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Application of the Oeko-Institut/WWF-US/ EDF methodology for assessing the quality of carbon credits

This document presents results from the application of version 3.0 of a methodology, developed by Oeko-Institut, World Wildlife Fund (WWF-US) and Environmental Defense Fund (EDF), for assessing the quality of carbon credits. The methodology is applied by Oeko-Institut with support by Carbon Limits, Greenhouse Gas Management Institute (GHGMI), INFRAS, Stockholm Environment Institute, and individual carbon market experts. This document evaluates one specific criterion or sub-criterion with respect to a specific carbon crediting program, project type, quantification methodology and/or host country, as specified in the below table. Please note that the CCQI website Site terms and Privacy Policy apply with respect to any use of the information provided in this document. Further information on the project and the methodology can be found here: www.carboncreditquality.org

Sub-criterion:	1.1.4 Barriers
Project type:	Household biodigesters
Date of final assessment:	31 January 2023
Score:	4

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Assessment

Relevant scoring methodology provisions

Some mitigation activities are financially viable but still face other obstacles such as information deficits or capacity constraints that hinder their implementation. In some instances, the institutional set-up of carbon crediting projects and the issuance of carbon credits can help to overcome these barriers. The methodology therefore employs an expert judgment on the likelihood that barriers prevent the implementation of a project type and that these barriers indeed can be overcome through the incentives of carbon credits. In arriving at this judgment, the aspects in the following should be evaluated:

Question
Does the project type face considerable non-financial barriers that can be identified in an objective and verifiable manner?
Is it possible to produce objective and verifiable evidence that the identified barriers are unique to the project type and do not apply to alternatives?
Is the market uptake of the technology underpinning the project type low although it is financially viable/competitive?
Can the barriers for this project type not be mitigated by additional financial means (and hence be assessed through the investment analysis)?
Is it possible to produce objective and verifiable evidence that carbon credits are indeed decisive for overcoming the barrier and does the incentive of carbon credits matches the strength of the barrier? (Note that this criterion can be assessed by analyzing the ΔIRR in the analysis of financial viability. The higher the Delta IRR is in relation, the more likely it may be that the revenues from the carbon credits are help overcoming the barriers.)

The scores are applied as follows:

	Score
It is very likely that barriers prevent the implementation of this project type and that the incentives through carbon credits will overcome these barriers.	5
It is very likely that barriers prevent the implementation of this project type and it is likely that the incentives through carbon credits will overcome these barriers. OR It is likely that barriers prevent the implementation of this project type and it is very likely that the incentives through carbon credits will overcome these barriers.	4
It is likely that barriers prevent the implementation of this project type and that the incentives through carbon credits overcome these barriers.	3
It is likely that barriers prevent the implementation of this project type, but it is uncertain that the incentives through carbon credits will overcome these barriers.	2
It is likely that barriers do not prevent the implementation of this project type and that the incentives through carbon credits do not help the project to overcome these.	1

Note that the application of this sub-criterion is optional. This sub-criterion should be used in combination with the sub-criterion on *financial attractiveness*. It may function as an additional criterion for activities where the assessment of the financial attractiveness has shown a high financial attractiveness even without carbon credits.

Information sources considered

1 IRENA - International Renewable Energy Agency (2017): Biogas for domestic cooking (Technology brief). Abu Dhabi, 2017. Online available at https://www.irena.org/publications/2017/Dec/Biogas-for-domestic-cooking-Technology-brief.

2 Mittal, S.; Ahlgren, E. O.; Shukla, P. R. (2018): Barriers to biogas dissemination in India: A review. In: *Energy Policy* 112, pp. 361–370. DOI: 10.1016/j.enpol.2017.10.027.

3 Ortiz, W.; Terrapon-Pfaff, J.; Dienst, C. (2017): Understanding the diffusion of domestic biogas technologies. Systematic conceptualisation of existing evidence from developing and emerging countries. In: *Renewable and Sustainable Energy Reviews* 74, pp. 1287–1299. DOI: 10.1016/j.rser.2016.11.090.

4 Putti, V. R.; Tsan, M.; Mehta, S.; Kammila, S. (2015): The State of the Global Clean and Improved Cooking Sector (ESMAP Technical Paper, 007/15). Washington, D.C: World Bank. Online available at https://openknowledge.worldbank.org/handle/10986/21878.

5 Roopnarain, A.; Adeleke, R. (2017): Current status, hurdles and future prospects of biogas digestion technology in Africa. In: Renewable and Sustainable Energy Reviews 67, pp. 1162–1179. DOI: 10.1016/j.rser.2016.09.087.

6 Adane, M. M., Alene, G. D., Mereta, S. T. and Wanyonyi, K. L. (2020). Facilitators and barriers to improved cookstove adoption: a community-based cross-sectional study in Northwest Ethiopia. Environmental Health and Preventive Medicine, 25(1). 14. DOI: 10.1186/s12199-020-00851-y

7 Mamuye, F., Lemma, B. and Woldeamanuel, T. (2018). Emissions and fuel use performance of two improved stoves and determinants of their adoption in Dodola, southeastern Ethiopia. Sustainable Environment Research, 28(1). 32–38. DOI: 10.1016/j.serj.2017.09.003

8 Donofrio, S., Maguire, P., Zwick, S. and Merry, W. (2020). Voluntary Carbon and the Post-Pandemic Recovery. Ecosystem Marketplace.

9 Household biodigester market development in Zambia – Lessons learned from the energy for agriculture project. https://snv.org/assets/explore/download/Biodigester%20market%20development_lessons%20learnt%20Zambia.pdf

10 Hyman, J. and Bailis, R. (2018). Assessment of the Cambodian National Biodigester Program, Energy for Sustainable Development, Volume 46, Pages 11-22. https://www.sciencedirect.com/science/article/pii/S0973082618302588

Assessment outcome

The project type is assigned a score of 4.

Justification of assessment

This assessment is applied to the following project type:

“Generation of biogas by anaerobic digestion of livestock manure, and possibly other household waste such as kitchen waste, through household size biodigesters (e.g., with a capacity of 2 m3). The biogas is used by households for cooking. The project type may include a compost unit that utilizes the fermented sludge from the biodigester to produce organic fertilizer. The project type reduces emissions by (i) avoiding methane emissions from the uncontrolled decomposition of livestock manure and (ii) by reducing the use of firewood or fossil fuels for cooking activities. Projects are located in rural areas in developing countries.”

Existence of non-financial barriers

Typical barriers identified in the literature (sources 1-3) include the following:

- High up-front installation cost, often exceeding monthly household expenditures even after receiving a capital subsidy.
- No access to finance.
- Procedural delays in getting financial support.
- Lack of awareness and/or confidence in biogas technology due to lacking information.
- Socio-cultural barriers like objections and stigmas towards using animal and human waste as raw material. The presence and magnitude of this barrier depends on the local values and culture.
- Lack of access to skilled labor for construction and maintenance.
- Unstable supply of feedstocks
    - livestock waste might be hard to collect from widespread grazing lands where cows are free-grazing.
    - the large amount of water needed for proper functioning of biogas plants poses a barrier especially for dry and drought-prone areas.
- Unreliable supply during cold months. During winters in cold areas, the production of biogas decreases considerably due to low temperatures inhibiting methanogenesis, which forces biogas users to switch to other fuels to fulfill their cooking needs.
- Actual or perceived cost disadvantages when compared to freely available solid biomass: Biogas for cooking activities faces competition from freely available solid biomass like firewood and cow dung.

Application of the barriers to the project type and not to alternatives

The barriers relate to manure management through household-scale biodigesters and not to its alternative as outlined in the definition of the project type, open compost pits, which hardly require any prerequisites to be established and maintained. The last two barriers of the list above specifically

apply to the use of biogas stoves and not to the use of traditional cook stoves, such as a simple three stone stove. The latter is available for free – just as firewood and cow dung as its energy carriers – and is traditionally deployed in many areas. Thus, its use evidently does not face barriers.

Market uptake of the project type

The prevalence of household size biodigesters differs significantly between countries and regions. While China, Nepal and other countries in South Asia have seen an exceptional uptake of biogas technologies (Putti et al. 2015), the dissemination of biogas in India remains very low although the government has actively supported the development of the technology for several decades. Nevertheless, the biogas share of the Indian fuel mix is still insignificant (Mittal et al. 2018). Regarding China, around 90% of the total biogas production of 2010 occurred in small-scale units. There is significant potential to further expand the production however (IRENA 2017).

In many African countries biogas uptake gradually increased between 2010 and 2016, mostly coming from a low baseline level, however. Thus, the technology has not yet overcome its initial stage in Africa (Roopnarain and Adeleke 2017).

Considering the barriers identified above and the fact that there is no rapid market uptake on a global level, it is very likely that the use of household-scale biodigesters faces significant barriers.

Overcoming of barriers through carbon credits

The following table assess the likelihood of carbon finance to contribute to overcoming each of the barrier identified above on a barrier-by-barrier basis:

Table 1 Assessment of likelihood that incentives through carbon credits overcome barriers

Barrier	Assessment outcome	Justification
High up-front installation cost	High	Market uptake of household biodigesters is often supported through dedicated biodigester programs. They provide financial support and technical assistance for building the market. Subsidies for the purchase of devices have been a key factor for the success of most biodigester programs. Attempts to phase-out these subsidies have led to the demand to drop significantly and programs had to reinstate the subsidy. As the donor funding for subsidies eventually will need to be phased out, carbon credits can provide a means for a continuation of the subsidy in biodigester programs. The likelihood that incentives from carbon credits help to overcome this barrier is therefore deemed to be high.
No access to finance	Medium	Lack of availability of commercial finance for biodigesters has been an issue observed in many biodigester programs. Even with government subsidies for household biodigesters the interest by private financial institutions to enter the market has been low in some cases e.g.; in Zambia (Source 9). Other programs e.g., in Cambodia

Barrier	Assessment outcome	Justification
		successfully established cooperation with local banks and credit unions (Source 10). Carbon finance might help to overcome this barrier by e.g., establishing a funding mechanism that is providing guarantees for biodigester loans. Guarantees might however more effectively be provided by governments while carbon markets revenues would be more effectively used for subsidizing purchases of the equipment and ensuring stable core funding of the programs. As there are mixed experiences on the success of biodigester programs in mobilising funding, the likelihood that incentives from carbon credits help to overcome this barrier is deemed to be medium.
Procedural delays in getting financial support	Medium	This barrier relates mainly to the timely provision of subsidies for the biodigester installation. Delays in getting applications approved will impact the overall cost of the system. Carbon credits might have an impact on lifting this barrier if project owners would use carbon credit proceeds to provide the subsidy directly to households. This would however only hold if project owners will manage to establish subsidy schemes that are more efficient than those of the government. Without skilled national administrators, there might be a risk for the private subsidy program to face similar issues as the government scheme. The likelihood that incentives from carbon credits help to overcome this barrier is therefore deemed to be medium.
Lack of awareness and/or confidence in biogas technology due to lacking information	High	Limited awareness of households about the opportunities of biodigesters is one of the key barriers for market uptake across all countries and regions. Evaluations of biodigester projects emphasize the importance of awareness raising campaigns for the successful introduction of the technology. Particular effective measures e.g., observed in a national biodigester program in Zambia include excursion and learning visits of prospective biodigester customers to sites with biodigesters in operation (Source 9). Carbon credits can provide an effective means for overcoming this barrier – both by providing required funding to conduct respective programs and by providing an institutional setting conducive for knowledge diffusion and exchange. The likelihood that incentives from carbon credits help to overcome this barrier is therefore deemed to be high.
Access to skilled workers for construction and repair	High	There are two main models of biodigesters. The most dominant one is made from bricks and will be built on location while the other is a prefabricated device made from plastic. The installation of both requires skilled labour, the former in that of skilled masons. A key to the success of biodigester programs e.g., in Cambodia (Source 10) was the establishment of an in-country network of construction companies and skilled masons. A lesson from implementing biodigester programs is that the stability of the local network and the availability of after-sales services are critical components for market uptake. Where changes in the institutional set up of support programs

Barrier	Assessment outcome	Justification
		took place (e.g., a donor pulling out of the program) this had a direct impact on the sales of the digesters. Carbon credits can help to overcome this barrier by creating an institutional set-up that that provides additional incentives for maintaining these national networks. The results-based character of carbon finance provides an incentive for project owners to ensure functioning after-sales services as a means for maintaining the devices in good condition. The likelihood that incentives from carbon credits help to overcome this barrier is therefore deemed to be high.
Unstable supply of feedstocks	Medium	To produce sufficient gas for household level application, the biodigesters will need to be fed with sufficient levels of livestock manure. If households only have access to an unstable supply this might results in a perceived lack of reliability of the technology. The availability of manure or another feedstock can however be projected beforehand e.g.; by assessing the number of animals belonging to a household. While carbon credits will not be able to change the available supply, the institutional set-up they provide can help potential customers to calculate the amount of gas they will likely be able to produce based on the size of their livestock. Due to the indirect effect, it is deemed that the likelihood of the incentives from carbon credits to overcome this barrier is medium.
Unreliable supply during cold months	Medium	Carbon credits will likely not directly impact the availability of supply during the cold months. The institutional set-up supported by carbon credits and education and training measures can however help to inform potential customers about the volume of gas that is available during these months. This would allow making an informed decision whether this would indeed be an issue for the particular use-case and not just a perceived disadvantage of the technology. Due to the indirect effect, the likelihood that the incentives from carbon credits help to overcome this barrier is therefore deemed to be medium.
Actual or perceived cost disadvantages compared with freely available biomass	High	The fact that biomass such as firewood or cow dung are freely available might make households hesitant to invest in an alternative system such as a household biodigester that comes with a high upfront investment. Observations from biodigester programs however show that overtime consumers will attach high value to the fact that they spend less time for collecting biomass. The institutional set-up of carbon credits can help overcome this barrier by raising awareness on the cost and opportunities of biodigesters over a longer horizon. The likelihood that incentives from carbon credits help to overcome this barrier is therefore deemed to be high.

Conclusion

Overall, the available information suggests that important barriers exist for the implementation of biodigesters and that carbon credits can be a vehicle to overcome some of these barriers. In practice, it seems likely that the implementation of such systems is accelerated through the additional incentives that carbon credits provide. Considering the literature on market uptake of the technology It seems however unlikely that the targeted households would not at all use biodigesters. A more realistic scenario therefore is that the carbon credits help accelerate market uptake.