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CLIMATE CHANGE MITIGATION TECHNOLOGY AND POVERTY REDUCTION THROUGH SMALL-SCALE ENTERPRISES

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Climate change mitigation technologies: Potential links to poverty reduction

Small-scale enterprises in developing countries have an important role to play in linking climate change mitigation to poverty reduction strategies through their crucial role as a source of income for the poor. The energy consumption in small-scale enterprises is significant in the total energy consumption by the poor, and targeting this group of enterprises may therefore provide an appropriate entrance to reach the poor with climate change-induced interventions. Small-scale enterprises contribute to a more equitable distribution of income and accessibility to the poor through their wide geographic dispersion and their flexible functioning as fall-back or diversification of household incomes beyond agriculture (Mead and Liedholm 1998; Ellis 2000; ILO 2005). Although there are few national-level statistics on small-scale enterprises in developing countries, partly due to the fact that a large majority of small-scale enterprises in these countries operate in the informal sector, it is known that small-scale enterprises dominate by their numbers. National-level data from India indicates that over 90 per cent of the 1.5 million registered micro-, small- and medium-scale enterprises in 2006 to 2007 were run by only the owner. Even for factories (with powered appliances having a minimum of 10 employees, or without powered appliances with a minimum of 20 employees), 72 per cent of the total number in India still has fewer than 50 employees. A cross-country comparison of data by Davis et al (2010) also indicates a high relevance of off farm resources in rural areas across developing regions, accounting for

50 per cent of total income in sampled countries from Eastern Europe and Latin America and for all but Vietnam among Asian countries, and between 22 and 41 per cent in African countries.

Considering this role of small-scale enterprises in providing incomes to the poor, the energy consumption patterns of small-scale enterprises therefore links climate change mitigation to poverty reduction in two directions. First, the impact upon the sustainability of global production is significant following the sheer numbers of small-scale enterprises. Second, it is clear that policies and technologies that affect the viability of this sector, whether positive or negative, will have economic and social impacts.

Two routes to the reduction of greenhouse gases by small-scale enterprises are through the use of renewable energy sources and increasing energy efficiency. The availability and adoption of technologies for renewable energy supply and energy efficiency links to poverty reduction, as their use influences many aspects of enterprise operation which, in their turn, affect the income and work circumstances of the poor. For both renewable energy supply and energy efficiency technologies, the potential size of beneficiary groups among small-scale enterprises is high. Renewable energy can contribute to increasing access to modern energy services, especially in rural areas at a distance from energy infrastructure where decentralized renewable energy supply can offer services at lowest cost. The scale of lacking energy infrastructure with the global population lacking access to electricity, estimated at 1.4 billion, or 21.1 per cent (IEA, 2010), shows that there is a substantial role for renewable energy options to play in creating access. Lacking electricity supply infrastructure is most prevalent in rural areas, with, respectively, only 14.3 and 51.2 per cent of rural populations in sub-Saharan Africa and South Asia having electricity access (IEA, 2010).

For energy efficiency, the potential demand is not as much defined by lack of energy access, but rather by the appliances used for energy services. The most substantial quantities of energy are used in manufacturing and processing enterprises, where energy efficiency gains can often be made in upgrading production technologies and processes. Taking the example of India again, it is known that the potential for energy efficiency technologies is high, as many Indian small-scale industries are working with technologies at least 50 years old, such as in energy-intensive industries in foundry and forging (World Bank, 2010). The data on India show that the SMEs involved in manufacturing account for over 80 per cent of the total number of industrial enterprises in the country (MSME, 2010). Enterprises in areas with low access to electricity or fossil fuels may also benefit from energy efficiency improvements, saving on energy use from biomass. A survey of energy consumption in Kenya (Kamfor, 2002) indicated that 97.5 per cent of the energy (in joules) in the surveyed energy-intensive cottage enterprises was provided by firewood or wood for charcoal. It is estimated that currently 2.7 billion people, or nearly 40 per cent of the global population, rely on traditional use of biomass for cooking (OECD/IEA, 2010), where energy efficiency gains can be made by improving the efficiency of stoves or fuel switching.

Although both renewable energy supply and energy efficiency have a clear potential to provide other and more direct benefits to small-scale enterprises than climate change mitigation, the understanding of actual impacts and influencing factors is limited. This often leads to assumptions that potential benefits follow naturally once the technologies are in place. Such assumptions may be positive for policy and project justification, but they are detrimental to achieving actual impacts upon climate change and poverty reduction.

For entrepreneurs, many potential benefits of the availability of renewable energy supply or energy efficiency technologies occur if their uptake in the enterprise leads to innovations that are much broader and much more complex than the uptake of the technology, such as in changes in production and accessing new markets. Only if the steps in the chain between (renewable) energy supply or supply of energy efficiency technologies and impacts are established, can any statements be made on true attribution of changes in enterprise to the technological inputs (Kooijman-van Dijk, 2008).

This chapter addresses the problem that although small-scale enterprises are an important means for poverty reduction and reducing vulnerability, even renewable energy and energy efficiency projects and policies that target poverty reduction often exclude or do not reach this sector. Rather than taking the mainstream approach of analysing opportunities and barriers for diffusion of technologies from the perspective of climate change objectives, here technologies for climate change mitigation will be viewed from the perspective of small-scale enterprises. Taking this approach leads us to consider these technologies as innovations no different from any other changes that potentially bring benefits to the enterprise. Making use of theory in the field of diffusion of innovations described in the following section, the core of this chapter, is formed by analysis of empirical data on renewable energy and energy efficiency. The empirical evidence is taken from studies specific for small-scale enterprises, which is analysed with regards to diffusion for use in small-scale enterprises and their potential role in contributing to poverty reduction. By taking such a demand and user-oriented approach, this chapter aims to contribute to improving the positive poverty reduction impacts and reducing negative impacts upon small-scale enterprises of climate change technology projects.

Diffusion of innovations for small-scale enterprises

The diffusion of innovations, such as the uptake of renewable energy or energy efficiency in small-scale enterprises, does not necessarily bring the enterprises to the cutting edge of the global market, but they can be crucial for (or contribute to) the viable operation of the enterprise. It is important to realize that it is true in all parts of the world that many entrepreneurs do not aspire for their enterprise to innovate or grow, but rather the enterprise serves to maintain a traditional way of life or work (Nooteboom, 1994). Research in The Netherlands indicates that only about 20 per cent of small-scale enterprises could be characterized as 'dynamic' as a measure of innovativeness (Nooteboom, 1994). In developing countries, the small-scale sector is dominated by artisans working with established, if not traditional, production technologies and methods, and producing traditional products. Many small-scale enterprises remain an (additional) source of income for mainly the owner (Grosh and Somolekae, 1996; Liedholm and Mead, 1999; Ellis 2000). Where enterprises' main function is to increase stability of income and reduce vulnerability to poverty, the interest to venture into innovations that entail risks is naturally low.

In a broad categorization of factors influencing adoption of innovations, Rogers (2003) distinguishes three aspects: the characteristics of the entrepreneurs as potential adopters; the characteristics of the innovations (in this case, climate change mitigation technologies); and the policy and institutional context for the diffusion to take place.

Where most research on innovations tends to focus on high-tech innovations, research specific for developing countries tends to focus on the organization of diffusion and on the characteristics of entrepreneurs that facilitate diffusion. Lall (1992) and Romijn (1996) identify 'technological capabilities' of entrepreneurs or enterprises as key. Such technological capabilities describe the substantial demands on skills, awareness and prioritization that are posed on entrepreneurs for successful adoption of technologies, even if the development efforts have been done elsewhere.

The characteristics of entrepreneurs influencing adoption choices of energy innovations are studied in this chapter in relation to categories of an entrepreneur's financial, physical, and natural, human and social assets as described in the Sustainable Livelihoods approach. The Sustainable Livelihoods approach (Bebbington, 1999; DFID, 2001) can be used to describe the factors influencing a person's strategies towards personal goals, taking as a starting point one's assets and access to assets in terms of finance, human assets, natural assets, physical assets and social assets.

Financial assets and access to finance form a condition for the investments necessary to realize enterprise innovations. Substantial profits are rare in the small-scale sector: these niches are typically limited to relatively well-off entrepreneurs (Barrett et al, 2001). In addition, access to credits and willingness to use credits is strongly related to financial independence and social structures that limit the personal consequences of risks involved with investments (Kooijman-van Dijk, 2008). Physical and natural characteristics such as availability and location of a physical site and building for enterprise operation, and access to natural resources are relevant for the ability to innovate, especially through access to customers. Financial assets can provide opportunities to overcome issues of location, but not of availability of resources, as will be discussed in the following section. Human assets have been partly discussed above as capabilities, but in the case of adoption of simple technologies, this can be interpreted as skills to use (rather than adapt) the technologies. However, the skills and social assets to be able to translate innovations into profit through accessing new markets or new customers are crucial to all innovations, regardless of level of complexity.

Within the category of factors influencing the diffusion related to the characteristics of the innovations themselves, Rogers (2003) identifies five types of variables that determine rates of adoption of innovations: the perceived attributes of the innovation; the type of innovation decision; communication channels; the nature of the social system; and the extent of change agents' promotion efforts. Promotion of renewable energy supply tends to focus on two of these variables: the communication channels and the promotion efforts of the change agents, such as local sales persons.

Rogers (2003) argues strongly that the first of the variables, taking the point of view of the potential accepter or rejecter of an innovation, is key to diffusion taking place. Five conceptually distinct characteristics are used to describe the factors that play a role in defining this perception:

1. relative advantage as perceived by the individual as better than the idea it supersedes;
2. compatibility with existing values, experiences and needs of potential adopters;
3. complexity of the innovation;
4. trialability, or the degree to which an innovation can be tried out;
5. 'observability' or visibility of results from earlier adopters to potential adopters of an innovation.

It is the first of these factors (the perceived advantage to the entrepreneur) that entails the link to poverty reduction of the discussed technologies, as their impacts upon enterprise operation are the key to changing entrepreneurs' livelihoods. Taking the above user perspective, increasing a focus on improving the relative advantage of innovations for potential users can therefore be expected to simultaneously increase the diffusion of technologies and have positive impacts upon poverty reduction.

Innovations for small-scale enterprise: Renewable energy and energy efficiency

Moving from general mechanisms and potential links between climate change mitigation technologies and poverty reduction through small-scale enterprise to understanding practice, the analysis below is based on empirical evidence specific to renewable energy and energy efficiency technologies. The characteristics of the innovations and the characteristics of the entrepreneurs that influence the adoption process are discussed.

Analysing the characteristics of innovations as perceived by potential users is a complex matter. The characteristics are related not only to the characteristics of the renewable energy technology, the alternatives available and the characteristics of the entrepreneur and his or her assets, but also on the enterprise sector and scale, the market for enterprise products, and the policy and technology supply context. Nevertheless, the analysis below is able to distil general findings, making use of empirical data on renewable energy and energy efficiency in small-scale enterprises. The findings on renewable energy supply below are based on the study by Kooijman-van Dijk (2008), which provides detailed analysis based on empirical data from the Indian Himalayas. The findings on energy efficiency in this chapter are based on a literature review of empirical studies on energy efficiency in small-scale enterprises in developing countries.

General characteristics of renewable energy supply as an innovation for small-scale enterprises

As the characteristics of renewable energy depend strongly upon the energy sources, energy forms and their supply mode, these will first be elaborated upon. Useful energy forms that can be provided by renewable sources are electricity, thermal energy and mechanical energy, and this is what is of interest to the end-user. The main renewable energy sources applicable to developing country contexts are wind, solar and hydro, as well as biomass and geothermal sources.

First we take a closer look at electricity supply from renewable energy sources. For electricity supply, the mode of supply organization is a large distinction. If the supply mode is through a centralized grid connection, the electricity supplied is typically from a range of sources. Without great dependency upon one energy source, the impact of renewable energy supply is then through its impact upon the electricity market, which may influence cost and reliability of supply. If the electricity supply mode is in decentralized form, though, the user does notice the impacts of the source through potential limits in volume of supply or reliability of supply. Although technically it is possible to adapt technical design (having larger systems) and storage capacity (adding batteries or water storage) to achieve required volumes and reliability of supply, the costs related to doing so are largely inhibitive. This is why, in practice, there are still large differences in supply patterns and therefore also appropriate end-uses depending upon the resource.

Solar energy is a relatively reliable energy source, with a high predictability of the resource through daily and seasonal irradiation patterns. The high certainty of solar irradiation, across regions, is a major reason for the popularity of photovoltaics (PV) as an electricity supply technology. This does not make PV automatically appropriate for use in small-scale enterprises, as the costs per kilowatt hour (kWh) of electricity production by PV leads to applications being focused on small demands. For rural electrification, typical products are solar lanterns and Solar Home Systems based on PV, which can supply a few hours of light, radio, small television or laptop or mobile telephone charging. In innovative organizational forms such as village systems, the potential of PV to meet other enterprise energy demands is becoming greater, depending largely upon costs of electricity storage.

The renewable energy sources of hydro and wind are less predictable than solar, and the availability of these resources is highly specific to the exact location. This locational characteristic of most renewable energy technologies has implications for the energy services and locations at which energy is provided, and therefore also on the potential benefits for enterprises. Where electricity generation from wind or hydro are feasible, typical system designs are at the community level, except for the smallest hydro systems, which are designed for individual household use similar to Solar Home Systems.

From both hydro and wind, common applications are for mechanical energy. Mechanical energy is a form of energy that typically finds its demand in the enterprise and agricultural sectors. These renewable energy sources are well proven to meet small-scale enterprise energy demands in milling or carpentry, and the diffusion of technologies in this field typically consists of upgraded traditional systems.

The third form of energy supply is that of thermal energy. By far the most common renewable energy source for thermal energy is biomass. Biomass is used at a large range of scales. At the top end, biomass is used in large-scale industry for process heat. At small scales, biomass is the most common resource for cooking, which is also an energy service demanded by enterprises such as restaurants or food processing. Technologies for the promotion of small-scale biomass applications are typically regarded as energy efficiency measures. These are discussed after the discussion related to renewable energy technologies below.

Renewable energy supply as an innovation: Relative advantage to the entrepreneur

This sub-section focuses on the first of the characteristics of the innovation influencing diffusion of innovations, according to Rogers (2003): that of relative advantage to the entrepreneur. Relative advantage is crucial to the understanding of the diffusion of innovations and of impacts upon poverty reduction.

For energy supply, location is related to the viability of the renewable energy supply option and to the alternatives available (is there a grid or access to fuels, or not?). The assets of the entrepreneur define a large part of the freedom to choose between alternatives. The financial and physical assets (defining, for instance, ownership of a workshop for the enterprise) and social assets (especially household and childcare tasks for women) of an entrepreneur have a high impact upon whether the location of an enterprise is close to markets or to energy access. If there is an electricity grid in the area, the demand, prices of alternatives and policies regarding connection define whether renewable energy technologies have a role to play. In the case of renewable energy being promoted as a means of rural electrification where there is no grid nearby, having electricity from renewable energy sources is often the only realistic supply option to meet small electricity demands locally. For larger demands, diesel generators form the default supply in un-electrified areas, and whether these can be substituted depends upon the renewable energy supply. This implies that renewable energy technologies provide additional options for entrepreneurs to access modern energy supplies.

Small-scale energy supply from hydro is very much bound to the location of the natural resource, especially in the case of direct mechanical energy, which is generated in direct proximity to the river. This inflexibility of location has a large impact upon the advantages of using this energy source for enterprises. In the Indian Himalayas, the location of the existing water mills in valleys and gorges along streams often does not coincide with the location of villages and roads which are located on hillsides and hilltops. Water mills are part of the tradition of this region; but only in those cases where the location of enterprises formed no barrier to customers were the businesses doing well. The upgrading of mechanical mills to the production of electricity for enterprise use is often promoted as a way of reviving traditional mills; but in the studied sites, such upgrading was found not to have any significant impact upon enterprise operation. Instead, a trend was perceived of new milling enterprises being established at locations close to customers, along roads and in newly electrified off-road villages, following access to diesel or grid electricity. In the case of direct use of hydro for enterprise activities, it appears therefore that the crucial context factor for benefits to small-scale enterprises is the location relative to customers.

In the Indian Himalayas, PV systems and decentralized hydro power stations were located in remote hill villages, typically several hours away by car and an additional several hours walk to rural towns. Less remote villages are, or are planned to be, electrified from the central grid. It is exactly the remoteness of the location that increases the relative advantage of using renewable energy sources, and at the same time impedes growth or the introduction of new products or services by an enterprise. Typical enterprise sectors even in the most remote villages are small grocery shops, tailors, millers, and carpenters, blacksmiths and masons. Energy services are lighting, mechanical energy and heating. The small volumes of energy supply available from PV cater only for the first of these services. Mechanical energy can be provided from hydro power, as discussed above. The impacts of having access to these energy services were found to be limited in terms of enterprise innovations, growth or incomes. This is related to the lack of demand from local customers in these remote locations in combination with the entrepreneurs' lacking financial, physical and social assets, while such assets are crucial to identify business ideas and implement them. The poverty impacts of the renewable energy services in remote locations are therefore limited to well-being rather than income improvement aspects of poverty reduction unless market links for enterprise products are established. This appears to be a phenomenon related to the remoteness of villages that are the most appropriate for energy supply through renewable energy, and therefore it is a factor that should be taken into consideration.

Nevertheless, the alternative provided from conventional energy supply through the grid or fuel distribution systems often also brings problems in terms of accessibility and reliability that may outweigh those that accompany renewable energy supply. For grid electricity, power shedding and scheduled and unscheduled down times can typically be experienced on a weekly, if not daily, basis. Such problems may contribute to a perceived advantage of energy from renewable sources even when electricity from the grid is available.

Renewable energy supply as an innovation: Compatibility, complexity, 'trialability' and 'observability'

Next to the relative advantage of the innovation, the other characteristics mentioned by Rogers (2003) related to the perception of the innovation are also relevant for the diffusion of renewable energy technologies: compatibility, complexity, 'trialability' and 'observability'. The compatibility of the design of most decentralized energy-supply systems is an issue, as enterprise energy demands other than lighting are low. Many examples of subsidized programmes for standardized PV systems have been shown to effectively rule out the diversification of available technical designs according to customer demands. The complexity of renewable energy supply is not an issue for end-users, but rather for installation and operation and maintenance. The complexity for the entrepreneur is not so much related to the functioning of the technology as how to optimize the impacts of changes in the enterprise. The relevance of the visibility of results from early adopters is already widely recognized in project development as a crucial factor in influencing potential customers' attitudes – for example, through providing initial systems at highly visible locations to enter new markets.

Energy efficiency as an innovation: Relative advantage, compatibility, complexity, trialability and observability

For energy efficiency, the characteristics of an innovation that influences adoption decisions are different than those of energy supply. First, the relative advantage of investing in energy efficiency is not obvious. Energy-efficient technologies and innovations may require significant investments in skills, time or money; but the benefits are difficult to see as they can only be measured as reduced consumption of energy not necessarily in absolute terms, but in reference to a scenario without these innovations. In the case of fluctuating manufacturing volumes, energy savings can hardly be perceived if a baseline has not been established. The recognition of the role of perception shows that one should be cautious about the opinions or stated requirements of entrepreneurs when assessing the potential of energy efficiency and cleaner production, as risk avoidance may lead to negative perception. What is measured, then, has a closer link to the levels of knowledge, awareness and expectations of entrepreneurs regarding market and policy developments than with actual potential benefits. Brown (2001), Jaffe and Stavins (1994) and Kounetas and Tsekouras (2008) refer to the 'energy efficiency gap' or 'paradox' as the situation in which cost-effective technologies exist but remain unadopted by many firms. Brown (2001) explains that obstacles to clean energy technologies include a low priority of energy issues among consumers, capital market imperfections, and incomplete markets for energy-efficient features and products, meaning that the energy efficiency aspects cannot be considered separate from the appliance. The benefits do exist, but they are not perceived strongly enough for the diffusion of innovations in this field to take place.

Second, energy efficiency is often not compatible with the existing values, experiences and needs of potential adopters, where (especially for small-scale enterprises) priority is given to survival in the short term and long-term strategies often do not exist.

Rogers's (2003) third characteristic is the complexity of the innovation. There are many different types of innovations in energy efficiency. Innovations in the energy efficiency of production processes include not only complex adaptations for which technological capabilities are obviously of great significance, but also innovations such as in lighting appliances that can be interpreted as changes in consumer goods, and innovations that can be interpreted as operational management (Kooijman-van Dijk, 2011). Trialability depends upon the type of energy efficiency innovation. Whereas operations management improvements have a low barrier, improvements requiring investments typically affect the whole production process, which cannot be tried without risk of influencing production and products.

Finally, observability, or visibility of energy efficiency impacts, is low. The experience in the case of energy efficiency improvements in small-scale enterprises in the foundry sector described by Pal et al (2008) was that unit owners with successful innovations do not share their positive experiences with other small enterprises in the same sector in the cluster; in fact, they were found to even present a negative impression of the technology. Research by Soni (2007) also encountered this phenomenon of negative promotion of energy efficiency due to enterprises within the same cluster viewing one another as competitors. Whether this lack of willingness to spread positive experience also holds between enterprises of different scales is not known. Pal et al (2008) do support the idea that large-scale enterprises will be willing to function as showcases for small-scale enterprises.

A way of overcoming barriers to spreading positive experiences with energy efficiency would be cluster-wide cooperation through associations to strengthen the market position of the cluster as a whole, focusing on the co-benefits of energy efficiency innovations in reaching new markets, rather than increasing competition between cluster members by focusing only on the benefits of energy efficiency in cost reduction. Increasing energy efficiency and modernizing production with regard to labour circumstances can be an effective instrument in improving such a market position, especially for the global market.

Conclusions and discussion

Although renewable energy and energy efficiency technologies can potentially contribute to socio-economic development through small-scale enterprises, this potential is not fully realized. Assumptions that potential benefits follow naturally once the technologies are in place are detrimental to achieving actual impacts upon climate change and poverty reduction, as the problems for entrepreneurs are not identified. Looking at the promotion of climate change mitigation technologies from the perspective of diffusion of innovations stresses the need to focus on the potential users, not only for the diffusion of the technology which is relevant from the technology-supply perspective in the long term, but also to increase the impacts upon climate change mitigation and poverty reduction.

This chapter shows that the perception of the innovation of potential end-users is indeed relevant to the diffusion of renewable energy and energy efficiency technologies, and that knowledge of the characteristics of the innovation is beneficial for understanding barriers to the diffusion of these innovations. It shows that not only are the 'objective' financial benefits relevant, but that for small-scale industries in developing countries in which entrepreneurs are typically lacking access to knowledge and awareness, and views on future market and policy development are frequently based on experiences in the past, rather than national or global trends, subjective perceptions play a strong role in influencing acceptance of innovations (Kooijman-van Dijk, 2008).

Concluding from the above, the empirical evidence on adopting climate change mitigation technologies in small-scale enterprise shows that the often cited risk adversity of entrepreneurs appears to be not so much a character trait, but at least partially related to the financial assets and social networks of an entrepreneur. Because taking risks may endanger the sustainability of a poor entrepreneur's livelihood, their livelihood assets are highly relevant for the diffusion of innovations even if there is a good chance of making profits.

The above leads to a discussion of implications for policies for climate change mitigation. First, the need to include the demands of small-scale enterprises is not met by current technology transfer agreements, which focus on high-tech and institution building for technological innovations. Second, small-scale enterprises are rarely targeted, and impacts upon income generation are limited if there is no special targeting of small-scale enterprises. Such special targeting should include a focus on the entrepreneur's perceptions, including opportunities for learning by doing and creating access to tacit knowledge, as stressed by Romijn (1996). For example, job training on renewable energy or energy efficiency technologies would be a way of contributing to realistic expectations of the potential advantages and skills of adopting such features.

However, it is clear from the above analysis that support in linking climate change mitigation technologies to poverty reduction should move beyond the scope of the technologies. For energy supply, business support may lead to increasing the energy demand for new products and services; therefore, basing demand on current demand patterns could be short sighted and limit the development of the small-scale enterprises. On the other hand, small-scale enterprises may move from remote to more centralized locations once financial assets allow for this, so that energy planning for the inclusion of small-scale enterprise demand in rural areas may not require uniform design of supply.

Popular policy instruments in the field of renewable energy and energy efficiency are co-financing of hardware and awareness-raising of environmental and cost benefits. Such policy instruments may not be the most appropriate to reach small-scale enterprises. Awareness-raising activities, rather than focusing on changing the attitude of the entrepreneur, would be productive in altering social assets if improvements of links to the value chain are sought. For both renewable energy and energy efficiency, this means links to downstream markets for enterprise products; and for energy-efficient production technologies, links to upstream technology suppliers are required. Initiatives for steering the CO_2 emissions of production through the demands on enterprise products have a potential to function mainly in the most extreme polluting enterprise sectors, where customers will find it worthwhile to monitor these issues. Small-scale enterprises can be influenced in their energy choices by markets with a high demand for quality products, while only very few access niche markets with a willingness to pay for sustainable energy in the production process.

Schemes specifically supporting access to markets related to the impacts of climate change mitigation technologies are scarce. An exception is the recently established Indian Technology and Quality Upgradation Support scheme (DCSME, 2010) in which the strategy to improve the competitiveness of small-scale industry includes, first, sensitizing small-scale manufacturing industry to save costs by improving energy efficiency, and, second, quality improvement of products, for which meeting international standards and improving energy efficiency are considered positive with regard to consumer preference. Hopefully this is a sign of recognizing the need to pay specific attention to small-scale enterprises in climate change mitigation policy, especially by emphasizing and supporting the benefits for entrepreneurs. Taking the perspective of entrepreneurs, finding and promoting additional advantages to technical innovations apart from the environmental sustainability aspect can be a highly beneficial strategy, not only for the entrepreneurs, but for climate change impacts.

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