Sustainable energy technology transfers through the CDM? Application of participatory approaches for decision making facilitation

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Abstract: The two big challenges for this century are world poverty and climate change. The clean development mechanism (CDM) has the potential to address both, through integrated programmes that will be in compliance with the needs and objectives of the host countries. Actual practice shows that CDM technology transfer is focused on reducing emissions at the lowest possible cost and less on the sustainable development priorities and objectives of the host countries. This paper discusses a participatory approach to facilitate energy decision makers and relevant stakeholders to define, evaluate and finally decide on the most suitable sustainable energy technologies to transfer and implement in a particular developing country through the CDM. Following an overview presentation of the methodology, the results from its application in Israel are presented and analysed. The last section comments on the case of Israel and provides insights of the adopted approach.

Keywords: participatory decision analysis; sustainable technology transfers; clean development mechanism; CDM; Israel.

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1 Introduction

Despite the numerous activities addressing global energy demand and security of supply issues, as well as the issue of climate change (Baumert and Pershing, 2004), attempts to combine possible solutions into an integrated approach have been relatively few. Poverty in developing countries could be alleviated by offering rural communities reliable, affordable and sustainable (with a view to local aspects) energy technologies, which would be in line with the Millennium Development Goals (United Nations, 2006). As these technologies often reduce or avoid greenhouse gases (GHGs) emissions, such projects would also address the climate change issue (Doukas et al., 2009). However, these kinds of practices are, unfortunately, rare.

An example of how different objectives can be combined in a policy mechanism is the Clean Development Mechanism (CDM) of the Kyoto Protocol (UNFCCC, 1998). The CDM has the explicit objective of both reducing GHGs emissions and supporting sustainable development in developing countries. Therefore, a typical CDM project would bring together industrialised EU countries' demand for certified emission reductions (CERs) and developing countries' demand for sustainable (energy) technologies and other means to achieve development goals (Michaelowa and Jotzo, 2005). The resulting technology transfer would be a low carbon technology, supporting the host countries' national development needs and priorities.

CDM has widely been acknowledged as a mechanism to assist emerging and developing countries in achieving a sustainable development path (Kim, 2004), with enhanced energy security of supply and lower GHG emissions (Flamos et al., 2008). In several Middle East and North Africa (MENA) countries, the implementation of technologies that have reached the stage of maturity within the EU, is still limited by several factors (Chadwick, 2006; Del Río González et al., 2005), such as infrastructural requirements, insufficient capital markets, unfamiliarity with the technology, etc. The next logical step would be to meet the challenge of developing country's specific portfolios of affordable, competitive, clean, efficient and sustainable low carbon technologies that could be successfully transferred and implemented through CDM in MENA countries.

In addition, sustainable technology transfer for climate change mitigation along with the use of the CDM could further strengthen the international partnerships with MENA countries through (German Aerospace Center, 2005):

- facilitating countries with developing economies to fulfil their growing needs and increasing demands in a sustainable climate friendly way
- contributing to the long term energy cooperation plans to accomplish their development objectives and strengthen their stability, security and prosperity
- contributing to the development of markets, which could impact on European energy industry competitiveness on an international scale and at the same time reduce the risks of climate change and acidification of the oceans.

In the above framework, the exploration of the potential of transferring sustainable energy technologies via the CDM is considered of significant importance. A number of studies have tried to assess the sustainable energy development needs and priorities of developing countries and which energy technologies would be suitable for that (Karakosta et al., 2008). One example is the 'Synthesis report on technology needs identified by parties not included in Annex I to the convention' prepared by the United Nations Framework Convention on Climate Change (UNFCCC, 2006) Subsidiary Body for Scientific and Technological Advice (SBSTA) presented in 2006. A second example is a study commissioned by the Netherlands Ministry of Foreign Affairs (2007) which has found that, for a sample of developing countries hosting CDM projects in which the Netherlands Government participates as an investor; host countries use different methods to assess the contribution of CDM projects and technologies to their sustainable development. In addition, United Nations Development Programme (UNDP), together with the Global Environment Facility (GEF) and the Climate Technology Initiative (CTI), prepared a handbook for 'Assessing technology needs for climate change' (Bonduki, 2003). The handbook aimed at helping countries find ways of encouraging technology transfers that would contribute to a low carbon sustainable energy economy. CTI also published another report with 'Methods for climate change technology transfer needs assessments and implementing activities' (CTI, 2002).

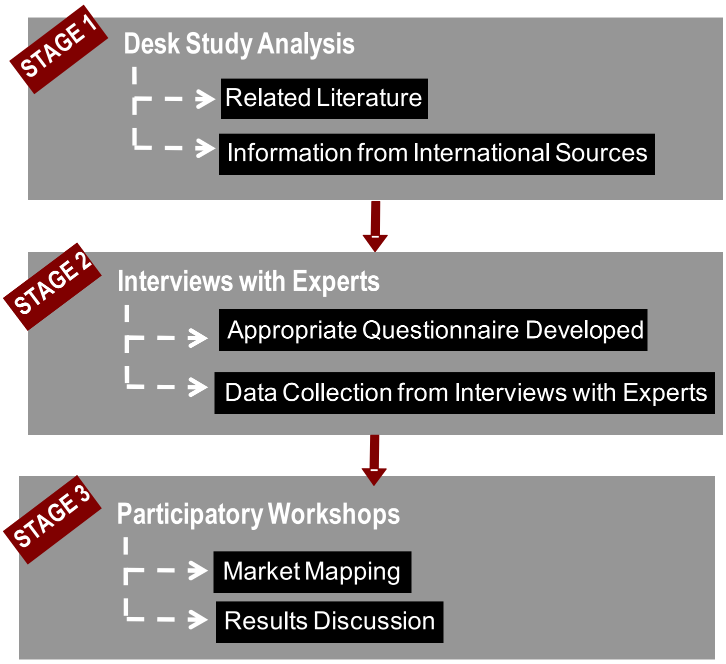
The recently completed project 'ENTTRANS: the potential of transferring and implementing sustainable energy technologies through the CDM of the Kyoto Protocol' (EC-DG Research FP6) has shown that for potential CDM host countries that lack of familiarity with new low carbon energy technologies among stakeholders of the energy sector could easily result in a focus, when elaborating on a sustainable energy strategy, on technologies that already exist in a country and/or that stakeholders are familiar with (JIN, 2007). ENTTRANS has, thus, shown that new knowledge of technologies is not easily fed into the countries' decision making process and that the CDM could play a role in this respect by enabling demonstration projects that involve technologies which follow from clearly assessed energy service needs in the host countries. To the best of our knowledge, an integrated methodological approach facilitating the host country's Designated National Authority (DNA) as well as energy decision makers and relevant stakeholders in selecting the most suitable sustainable energy technologies for effective technology transfer to be implemented through the CDM, while being simultaneously in accordance with the specific developing country's sustainable development needs and priorities is not available in the literature.

In the above framework, this paper provides a brief overview of the methodology that has been employed by the ENTTRANS project and presents the results from its application in Israel, which already has 34 CDM projects (at registration, request for registration and validation stage) (Fenhann, 2009). The methodological approach presented provides a systematic method for integrating information from several different stakeholders and could be used repeatedly to monitor the progress made by the specific examined host country over time. The case study analysis of Israel includes an assessment of its sustainable energy needs and priorities and technologies suitable to fulfil them (Israel Ministry of Environmental Protection, 2007); an assessment of possible factors affecting the roll out of these technologies including skill shortages, data shortages, informal support networks, fuel supply chains, financial mechanisms for funding among the different scales and levels of risk and an assessment of minimum requirements of CDM policy and project implementation, at the national and international level, for individual technologies and the extent to which potential CDM host countries meet these, including opportunities for small-scale renewables and large scale energy sector CDM projects. The last section presents conclusions and recommendations which explore the country variations and highlights some of the problems in transferring low carbon sustainable technologies.

2 Methodological approach

The methodological approach is structured along three stages as presented graphically in Figure 1. The objective was the identification of host country's specific energy needs and priorities as well as the low carbon energy technologies that are most appropriate to fulfil these needs.

Figure 1 Methodological approach (see online version for colours)



Stage 1 desk study analysis

The 1st stage involved a desk study analysis for the case of Israel providing an overview of the current CDM status and institutional framework, as well as information regarding technologies appropriate to be implemented under the CDM 'umbrella'. In particular, the Israeli context as regards the current energy market and the renewable energy sources (RES) and energy efficiency (ENEF) potential was analysed. Furthermore, the research and development (R&D) status of a set of low carbon technologies and related investment, operation and maintenance costs for the technological alternatives was structured in the form of technology briefs.

Stage 2 interviews with experts

An appropriate questionnaire was developed to facilitate bilateral interviews with stakeholders. The interviewees were compiled from stakeholder lists developed in conjunction with the Interdisciplinary Centre for Technological Analysis and Forecasting at Tel Aviv University (ICTAF) and in accordance with the guidance published by UNDP Technology Needs Assessment and the UK Department for International Development. The stakeholders were selected in order to include representatives from: government departments with responsibility for energy, environment and development; local governments; representative national and international companies or bodies in other GHG intensive sectors; companies, industry and financial institutions involved in the manufacture, import and sale of environmentally sound technologies; international organisations and donors; non-governmental organisations (NGOs) involved with the promotion of environmental and social objectives; institutions that provide technical and scientific support to both governments and industry, e.g., academic organisations, industry R&D, think tanks, consultants, local community representatives, etc. The questionnaire addressed the needs and priorities of Israel, appropriate technologies to fulfil these needs and priorities and info on which sustainable development benefits these technologies would deliver. Each question could be answered by assigning values from one (low priority, suitability, etc.) to five (very high priority, suitability, etc.). The outcomes of these interviews were:

- An assessment of Israeli main energy technology needs and priorities for the medium to the longer term (e.g., up to 2020). Examples of such needs and priorities were: (improved) provision of electricity for industrial appliances; (improved) provision of electricity for agricultural production; (improved) provision of electricity for households, both in rural communities and urban communities; (improved) provision of electricity for service sectors; (improved) heat delivery for industry; (improved) heat delivery for households; (improved) heat delivery for service sectors; energy for cooling purposes (e.g. medicines); energy for cooking and municipal solid waste management.
- An assessment of low carbon energy technologies, which would be suitable and appropriate for fulfilling these energy service priorities, as well as an assessment of their sustainable development benefits and drawbacks. The technologies were assessed in terms of:
  - *Economic benefits:* energy supply diversification and reliability, replicability potential in the country, lower dependency on imported fuels, grid stability, energy price stability, etc.
  - *Environmental benefits:* improvement of local air quality, GHG emission reduction, land protection, improved water quality, solid waste management, ecological conservation, etc.
  - *Social benefits:* increased socio-economic welfare, poverty alleviation, health improvement, better education, empowerment through training, etc.

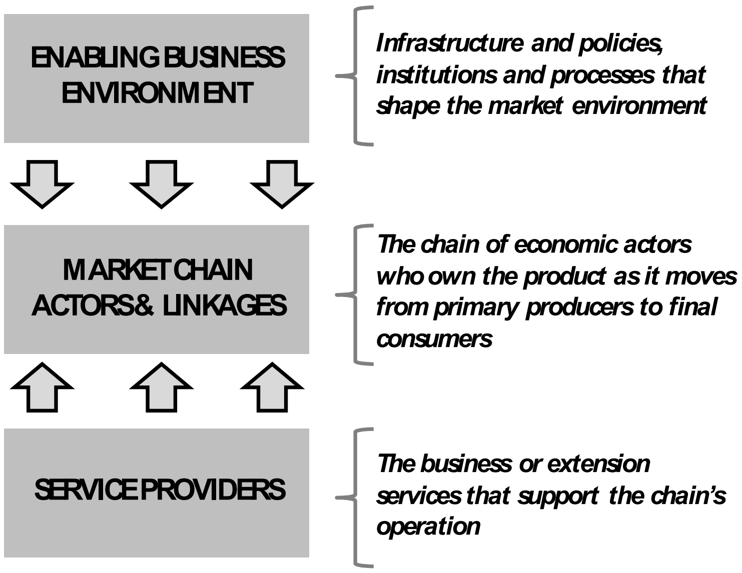
In order to facilitate stakeholder assessments, the ENTTRANS consortium also prepared 38 descriptions of sustainable energy technologies which stakeholders could use as background material while filling out the questionnaire.

Stage 3 participatory workshops

Participatory workshops have been organised in the case study countries. Energy market stakeholders and other key players have participated in the workshops and provided their views and inputs. The discussions were structured in a way to facilitate the elicitation of required data and information on local circumstances and preferences. More specifically, the purpose of these workshops was to explore the implementation chain circumstances of sustainable energy technologies. The approach used for exploring technology implementation chains was that of market mapping, which was pioneered in developing countries by Albu and Griffith (2005) to extend the sustainable livelihoods approach to the market for rural farmers. The approach is participatory and allows a 'map' of the relevant market to be drawn in terms of:

- the market chain actors who own a project or technology as it moves through the implementation chain: e.g., product traders, local markets, intermediary traders, processors, producers and end users
- the business environment in terms of infrastructure and policies, institutions and processes that shape the market environment: e.g., trade policy, contract enforcement, tax and tariff policy, corruption, regulations for business, trends, registries
- the business and extension service partners that support the market chain's operation: e.g., market information, financial services, market advisors, project preparation skills.

Figure 2 The market map method



Source: Albu and Griffith (2005)

Market mapping was applied to those technologies that were better fulfilling the energy needs and priorities of Israel (stage 2). The implementation chains for these technologies were analysed in these workshops as well as how the CDM could help improve technology implementation aspects, e.g., by providing extra financial returns on investment, building additional (human) capital for technology operation and maintenance and acting as a tool to demonstrate technologies that stakeholders in the host country have not yet been familiar with. Examples of implementation chain aspects could be: limited affordability of the technology, the existing domestic legal/institutional framework, existing energy subsidy policies, bureaucracy (e.g., in favour of conventional energy sources), non-transparent decision making procedures, large scale state-ownership of enterprises, availability of cheaper but less sustainable alternative technologies, non-transparent investment climate, lack of investment protection, lack of technically educated human resources resulting in insufficient know-how and maintenance expertise, etc. The application of the market mapping approach to technology transfer activities is novel and was used in this study to explore the system into which the technology would be transferred in the Israel. Albu and Griffith (2005) describe the process of technology diffusion by dividing the market map into three elements: the business enabling environment; the market chain and the market supporting services. These elements are illustrated in Figure 2.

3 Results

The ENTTRANS methodology was applied in five countries: Chile, China, Israel, Kenya and Thailand. These countries were selected because of their different profiles in terms of geographical location, energy profile, population size and economic profile. Chile has been an active CDM host country since the year 2000 with 68 projects in the pipeline (as of March 2009) and with an efficiently operating DNA. China is presently the CDM frontrunner among host countries with 1,682 projects in the pipeline and with an extensive CDM policy since 2005. Moreover, China could and in some cases has already become an important producer of low carbon technologies to other countries in the world. Israel hosts 34 projects and is an interesting case study country in the Mediterranean as it has been active in developing technologies that are particularly suitable for warm regions, e.g., energy towers in deserts. Kenya has recently become a CDM host country in the sub-Sahara African region with a large potential for hydropower and which has recently discovered coal. Finally, Thailand is an example of a host country with an active government policy for supporting clean energy production, but which has long been reluctant to host CDM projects. Given the limitation of resources for the ENTTRANS project, it was not possible to select more countries, but the countries selected cover, given their profile, the several different categories of (potential) host countries.

This section presents, an illustration of the results from the ENTTRANS approach for the case of Israel (Sharan and Vaturi, 2007) [the discussion of the results for China, Kenya, Chile and Thailand can be found in JIN (2007)].

Stage 1

The desk study analysis for the case of Israel resulted in an overview of Israel's CDM portfolio and institutional framework, as well as the identification of some technologies appropriate to be implemented under a CDM project.

The Israeli DNA is under the ministerial responsibility of the Ministry of the Environment and was established in 2004. It includes representatives of governmental and public bodies. Israel, which is classified as a non-Annex 1 country under the Climate Change Convention, provides an especially attractive option for CDM projects for a wide variety of reasons. These include, among others:

- technological and scientific expertise, including wide experience in the field of 'clean' technologies
- open access to a wide range of data, including air pollution monitoring results
- availability of local professionals, including scientists, engineers and lawyers.

The potential CDM project opportunities for Annex 1 countries that were found relevant for Israel cover several sectors, such as energy, transport, waste, industrial and public buildings, industry and land use. The desk study analysis identified the following areas/market niches where renewable and new energy efficient services could be successfully launched, possibly through the CDM:

- large public buildings (such as universities)
- isolated areas such as unrecognised Bedouin villages
- energy conservation in arid areas
- solar collectors for water heating for residences, hotels and medical centres
- solar collectors for water heating at high temperature for industrial use.

Stage 2

For this stage, the assessment of priorities and needs and suitability of technologies in Israel, key stakeholders in the energy and financial sectors were selected. Among them were investors, renewable energy company representatives, planners, energy service company representatives and decision makers at the local and national level. Only representatives of domestic companies and organisations were invited to participate and they had to work for companies and organisations which had been involved in the Israeli energy market for at least two years. Eventually, 45 stakeholders from the following categories collaborated with the research team:

- *Government:* DNA committee members, government delegates, relevant ministry departments, NGOs representatives – these stakeholders are active in the field of CDM policy making in Israel and represent official and public units inside and outside the national government involved in assessing CDM issues.
- *Major industry and business associations:* commercial sector, industrial sector, chamber of commerce, industrial chamber – these public organisations represent key economic sectors such as industry, transport and the construction and are responsible for most of the national energy consumption.
- *Enterprises, technical agencies and other organisations:* energy agencies, ESCOs, utilities – these stakeholders represent the private sector and the potential entrepreneurs for CDM projects.
- *Representations of major International Financial Institutions (IFIs) and donors:* IFIs, European Investment Bank (EIB), World Bank – this group includes potential donors for financing and investment in CDM projects.

Energy service needs and priorities in Israel

With respect to energy service needs and priorities in Israel, there was a common understanding among the stakeholders interviewed that energy is essential for day-to-day life. Table 1 presents the alternative energy needs and priorities, which stakeholders were asked to rank each need and priority by assigning values from 0 – not relevant for Israel to 5 – very high priority (5 – very high, 4 – high, 3 – medium, 2 – low, 1 – very low, 0 – not relevant for Israel, n.a. – no opinion) (Israel Ministry of Environmental Protection, 2007).

Table 1 The alternative needs and priorities

Needs and priorities	
N1	Electricity for industry
N2	Electricity for agriculture
N3	Electricity for households – rural communities
N4	Electricity for households – urban communities
N5	Electricity for service sectors
N6	Heat for industry
N7	Heat for households
N8	Heat for service sectors
N9	Energy for cooling for all sectors
N10	ENEF in industry
N11	Municipal solid waste management
N12	Other needs and priorities

The assessment of Israel's needs and priorities indicated *electricity for households* (N3, N4) as very important, since electricity consumption by households is one of the main drivers for the annual increase in energy consumption in Israel. However, some stakeholders assumed that this trend would be moderate since most of the residential buildings in Israel already use air conditioning systems. In general, the interviews did not show a clear distinction between rural and urban communities.

The interviewees also considered of very high importance the service of *electricity for service sectors* (N5), mainly based on the argument that recent national economic developments showed a shift from agriculture and industry towards commercial and health service activities. There was a consensus among stakeholders interviewed that the need for electricity in this sector was high and would remain high in the short to medium term, while there were no incentives to cut electricity usage in these sectors.

ENEF in industry (N10) was also considered a very important energy service for Israel. This was due to the fact that improvement of energy consumption systems for more efficient energy use was considered critical for the industrial sector, both from an economic and environmental point of view.

Electricity for industry (N1) resulted as high priority in Israel, due to the high annual rate of industrial growth and consequently the growing need for electricity. This growth is largely accompanied by an increased use of automatic machines such as robots, in particular in high-tech industries.

The opinions on *heat for industry* (N6) differed in the sense that in some industries heat is much needed, whereas in other industries the need for heat is very low. Despite the trend of moving from traditional industries to high-tech and services, there is an essential need for efficient heat technologies in the heavy industries. Some stakeholders mentioned the potential for wide utilisation of cogeneration systems in the industrial sector, which could simultaneously cover a significant part of electricity and heating needs. Nonetheless, this service was considered important by Israeli stakeholders.

The rest energy service needs were considered by stakeholder as either of medium, low or very low importance for Israel.

Suitable sustainable energy technologies for Israel

Stakeholders also assessed the suitability of clean energy technologies for fulfilling the services that addressed as essential for Israel. Three categories of technologies were found very suitable and rank as very high: solar based technologies, ENEF improvement in residential dwellings, and coal to gas fuel switch technologies. Table 2 presents the results from the set of interviews as regards the most suitable energy technologies to fulfil the country's need and priorities.

Table 2 Suitable sustainable energy technologies

Israel
Solar photovoltaic (PV)
Solar thermal
Sustainable building design
Energy saving lamps
Air conditioning
Coal to gas for power
Wind power
Municipal solid waste methane combustion
Solar lanterns

- *Solar*: solar PV and solar thermal for water heating were particularly mentioned, due to the high potential for solar-based technologies in Israel. However, suitability of PV technologies might be threatened by the rather high costs associated with the technology. Solar thermal has been relatively well proven as it is already applied in Israel.
- *Efficiency improvement in buildings*: sustainable building design, improved air conditioning and energy-saving lamps were considered very suitable technologies for Israel with the objective to reduce energy demand in households that resulted as a very important priority. Some stakeholders explained that sustainable building design would fit well in the new Israeli building standards which encourage energy use reduction in buildings. The same was assumed for passive cooling technologies and solar cooling technologies that contribute to ENEF and have already been applied in construction of buildings in Israel.
- *Coal to gas*: there was a consensus among the interviewees that the current process of switching from coal to gas in energy production in Israel will continue according to the energy plan of the government and Israel Electric Corporation (IEC).
- *Wind energy* was ranked high in terms of suitability. However, only a small amount of wind energy capacity has been installed in Israel in specific high areas. Most of the interviewees were convinced that if Israel were able to overcome some technological and political obstacles, wind power can be a more important source of clean energy in Israel.

Stage 3

In the framework of the ENTTRANS project, ICTAF has organised two participatory stakeholders' workshops. The first one took place on January 2007 and the second on October 2007. The main aims of the participatory workshops were:

- to analyse the feedback collected through the questionnaires completed at stage 2, on energy needs and technology priorities
- to explore the existing market system into which a new low carbon technology would be introduced through the CDM by using the 'market mapping' approach
- to explore how the CDM affected this process at the international and national levels and also how it could facilitate market adoption of technologies.

In these workshops the focus was laid on solar energy technologies for electricity and how the CDM could help support their diffusion. Biofuels, clean coal and solar PV, CDM issues and emissions trading were also discussed.

Opportunities identified from market mapping

Israeli stakeholders recognised opportunities in the solar market for power generation and for small scale technologies as delivering benefits for energy security to the country. According to stakeholders, Israel has built up experience with a range of technologies and has a good potential for a variety of applications. An important driver for the implementation of new technologies is the need for low carbon and energy security of supply. However, stakeholders mentioned that only by including external effects from conventional fossil fuel combustion in the cost calculations (e.g., energy prices) would justify the additional initial financial risk related to introducing and implementing new technologies.

Table 3 Summary of opportunities in Israel

Opportunities for renewable energy technologies	• Significant current experience with a range of technologies and good potential for a range of applications (especially solar) • Key driver is considered the need for low carbon energy mix and increased security of energy supply • Costs taking account of externalities can justify the additional initial financial risk • Environmental and health advantages • Export opportunities of RES technological products • Solar thermal technologies: mature technologies, able to provide electricity and water heating • Contribution for the development of new local industry (e.g., solel)
Opportunities for ENEF technologies	• Contribution for a better environment • Increased security of energy supply • Improving living standards • Does not need large investments • Increase of public awareness

The key opportunities seen by the participants in utilising the 'new' technologies discussed for the Israeli market mapping included the following trade and sustainability benefits:

- trade opportunities
- economic development and superior technology
- electricity load balancing and security of supply
- poverty alleviation
- increased funding and new policy directions
- improved skills.

A summary of the identified opportunities arising from the market mapping analysis in Israel is provided in Table 3.

Barriers identified from market mapping

Israel considered blockages in both renewables and ENEF technologies and stakeholders were concerned with the apparently higher costs, lack of regulations, standards and enforcement, lack of incentives to adopt energy efficient measures, lack of awareness, lack of competition and interestingly the lack of cooperation between industry and R&D. This latter reflects part of the role of a functioning market network.

In general, based on the market mapping the main barriers regarding the implementation of renewable energy technologies and ENEF technologies in Israel can be summarised in the following Table 4.

Table 4 Summary of barriers in Israel

Barriers for renewable energy technologies	• High upfront costs • Lack of regulations and standards to support technology development • Economic obstacles for clean energy technologies such as solar PV • Lack of competition in the energy sector • Limited social awareness
Barriers for ENEF technologies	• Insufficient cooperation between industries and R&D • Insufficient incentives for investment in ENEF technologies • Existing standards to support technology development are not obligatory

To sum up the outcomes of the application in Israel, the following key points could be highlighted:

- ENEF in industry and electricity for industry was seen as high priority areas and perhaps reflect a need which has been growing over time due to lack of investment in this area and aging of current technologies.
- Electricity for households was also considered a priority.
- Electricity for the service sectors is considered of particular importance.

- There was more emphasis on a range of smaller scale technologies for space and water heating, for cooking, lighting and distributed generation.
- Solar PV was highly rated in Israel despite the high costs of this technology.
- The solar thermal technologies were considered mature technologies. Therefore, these technologies could provide electricity, heating and cooling in many places in Israel.
- Due to the need to limit demand in the domestic sector, ENEF technologies related to buildings were rated highly.
- To assure reduction of GHGs emissions derived from using fossil fuels, additional systems using solar PV and solar thermal should be introduced.
- CDM and other financial tools might be efficient tools to promote implementation of some technologies, especially when such incentives of the Israeli government do not exist.

The suitability and appropriateness of sustainable energy technologies is generally are not limited by the level of knowledge and R&D activities in the areas of clean energy technologies. However, the opportunities for implementation of most technologies are limited since they are not always suitable for the local geographic, climate and socio-economic circumstances in Israel.

In general, the representatives of R&D organisations and the governmental experts were familiar with most of the technologies, while NGOs and commercial organisation/consultancy representatives were not and mainly focused on their 'own' specific technology, e.g., solar PV, bio-diesel or fuel cells. The technology descriptions that have been developed and the extensive discussions among the stakeholders have established the required climate for a more objective assessment of alternative technological options. Awareness raising activities and technology promotional campaigns are expected to strive towards the overcoming of the above mentioned barrier and consequently to the easier adoption of new low carbon energy technologies by stakeholders of the energy market in Israel.

4 Conclusions

The (usually not professed) truth is that we are not destroying the planet due to lack of technology, but due to lack of application of technology. Another truth is that we should better separate energy technologies in appropriate for a specific energy system and not appropriate ones instead of separating them in 'good' and 'bad' ones. In this regard, the proposed participatory approach may facilitate energy decision makers and relevant stakeholders to define, evaluate and finally decide on the most suitable sustainable energy technologies to transfer and implement in a particular developing country through CDM. With the appropriate use, the proposed methodology could act as a useful decision support tool for the assessment of a host country's main energy needs and priorities. Following that, the most suitable low carbon energy technologies to fulfil these needs, are ranked from the most attractive to the least one, taking into consideration the sustainable benefits these technologies may deliver as well as the host country's existing market system into which the low carbon technology would be introduced through the CDM. The lack of familiarity among some of the interviewees regarding the less well-known energy technologies and the consequent negative impact on the sustainable transfer of such technologies could be alleviated with such a participatory approach that facilitates the diffusion of information among the stakeholders and the development of a global view as regards the energy market of the host country.

Therefore, the paper provides useful results that could facilitate the Israeli DNA as well as future project investors to put on the map the most suitable sustainable energy technologies, to transfer and implement via CDM. In addition, the methodological approach presented provides a systematic method for integrating information from several different stakeholders and could be used repeatedly to monitor the progress made by the specific examined host country over time.

To this end it can be mentioned that the ENTTRANS approach is a participatory in-country process that could serve as a support tool for the formulation of strategies for the promotion of new energy technologies through the CDM, by exploring the technology transfer process and the energy market structure. The participatory element is considered of high importance as it helps to obtain insight into which energy services stakeholders perceive as important, which technologies they consider suitable for that, and how the CDM could support their implementation. A significant perspective for further research in this area is to elaborate on technology implementation chains and to explore how ad-hoc CDM project implementation will be bundled in programmatic CDM activities and how these activities will be incorporated into an integrated sustainable energy strategy for the developing countries, serving the threefold energy policy objective of security of supply, environmental protection and competitiveness. In this framework, a dynamic energy market mapping in conjunction with the monitoring of CDM projects implementation would provide valuable insights on the effects of programmatic CDM activities in the host country energy system.

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