EDITORIAL
e-ISSN: 3084-7850

REPIAMA | Revista Peruana de Ingeniería, Arquitectura y Medio Ambiente

The eminent need for the diversification of the energy matrix for the economic survival of Huánuco

La eminente necesidad de la diversificación de la matriz energética para la supervivencia económica de Huánuco

Verenisa Nohely Condezo Beteta[1,a]

Institutional affiliation

[1] Universidad Nacional Hermilio Valdizán, Huánuco, Perú.

Academic degree

[a] Master's Degree in Research and higher education teaching.

Received: 20/11/25
Approved: 28/12/25
Published: 06/01/26

The global energy dynamic continues intrinsically linked to hydrocarbons, organic compounds composed of hydrogen and carbon that, after millions of years of geological processes, constitute the foundation of modern industrial development.

This resource originates from the anaerobic decomposition of microorganisms, such as plankton and algae, deposited in sedimentary basins, where pressure and high temperatures transform this organic matter into the so-called "black gold" (Selley and Sonnenberg, 2015). Subsequently, through fractional distillation processes in refineries, essential derivatives that sustain life are obtained: from liquid fuels such as gasoline, diesel, and LPG to key inputs for the petrochemical industry, such as plastics, fertilizers, and lubricants (Albright, 2008).

In Peru and around the world, fossil fuels not only constitute the basis of the energy matrix but also act as a true geopolitical engine that shapes international relations, economic security, and market stability; indeed, the control and the accees to resources such as oil and gas have historically shaped strategies of power and dependence among States (Merino García and Martínez Pérez, 2024). Nevertheless, this energy order is undergoing an accelerated reconfiguration driven by global decarbonization targets, which require a significant reduction in CO_2 emissions of around 45% by 2030 through the progressive replacement of fossil fuels with renewable energies and innovations such as green hydrogen (Perú Energía, 2024). This process, far from eliminating geopolitical tensions, redefines them, giving rise to a new scenario in which competition for critical minerals and clean technologies replaces the traditional dispute over hydrocarbons, shaping what some authors refer to as the transition toward a "decarbonization consensus" in a multipolar world (Bringel and Svampa, 2023).

Under this premise, in the city of Huánuco, the instability of the energy resource is not merely a matter of prices but rather a structural energy security problem. Any fluctuation in the production of the countries Any fluctuation in the production of the member countries of the Organization of the Petroleum Exporting Countries (OPEC) or the imposition of international sanctions has a direct and severe impact on local supply in districts such as Amarilis and Pillco Marca (Instituto Peruano de Economía [IPE], 2026). In the regional context, this dependence

Cite as: Condezo Beteta, V. N. (2026). The eminent need for the diversification of the energy matrix for the economic survival of Huánuco. *Revista Peruana de Ingeniería, Arquitectura y Medio Ambiente*, *3*(1), 7-9. https://doi.org/10.37711/repiama.2026.3.1.1

takes on critical dimensions of logistical and economic vulnerability, as hydrocarbons must be transported from storage facilities located on the coast, such as the Conchán Refinery, through the Central Highway, a corridor highly exposed to disruptions. This route, vulnerable to climatic and social factors, increases freight costs and jeopardizes the continuity of supply. In 2026, this instability becomes evident: the configuration of domestic prices is severely affected by the increase in international market prices, driven by conflicts in the Middle East and dollar volatility. This fragility is exacerbated when the price of a barrel of crude oil exceeds one hundred dollars, which immediately translates into an increase in the prices of essential goods and highlights the “umbilical cord” that still links our economy to oil (Diario Ahora, 2026).

Faced with this risk scenario, there is an urgent need to diversify the energy matrix toward renewable sources in order to reduce exposure to global crises. In this context, Huánuco has begun to explore, albeit incipiently, the use of renewable resources, highlighting the hydropower potential of the Huallaga River basin and the development of reforestation projects for bioenergy purposes (Carrión Mogollón, 2018). Various studies emphasize that this lignocellulosic biomass can be transformed into energy through processes such as combustion, gasification, or biofuel production, thereby contributing to the reduction of greenhouse gas emissions and the strengthening of rural economies (Rusch et al., 2021). In this context, Huánuco has begun to explore, albeit incipiently, the use of renewable resources, highlighting the hydropower potential of the Huallaga River basin and the development of reforestation projects for bioenergy purposes (Carrión Mogollón, 2018). Various studies emphasize that this lignocellulosic biomass can be transformed into energy through processes such as combustion, gasification, or biofuel production, thereby contributing to the reduction of greenhouse gas emissions and the strengthening of rural economies (Rusch et al., 2021). In this context, the incorporation of bamboo into regional strategies not only promotes energy security but also drives circular economy models and the transition toward cleaner and more resilient energy matrices (Evans et al., 2010; Gobierno Regional Huánuco, 2020). Although the impact of these initiatives is still incipient, strengthening them is essential to mitigate climate change and develop sustainable energy projects, supported by the use of specialized technologies and the implementation of adequate infrastructure to ensure energy supply for both the industrial sector and the population (Rojas, 2024).

To mitigate dependence on hydrocarbons, it is proposed to implement municipal ordinances that incentivize the use of renewable energy through tax benefits, such as the reduction of municipal service fees and the simplification of licensing procedures for microgeneration projects (Ministerio de Energía y Minas (MINEM), 2026). In parallel, coordination with the Regional Government should prioritize the completion of the 3,500 m² natural gas plant, whose demand study, scheduled for March 2026, is essential for establishing a more economical backup energy matrix with a lower environmental impact (Gobierno Regional Huánuco, 2026). Likewise, the adoption of solar panels is presented as one of the most viable and rapidly implementable alternatives, considering that the costs of photovoltaic kits in the Peruvian market have reached historically competitive levels, allowing for shorter investment payback periods in both urban and rural areas. In addition, the use of residual agricultural and livestock biomass through anaerobic biodigesters makes it possible to generate biogas and organic fertilizers in areas such as Santa María del Valle (ComUnidad, 2021). Similarly, harnessing the hydropower potential of the Huallaga River through the implementation of small hydroelectric power plants constitutes a viable alternative for strengthening energy security in the city of Huánuco, by enabling decentralized and sustainable electricity generation, in accordance with the country's energy diversification policies (MINEM, 2023). Finally, the implementation of hybrid micro-wind systems in the high-Andean areas of Amarilis and Pillco Marca represents a technically viable solution to guarantee electricity supply in rural institutions, increasing regional energy resilience in the face of climate variability and dependence on external sources (Alonso, 2019).

Consequently, the energy transition in Huánuco should be implemented through an integrated management model that combines energy audits, the technical utilization of solar radiation, and the efficient use of residual biomass, together with a cross-cutting university educational approach that directs research toward the development of clean technologies adapted to local geographical and socioeconomic characteristics. This systemic approach not only makes it possible to optimize the use of available energy resources but also to strengthen scientific and technological capacities within academia, contributing to a sustainable and context-specific transition (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2021).

Ultimately, monitoring external markets is no longer merely a technical exercise but has become an early warning tool; in this scenario, environmental protection in Huánuco has ceased to be merely an ethical imperative and has become a fundamental strategy for economic survival.

"Frente a la crisis global, respuesta local: diversificar hoy para no detenernos mañana".

In the face of the global crisis, a local response: diversify today to let's not stop tomorrow.

References

Albright, L. (Ed.). (2008). *Albright's Chemical Engineering Handbook*. CRC Press. https://doi.org/10.1201/9781420014389

Alonso, B. B. (2019). *Aprovechamiento de energía eólica para mejorar la calidad de vida en el centro poblado de Llicua alta, Amarilis Huánuco 2019* [Bachelor's Thesis, University of Huánuco]. Institutional Repository of UDH. https://repositorio.udh.edu.pe/handle/123456789/2191

Bringel, B., y Svampa, M. (2023). Del "*Consenso de los Commodities" al "Consenso de la Descarbonización*". Nueva Sociedad. Nueva Sociedad, (306), 51-70. https://nuso.org/articulo/306-del-consenso-de-los-commodities-al-consenso-de-la-descarbonizacion/

Carrión Mogollón, S. Y. (2018). *Evaluación de la intercuenca Alto Huallaga haciendo uso de la hidrología de bosques* [Bachelor's Thesis, Pontificia Universidad Católica del Perú]. Institutional Repository PUCP. http://hdl.handle.net/20.500.12404/14598

ComUnidad. (2021, march 30). *Biol Market is making its way through in Huánuco The Installation of Biodigesters Enables the Production of Biogas and the Commercialization of Biol. Development Support Projects.* https://com-unidad.pe/main/proyectos/mercado-de-biol-se-abre-paso-en-huanuco

Diario Ahora. (2026, march 11). Huánuco: Transport operators report alleged fuel price speculation and warn of arbitrary fare increases. *Diario Ahora.* https://ahora.com.pe/noticia/huanuco-transportistas-denuncian-presunta-especulacion-de-combustible-y-alertan-alza-arbitraria-de-pasajes

Evans, A., Strezov, V., & Evans, T. J. (2010). *Sustainability considerations for electricity generation from biomass. Renewable and Sustainable Energy Reviews*, 14(5), 1419-1427. https://doi.org/10.1016/j.rser.2010.01.010

Gobierno Regional Huánuco. (2020, september 15). *More than 480,000 bamboo seedlings will be used to reforest degraded soils in Huánuco. Gob.pe.* https://www.gob.pe/institucion/regionhuanuco/noticias/302696-mas-de-480-mil-plantones-de-bambu-se-usaran-para-reforestar-suelos-degradados-en-huanuco

Gobierno Regional Huánuco. (2026, march 2). Huánuco: Governor appeals to MINEM to expedite electrification and natural gas projects for Huánuco. *Gob.pe.* https://www.gob.pe/institucion/regionhuanuco/noticias/1360424-huanuco-gobernador-gestiona-ante-el-minem-aceleracion-de-proyectos-de-electrificacion-y-gas-natural-para-huanuco

Instituto Peruano de Economía. (2026, march 16). The average price of fuels increased by up to 27% this month. *El Comercio*. https://elcomercio.pe/economia/peru/precio-promedio-de-los-combustibles-se-incremento-hasta-27-ipe-noticia/

M García, P. A., and Martínez Pérez, J. M. (2024). Energy sector economics and geopolitics: from fossil fuels to transition minerals. ICE, Revista de Economía, (935). https://doi.org/10.32796/ice.2024.935.7795

Ministerio de Energía and Minas. (2023, december 31). *Plan Nacional de Electrificación Rural (PNER). Plan.* Gob.pe. https://www.gob.pe/institucion/dger/informes-publicaciones/5003343-plan-nacional-de-electrificacion-rural-pner

Ministerio de Energía and Minas. (2026, january 21). *Promotes nine major solar energy projects worth more than US$1.268 billion to strengthen the country's renewable energy generation.* Gob.pe. https://www.gob.pe/institucion/minem/noticias/1338149-minem-impulsa-9-grandes-proyectos-de-energia-solar-por-mas-de-us-1-268-millones-para-fortalecer-la-generacion-renovable-del-pais

Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura. (2021). *Engineering for sustainable development: delivering on the Sustainable Development Goals*. https://unesdoc.unesco.org/ark:/48223/pf0000375644

Perú Energía. (2024, September 16). *Decarbonization will depend on renewable energy and green hydrogen.* https://peruenergia.com.pe/energias-renovables-e-hidrogeno-verde-para-la-descarbonizacion/

Rojas, R. (2024, mayo 8). *Climate change puts Peru's energy security at risk. Stakeholders.* https://stakeholders.com.pe/informes/cambio-climatico-pone-en-riesgo-seguridad-energetica-en-el-peru/

Rusch, F., de Abreu Neto, R., de Moraes Lúcio, D., and Hillig, É. (2021). *Energy properties of bamboo biomass and mate co-products*. *SN Applied Sciences,* 3(6),1-8. https://doi.org/10.1007/s42452-021-04584-7

Selley, R. C., and Sonnenberg, S. A. (2015). *Elements of petroleum geology* 3.ª ed.). Academic Press. http://www.sciencedirect.com:5070/book/monograph/9780123860316/elements-of-petroleum-geology

Correspondence:
Verenisa Nohely Condezo Beteta
Email: vcondezo@unheval.edu.pe