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Final Report

BEEP Review

Indo-Swiss Building Energy Efficiency Programme (BEEP) – Phase II

Impressum

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Abstract

This document comprises the review of the ongoing phase of the Indo-Swiss Building Energy Efficiency Programme (BEEP), which is supported by the Swiss Agency for Development and Cooperation (SDC) and is part of the Global Programme Climate Change (GPCC) of the SDC. The BEEP is implemented under a Memorandum of Understanding (MoU) between the Ministry of Power, Government of India, and the Swiss Federal Department of Foreign Affairs (FDFA). The goal of the review is to evaluate if the programme has achieved or is on track for achieving the objectives that were defined and in particular evaluate the relevance, impact, effectiveness, efficiency, and sustainability of the BEEP.

The review provided good feedback regarding the progress of the programme within the framework of the BEEP. Most of the objectives defined by the GPCC were achieved successfully. However, the accomplishment of an extended local implementation will depend on the future dissemination of the gained knowledge by the various project partners. The programme was able to bring together building professionals, public institutions, and national and state level stakeholders on the topic of energy efficiency in buildings. Now that the network has been created, it should be kept active to spread awareness on energy efficiency.

Although minor adjustments to the original planning had to be made, the BEEP managed to achieve considerable results for each of the main targeted goals. If the programme focuses on disseminating learning and results, during the rest of the second phase or during a possible additional third phase, the impact of the programme could be significant.

To ensure a positive impact of the programme in long term, there needs to be regular reviews on how the knowledge is being transferred and used by the different actors. This document lists some recommendations about the possible future development of the BEEP.

Executive Summary

Based on the analysis of the documentation available and on the interviews performed by the review team in Switzerland and India, the achievements of the programme at its current state are assessed in this report.

The ongoing programme (Phase II)[1] started in 2013 and will finish by the end of 2016. The second phase builds on the work carried out in the first phase, which started in 2008. The overall goals of BEEP's phase II are the reduction of energy consumption in new commercial buildings and elaboration of best practices for the construction of low-energy residential and public buildings in India. The BEEP is in line with the priorities of the Bureau of Energy Efficiency/Ministry of Power to reduce the energy consumption in the new residential, commercial and public buildings.

The work done so far constitutes an important basis for the achievement of the targeted goals and will contribute in achieving the main objectives of the GPCC. The programme is subdivided in five outcomes. There were significant achievements from all the outcomes. The achievements for each outcome are listed below:

Outcome 1: *Builders and developers implement energy-efficient solutions for new commercial buildings*
Design charrettes were conducted with support from Swiss and Indian experts for 16 projects covering major building types in India. The Swiss experts connected very well with the Indian

[1] This report makes reference to the administrative numbering of the project phases as per SDC's procedures and records. The preparatory phase is referred to as Phase 1, whereas the main implementation phase is referred to as Phase 2.

context and brought in rich experience, credibility, and use of latest tools, which helped in convincing participants about the recommended energy efficiency measures. 11 out of these 16 projects have implemented or committed to implement a majority of energy efficiency recommendations discussed during the charrettes. Some of the recommendations are well quantified and specified, and can be straightaway incorporated in future designs by architects, consultants, and builders easily.
There were five entries in the external movable shading design competition that were awarded and selected for further development.

Outcome 2: *Building professionals have access to certified information on the characteristics of Indian thermal insulation products*
Five labs have been upgraded and benchmarked against international labs for testing insulation products in India. A manual for building insulation testing has been released. Certified information on the characteristics of Indian thermal insulation products are being compiled and will be released in 2016.

Outcome 3: *The design guidelines and the Minergie-India label are used as a reference by residential sector stakeholders in the composite, warm humid and cold climatic regions*.
Design guidelines for residential buildings for one region (Composite and hot-dry climate) were published and recognized as high quality publication by the stakeholders. Currently, the guidelines for the warm-humid zone are in progress and will be published shortly. Next will be the guidelines for the cold region.
The design guidelines for all regions will be useful in disseminating and improving the knowledge about energy-efficient design of residential buildings in India. It is assumed that if the guidelines are systematically used for the future design of energy-efficient buildings, there is a huge potential for the reduction of energy consumption and carbon dioxide emissions in the residential building sector.

Outcome 4: *The design templates are used as a reference by public building sector stakeholders in 5–10 selected states*
Four templates for the design of energy-efficiency public buildings for one state are published and two more for other states are planned to be published or are in the process of preparation.

Outcome 5: *Increased knowledge and awareness on climate-responsive, high-performance, energy-efficient solutions for new buildings among India's building sector professionals, end-users, local authorities, and policy makers*
The subject matter expertise, knowledge, and support shared by the Indo-Swiss project management teams were of high standards and quality and helped increase the knowledge of the actors involved in the project. The actors appreciated the collaboration with the Indo-Swiss team leaders and reported it to be beneficial. As the project is endorsed on the highest political level (at the National Ministries), the support and ownership is also quite high. Internationally, the project gained visibility through the presentation of the Building Guidelines (Outcome 3) on a multilateral level. As a result of their high quality and exemplary function, the Guidelines were quoted as a reference in the intended Indian contribution to reduce global warming emissions for the COP 21 Climate Conference in Paris in 2015. These positive features are setting the seed for a broader replication. However, at the current status of the project, the implementation of the learning seems to be confined to the supported case studies and pilot projects (particularly outcomes 1 and 4).

Despite the significant numbers of published documents and achieved goals, an important part of the work needs to be completed. On the one hand the number of provided documents, mainly concerning the design templates in outcome 4, has not been reached, on the other hand the dissemination of the existing BEEP deliverables outside of the BEEP community, and effective use

of the newly acquired knowledge, merits particular attention in the remaining time of the current phase, as well as for a possible Phase III.

For all activities, the most conducive level of actor's involvement must be sought.

This review includes separate recommendations for each of the described outcomes in the appropriate evaluation chapter. The list below represent a recapitulation of the main aspects emerged during the BEEP analysis. **For the detailed recommendations, please refer to the respective Outcomes in the main text of the present report**.

Main recommendations in the remaining time of the project:

1. Conduct the remaining charrettes and provide further support to select projects to ensure proper commissioning and training of building operators. This will be a new task but because of its importance in ensuring delivery of energy efficiency in the actual building, it is recommended in the current phase.
2. Prepare case studies documenting the Energy Conservation Measures (ECMs) incorporated in the charrettes, which were successfully executed. Emphasis has to be given on how the ECMs were designed and incorporated in the building. Also include the life cycle cost analysis.
3. Support the winning entries of external movable shading design competition in prototyping and testing their designs.
4. Develop business cases of insulation in walls and roof for different building types and different climatic zones. This should include insulation selection, cost benefit analysis, and detailed sections of walls and roofs considering construction practises in India.
5. Ensure a solid technical review of the Guidelines because it will be used by thousands of students and professionals and carry a risk that it may not be well used or understood.
6. Case studies can be created to demonstrate the use of design templates in coming out with high quality building designs incorporating the best practices of energy efficiency measures. For the remainder of templates that will be developed in the remaining time of the project maintaining quality should be the focus instead of number of templates.
7. Use the remaining time of Phase II for awareness raising at the State and Municipal level in view of a closer involvement in Phase III.
8. Perform an actors analysis, and define which Knowledge will be useful to which group of actors (for instance, identify the best suitable level of government – municipal, states, or central state) for policy dialogue, for showcasing, and so on.

Overall recommendations for Phase III

The evaluation team supports the continuation of the BEEP project in a third phase, with a strong focus on a broader outreach and going to scale.

Pathways for involving the different levels of government (Central, State, Municipal) need to be tackled more proactively, according to their specific responsibilities.

Charrettes are viewed as excellent means not only for strengthening capacities of directly involved practitioners, but also for solid documentation and showcasing. This element should be continued, and used more strategically in order to raise the knowledge level of the decision makers, building occupants (potential buyers), Practitioners and Academia.

The active involvement of, and push by State and Municipal Authorities should be enhanced by proactively promoting the Templates for Public Buildings. Most conducive Communication Channels must be sought.
Templates for Government buildings should be continued with a clear strategy of linking the practical work with the policy level. The work on the templates could be combined with concrete

Charrettes and subsequently with a support of the State Government in view of a better informed dissemination of the subject.

A clearer Knowledge Management Strategy with Actors Analysis should be conducted during the preparation of Phase III, for strong integration and interlinking of the various elements of BEEP.

Possible elements

1. The Charrettes should be continued as starting and melting points for joint planning by investors, practitioners, students in order to showcase procedures and technologies for energy-efficient residential and commercial buildings. Charrettes should be considered to be used as showcase elements also for Decision Makers, possibly by combining with the Templates for Public Buildings.
2. Main attention should be given to the shading, including architectural elements as well as the questions of the blinds.
3. Insulation should be a focus of the project in terms of integrating insulation in building design, and use of thermal insulation practically. Respective Capacity Development should be conducted. However, the testing of insulation materials should be discontinued as this part can now be conducted without additional support from BEEP.
4. Building Guidelines should be broadly disseminated and proper use of the Guidelines supported.
5. To reach scale, continue the practical showcasing with a link to the decision-making level. Templates for public buildings should be continued with a clear strategy of linking the practical work with the policy level.
6. Establish a Knowledge Management Concept and Communication Pathways for more effective outreach and use of the BEEP achievements beyond the project.

Partners and Scaling Up

1. Find the right level of Government – tackle the State or Municipal Authorities responsible for the regulations related to Building Stock, and relate to the Central Government for overall political guidance.
2. Perform an Actors Analysis in order to target the best agents for widespread implementation of meaningful Concepts for energy-efficient building practices. At the Decision-Makers level, assess the leverage potential of working through State Authorities or Municipal Authorities.
3. Focus on Students and Academic Institutions for upgraded curricula, training on systemic approaches, involvement in the Charrettes Trainings and use of the Knowledge Products. Involve students from architecture an engineering background jointly.
4. Continue working with practitioners.

Technical recommendations

1. Introduce charrettes during early stage of design and provide support till commissioning of the building.
2. In India, outdoor conditions are such that external movable shades are difficult to maintain. Hence, explore the use of in-pane movable shades. Existing buildings can be used first to showcase and evaluate the performance of movable external shading technologies.
3. Prepare a chapter on building insulation for inclusion in the building materials course because currently it is not given proper emphasis in the architectural and civil engineering curriculum.
4. Create a communication campaign by usual publishers on energy-efficiency in buildings, public institutions as well as in governmental offices to spread information about the guidelines and templates and their expected impacts on energy-efficiency in buildings. Look for pathways to raise awareness among the General Public.
5. Add some chapters about thermal comfort and sustainability in the guidelines to ensure a higher occupants' acceptance. Some key values should be indicated to help the calculations and design work.

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Acronyms and abbreviations

BEE	Bureau of Energy Efficiency
BEEP	Indo-Swiss Building Energy Efficiency Programme
COP	annual Conference of Parties of the UNFCCC
DST	Department of Science and Technology, Government of India
ECBC	Energy Conservation Building Code
ECM	Energy Conservation Measure
GPCC	Global Programme Climate Change of SDC
GHG	Greenhouse Gas
HVAC	Heating Ventilation and Air Conditioning
IIF	India Insulation Forum
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
JAC	Joint Apex Committee
JIG	Joint Implementation Group
MoU	Memorandum of Understanding
NGO	Non-governmental Organization
NID	National Institute of Design
OECD	Organisation for Economic Co-operation and Development
PMTU	Project Management and Technical Unit
SDC	Swiss Agency for Development and Cooperation
UNFCCC	United Nations Framework Convention of Climate Change
VLT	Visual Light Transmission
VRV	Variable Refrigerator Volume

1. Introduction

This review is expected to provide a critical independent view on how the SDC funded Building Energy Efficiency Programme (BEEP) is being implemented. After a general overview about the BEEP in chapter 2 and the methodology used in chapter 3, chapter 4 "Evaluation of BEEP phase II" refers to the review and recommendations for each of the five designated outcomes of phase II. Chapter 5 "Overall Assessment" refers to the general recommendations regarding the improvement of the project strategy for the remaining project phase (until Dec. 2016) and beyond.

1.1. Evaluation objectives

The objective of the review is to provide insights into the results, effectiveness, efficiency, relevance, and sustainability of the project and to point out lessons learned in promoting energy efficiency in buildings. The review focuses in particular on:

- How energy-efficient measures are being integrated in the building design
- The efficacy of the training of the different stakeholders (consultants, architects, developers and builders) and developing their competences
- Developing competences on thermal insulation labs
- Training needs for buildings' occupants to achieve estimated energy savings
- The project's outreach to the builders and planners

1.2. Scope of work

The review is based on the set of criteria prescribed by OECD, namely relevance, impact, effectiveness, efficiency, and sustainability. Therefore, the goal of the review is to evaluate the progress and report the achievements based on the defined evaluation criteria. The analysis will result in recommendations for the remaining period and for the future orientation of the project.

The evaluation criteria sorted by topics are:

Relevance

- Enhance energy efficiency in general and its relevance in the improvement of India's future energy scenario in the context of smart cities.
- Relevance of the strategy and approach followed under the project.
- Contribution to GPCC goals and objectives.

Impacts

- What were the pioneering contributions of the BEEP in the field of building energy efficiency and GHG mitigation?
- Did the project commit with the right mix of stakeholders such as ministry, builders, developers, testing labs, academics, architects and so on?
- Did the project adapt adequately to changes in the policy and regulatory environment and to specific opportunities that presented themselves?
- Was the policy impact of the project adequate? How did the project address policy or contribute towards policy processes at national level?

- What was the impact of the project in terms of transfer of Swiss technical know-how on energy efficiency in buildings?
- What were the innovations for emissions reduction which were effectively conducted under the project and what were the effective results?
- What was the impact and learning from transfer and management of technical know-how for builders, project developers, consultants, and thermal insulation labs?

Effectiveness and Efficiency of Strategy

- Was the choice of target group adequate?
- How effective was the project in linking implementation actions with policies?
- Was the resulting dissemination strategy adequate?
- What did the builders, developers, municipal authorities and other partners learn from the project?
- Did the project outcomes and outputs correspond with the originally defined objectives?
- How effective were the monitoring instruments used at the different levels of the project implementation?
- Was the project efficient and effective (cost-benefit ratio) regarding the SDC funds?

Sustainability

- Should the project consolidate its activities or expand to new areas/sectors? Which are the other areas/sectors where the project should expand to?
- Should the project continue to focus on Swiss know-how transfer or rather on expanding with Indian stakeholder in the remaining period? What strategies does the project need to adopt for accelerating the diffusion of measures to increase energy efficiency in buildings?
- Should the project commit differently with the government (national and state)?
- What should be the role of other stakeholders such as academic or research institutions that could contribute to the project efforts?
- What is the potential for further enhanced cooperation with authorities, dwellers, architects or investors?

Recommendations

- Which recommendations shall be formulated for the remaining period or for a potential new phase?

2. Programme background

2.1. Overview

India's construction sector has been facing unprecedented growth due to an economic and demographic boom. It is forecasted to grow at 7-8 percent each year over the next decade. In fact, the total Indian building floor space is expected to increase by two to four fold by 2030 compared to 2010, which implies that an additional nine billion square meters will be built even in the most conservative scenario. While this unprecedented growth is a positive indicator for India's development, the country faces considerable challenges in terms of energy supply, as well as the carbon dioxide emissions. At the moment, buildings in India (both commercial and residential) account for 34 percent of the country's total electricity consumption.

The Indian Government recently declared its intention to support the implementation of 100 smart cities in the country. As India's building stock is quickly increasing, a large scope for energy savings exists through introducing new guidelines to promote energy efficiency in buildings. To achieve this objective, the central Government of India issued the Energy Conservation Building Code (ECBC) in 2007 for commercial buildings. The code was adapted and declared mandatory in many, but not all States.

In view of supporting this objective, the Swiss Agency for Development and Cooperation (SDC) in partnership with the Ministry of Power, Government of India, is supporting a project to reduce energy consumption in new commercial, residential and public buildings. On November 8th 2011, a memorandum of understanding (MoU) between the Swiss and the Indian government was signed for a five-year Indo-Swiss cooperation project on building energy efficiency (BEEP). The main objectives of the project are to reduce energy consumption in new commercial buildings through efficient design and construction, implement innovative technologies as well as develop competences, and disseminate knowledge on the construction of low-energy residential and public buildings.

2.2. Project components

Five outcomes to be achieved were defined for the project (see Project Log Frame and Project Document):

Outcome 1 (**Design Charrettes**): 'Builders and developers implement energy-efficient solutions for new commercial buildings'.

Outcome 2 (**Insulation Materials Testing**): 'Building Professionals have access to and make use of certified information on the characteristics of Indian Thermal insulation products.'

Outcome 3 (**Residential design Guidelines and Minergie-India label**): 'The BEEP design guidelines and a Minergie-India label are used as a reference from different stakeholders of the residential sector in India's three main climatic regions, namely composite, warm humid, and cold.'

Outcome 4 (**Design Templates for public building sector**): 'The design templates are used as a reference from the stakeholders in the public buildings sector in 5-10 selected states.'

Outcome 5 (**Knowledge Management**): 'India's building sector professionals, end-users, local authorities and policy makers are increasingly aware of climate-responsive, high-performance, energy-efficient solutions for new buildings and have access to relevant knowledge.'

These outcomes are categorized in four topics:

i. (Design Charrettes): Promoting integrated design practices among India's builders and planners as a tool for energy-efficient building design.
ii. (Insulation Materials Testing): Reinforcing India's testing capacities for building insulation materials.
iii. (Guidelines and Minergie / Templates for public buildings): Promoting exchange of best practices and dissemination of knowledge on the design of energy-efficient residential and public buildings.
iv. (Knowledge Management): Gaining know-how and increasing the number of professionals in the building sector.

The current phase (phase II) is for the period 2013-2016. It is based on the work carried out under the first phase (phase I) of the project, which lasted from 2008-2012. The programme steering and oversight is ensured through the Joint Apex Committee (JAC) and the Joint Implementation Group (JIG). Two Project Management and Technical Units (PMTU) are responsible for the programme implementation. In Switzerland, the PMTU is based at Effin'art, Lausanne, and in India, it is based at Greentech Knowledge Solution Pvt. Ltd, New Delhi.

During the last three years, BEEP phase II truly delivered on the four objectives mentioned above. Some of the key achievements are the following:

- Sixteen integrated design workshops were held for large commercial and public buildings, resulting in strategies to reduce energy consumption by 20-40 percent.
- Guidelines for energy-efficient multi-storey residential buildings for composite and hot climates were published. They were officially launched by the Government of India in 2014.
- Energy-efficient design recommendations were integrated into the construction of a public building in the city of Jaipur, Rajasthan, resulting in energy savings of more than 30 percent.
- About 1000 professionals of the building sector were made aware of integrated design methodologies and best practices for energy-efficient buildings.
- Laboratory capacities in India were developed and strengthened to test the thermal performance of insulation materials and assemblies.

The following activities, which were approved by the project steering bodies under the annual action plan 2016, are planned for the remaining period of the project:

- Remaining integrated design charrettes to be carried out and energy efficiency measures to be developed for upcoming building projects.
- More building professionals and practitioners to be introduced to integrate design practices and trained in energy-efficient designs.
- Comprehensive guidelines on designing energy-efficient residential buildings to be developed for two more climatic regions.

3. Methodology used

The review is a qualitative assessment based on four main parts: (a) a documentation review, (b) the inception report, (c) interaction with the main stakeholders and the implementation partners in Switzerland and India including several site visits and (d) the final report (the present document).

3.1. Documentation review

The first part of the work offered insight into the project and its objectives. The relevant project documentation received from the SDC was analysed (see list of available documentation in ANNEX A – Documents provided by SDC).
Second, an appropriate methodology for the review of phase II was defined. The chosen procedure was documented in the Inception Report.

3.2. Inception report

An Inception Report was delivered to the project team (SDC). The document includes the chosen methodology for review of phase II which was first discussed and defined within the project team (as mentioned above).

3.3. Interaction with stakeholders and partners

Interviews were performed by the review team to report about the interactions between the stakeholder and the project partners. Most of them took place during the site visits in India.

The course of the structured interviews and site visits included the following steps:

- The interview questionnaire (see ANNEX E - Set-up of structured interviews) was delivered in advance to the SDC and then partially to the designated stakeholders. The stakeholders were listed by SDC; the list also contained the planned site visits and was evaluated and adapted by the review team based on the review documentation and their feedback.
- The proceedings of the meetings, the interviews and the site visits conducted by the review team and the SDC are documented in Annex B, C and D.
- The meetings, interviews and site visits were documented provisionally during the visit in India.
- A debriefing with the SDC India took place during the last day of the visit in India.

3.4. Final report

The observations and analysis of the interactions in India and Switzerland are summarised in the final report. The project outcomes were compared with the initial goals defined by the indicators listed in table 1. A qualitative and quantitative evaluation was performed. The questions about the effectiveness, efficiency, relevance and sustainability of the project were answered.

A draft version of the final report was delivered to the SDC. The Feedback from SDC were included in this final version, which will be presented to SDC in a debriefing meeting in Bern.

Table 1: *Indicators for impact assessment of the programme, according to Project Document*

No. of outcomes	Outcome indicators for assessment
Outcome 1	a) Number of energy efficiency measures adopted in the final design of the 20 charrette projects. b) Number of Indian builders and developers of commercial buildings regularly opting for integrated design approach and regularly opting for energy advisory services and/or energy-efficient strategies in their projects.
Outcome 2	a) Number of insulation material products and number of important insulation products manufacturers whose test results are published in the data-book. b) Number of building design professionals who have access to the data-book and are using it for the design of buildings.
Outcome 3	a) MoP/BEE notifications/communication on the issue of design guidelines for residential buildings. b) Number of building professionals, builders, end-users, and banks using the design guidelines. c) MoP/BEE notifications/communication on the Minergie-India label. d) Number of building projects registered/labelled under Minergie-India label.
Outcome 4	a) Number of states issuing notifications/communication on design templates for public buildings. b) Number of public buildings designed following the guidelines.
Outcome 5	a) Number of Indian professionals attending the advance training programmes and applying the knowledge gained in the training programmes. b) Number of visitors to the programme website, number of down-loads of tools, number of Indian professionals joining the CoP /forums, etc.

3.5. Evaluation programme

Table 2 shows the timeline of the evaluation programme.

Table 2: *Overview of the main activities planned, including timeline and expected deliverables.*

Date	Activity	Deliverable
07.04.	Kick-off: Initial skype meeting (without Mr. Garg)	
09.04.	Separate meeting in India between SDC and Mr. Garg	
09-25.04.	First phase desk review based on documents and information provided by SDC India (relevant project documents, review reports, minutes of meetings, promotional products, workshop details, media coverage and all other materials related to the project)	
14.04.	Web interaction of the review team	
25.04.	Interaction with Swiss PMTU (Effin'art)	
25.04.	Submission of the draft inception report including proposed methodology, task distribution and outline final report for the review.	Draft inception report

27.04.-04.05	Review activities in India including Stakeholder interactions, personal interviews and visits of on-going projects.	
27.04.	Team meeting with SDC India / Briefing on BEEP	Final inception report
04.05.	Work within the team / Debriefing with SDC and BEE	Identification of additional needed information by the review team
05.-11.05.	Second phase review and eventual identification of additional interviews (mainly by skype or similar)	
12.05.-15.06.	Additional interviews and writing of the report.	Draft report
20.06-30.06.	Editing report to incorporate response and feedback on the draft report by SDC India.	Final report and presentation
		Financial reports

4. Evaluation of BEEP phase II

According to the answers received during the interviews, the following observations were made:

- All of the various partners involved in the project (from practice to governmental level) provided a positive impression about the BEEP.
- The national government confirmed that the BEEP was relevant to the implementation of their strategic targets.
- The composition of the project team was complimented. The balance between the responsibilities of both the Indian and Swiss parts involved in the project was appreciated.
- The number of scheduled meetings seemed to be relatively high (JAC and JIG meetings), but the administrative work that needed to be done was acceptable.
- Because of its realistic and appropriated goals, the interviewed partners judged the project to be the best international project on which they collaborated.
- The project steering and organization allowed some flexibility with the goals' definition (it was possible to adapt some of the objectives during the ongoing phase of the programme).
- All the partners wanted the project to be continued.

4.1. Outcome 1: IDP charrettes and design competition for external movable shades

The goals of outcome 1 were to contribute in the design of 20 energy-efficient buildings following an integrated design process approach and increase awareness and capacities of more than 1000 building sector professionals in the integrated design process. Initially, the focus was on commercial buildings, subsequently it was also opened to public and residential buildings.

The goal of the design competition for external movable shades was to influence participants to create innovative, India-specific designs and solutions. The activity to organise design competition for external movable shades was approved as a part of action plan for 2014 by JAC during the meeting held on 18th December, 2013.

Achievements regarding the outcome 1:
Sixteen charrettes have been performed. Out of these 16 selected projects, 11 have committed or implemented a majority of recommendations. A short movie has been prepared for public awareness on "Savings Energy: Integrated Design Way".

The design competition for external moving shades was organised successfully. Out of a total of 31 entries, 5 were awarded.

Positive aspects:
The project team has chosen major building types for the charrettes. These include IT, hospital, office, residential, and academic institutions. During the charrettes, the building performance was quantified using energy simulation. According to the project team estimates, if all the recommendations made during the charrettes are implemented; it will lead to an energy saving of 25 to 40%. One of the projects – Aranya Bhavan at Jaipur - has been constructed and is being monitored for its energy performance. The total built-up area impacted by the charrettes is approximately 1.2 million m^2. Based on the interviews conducted during the review, it is understood that Swiss experts connected very well with the Indian context. They brought in rich experience, credibility, and use of latest tools for quantification which helped in convincing the charrettes participants about the recommended energy efficiency measures. Also, the design communication was very effective and helped in reducing the time spent in design by reducing the number of iterations.

External shading is a very important aspect of energy efficiency and the competition was a good idea to get innovative designs and involve various groups. Involving NID for evaluating the entries and CEPT for testing the prototype was the right step considering the expertise of these two organisations.

Negative aspects:
Most of the projects selected for the charrettes had their designs and/or the budget frozen before the charrettes were conducted. For most of the projects, it was too late for façade or layout changes. Though the charrettes were helpful in introducing energy efficiency measures in the design, they could not utilise the maximum potential because of other constraints already in place. It seems that the designs are better than the original but not the best. Care has to be taken while showcasing these design/buildings to ensure that they are not taken as the best examples of energy efficient buildings. The design features have to be clearly highlighted and promoted and it should be ensured that the overall strategy and integration is highlighted. For example, water cooled chillers in buildings lead to energy efficiency. However, it has to be communicated, that for dry regions such as Rajasthan, it is important to have a good rain water harvesting and waste water treatment system in place for providing treated water to the chillers.
In the interviews, the participants mentioned that the design intervention were concentrated for 2-3 days and not throughout the long process of design, procurement and commissioning. Some of the projects selected for the charrettes expressed a desire for more support during the design, execution and commissioning stages. This seems to be a challenge as the project works under a specified time-frame. The execution of projects usually is slow and takes time before being commissioned.

The external movable shade competition was rather technically demanding. A simplification would probably have attracted more applicants and maybe more innovative ideas at the concept level. Though, this would have meant a longer hand-holding period and more in-depth guidance afterwards.

Relevance
The relevance of integrated charrettes is quite high as early stage design interventions play a very important role in achieving energy efficiency in buildings. Early stage design optimisation helps in achieving higher levels of energy efficiency with lesser initial cost and more design flexibility. An integrated design process is important in various aspects and includes the active and continuing participation of building owner, users, architects, civil, mechanical and electrical engineers, structural engineers, specifications specialists, and consultants from many specialized fields. Charrettes at the early stage of design helps in achieving goals optimally. Simulation tools help in quantifying design aspects in various terms such as energy savings, cooling/heating load reduction, and daylight availability.

In tropical climates such as in majority of regions of India, high amount of solar radiation causes significant amount of heat gains in buildings through windows, thereby increasing cooling requirements and thermal discomfort in buildings. It is very important to cut the direct solar radiation into buildings. To do so, external movable shades are more effective than internal shades in reducing the heat ingress into the buildings. Further, movable shades give daily and seasonal controls as compared to static shades. This aspect of external movable shades is missing in Indian buildings and is a very relevant energy conservation measure.

Effectiveness and Efficiency
The project team has chosen various types of buildings for the charrettes, such as IT, hospital, office, residential, and academic institutions. Some of the selected building projects are of very high visibility such as WTC Gift City Gandhinagar, Aranya Bhawan Jaipur, Jupiter hospital Pune, Symbiosis Indore, IIIDEM New Delhi. These charrettes were very well organized and Swiss experts connected well with the Indian context. In the proposal, 20 charrettes were proposed out of which 16 charrettes have been performed. Out of these 16 selected projects, 11 have committed/implemented a majority of recommendations. 4 projects are delayed/stalled because of approval or funding issues. One project did not incorporate the charrette recommendations because of various reasons.

The project planning for external movable shading competition was successfully conducted; a web portal was developed for participants to submit their entries. The design competition could attract 31 entries. However, it seems that the level of details (such as operating mechanism, overall design and aesthetics and controllability of shading for optimising trade-off between SHGC and Visual Light Transmission (VLT) operation) asked in the competition submittal discouraged ideas at conceptual level. The competition expected a higher level of maturity in the submission, which could have been achieved by interdisciplinary teams of architects, engineers and designers.

Impact
The impact of the design charrettes has been mixed. Not all projects could incorporate the charrettes recommendations. One project was constructed without incorporating the recommendations and other are stalled due to approval issues (beyond the control of BEEP). It is estimated that there is a potential of about 24 to 40% energy savings over the conventional design as witnessed during the charrettes. For realising the full energy saving potential of these design interventions, it is essential that care is taken in all stages of construction (detailed design, construction, commissioning, and training) and operations.

The winning entries of the ‘movable shades’ - competition were tested at CEPT Ahmedabad. Based on the test, it seems that there is a reduction in solar gains by a factor of four as compared to clear

glass. The ideas need to be further prototyped and developed for manufacturing and commercialisation.

Sustainability
Charrettes have been appreciated by all the interviewed participants. They all agreed that charrettes have to be included in the design process. As of now, Swiss experts were facilitating the charrettes. It is not clear how many new professionals in India are now equipped to conduct future charrettes, especially in view of the required expertise in terms of use of high end computational tools for evaluating building designs.

During the charrettes, various measures were discussed and recommended to improve the designs. Some of these recommendations (Roof insulation and Photovoltaics) are very well quantified and specified, and can be straightaway incorporated in future designs.

Shading design competition has created awareness and brought out some designs for external shading on windows. This has triggered the need and importance of external movable shading. Sustained efforts are required for testing various designs, prototyping, productization and commercialisation.

Recommendations

<u>In remaining time of the project</u>

1. The remaining charrettes should be conducted.
2. Further support to be provided to the buildings that are in construction stage to ensure proper commissioning and training of operators
3. Conduct a tour of professionals, within India to demonstrate best practise of energy efficiency measures in Indian buildings. In this case, the project must assure that the showcase buildings feature top state of the art
4. Prepare further case studies documenting the ECMs incorporated in the charrettes projects which were successfully executed, such as the one done for Aranya Bhavan. Emphasis has to be given on how the ECMs were designed and incorporated in the building. Also include the life cycle cost analysis.
5. Support the winning entries of external movable shading design competition in prototyping and testing their designs.

<u>Next Phase of the Project</u>

1. It is recommended to introduce charrettes during early stage of design and provide support till commissioning of the building.
2. Building operation is a very important aspect for achieving energy efficiency. If not operated properly, the benefits of energy efficiency measures might not be achieved. To ensure that operations are in line with the design intent, training of the operators is required. The project team should be involved in commissioning, training of operators, and monitoring of the projects.
3. To demonstrate best practice energy efficiency measures in Indian buildings, tours can be arranged in India by BEEP.
4. Students from architecture and engineering background can be involved in the project as observers in charrettes.

5. External movable shading design competition was conducted at a higher level and there is a need to conduct it at preliminary level where anyone can bring their innovative ideas. These ideas can be mentored in two or three days mentored workshops.
6. Events similar to hackathons[2] can be organised where experts continuously support teams for their work. Summer school for design, engineering and business students is also a good idea to disburse knowledge and get good designs.
7. In India, outdoor conditions are such that external movable shades are difficult to maintain, in such cases in-pane movable shades can also be considered.
8. Existing buildings can be first candidates to showcase and evaluate the performance. It should be communicated that the proper design of building is the first step for energy efficiency and reducing the need for external movable shading is preferred. External shading can enhance/support the design.

4.2. Outcome 2: Insulation Materials Testing

The goals of outcome 2 were to upgrade up to four laboratories to undertake testing of insulation materials and create a database on the tested characteristics of the thermal insulation products and building envelope components (e.g. insulated wall panels) to be made available to building design professionals.

Achievements regarding the outcome 2:
Technical support was provided to 5 Indian labs through training and testing equipment upgradation to measure thermal conductivity. A manual for building insulation testing has been released.

Positive aspects:
Through this project, BEEP has brought the insulation stakeholders together, and helped the creation of the India Insulation Forum (IIF). Technical assistance was given to BEE & IIF for labelling activities. Round-robin testing of insulation material in Indian laboratories and benchmarking against international lab (EMPA, Switzerland) was performed, which is a very useful exercise. Study tour, international exposure and the manual helped the laboratory staff to learn and implement international best practices.

Negative aspects:
Locations for the labs were chosen to cover major cities in the country; however, two labs in the same city (Ahmedabad) do not necessarily add much value. Only thermal properties are being tested in the supported labs but there is a need to test other properties such as acoustics, fire, dimensional changes, moisture, and bio-deterioration. Nirma lab in Ahmedabad already has a good setup for testing of insulation materials. It would have been better that instead of upgrading equipment at Nirma, money could have been utilised for adding another lab in some other city. It seems that there is not much demand of third party testing of building insulation products in India.

Relevance
In India, the insulation market for building sector is not mature. In a tropical country such as India, there are several benefits of installing insulation such as increase in thermal comfort, higher energy

[2] A hackathon is an event in which usually computer programmers and others involved in software development, including graphic designers, interface designers and project managers, collaborate intensively on software projects. Hackathons typically last between a day and a week.

efficiency, and better acoustics. Based on the request of the project partners from the Government of India, BEEP tried to address several key barriers in the growth of building insulation material market in India. This has been done through building technical capacities in labs in India and launching a national programme to test insulation products. It is felt that lack of third party certification is not the main bottle neck in use of insulation in buildings in India. Testing facilities for insulation products was probably not the only or the most important thing to work on. The thermal insulation surely is an important part of an energy efficient building concept, but other aspects which would also help in increasing the use of insulation are awareness building among the architects, builders and building owners, skilled applicators, demonstration projects, cost effective methods of achieving the desired insulation levels in the facade. Currently, it seems that there are two major impediments in the use of wall insulation. The first one is that it is not cost effective – particularly if an accurate Life Cycle Cost Analysis is not integrated in the concept process – and the second one is lack of skilled applicators. Insulation is not the only building product where third party testing facilities are not sufficiently available in the country. Many other components such as VRV air-conditioners, lighting fixtures, fenestration, window frames do not have sufficient and international standard testing facilities in the country. From the point of view of relevance, because it is a main aspect of the ECBC, insulation represents an important but just one of the priorities among these.

It was expected that Building Practitioners (Architects, Engineers) would make better use of insulation material if good quality certified material is available. However, this target has not been reached and effort is required to implement this aspect.

Effectiveness and Efficiency
The project has met the objective by building technical capacities for five Indian labs for testing insulation material though training, technical support and testing equipment upgradation. However, the labs could have been better distributed across India.

Impact
Round robin testing of the material has been done to benchmark labs. Once database comes in the public domain, it will be useful to select right insulation material as per the climate/location. Training given to lab staff has good impact and will enhance their skills for accurate testing.

Sustainability
Currently, there is hardly any demand for third party testing of insulation products. Probably this would change with a mandatory requirement of insulation in the future. By now there are various reasons for this such as very little use of insulation in buildings: lack of awareness about these testing laboratories, lack of codes/stringent application of codes demanding third party testing and certification.

Recommendations

<u>In remaining time of the project</u>

1. More awareness building is to be done for all stake holders on selecting insulation: architects, building owners, applicators and consultants. Emphasis is to be paid on evaluating the insulation products on all relevant aspects and not just on thermal properties.
2. Business cases of insulation in walls and roof for different building types and different climatic zones to be developed. This should include insulation selection, cost benefit analysis and detailed sections of walls and roofs considering construction practises in India.

3. Training of architects and insulation applicators on how to apply insulation and integrate with current construction practises in collaboration with product supplier.

Next Phase of the Project

1. Insulation should be a focus of the project in terms of integrating insulation in building design, and use of thermal insulation practically. Respective Capacity Development should be conducted. However, the testing of insulation materials should be discontinued as this part can now be conducted without additional support from BEEP.
2. Building insulation is not given proper emphasis in architectural and civil engineering curriculum. A chapter can be prepared for inclusion in building materials course.
3. Centres of excellence can be established across the country with industry and academic partnership.
4. An idea that could be examined is the development of indigenous insulation materials. Research could be supported to explore the possibility of making insulation products out of agricultural waste. One such potential material is rice husk. Converting this waste into insulation might deliver low cost insulation product and also reduce the emission associated with burning of agricultural waste. Though, research and development of new insulation materials is time and cost intensive and difficult to connect with the time-frame and budget of a BEEP phase. Only a little support to the local insulation industry can be considered at this point.

4.3. Outcome 3: Guidelines for residential buildings and adaptation of Minergie to India

The goals of the outcome 3 were to publish design guidelines and adapt the Minergie-label (a label developed in Switzerland to certify energy-efficient buildings) for India's three main climatic regions, namely composite, warm humid and cold climate, and which will be used as a well-known reference by different stakeholders of the residential sector.

Achievements regarding the outcome 3:

- The BEEP Design Guidelines[3] are (partially) available: The guidelines for energy-efficient multi-storey residential buildings in Composite and Hot-Dry Climates were published in 2014 (540 hard copies and 983 downloaded until now). The publication of the guidelines for "warm-humid" climate is due shortly and the one for the "cold" climate is still planned in the remaining time of the project.
- Charrettes on residential building were successfully conducted.
- The guidelines were promoted during seminars in India and referenced on websites.

Because Minergie probably offered a manageable approach with different possible products and a long (more than 20 years) marketing experience in Switzerland, the project proposed to adapt the Minergie-label into India. On the other hand, a few existing labels are already available in the Indian market such as:

- BEE energy labels (ECBC for new and star rating system for existing commercial buildings)
- Green labels as IGBC and GRIHA
- International labels as LEED

[3] Design Guidelines for Energy-Efficient Multi-Storey Residential Buildings: Composite and Hot-Dry Climate (Sept. 2014)

During the BEEP project, it was decided to focus on other topics than the ones covered by Minergie in order to have a bigger impact on energy-efficiency. In addition, the adaptation of the Minergie-label to local conditions would need several efforts. For these reasons, it was decided during the project and validated during JAC 7 not to develop a Minergie-Label for India although some stakeholders would have appreciated a probably easier label to use, like Minergie. Hence, the following chapter will only include the evaluation of the guidelines for residential buildings.

Positive aspects:
The Guidelines represent a useful instrument that will significantly improve the understanding and knowledge about energy-efficient design of residential buildings in India and will help to disseminate the knowledge all around India. The content is qualitatively high and well structured. The key values are based on monitoring data and complementary simulations and hence, constitute a realistic planning basis.
By means of architectural measures that are easy to implement and improve the comfort without necessarily increasing the project budget, the guidelines can be applied in such social projects as "housing for all". Less specifically, the listed recommendations are part of the integrated design process which focuses on the architecture at first and in consequence, avoids sophisticated and expensive solutions that have to be implemented in a further planning phase to compensate early mistakes. Air conditioning supply for example, is usually much more expensive than the contribution to a pleasant room temperature by natural air ventilation concepts or activating thermal mass in the rooms.

It is assumed that if the guidelines are systematically used as a basis for the future design of energy-efficient buildings, a huge potential for the reduction of the energy consumption and carbon dioxide emissions in the residential building sector is to be expected. The Guidelines were mentioned as part of India's Intended Nationally Determined Contribution (INDC) towards the COP21 in Paris in 2015.

The Guidelines can be used as a planning basis. It has nearly the same effects as a label. However, because it is not mandatory, it is not required that you credit its usage, and therefore can be used by a wide range of experts. Hence, the utilisation of the Guidelines all around India and more consequently in the examined regions is to be expected if an effective dissemination is undertaken.

Negative aspects:
The first Guidelines were published in 2014. Though, the number of distributed copies, 1500, in two years seem to be improvable. Further efforts on dissemination of the existing and future publications need to be done.

Relevance:
Since residential buildings represent 90% of the total building stock in India and covers 21% of India' electricity consumption, the potential for reduction of energy consumption and carbon dioxide emissions, thanks to the systematic implementation of the measures recommended in the Guidelines, can be significant. Moreover, the implementation of the recommendations can significantly improve thermal comfort in residential buildings and in consequence, reduce cooling needs. The focus on architectural measures to avoid to recourse to cooling devices simplifies the design and thus, the Guidelines can be used by a large number of professionals. Likewise, the absence of an official certification process makes the Guidelines more accessible and increases the potential impact of the Guidelines.

Impact:
According to some interviewees the Guidelines are one of the first documentation of this nature - combining theory and practical recommendations - published recently in India about energy-efficiency in buildings and consequently have a pioneer status. Therefore, they represent a meaningful step for Indian contribution to reduce global warming emissions as they were acknowledged on the Climate Conference in Paris in 2015. This means that their dissemination at political level already has taken place and is effective. The mention of the Guidelines for planning and construction processes should be made at state level to reinforce their systematic utilisation, for instance for public programmes like "housing for all". The dissemination is an essential step to be undertaken to ensure the long term utilisation and potential impact of the Guidelines. The publication of the two remaining Guidelines for the cold and warm-humid regions of India will finally cover four important climatic regions of India.

Effectiveness and efficiency
As mentioned before, some of the interviewed architects were not aware of the Guidelines which raises questions about the effectiveness of marketing. The most relevant stakeholders to inform are the Universities since they will ensure the dissemination for future professionals. With a small budget, the dissemination of the Guidelines can potentially influence the majority of the building stock in India.

Sustainability
Despite the significant amount of published documents and achieved goals, consequent work still needs to be completed, mainly concerning the publication of guidelines for the remaining climatic regions. Moreover, the usefulness of the guidelines could be further improved by including additional information about sustainability, thermal comfort, material quality or embodied energy for instance. Furthermore, the Guidelines should be extended to other building techniques as natural ventilation for instance. To increase the sustainability of the projects, it is advised to include social aspects as, for instance, how can the occupants' acceptance for new technologies be improved?

Recommendations:
A general recommendation that should ensure the programme to be effective in the long term would be to perform regular reviews about the utilization of the guidelines by the different actors. Their feedback about how often they use the available documentation, how they improved their understanding and ability to design energy-efficient buildings and what kind of information they miss should help to improve the documentation in the future. A synthesis of the design parameters and key values in a tabular form should facilitate the learning process and give a quicker access to pertinent information.

A solid technical review of the Guidelines could be necessary because it will be used by thousands of students and professionals and carry a risk that it is not well used or understood.

To ensure a systematic use of the guidelines in the design phase of energy-efficient buildings, significant dissemination efforts need to be undertaken. The Guidelines should be integrated in the curriculum of architecture and engineering students as well as in practice. Training of University teachers could be a great idea. Generally, collaboration with universities should take place so that seminars and trainings could be organized to create awareness and train most of the stakeholders. A strategy could be developed to convince the stakeholders to use the Guidelines as if it was a certification process.

A communication campaign by usual publishers on energy-efficiency in buildings, public institutions as well as in governmental offices should spread information about the guidelines and its expected impacts on energy-efficiency in buildings.

4.4. Outcome 4: Templates for public buildings

The objective of the outcome 4 is to support states in developing energy-efficient design templates for public buildings. In 5-10 selected states, the design templates were meant to be used by professionals and state designated agencies and have been officially recognized as well-known references.
The templates are mainly developed for regularly replicated buildings within each state, like court buildings, primary health centres, schools and government offices. The goal of the templates is to design more energy-efficient public buildings based on best practice examples. The templates give recommendations for the orientation, the building envelope, lighting, building components (HVAC) and other equipment. In addition, reports of best-practice examples include a methodology description to analyse and design energy-efficient public buildings, and a theoretical part about building physics and recommendations for renewable energy applications.

Achievements regarding the outcome 4:

- Design templates for four public buildings in the state of Karnataka are available.
- Generic Guidelines for the state Rajasthan are drafted.
- The development of Guidelines for the state of Andhra Pradesh is planned.

Negative aspects
Only three states were examined and a small amount of buildings were analysed. Examples have to be found in the other states to create further templates.

Relevance
Best practice examples are referred and constitute a relevant reference for public authorities. The systematic utilisation of the references should ensure a long-term energy-efficient design of public buildings. For the moment, the analysis is not generalised in India, ideally the approach should be followed systematically for all new public buildings planned.

Impacts
The project team faced difficulties to convince all the states to work on the project. Only a few states that were already aware of energy efficiency accepted to collaborate. To increase the potential impact, collaboration with the remaining states should take place. A strategy with recommendations should be established for the future approach of the states. Therefore, the role of the BEE could be important. In addition, commitments with the states should be introduced to ensure energy-efficient design and utilisation of the templates for future public building projects. If the templates are systematically used as a reference instrument for the design of energy-efficient public buildings, the resulting energy saving and carbon dioxide reduction is potentially significant.

Effectiveness and efficiency
Compared to the Guidelines for residential buildings which can impact on a significant number of buildings, efforts and costs for the realisation of templates on energy efficiency for the smaller amount of public buildings are relatively important. However, the relevance of best-practice

examples and collaboration with authorities is significant regarding the dissemination of the subject.

Sustainability
The provided monitoring of the analysed BEEP buildings is necessary to demonstrate the effective improvements regarding energy efficiency. Successful results should help to spread the methodology in other states. The consideration of Swiss experience in monitoring projects could be important in order to convince potential partners.

Recommendations:
The Templates are listing the best practice examples that can be used as a reference basis. In order to simplify and to improve the accuracy of the Templates, they should possibly focus on a few examples only.
Some chapters about thermal comfort and sustainability should be added in order to ensure a higher occupants' acceptance. Some key values should be indicated to help the calculations and design work. It would also facilitate the learning process by quickly giving essential information, ideally in summarizing tables.

States or cities may consider the compulsory use of the templates in the planning phase to ensure its utilization and expected long term effect in the future. Though, the main focus of BEEP should consist of raising the awareness and increasing the technical skills, architects and public institutions should be involved in the methodology recommended in the templates as soon as possible. The framework described in the methodology should be covered as much as possible by Indian experts, especially for the simulations. Also in the Templates case, it is recommended to perform a solid technical review to reduce the risks for wrong understanding or utilisation of the documentation or to avoid the Templates not being used.

4.5. Outcome 5: Knowledge Management

Outcome 5 of the project is entitled "knowledge and awareness of climate-responsive, high performance, energy-efficient solutions for new buildings are increasing among India's building sector professionals and end-users, local authorities, and policy makers." The outcome is divided in 4 outputs, which are closely linked to the activities of *Outcomes 1-4* above: (i) the development and dissemination of design tools for new buildings, (ii) the capacity development of Indian professionals, (iii) awareness-raising among policy makers and professionals for the benefits of energy-efficiency in Buildings, and (iv) overall dissemination of results.

The project has reached a respectable number of actors, and produced some good-quality products as stated in the Outcomes 1-4 description above. Knowledge exchange reportedly took place in following – quantitative – achievements:

Table 3: *Overview of indicators and observed results.*

Output	Indicators ***as per Project Logframe***	- Observed results, ***quantitative***
(i)	design tools to develop energy efficient solutions were developed (e.g. the building guidelines for residential buildings)	- 1 Design Guideline for Energy-Efficient Multi-Storey residential Buildings - case-study documentation of Completed Charrette Project of Rajasthan Forestry Department Office Building.

		- 3 Templates for Government Buildings - Training Manual on Thermal Properties of Insulation Material - Integrated Design Charrettes: Documentation of 6 case studies - Documentation of State-of-the-Art Swiss Building case studies - Training Material of past trainings available (all available on the BEEP website: http://beepindia.org)
	Distribution of Tools among building professionals	- There was no evidence for swift and broad dissemination
(ii)	At least 70 Indian Professionals have increased knowledge on the application of energy-efficient solutions	- In the Charrettes and Construction of Public Buildings, greater number of persons were involved and trained on the job
	Additional 3-5 persons have increased know-how acquired from Swiss laboratories	- 10 persons from five Indian labs have attended classrooms and lab training provided by Prof Roulet from EPFL
(iii)	At least 20 policy makers and building professionals have increased awareness	- Visit and exposure tour in Switzerland, 2010 June (3 policy makers and 10 building professionals) - Visit and exposure tour in Switzerland, 2013 May (3 policy makers) - Visit and exposure tour in Switzerland, 2013 September (5 policy makers, 6 building professionals) - Total: 11 policy makers, 16 influential building professionals
(iv)	Number of members of network and Community of Practise of sustainable building professionals	- Number of persons in the BEEP network through charrettes, stakeholder meetings, awareness seminars, and training programmes: 1200 (list as per March 2016)
	Number of group members joining Community of Practise	Some of the indicators to assume the number of professionals who have got an exposure to new technical knowledge are: - Number of persons in BEEP network: ~ 1200 - Hard copies of guidelines distributed: ~540 - Number of downloads of the residential guidelines as 20th June 2016: ~980 - Number of downloads of the insulation material testing material: ~130

		- Number of professional groups participating in the external movable shading design competition: ~30
	Number and type of discussions on the forum users	- Discussions have mostly been held during BEEP events
	Number of events, other dissemination products, internet-based publications *Number of reached persons in total (see above + in total with other events): ~2'000 professionals in contact with BEEP.* *Training of trainers for design charrette and insulation testing: ~50 professionals*	- 5 trainings with thematic focus took place - 10 Integrated Design' Seminars took place - 1 National Workshop was conducted - A project website exists, where above-mentioned Knowledge Products and Training Material is uploaded - A BEEP video was produced, Saving Energy: the integrated design way' – the video is available through various linked YouTube channels, and viewed at seminars and trainings. - A BEEP Newsletter is produced (annual issue, 2 issues published, 3rd under preparation, sent to about 1000 professionals through e-mails)

The Evaluation Team considers the **knowledge products** enumerated above to be relevant and of high quality. Also, the numbers of people involved in the trainings and workshops are impressive. We also wish to state that the project documentation and reporting by the Implementing Agencies (made available to the evaluators, see list of documents) is very professional and informative.

The following reflections shall look into the ***qualitative*** aspects of the Knowledge Management, namely how the relevant knowledge reaches the relevant actors in order to reach impact. The Knowledge Products enumerated in the table above are considered to be solid elements that support the goal of the Knowledge Management.

Relevance
Knowledge management activities aim at bringing **best-available technologies, knowledge and knowhow** to the **best suitable actors**, and assure the replication and dissemination of the learnings in order to reach, or scale up the project goals. The overall goals of BEEP's phase II are the reduction of the energy consumption in new commercial buildings and the elaboration of best practices for the construction of low-energy residential and public buildings in India.
Knowledge Management will support the way of 'how this can be reached'.

BEEP tackled several actors in the project:

Outcome 1 (IDP Charrettes): targeting Builders and developers, investors, architects, engineers, building energy professionals.

Outcome 2 (Insulation Materials Testing): targeting testing laboratories, insulation materials manufacturers, and applicators.

Outcome 3 (Residential Guidelines and Minergie): targeting Architects, Builders and developers, home buyers, banks.

Outcome 4 (Templates for public buildings): targeting state public works departments.

Overarching, the State and National Authorities are targeted, to support the decision-making with regards to policies and guidelines in order to implement the Energy-Efficient Building concepts.

All interviewed persons from the above fields of actors stated that the knowledge, and processes of integrating knowledge from various disciplines, was very useful to them. Furthermore they clearly stated how much they appreciated the Indian and Swiss Team Leaders, for their methods in organising and running the various learning events. The understanding of the "local way of doing" by the Swiss Input was particularly appreciated.

Knowledge Transfer to Practitioners: Professionals involved in the Charrettes (and interviewed by the Review Team) unanimously stated that the knowledge transferred was highly valuable, and improved their understanding of the integrated planning for large buildings.
Although they noted that the learnings were important, they also reported that replication beyond the Charrettes (i.e. in upcoming new construction projects) would be very difficult, for various reasons:

- Architects and Engineers do not usually plan in a joint, concerted action. This element of the Charrette is thus not replicated outside the project.
- Investors are interested in fast return on investment and do not see the interest in higher initial costs (albeit only 3-5% of the 'conventional' costs)
- No binding policies exist; furthermore, according to the interviewed persons, policies were not considered of prime importance to the planners and practitioners
- The occupants of the buildings (both residential and commercial) do not request for Energy-Efficient Buildings, because the awareness on increased comfort with lower energy need is not yet widespread.

Knowledge Transfer / Academia: The potential of working with Universities was tackled through the competition for Shading Systems, the insulation materials testing labs, and Charrettes training. Some of these activities have been judged to be of very high quality. However, the review team was under the impression that the potential of the academic institutions is not yet fully tapped, and that the interlinkage with other outcomes (for instance: involvement of Students in the Charrettes) would be very valuable immersion events for Architectural and Engineering Students, from the outset of their studies/professional trainings. It was also stated that the Guidelines had the advantage of being hands-on tools rather than binding and complex instructions, and that the Guidelines could be integrated in the curricula of architectural and engineering students.

Knowledge Transfer / Authorities: In addition to those actors, representatives from the **National Government** were involved in the project. These actors at the Policy Level lauded the project for bringing in concrete, useful, and relevant knowledge and result-oriented processes. The 'Residential Building Guidelines' are considered to be very valuable, and supporting visibility on multilateral level (potential knowledge sharing internationally).

BEEP benefits from a very high level of commitment on the National Government Level. The Learnings back to this level of Decision-Making is quite conducive through the two Steering Committees of the BEEP Project (JAC and JIG). The dialogue in these Steering Groups is

fundamentally precious for the visibility, and success of BEEP's overall positioning. Also, the awareness and knowledge transferred through the dialogue to the Central Government has been conducive, for instance, in adding the Building Guidelines to India's INDC, which is considered a success of the project.

However, construction of buildings is regulated at the State and Local levels. Guidelines and Standards issued at National level therefore have no binding character unless they have been ratified by the individual states. Hence, the role to adapt, enforce and supervise Building Standards or Templates lies with the state governments.
With Outcome 4 of BEEP, the transferring of knowledge to the State Governments was tackled, but difficult to reach; two reasons could be seen for the lack of interest: (a) because only few states had ratified the Building Standard for Public Buildings (ECBC), only these states see the benefits to collaborate in the BEEP, or (b) because they have not been contacted through the suitable, appropriate communication channel, the awareness could not reach them or did not get the required legitimacy.

Knowledge Transfer / Private Sector: The private sector is involved, at one hand, as manufacturers of construction materials and elements. The private sector also needs to be in the loop of the Knowledge Transfer, as construction materials are an important element for the improvement of Building Energy Efficiency (shades, insulation material, etc.). The private sector was involved on the Charrettes, but clearly needs better awareness on market orientation for replication, improvements of the learning from Charrettes, and generally for improved buildings.

Even more crucially important are the investors and developers that provide the funding for the commercial and residential buildings. Our interviews have shown that well informed investors (e.g. the Hospital Owner in Mumbai) very much agree to increased investment costs (3-5%). This readiness is here thanks to the notion of the need for energy savings, and because of the awareness that the return on investment is met rather rapidly.

Communication Pathways: In our discussions, we noticed that very valuable information on BEEP was often transferred 'by coincidence'. For instance, only about 50% of the charrettes partner got to know about the possibility to participate through the website or newspaper advertisements. The others (including all interviewed) knew it through personal contacts. Hence, the number of applicants was limited and below the expected number (the low number of conducted Charrettes also is due to severe selection criteria for the Charrettes, ensuring the quality and success).
Likewise, the existence of the Residential Building Guidelines does not seem to be sufficiently known by the practitioners, engineers, architects outside of the BEEP. A non-representative number of interactions during the review showed that knowledge on the existence of the Guidelines was rather scarce.

Dissemination through the Website: The BEEP website is built up as a very useful website for the BEEP community. The site is mainly used for storing and dissemination of Case Study Reports, Training Material, etc. and gives easy access to this documentation and project-related information.
However, the Website is difficult to find with a keyword search (e.g. search for 'building efficiency India' does not lead to the website), and the information on the website is not very appealing to a new visitor.

Effectiveness and Sustainability
The variety of the actors tackled by the BEEP Project is important for fostering the improvement of energy-efficiency by means of policy support, awareness and strengthening of knowhow and

dohow. However, the high number of trainees does not actually give us an indication on the effective use of the acquired knowledge for developing building projects.
Actors at the Central Government are highly committed to the project, yet, the sovereignty over building codes and enforcement lies with the State governments. The project might have a stronger effectiveness by direct interaction on the level of the States, or Municipalities. The direct involvement with the Decentralised Authorities might also give support to the aim of the Central Government to have the use of Energy-Efficiency Guidelines strengthened.

A better involvement of the Academia, for instance by upgraded curricula for the architectural and engineering students, would guarantee for a more effective and sustainable fundament for the future generation of professionals. However, the problem being urgent, entry points must be strengthened at all levels, including the right level of policy, public awareness, the practitioners, as well as the investors. By closing the loop of the various actors, awareness on the needs for energy-efficient buildings can be strengthened and leveraged.

Impact
Whereas knowledge products, and trainings, are excellent tools for sharing and documenting experiences and best practices, their existence does not guarantee the informed application of the information by trainees and other potential users. Therefore, sustainable learning and application requires immersion in a thematic field that is relevant to the topics of interest of the users. The Knowledge Management Indicators of the current project is mainly based on a series of trainings and seminars. An interview carried out with two trainers trained in the BEEP project revealed that their knowledge is carried further in the frame of their university classes. We have not been able to assess further, whether the trainees are currently applying the learnings, and if the bulk of the trained trainers are further using their knowledge from the BEEP project.

Recommendations for the reminder of Phase II

1. For high awareness among all actors, including the occupants of the buildings, officials, practitioners and students: continue to document the effected Charrettes and other Buildings for showcasing. This documentation shall inform on the innovative and high-quality elements that lead to better energy efficiency, but also the missing elements, which could still lead to further improvements. If resources allow so, organise focused study tours for awareness raising.
2. Steer the attention of the project to the right level of government: Since the Building Codes are determined by the States, rather than the Central Government, use the remaining time to showcase templates and charettes to State and Municipal Governments, with the relevant information on potential to reduce energy consumption.
3. Strengthen Pathways for meaningful dissemination of the existing Tools and Documentation, such as the Guidelines. To do so, channels outside of the project such as the professional societies and Associations, Universities, and Government Offices can also be tapped, in addition to the currently used channels of BEEP.
4. Make the BEEP Website more accessible.
5. Use the Charrettes as starting and melting point: in addition to the currently involved actors, allow for Scholars to participate in the Charrettes

Recommendation for a further phase of BEEP

1. Elaborate a knowledge management strategy. This must include: communication pathways that are differentiated according to the group of actors, and a solid analysis of the roles and responsibilities of actors in order to tackle the relevant level of actors, with the relevant information

2. Consider including a steering body at the level of State and / or Municipal governments
3. Consider stronger involvement of academia with curriculum development
4. Consider awareness campaign towards general public
5. Training of the trainers who have rich practise experience. They will be instrumental during and beyond the project duration.
6. Assess effectivity of the trainings of the previous phase in order to design future dissemination activities.

Risks

The project relies on leaders and partners from the government. If one of the key staff or partners leaves the project, the risk of losing momentum at national level and knowledge in general would be relatively high. This is why the project should not rely on single-person constellations.

Switzerland seems to have a pioneering role, or at least a much reputed role with the BEEP in India. The BEEP is much appreciated by all involved partners, for its precise and results-oriented approach. However, other actors coming in with larger means and higher visibility might overtake the visibility of Switzerland. Hence, good communication concepts should be developed in order to keep the momentum alive.

5. Overall Assessment

Energy has emerged as a critical issue and high priority for the country due to concerns related to energy security and global climate change. Energy-efficient buildings offer opportunities to (a) save electricity, (b) reduce greenhouse gas (GHG) emissions, (c) lower energy bills for the building owners, and (d) provide better thermal comfort to the building occupants.

The BEEP project contributes to the efforts of the Indian Government to reduce greenhouse gas (GHG) emissions from the building sector through innovation particularly supported by good practices from Switzerland. By improving energy efficiency in buildings, a relevant contribution is made for the reduction of GHG, The majority of the expected outcomes have been achieved successfully.

Hence, the BEEP project is acting in a highly relevant field globally by supporting the overall GHG reduction; the project is also relevant, for its alignment with the Indian government's priorities, as well as with the Goals set in the Strategies of the GPCC of India.

The collaboration between the different project actors was successful mainly due to good quality partners. However, the majority of the responsibility was set on a few individuals only, alike for the significant knowledge which remains within a limited circle of stakeholders. The biggest challenge the project has to face for the remaining time is to disseminate the knowledge and reach a significant number of buildings. Communication pathways have to be improved for better outreach.

In its second phase, the BEEP was instrumental in making the prove of concept. **The evaluation team supports continuation of the BEEP in a third phase**, whereas the main focus of the third phase should be on a broader outreach.

In order to reach scale in the third phase, the different elements of BEEP should be geared strategically to support (1) Capacity Development of Planners and Practitioners, (2) Awareness of Investors and Building occupants and (3) the Policy Level.

Overall recommendations

In the view of the Reviewers, the BEEP project should be continued, with a main focus on 'going to scale'.

In order to reach scale, pathways for involving the different levels of government (Central, State, Municipal) need to be tackled more proactively.

Charrettes are viewed as excellent means not only for strengthening capacities of directly involved practitioners, but also for solid documentation and showcasing. This element should be continued, and used more strategically in order to raise the knowledge of the decision makers, building occupants (potential buyers), Practitioners and Academia.

The active involvement of, and push by State and Municipal Authorities should be enhanced by proactively promoting the Templates for Public Buildings. Most conducive Communication Channels must be sought.
Templates for Government buildings should be continued with a clear strategy of linking the practical work with the policy level. The work on the templates could be combined with concrete Charrettes and subsequently with a support of the State Government in view of a better informed dissemination of the subject.

A clearer Knowledge Management Strategy with communication pathways should be elaborated for Phase III, for better continued integration and interlinking of the various elements of BEEP.

ANNEX A – Documents provided by SDC

	Document	File Name	Remarks
Project Documents			
1	Terms of Reference (ToR) Review of the Building Energy Efficiency Project (BEEP)	BEEP ToR Review	
2	Credit Proposal	BEEP CP phase 2	
3	Building Energy Efficiency Project (BEEP)	Factsheet BEEP	
4	Global Programme Climate Change India Strategy 2014-17	GPCC India Strategy 2014-2017	
5	Indo-Swiss Building Energy Efficiency Programme (BEEP) – Phase II	ProDoc BEEP 2	
6	Evaluation Policy Swiss Agency for Development and Cooperation	SDC's Evaluation Policy	
7	Progress reports	Annual report + Annexures 2012, 2013, 2014, 2015 Mid Term Progress Report 2013, 2014, 2015	
8	Minutes of steering body meting	Joint Apex Committee (JAC) and Joint Implementation Group (JIG) Meeting: - 24.02.2012 Joint JAC 1 & JIG 1 - 02.05.2012 JIG 2 - 18.07.2012 JIG 3 - 13.08.2012 JIG 4 - 21.12.2012 Joint JAC 2 & JIG 5 - 05.03.2013 JIG 6 - 02.05.2013 Joint JAC 3 & JIG 7 - 18.07.2013 JIG 8 - 22.11.2013 JIG 9 - 18.12.2013 JAC 4 - 27.06.2014 JIG 10 - 30.07.2014 JAC 5 - 17.11.2014 JIG 11 - 26.11.2014 JAC 6 - 17.11.2014 JIG 11 - 04.03.2015 JIG 12 - 08.05.2015 JIG 13 - 16.12.2015 JAC 8 & JIG 14 - 22.02.2016 JIG 15	Handouts, Presentations, Images, Minutes
Project outputs documentations			
	Outcome 1: Design charrettes		
9	Charrette case studies	CS1-6	
10	Charrette Reports	Charrette 3_Aranya Bhawan_report Charrette 8_Jupiter Hospital_report Charrette 9_WTC_report Charrette 10_IIIDEM_report Charrette 15_DB Pride_report	
	Outcome 2: Insulation materials testing		
11	Building Insulation Materials Testing for BEEP Partner Labs	Summary of training programme 15.05.2015	
12	Workshop on Building Insulation Materials Application & Testing	Workshop Summary 19.06.2015	
13	Measuring the Characteristics of Thermal Insulation Materials	Draft Training Manual –Version 5 May 2015	Author: Claude Alain-Roulet
	Outcome 3: Residential design guidelines and the Minergie-India label		
14	Design Guidelines for Energy-Efficient Multi-Storey Residential Buildings	Design Guidelines RB_Composite & Hot Dry (Book)	Composite and Hot-Dry Climates
	Outcome 4: Design templates for public building sector		
15	Design Template for energy Efficient and Thermally Comfortable District Court Building in Moderate Climatic Regions of Karnataka	Karnataka District Court Technical Report 13.05.2014	

16	Support to Public Works Department Rajasthan for Designing an Energy Efficient and Thermally Comfortable District Court Building in Banswara, Rajasthan	Rajasthan District Court Technical Report – Consolidated Version Sept. 2014	
17	Energy Efficient and Thermally Comfortable District Office Building, Bijapur, Karnataka	Karnataka District Office Technical Report March 2015	
18	Energy Efficient and Thermally Comfortable Rehabilitation Centre and Home for MR Women and Children, Barmer, Rajasthan	Rajasthan Rehab Centre Draft Technical Report May. 2015	
19	Guidelines for Energy-Efficient & Thermally Comfortable Public Buildings in Karnataka	Draft, Chapters 1 and 2	
	Outcome5: Knowledge Management / Communication		
20	Aranya Bhawan Posters 26.08.2015	Beep.poster_1-5	
21	Newsletter	BEEP Newsletter_June2014 BEEP Newsletter_June2015	
22	Seminar on “Sustainable Architecture: Integrated Approach to Energy-Efficient Building Design”	Seminar_Delhi_report 23.07.2013	
23	Seminar on “Sustainable Architecture: Integrated Approach to Energy-Efficient Building Design”	Seminar_Bangalore_report 11.11.2013	
24	Seminar on “Integrated Approach to Energy-Efficient Building Design”	Seminar_Jaipur_report 16.12.2013	
25	Seminar on “Integrated Approach to Energy-Efficient Building Design”	Seminar_Hyderabad_report 16.12.2013	
26	Seminar on “Integrated Approach to Energy-Efficient Building Design”	Seminar_Jaipur_report 24.09.2014	
27	Seminar on “Integrated Approach to Energy-Efficient Building Design”	Seminar_Gandhinagar_proceedings 15.11.2014	
28	Seminar on “Integrated Approach to Energy-Efficient Building Design”	Seminar_Indore_proceedings 07.04.2015	
29	Seminar on “Integrated Approach to Energy-Efficient Building Design”	Seminar_Indore_proceedings 06.02.2016	
30	Seminar on “Integrated Approach to Energy-Efficient Building Design”	Seminar_Chennaie_proceedings 19.03.2016	
31	Baseline Scenario of Energy Consumption of Urban Multi- Storey Residential Buildings in India	PLEA Conference Paper 16.12.2016	*XXX (Name of the authors)*
32	Use of Integrated Design Approach for Realizing High Emergy Performance in Commercial Buildings	AIC Tech 16.01.2015	Prashant Bhanware, Kanagaraj Ganesan
33	Paramteric Analysis using dynamic Energy Simulation Tools to evaluate the performance of Building Envelope in the Residential Buildings of Composite Climatic Region of India	IBPSA_Paper 27.08.2015	Pierre Jaboyedoff, Kira Cusack, Prashant Bhanware, Kanagaraj Ganesan, Saswati Chetia, Sameer Maithel
34	Swiss policy tour May 2013	Part 1 – Report Part 2 – Presentations	With Minergie Presentation in Berne
35	Swiss technical tour September 2013	Tour Report Annex 1 – Programme Annex 2 – Presentations	With Pierre Jaboyedoff, Heinrich Gugerli,…
36	Earth Air Tunnel Training Design 25-26.07.2013	EAT Training Programme Feedback Analysis User Manual_EasyPipes Basics_13 Aug 2013 User Manual_EasyPipes Plus.19Aug13	
37	Advanced Simulation Training 14.01.2014	Bangalore Sim Training report	
38	Charrette Condutors Training 08-10.12.2014 02-04.12.2015	Proceedings	
39	GIFT Training 06-07.08.2015	GIFT Training report	
40	Radiant Cooling Training 06.12.2015	Radiant Training report	

ANNEX B – Interviews in Switzerland

Meeting Partners	**Participants**
25 April 2016 (Bern)	
Effin'Art (Swiss PMTU	**Mr. Pierre Jaboyedoff** **Mr. Dario Aiulfi**
25 April 2016 (Bern)	
IN:CH Academy Bangalore India	**Mr. Jürg Grunder**

ANNEX C – Interviews in India

Meeting Partners	**Participants**
27 April 2016 (Delhi)	
1) Greentech Office (Indian PMTU)	**Mr. Sameer Maithel, Ms. Saswati Chetia, Ms. Vernica Prakash, Mr. Prashant Bhanware**
2) BEE (Bureau of Energy Efficiency)	**Mr. Sanjay Seth**
3) JAC Member	**Prof. Ashok Lall**
28 April 2016 (Jaipur)	
4) Rajasthan State Road Develop Corporation (RSRDC) & Public Works Department (PWD)	**Mr. Akshaya Jain** **Dr. SS Chaudhary** **Mr. Arvind Bhargava**
29 April 2016 (Ahmedabad)	
5) World Trade Centre, GIFT City	**Mr. Jignesh Chag**, Project Management team
6) NIRMA University	**Prof. Vikas Lakhera**, Partner insulation lab visit
7) Karnataka Public Works Department (phone call)	**Mr. K. Udaya**
30 April 2016 (Ahmedabad)	
8) National Institute of Design	**Prof. Praveen Nahar**
9) CEPT University	**Prof. Rajan Rawal, Mr. Yash Shukla**
9) GIFT City	**Mr. Pankaj Sampat**
01 Mai 2016 (Mumbai)	
10) charrette partners	**Ms. Meenal Sutaria, Mr. Shirish Deshpande**
02 Mai 2016 (Mumbai / Delhi)	
11) Jupiter Hospital, Thane	**Dr. Ajay Thakker, Dr. Nilesh Shinde**
12) Energetic Consulting Pvt.Ltd Team	**Mr. Shirish Deshpande**
13) Industry Association partner	**Mr. Isaac Emanual**, India Insulation Forum Coordinator **Mr. M. Swaminathan, Dr. Sunil Bajaj**
03 Mai 2016 (Delhi)	
14) charrette partners (phone calls)	**Mr. Nilesh Patil**
15) Ministry of New & Renewable Energy	**Dr. A K Tripathi**
16) Ministry of Power	**Mr. P.T.Bhutia**

ANNEX D – Site visits in India

IIIDEM, Project site visit, Dwarka, Delhi
Site Visit Aranya Bhawan
World Trade Centre Site visit, GIFT City

ANNEX E - Set-up of structured interviews

Introduction:

- Which were the three most **positive / negative aspects** of the BEEP in your opinion?
- What would you miss most if BEEP hadn't been launched?

Organisation:

- Do you think the mixture of the **project team** was appropriate to the objectives? Does the team show the necessary skills and know-how for the project?
- Does the planned **project duration** fit with the objectives initially set? Could the project goals be reached in a shorter period or more efficiently? Is there any potential for optimization and eventually where?
- How efficient / effective is the **administration process** in your opinion? How could it be improved? What is the amount of the administration expense (in % of the total project expenses) in your estimation?

Objectives:

- Do you think the **defined objectives** were the right ones? Were the objectives defined correctly?
- How **realistic** was the achievement of the formulated objectives? Can / could they be achieved?
- Does the number of stated objectives fit with the **available time and financial means**?

Methodology:

- Do you think the **chosen methodology** is appropriate to meet the objectives?
- Is the methodology open to **changes** during the project?
- Does the methodology fit the **local conditions**?

Focus:

- Do you think the project focused on relevant topics or set the right **priorities**?
- Would you have chosen **other priorities**? Which ones?

Results:

- Do you think the results achieved the desired **effects**?
- Which most important **targets** were **reached**? Which relevant ones were not reached?
- What are the main **reasons** for possible failures?

Financing:

- Do you think the financial means were **enough / appropriate** to reach the project tasks?
- Are any **failures** caused by financial reasons or problems?
- Was the financial structure open to changes during the project?

Indo-Swiss Cooperation:

- Are there any particular **negative / positive aspects** in the cooperation you would like to highlight? **Benefits / disadvantages**?
- Should the project continue to focus on **Swiss know-how** transfer or rather on expanding with Indian stakeholder in the remaining period?
- Should the project engage differently with the **government** (national and state)? What is the potential for further enhanced cooperation with **city authorities?**

Various:

- What is the **added value** for India related to the project collaboration?
- Which suggestions would you make for **future projects**?
- What is the potential for **further cooperation** between Swiss and Indian companies (based on BEEP)?
- What are you most **proud** of within the achievement realized in the second phase of BEEP?
- What were your **"lessons learned"**?