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Sustainability Assessment

of Improved Household Cookstove Dissemination

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1 Introduction

The Development Assistance Committee of the Organisation for Economic Co-operation and Development (OECD DAC) defines sustainability as:

1. " ... the continuation of benefits from a development intervention after major assistance has been completed
2. the probability of continued long term benefits, and
3. the resilience to risks of the net benefit flows over time."[1]

Considering this, a development project can be considered sustainable if its achievements continue into the long term. The project needs to generate measurable impact and outcomes after all external support has ended. As such, an ongoing project's sustainability can only be estimated by approximating the project's long-term impacts.

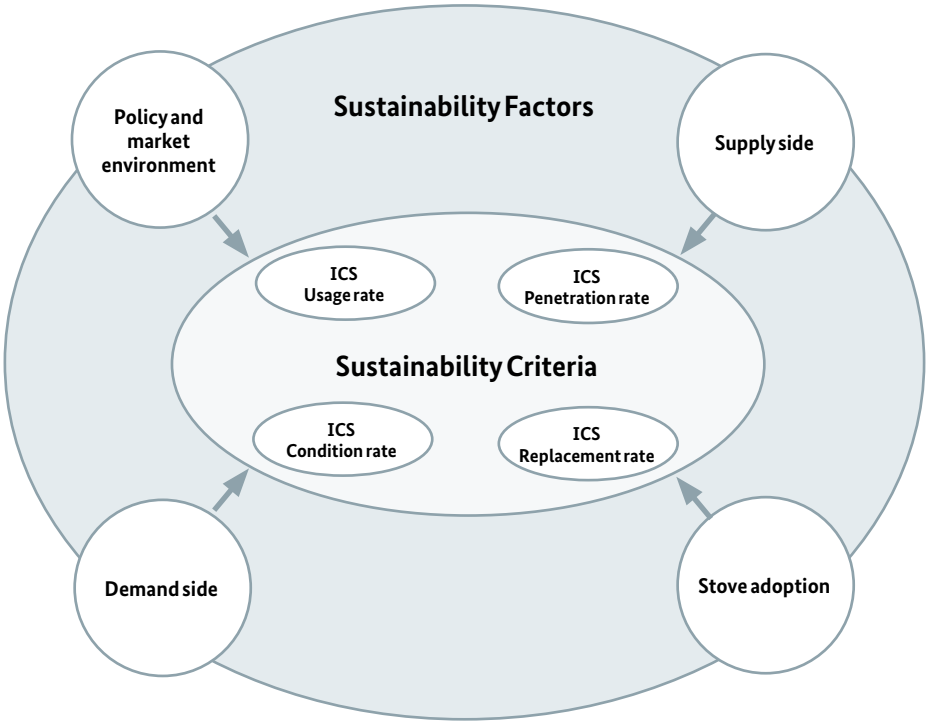
Since the late seventies, stove projects have been carried out all over the world, meaning that experiences in the dissemination and promotion of improved cooking stoves are numerous. Many of these projects and experiences have been evaluated by implementing agencies and donors; one comprehensive evaluation regarding successes and failures was carried out by the World Bank in 1994.[2]

Over the last 30 years, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) has gained a great deal of experience in supporting the dissemination of efficient biomass stoves. Based on its own lessons learnt and with reference to the World Bank review, GIZ's programme on "Poverty-oriented Basic Energy Services (HERA)" developed a detailed list of indicators for assessing sustainability in 2011.

GIZ HERA identifies two categories for sustainability:
1. Sustainability criteria that describe the current market situation and assess whether changes induced by the project are sustainable or not; and
2. Sustainability factors that influence the probability of achieving sustainable results.

1 "Glossary of Key terms in Evaluation and Results Based Management" OECD DAC Working Group on Aid Effectiveness. 2002.

2 "What makes people cook with improved biomass stoves? An international review of stove programs." Barnes, Openshaw, Smith, van der Plas. May 1994. World Bank Technical Paper Number 242



This framework for sustainability assessment mainly relates to local artisanal or semi-industrial stove production, though many of the sustainability factors might also be applied to imported stoves. However, the import of products raises additional questions that are not fully considered here, as GIZ's focus has been on supporting the development and promotion of local production and demand in the past.

This publication addresses project implementers in the field of improved cookstove dissemination. The framework was initially developed to serve as a guideline for sustainability studies, aiming at comparable evaluation outcomes of cookstove interventions. The outcomes are intended to provide a comprehensive overview of the cookstove market and to generate recommendations for improving the creation of projects. However, even though this framework may serve as a guide for evaluations, it also identifies all the key factors that should be considered during the design phase of a new intervention. Therefore, the framework may also be used as a template for evaluating and (if need be) adjusting new project designs prior to the actual implementation phase.

Over the past two years, sustainability assessments have been conducted by the Energising Development programme in Uganda, Kenya and Burkina Faso in the context of stove sector support. The present publication incorporates the lessons learnt as well as the results of these assessments. The framework, as it currently stands, is, however, open to change. We kindly invite our partners to use this framework to evaluate the stove markets targeted in their own projects; please send us your comments as well. It will help us keep the framework applicable to the situation on the ground and also useful for efficient and effective study implementation. We would be happy to receive your comments at *hera@giz.de*.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2 Sustainability criteria

The importance of developing markets for improved cooking stoves (ICS) has been one of the lessons learnt over the past decade. However, not only the production and sale of a large number of improved stoves but also their usage and, ultimately, replacement when broken are all vital elements for ensuring a sustainable stove market.

On the demand side, four elements are used as measurable sustainability criteria for improved cookstove programmes:

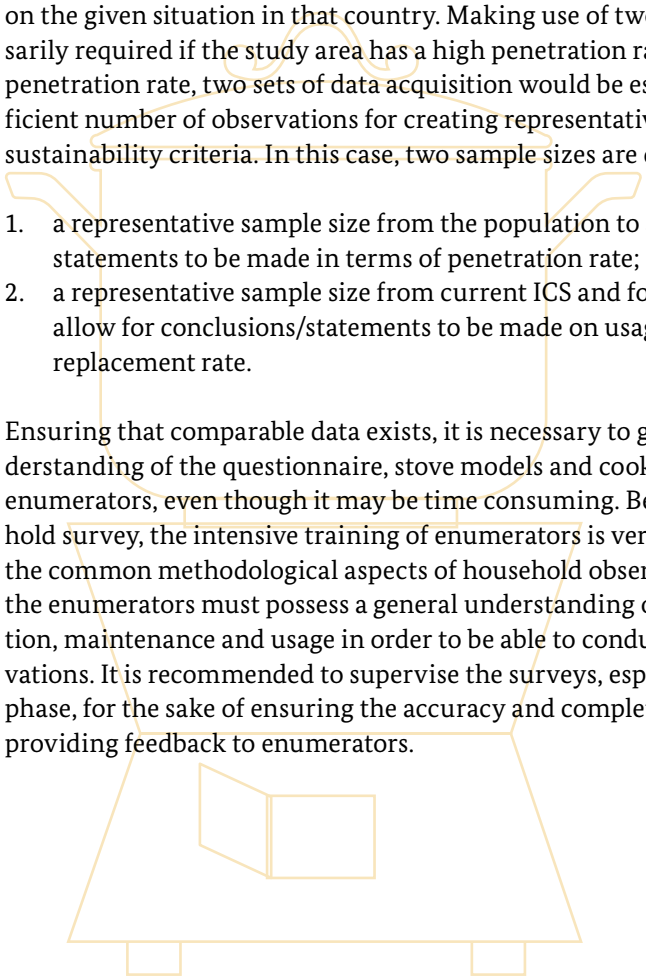
2.1 ICS penetration rate
2.2 ICS usage rate
2.3 ICS condition rate, and
2.4 ICS replacement rate.

Experience from former sustainability assessments has shown that even though the ICS penetration rate is a crucial sustainability criterion, it should be granted less weight than the other three. A high penetration rate is not always a strong indicator for sustainability of stove markets and vice versa; rather, the penetration rate provides information about the significance of stove distribution.

The methodological approach taken and the applied data gathering tools used are highly dependent on both the project's approach in a specific country and on the given situation in that country. Making use of two samples is not necessarily required if the study area has a high penetration rate. In the case of a low penetration rate, two sets of data acquisition would be essential to ensure a sufficient number of observations for creating representative data concerning all sustainability criteria. In this case, two sample sizes are drawn:

1. a representative sample size from the population to allow for conclusions/ statements to be made in terms of penetration rate;
2. a representative sample size from current ICS and former owners to allow for conclusions/statements to be made on usage, condition and replacement rate.

Ensuring that comparable data exists, it is necessary to generate a common understanding of the questionnaire, stove models and cooking energy among the enumerators, even though it may be time consuming. Before starting a household survey, the intensive training of enumerators is very important. Besides the common methodological aspects of household observations and surveys, the enumerators must possess a general understanding of stoves, their operation, maintenance and usage in order to be able to conduct the required observations. It is recommended to supervise the surveys, especially during the first phase, for the sake of ensuring the accuracy and completeness of answers and providing feedback to enumerators.

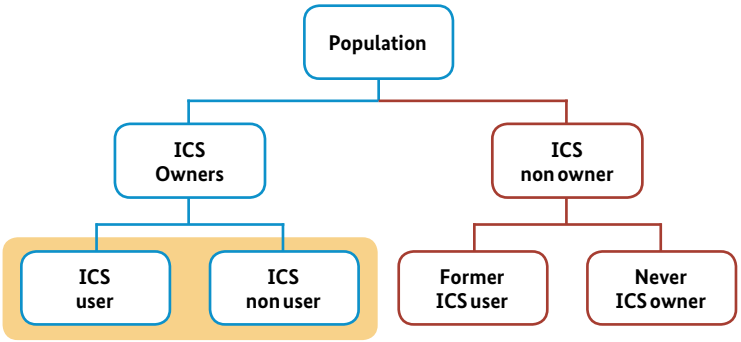


2.1 ICS usage rate

Within the framework ICS, owners are only defined as users if an ICS is used on a daily basis for at least one meal.[4] The higher the usage rate of the ICS, the greater the acceptance rate of the technology by its users, indicating that a longer-lasting change in behaviour has been achieved. Hence, ICS ownership alone is not a reliable indicator of the sustainability of behavioural change.

What should be measured?

[(ICS users x 100) / (ICS owners)]



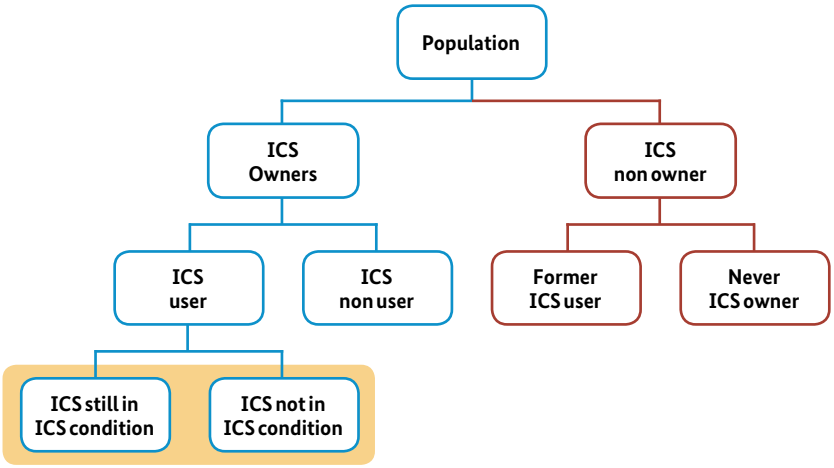
4 The definition of usage must be adapted for special cooking stoves and needs (e.g. Mirt Stove in Ethiopia).

2.2 ICS Condition rate

Maintenance and repair are necessary to extend the lifespan of an ICS and ensure its positive effects (fast cooking, fuel savings, etc.). They also indicate that the technology is valued by users. This criterion is, however, difficult to measure. A more objective approach has, therefore, been created: using professional observation and stove tests to identify whether or not a stove continues to fulfil the performance of an ICS. The better the condition of the ICS during continued use, the higher its value by users.

What should be measured?

[(stoves in use and fulfilling criteria of ICS x / total stoves in use)]

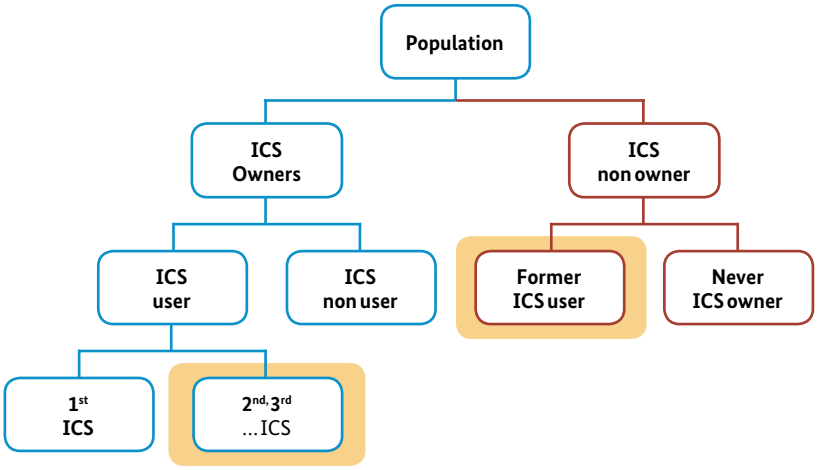


2.3 Replacement rate

When an ICS is damaged beyond repair, the household is confronted with the ultimate sustainability test: going back to the default stove or replacing the outdated ICS with a new one. This must not to be the same model, but should fulfil ICS performance criteria.

What should be measured?

[(Households who replaced their ICS x 100) / (households whose stove broke down (those who replaced + those who did not replace)]

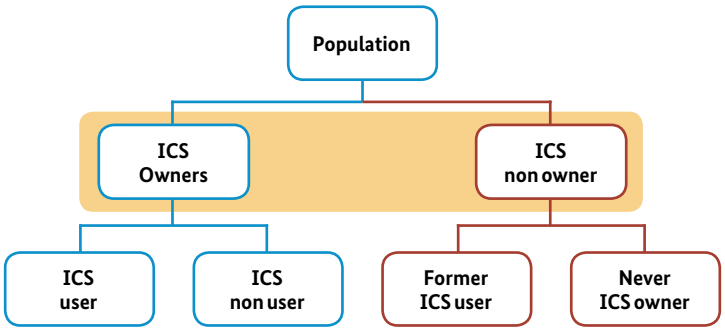


2.4 ICS penetration rate

The ICS penetration rate is an important indicator of the significance of stove dissemination. However, a high penetration rate is not necessarily a strong indicator for a self-sustaining market and vice versa in every country.

What should be measured?

[(ICS owners x 100) / (total sample size)]



Evaluation of stove performance

Stove tests are indispensable for questions and observation for evaluating the performance of the stove during an assessment from various dimensions such as fuel efficiency, emission, safety, etc. Various stove tests can be applied:

1. Water Boiling Test (WBT) - WBT is a laboratory test that evaluates a stove's technical performance in a controlled environment. This method focuses on the simulation of cooking practices by boiling water. Key parameters that can be investigated by WBT include: thermal efficiency, specific fuel consumption, time to boil, burning rate, fire power and turn down ratio.

2. Controlled Cooking Test (CCT) - CCT is a laboratory or field test that evaluates the performance of cooking stoves using a standardised local cooking task(s). This method reveals the behavior of the stove under the ideal cooking conditions in a locality/project area. The key parameters that can be investigated by CCT are fuel consumption, speed of cooking and user satisfaction.

3. Kitchen Performance Test (KPT) - KPT is a field test that evaluates the performance of the stove as well as the effectiveness and impact of the cookstoves in real cooking settings. The process of KPT involves both a qualitative survey and quantitative measurements (e.g. fuel consumption). Two kinds of qualitative surveys are carried out, such as a pre-treatment survey which is designed to assess the situation in households before stove dissemination and post-treatment surveys which are designed to assess the impact of cookstoves in households after dissemination. KPT is useful in gauging user satisfaction, determining per capita fuel consumption and the impact and effectiveness of stove interventions.

4. Safety test - This is a physical test aimed at evaluating the safety measures of stoves, e.g. safety measures with regard to skin burns or fire outbreaks while the stove is in use. The indicators evaluated include stove durability, suitability of materials used, handling features, fuel feeding provisions, etc.

5. Emissions test - This involves monitoring and measuring stove emissions or by-products of incomplete combustion during operation using standard emission testing protocols. Monitored emissions include carbon dioxide (CO_2), carbon monoxide (CO) and particulate matter (PM) which pose a significant health threat to stove users.

Further information about stove testing methods is available in the Cooking Energy Compendium: *https://energypedia.info/wiki/Testing_of_Woodfuel_Stoves*
or at the website of the Global Alliance for Clean Cookstoves:
http://www.cleancookstoves.org/our-work/standards-and-testing

3 Sustainability factors

There are many factors that may positively or negatively influence the ICS usage rate, ICS condition rate, ICS replacement rate and ICS penetration rate of improved stoves. GIZ HERA considers four factor categories; these are factors which:

- influence the decision to continue producing and selling ICS among manufactures (supply side),
- promote continuous high demand for ICS purchase (demand side),
- encourage ICS users to use, maintain/repair and replace their stoves (stove adoption), and
- enhance a supportive environment for ICS markets (policy and market environment).

However, determining the relevance and influence of each factor is difficult; these factors can assume various roles depending on the project context and the approaches used. Therefore, the weight given to each factor must be carefully thought out so that the appropriate factors are selected.

Sustainability Factors of the Supply Side

→ Factors which influence the decision to continue producing and selling ICS among manufactures

Sustainability Factors	Indicators	What should be measured?	Comments
Stove production and sales continue at the same or an increased level (sales figures) after project implementation	The absolute and relative numbers of stoves produced and sold are the same or higher compared to the amounts produced and sold when the project ended.	Number of stoves produced and number of stoves sold compared to "baseline" (production and sales at the end of project implementation).	Both can be gathered through project data and interviewing stove producers/dealers.
Capacities among all actors of the ICS value chain (technical skills, business skills) and knowledge-transfer	Business skills	Record keeping of purchase, production, sales figures.	Be aware that record keeping for on-going projects may only be followed because it is required by project/donor.
	Pricing	Producers/retailers consider costs of stove materials, labour and marketing in pricing their products – they are aware of the profit they make.	
	Technical skills: Quality of stoves	Quality of stoves according to production standards (e.g. stove dimensions).	Modifications can influence stove performance.
	After-sales services	Existence and quality of after-sales services (# of stoves repaired and # of stoves replaced).	
	Competence in instructing users on proper usage	Producer knowledge of proper usage? Did consumers receive training?	
	Institutionalised training for producers	Number of producers trained by existing producers or an institution/ NGO.	All types of training should be considered (e.g. technical, marketing, organisational development) as well as re-trainings.
	Degree of internal/self-organisation	Producer/retailer associations - existence of responsibilities, tasks, budgets?	
Capacities of producers and retailers in marketing activities	Consumer data is available and used by producers/retailers	Knowledge among producers/retailers about typical customers, their needs and preferences regarding cooking technologies.	
	Variety of marketing activities initiated and carried out by producers/retailers	• Regular marketing activities being carried out in the target market • Marketing activities: e.g. roadshows, demonstrations, field days • Marketing materials: sign posts, flyers, business cards, billboards, radio • Has a brand been created?	Applies only to large-scale stove production or associations.
	Inclusion of flexible consumer payment options	Does the producer/retailer accept payment in installments and/or in kind?	

Sustainability Factors	Indicators	What should be measured?	Comments
Stove production and sales/trade is profitable	Price covers costs and creates profit for every actor in the stove value chain.	• Profit for producers of stoves or stove components (income from stove sales minus material, labour costs of stoves produced, retailing and marketing costs, and, if applicable, taxes) • Profit for sales persons (income of stoves sold minus costs for purchasing stoves and retail costs, e.g. stocking, publicity).	Very important for sustainability and long lasting success!
No direct (cash) subsidy for producers for sold stoves	Prices reflect material, production and labour costs of stoves, including all parts and retail costs, plus profit margin.	Cost calculation of stoves and stove parts.	
Low vulnerability of input supply	Access to raw materials	• Availability of raw materials (consistently available during the last 5 years and outlook for the future?) • Price development of raw material during the last 5 years and outlook.	
Stove producers and sales persons feel responsible for their business (ownership)	Producer's perception of his/her own business	Producer's perception regarding his/her own business	
	Producers make independent, informed business decisions.	• Investments, risk-taking by businesses • Are they formal or informal businesses?	
Availability of access to (micro-) financing for producers and sales persons, if needed	Micro-financing accessible for producers and sales persons at reasonable conditions.	• Producers can make investments (if necessary) due to access to micro-financing • Producers can pay back loans.	
Competition among producers	• Existence of various producers in one region • Client can choose among different stove producers.	Producers recognise competition in the stove sector (number of producers today vs. 5 years ago).	

Sustainability Factors for Demand Side

→ Factors which promote continuous high demand for ICS purchase

Sustainability Factors	Indicators	What should be measured?	Comments
High/increasing "problem pressure" promotes continuously high demand for ICS	Commercialised access to wood fuel in intervention area	Markets for wood fuel: • Price of wood and its development • Number of people buying fuelwood	
	Increasing pressure on wood resources	• Number and percentage of people using wood fuels • Statistical numbers for deforestation	
	Realisation of fuelwood scarcity	Perception of fuelwood scarcity	
	Awareness of health problems due to high indoor air pollution	Perception of health problems due to high indoor air pollution	
Technical potential of ICS for convenient use	ICS accepts different sorts and shapes of fuel, is easy to light, heats water quickly, respects traditional cooking habits and is safe	Perception of convenient use by ICS users	
Positive perception of ICS by target group	User satisfaction with ICS: better performance than baseline stoves	Awareness of ICS benefits (efficiency, reduction of emissions, saving money and time)	
	Appealing appearance/design	User perception of ICS as modern and attractive	
	Purchase/installation are "affordable"	• User willingness to pay for ICS • Purchasing power and consumer payback time	
	ICS is perceived by target groups as “convenient”	User perception of convenient use	

Sustainability Factors for Stove Adoption

→ Factors which encourage ICS users to use, maintain/repair and replace their stoves

Sustainability Factors	Indicators	What should be measured?	Comments
Users realise (observe) the benefits of using ICS	ICS performs better (benchmarks) than baseline stove	Saved fuel and time, reduced emissions and effort, increased safety, saved fuel costs	Based on perception of ICS user
	Correct usage of stove	Correct usage of stove (regarding fuel and technology)	Performance of a stove in a household is not only a function of the technology itself: correct user behaviour also contributes to the user's realisation of the benefits of an improved stove.
	Living conditions of women have improved	Living conditions of women (less workload, less smoke, better working conditions in the kitchen)	
ICS after-sales services (e.g. repair, replacement) are available, accessible and affordable	Households are able to access and afford repair services	• Household knowledge of after-sales services • Location and accessibility of service providers	In some cases, certain stoves cannot be repaired.
	Households are able to access and afford new stoves or stove parts	Household willingness and ability to pay for services Prices of after-sales services Condition of stove (observation)	
ICS have consistent (good) quality	Variation among stoves of the same type is negligible with regard to: • Durability • Efficiency and Emission	• Existence of standardised production processes for stoves and stove parts (e.g. tools, moulds or industrial production) as well as knowledge and utilisation of them by producers • Efficiency • Emission • Durability • Lifespan	Please see box "Evaluation of stove performance" on page 14. Stove tests
	Long-term (autonomous) quality control	Institutions carrying out quality controls	

Sustainability Factors for Policy and Market Environment

→ Factors which enhance a supportive environment for ICS markets.

Sustainability Factors	Indicators	What should be measured?	Comments
Recognition and acknowledgement by politicians	• Politicians perceive cooking energy as a relevant topic for domestic policies	• Opinion of politicians from various sectors (energy, health, environment, forestry, agriculture, education, culture, gender, etc.) • Ranking of political priorities in various sectors (see above) • Cooking energy outlook for the next 10 years	Currently governing and oppositional politicians must both be taken into consideration
Reflection of cooking energy in national policies and strategies with a focus on enabling basic conditions for ICS markets (cross-sectoral: energy, health, environment, forestry, agriculture, education, culture, gender, etc.)	• Cooking energy is integrated into national policies and strategies: PRSPs, sectoral strategies, strategies contributing to UN conventions, etc. • Existence of specific cooking energy strategies: BEST, national access targets, etc.	Literature reviews, PRSPs, BEST, sectoral strategies, etc.	
National strategies and policies are implemented to encourage ICS use and market development	• Existence of national programmes: R&D, public R&D institutes, national standards for ICS, national campaigns, national awareness raising, etc. (Government takes no direct role in production or distribution of ICS or spare parts) • National funds for implementation are existent and accessible	Activities by public stakeholders (research institutions, public testing centres, national bureaus for standards, schools, forestry departments, extension services, local governments, etc.) and respective financial budget allocations	
Regulative mechanisms are supportive for a sustainable stove market	• Taxation positively influences ICS value chain: raw materials (local and imported), stoves, income • No import barriers on raw materials for local production	• Tax portion of production costs • Financial plans for cooking energy within ministries	• Non-transparent regulative mechanisms (e.g. abrupt changes in taxation) can negatively influence the stove market. • Financial plans will be difficult to access unless they are already public
In cases of existing subsidy schemes, they should be issued in combination with clearly defined target groups and exit strategies	• Existence and implementation of economically viable exit strategies for the elimination of the subsidy • All partners know and support the exit strategy • Reduction of subsidies over time • Replacement of subsidies with commercial financing schemes	• Planning documents • Knowledge by partners • Strategies for selection of target group (existence of micro-finance schemes)	
Recognition and acknowledgement by civil society/social environment	• Representatives from civil society (relevant NGOs, faith groups, associations) perceive cooking energy as a relevant topic for their field of work • Product is well known within civil society • Members of civil society raise awareness of ICS • Large % of population aware of ICS benefits • Producer associations represent interests of producers and influence on regulative framework for stove production	• Opinions of civil society representatives. • Knowledge/attitude of civil society with regard to ICS. Existence of campaigns and informational material • Knowledge and opinions of population. How does society value the technology? • Existence of producer associations and screening of activities • Economic viability of producer associations w/o drastically reducing profit of producers	To be answered in a qualitative manner

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