



Energy Accounts

Working Paper



MAY 2016

Acknowledgements

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Country Steering Committee

Costa Rica established a National Steering Committee (NSC), in order to mainstream NCA into policy making and support Environmental Accounts development. The technical advice, data and information provision by representatives of Ministries and government agencies under the Committee's direction is gratefully acknowledged through its members:

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Disclaimer

This document was prepared with figures from the Energy and Emission Account for the period 2011-2013 published in May 2016. However, the accounting tables for the Energy and Emissions Accounts available on the website of the Central Bank of Costa Rica correspond to the latest updated version. Given the ongoing revision process and strengthening of the Environmental Accounts, it is possible that the figures in this report do not match the figures published in the updated accounting tables of the website. To have access to the accounting tables published in May 2016, please address your request to the following e-mail address: estadisticasambientales@bccr.fi.cr.

This work is part of an ongoing, continuous improvement process of Environmental Accounts compilation. It is therefore not a final or definitive version. The Central Bank of Costa Rica (BCCR) would appreciate suggestions, comments and the submission of complementary and updated data sources, which may help improve future versions of the accounts.

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ABBREVIATIONS AND ACRONYMS

AVG	Aviation gasoline
BCCR	Central Bank of Costa Rica
CNFL	National Power and Light Company
CO ₂	Carbon dioxide
CPC	Central Product Classification
DSE	Sectoral Directorate of Energy
EA	Economic activity
GVA	Gross Value Added
ICE	Costa Rican Electricity Institute
IMN	National Meteorological Institute
ISIC	International Standard Industrial Classification
MINAE	Ministry of Environment and Energy
MOPT	Ministry of Public Works and Transport
MT	Metric Ton
MWh	Megawatt Hour
PN	Product nomenclature
RECOPE	Costa Rican Oil Refinery
SEEA	System of Environmental-Economic Accounting
SEEA-E	System of Economic and Environmental Accounting for Energy
SNA	System of National Accounts
SUT	Supply and use table
TJ	Terajoule
WAVES	Wealth Accounting and the Valuation of Ecosystem Services

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1. EXECUTIVE SUMMARY

The energy account recognizes the relationship of the energy sector with the environment and the economy by accounting its interactions and exhibiting the reciprocal influences between them. The central framework of the System of Environmental Economic Accounting (SEEA) recognizes “the ever increasing importance of information on the environment and the need to place this information in an economic context understood by central policymakers” (United Nations et al. 2014, p.2).

The first exercise of the Energy Account for Costa Rica is focused on the use of energy in physical terms for the period 2011-2013. The account shows the use of energy according to the different economic activities responsible for its use. Additionally, an energy supply table is derived from the Energy Balances. This table corresponds to a rearrangement of information in the supply section of the Energy Balances; therefore it does not add any additional information. Nevertheless, this rearrangement allows performing a better analysis regarding the supply of energy and its uses as a whole.

There are basic conceptual differences between the methodology used to construct the energy balances and the one used to construct the energy accounts, both which are complemented with the use of instruments such as the Supply and Use Tables (SUTs). The SUTs allow corroborating the use of energy products with their primary sources, therefore assisting to achieve the main objective of the environmental accounts.

From the energy account it is possible to obtain estimates of the use of energy (in TJ) by type of energy (primary or secondary) and by source. More than 50% of the energy used per year corresponds to fossil fuels and others, followed by 30% of energy derived from renewable sources, mainly for the generation of electric energy as well as for final consumption of households and certain industries (biomass and firewood). Finally, 19% of the energy corresponds to electricity.

Final energy consumption of households is high, and corresponds mainly to the use of fossil fuels, followed by electricity and firewood. Fuels are mostly consumed for the use of private vehicles. Energy consumption for the manufacturing of sugar is also relevant. The bagasse from the sugarcane is used to generate electricity and to generate heat and steam necessary for its production process. Another aspect to highlight is the use of fuels in transport activities. Although high, this sector does not include neither the energy consumed by private vehicles (which is assigned to households consumption), nor the energy consumed by transport fleets that belong to specific activities (which is assigned to each of the activities, respectively). An additional aspect that stands out is the energy consumption coming from electricity generation and export of commodities; with the latter one corresponding mainly to fuel sold to airplanes from international companies in national airports.

The CO₂ emissions account associates emissions with the economic activities that are responsible for the energy consumption causing them. Consequently, the CO₂ emissions account is derived from the energy use account by applying an emission factor per unit of used energy.

Approximately 70% of gross CO₂ emissions from the energy sector generated from fuel combustion, while the remaining 30% resulted from the use of renewable

sources e.g. geothermal energy, bagasse, coffee husks and other vegetable residues, and firewood.

A consistent information system such as the energy accounts and the CO₂ emissions account contributes to a better design and implementation of the policies of energy sector. The design of such policies derived from evidence and impact valuation can inform about energy-efficiency strategies with a higher impact over people, the economy and the environment, based on objectively constructed data.

2. INTRODUCTION

This document presents the results obtained for the Energy Account and its associated carbon dioxide (CO₂) Emissions Account for the years 2011 to 2013. This publication was developed with support from the Wealth Accounting and the Valuation of Ecosystem Services (WAVES) initiative. It presents the results of coordinated work between the Central Bank of Costa Rica (BCCR) and the Ministry of the Environment and Energy (MINAE) —particularly from the Vice-ministry of Energy and the Sectorial Directorate of Energy (DSE).

The report is structured as follows. Section 4 presents the first results of the Energy Account for Costa Rica. Section 5 shows the results of the CO₂ Emissions Account. Section 6 mentions some of the main uses of the accounts. Finally, section 7 addresses some aspects to consider for future work and development of the accounts.

3. NATIONAL CONTEXT

The energy sector of Costa Rica has been recognized for its electricity generation derived from renewable sources. However, the national energy matrix is intensive in the use of fossil fuels. According to the National Energy Balance of 2013 (DSE, 2015b), the final consumption of energy for 2013 was of 157 740 TJ. Fuel sources correspond to 61% of total consumption, followed by electricity and biomass with a share of 21% and 18% of total consumption, respectively. The Balance also indicates that the sector with the highest share of energy demand is the transport sector with 47%, followed by the industry sector with 25% and the residential sector with 14%.

The energy account recognizes the relationship of the energy sector with the environment and the economy by accounting its interactions and exhibiting the reciprocal influences between them. The central framework of the System of Environmental Economic Accounting (SEEA-CF) recognizes the “the ever increasing importance of information on the environment and the need to place this information in an economic context understood by central policymakers” (United Nations et al. 2014, p.2).

The Costa Rican economic context in which the energy sector is framed is characterized by a significant change in its production structure. Over the past 50 years Costa Rica has shifted from a model with a predominant agricultural sector towards a model with greater relative importance of the manufacture sector. In recent years, the service sector has become the most relevant one in terms of share of GDP (see Table 1).

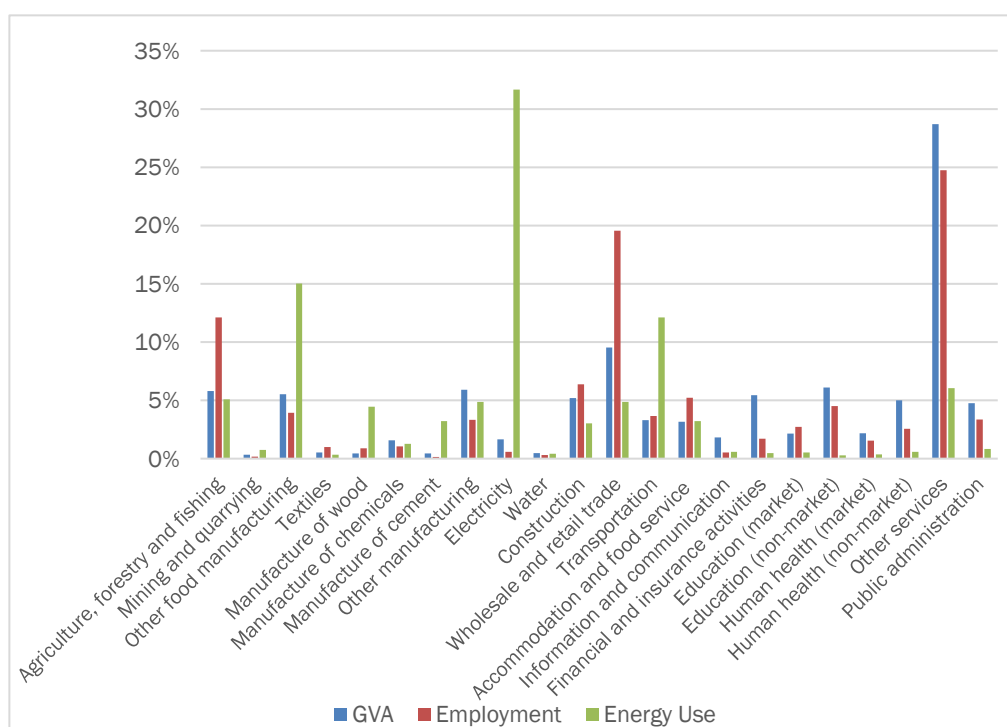
Figure 1 shows the share of economic activities in gross value added, formal employment, and use of energy when considering both the final use of energy and its use for transformation into energy products. The activities with the highest contribution to the country's gross value added and employment are services and wholesale and retail trade activities. The electricity industry stands out due to its high use of primary energy for transformation into electric energy, followed by the food and beverage service and transport activities.

TABLE 1. Costa Rica: Percentage contribution to GDP by economic activity (basic prices)

Year	Agriculture	Manufacturing	Wholesale and retail trade	Services	Other
1966	23	17	21	10	29
1991	13	22	19	23	21
2012	6	15	13	37	29

Source: System of National Accounts (BCCR, 2016).

FIGURE 1. Costa Rica: Share of gross value added, employment and energy use by industry, 2013



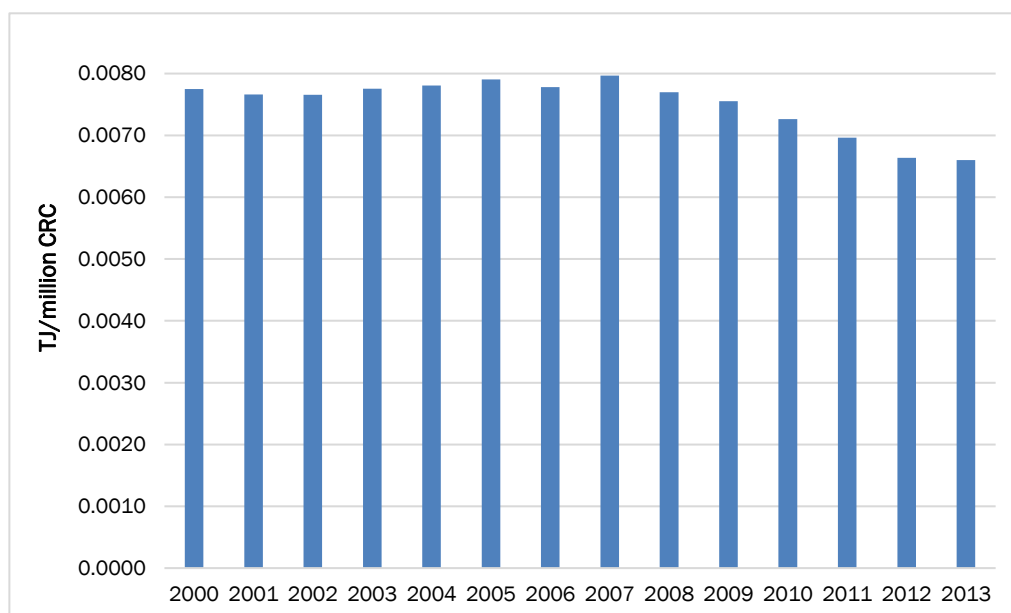
Source: Authors' calculations based on data from the Supply and Use Table, Costa Rica 2013 (BCCR, 2016).

In order to carry out their economic activities, each sector of the economy uses different amounts and sources of energy. The Energy Intensity indicator reflects the amount of final energy required for domestic production. Figure 2 shows the energy intensities of the country, defined as the amount of terajoules (TJ) required to generate 1 million of CRC (constant CRC from 2012) for the period 2000-2013.

In year 2000, the energy requirement to produce 1 million CRC was of 0.0077 TJ, whereas in 2013 the energy requirement to produce the same amount was of

0.0066 TJ. Figure 2 shows a declining trend of the Energy Intensity indicators, reflecting higher energy productivity possibly attributed to a higher efficiency in energy use. This trend can also be a reflection of a change in the structure of economic activities, in particular of a larger sector of services that is less intensive in the use of energy. Therefore, this indicator is linked to the behavior of particular energy intensities of different economic activities and their corresponding share of the total domestic economy.

FIGURE 2. Costa Rica: Energy intensity (TJ/million CRC), 2000-2013 ^{a/}



a/ Chained volume at previous year prices, reference 2012.

Source: Own elaboration with data from BCCR and Energy Balances (DSE, 2015b).

The creation of an energy account allows identifying in much greater detail the level of intensity of economic activities with respect to the use of energy resources. The level of detail depicted in the account tables allow to quantify the energy dependency from productive sectors of the country by source type and industry. It also allows quantifying the input-output interactions that emerge from energy consumption. By these means, it is possible to have better information regarding the use of energy and to support policy-making decisions.

4. ENERGY ACCOUNT OF COSTA RICA 2011-2013

4.1. Conceptual Framework

The system of Energy Accounts consists of a set of coherent tables that are consistent, integrated and related to energy. These tables show the reciprocal influences between the economy and the environment, as well as the existence of environmental stocks and their variations, both in physical and monetary terms.

The System of Environmental Economic Accounting (SEEA) is based on the fundamental principles of the System of National Accounts (SNA) and it consistent with it. The SNA is the international statistic standard used to measure the economic activity, wealth and general structure of an economy. It enables to present economic data in a suitable format for its analysis and formulation of economic policy and decision-making processes.

The SEEA constitutes a satellite system that is based in the principles of the SNA. The accounts of the SEEA consider availability, use, depletion and degradation of natural resources. This is complete and internally consistent system, whose design enables its implementation in a partial or modular way.

The first exercise of the energy account for Costa Rica is based on the use of energy in physical terms for the period 2011-2013. Although it is possible to obtain the use of each energy source in their original physical units (e.g. MWh, tons, etc.), we use terajoules (10^{12} J) as a homogeneous energy unit to allow for comparisons between energy sources.

The energy account shows the use of energy by economic activity responsible for its use. This allows to identify the relative energy intensities and the variations in energy efficiency per economic activity. The setup of the energy account shows the use of primary energy (i.e. energy directly obtained from natural resources) and secondary energy (i.e. energy products supplied by other economic sectors) in a combined way, accounting for it once: when it is consumed.

The classification by economic activity that is used to assign energy uses corresponds to an aggregation of 128 economic activities that can be found in the SUTs published by the BCCR (BCCR, 2016). The aforementioned aggregation, which was elaborated according to ISIC and economic activity, can be found in the Appendix.¹

In addition to this, the energy supply table is obtained from the Energy Balances. This table is a rearrangement of the information presented in the supply section of the Balance, therefore not contributing with any new information. Nevertheless, this rearrangement allows for a more accurate analysis of the supply and use of the energy as a whole.

¹ See Appendix, Table A1: Costa Rica: Classification of economic activities, Energy Account.

4.2. Sources of information

The main input for the elaboration of the energy account are the Energy Balances developed by the Sectorial Directorate of Energy on an annual basis (DSE, 2015a and DSE, 2015b). The balances show the supply, transformation and final consumption of the different energy products in physical units (TJ) by energy source (whether primary or secondary).

The supply is obtained from domestic production, imports and exports, transfers, inventory changes and unused energy. Final energy consumption is shown at institutional levels: residential, services, wholesale and retail trade, public, transport, industry and agriculture. In addition, it includes an unidentified consumption item that corresponds to less than 1% of the total energy consumed.

The *control totals* —defined as the total amount of each energy product used per year in the different economic activities, exports, households and inventories— are retrieved from the energy balances.

The main source of information used to disaggregate control totals by their different uses are the annual Supply and Use Tables (SUTs) published by the SNA (BCCR, 2016). SUTs present the information disaggregated by column according to the *Economic Activity* (EA) that corresponds to a group of ISIC activities, and also disaggregated by row according to the *Product Nomenclature* (PN) that refers to a nationalization of the Central Product Classification (CPC).

From the SUTs it was possible to identify the use of gasoline (PN073), diesel (PN074), bunker (PN075), other fuel sources and petroleum coke (PN077) and electricity, gas, steam, and air conditioning (PN117) per economic activity.

Based on both sources of information and expert criterion, control totals of each source are disaggregated between the different economic activities.

4.3. Conceptual differences between energy balances and the energy account

There are basic conceptual differences between the methodology used to construct the energy balances and the one used to construct the energy accounts, both which are complemented with the use of instruments such as the Supply and Use Tables (SUTs). The SUTs allow to corroborate the use of energy products with their primary sources, therefore assisting to achieve the main objective of the environmental accounts.

Energy balances are based on the territory principle, which implies that the domestic economy is separated from the rest of the world according to the geographical borders of the country. Conversely, environmental accounts follow the residence principle, as do national accounts. This implies that the energy products consumed by non-residents of the country —whether inside or outside of territorial borders— are considered as exports; while consumption by domestic residents within the country or in the rest of the world is considered domestic consumption. Hence, adjustments need to be made to correct for this difference.

Another important aspect concerns non-energy uses. Energy balances show separately the use given to each product as intended for energy or non-energy uses. The energy account does not include the non-energy uses of energy products, since the energy contained in those products is not finally used.

Finally, it is important to note that, according to the principles of the national accounts, energy produced as a secondary activity by certain industries (considered as self-producers or self-generators) must be allocated to the sector within which the transactions take place. For the purposes of the energy account, self-generators are incorporated into their corresponding main economic activity.

4.4. Particularities in the compilation of the energy account

As mentioned in subsection 3.2, the information used to compile Costa Rica's energy account was taken from the national energy balances and the SUTs from the SNA. The process of compilation of the account has the following particularities and challenges, described according to its energy source.

4.4.1. Primary energy

- Renewable sources used for electricity generation: In Costa Rica electricity is generated from hydropower, geothermal energy, wind and solar energy, which constitute primary energy used for the activity of electricity generation. According to the SEEA-E (United Nations, 2015), energy from renewable resources is accounted for in terms of total energy produced; hence, losses during the capture of energy from renewable resources are not included in the use table.
- Bagasse, coffee husk and other vegetable residues: According to the energy balances, these energy sources are used for electricity generation and steam and heat production used in industrial processes within the same activities. Consequently, the use of these energy products is attributed to the corresponding branch of the food and beverage activity. Only for the case of bagasse is a part of it assigned to electricity generation, as some self-producers inject the surplus of electricity produced into the national electricity grid. The losses perceived by sugar producers when injecting electricity into the grid are assigned to their economic activity, but they could be reassigned to the users of the electric grid in future analyses.
- Firewood: Control totals and subtotals from the energy balances and in some cases the Gross Value Added (GVA) are used to allocate the use of firewood by economic activity for each sub-total. A part of firewood is used for the production of charcoal. This use and the associated losses are assigned to the chemical industry (in which the transformation process occurs).
- Biogas: Biogas is the result of the processing of residues in biodigesters. According to MINAE, their use is assigned exclusively to households (used for cooking).
- Mineral coal (anthracite): Based on information from MINAE, it has been identified that its use is exclusive to the national cement industry.

4.4.2. Secondary energy

- Electricity: Its use is allocated using the control total of the energy balances and it is disaggregated by economic activity according to the percentage of electricity expenditure incurred by each activity, as indicated in the SUTs from national accounts. This allocation assumes that all sectors pay the same unit price for the electricity they consume. Moreover, there is information available on electricity consumption by economic activity ISIC for the Costa Rican Electricity Institute (ICE) and the National Power and Light Company (CNFL). Nevertheless, this information is not used. It could be completed and used to validate the estimates obtained from the SUT.
- Diesel and gasoline: For both cases the control totals of the energy balances are used and their use is allocated by economic activity according to the SUTs. As previously mentioned, the allocation assumes that all sectors pay the same unit price for their fuel consumption. For these two fuels there are challenges yet to be solved. First, there may be uses that are not necessarily associated to transportation, but instead they may be associated to industrial processes or other activities. In order to enrich the analysis and modeling, it could be valuable to distinguish between both types of uses by economic activity. Second, in order to validate the estimates by residence principle, information could be retrieved from the Ministry of Public Works and Transport (MOPT) or from customs to identify fuel consumption by non residents in the country, as well as consumption of domestic residents outside of the country.
- Bunker: SUTs are used to allocate the use by economic activity, based on the control totals of the energy balances.
- Jet fuel: Control totals of the energy balances are used. Expenditures in jet fuel by economic activity are included in the SUTs as part of the gasoline product. Therefore, it is necessary to realize the respective adjustments between both products. A challenge remains regarding the records of purchases of jet fuel. Only LACSA (acronym for Costa Rican Airlines SA) —group subsidiary of the airline Avianca— is a resident unit that purchases jet fuel in the country and is included in the EA095. The rest of jet fuel corresponds to purchases of non-residents. Therefore, it is necessary to inquire the amount of fuel that corresponds to the use of LACSA as well as its place of purchase, in order to make the adjustments with respect to the residence principle. Two different options are considered to do so: a) consult with AVIANCA to verify if they have detailed information, or b) consult the number and duration of flights of LACSA and from this information estimate the amount of fuel used. Once this information is available it is necessary to revise the proportions used to disaggregate the use of gasoline.
- Aviation gasoline (AVG): Control totals of the energy balances are allocated as mainly being used by the air transport sector because the AVG is used primarily for internal flights of domestic companies and for irrigation in the agriculture sector (by contract). It would be important to validate this allocation with information from RECOPE and/or Civil Aviation.
- Liquid petroleum gas (LPG), Kerosene and Petroleum coke: Control subtotals and totals of the energy balances are used. In the SUTs these products are under the PN “Other fuel sources” together with petroleum coke. The control sub-totals were disaggregated from the SUT once that the use of the cement

industry was deleted, which is the industry that uses petroleum coke. It is assumed that this industry does not use kerosene or LPG.

- Gas oil and IFO 380: Control subtotals and totals of the energy balances are used and their use is allocated according to the balance as the best estimate available. The disaggregation of the subtotals is done according to GVA. Information regarding these products regarding their specific uses can be inquired from RECOPE or MINAE to validate existing estimates. Expenditure in gas oil is included within the diesel product in the SUTs. Although it represents only 0.7% of diesel, once that complete information becomes available it is necessary to realize adjustments to the disaggregation used for diesel.
- Charcoal: Charcoal is produced in the country from firewood and according to the information of the energy balances it is used entirely by households.

4.4.3. Other considerations

- Energy balances include an item of “non-identified consumption” within the total consumption. Since energy accounts do not include items related to non-identified uses or statistical discrepancies, it is concluded that the estimates of the supply in the balances are more robust than the estimates of consumption. Consequently, it is preferable to use the control totals obtained from the supply information. This implies that, in all products where non-identified consumption was found, this item is prorated between each economic activity, according to the energy share of the corresponding energy product. In order to allocate this item in the best possible way, one could directly consult the primary sources about it.
- Losses in distribution and during transformation processes are directly associated with the economic activity responsible for the losses. For example, for the case of electricity generated by sugar mills, losses are directly associated to the economic activity of sugar manufacturing within the food and beverages sector.
- The compiled energy use tables include the final use of energy and its use for transformation in the production of energy products without making any distinction between them. Therefore, if one would want to obtain only the total net use of energy in the country, it is possible to discount the production of energy products from the total use of energy; in a way that the total transformed energy is discounted.

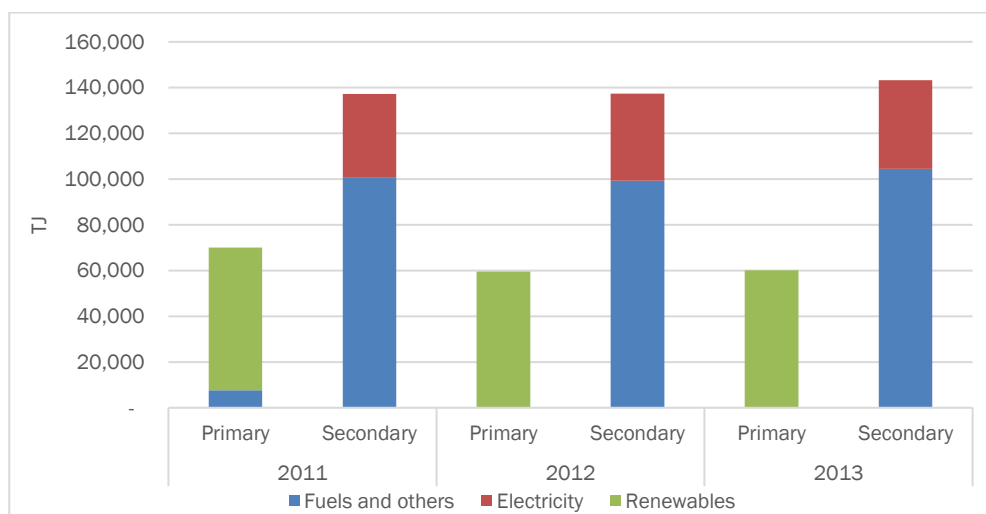
4.5. Results

From the energy account it is possible to obtain estimates of the use of energy (in TJ) by source and type of energy (primary or secondary)². More than 50% of the energy used per year corresponds to fossil fuels and others, followed by 30% of energy derived from renewable sources, mainly for generation of electric energy and for final consumption of households and certain industries (biomass and firewood). Finally, 19% of the energy corresponds to electricity (Figure 3). Figure 3 shows the

² The item “oil, fuels and others” include the following energy products: raw oil, gasoline, diesel, bunker, AVG, jet fuel, LPG, kerosene, gas oil, petroleum coke, IFO 380, mineral coal (anthracite) and charcoal. “Renewables” correspond to the use of hydropower, geothermal energy, wind and solar energy, bagasse, coffee husks, other vegetable residues, biogas and firewood.

total use of energy including final use and use for transformation; i.e., it does not correspond to a net total of energy consumed, but to the total requirements of the different energy sources.

FIGURE 3. Costa Rica: Total energy requirements composition by source (TJ), 2011-2013

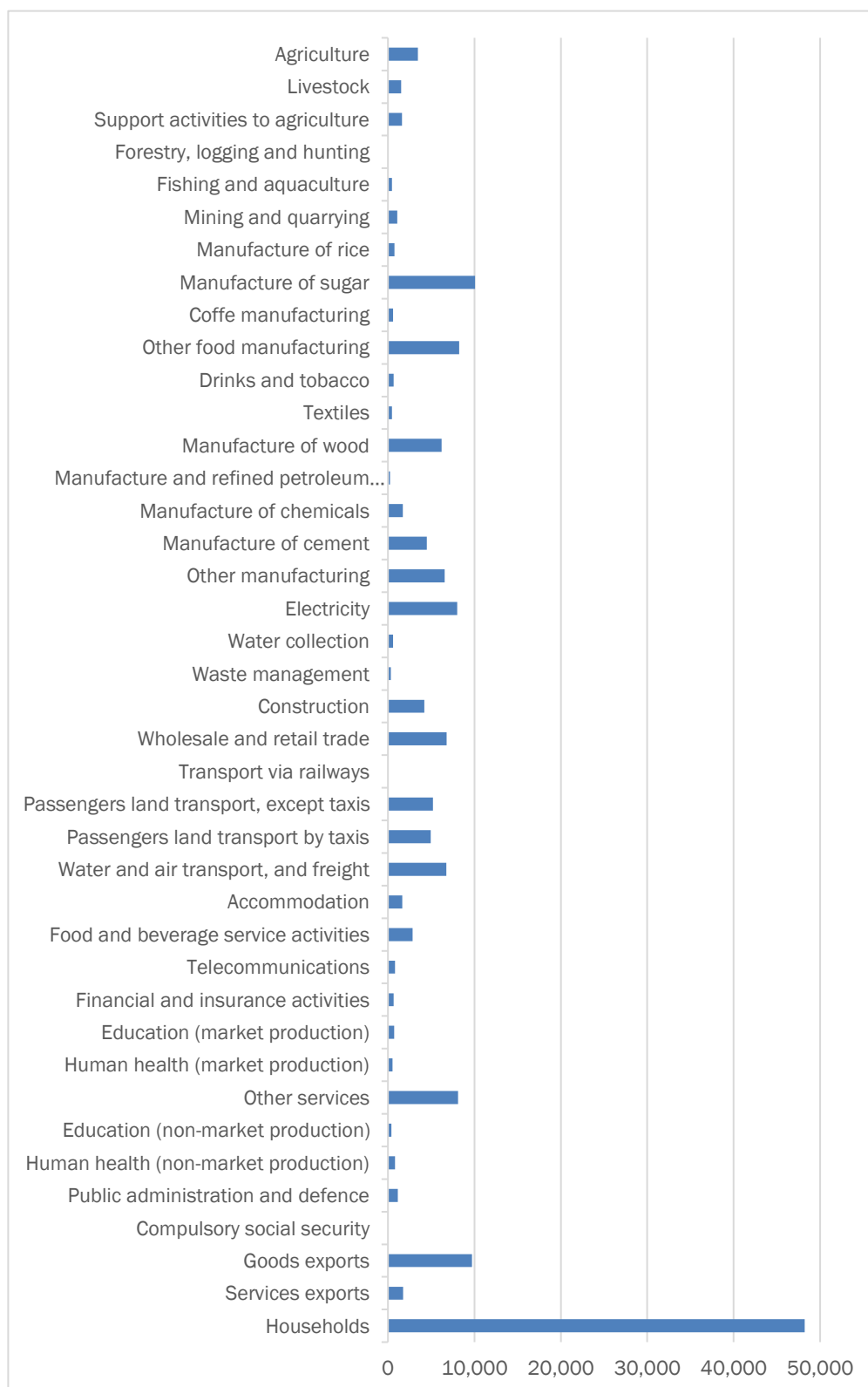


Source: Own elaboration with data from the Energy Accounts.

As mentioned in previous sections, the greatest benefit of the energy account data is that it allows to identify the use of energy by different economic activities. Figure 4 shows this information for 2013. There is high final energy consumption by households, corresponding mainly to the use of fuels, and followed by electricity and firewood. As for fuels, they are mainly devoted to the use of privately owned vehicles.

Energy consumption for the manufacturing of sugar is also relevant. The bagasse from the sugarcane is used to generate electricity and to generate heat and steam necessary in its production process. Another aspect to highlight is the use of fuels in transport activities. Although high, this sector does not include neither the energy consumed by privately owned vehicles (which is assigned to households consumption), nor the energy consumed by transport fleets that belong to specific activities (which is assigned to each of the activities, respectively). An additional aspect that stands out is the energy consumption coming from electricity generation and export of commodities; with the latter one corresponding mainly to fuel sold to airplanes from international companies in national airports.

FIGURE 4. Costa Rica: Total net energy use by economic activity (TJ), 2013



Source: Own elaboration with data from the Energy Accounts of Costa Rica 2011-2013.

Tables 2, 3 and 4 show the energy use tables obtained from the energy account. These are disaggregated by economic activity, exports, final use and change in inventories for the 3 largest types of energy products used and the reference year. They also include the net production of energy products in the country, in a way that it is possible to obtain the net use of energy. Tables 5, 6 and 7 show the same tables with the percentage composition use by economic activity.

TABLE 2. Costa Rica: Energy use (gross and net) by energetic source and economic activity (TJ), 2011

	Electricity	Fuels and others	Renewables	Total	Electricity produced	Fuels produced	Charcoal produced	Total (net)
Agriculture	415	979	-	1,394				1,394
Livestock	438	714	-	1,152				1,152
Support activities to agriculture	2	653	-	655				655
Forestry, logging and hunting	1	188	-	189				189
Fishing and aquaculture	18	1,014	-	1,032				1,032
Mining and quarrying	53	150	-	204				204
Manufacture of rice	35	64	770	869				869
Manufacture of sugar	100	363	8,188	8,652	-500			8,151
<i>Electric Grid Supply Losses</i>	-	-	191	191				191
Coffee manufacturing	290	15	426	731				731
Other food manufacturing	1,437	2,097	1,821	5,356				5,356
Drinks and tobacco	603	948	87	1,638				1,638
Textiles	96	205	-	301				301
Manufacture of wood	422	193	5,451	6,067				6,067
Manufacture and refined petroleum products	87	11,981	-	12,069		-6,422		5,647
Manufacture of chemicals	703	880	32	1,615			-32	1,583
<i>Transformation Losses</i>	-	-	97	97				97
Manufacture of cement	38	3,644	-	3,682				3,682
Other manufacturing	2,839	2,954	334	6,128				6,128
Electricity	785	9,796	32,036	42,617	-34,893			7,724
<i>Distribution Losses</i>	3,805	-	4	3,809				3,809
Water collection	536	36	-	572				572
Waste management	68	140	-	208				208
Construction	349	2,552	-	2,901				2,901
Wholesale and retail trade	1,790	1,539	-	3,329				3,329
Transport via railways	-	-	-	-				-
Passengers land transport, except taxis	120	5,378	-	5,498				5,498
Passengers land transport by taxis	-	3,079	-	3,079				3,079
Water and air transport, and freight	193	8,648	-	8,840				8,840
Accommodation	1,049	227	350	1,627				1,627
Food and beverage service activities	46	371	581	998				998
Telecommunications	980	102	-	1,082				1,082
Financial and insurance activities	913	44	-	957				957
Education (market production)	261	3	-	264				264
Human health (market production)	135	333	-	468				468
Other services	3,148	2,756	-	5,905				5,905
Education (non-market production)	210	44	-	253				253
Human health (non-market production)	540	177	-	717				717
Public administration and defense	603	453	-	1,056				1,056
Compulsory social security	3	0	-	3				3
Goods exports	-	9,508	-	9,508				9,508
Services exports	1,148	-	-	1,148				1,148
Households	12,153	35,234	12,054	59,441				59,441
Changes in inventories	-	1,068	-	1,068				1,068
Total	36,412	108,534	62,424	207,370	-35,393	-6,422	-32	165,522

Source: Own elaboration with data from the Energy Accounts 2011-2013.

TABLE 3. Costa Rica: Energy use (gross and net) by energetic source and economic activity (TJ), 2012

	Electricity	Fuels and others	Renewables	Total	Electricity produced	Charcoal produced	Total (net)
Agriculture	388	3,082	-	3,470			3,470
Livestock	760	794	-	1,555			1,555
Support activities to agriculture	29	1,618	-	1,648			1,648
Forestry, logging and hunting	0	40	-	40			40
Fishing and aquaculture	67	353	-	421			421
Mining and quarrying	85	980	-	1,065			1,065
Manufacture of rice	56	47	675	779			779
Manufacture of sugar	66	163	8,707	8,936	-643		8,293
<i>Electric Grid Supply Losses</i>	-	-	277	277			277
Coffee manufacturing	62	97	492	651			651
Other food manufacturing	2,059	4,622	1,860	8,541			8,541
Drinks and tobacco	121	516	37	674			674
Textiles	197	148	-	345			345
Manufacture of wood	159	272	5,750	6,182			6,182
Manufacture and refined petroleum products	58	113	-	171			171
Manufacture of chemicals	931	858	36	1,825		-36	1,790
<i>Transformation Losses</i>	-	-	107	107			107
Manufacture of cement	371	3,386	-	3,757			3,757
Other manufacturing	1,824	4,075	358	6,257			6,257
Electricity	789	6,468	33,318	40,576	-35,985		4,591
<i>Distribution Losses</i>	3,892	-	4	3,896			3,896
Water collection	440	144	-	584			584
Waste management	29	284	-	313			313
Construction	481	3,235	-	3,715			3,715
Wholesale and retail trade	2,139	4,023	-	6,162			6,162
Transport via railways	-	37	-	37			37
Passengers land transport, except taxis	40	5,102	-	5,142			5,142
Passengers land transport by taxis	6	5,337	-	5,342			5,342
Water and air transport, and freight	226	6,787	-	7,013			7,013
Accommodation	1,119	329	349	1,798			1,798
Food and beverage service activities	1,642	798	624	3,064			3,064
Telecommunications	682	185	-	867			867
Financial and insurance activities	614	116	-	730			730
Education (market production)	311	463	-	774			774
Human health (market production)	265	315	-	580			580
Other services	2,996	5,273	-	8,269			8,269
Education (non-market production)	327	72	-	399			399
Human health (non-market production)	467	393	-	861			861
Public administration and defense	499	609	-	1,108			1,108
Compulsory social security	6	1	-	8			8
Goods exports	-	9,089	-	9,089			9,089
Services exports	1,446	-	-	1,446			1,446
Households	12,482	29,705	6,892	49,079			49,079
Changes in inventories	-	-566	-	-566			-566
Total	38,137	99,360	59,487	196,983	-36,628	-36	160,320

Source: Own elaboration with data from the Energy Accounts 2011-2013.

TABLE 4. Costa Rica: Energy use (gross and net) by energetic source and economic activity (TJ), 2013

	Electricity	Fuels and others	Renewables	Total	Electricity produced	Charcoal produced	Total (net)
Agriculture	410	3,038	-	3,448			3,448
Livestock	750	785	-	1,535			1,535
Support activities to agriculture	30	1,581	-	1,611			1,611
Forestry, logging and hunting	0	36	-	36			36
Fishing and aquaculture	73	380	-	453			453
Mining and quarrying	96	966	-	1,062			1,062
Manufacture of rice	49	39	666	753			753
Manufacture of sugar	76	171	10,482	10,730	-660		10,070
<i>Electric Grid Supply Losses</i>	-	-	268	268			268
Coffee manufacturing	59	53	488	601			601
Other food manufacturing	2,222	4,269	1,762	8,253			8,253
Drinks and tobacco	135	492	26	653			653
Textiles	195	278	-	473			473
Manufacture of wood	141	294	5,776	6,211			6,211
Manufacture and refined petroleum products	117	103	-	220			220
Manufacture of chemicals	989	747	38	1,774		-38	1,736
<i>Transformation Losses</i>	-	-	115	115			115
Manufacture of cement	354	4,154	-	4,508			4,508
Other manufacturing	1,758	4,277	537	6,572			6,572
Electricity	801	11,194	32,209	44,204	-36,183		8,021
<i>Distribution Losses</i>	3,895	-	4	3,899			3,899
Water collection	458	125	-	582			582
Waste management	34	283	-	317			317
Construction	384	3,834	-	4,217			4,217
Wholesale and retail trade	2,621	4,166	-	6,786			6,786
Transport via railways	-	42	-	42			42
Passengers land transport, except taxis	44	5,156	-	5,200			5,200
Passengers land transport by taxis	6	4,929	-	4,935			4,935
Water and air transport, and freight	243	6,508	-	6,751			6,751
Accommodation	991	290	373	1,654			1,654
Food and beverage service activities	1,478	748	626	2,852			2,852
Telecommunications	638	181	-	819			819
Financial and insurance activities	528	123	-	651			651
Education (market production)	277	454	-	731			731
Human health (market production)	249	266	-	515			515
Other services	3,076	5,044	-	8,120			8,120
Education (non-market production)	332	67	-	400			400
Human health (non-market production)	502	301	-	804			804
Public administration and defense	537	603	-	1,141			1,141
Compulsory social security	6	2	-	8			8
Goods exports	-	9,722	-	9,722			9,722
Services exports	1,739	-	-	1,739			1,739
Households	12,465	29,161	6,585	48,211			48,211
Changes in inventories	-	-194	-	-194			-194
Total	38,756	104,672	59,956	203,384	-36,843	-38	166,503

Source: Own elaboration with data from the Energy Accounts 2011-2013.

TABLE 5. Costa Rica: Share of energy use (gross and net) by energetic source and economic activity, 2011

	Electricity	Fuels and others	Renewables	Total	Electricity produced	Fuels produced	Charcoal produced	Total (net)
Agriculture	1.1	0.9	0.0	0.7				0.8
Livestock	1.2	0.7	0.0	0.6				0.7
Support activities to agriculture	0.0	0.6	0.0	0.3				0.4
Forestry, logging and hunting	0.0	0.2	0.0	0.1				0.1
Fishing and aquaculture	0.1	0.9	0.0	0.5				0.6
Mining and quarrying	0.1	0.1	0.0	0.1				0.1
Manufacture of rice	0.1	0.1	1.2	0.4				0.5
Manufacture of sugar	0.3	0.3	13.1	4.2	1.4			4.9
<i>Electric Grid Supply Losses</i>	0.0	0.0	0.3	0.1				0.1
Coffee manufacturing	0.8	0.0	0.7	0.4				0.4
Other food manufacturing	3.9	1.9	2.9	2.6				3.2
Drinks and tobacco	1.7	0.9	0.1	0.8				1.0
Textiles	0.3	0.2	0.0	0.1				0.2
Manufacture of wood	1.2	0.2	8.7	2.9				3.7
Manufacture and refined petroleum products	0.2	11.0	0.0	5.8		100		3.4
Manufacture of chemicals	1.9	0.8	0.1	0.8			100	1.0
<i>Transformation Losses</i>	0.0	0.0	0.2	0.0				0.1
Manufacture of cement	0.1	3.4	0.0	1.8				2.2
Other manufacturing	7.8	2.7	0.5	3.0				3.7
Electricity	2.2	9.0	51.3	20.6	98.6			4.7
<i>Distribution Losses</i>	10.4	0.0	0.0	1.8				2.3
Water collection	1.5	0.0	0.0	0.3				0.3
Waste management	0.2	0.1	0.0	0.1				0.1
Construction	1.0	2.4	0.0	1.4				1.8
Wholesale and retail trade	4.9	1.4	0.0	1.6				2.0
Transport via railways	0.0	0.0	0.0	0.0				0.0
Passengers land transport, except taxis	0.3	5.0	0.0	2.7				3.3
Passengers land transport by taxis	0.0	2.8	0.0	1.5				1.9
Water and air transport, and freight	0.5	8.0	0.0	4.3				5.3
Accommodation	2.9	0.2	0.6	0.8				1.0
Food and beverage service activities	0.1	0.3	0.9	0.5				0.6
Telecommunications	2.7	0.1	0.0	0.5				0.7
Financial and insurance activities	2.5	0.0	0.0	0.5				0.6
Education (market production)	0.7	0.0	0.0	0.1				0.2
Human health (market production)	0.4	0.3	0.0	0.2				0.3
Other services	8.6	2.5	0.0	2.8				3.6
Education (non-market production)	0.6	0.0	0.0	0.1				0.2
Human health (non-market production)	1.5	0.2	0.0	0.3				0.4
Public administration and defense	1.7	0.4	0.0	0.5				0.6
Compulsory social security	0.0	0.0	0.0	0.0				0.0
Goods exports	0.0	8.8	0.0	4.6				5.7
Services exports	3.2	0.0	0.0	0.6				0.7
Households	33.4	32.5	19.3	28.7				35.9
Changes in inventories	0.0	1.0	0.0	0.5				0.6
Total	100	100	100	100	100	100	100	100

Source: Own elaboration with data from the Energy Accounts 2011-2013.

TABLE 6. Costa Rica: Share of energy use (gross and net) by energetic source and economic activity, 2012

	Electricity	Fuels and others	Renewables	Total	Electricity produced	Charcoal produced	Total (net)
Agriculture	1.0	3.1	0.0	1.8			2.2
Livestock	2.0	0.8	0.0	0.8			1.0
Support activities to agriculture	0.1	1.6	0.0	0.8			1.0
Forestry, logging and hunting	0.0	0.0	0.0	0.0			0.0
Fishing and aquaculture	0.2	0.4	0.0	0.2			0.3
Mining and quarrying	0.2	1.0	0.0	0.5			0.7
Manufacture of rice	0.1	0.0	1.1	0.4			0.5
Manufacture of sugar	0.2	0.2	14.6	4.5	1.8		5.2
<i>Electric Grid Supply Losses</i>	0.0	0.0	0.5	0.1			0.2
Coffee manufacturing	0.2	0.1	0.8	0.3			0.4
Other food manufacturing	5.4	4.7	3.1	4.3			5.3
Drinks and tobacco	0.3	0.5	0.1	0.3			0.4
Textiles	0.5	0.1	0.0	0.2			0.2
Manufacture of wood	0.4	0.3	9.7	3.1			3.9
Manufacture and refined petroleum products	0.2	0.1	0.0	0.1			0.1
Manufacture of chemicals	2.4	0.9	0.1	0.9		100	1.1
<i>Transformation Losses</i>	0.0	0.0	0.2	0.1			0.1
Manufacture of cement	1.0	3.4	0.0	1.9			2.3
Other manufacturing	4.8	4.1	0.6	3.2			3.9
Electricity	2.1	6.5	56.0	20.6	98.2		2.9
<i>Distribution Losses</i>	10.2	0.0	0.0	2.0			2.4
Water collection	1.2	0.1	0.0	0.3			0.4
Waste management	0.1	0.3	0.0	0.2			0.2
Construction	1.3	3.3	0.0	1.9			2.3
Wholesale and retail trade	5.6	4.0	0.0	3.1			3.8
Transport via railways	0.0	0.0	0.0	0.0			0.0
Passengers land transport, except taxis	0.1	5.1	0.0	2.6			3.2
Passengers land transport by taxis	0.0	5.4	0.0	2.7			3.3
Water and air transport, and freight	0.6	6.8	0.0	3.6			4.4
Accommodation	2.9	0.3	0.6	0.9			1.1
Food and beverage service activities	4.3	0.8	1.0	1.6			1.9
Telecommunications	1.8	0.2	0.0	0.4			0.5
Financial and insurance activities	1.6	0.1	0.0	0.4			0.5
Education (market production)	0.8	0.5	0.0	0.4			0.5
Human health (market production)	0.7	0.3	0.0	0.3			0.4
Other services	7.9	5.3	0.0	4.2			5.2
Education (non-market production)	0.9	0.1	0.0	0.2			0.2
Human health (non-market production)	1.2	0.4	0.0	0.4			0.5
Public administration and defense	1.3	0.6	0.0	0.6			0.7
Compulsory social security	0.0	0.0	0.0	0.0			0.0
Goods exports	0.0	9.1	0.0	4.6			5.7
Services exports	3.8	0.0	0.0	0.7			0.9
Households	32.7	29.9	11.6	24.9			30.6
Changes in inventories	0.0	-0.6	0.0	-0.3			-0.4
Total	100	100	100	100	100	100	100

Source: Own elaboration with data from the Energy Accounts 2011-2013.

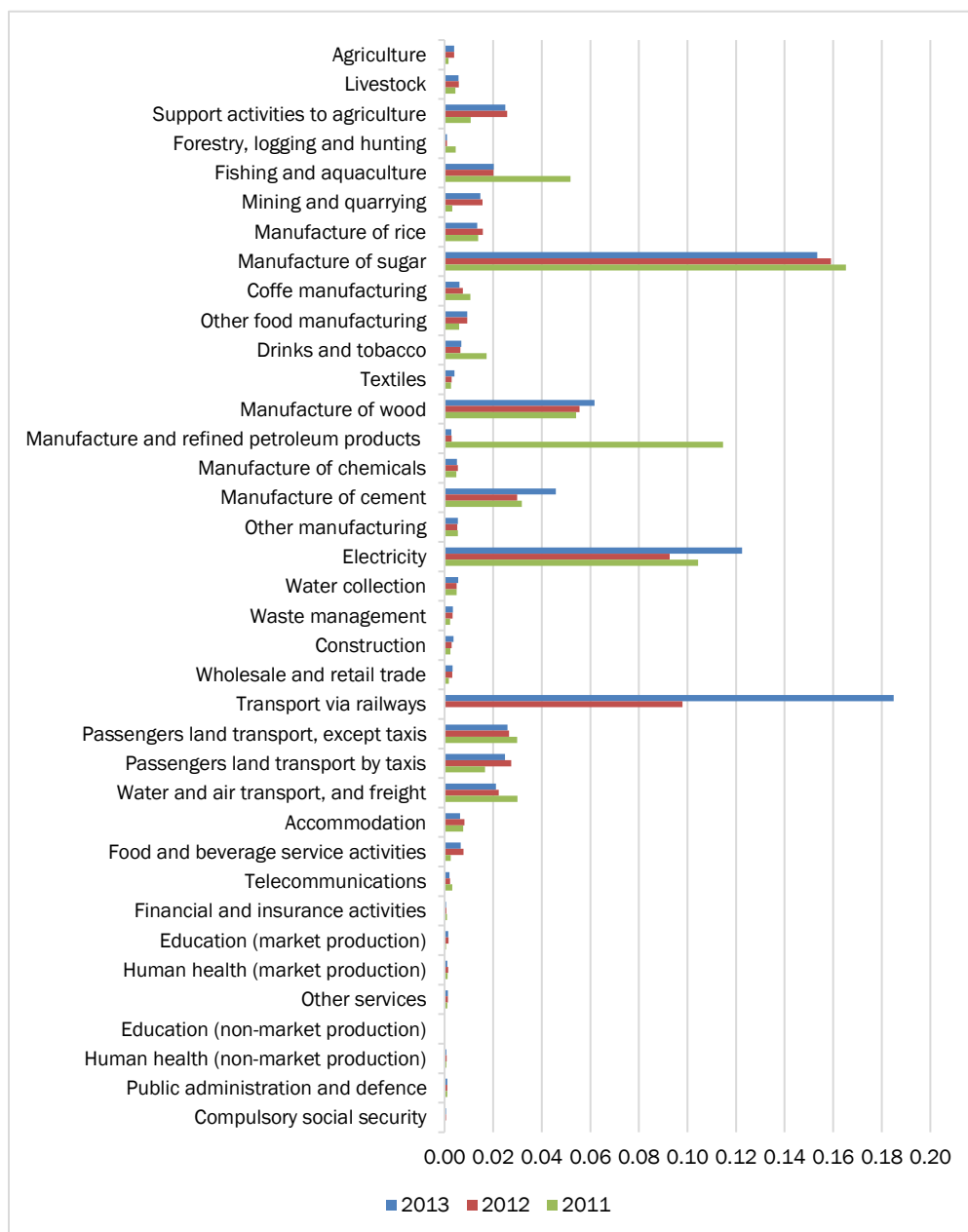
TABLE 7. Costa Rica: Share of energy use (gross and net) by energetic source and economic activity, 2013

	Electricity	Fuels and others	Renewables	Total	Electricity produced	Charcoal produced	Total (net)
Agriculture	1.1	2.9	0.0	1.7			2.1
Livestock	1.9	0.8	0.0	0.8			0.9
Support activities to agriculture	0.1	1.5	0.0	0.8			1.0
Forestry, logging and hunting	0.0	0.0	0.0	0.0			0.0
Fishing and aquaculture	0.2	0.4	0.0	0.2			0.3
Mining and quarrying	0.2	0.9	0.0	0.5			0.6
Manufacture of rice	0.1	0.0	1.1	0.4			0.5
Manufacture of sugar	0.2	0.2	17.5	5.3	1.8		6.0
<i>Electric Grid Supply Losses</i>	0.0	0.0	0.4	0.1			0.2
Coffee manufacturing	0.2	0.1	0.8	0.3			0.4
Other food manufacturing	5.7	4.1	2.9	4.1			5.0
Drinks and tobacco	0.3	0.5	0.0	0.3			0.4
Textiles	0.5	0.3	0.0	0.2			0.3
Manufacture of wood	0.4	0.3	9.6	3.1			3.7
Manufacture and refined petroleum products	0.3	0.1	0.0	0.1			0.1
Manufacture of chemicals	2.6	0.7	0.1	0.9		100	1.0
<i>Transformation Losses</i>	0.0	0.0	0.2	0.1			0.1
Manufacture of cement	0.9	4.0	0.0	2.2			2.7
Other manufacturing	4.5	4.1	0.9	3.2			3.9
Electricity	2.1	10.7	53.7	21.7	98.2		4.8
<i>Distribution Losses</i>	10.0	0.0	0.0	1.9			2.3
Water collection	1.2	0.1	0.0	0.3			0.3
Waste management	0.1	0.3	0.0	0.2			0.2
Construction	1.0	3.7	0.0	2.1			2.5
Wholesale and retail trade	6.8	4.0	0.0	3.3			4.1
Transport via railways	0.0	0.0	0.0	0.0			0.0
Passengers land transport, except taxis	0.1	4.9	0.0	2.6			3.1
Passengers land transport by taxis	0.0	4.7	0.0	2.4			3.0
Water and air transport, and freight	0.6	6.2	0.0	3.3			4.1
Accommodation	2.6	0.3	0.6	0.8			1.0
Food and beverage service activities	3.8	0.7	1.0	1.4			1.7
Telecommunications	1.6	0.2	0.0	0.4			0.5
Financial and insurance activities	1.4	0.1	0.0	0.3			0.4
Education (market production)	0.7	0.4	0.0	0.4			0.4
Human health (market production)	0.6	0.3	0.0	0.3			0.3
Other services	7.9	4.8	0.0	4.0			4.9
Education (non-market production)	0.9	0.1	0.0	0.2			0.2
Human health (non-market production)	1.3	0.3	0.0	0.4			0.5
Public administration and defense	1.4	0.6	0.0	0.6			0.7
Compulsory social security	0.0	0.0	0.0	0.0			0.0
Goods exports	0.0	9.3	0.0	4.8			5.8
Services exports	4.5	0.0	0.0	0.9			1.0
Households	32.2	27.9	11.0	23.7			29.0
Changes in inventories	0.0	-0.2	0.0	-0.1			-0.1
Total	100	100	100	100	100	100	100

Source: Own elaboration with data from the Energy Accounts 2011-2013.

From the new information available it is possible to develop indicators of efficiency and energy intensity disaggregated by economic activity. Figure 5 shows as an example the energy intensity indicator by economic activity for the period 2011-2013, expressed as the number of TJ used per million of CRC from the produced GVA.

FIGURE 5. Energy intensity by economic activity (TJ/ million CRC), 2011-2013 ^{a/}



a/ Chained volume at previous year prices, reference 2012.

Source: Own elaboration with data from the Energy Accounts.

5. CARBON DIOXIDE EMISSIONS ACCOUNT OF COSTA RICA 2011-2013

5.1. Conceptual framework

The carbon dioxide emissions account associates emissions with the economic activity responsible for the energy consumption generating such emissions. The CO₂ emissions account is created from the energy use account by applying an emission factor per unit of energy used:

$$\text{Emissions of CO}_2_{ij} = \text{Energy Use}_{ij} * \text{Emission Factor}_j$$

In other words, CO₂ emissions by activity *i* are estimated, arising from the combustion of *j* as the product of its energy use multiplied by the emission factor corresponding to its energy source *j* (Harris, 2010).

The CO₂ emissions account is compiled in terms of gross emissions and shows the economic activity responsible for the generation of such emissions, even when there could be CO₂ emission reductions from other sectors. Carbon mitigation, capture or sequestration should be reflected in a separate account; e.g. the ecosystem services account.

Resulting emissions of the energy sector depend on the economic growth of the country, its productive structure, energy intensity and amount of CO₂ emissions by energy source used. Therefore, identifying the composition of the energy uses and the CO₂ emissions associated to them are essential elements to follow up on policies related to climate change and emissions mitigation, as an input to evaluate the achievements of sustainable development goals.

5.2. Sources of information

Information is retrieved from the use tables of the energy account. The emission factors applied correspond to the official ones that the National Meteorological Institute (IMN) facilitated to the DSE.³

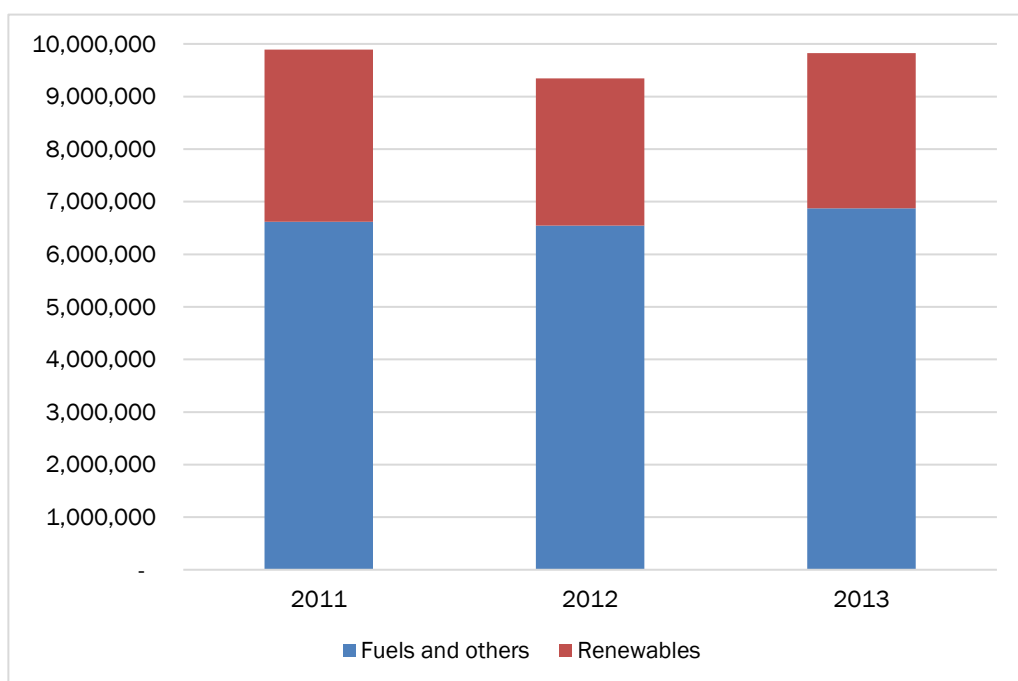
5.3. Results

Figure 6 shows the total number of metric tons of carbon dioxide emitted by energy source for the years 2011, 2012 and 2013. Approximately 70% of the CO₂ emissions from the energy sector are derived from the use of fossil fuels, whereas the remaining 30% comes from the use of renewable sources, namely geothermal energy, bagasse use, coffee husks, other vegetable residues, and firewood consumption by households and other economic activities.

It is important to highlight that such emissions are gross emissions per activity; this is why the emissions from renewable sources like firewood are accounted for. Even though carbon sequestration can happen at a previous stage, the purpose of the CO₂ emissions account is to show the activity that is responsible for the emissions in gross terms, without considering sequestration or mitigation.

³ See Appendix, Table A2: Applied emission factors (MT of CO₂/TJ).

FIGURE 6. Costa Rica: CO₂ Emissions by energy source (MT), 2011-2013



Source: Own elaboration with data from the Energy Accounts of Costa Rica 2011-2013.

From the energy account presented in Section 4, and by means of the implementation of the corresponding emission factors, it is possible to obtain the CO₂ emissions by type of energy source used and economic activity in MT (Table 8). Likewise, table 9 shows the percentage composition of these emissions by economic activity.

TABLE 8. Costa Rica: CO₂ emissions by source and economic activity (MT), 2011-2013

	2011			2012			2013		
	Use of Fuels and others	Use of renewable resources	Total	Use of fuels and others	Use of renewable resources	Total	Use of fuels and others	Use of renewable resources	Total
Agriculture	71,586	-	71,586	225,552	-	225,552	222,350	-	222,350
Livestock	52,670	-	52,670	58,195	-	58,195	57,562	-	57,562
Support activities to agriculture	48,401	-	48,401	116,019	-	116,019	113,175	-	113,175
Forestry, logging and hunting	13,791	-	13,791	2,956	-	2,956	2,689	-	2,689
Fishing and aquaculture	75,106	-	75,106	26,106	-	26,106	28,116	-	28,116
Mining and quarrying	11,139	-	11,139	69,402	-	69,402	68,383	-	68,383
Manufacture of rice	4,776	77,194	81,971	3,412	67,755	71,166	2,861	66,749	69,609
Manufacture of sugar	26,589	819,043	845,632	11,845	870,956	882,801	12,417	1,048,478	1,060,895
Electric Grid Supply Losses	-	19,150	19,150	-	27,671	27,671	-	26,826	26,826
Coffee manufacturing	1,095	42,776	43,871	6,448	49,552	56,000	3,672	49,166	52,838
Other food manufacturing	148,902	185,301	334,203	328,787	189,920	518,707	302,132	179,131	481,263
Drinks and tobacco	68,387	9,761	78,147	36,408	4,121	40,529	34,678	2,951	37,628
Textiles	14,267	-	14,267	10,761	-	10,761	20,570	-	20,570
Manufacture of wood	13,298	584,917	598,215	19,535	617,729	637,264	21,128	620,950	642,077
Manufacture and refined petroleum products	384,649	-	384,649	8,056	-	8,056	7,073	-	7,073
Manufacture of chemicals	62,429	3,622	66,051	60,998	3,986	64,984	53,065	4,289	57,354
Transformation Losses	-	10,865	10,865	-	11,957	11,957	-	12,866	12,866
Manufacture of cement	320,458	-	320,458	302,010	-	302,010	374,639	-	374,639
Other manufacturing	203,208	37,412	240,620	277,801	40,140	317,941	291,305	60,144	351,450
Electricity	722,198	25,134	747,331	457,537	32,320	489,857	797,408	33,173	830,581
Distribution Losses	-	214	214	-	242	242	-	242	242
Water collection	2,519	-	2,519	10,337	-	10,337	8,943	-	8,943
Waste management	10,299	-	10,299	20,429	-	20,429	20,408	-	20,408
Construction	185,171	-	185,171	236,931	-	236,931	281,815	-	281,815
Wholesale and retail trade	111,609	-	111,609	292,317	-	292,317	299,663	-	299,663
Transport via railways	-	-	-	2,711	-	2,711	3,124	-	3,124
Passengers land transport, except taxis	397,071	-	397,071	377,765	-	377,765	381,777	-	381,777
Passengers land transport by taxis	219,973	-	219,973	383,150	-	383,150	356,054	-	356,054
Water and air transport, and freight	628,379	-	628,379	498,686	-	498,686	480,576	-	480,576
Accommodation	16,404	39,208	55,612	22,420	39,054	61,474	20,137	41,763	61,901
Food and beverage service activities	24,850	65,127	89,978	52,276	69,864	122,140	49,270	70,100	119,370
Telecommunications	7,237	-	7,237	13,335	-	13,335	13,064	-	13,064
Financial and insurance activities	3,075	-	3,075	8,170	-	8,170	8,643	-	8,643
Education (market production)	227	-	227	32,452	-	32,452	31,862	-	31,862
Human health (market production)	21,427	-	21,427	22,604	-	22,604	19,075	-	19,075
Other services	200,782	-	200,782	384,759	-	384,759	367,445	-	367,445

	2011			2012			2013		
	Use of Fuels and others	Use of renewable resources	Total	Use of fuels and others	Use of renewable resources	Total	Use of fuels and others	Use of renewable resources	Total
Education (non-market production)	3,054	-	3,054	5,133	-	5,133	4,801	-	4,801
Human health (non-market production)	12,538	-	12,538	28,013	-	28,013	21,249	-	21,249
Public administration and defense	31,762	-	31,762	43,620	-	43,620	43,256	-	43,256
Compulsory social security	20	-	20	106	-	106	111	-	111
Households	2,501,415	1,349,918	3,851,332	2,089,866	771,758	2,861,624	2,048,385	737,326	2,785,711
Total	6,620,758	3,269,641	9,890,399	6,546,910	2,797,025	9,343,935	6,872,882	2,954,153	9,827,035

Source: Own elaboration with data from the Energy Accounts 2011-2013.

TABLE 9. Costa Rica: Share of CO₂ emissions by energetic source and economic activity, 2011-2013

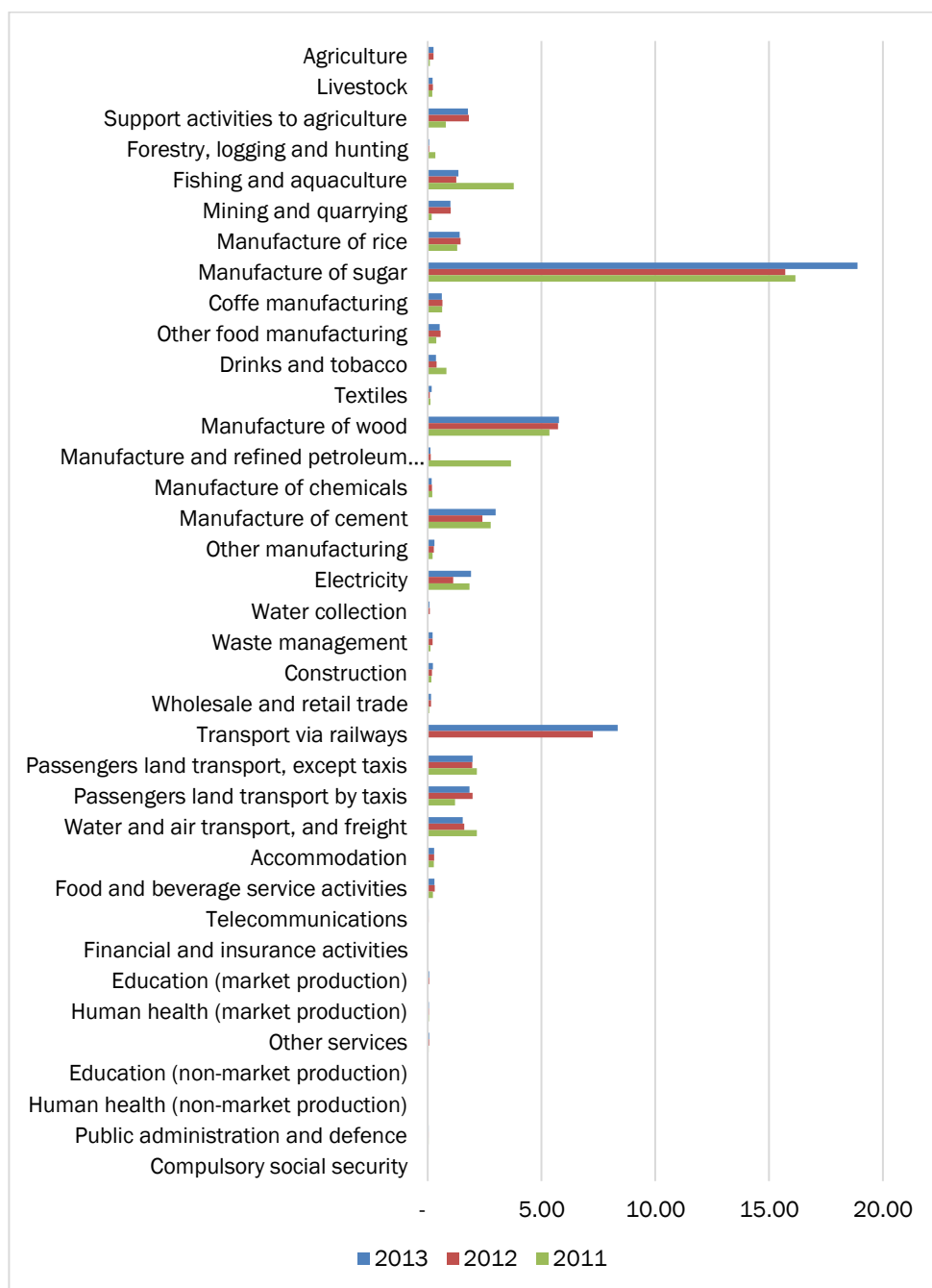
	2011			2012			2013		
	Use of fuels and others	Use of renewable resources	Total	Use of fuels and others	Use of renewable resources	Total	Use of fuels and others	Use of renewable resources	Total
Agriculture	1.1	0.0	0.7	3.4	0.0	2.4	3.2	0.0	2.3
Livestock	0.8	0.0	0.5	0.9	0.0	0.6	0.8	0.0	0.6
Support activities to agriculture	0.7	0.0	0.5	1.8	0.0	1.2	1.6	0.0	1.2
Forestry, logging and hunting	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Fishing and aquaculture	1.1	0.0	0.8	0.4	0.0	0.3	0.4	0.0	0.3
Mining and quarrying	0.2	0.0	0.1	1.1	0.0	0.7	1.0	0.0	0.7
Manufacture of rice	0.1	2.4	0.8	0.1	2.4	0.8	0.0	2.3	0.7
Manufacture of sugar	0.4	25.0	8.6	0.2	31.1	9.4	0.2	35.5	10.8
Electric Grid Supply Losses	0.0	0.6	0.2	0.0	1.0	0.3	0.0	0.9	0.3
Coffee manufacturing	0.0	1.3	0.4	0.1	1.8	0.6	0.1	1.7	0.5
Other food manufacturing	2.2	5.7	3.4	5.0	6.8	5.6	4.4	6.1	4.9
Drinks and tobacco	1.0	0.3	0.8	0.6	0.1	0.4	0.5	0.1	0.4
Textiles	0.2	0.0	0.1	0.2	0.0	0.1	0.3	0.0	0.2
Manufacture of wood	0.2	17.9	6.0	0.3	22.1	6.8	0.3	21.0	6.5
Manufacture and refined petroleum products	5.8	0.0	3.9	0.1	0.0	0.1	0.1	0.0	0.1
Manufacture of chemicals	0.9	0.1	0.7	0.9	0.1	0.7	0.8	0.1	0.6
Transformation Losses	0.0	0.3	0.1	0.0	0.4	0.1	0.0	0.4	0.1
Manufacture of cement	4.8	0.0	3.2	4.6	0.0	3.2	5.5	0.0	3.8
Other manufacturing	3.1	1.1	2.4	4.2	1.4	3.4	4.2	2.0	3.6
Electricity	10.9	0.8	7.6	7.0	1.2	5.2	11.6	1.1	8.5
Distribution Losses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water collection	0.0	0.0	0.0	0.2	0.0	0.1	0.1	0.0	0.1
Waste management	0.2	0.0	0.1	0.3	0.0	0.2	0.3	0.0	0.2
Construction	2.8	0.0	1.9	3.6	0.0	2.5	4.1	0.0	2.9
Wholesale and retail trade	1.7	0.0	1.1	4.5	0.0	3.1	4.4	0.0	3.0
Transport via railways	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Passengers land transport, except taxis	6.0	0.0	4.0	5.8	0.0	4.0	5.6	0.0	3.9
Passengers land transport by taxis	3.3	0.0	2.2	5.9	0.0	4.1	5.2	0.0	3.6
Water and air transport, and freight	9.5	0.0	6.4	7.6	0.0	5.3	7.0	0.0	4.9
Accommodation	0.2	1.2	0.6	0.3	1.4	0.7	0.3	1.4	0.6
Food and beverage service activities	0.4	2.0	0.9	0.8	2.5	1.3	0.7	2.4	1.2
Telecommunications	0.1	0.0	0.1	0.2	0.0	0.1	0.2	0.0	0.1
Financial and insurance activities	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.1
Education (market production)	0.0	0.0	0.0	0.5	0.0	0.3	0.5	0.0	0.3
Human health (market production)	0.3	0.0	0.2	0.3	0.0	0.2	0.3	0.0	0.2
Other services	3.0	0.0	2.0	5.9	0.0	4.1	5.3	0.0	3.7

	2011			2012			2013		
	Use of fuels and others	Use of renewable resources	Total	Use of fuels and others	Use of renewable resources	Total	Use of fuels and others	Use of renewable resources	Total
Education (non-market production)	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.0
Human health (non-market production)	0.2	0.0	0.1	0.4	0.0	0.3	0.3	0.0	0.2
Public administration and defense	0.5	0.0	0.3	0.7	0.0	0.5	0.6	0.0	0.4
Compulsory social security	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Households	37.8	41.3	38.9	31.9	27.6	30.6	29.8	25.0	28.3
Total	100	100	100	100	100	100	100	100	100

Source: Own elaboration with data from the Energy Accounts 2011-2013.

Based on this information, we estimate the intensity indicator, defined as the MT of CO₂ emitted per million of CRC from the produced GVA by economic activity (Figure 7).

FIGURE 7. Costa Rica: CO₂ intensity by economic activity (MT/million CRC), 2011-2013 ^{a/}



a/ Chained volume at previous year prices, reference 2012.

Source: Own elaboration with data from the Energy Accounts of Costa Rica 2011-2013.

6. USE OF THE ENERGY AND EMISSIONS ACCOUNTS

A consistent information system such as the energy and CO₂ emission accounts contribute to a better design and implementation of policies for the energy sector. The design of such policies from evidence and the valuation of their impacts, can inform about strategies of energy efficiency that may have a higher impact over people, the economy and the environment, based on objectively constructed data.

To formulate a policy as a response to an environmental issue, e.g. the impact of CO₂ emissions from the energy sector on climate change, it is essential to understand the anthropogenic impacts on the physical environment. Understanding energy needs, their possible constraints and solutions, and understanding the effects of using economic instruments in the energy sector on the economy and the environment, are key issues to finding effective responses.

The accounts can help to identify and coordinate the necessary information to manage policies in a more documented way. In addition, from these accounts it is possible to obtain descriptive indicators to assess energy interactions between different sectors, both in physical and monetary terms. They also provide detailed statistics to achieve a better management of the economy as a whole, as they allow for the design of strategies that maximize the contribution of natural resources to economic growth by balanced exchanges between the different stakeholders and activities.

7. CONSIDERATIONS FOR NEXT STEPS

One aspect to consider in the steps to follow for further improvement and strengthening of the environmental accounts is to search for additional information in the primary sources that would allow to clarify some of the results, as well as to validate the results that have been obtained in the energy account from the energy balances and SUTs. In particular, it is necessary to seek information from ICE and CNFL to validate the disaggregation of the use of electricity. Likewise, it is necessary to retrieve information from LACSA, MOPT and RECOPE that will allow improving the obtained estimates for the transport sector, and ideally to separate the use of fuels between transport and other sectors.

The development of the energy account and its associated emissions account for the years prior to 2011 will depend on the availability of information of the SUTs from the SNA. If it were not possible to obtain the disaggregation of the 128 economic activities included in the SUTs of 2011-2013 for prior years, an option could be to compile the accounts for those years in more aggregate terms.

On the other hand, it may be useful to consider the development of an energy account in monetary terms, as to analyze other relevant aspects such as the incidence of taxes and subsidies.

Finally, even though this exercise developed the CO₂ emissions account, it may be worth considering the extension of the emissions account to incorporate other GHG.

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9. APPENDIX

TABLE A1. Costa Rica: Classification of Economic Activities, Energy Account

Classification Energy Account	Classification E.A. BCCR	EA code (BCCR)	ISIC Class (4 digits)
1. Agriculture	Growing of bean	EA001	0111
	Growing of corn	EA002	0111
	Growing of cereals, leguminous crops and oil seeds n.e.c.	EA003	0111
	Growing of rice	EA004	0112
	Growing of watermelon	EA005	0113
	Growing of melon	EA006	0113
	Growing of onion	EA007	0113
	Growing of squash	EA008	0113
	Growing of potatoes	EA009	0113
	Growing of other vegetables, roots or tubers n.e.c.	EA010	0113
	Growing of sugar cane	EA011	0114
	Growing of flowers	EA012	0119
	Growing of foliage	EA013	0119 0230
	Growing of banana	EA014	0122
	Growing of plantain	EA015	0122
	Growing of pineapple	EA016	0122
	Growing of "African palm" (oil)	EA017	0126
	Growing of coffee	EA018	0127
	Growing of other fruits, nuts and other oleaginous fruits	EA019	0121 0122 0123 0124 0125 0126
	Growing of other non-perennial and perennial crops	EA020	0115 0116 0119 0127 0128 0129
	Plant propagation	EA021	0130
2. Livestock	Raising of cattle	EA022	0141
	Raising of pigs	EA023	0145
	Raising of poultry	EA024	0146
	Raising of other animals	EA025	0141 0142 0143 0144 0146 0149 0150
3. Support activities to agriculture and post-harvest crop activities	Support activities to agriculture and post-harvest crop activities	EA026	0161 0162 0163 0164
4. Forestry, logging and hunting	Forestry, logging and hunting	EA027	0170 0210 0220 0240
5. Fishing and aquaculture	Marine and freshwater fishing	EA028	0311 0312
	Marine and freshwater aquaculture	EA029	0321 0322
6. Mining and quarrying	Quarrying of stone, sand and clay	EA030	0810
	Extraction of salt	EA031	0893

Classification Energy Account	Classification E.A. BCCR	EA code (BCCR)	ISIC Class (4 digits)
	Other mining and quarrying n.e.c.	EA032	0510 0520 0610 0620 0710 0721 0729 0891 0892 0899 0910 0990
7. Manufacture of rice	Manufacture of rice	EA039	1061
8. Manufacture of sugar	Manufacture of sugar	EA042	1072
9. Coffee manufacturing and production of coffee products	Coffee manufacturing	EA045	1079
	Production of coffee products	EA046	1079
10. Other food manufacturing	Processing and preserving of meat	EA033 / EA034	1010
	Processing and preserving of fish, crustaceans and mollusks	EA035	1020
	Processing and preserving of fruit and vegetables	EA036	1030
	Manufacture of vegetable and animal oils and fats	EA037	1040
	Manufacture of dairy products	EA038	1050
	Production of milling products, except rice, and starches and starch products/ Production of macaroni, noodles, and similar starchy products	EA040 / EA044	1061 1062 1074
	Manufacture of bakery products and "tortillas"	EA041	1071
	Manufacture of cocoa, chocolate and sugar confectionery	EA043	1073
	Manufacture of prepared meals and dishes and Manufacture of other food products n.e.c.	EA047	1075 1079
	Manufacture of prepared animal feeds	EA048	1080
11. Drinks and tobacco	Distilling, rectifying and blending of spirits; manufacture of wines; manufacture of malt liquors and malt; manufacture of soft drinks; production of mineral waters and other bottled waters and manufacture of tobacco products	EA049 / EA050 / EA051	1101 1102 1103 1104 1200
12. Textiles	Manufacture of textiles	EA052	1311 1312 1313 1391 1392 1393 1394 1399
	Manufacture of wearing apparel	EA053	1410 1420 1430
	Tanning and dressing of leather; dressing and dyeing of fur Manufacture of luggage, handbags and the like, saddlery and harness.	EA054	1511 1512
	Manufacture of footwear	EA055	1520
13. Manufacture of wood and of products of wood and cork; manufacture of articles of straw and plaiting materials; furniture manufacturing	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	EA056	1610 1621 1622 1623 1629
	Manufacture of furniture	EA079	3100

Classification Energy Account	Classification E.A. BCCR	EA code (BCCR)	ISIC Class (4 digits)
14. Manufacture of coke and refined petroleum products / Manufacture of basic chemicals, fertilizers and nitrogen compounds, / Manufacture of other chemical products n.e.c. and manufacture of man-made fibers	Manufacture of coke and refined petroleum products / Manufacture of basic chemicals, fertilizers and nitrogen compounds, / Manufacture of other chemical products n.e.c. and manufacture of man-made fibers	EA059 / EA60 / EA065	1910 1920 2011 2012 2029 2030
15. Manufacture of chemicals and chemical products	Manufacture of plastics and synthetic rubber in primary forms / Manufacture of plastics products	EA061 / EA68	2013 2220
	Manufacture of pesticides and other agrochemical products	EA062	2021
	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	EA063	2022
	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	EA064	2023
	Manufacture of pharmaceuticals, medicinal chemical and botanical products	EA066	2100
	Manufacture of rubber products	EA067	2211 2219
16. Manufacture of cement, lime and plaster; manufacture of articles of concrete, cement and plaster; cutting, shaping and finishing of stone; manufacture of other non-metallic mineral products n.e.c.	Manufacture of cement, lime and plaster; manufacture of articles of concrete, cement and plaster; cutting, shaping and finishing of stone; manufacture of other non-metallic mineral products n.e.c.	EA071	2394 2395 2396 2399
17. Other manufacturing	Manufacture of paper and paper products	EA057	1701 1702 1709
	Printing and reproduction of recorded media and Publishing of books, periodicals and other publishing activities	EA058	1811 1812 1820 5811 5812 5813 5819
	Manufacture of glass and glass products	EA069	2310
	Manufacture of refractory products, clay building materials and other porcelain and ceramic products	EA070	2391 2392 2393
	Manufacture of basic metals	EA072	2410 2420 2431 2432
	Manufacture of fabricated metal products, except machinery and equipment	EA073	2511 2512 2513 2520 2591 2592 2593 2599
	Manufacture of electronic components and boards and manufacture of computers and peripheral equipment	EA074	2610 2620
	Manufacture of electronic and optical products	EA075	2630 2640 2651 2652 2660 2670 2680

Classification Energy Account	Classification E.A. BCCR	EA code (BCCR)	ISIC Class (4 digits)
	Manufacture of electrical equipment and machinery n.e.c.	EA076	2710 2720 2731 2732 2733 2740 2750 2790 2811 2812 2813 2814 2815 2816 2817 2818 2819 2821 2822 2823 2824 2825 2826 2829
	Manufacture of motor vehicles, trailers and semi-trailers and manufacture of other transport equipment	EA077 / EA078	2910 2920 2930 3011 3012 3020 3030 3040 3091 3092 3099
	Manufacture of medical and dental instruments and supplies	EA080	3250
	Other manufacturing n.e.c.	EA081	3211 3212 3220 3230 3240 3290
	Repair and installation of machinery and equipment	EA082	3311 3312 3313 3314 3315 3319 3320
18. Electricity, gas, steam and air conditioning supply	Electricity, gas, steam and air conditioning supply	EA083	3510 3520 3530
19. Water collection, treatment and supply and Sewerage	Water supply and sewerage	EA084	3600 3700
20. Waste management and remediation activities	Waste management and remediation activities	EA085	3811 3812 3821 3822 3830 3900
21. Construction	Construction of buildings	EA086M	4100
	Construction of buildings	EA086UF	4100
	Construction of buildings	EA086NM	4100
	Construction of roads and railways	EA087M	4210
	Construction of roads and railways	EA087UF	4210
	Construction of public service and other civil engineering	EA088M	4220 4290 4311
	Construction of public service and other civil engineering	EA088UF	4220 4290 4311
	Specialized construction activities	EA089	4312 4321 4322 4329 4330 4390
22. Wholesale and retail trade	Wholesale and retail trade	EA090	4510 4530 4540 4610 4620 4630 4641 4649 4651 4652 4653 4659 4661 4662 4663 4669 4690 4711 4719 4721 4722 4723 4730 4741 4742 4751 4752 4753 4759 4761 4762 4763 4764 4771 4772 4773 4774 4781 4782 4789 4791 4799
23. Transport via railways	Transport via railways	EA092	4911 4912
24. Passengers land transport, except taxis	Passengers land transport, except taxis	EA093	4921 4922
25. Passengers land transport by taxis	Passengers land transport by taxis	EA094	4922
26. Water and air transport, and freight	Water and air transport, and freight	EA095	4923 4930 5011 5012 5021 5022 5110 5120
	Postal and courier activities	EA099	5310 5320
27. Accommodation	Accommodation	EA100	5510 5520 5590

Classification Energy Account	Classification E.A. BCCR	EA code (BCCR)	ISIC Class (4 digits)
28. Food and beverage service activities	Food and beverage service activities	EA101	5610 5621 5629 5630
29. Telecommunications	Telecommunications	EA103	6110 6120 6130 6190
30. Financial and insurance activities	Monetary intermediation	EA105	6411 6419
	Activities of holding companies, funds and investment companies and other financial service activities	EA106	6420 6430 6491 6492 6499
	Insurance, reinsurance and pension funding, except compulsory social security	EA107	6511 6512 6520 6530
	Activities auxiliary to financial service and insurance activities	EA108	6611 6612 6619 6621 6622 6629 6630
31. Education (market production)	Education	EA127M	8510 8521 8522 8530 8541 8542 8549 8550
32. Education (non-market production)	Education	EA127NM	8510 8521 8522 8530 8541 8542 8549 8550
33. Human health and social work activities (market production)	Human health and social work activities	EA128M	8610 8620 8690 8710 8720 8730 8790 8810 8890 8891 8892 8893 8894 8895 8896 8897 8898 8899
34. Human health and social work activities (non-market production)	Human health and social work activities	EA128NM	8610 8620 8690 8710 8720 8730 8790 8810 8890 8891 8892 8893 8894 8895 8896 8897 8898 8899
35. Other services	Maintenance and repair of motor vehicles	EA091	4520
	Warehousing and storage	EA096	5210
	Support activities for transportation	EA097	5221 5222 5223
	Cargo handling and other transportation support activities	EA098	5224 5229
	Motion picture, video and television program production, sound recording and music publishing activities and Programming and broadcasting activities	EA102	5911 5912 5913 5914 5920 6010 6020
	Information services, computer programming and consulting, software publishing and related	EA104	5820 6201 6202 6209 6311 6312 6391 6399
	Real estate activities	EA109M	6810 6820
	Real estate activities	EA109UF	6810 6820
	Legal activities	EA110	6910
	Accounting, bookkeeping and auditing activities; tax consultancy	EA111	6920
	Activities of head offices; management consultancy activities	EA112	7010 7020
	Architectural and engineering activities; technical testing and analysis	EA113	7110 7120

Classification Energy Account	Classification E.A. BCCR	EA code (BCCR)	ISIC Class (4 digits)
	Scientific research and development	EA114M	7210 7220
	Scientific research and development	EA114UF	7210 7220
	Scientific research and development	EA114NM	7210 7220
	Advertising and market research	EA115	7310 7320
	Other professional, scientific and technical activities	EA116	7410 7420 7490
	Veterinary activities	EA117	7500
	Activities renting and leasing of tangible and intangible non-financial assets	EA118	7710 7721 7722 7729 7730 7740
	Employment activities	EA119	7810 7820 7830
	Travel agency, tour operator, reservation service and related activities	EA120	7911 7912 7990
	Security and investigation activities	EA121	8010 8020 8030
	Services to buildings and landscape activities	EA122	8110 8121 8129 8130
	Office administrative, office support and other business support activities	EA123	8211 8219 8220 8230 8291 8292 8299
	Arts, entertainment and recreation	EA129	9000 9101 9102 9103 9200 9311 9312 9319 9321 9329
	Activities of membership organizations	EA130M	9411 9412 9420 9491 9492 9493 9494 9495 9496 9497 9498 9499
	Activities of membership organizations	EA130NM	9411 9412 9420 9491 9492 9493 9494 9495 9496 9497 9498 9499
	Repair of computers and personal and household goods	EA131	9511 9512 9521 9522 9523 9524 9529
	Washing and (dry-) cleaning of textile and fur products	EA132	9601
	Hairdressing and other beauty treatment	EA133	9602
	Funeral and related activities	EA134	9603
	Other personal service activities n.e.c.	EA135	9609
	Activities of households as employers of domestic personnel	EA136	9700
36. Public administration and defense; compulsory social security	Administration of the State and the economic and social policy of the community	EA124	8411 8412 8413
	Provision of services to the community as a whole	EA125	8421 8422 8423
37. Administrative services of compulsory social security schemes	Compulsory social security activities	EA126	8430

Source: Own elaboration based on National Accounts Classifications (BCCR, 2016) and ONU (2009).

TABLE A2. Emission Factors (MT of CO₂/TJ)

Source	Emission Factor
Geothermal	0.02
Bagasse	100.00
Coffee husks	100.00
Other plant residues	100.00
Biogases	54.90
Firewood	112.00
Mineral coal (anthracite)	95.70
Gasoline	70.02
Diesel	74.08
Bunker	70.02
Aviation gasoline	69.30
Jet fuel	71.50
LPG	63.14
Kerosene	71.90
Gas oil	75.38
Petroleum coke	92.71
IFO 380	77.37
Charcoal	112.00

Source: National Meteorological Institute.