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TECHNICAL NOTE Nº 11

OUTLOOK CLEAN COOKING IN LATIN AMERICA AND THE CARIBBEAN

Energy Join us

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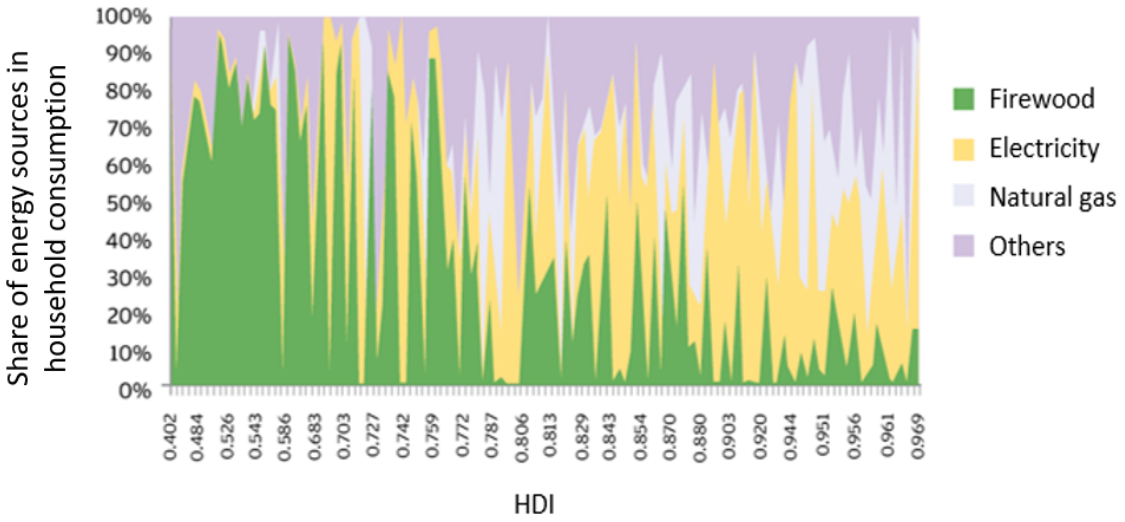
1. Introduction

According to figures from the World Health Organization (WHO), approximately 2.1 billion people worldwide cook on open-fire stoves, burning kerosene, wood, animal waste, agricultural residues, or charcoal, resulting in indoor air pollution. This pollution is associated with around 6.7 million deaths each year due to noncommunicable diseases such as stroke, ischemic heart disease, chronic obstructive pulmonary disease, and lung cancer.

Moreover, the population groups that have suffered the greatest impacts and morbidity from the use of polluting fuels and household air pollution are those with the lowest economic resources, among whom women and children are the most vulnerable.

In Latin America and the Caribbean (LAC), 95% of household consumption of polluting fuels comes from firewood. For this reason, the high consumption of this fuel is associated with a lower Human Development Index in the countries, as shown in Figure 1.

Figure 1. Correlation between the Human Development Index (HDI) and firewood consumption in households



Source: FIESP-OLADE Study, 2012[1]

On the other hand, the indiscriminate and irrational use of firewood can lead to deforestation problems, which in turn cause several adverse effects such as soil instability, increased atmospheric carbon concentration, local climate changes, and destruction of forest wildlife.

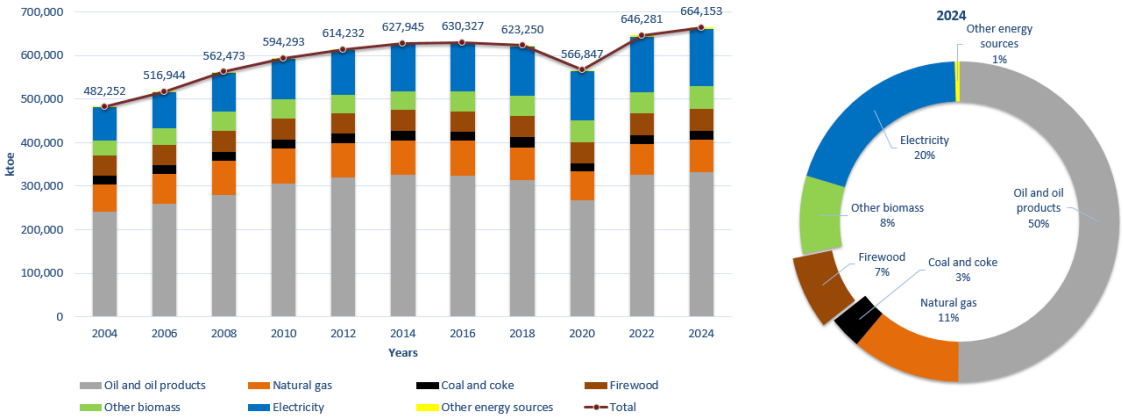
[1]Although the chart is from 2012 and the index values may have changed since then, the objective is to illustrate the indicated correlation between the Human Development Index and residential firewood consumption, which still holds

In order to close this gap in sustainable and healthy energy development for the population, the United Nations included as SDG 7 the goal of achieving universal access to affordable and clean energy. However, reducing the consumption of firewood and other polluting fuels also contributes to other SDGs such as: No. 3. Good Health and Well Being 5. Gender equality 10. Reduced Inequalities and No. 15. Life on Land

2. Status of Firewood Consumption in Latin America and the Caribbean

In LAC, firewood consumption has represented on average, during the last 20 years, 8% of total final energy consumption and 7% of this total in the year 2024. See Figure 2.

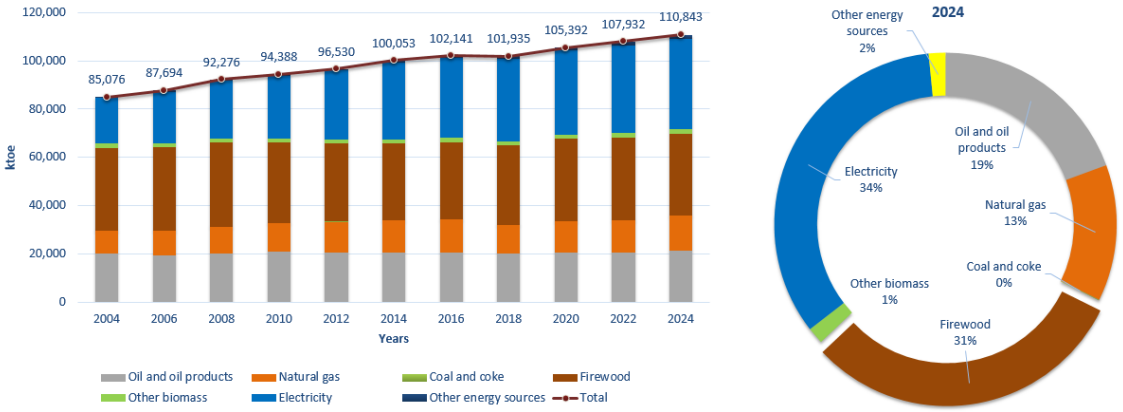
Figure 2. Share of Firewood in Total Final Energy Consumption



Source: sieLAC-OLADE, 2024

As for the share of firewood in residential consumption in LAC, this has decreased in the last 20 years, going from 43% in 2004 to 31% in 2024. However, it still represents a very important fraction of the energy consumption matrix of this sector, surpassed only by electricity. See Figure 3.

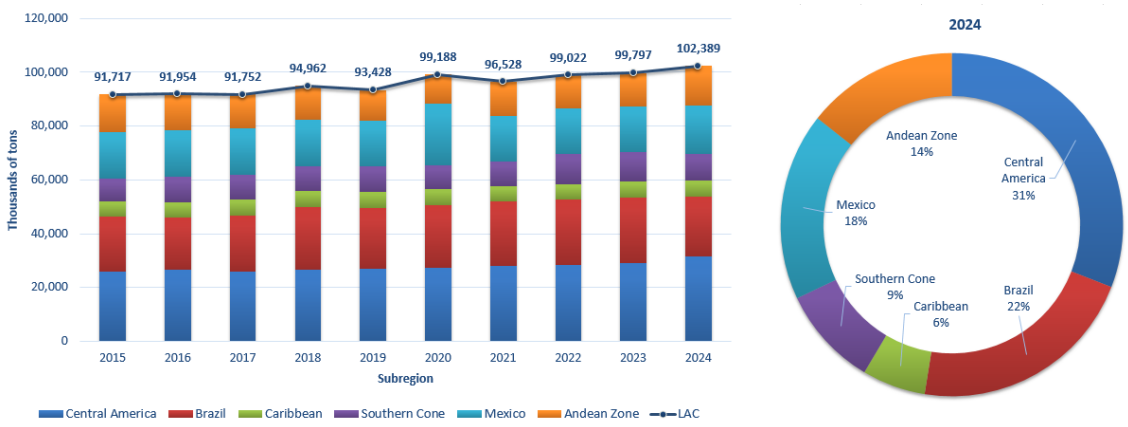
Figure 3. Share of Firewood in Residential Final Energy Consumption



Source: sieLAC-OLADE, 2024

Firewood consumption in the residential sector has remained fairly stable over the last decade in LAC and has been geographically concentrated mainly in Central America, Brazil, and Mexico, with the Central America subregion accounting for nearly one-third of this consumption. It is estimated that in 2024, 78 million people in the region used firewood for cooking and heating their homes, representing 12% of the regional population. See Figure 4.

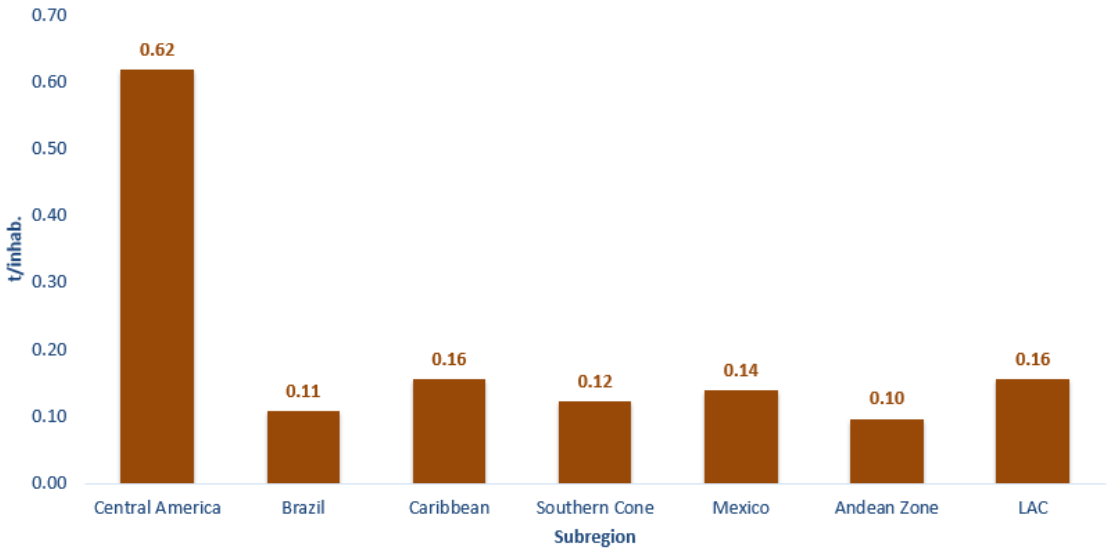
Figure 4. Historical Evolution of Residential Firewood Consumption and Geographic Distribution in LAC.



Source: sieLAC-OLADE, 2024

If we consider firewood consumption in relative terms, this condition is much more noticeable, since Central America greatly exceeds the rest of LAC subregions in residential consumption per capita of firewood. See Figure 5.

Figure 5. Per capita consumption of firewood in the residential sector by subregion of LAC, year 2024.



Source: sieLAC-OLADE, 2024

3. Opportunities and Challenges for Firewood Consumption Substitution in the LAC Residential Sector

To achieve sustainable energy development goals and improve the quality of life and health of the population in LAC, it is necessary to reduce firewood consumption in households, either by replacing it with modern energy sources such as LPG, natural gas, and electricity, or by using it in a much more rational and efficient manner. However, this process involves opportunities, but also many challenges that need to be overcome.

Opportunities:

As a region, LAC has a high rate of electricity coverage of around 97%, that is, 97 out of every 100 inhabitants have access to electricity.

LAC has great untapped potential for electricity generation with renewable energy sources, such as hydro, wind, solar and geothermal, which could contribute to providing clean and affordable electricity for users.

There are several distributed generation projects in the countries of the region that could facilitate the supply of electricity to rural or isolated areas.

LAC also has abundant reserves of primary hydrocarbons and although it is currently a net importer of derivatives, with adequate investment in infrastructure, it could become self-sufficient or even an exporter of such energy products as LPG, which is considered one of the most viable alternative sources for replacing firewood.

There is regional experience in the design and construction of efficient wood-burning stoves and in programs for their implementation, mainly in the Central America subregion.

Challenges:

Firewood is consumed mainly in rural and isolated areas, with difficult access to alternative energy sources.

Firewood is generally a source of direct appropriation, that is, obtaining it does not represent an economic cost for users.

In many communities, the use of firewood is part of a cultural and traditional heritage that is very difficult to change.

Central America, as the subregion that concentrates most of the residential consumption of firewood in the region, is a clear importer of potentially alternative fuels such as LPG and natural gas and has a lower electricity coverage rate in the LAC region.

As cooking, heating and water heating in homes are more intensive final energy uses than other uses such as lighting, refrigeration, etc., and usually with a high time matching factor, their electrification requires greater capacity for generation, transmission and distribution of electricity.

The distribution of alternative sources to firewood for residential consumption, such as LPG, natural gas and electricity, in rural or isolated areas requires investment in

infrastructure and logistics that generally do not represent cost-effective projects for investors.

4. Prospects for increasing access to clean cooking for the population in LAC until 2035

This section provides prospective analysis and scenarios for improving access to clean cooking in LAC for the next decade, specifically in terms of a reduction in the consumption of residential firewood, either by replacing this source with other modern energy sources or by its more efficient use.

To evaluate the impact of these alternatives, it is necessary to define a baseline scenario (BAU), where the behavior of residential firewood use in the region follows historical trends and patterns without substitution measures and an alternative scenario (Target), where these measures are modeled, for the projection period 2025-2035, with base year 2024.

For the construction of these scenarios, the following hypotheses were considered:

Hypothesis for BAU scenario (no substitution)

1) The population of LAC would continue to increase until 2035, with the average annual growth rate that has been recorded in the last 14 years (1%).
2) The percentage of the population that consumes firewood in the residential sector in LAC (12%) remains constant in the projection period (2025-2035).
3) The per capita consumption of useful energy for cooking with firewood of the population that consumes this source remains constant during the projection period.
4) Two modalities of the use of wood for cooking are considered, one in open-fire stoves and the other in improved wood-burning stoves.
5) It was assumed that the percentage of the population that uses firewood for cooking in open-fire stoves is 75% and the percentage that uses firewood in improved stoves is 25%[2].
6) It is considered that the energy efficiency for open-fire stoves is 15%, while for improved wood-burning stoves it is 35% and that these efficiencies remain constant during the projection period[3].

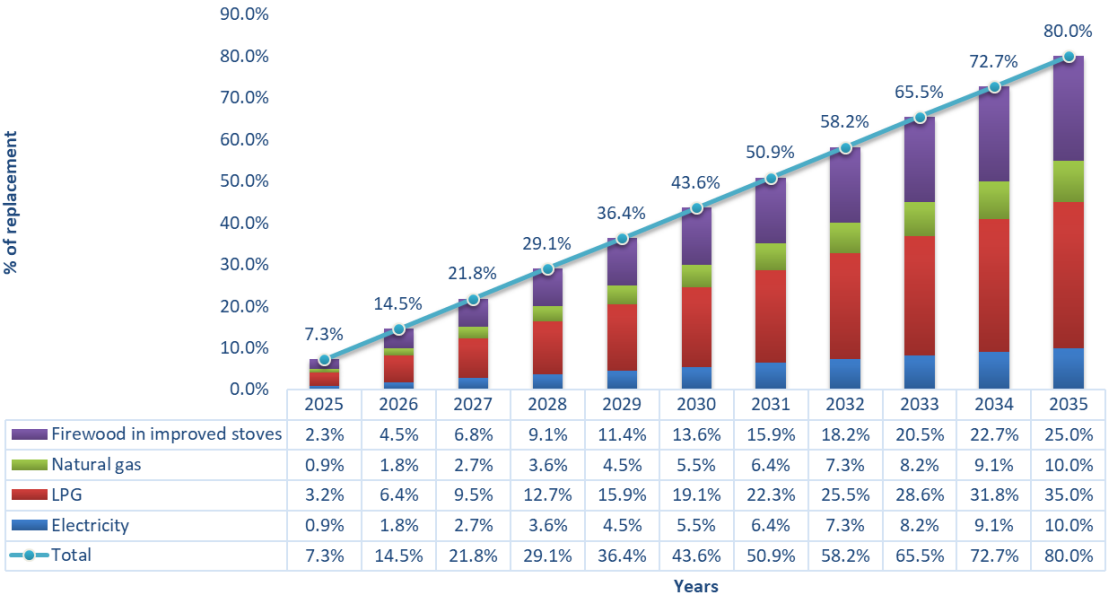
[2]These percentages were assumed based on the article published by the World Bank in November 2020: “Cooking is a risk for nearly half of Latin Americans,” which indicates that in countries with the lowest access to clean fuels and stoves, this access is below 25%. https://www.bancomundial.org/es/news/feature/2020/11/11/cocina-energias-modernas-combustibles-limpios-latinoamerica

[3] These efficiencies were estimated based on the article "Implementation of improved wood-burning stoves and the reduction of Greenhouse Gases (GHG): the case of the Haku Wiñay / Noa Jayatai Project in Peru", published in 2022 by the Universidad Privada de Tacna. https://revistas.upt.edu.pe.

Hypothesis for Meta scenario (with substitution)

1) Modern alternative sources to firewood for cooking use are considered to be electricity, LPG, and natural gas [4]
2) The useful energy associated with the consumption of firewood in the residential sector during the projection period, in this scenario, is the same as in the BAU scenario (without firewood replacement).
3) It was considered that by 2035, 80% of the useful energy, which in the trend scenario would be supplied by wood in open-fire stoves, is replaced by substitute sources and cooking modalities, in percentages indicated in Figure 6, which increase linearly in the period (2025-2035).
4) It was considered that 55% of the useful energy that would be supplied by firewood in improved stoves in the year 2035, in a trend scenario, will be replaced by modern sources in the percentages indicated in Figure 7.
5) The population considered to have access to clean cooking includes those who do not use firewood as an energy source for cooking.

Figure 6. Percentages of replacement of useful energy provided by wood in open-fire stoves in the period 2025-2035.

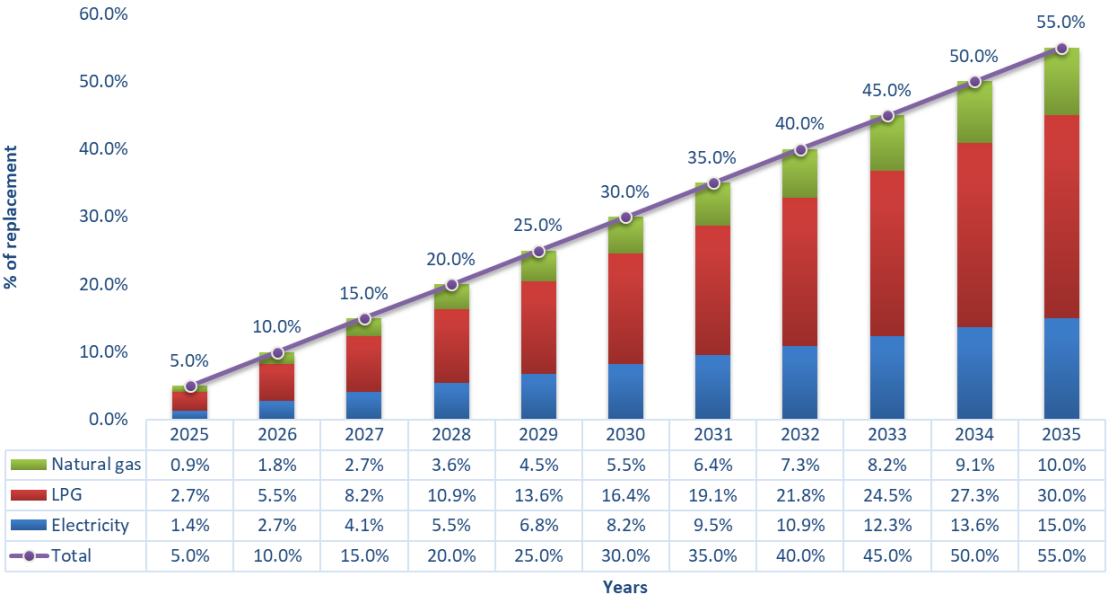


	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Firewood in improved stoves	2.3%	4.5%	6.8%	9.1%	11.4%	13.6%	15.9%	18.2%	20.5%	22.7%	25.0%
Natural gas	0.9%	1.8%	2.7%	3.6%	4.5%	5.5%	6.4%	7.3%	8.2%	9.1%	10.0%
LPG	3.2%	6.4%	9.5%	12.7%	15.9%	19.1%	22.3%	25.5%	28.6%	31.8%	35.0%
Electricity	0.9%	1.8%	2.7%	3.6%	4.5%	5.5%	6.4%	7.3%	8.2%	9.1%	10.0%
Total	7.3%	14.5%	21.8%	29.1%	36.4%	43.6%	50.9%	58.2%	65.5%	72.7%	80.0%

Source: Own elaboration

[4] In natural gas, the possibility of using biogas is also included

Figure 7. Percentages of replacement of useful energy provided by wood in improved stoves in the period 2025-2035.



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Natural gas	0.9%	1.8%	2.7%	3.6%	4.5%	5.5%	6.4%	7.3%	8.2%	9.1%	10.0%
LPG	2.7%	5.5%	8.2%	10.9%	13.6%	16.4%	19.1%	21.8%	24.5%	27.3%	30.0%
Electricity	1.4%	2.7%	4.1%	5.5%	6.8%	8.2%	9.5%	10.9%	12.3%	13.6%	15.0%
Total	5.0%	10.0%	15.0%	20.0%	25.0%	30.0%	35.0%	40.0%	45.0%	50.0%	55.0%

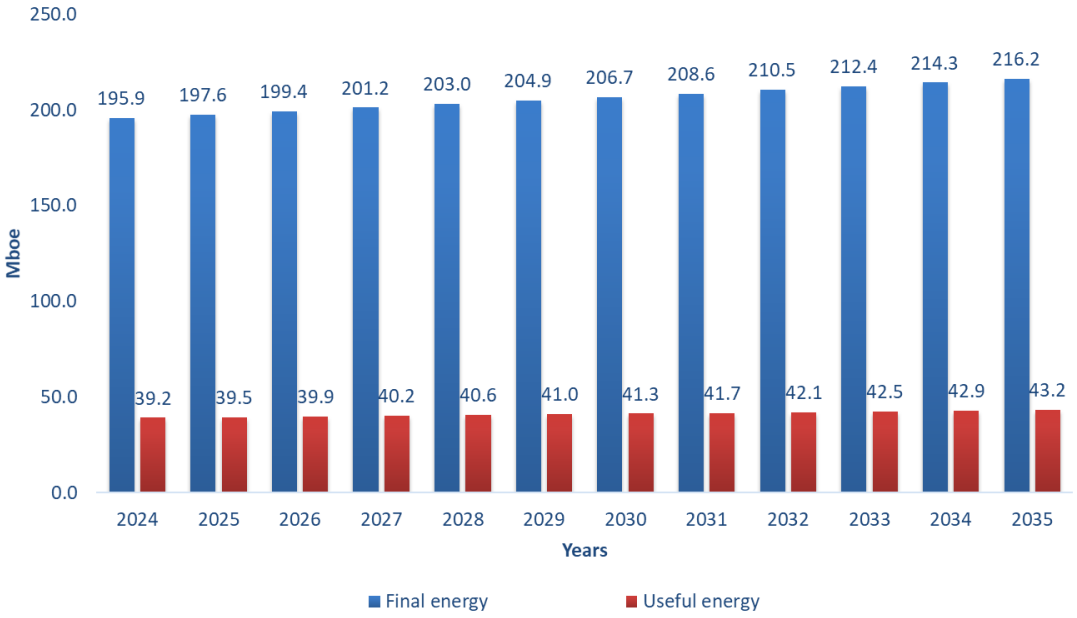
Source: Own elaboration

The substitution percentages considered for 2050 were defined considering the level of access and affordability that the countries with the highest firewood consumption in the residential sector would have to alternative energy sources and the equipment needed for their use. For example, it is estimated that there are better prospects for replacing firewood with LPG than with electricity and natural gas, and that the total substitution rate will be higher for open-fire stoves than for improved firewood stoves.

5. BAU scenario: Projection of the final energy and useful energy provided by wood for cooking in the period 2024-2035.

According to the hypotheses of the reference scenario (BAU), without substitution of firewood consumption, this source would provide during the projection period, the final energy and useful energy for cooking that is seen in Figure 8.

Figure 8. Remaining useful energy provided by wood in the period 2024-2035.



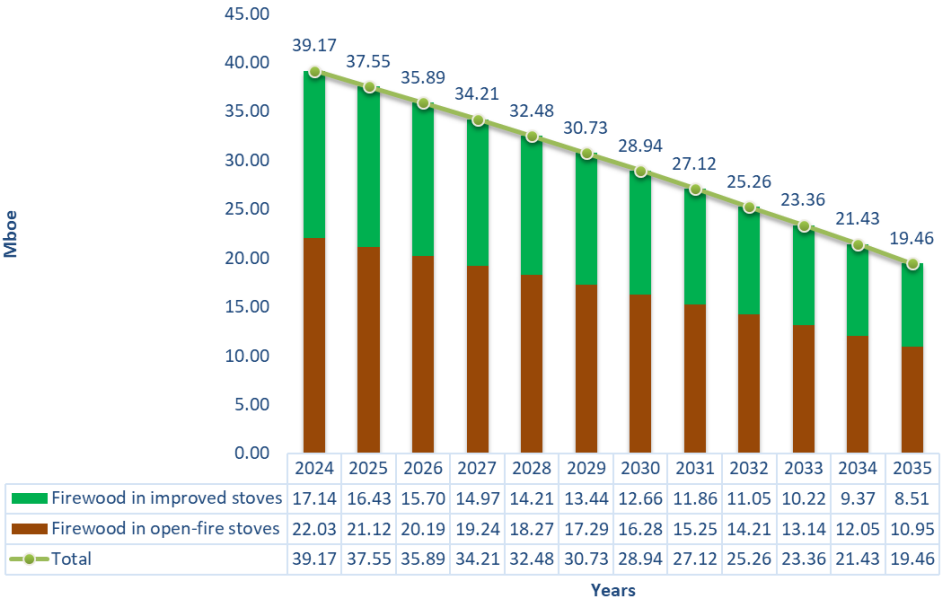
Source: Own elaboration

It is important to remember that useful energy is the amount of energy actually utilized for the energy service—in this case, the heat needed to cook food, regardless of the fuel used—while final energy is the net combustion heat provided by the fuel, in this case firewood, which depends on the mass of the fuel burned and its lower heating value. The difference between these two variables is determined by the efficiency in the consumption process.

6. Remaining useful energy for cooking provided by wood in the period 2024-2035

After simulating the partial substitution of the useful energy provided by firewood in 2035 with alternative energy sources and cooking technologies, the remainder is 20% of the useful energy projected in the baseline scenario for open-fire stoves and 45% of the useful energy projected in the baseline scenario for efficient firewood stoves. The remaining useful energy provided by wood in each year of the projection period can be seen in Figure 9.

Figure 9. Remaining useful energy provided by wood in the period 2024-2035.



	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Firewood in improved stoves	17.14	16.43	15.70	14.97	14.21	13.44	12.66	11.86	11.05	10.22	9.37	8.51
Firewood in open-fire stoves	22.03	21.12	20.19	19.24	18.27	17.29	16.28	15.25	14.21	13.14	12.05	10.95
Total	39.17	37.55	35.89	34.21	32.48	30.73	28.94	27.12	25.26	23.36	21.43	19.46

Source: Own elaboration

7. Substitution Scenario: Calculation of the population that consumes firewood for cooking by 2035.

Based on the hypothesis that per capita consumption of useful energy provided by firewood for cooking remains constant during the projection period, the remaining firewood-consuming population in the substitution scenario is determined each year by applying the rule of proportionality. See Figure 10.

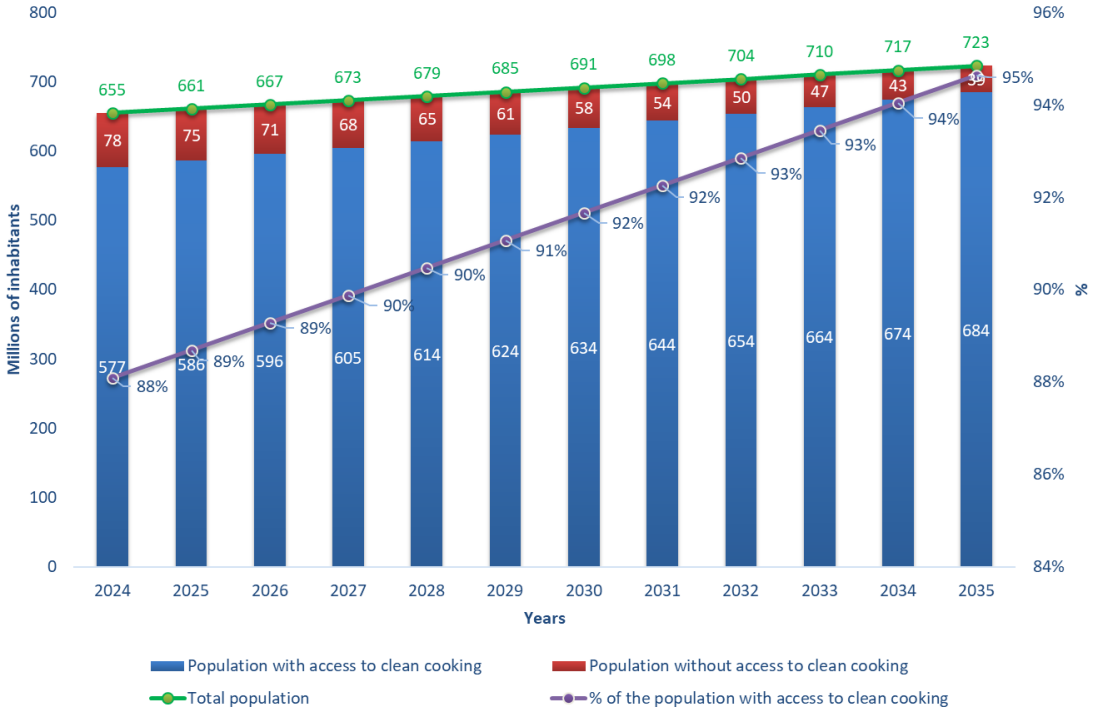
Figure 10. Useful energy from wood and population that consumed wood for cooking in the period 2025-2035.

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Useful energy from firewood without replacement	39.17	39.53	39.88	40.24	40.61	40.97	41.34	41.72	42.09	42.47	42.86	43.24
Useful energy from firewood with replacement	39.17	37.55	35.89	34.21	32.48	30.73	28.94	27.12	25.26	23.36	21.43	19.46
Population that consumes firewood with replacement	78.00	78.70	79.42	80.13	80.86	81.59	82.32	83.07	83.82	84.58	85.34	86.11
Population that consumes firewood without replacement	78.0	74.8	71.5	68.1	64.7	61.2	57.6	54.0	50.3	46.5	42.7	38.7

Source: Own elaboration

As shown in the previous figure, in the scenario of partial substitution of firewood by modern alternative sources, the population in LAC that would still use it for cooking in 2035 is estimated at 38.7 million people, which represents 5% of the projected total population for that year. Therefore, the population with access to clean cooking would be 95%. The evolution of this indicator in the projection period is seen in Figure 11.

Figure 11. Evolution of the % of the population with access to clean cooking in the firewood substitution scenario in the period 2024-2035

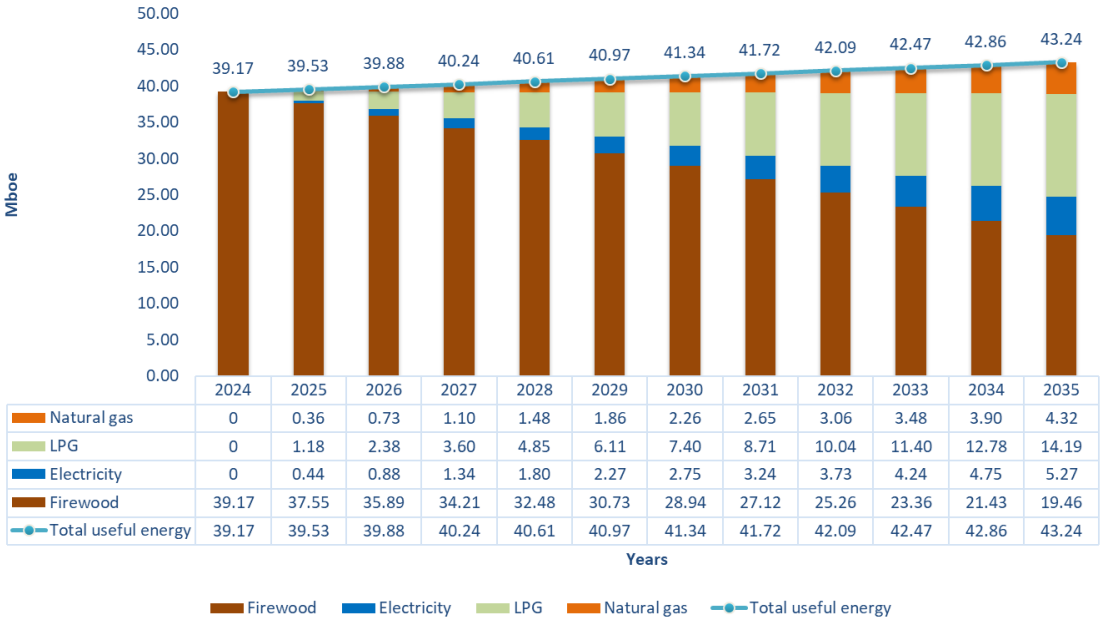


Source: Own elaboration

8. Participation of alternative sources in the substitution of useful energy for cooking projected in the trend scenario

The useful energy provided by firewood for cooking in the reference scenario (without firewood substitution) would be covered in the substitution scenario by a mix of firewood, electricity, LPG, and natural gas, as shown in Figure 12.

Figure 12. Coverage of the useful energy of the reference scenario with the participation of modern sources in the scenario with substitution of firewood



	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Natural gas	0	0.36	0.73	1.10	1.48	1.86	2.26	2.65	3.06	3.48	3.90	4.32
LPG	0	1.18	2.38	3.60	4.85	6.11	7.40	8.71	10.04	11.40	12.78	14.19
Electricity	0	0.44	0.88	1.34	1.80	2.27	2.75	3.24	3.73	4.24	4.75	5.27
Firewood	39.17	37.55	35.89	34.21	32.48	30.73	28.94	27.12	25.26	23.36	21.43	19.46
Total useful energy	39.17	39.53	39.88	40.24	40.61	40.97	41.34	41.72	42.09	42.47	42.86	43.24

Source: Own elaboration

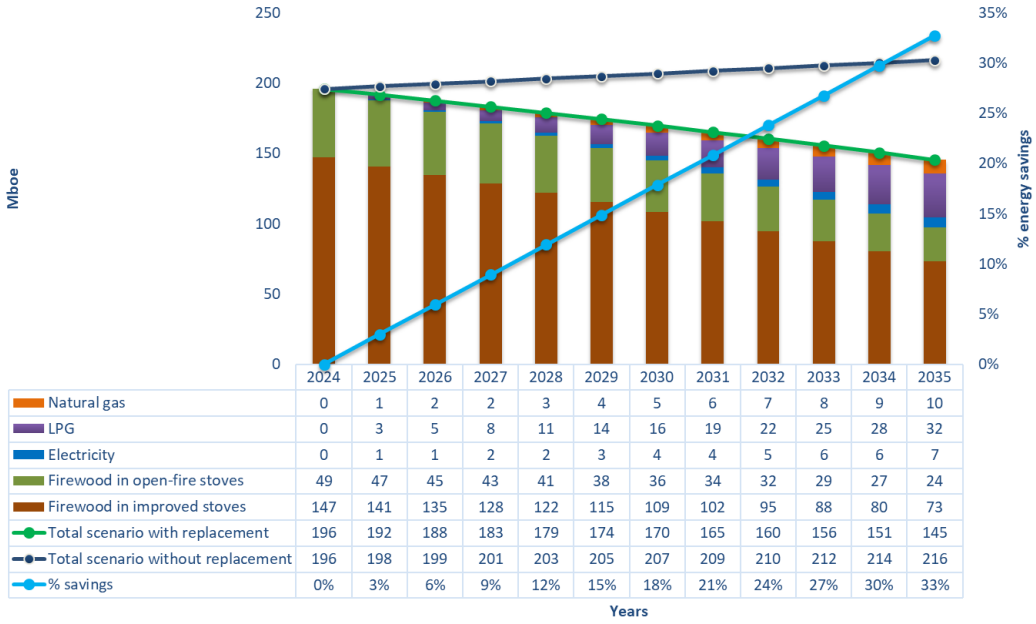
To convert the useful energy mix into final energy, each value is divided by a reference energy efficiency for each cooking energy source. The efficiencies considered are shown in Table 1 and the final energy mix for the substitution scenario is indicated in Figure 13.

Table 1. Reference energy efficiencies for cooking

Cooking source or method	Energy Efficiency
Firewood in open-fire stoves	15%
Firewood in improved stoves	35%
Electricity	75%
LPG	45%
Natural gas	45%

Source: Own elaboration

Figure 13. Final energy mix to cover the useful energy provided by wood in the reference scenario and energy savings due to the partial substitution of wood.



	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Natural gas	0	1	2	2	3	4	5	6	7	8	9	10
LPG	0	3	5	8	11	14	16	19	22	25	28	32
Electricity	0	1	1	2	2	3	4	4	5	6	6	7
Firewood in open-fire stoves	49	47	45	43	41	38	36	34	32	29	27	24
Firewood in improved stoves	147	141	135	128	122	115	109	102	95	88	80	73
Total scenario with replacement	196	192	188	183	179	174	170	165	160	156	151	145
Total scenario without replacement	196	198	199	201	203	205	207	209	210	212	214	216
% savings	0%	3%	6%	9%	12%	15%	18%	21%	24%	27%	30%	33%

Years

Source: Own elaboration

As shown in the previous figure, due to the partial substitution of firewood with modern energy sources and greater adoption of efficient firewood stoves, an energy saving of 33% is achieved in 2035 compared to the projected value in the reference scenario (without firewood substitution).

As for the electricity required for the replacement, this would be 7 Mbep by 2035, which is equivalent to approximately 11 TWh, energy that could be supplied by a 6,000 MW photovoltaic park or a wind farm with 3,000 MW of installed capacity.

9. Conclusions

1) To achieve 95% of the LAC population using modern energy sources other than firewood for cooking by 2035, according to the prospective exercise conducted and described in this document, it would be necessary to provide access to substitute sources such as electricity, LPG, natural gas, and biogas to around 50 million people, in addition to increasing the use of improved firewood stoves.

2) In physical units, by 2035 it would be necessary to provide approximately 1.7 billion cubic meters of natural gas, 46 million barrels of LPG, and 11 TWh of electricity to replace 62 million tons of firewood that year. This requires investments in greater electricity generation capacity, strengthening electricity distribution systems, increasing the production or import of LPG and natural gas, and implementing or expanding distribution systems for these sources.

3) These requirements, regarding international fuel prices and the average electricity price in LAC, represent an estimated investment of approximately 7.7 billion US dollars.

4) It is necessary to ensure that the final consumer prices of modern energy sources, substituting firewood, are affordable for the economically disadvantaged population segments, who account for the highest firewood consumption in their households.

5) It is also important to study the cultural and traditional aspects of the communities, in terms of cooking methods, since many projects to replace firewood with modern fuels or even to implement efficient firewood stoves fail due to these aspects.

10. References

- Who, 2024, Domestic air pollution https://www.who.int/es/news-room/fact-sheets/detail/household-air-pollution-and-health

- OLADE, 2025, Energy Information System of Latin America and the Caribbean (sieLAC), https://sielac.olade.org/

- Grupo Banco Mundial, 2020, “Cocinar es un riesgo para casi la mitad de los latinoamericanos” https://www.bancomundial.org/es/news/feature/2020/11/11/cocina-energias-modernas-combustibles-limpios-latinoamerica

- Universidad Privada de Tacna, 2022, "Implementation of improved wood-burning stoves and the reduction of greenhouse gases (GHG): the case of the Haku Wiñay / Noa Jayatai Project in Peru" https://revistas.upt.edu.pe

- ECLAC, 2025, Portal de Datos y Publicaciones Estadísticas (CEPALSTAT), https://statistics.cepal.org/portal/cepalstat/index.html?lang%3Des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