



Empowering Women in Green Energy Business: Bridging Economic, Social, and Environmental Gaps in Rural Communities

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Abstract: This research aims to investigate the role of women in initiating green energy businesses in *Cibodas* Village and the factors influencing their empowerment. Qualitative methods were used to gain an in-depth understanding of women's experiences, perceptions, and empowerment strategies in the context of green energy business. In-depth interviews, focus group discussions, and participant observation were conducted to collect data from village women involved in the initiative. The research results show that village women have an important role in identifying potential natural resources, planning, and managing green energy projects, and promoting environmental awareness at the local level. Supporting factors such as family support, access to training and resources, and supportive regulations play a crucial role in empowering women, while inhibiting factors such as limited access to capital and technology, gender stereotypes, and lack of market access are challenges that need to be overcome. This research provides valuable insights for the development of sustainable development policies and practices, and highlights the importance of strengthening the role of women in the transformation towards green energy and a sustainable economy

Keywords: women's empowerment, green energy business, gender roles, sustainable development

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INTRODUCTION

In recent decades, women's empowerment has become a crucial global issue. Women's involvement in various spheres of life, both in development processes and in decision-making, is seen as a strategic step to strengthen women's position and role in society. This participation not only recognizes women's existence and capacity but also plays a role in overcoming social perceptions that have traditionally placed women in a subordinate position, such as limited roles in the domestic sphere, vulnerability to violence, and experiences of structural injustice and oppression.

Women, recognized as agents of change, play a significant role in driving progress across various development sectors, including economic, social, and environmental. Increasing access



to education, strengthening critical awareness, and ensuring equal rights are essential foundations for building women's capacity to participate actively in sustainable development. Therefore, women's empowerment is not solely related to efforts to achieve social justice but also contributes to addressing various global development challenges, such as economic inequality and environmental degradation (Köprülü & Avcı, 2022).

Within the framework of sustainable development, the relationship between women's empowerment and the adoption of environmentally friendly business practices, or green business, is gaining increasing attention. Women who enjoy economic and social independence tend to be more open to adopting sustainability principles in their entrepreneurial activities and business management. This is supported by the view that women generally have greater sensitivity to environmental issues, community welfare, and long-term sustainability, and thus may become important actors in driving the transition to a green economy.

In line with this, Nguyen et al., (2023) found that businesses led by women are more likely to adopt green business practices, driven by both internal motivations, such as environmental concerns, and external factors, such as market demand and regulatory policies. Gender factors have been shown to play a role in encouraging small and medium-sized enterprises to adopt more sustainable practices. These findings confirm that women's empowerment not only impacts individual well-being but also makes a significant contribution to achieving the Sustainable Development Goals (SDGs), particularly in strengthening the green economy and environmental protection.

However, on-the-ground conditions indicate that women still face structural obstacles that hinder the optimal fulfillment of their roles. These barriers include limited access to resources, education, financing, economic opportunities, and involvement in decision-making processes. These challenges are critical issues that need to be addressed to optimally realize women's role as key actors in green business development and inclusive sustainable development.

In line with women's role as agents of change in sustainable development, their involvement in the green energy sector is a tangible contribution to environmental conservation efforts and to strengthening local economies. Green energy businesses are business activities focused on the production, distribution, and utilization of energy sourced from renewable natural resources, with minimal carbon emissions and other harmful pollutants (Anwar et al., 2023; Todos, 2023). This business model not only supports the transition to clean energy but also opens up opportunities for more inclusive participation for community groups, including women, in sustainable economic development.

In the local context, empowering women to initiate and manage green energy businesses in *Cibodas Village* is crucial to promoting sustainable development at the village level. Growing awareness of the importance of environmental protection and sustainable use of natural resources encourages the need for women to play an active role, not only as implementers but also as managers and decision-makers in green energy businesses (Muhaimin, 2022; Tenner & Hörisch, 2021). This involvement strengthens women's position in village development while contributing to energy and environmental security.

Several previous studies have emphasized the importance of women's participation in environmental management and sustainable development (Krause et al., 2019). In fact, Sundberg et al., (2020) demonstrated that women have strategic potential in climate change mitigation and adaptation efforts. However, studies specifically addressing women's empowerment strategies in green energy business development at the local level, particularly in rural contexts, are relatively limited.

These limitations indicate a research gap regarding how the role, strategies, and impact of women's empowerment can be optimized in green energy business development at the village level. Therefore, this research is important and relevant in filling this gap and providing an empirical contribution to strengthening women's roles as key actors in sustainable energy development in *Cibodas Village*.

This study aims to address the knowledge gap regarding women's roles in green energy business development at the local level, with a focus on the context of *Cibodas* Village. To achieve this objective, the study employed a mixed-methods approach, combining qualitative and quantitative methods to gain a comprehensive understanding of the processes and dynamics of women's empowerment. The scope of the study includes an analysis of empowerment strategies implemented to increase women's participation in renewable energy initiatives, as well as an assessment of the social, economic, and environmental impacts resulting from such involvement. The results of this study are expected to make theoretical contributions to the study of women's empowerment in the context of green energy businesses, while also offering practical recommendations for policymakers, development practitioners, and community leaders for designing and implementing sustainable women's empowerment models at the village level.

METHOD

This research was conducted over three months, from June to August 2024, and focused on women's empowerment in *Cibodas* Village. The study began by examining the initial conditions of women, particularly their economic activities, levels of participation, and involvement in environmental management prior to the introduction of biogas waste management initiatives. The research then explored the strategies and forms of intervention implemented by empowering agents to encourage women, especially mothers, to participate in the biogas waste management program. A qualitative approach was employed to gain an in-depth understanding of women's experiences, perceptions, and empowerment strategies within the context of green energy businesses. This approach involves several stages systematically designed to collect high-quality, relevant data. First, this study involved 8 respondents who were selected for their ability and capacity to provide data considered representative of the research's data needs. In-depth interviews using a structured interview guide with key stakeholders, such as village women directly involved in green energy business initiatives, community leaders, local entrepreneurs, and figures who have knowledge and experience of the social and economic dynamics of *Cibodas* Village. These in-depth interviews will enable researchers to gain a deep understanding of their motivations, challenges, and expectations regarding green energy businesses. Furthermore, this study will facilitate focus group discussions with village women as part of a participatory approach. These group discussions will allow participants to share their ideas, experiences, and expectations regarding empowerment and the development of green energy businesses. It also allows researchers to understand the collective perspectives of village women on the initiative. Participatory observation will also be conducted to understand the dynamics of the community and social environment in *Cibodas* Village. This observation will allow researchers to directly observe the interactions between village women and environmental factors that influence their participation in green energy businesses. Data collected from in-depth interviews, focus group discussions, and participant observations will be analyzed thematically and then validated to ensure data quality and maintain the security of the data obtained. This thematic analysis involves coding data, identifying key patterns and themes, and interpreting the resulting findings. With this approach, it is hoped that this study can produce a rich and comprehensive understanding of the role of women in initiating green energy businesses in *Cibodas* Village. Overall, this qualitative approach is expected to provide an in-depth understanding of the dynamics, strategies, and impacts of women's empowerment in the context of green energy businesses at the village level. The results of this study are expected to provide valuable contributions to the theoretical and practical understanding of women's empowerment in addressing environmental challenges and creating a sustainable economy in rural areas.

RESULT AND DISCUSSION

The role of women in sustainable development is increasingly recognized as crucial to achieving global development goals. Women possess strategic potential as agents of change in

society, particularly through their involvement in economic, social, and environmental development. Therefore, women's empowerment is an integral aspect of efforts to achieve sustainable development. One concrete example of women's empowerment in the context of sustainable development is their involvement in the green energy sector. In *Cibodas* Village, green energy business practices have been developed through the utilization of biogas byproducts, which are marketed as an alternative energy source. This business is not only environmentally oriented but also opens up opportunities for women's participation in productive economic activities based on renewable energy. Geographically, *Cibodas* Village covers an area of 1,273.44 hectares and has a population of 12,120. The village is situated in a hilly area at an altitude of approximately 1,260 meters above sea level, with temperatures ranging between 18 28°C. These natural conditions mean that the majority of the village's land is used for agriculture and plantations, accounting for 34.06% and 27.56%, respectively. *Cibodas* Village's natural resource potential significantly supports the development of the agricultural and livestock sectors. Village data from 2023 show that 1,772 residents work as individual livestock farmers and 566 as independent livestock entrepreneurs. This provides crucial capital for developing biogas-based green energy businesses while also strengthening women's role in sustainable local resource management. Based on the number of farmers, it can be a potential as well as a new problem that arises, for example, the large amount of cow dung produced by *Cibodas* village every day, which will certainly have an impact on environmental pollution, both air pollution, because it will cause an unpleasant odor, since most of the livestock pens are not far from the owner's house. In addition, because of the natural conditions with a mountainous landscape, people can easily dispose of cow dung by making a flow from the cage directly into the river below. This condition will certainly have a negative impact on the river ecosystem and pollute it. Therefore, since 2016, biogas has been first released in *Cibodas* village as an effort to overcome the problem of cow dung. It is hoped that biogas will be the answer to the problems caused by cow dung. The following is the distribution of the increase in biogas use in *Cibodas* Village, based on the 2024 *Cibodas* Village data.

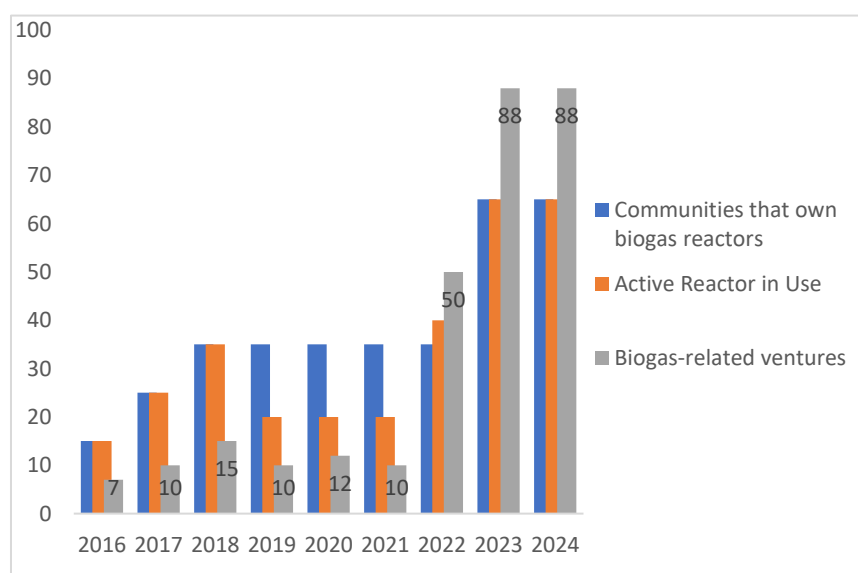


Table 1. Distribution of Biogas users in *Cibodas* Village
 Source: *Cibodas* Village Data 2024

Based on Table 1. It can be seen that the number of people using Biogas has increased, especially among livestock farmers. However, between 2016 and 2021, the increase was insignificant, whereas between 2022 and 2024 it was significant, with 40 new users installing biogas reactors. There was a repair of the reactor owned by the previous user and the installation of a new biogas reactor. The installation of new biogas reactors is inseparable from the development of business

opportunities derived from the utilization of biogas waste. Derivative products such as bio-slurry fertilizer, vermicompost (a product of worm processing), and vermiculture have opened new economic opportunities that the community can manage productively. In the context of women's empowerment, these business opportunities provide alternative economic activities that are relatively easy for women to access and implement, particularly at the household level. Women's involvement in the management and utilization of these biogas derivative products not only increases family income but also strengthens women's role in managing local resources oriented towards environmental sustainability.

The Central Role of Women in Green Energy Management Initiators and Drivers of Green Energy Initiatives

Women often act as key drivers of household income through their involvement in sustainable energy-related activities, demonstrating the role of women's empowerment in advancing community-based sustainable development. In *Cibodas* Village, the role of women as drivers of green energy business initiatives has had a significant impact on the economy of families and communities. One rapidly growing form of green energy business is the management of biogas output. This potential was initially used only to a limited extent by communities with biogas reactors. However, along with a deep understanding of managing family income and expenses, women in this village saw great potential in managing biogas waste, which could be reprocessed to produce high-value products. Initially, the use of biogas was limited to those with biogas reactor facilities. However, this waste management service is currently accessible to the general public. Biogas output waste can be used as a medium for breeding worms, which are then sold as high-value commercial products. In addition, the worms produce vermicompost (fertilizer from worm castings), which is also in demand on the market as a high-quality organic fertilizer. These products have significantly increased family incomes in *Cibodas* Village, created new economic opportunities, and reduced dependence on conventional resources. Figure 1 illustrates the worm breeding activities managed by women in *Cibodas* Village.



Figure 1: Biogas waste as a place to breed worms
Source: Researcher Documentation

One of the women who played a major role in the success of this green energy business is Mrs. Yeti (name changed). Mrs. Yeti is an exemplary figure of initiative and innovation in the village's green energy business. Armed with the basic training she received, Mrs. Yeti, with CSR, continues to innovate in managing biogas waste to make it more efficient and beneficial. With her perseverance and creativity, she developed a worm-breeding method that not only generates additional income but also optimally utilizes local resources. This effort attracted the attention

of the mothers in the village, who then competed to participate in the biogas derivative product management business. Mrs. Yeti's success in the green energy business is evident not only economically but also in her ability to inspire other women in the village to get involved. With her friendliness and spirit of sharing, Mrs. Yeti does not hesitate to share her knowledge and experience with anyone interested. On various occasions, she holds small training and experience-sharing sessions on managing a biogas outsourcing business, from breeding worms to making vermicompost. This not only helps other women run similar businesses but also strengthens social relationships and mutual support among community members. In addition, the involvement of Mrs. Yeti and other women in *Cibodas* Village in the green energy initiative underscores the importance of women's empowerment in an environmentally based economy. Their role is not limited to being workers but also to being innovators who can identify opportunities in waste and available local resources. Through this biogas output business, they help create a circular economic system in the village, where each product has added value that can be used to improve the welfare of families and communities. With the development of this green energy business, women in *Cibodas* Village have not only succeeded in increasing household income but also in building environmental awareness in the community. Environmentally friendly biogas waste management positively impacts the surrounding environment by reducing pollution and utilizing waste productively. The role of women in this initiative has paved the way for a more sustainable economic transformation of the village, as well as proving that women have great potential as initiators and main drivers of broad-impact green energy initiatives. Below are some products made from cow dung and their market prices.

No	Types of biogas output	Unit	Price
1.	Worm	1 kg	28.000
2.	Vermicompost Fertilizer	1 Bag	25.000
3.	Bioslurry fertilizer	1 Bag	3 .000
4.	Dried Worms	1 kg	200.000

Table 2 Lurana Biogas Product Prices
Source: Based on researcher interview results

The selling price in the field is a magnet for the *Cibodas* village community to participate in installing biogas reactors, because the community has envisioned the income they will earn by utilizing biogas output for vermicompost cultivation. Based on the results of field interviews with several mothers who are pioneers in utilizing biogas output for vermicompost cultivation, namely Mrs. Yeti and Mrs. Oni, they said that the reason they were interested in cultivating worms with gas output media earlier was because of the need for additional income to help household income, easy work methods. It does not take long for the community to feel the benefits, as the harvest season lasts only 1 month. Based on the interview, a picture of their monthly income was obtained.

Seeing the success of previous mothers in processing biogas waste into raw materials for worm cultivation is one reason other women follow in their footsteps. In addition to seeing the direct impact on the actors, the role of women who motivate and teach each other is also significant. The willingness to learn and sincere sharing among *Cibodas* women are key to the success of the green energy business in *Cibodas* village.

Community environmental educators and extension workers

Women's role as educators and environmental educators positions them as strategic agents of change in the community empowerment process. Through this educational function, women not only transfer technical knowledge regarding biogas use and management but also facilitate a contextual, experiential environmental education process. This process helps communities

understand the link between waste management, renewable energy utilization, and environmental sustainability, including through the practice of worm breeding and the production of vermicompost as a biogas byproduct. Mrs. Yeti, for example, has been a clear example in carrying out this role. As a pioneer in biogas outsourcing management, Mrs. Yeti frequently holds informal training for village women to provide basic knowledge about the benefits of biogas and its waste management. It is not uncommon for many women to visit Mrs. Yeti's land, whether for casual discussions or to learn about the biogas outsourcing business, demonstrating that the educational process is not top-down but rather participatory, a key characteristic of community empowerment. This communicative, easy-to-understand approach helps increase community participation and strengthen acceptance of renewable energy practices at the community level. Beyond technical education, women as environmental educators also play a role in building collective awareness of environmental issues. Community social spaces, such as community meetings and religious activities (e.g., weekly Wirid Yasin recitations), serve as a medium for environmental learning and information exchange on developments and challenges in managing biogas byproducts. This strategy reflects the implementation of community-based environmental education, where the learning process occurs continuously in everyday social life. The success of women's roles as environmental educators is inseparable from the strong social capital within the community, particularly the mutual trust between members. This trust facilitates information dissemination and encourages gradual changes in community attitudes toward more environmentally conscious behavior. Thus, field practices carried out by women serve not only as educational activities but also as a community empowerment mechanism that strengthens local capacity to support sustainable energy development.

Liaison and Collaborator with Government and Private Institutions

As liaisons and collaborators with the government and private institutions, women in *Cibodas Village* play an important role in bridging green energy programs and environmental initiatives held by external parties. The successful management of biogas output by the women in this village makes them key agents trusted by the government and private organizations to introduce and implement new programs. For example, Mrs. Yeti and Mrs. Oni, who have successfully developed biogas-derived products such as vermicompost and worm breeding, are often chosen as community liaisons for Corporate Social Responsibility (CSR) programs from companies or government environmental programs. Their ability to understand community needs while facilitating communication between external parties and the local community makes the program easier for villagers to adopt and accept. In addition to serving as liaisons, these women's roles also involve intensive coordination to ensure that the proposed program aligns with the community's needs and characteristics. Women like Mrs. Yeti and Mrs. Oni not only introduce the program but also explain its long-term benefits to residents. With a good understanding of the local context, they can explain the program's technicalities in language that is easily understood by the community. This creates effective communication between the government or private institutions with the community, so that the programs introduced can be implemented well and sustainably. The presence of these women as liaisons and collaborators also enhances the effectiveness of implementing CSR programs or government initiatives at the local level.

In the context of CSR, the involvement of women with experience in the green energy business adds value to the program's success, as they can conduct initial assessments of potential successes and challenges that may be encountered in the field. In addition, their involvement as local coordinators ensures that the programs receive community support, as they are considered to have support from women they trust. As a result, CSR or government environmental programs facilitated by village women tend to be accepted and implemented more quickly, with high community participation. This can be seen from the existence of several CRS programs in

Cibodas Village that aim to increase the success of the green energy business, such as land development from Bank Madani CSR and the establishment of a hut for women's meetings equipped with a worm dryer. Furthermore, the role of women as liaisons is not only beneficial to the government or private institutions but also to the community itself. With direct access to resources, training, and technical support provided by external parties, the *Cibodas* Village community can continue to develop green energy initiatives independently. This encourages the sustainability of renewable energy projects in the village and improves the technical and managerial skills of women in the community. In this way, these women are not merely connectors but agents of empowerment who bring progress and socio-economic transformation to their communities. To make it easier to understand the Central Role of Women in Green Energy Management, the following framework is used.

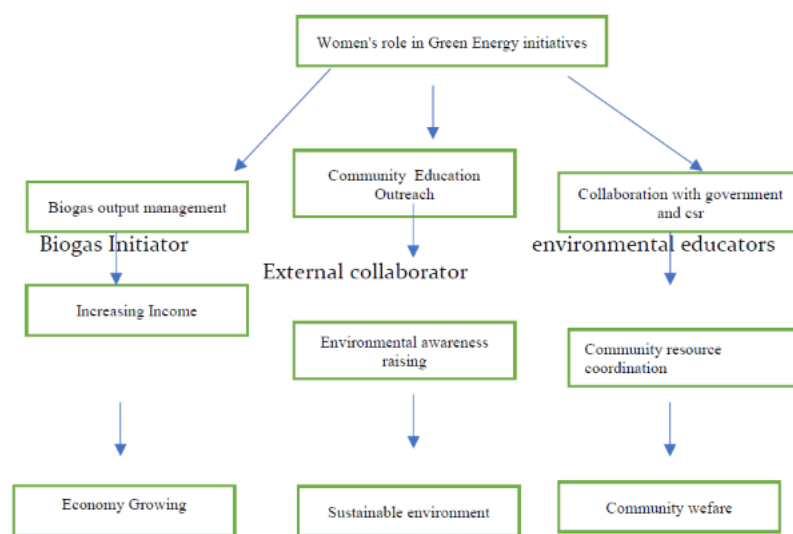


Figure 2: Image of the framework model for the Central Role of Women in Green Energy Management

Discussion

The Role of Women in Initiating Green Energy Business

The role of women cannot be underestimated in the context of improving and developing a region or area. In addition to women being seen as figures who manage family finances, educate children, and raise children, many women support household welfare (Komalasari & Agustin, 2022; Richmayati et al., 2023). Women also play a dual role, namely as homemakers and income earners, and, not infrequently, many women play a significant role in decision-making (Widiah Qusminingrum et al., 2021). As figures who are accustomed to dual roles and being managerial in the household, women become targets and even perpetrators in providing impacts or influences to other women due to gender reasons, the same fate and burdens, which, even if examined, are only subjective reasons. Micunovic, (2006) also stated the same thing that women are often targeted because of their dual roles and managerial responsibilities, and reasons of gender equality. Therefore, many community empowerment programs, both those managed by the government in a top-down approach and those initiated by women themselves based on their needs (bottom-up), are often managed or chaired by women. This approach recognizes the important role of women in leading and managing sustainable, impactful empowerment initiatives. In the top-down context, the government recognizes the importance of women's involvement in driving community development, so that they are given a significant role in decision-making and implementation of these programs (Atieno et al., 2023; Olaniran & Perumal, 2021).

On the other hand, the bottom-up approach allows women to identify and address the problems they face directly and mobilize community resources and support to achieve their empowerment goals (Joshi & Rao, 2018; Witenstein & Iyengar, 2021). Thus, through both top-

down and bottom-up approaches, the active involvement of women in the management and leadership of community empowerment programs is an important step towards inclusive and sustainable development. Women have an impact not only on social and economic aspects but also on environmental sustainability and the overall well-being of the community. (Girdhar & Girdhar, 2022; Uzoaru, 2023). In many cases, women are powerful agents of change in fighting for equitable access to education, economic empowerment, and health across communities. In addition, women often play an important role in preserving local culture and implementing sustainable practices in natural resource management. Therefore, actively involving women in the regional development process will have a positive impact on all parties involved.

This study revealed that women play an important role in initiating green energy businesses in *Cibodas* Village. Through in-depth interviews and group discussions, it was found that village women are actively involved in various aspects of the green energy business, from identifying potential natural resources for utilization to planning and implementing projects and marketing green energy products. Women are also agents of change, encouraging community participation in the use of renewable energy and promoting environmental awareness at the local level (Jones et al., 2020). Every role these women carry out is inseparable from that of field assistants for the Perum Jasa Tirta II-fostered group. As the initiator of the formation of the independent Women Farmers group in *Cibodas* Village, which focuses on worm cultivation, making vermicompost (worm castings), and using live and dried worms as outputs from the Community's biogas use. As the initiator and at the same time field assistant for the program, they first identify needs before formulating the program by involving several mothers who are considered to have important roles in the Areng village. The forms of role interests usually seen from various aspects, such as closeness factors or extensive friendships in the Community, are considered important factors in determining respondents' role interests in identifying Community needs. Moschini, (2022) revealed the same thing, revealing that broad friendships provide support and trust, influencing a person's Decisions and Actions towards a novelty. Therefore, involving women from Kampung Areng village with broad friendships is considered to have a significant influence on others (Werker et al., 2016). The next factor is that they have a role in the village government, such as mothers of RT and RW, who have a role in social activities in the community, such as the head of the women's religious study group, and the last is the factor of ability to capture learning and the ability to invite others to join the program (Morelli et al., 2019).

After identifying the respondents to be invited to identify community needs, the next step is to determine the priority programs to be implemented based on the analysis of the needs of the Areng Village Community, namely, worm cultivation using external media from biogas. This program was selected because it is considered very easy to apply (minimal capital), it uses natural resources around the Community, namely their own cow dung, the cultivation stages are not too complicated for the Community to understand, do not take much time in maintenance, and of course, the harvest will always sell well on the market. (Sylviani et al., 2020) expressed the same thing: a program with minimal capital, natural resources available in the Community, and carried out with simple cultivation stages that take little time, and, of course, the results that sell well on the market will definitely be easily accepted in the Community. The planning and implementation stages of the project (program), of course, also involve mothers as objects and subjects of empowerment; this is done to foster a sense of ownership and full participation of each member towards the sustainability and success of the program to be implemented (R. Chesikaw, 2016; Santi Legianti Sutandi, 2023). In the planning stage, each member is given space to provide opinions regarding when, where and what kind of learning model they want. Likewise, in the implementation stage, initial training is carried out by field facilitators, while subsequent training is carried out by fellow members. Because it is considered more open and easier to understand the training material. (Abbas et al., 2018) revealed that the training model led by colleagues or co-workers is more open, easily accessible, satisfying and

effective. Furthermore, if obstacles are encountered in the field and a more in-depth explanation of implementation issues is needed, members may contact the facilitator.

The last stage is the marketing stage of products produced by the community, especially women in the Areng village. The role of women here is to maintain product quality in accordance with the standards taught in previous training. In addition, they take the initiative to disseminate information about worm cultivation products on their social media, including Facebook and WhatsApp groups. According to these mothers, this will expand the market reach of the worm-cultivation products they produce, thereby increasing market prices (Yuniarti et al., 2020).

Supporting and Inhibiting Factors for Women's Empowerment

Although village women in *Cibodas* Village have succeeded in initiating green energy businesses, there are supporting and inhibiting factors that influence their empowerment process. Supporting factors include government training and CSR, as well as support from fellow members. In the context of the green energy business in *Cibodas* Village, several factors, both supporting and inhibiting, influence women's empowerment. The main supporting factor is awareness of the importance of environmental protection and sustainability, which encourages people to switch to green energy. (Kavals et al., 2023). Women can play an important role in this green energy business by participating at various stages of renewable energy production, distribution, and marketing, such as producing biogas from organic waste or installing solar panels. Support from local governments and non-governmental organizations in providing skills training and access to business capital is also a significant supporting factor for women's empowerment in the green energy sector. However, several factors can prevent women from playing an active role in the green energy business in *Cibodas* Village, such as gender stereotypes and limited market access. One of them is the limited access of women due to being busy taking care of the household and having small children. (Berniell et al., 2023) revealed that women's limitations in the world labor market are due to household responsibilities, having small children and unequal division of household labor (Quadlin, 2022). Not having private land for cultivation and not having their own cattle means some housewives interested in the green business of worm cultivation have to buy neighbors' cow dung as a medium for worm cultivation. In addition, the patriarchal culture that is still strong in some rural communities can be an obstacle for women to take on leadership roles or make decisions in the green energy business, such as the absence of a husband's permission on the grounds of having to take care of children at home. By addressing these inhibiting factors through training programs, capacity building, policy support, and access to resources, women in *Cibodas* Village can be more successful in their roles in the green energy business. This not only increases women's economic independence but also significantly contributes to the sustainable energy transition through the use of renewable energy while promoting gender equality by strengthening women's roles as key actors in low-carbon energy development at the local level.

Economic, social and environmental impacts

The implementation of women-led green energy businesses in *Cibodas* Village has had a significant social and economic impact. In *Cibodas* Village, a woman's innovative spirit has given rise to an extraordinary transformation: a green energy business. With their determination, they have not only changed the local energy landscape but also strengthened the position of women in society, socially, economically, and environmentally. The involvement of women in running a green energy business not only creates new sources of income but also serves as an important catalyst for cultural change that encourages women's empowerment. (Arias et al., 2023) revealed that women's involvement in green energy encourages empowerment and income strengthening, and cultural change in society is driven by women's participation in green businesses (Fajardo, 2020; Nguyen et al., 2023). Cultural changes among women in *Cibodas*

Village can be seen in their participation in meetings related to worm cultivation, as they believe it will impact their future income. This shows a new culture, namely the culture of wanting to continue learning to increase knowledge and skills, or more familiarly known as a culture of continuous learning (Nuraeni & Rustaman, 2019; Rahmah & Alawiya, 2022). The willingness to learn together and the sincerity in sharing are also among the strengths of women in *Cibodas* Village. No one feels smarter or stupider, but they are committed to learning and succeeding together. In the social realm, women's participation in the green energy sector has contributed significantly to a paradigm shift in their role and status in society. They are no longer seen as individuals limited to the domestic sphere, but as agents of change with great potential to inspire the younger generation (Dutt, 2004). Their presence as key actors in this business provides a strong example for young women to pursue their dreams and take an active role in sustainable development. The involvement of women in *Cibodas* in the green economy also makes them more confident individuals and feel that they have potential and abilities, especially in the field of biogas waste cultivation and processing, such as some mothers are no longer ashamed to meet other people, because with the biogas waste processing and worm cultivation program, many visitors come to visit, both from students who come to observe, learn and conduct research, village government groups from various villages in Indonesia who conduct comparative studies and not infrequently mothers in *Cibodas* become speakers. On the economic side, the green energy business has opened up new opportunities for local economic growth, around Rp. 1,340,000 additional income for women with worm cultivation. This has a very positive impact on the family's finances without leaving children and husbands at home. By creating new jobs, this business not only increases overall family income but also reduces gender inequality in access to economic opportunities. In addition, reducing dependence on fossil fuels paves the way for greater economic resilience, protecting communities from price fluctuations and energy supply disruptions. This can be seen from the award that *Cibodas* Village received in 2016 as an independent village, due to its ability to meet energy needs, namely biogas from cow dung (Harahap, 2018).

However, the impact of the green energy business in *Cibodas* Village extends beyond social and economic aspects. Environmentally, the transition to green energy has brought invaluable benefits. The use of renewable energy sources not only reduces carbon footprint and air pollution but also protects local biodiversity. Thus, this business is not only an example of success in integrating sustainable development principles into business practices, but also an important milestone in preserving the environment for future generations.

CONCLUSION

This study clearly confirms the important role played by women in initiating and managing green energy businesses in *Cibodas* Village. Despite facing challenges such as limited access to resources and knowledge, women's empowerment in the green energy sector has had a significant impact across many aspects of life. Socially, women's involvement has strengthened their status and role in society, inspired the younger generation to follow in their footsteps, and created a solid support network among women.

Economically, women-led green energy businesses have created employment opportunities, increased household income, and reduced reliance on fossil fuels, contributing to more inclusive local economic development.

Environmentally, the transition to clean energy led by women has brought invaluable benefits, protecting local ecosystems and reducing environmental harm. To maximize women's potential in driving the transition to clean energy, the right support from various parties is essential. The government, non-governmental organizations, and the private sector need to work together synergistically to provide integrated support, including access to education, training, business capital, and market networks. With strong, continuous collaboration among stakeholders, women's potential in the green energy sector can be optimized, resulting in a

greater impact on the transition to clean, sustainable energy. In conclusion, this study shows that empowering women in the green energy business in *Cibodas Village* is not only about creating economic opportunities, but also about creating positive social and environmental change. By harnessing women's full potential and providing the right support, we can accelerate the journey towards a sustainable and inclusive future for all.

Community empowerment activities, especially strengthening women as subjects of empowerment in the realization of green energy businesses, are not easy to carry out. However, they are also not impossible to achieve by fully involving women at every stage of the existing program. In addition to the full involvement of women and support from various parties and circles, a sustainable program system is also expected to empower women as a whole, not just seasonally. The key contribution of this study is to demonstrate that women's empowerment in green energy businesses is not only an economic strategy but also a driver of social transformation and environmental sustainability. Sustainable and collaborative support from governments, civil society, and the private sector is essential to strengthen program effectiveness and ensure long-term empowerment outcomes.

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