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THE ROLE OF POVERTY AND GENDER ON HOUSEHOLDS' ENERGY USE IN SELECTED EUROPEAN COUNTRIES

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Purpose of the article: In the context of Sustainable Development Goals, declining poverty (Goal 1) and achieving gender equality (Goal 5) are still behind the track, and the gaps are not yet ready to be rapidly fulfilled. As part of Goal 7, energy consumption-related targets still lack the potential to be targeted. Considering these elements, this study aims to determine the impact of poverty and gender equality on the energy consumption of households in several European countries. Using data from 2010 to 2022 and a pooled OLS based on Driskoll-Kraay estimators, we found statistically significant results regarding the impact of poverty (a negative sign) and gender (a negative sign) on household energy consumption. Accordingly, various stakeholder recommendations are presented based on the study results.

Keywords: social inequality; gender; energy; SDGs; OLS

Introduction

The "poverty vs. energy paradox" highlights a critical inequality where economically disadvantaged households often pay disproportionately more for their energy needs compared to wealthier households. This inequity arises because lower-income families lack access to energy-efficient appliances or affordable clean energy sources, forcing them to rely on costlier, inefficient alternatives. As Saghir (2005) suggests, this vicious cycle leaves these households unable to break free from poverty, perpetuating economic disparities.

Indrawati (2015) reinforces this notion, emphasizing that energy poverty—the inability to access affordable, reliable, and clean energy—traps individuals and communities in a state of economic stagnation. Without access to modern energy solutions, poor households are unable to transition to more sustainable energy practices, perpetuating their dependence on costly and polluting energy sources.

The consequences of energy poverty extend beyond economic burdens. As Roser (2021) points out, energy poverty contributes to significant environmental and health challenges. Inefficient energy use in homes leads to indoor pollution, higher carbon emissions, and biodiversity loss, exacerbating global environmental crises. For individuals, prolonged exposure to indoor pollution causes severe health problems, adding to their financial and social constraints.

Furthermore, Bentley et al. (2023) address the psychological toll of energy poverty. When households are unable to afford adequate heating or cooling, their mental health deteriorates, adding another layer of vulnerability to already disadvantaged populations. On a broader scale, governments face increased fiscal pressures as they allocate resources to address the cascading impacts of energy poverty on public health and welfare.

Research on the role of gender in household energy use highlights significant differences in behaviors, decision-making, and energy consumption patterns influenced by gender dynamics. Multiple studies reveal that women play a critical role in driving energy efficiency and sustainability in domestic settings. Bartiaux (2022) demonstrates that women are often the primary decision-makers when it comes to adopting energy-saving measures, such as implementing home improvements for better insulation. Similarly, Rainisio, Boffi, and Pola (2022) emphasize the role of women's self-efficacy in promoting sustainable energy practices in Italian households.

Shrestha and Tiwari (2021) provide a comprehensive review of the importance of integrating gender perspectives into energy policies, noting that women tend to prioritize sustainability and adopt clean energy solutions when given the opportunity. Supporting this, Aryal, Mottaleb, and Ali (2019) identify differences in household energy choices, with women often favoring cleaner, renewable energy sources over traditional or polluting alternatives.

Gendered responsibilities also influence energy consumption. Grünewald and Diakonova (2020) argue that women's involvement in household chores directly affects electricity demand, often increasing their energy use in managing domestic tasks. Similarly, Petrova and Simcock (2021) address how gender inequities in energy poverty disproportionately impact women, limiting their access to modern energy solutions.

Finally, studies by Elnakat and Gomez (2015) and Pachauri and Rao (2013) suggest that involving women in energy management decisions can optimize energy consumption and improve household efficiency. This is further supported by Sintov and White's (2019) exploration of "thermostat wars," where gendered negotiations over thermal comfort significantly influences household energy settings.

Results and discutions

Poverty and gender equality stand as two critical pillars of the United Nations Sustainable Development Goals (SDGs), forming the foundation for a better, more inclusive future. Goal 1 (No Poverty) seeks to eradicate extreme poverty, while Goal 5 (Gender Equality) aims to empower women and ensure equal opportunities. Together, these objectives intertwine with Goal 7 (Affordable and Clean Energy), highlighting the need for equitable energy access to support sustainable development.

The transition to renewable and sustainable energy sources is not only essential for combating climate change but also for achieving these interconnected goals. However, the high costs associated with renewable energy infrastructure, coupled with affordability challenges for low-income households, pose significant obstacles. In this landscape, social and economic disparities—particularly poverty and gender inequality—play a critical role in shaping the success of energy transitions.

Poverty limits access to clean energy solutions, forcing households in economically disadvantaged regions to rely on traditional, polluting energy sources such as wood or coal. This reliance not only perpetuates environmental degradation but also reinforces cycles of poverty due to health risks and inefficient energy use.

Gender inequality further complicates the equation. In many societies, women are the primary energy managers in households, often bearing the responsibility for cooking, heating, and other domestic energy needs. Yet, gender disparities in decision-making and financial autonomy can hinder the adoption of sustainable energy technologies. Empowering women through education, resources, and inclusion in

energy policy decisions can catalyze broader adoption of clean energy and amplify its benefits for entire communities.

This intersection of poverty, gender equality, and energy transition underscores the need for integrated approaches to sustainable development. Addressing these challenges holistically can create pathways to more resilient and equitable societies while mitigating the impacts of climate change.

The dominant energy sources for cooking and heating based on household income levels, highlighting a direct correlation between income and access to cleaner, more efficient fuels. This framework provides insight into energy consumption patterns and their associated social, environmental, and health impacts.

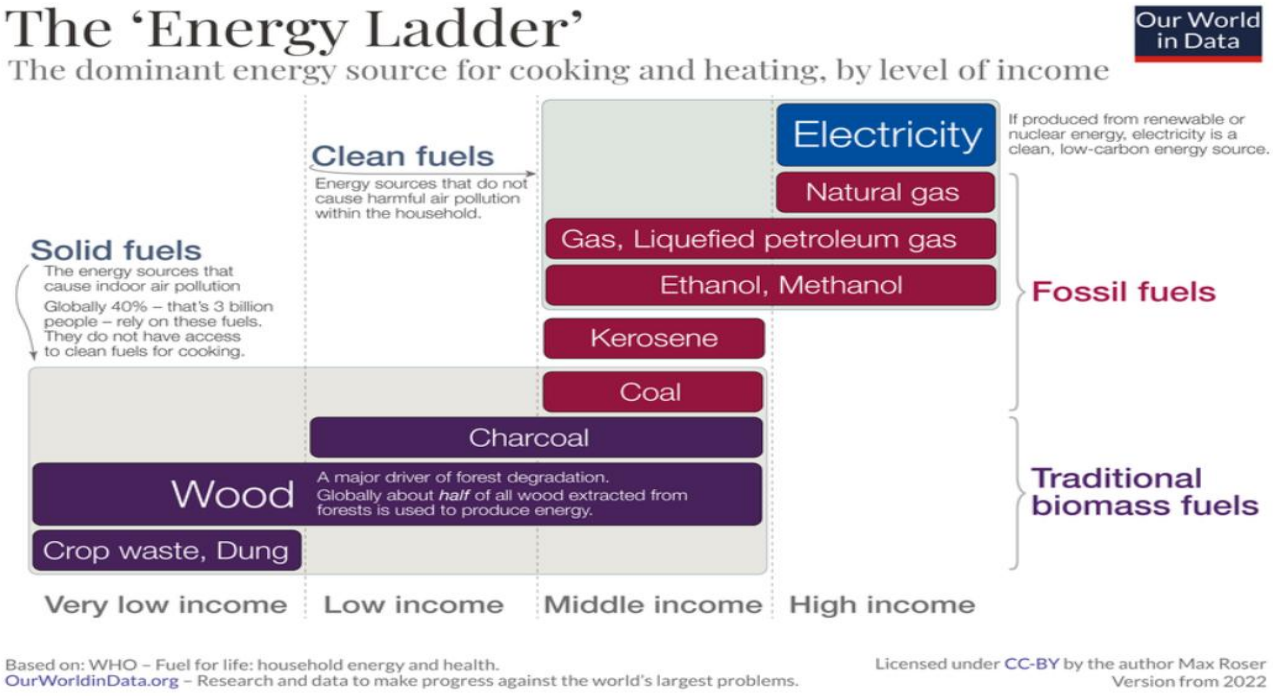


Figure 1. The "Energy Ladder" framework

The "Energy Ladder" framework vividly illustrates the challenges of transitioning to clean energy, particularly for low-income households. Addressing the barriers at each stage—whether affordability, infrastructure, or awareness—is essential for achieving equitable and sustainable energy access. By enabling upward mobility on the energy ladder, policymakers can simultaneously improve health outcomes, reduce environmental impacts, and promote economic development.

1. Income Levels and Energy Sources

- Very low income: Households in this bracket primarily rely on traditional biomass fuels such as wood, crop waste, and dung. These fuels are associated with significant health risks due to indoor air pollution and environmental degradation, as half of all wood extracted globally is used for energy production. Dependency on these fuels perpetuates a cycle of poverty, as they are inefficient and time-intensive to collect.
- Low income: As income increases slightly, households may shift to charcoal and coal, which are marginally more efficient but still contribute to indoor pollution and deforestation. This

progression marks a step up the energy ladder but remains unsustainable and harmful to health and the environment.

- Middle income: Households in this category begin transitioning to fossil fuels like kerosene, liquefied petroleum gas (LPG), and ethanol/methanol. While these fuels are cleaner than biomass, they still produce carbon emissions and depend on fossil-based resources.
- High income: At the top of the energy ladder, high-income households predominantly use clean fuels such as natural gas and electricity, which, when generated from renewable or nuclear sources, provide low-carbon and pollution-free energy. Access to these fuels minimizes health risks and environmental impacts.

2. Health and environmental impacts

- Indoor air pollution: Traditional biomass fuels and solid fuels like coal and kerosene contribute significantly to indoor air pollution, which affects nearly 3 billion people globally. This is a leading cause of respiratory illnesses, particularly for women and children who spend more time in the home.
- Deforestation and biodiversity loss: The reliance on wood and crop waste in low-income households drives deforestation, reducing biodiversity and contributing to environmental degradation.
- Carbon emissions: The transition to fossil fuels reduces indoor pollution but increases greenhouse gas emissions, making this stage a critical point for interventions promoting sustainable alternatives.

3. Economic and Social Implications

- Energy affordability: The cost of clean fuels and the infrastructure required for their use (e.g., electricity grids) often places them out of reach for low-income households, perpetuating reliance on traditional energy sources.
- Energy inequity: The energy ladder underscores the stark inequities in global energy access. While high-income households benefit from clean, efficient energy, billions of low-income households remain trapped in unhealthy and unsustainable energy practices.
- Gender dimensions: Women, particularly in very low-income households, bear the brunt of energy poverty. They are often responsible for collecting fuel, exposing them to physical strain, lost economic opportunities, and higher health risks.

4. Solutions and policy implications

- Promoting clean energy access: Expanding infrastructure for electricity and subsidizing clean fuels like LPG can help households climb the energy ladder faster, reducing health and environmental harms.
- Renewable energy integration: Scaling up renewable energy sources such as solar and wind can lower the carbon footprint of electricity and make clean energy more accessible.
- Education and outreach: Awareness campaigns can educate low-income households on the benefits of clean energy solutions, fostering demand and acceptance for new technologies.
- Targeted funding: Governments and organizations should prioritize funding initiatives that address energy poverty, particularly in vulnerable regions where traditional biomass is still the dominant energy source.

Gender plays a pivotal role in shaping household energy consumption patterns, with women exerting significant influence over energy-related decisions. According to Senjawati et al. (2018), women are more involved in household energy management, influencing decisions such as the selection of

energy sources, energy-saving practices, and appliance usage. This greater involvement stems from women's traditional roles in managing domestic tasks, giving them a critical perspective on energy needs and usage efficiency.

Involving women in energy-related decision-making has tangible benefits for households. Shrestha et al. (2020) highlight that when women are actively engaged in energy planning, households can reduce their electricity bills by up to a quarter. This finding underscores the importance of integrating women's perspectives into energy policies and household management, as their emphasis on efficiency and sustainability can lead to cost savings and better resource utilization.

Beyond individual households, women's involvement in broader management roles contributes to environmental sustainability. Haque (2017) and Garcia-Martin & Herrero (2020) emphasize that women's participation in energy management significantly reduces carbon emissions. Their focus on adopting sustainable practices and cleaner energy sources aligns with global climate goals, demonstrating the broader societal impact of gender inclusivity in energy management. The research employs a robust methodological framework to analyze the relationship between poverty, gender equality, and energy use across selected countries. Two key approaches are utilized to ensure accuracy and reliability in the estimation of coefficients and the assessment of distributional effects.

The findings of this research highlight the interconnectedness of poverty, gender participation, and public investments in shaping energy use and environmental sustainability. These results shed light on critical pathways to address energy poverty, promote gender equality, and advance clean energy transitions.

The research reveals that poverty significantly decreases household energy consumption, but not in a beneficial way. Poverty restricts access to reliable energy sources, forcing households to rely on informal energy options such as wood, crop waste, and other biomass. This reliance leads to energy poverty, where families are unable to meet basic energy needs. The environmental consequences of such practices are stark, as these informal energy sources contribute to deforestation, indoor air pollution, and overall environmental degradation. These findings underscore the urgent need for targeted interventions to provide affordable and sustainable energy access for low-income populations.

Another key finding is the impact of women's participation in the labor market and decision-making processes, particularly in leadership roles such as national parliaments. Women's increased involvement is linked to higher education levels and a stronger sense of responsibility, which translate into environmentally friendly behaviors and greater energy efficiency. Women tend to advocate for policies and practices that prioritize sustainability, reflecting their critical role in advancing energy transitions. These insights emphasize the importance of empowering women as decision-makers in both household and institutional contexts to drive progress toward energy efficiency and sustainability.

Public investments in environmental protection emerge as a cornerstone for achieving energy equity and sustainability. By allocating resources to renewable energy sources, governments can expand access to clean energy while gradually phasing out fossil fuels. Such investments not only address climate change but also contribute to energy justice, ensuring that marginalized communities benefit from the transition. Increasing financial support for green energy initiatives and policies further accelerates the shift to sustainable energy systems, fostering economic growth and environmental protection.

Conclusions

Poverty emerges as a critical barrier to accessing sustainable energy solutions. Low-income households are disproportionately reliant on informal and polluting energy sources like biomass, wood, and crop waste, leading to energy poverty and environmental degradation. To break this cycle, policies

must focus on improving access to affordable and clean energy sources for vulnerable populations. Expanding subsidies for renewable energy and ensuring infrastructure development in underserved areas are essential steps toward alleviating energy poverty.

Gender diversity plays a transformative role in energy decision-making and sustainability. Women's participation in labor markets, policymaking, and household energy management contributes to more sustainable energy practices and greater energy efficiency. Empowering women through education, leadership opportunities, and inclusion in national and local energy policies is vital for fostering equitable energy transitions. Social programs that promote gender equity can amplify the benefits of clean energy access while addressing systemic inequalities.

Strategic public spending and well-designed policies are indispensable for achieving energy justice. Investments in renewable energy technologies, clean energy infrastructure, and energy efficiency programs can accelerate the transition away from fossil fuels. Public financing should prioritize green projects and innovations while addressing affordability and accessibility for marginalized communities. Additionally, regulatory frameworks must align with global sustainability goals, ensuring a fair and inclusive energy transition.

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