by several

[1]Some of this energy was produced locally and a portion was imported.

industries, and also by households, the government, and non-profit institutions in processes such as cooking, artificial lighting, heating, or cooling.

The figure shows quantities of energy in terajoules used by the different economic industries and households in the rows, coming from the various energy sources in the columns. Darker tones represent higher uses of energy relative to total consumption. According to this, household final consumption of represents around 47% of total use and even surpasses slightly all consumption of energy used as inputs in production (46%). This is due not only to the fact that households are the main users of fuelwood (which has a high calorific content), but also of gasoline, liquefied petroleum gas (for cooking), and electricity.

[Table 9, p.31 AD, Energy use burden for Guatemala]

Additionally, table 10 shows the ten largest users of energy, excluding the use of fuelwood[2]. The largest user of energy of all types in the Guatemalan economy is by far the production and distribution of electricity with a total of 61,594 TJ, equivalent to 27% of the energy use for intermediate consumption in 2006. This means that the Guatemalan society uses a large percentage of energy of different kinds (such as coal, bunker, diesel, bagasse, etc.), which in many cases is imported, to produce electricity.

Notes on Greenhouse Gas Emissions

The total anthropocentric contribution to greenhouse gas emissions from the combustion of different energy sources amounted to 45.6 million carbon dioxide metric tons equivalent in 2006. In general terms, that is less than 1% of total world emissions. Nevertheless, it can still carry financial consequences or opportunities when it comes to international treaties on the matter. Table 11 shows the distribution of emissions among groups of economic industries.

[Table 11, p.31 AD, Greenhouse Gas Emissions from energy combustion 2006]

If we narrow the focus on individual activities Figure 4, shows the greenhouse gas emissions of the top five emitting industries on the left of the vertical axis with bars and those of households on the right of the vertical axis with a line. Households emissions are considerably higher, due to the high carbon content of fuelwood and their large use of that product, coupled with the considerable use of gasoline.

Among the top emitters, it is interesting to note that the emissions of the first economic industry on the bars (production and distribution of electricity) more than doubles those of its follower. This is consistent with the high use of fossil fuels in the production of electricity.

The second industry on the graph is the production of bread which is there because of its high use of fuelwood. In a GHG inventory (those advocated by the Inter Governmental

---

[2]This is done for presentation purposes, given that fuelwood use dwarfs all other uses. Around 85% of fuelwood is used by households.

Panel on Climate Change) emissions from biomass do not count toward the total emissions and are left as "memorandum items", this in order to avoid double counting. In the supply and use accounting structure of the SEEA, this is not a problem, and hence they are included. If fuelwood and bagasse were excluded, bakeries and mills would be excluded from this list and cement production and retail trade would replace them. Finally, due to its high use of different fuels, the transportation industry is also important in this context.

Energy intensity

Figure 5 shows an indicator called energy intensity for six economic industries for 2001-2006. Due to the nature of each type of economic activity, we can find these at different general levels of intensity. Some industries need less energy to produce one unit of value added, like retail trade for example, and others, like cement production need considerably more. For that reason it is not altogether adequate to compare intensities between industries. However, it is possible to compare how a specific industry fares through time. In that way, we can see if use of energy per unit of value added has improved or become worse.

[Fig 5. p. 36, AD, Energy intensity for selected industries]

In the case of Guatemala, the production of bread shows a decrease in its intensity in the period. The production of ceramics shows a more erratic behavior, but mantains its high level of energy use, whereas transportation and general mills have a more stable energy intensity over time. This is probably due to the fact that technology is replaced less often in those activities.

Tables of results

Energy supply

Energy supply for Guatemala in the period 2001-2006 is divided into eleven groups of energy commodities, which in turn can be divided into primary and secondary energy sources. These are shown in Table 1, where the largest supply of energy corresponds to fuelwood in caloric terms (about 46% of all energy use). The supply of refined products from oil represents around 30%, which comes mostly from imports. Coal is imported in its entirety. Primary sources are the largest component, with 73% of total supply in 2001 and 65% in 2006.

[Table 1, p.16, AD, Energy supply by energy commodity]

It is important to note that table 2 shows that between 28% and 36% of total energy came from imports between 2001 and 2006, while the energy produced domestically saw its share reduced from 73% to 64% during the analysis period. This is consistent with a reduction of oil production in the country and an increase in relative terms of oil refined products.

[Table 2, p. 17, AD, Energy supply by groups of economic activity]

In monetary terms, the importance between primary and secondary sources is reversed, due to the higher unit price of electricity and imported refined products from oil when compared with fuelwood or bagasse. Secondary sources, in this case, represented 77% of all energy transactions in the economy in 2001 and 84% in 2006 (see table 3). Bagasse, which is a by product of the sugar cane milling process, was not valued in monetary terms.

[Table 3, p.18, AD, Monetary supply]

Energy use

Conceptually, energy use must be equal to its supply, and that means that the energy produced in the country must be used in its entirety by economic agents, either by industries, in final consumption, or as exports. The ability to disaggregate energy use by type of economic activity is one of the advantages of an energy account, because it allows us to track the economy's energetic performance, but also the energy consumption of its individual agents.

Guatemala consumed an average of 45,299.8 terajoules of energy in all its forms during 2001-2006 and the largest consumers of energy were households with a use of around 51% of available energy in 2001, and about 46% in 2006, especially for their use of fuelwood (see table 4).

[Table 4, p.20, AD, Energy use in monetary terms]

During that time, the group of economic activities labelled as manufactures consumed an average of 20% of the available energy annually, while the single utility sector of the economy in charge of the production of electricity consumed also an average of 20% of energy of all types. The transportation sector, which is the largest user of diesel fuel in the country, became a distant fourth place in this list. Overall, exports as a use category decreased in relative terms from representing 11% of total energy use in 2001 to 7% in 2006.

In monetary terms, the use of energy has a different behavior (see table 5). For example, in contrast with their use in calorific terms, their use in monetary terms was of approximately 29% of total energy use between 2001 and 2006. This is largely due to the fact that their largest energy input comes in the form of fuelwood, which has a lower value per unit than other energy types, and a large share comes from self extraction, not purchases.

[Table 5, p.21, AD, Energy use in monetary terms]

The list of largest consumers of energy commodities in monetary terms is headed by manufactures with an average of 22% annual use of the total energy available, followed by wholesale and retail trade with 10%. It is also interesting that in monetary terms, exports become more important, with about 9% of anual use in the 2001-2006 period.

Greenhouse Gas Emissions

Once we established the use of energy by the different economic activities of Guatemala, a further step allowed us to estimate the greenhouse gasses that were emitted to the atmosphere as a result of the combustion of energy products.

Table 6 shows these emissions both in metric tons, as well as in a unit which makes nitrous oxide and methane emissions equivalent to those of carbon dioxide. Given the high carbon content in fuelwood and its generalized use in Guatemala, households top the list of emitters with a responsibility of about 60% of all emissions in carbon dioxide tons equivalent in 2006 (over a 20 year horizon). Economic industries labelled manufactures were responsible of about 18% and the group of Utilities, where the production and distribution of electricity is included, was responsible for close to 13% of total emissions in that same year.

Energy Supply and Use tables

It is possible to construct for every year in the study a supply and use table with the information shown so far. These types of tables give us an overall view of energy flows for the entire country. The columns in this case show the different energy products, either offered by any of the economic activities in the rows, or used by them. Table 7 shows this in terajoules.

[Table 7, p. 24, AD, Supply and Use Tables for 2006 in terajoules]

Additional Indicators

The information on flows allowed us to construct an indicator showing the intensity with which energy is used. This indicator measures how much energy is necessary to generate one unit of value added or newly generated wealth in that year. We saw some insights using this indicator in the discussion on energy intensity.

We also computed the decoupling indicator, a measure that measures the gap between the growth rate of energy consumption and the growth rate of the economy. In an ideal situation, the economy would grow infinitely, while the consumption of energy would decrease over time. This would mean that the country would be so efficient with its resources that it could produce more each year with the same consumption of energy as in the previous year, or have the same production, but with less energy. On an aggregate basis, the Guatemalan economy showed a clear example of decoupling where the economy grew at a much more rapid pace than that of its energy demand.