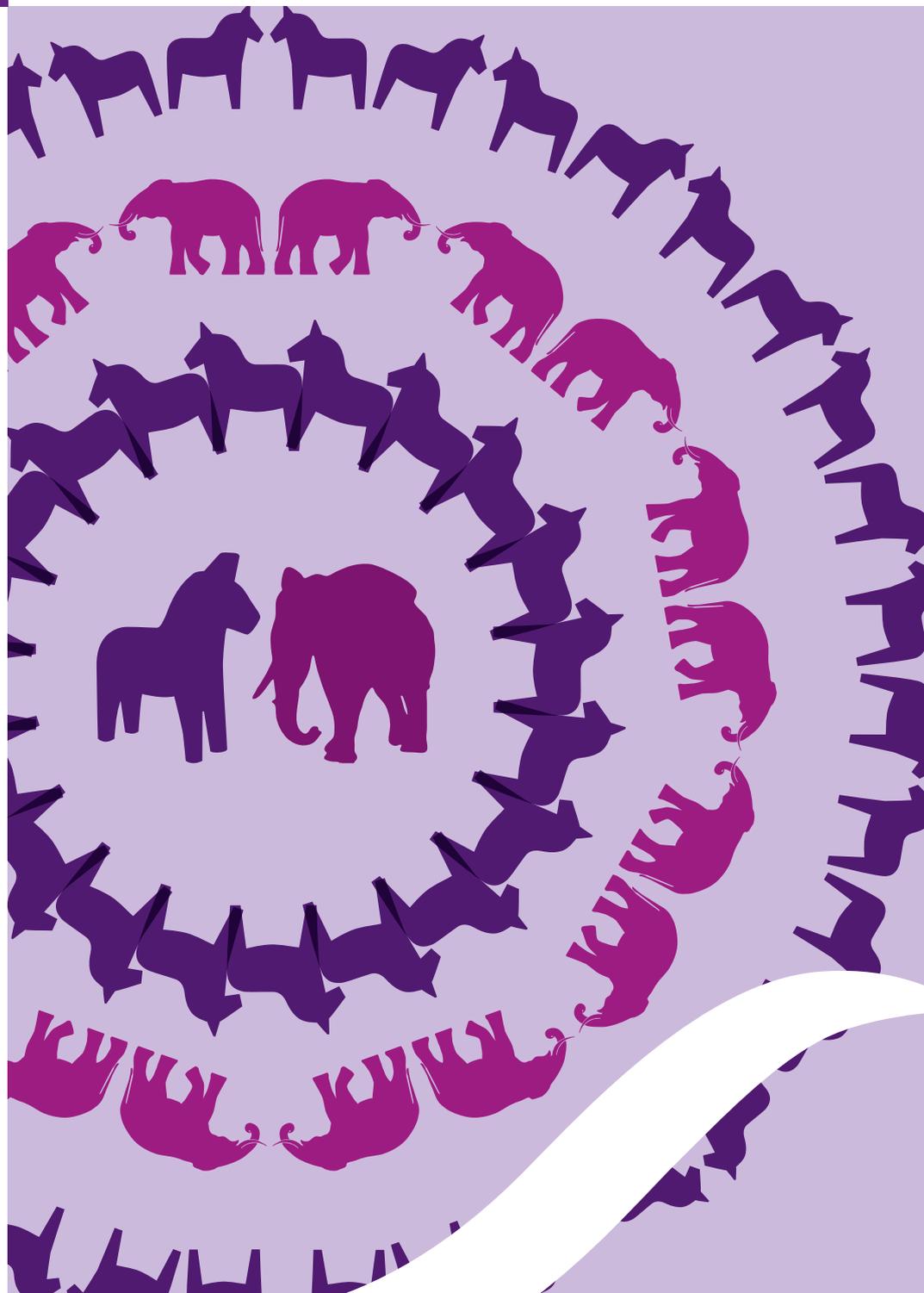


Full scale implementation manual for STIL2 India



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Foreword

This manual is the result of cooperation between the Bureau of Energy Efficiency (BEE) in India and the Swedish Energy Agency (SEA). Financing of the cooperation is made through Swedish International Cooperation Agency (Sida). The manual is edited by the Swedish consultants ÅF-Infrastruktur AB, Energy Management.

The manual has been developed in 2013 and advices in detail how to implement the STIL2 on full-scale in India for one year, one building category. Estimated total no of categories (number of years) in India is 5–7.

The first building category is planned to be offices and most probably official offices only. The manual is written with general examples, but the enclosed protocol is designed specifically for office buildings.

The protocol and some of the material will have to be updated, adjusted for other building categories.

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Summary

This manual details how to manage the STIL2 project full-scale implementation. The manual covers preparation, project organisation, major activities and staffing to be performed over one year. One year is equivalent to one building category, and a full scale implementation will include 5–7 categories. Enclosed documents entail further details on certain aspects. For example the Gantt-scheme is useful.

Detailed planning and manning however, is highly dependent on how the BEE decides to outsource the assignment and which parts that have already been cover. The number of auditors and hours required per building as well rely on sample size and requested indicators. The proposal here is however based on our findings in the pilot study 2012 and assuming a sample size of not more than 200 buildings.

Main project activities are:

- Project management
- Create a base structure
- Select building category
- General information and anchorage
- Sample
- Hire entrepreneurs for inventories
- Fine-tune the method and planning
- Harmonize the team of auditors
- Specific information to selected building managers
- Auditors' preparatory work
- Audits
- Quality assurance
- Compile results
- Analyse results
- Report results

The sequence of activities is important: Create a structure, anchorage the general idea and select building category first, so that you can be assured that many experts, building managers and auditors are informed and interested to support. Thereafter the detailed time plan and activities shall be settled, which is also very important. To reach at a good sample and inventory result, the expert pool; hired experts, the reference and the steering group must be on board and engaged.

Before instructing the hired entrepreneurs/auditors, a firm method and time-plan must have been agreed. Instructions to the auditors must be very clear as well as the required timing and reporting dates, because the inventories' part is the most intense part of the project implementation and management cannot afford to have delays.

The statistical material can only be compiled once all the data has been completely collected and quality assured, and it is a time constraint task to compile and analyse data in the end of the year.

The project is designed in cycles of one year. It is possible and advisable though to commence some of the preparatory activities already in the fall the year before in order to level out peaks in activities. Also, it can be wise to do part of the public outreach and results dissemination early the year after rather than around Christmas and New Year if these are national holidays. View below the weekly and accumulated hours per week as it is planned in this manual.

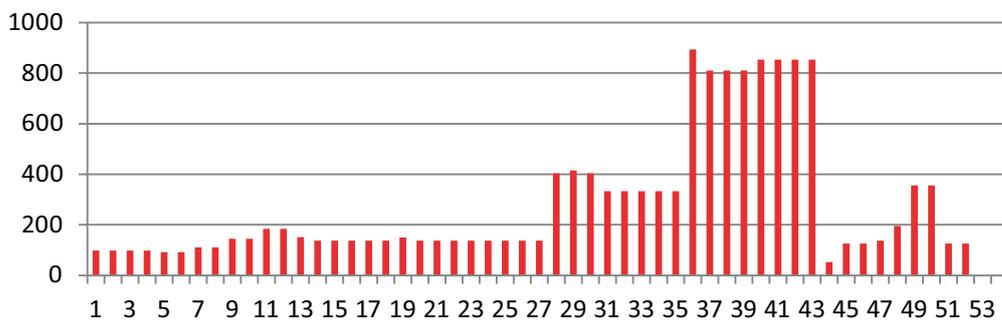


Figure 1 Total number of hours for the entire project team per week over the year (weeks 1–52)

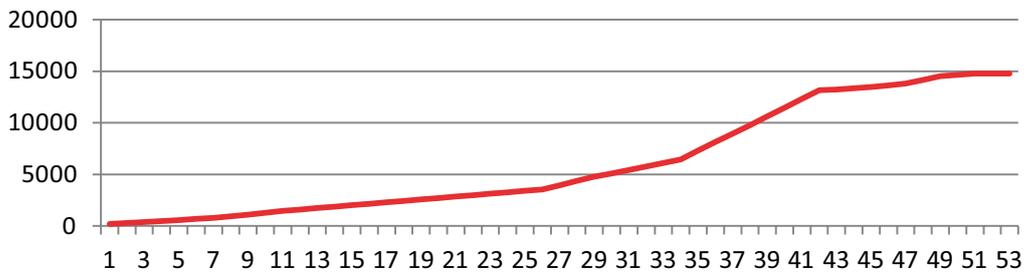


Figure 2 Accumulated number of hours for the entire project (weeks 1–52)

1 Project rational

Baseline statistics on energy use in buildings are highly relevant for any country in which there are national programs coming up that include energy performance in buildings.

Total energy use, or total energy use per square meter is sometimes not sufficient when it comes to designing well targeted programs for improved energy performance. Rather, energy use by type of energy (heat, electricity, embedded generation, etc.) will be required and by type of end use (installations, lighting, AC, ventilation, appliances and other equipment). The enhanced statistics is needed as a compass for what areas to focus on in terms of national legislation, procurement policy recommendations and incentive schemes.

The purpose of the STIL2 project is to find out, on a national level, how electric energy use in premises is distributed between the different areas of use, for example lighting, ventilation and computers. The project is designed to single out and cover one building category per year and consecutively to include all categories. A nation may need 5–10 years to cover all its relevant categories and then return to the first. This way, figures are updated regularly.

The results of the surveys, apart from being included in the national energy statistics, can also be used as a reference value for the energy declaration of buildings.

Knowledge as to how much electricity and other energy used in premises and what it is used for, is further required in order to be able to make forecasts of future electricity use and to evaluate the potential of energy efficiencies.

Estimates about the potential energy savings through different energy efficiency measures are further made as part of the STIL2 project. Results of these calculations suggest the order of magnitude that various measures may have, and thus guides policy makers in creating road maps for implementation.

2 Project functions

The STIL2 project consists of two equally important steps: **the energy audits** and **the statistical analysis**. The project team will be including a number of different categories of staff as specified below. Moreover, the project requires a steering group for each category with strategic policy and budgeting insight, as well as a reference group with representatives from the building real estate sector, building management and relevant tenants.

2.1 The project management

Project management includes staffing the project, design a work schedule and time allocation for different project staff, budget and reporting. It further includes important decisions on methodology, framing and delimitation of the analysis. One initial task that the project management will be responsible for is the inception report that will give clarity to all those project management aspects.

2.2 The steering group

The steering group will see to that the project sustains over the number of years that is required for wanted and useful results. Thus, they will advise as regards which building categories to cover and how resources can be coordinated to sustain the project. If relevant, they can also suggest coordinating with other on-going programmes. The steering group includes the project manager, financiers and selected other important governmental agencies with ongoing or planned projects in the building sector. There can as well be members from academia.

2.3 The secretariat

The secretariat, consisting of 3–5 persons, will be the core hub for strict secrecy and good order of material from different building owners that have been selected for the statistical survey. It is the secretariat that has the crucial task of contacting the selected buildings and, if required, convinces them to cooperate for the good of the sector. The secretariat will seek to get all the required information from the building managers in due time for the audits. The secretariat will further compile relevant climate data and in some cases data other than building data required to calculate agreed key parameters, e.g. number of pupils or other. They will further serve the auditors with background material and contact details to the selected buildings. The secretariat will keep order of files concerning the samples and sample weights. They will communicate time plans to the auditors. It is the secretariat that administers the web-page and that makes sure to file and compile relevant data from the final, quality assured protocols. The secretariat further administers feedback to building owners.

2.4 The quality assurance engineers

The quality assurance engineers (QAE) will be involved in the initial process of adjusting the methodology to suit the building category of current concern. They will carry out or at least be involved in the pilot studies and also in discussions with the reference group in order to adjust the methods and protocol so that it properly covers the sought for data. The quality engineers join all initial discussions such as the hearing, the pilot, and the initial reference group meetings. Later they, together with the secretariat, arrange the auditors training. If required, the QAE assist both the secretariat and the auditors during audit preparations so that the delimitation and background material for each building is adequate and satisfactory for the statistics. They later check plausibility of each audit and carries out sample checks within the sample. The QAE needs to be very well merited building energy auditors. They shall have licence to mount electricity loggers in high tension systems. They shall also have a good understanding of the overall objective of the study.

2.5 The auditors

The auditors take the final contact with building owners before the inventory, updates missing data and support the QAE to evaluate whether the audit can give acceptable quality. The auditors perform inventories, finalise protocols, and review after QAE comments. After the inventory, the auditors shall await results, be available for further services, and use data to recommend savings.

2.6 The reference group

The reference group contains representatives from the house managers but also the tenants and if relevant other agencies that control the activities or other branch organisations that may benefit from certain indicators.

2.7 The analysts

The analyst shall have good understanding of both energy in buildings and statistics. The task is to compile data with statistical weights as well as analysing data and correlations if any. The analyst shall provide diagrams and tables. The analyst shall as well calculate the estimated national savings potential from different measures.

3 Main project activities

This manual covers the entire project including preparatory steps and pilot investigations for the initial setting up and first building category. Coming building categories will require basically all the same elements, but of course there will also be opportunities to reuse material and the web-page structure. It is also recommended to retain the same project team and auditors. Even so, the experience from full scale implementations in Sweden is that time requirements basically remain the same because, in effect, all project activities will have to be repeated for each specific new building category.

In the particular case of Indian implementation of the STIL2, there have been pilot studies (2010–2012) and secretariat preparations (2013) carried out already by BEE, the Swedish Energy Agency and ÅF. In a full scale implementation therefore, these activities will not be required unless many years have passed.

3.1 Create a base structure

Create a base structure

Appoint staff

Steering group; formation and meeting schedule

Reference group; formation and meeting schedule

Create a reference library and a list of ongoing projects of relevance

Write inception report

Before getting started and before even selecting the first building category, it is relevant to create a structure of relevant parties in the sector, political goals, ongoing other programmes etc. Who knows and who is interested? This will be instrumental for the project implementation in several ways, since it will help the project management in deciding e.g.:

- order of priority for buildings and regions to be studied
- preferred actors to include in the reference group for certain categories
- available expertise
- current trends
- established classification of energy end-use equipment in different branches

3.1.1 Appoint staff

3.1.1.1 Appoint management and secretariat

The staffing structure for the STIL2 implementation may be more or less internalised at the BEE and complemented with external staff and experts. Since the BEE is a rather small organisation with a broad mandate, it is however recommended to outsource large parts of the project.

It is recommended still that there is a BEE project manager and at least two staff representatives that have good insight in statistics and in buildings energy use. Other project functions can be outsourced.

3.1.1.2 Appoint a statistical expert

It is recommended to appoint an external expert that has a good understanding of the Indian population, climate and building sector. Earlier national statistics may serve to guide in the categorisation, clustering and sampling and it is important to use a reliable sampling method for the STIL2 India.

3.1.1.3 Appoint quality assurance experts (QAE)

There should be two building audit experts appointed as having the quality assurance responsibility. These two shall have access to all uploaded draft protocols check their plausibility before accepting them as part of the statistical material. If there are any questionable figures or mistakes in the filling in of the protocol, the QAE should communicate this back to the concerned engineer and ask for a correction. In some cases, it will be required to solve the issue together and in exceptional cases, the QAE will need to revisit the building.

The QAE should in any case perform on site checks in about 10% of the sample, spread over different regions in order to prevent any systematic errors.

3.1.2 Steering group; formation and meeting schedule

The Project management shall form a steering group and suggest a meeting schedule for the Steering group. About six meetings a year is appropriate, plus the hearing.

3.1.3 Reference group; formation and meeting schedule

The Project officer and Project manager shall together form a steering group and suggest a meeting schedule for the Steering group. At least two meetings a year is appropriate, plus the hearing:

- First meeting to suggest/review indicators;
- Second to follow up on results and discuss dissemination of the same.

3.1.4 Create a reference library and a list of ongoing projects of relevance

The secretariat officers and staff will scan the currently available reports and statistics on energy use in buildings and structure it with a key. The reference library shall be accessible through the web-page for all project members to view.

3.1.5 Write inception report

One important task to be carried out by the project management is to write an inception report detailing staff, allocation of responsibilities, methodology and important dates for the implementation.

3.2 Select building category

Select building category

Decide type of building and geographical limitation

Define frame for statistics

Appropriate register

3.2.1 Decide type of building and geographical limitation

The sampling process is based on category strata where the type of tenants basically serves to define the different strata. When we refer to building category therefore, it is basically the tenant category. Typically, strata can be offices, schools, healthcare, sports, retail, and other. This categorisation is a very important exercise and the aim is to cover all non-domestic buildings in the country, yet controlling precision in results analysis.

More than strata, it can be practical to also apply clusters. That is, rather than sampling randomly from all buildings within a category, clusters are formed so that certain regions representing e.g. the different climate zones or administrative zones. Population density can as well be one factor to be used for clustering.

Reasons for working with strata and clusters are practical and serve to give more homogenous results for each category. The strata shall be such that the result within each stratum is more accurate than results would have been from a sample without strata. Strata shall not be too many, so that the number of objects within each strata are still normal distributed, i.e. at least two hundred. Another reason for not having too many strata is the pace of updating data need be sufficiently high to produce useful figures for the sector. New data for each building category cannot be more than ten years old if they shall be relevant for current policy and legislation.

Clustering is as well motivated by practical and budget reasons. For example, the entrepreneurs that shall carry out inventories may save significant time if sampled objects can be clustered into certain geographical areas.

Creating strata and clusters may take extra time, but because the actual data collection is rather specialised and time consuming itself, it makes sense to pre-plan, categorise and cluster, rather than doing a complete random sampling of all public buildings in the country.

It is advisable to involve a statistical expert in the creation of strata and clusters, because in the end it will be important to understand and be able to calculate how different sampled building objects contribute to the whole picture based on their sampling weights. An experienced statistician may as well have better insight in what registers are available and therefore what can be practical strata. An experienced building engineer is as well crucial to involve, ensuring that the strata provide better homogeneity than the un-stratified population would have done.

3.2.2 Define frame for statistics

When the logic for categorisation and clustering is settled, it is required to design a register or frame for the population that follows these definitions. This population or part of population will be used to sample objects, which in turn is required in order to be able to present the results as on a national/aggregated level with statistical significance. If the buildings are not randomly sampled the study will be a multiple case study of a number of selected buildings. This means that there will not be any statistical significance in the presentation of the results, and therefore not possible to express the results on an aggregated level.

There must be a defined population of buildings, for example office buildings in India. If it's not possible to define a population of buildings on national level, another population could be defined, for example all *official* office buildings in India or any sub region. Some relevant factor must be used for calculating the statistical probability and thus weight of each randomly selected building. This factor can for example be the total square meters or the annual electricity use.

If the random sample of buildings is selected from a known population the study can use weights to present the results on an aggregated level.

3.2.3 Appropriate register

An appropriate register is required before the sampling can be made, and the task is to find or create a register covering the desired buildings. Typically, there are registers based on actual physical buildings, power connections or owners/tenants (workplaces, homes). The type of register to be used shall describe the buildings, its demarcation and features (technical and in terms of current tenants' activities – e.g. school, what type of school? How many hours per day?)

A building register may fail to group buildings that are used by the same tenant (e.g. a school that have classrooms in one building and canteen in another),

whereas a register of schools may be vague on what buildings to include. The appropriate register therefore requires some open-minded thinking and it can often be instrumental to create specific registers, such as combining two existing registers or complementing an existing register. For the sampling, it will be important that each object is clearly demarked in the list/register.

When the register is prepared, the secretariat or an external statistical expert can proceed to sampling. However, in parallel, it is due time to proactively engage relevant building owners and other experts in the upcoming activities through general information and outreach activities. It will be easier to target the information well once the building category, strata and perhaps clusters are settled and it will be instrumental to have some dialogue with the target group before sampling, e.g. in order to get some understanding on the expected fall off of respondents and therefore required oversize margin of sample.

Before actual sampling is made, parallel with analysing the most appropriate sample method, it is motivated to start general information and outreach activities in order to anchorage the study among leading partners and the broad number of building owners in the chosen building category, refer to the below chapter.

3.3 General information and anchorage

General information and anchorage
Create a web-page
Update the web-page
Elaborate printed information material
Hearing

The outreach activities shall be well formulated, simple and broad for a start. The culmination of early outreach activities is the Hearing. However, it is positive if other more profound material is also available, should interested parties want to know more. Therefore, it is advised to design the web-page and up-load background information as well as information material to the extent available up front the hearing. Below follows instructions for the web-page design and some proposed material, thereafter a brief presentation of how a hearing can be arranged.

3.3.1 Create a homepage – a project website

It is recommended to establish a site for the BEE STIL2 project in India with both a public interface and an internal administration site for the project members. Initially, a decision at BEE as regards software and site to use is required. Below are instructions for Share-point view, or for a similar alternative soft-ware that BEE may suggest. It is suggests how to organise the information and the recommended level of access for different users.

3.3.1.1 Main features of the project website

- A robust website structure accessible from all web browsers;
- A graphical and user friendly lay out;
- Allowing multiple users with various rights to access and edit information, from various location;
- A sufficiently strong login system with personal user name and password;
- Ability to handle all necessary file formats;
- Sufficient disc space;
- Backup system;
- Long term availability and support of the website.

3.3.1.2 Technical specifications

In a full scale version of the STIL2 project there are large quantities of information that must be handled and coordinated among many actors. To be able to keep this data structured and not losing any information a project website is a powerful tool. The website should contain both public information about the STIL2 project and an internal section where information for those who work in the project can be handled. This internal section shall be login required. The logins should be handled by the administrator of the website who also must keep records of who and what kind of rights to access and edit information each project member has.

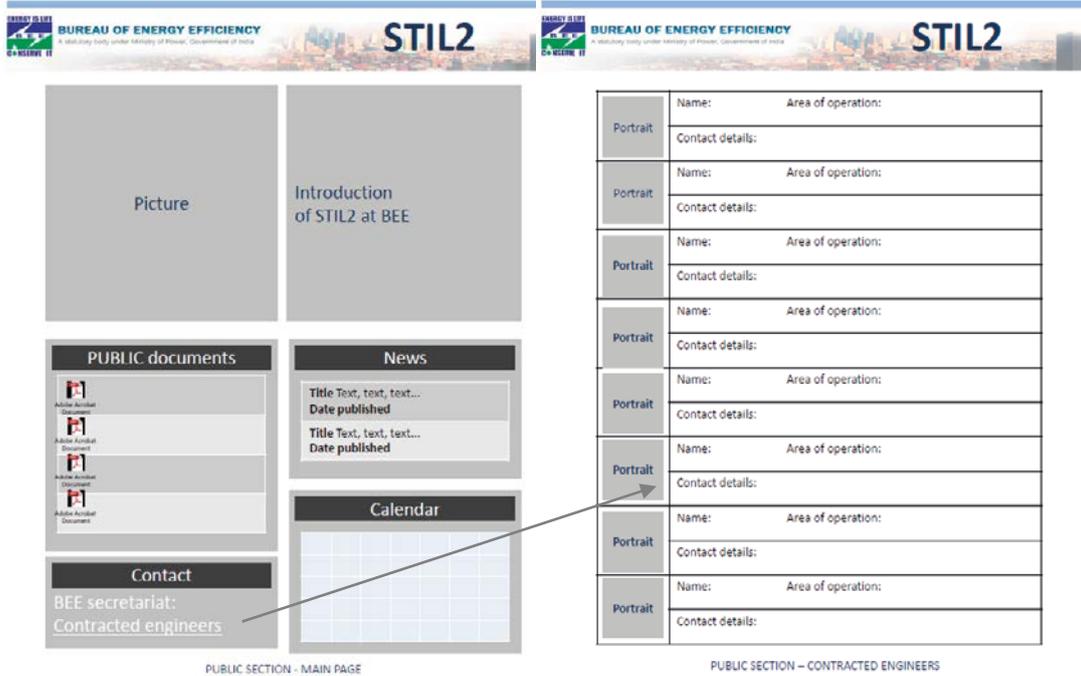
The proposed structure of the web-page is;

- A public section, containing;
 - A picture or video;
 - An introductory text;
 - A library of public documents;
 - Contact details (also with a link to a separate page listing the contracted engineers);
 - News, and;
 - A calendar.
- A project members section, containing;
 - A calendar;
 - A library of common documents;
 - A library of protocols;
 - A chat forum;
 - A library of background documents;
 - A library of feedback documents.

A layout example is given here, and the sections described follow this layout. Different web-design software has different features, and BEE may want to adjust the design as to suit the soft-ware tool they use.

3.3.1.3 Public section

Public section, main page and list of contracted engineers:



This section should contain public information about the project. The information should be aimed for the general public but also for the building owners participating in the study, searching for further information about the project and how they can prepare for the audits.

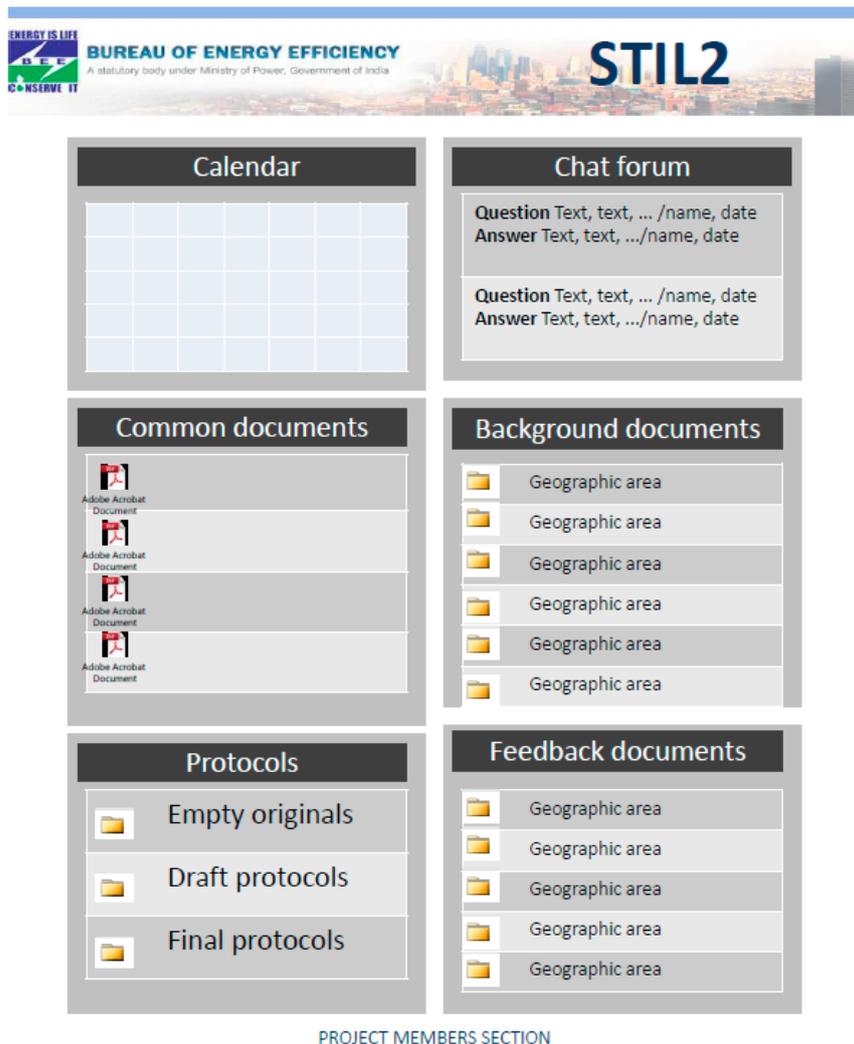
The reference library developed during inception shall be accessible here. The public section shall further contain reports of pre-studies, presentations of the project and name and contact information of the project members.

Documents with name and pictures of the auditors who are to perform the audits could also be a suitable service for the building owners participating in the project. It is advised that this forms a separate page to be filled in once engineers are hired for the project.

The public section should have public reader access and only the administrator should have the right to edit contents and up-load and documents.

3.3.1.4 Project members section (internal for project)

Project members section:



To access this section of the website a login is required. The login is personal and unique for each project member, the main types of members being the secretariat and engineers. The login is needed since potentially secret information is stored here. The login also allows the secretariat to monitor who access and edit what data. Two levels of access should be given: all project members shall have access to the project members section – common part. In the libraries with building specific data (background, protocols and feedback) the secretariat shall have full access, but for the contracted engineers, access shall be given by region or building and only to those engineers that have been assigned to handle that specific region or building.

The following sub sectors described are repeated for each year (or building category) studied in the STIL2 project, using tabs or similar.

Background information for each building object

When the STIL2 project is launched in full scale a large number of objects (buildings) will be handled by first the project secretariat and thereafter the auditors (engineers).

In the phase when the objects which are to be included in the project are selected, basic information about these will be collected. On the website there should be a section where information about each object is stored; background documents.

Since there are a large number of objects included in the study the objects could be grouped preferably by geographical location. When the basic information about the objects is collected by the secretariat, it should be uploaded to a folder for this specific object. The folder shall also contain a diary of the secretariats dialogue with the building owner covering such things as explanations to the material, directions for keys, parking facilities, notes about suitable timeslots during the day to visit different parts of the building or any other practical issues about the audit.

When the auditors then are assigned objects all required information should be present in these folders. If not, there should be information why and how it can be obtained. The auditors/engineers need both read and write access to this information, since they may also want to add documentation, photos or notes from phone calls.

However, the rule shall be that most background information should be gathered by the secretariat and any additional information obtained by the auditor should be reflected in the protocol.

The access structure to the background is proposed to be:

Folder	Category	Read	Write
Library of background documents	Secretariat	X	X
	All Auditors/engineers	X	–
	Assigned Auditors/engineers	X	–
	Quality assurance engineers	X	–
Subfolder, e.g. geographic region	Secretariat	X	X
	All Auditors/engineers	–	–
	Assigned Auditors/engineers	X	–
	Quality assurance engineers	X	–
Subfolder, e.g. Specific building/object	Secretariat	X	X
	All Auditors/engineers	–	–
	Assigned Auditors/engineers	X	X
	Quality assurance engineers	X	X

Protocols

The protocol section of the website should consist of three folders.

1. The first folder containing the empty original version of the protocol for each building/object. The secretariat prepares the protocols with building ID from the sampling, so that there can be no confusion about which building it concerns.
2. The second folder is where the auditors upload the first draft of the protocols for the head of auditors to evaluate.
3. The third folder is where the final versions of the protocols are stored. These are quality controlled by the head of auditors and are the base of the analysis performed.

Access recommendations for the protocols' folders:

Folder	Category	Read	Write
1	Secretariat	X	X
	All Auditors/engineers	–	–
	Assigned Auditors/engineers	X	–
	Quality assurance engineers	X	–
2	Secretariat	X	–
	All Auditors/engineers	–	–
	Assigned Auditors/engineers	X	X
	Quality assurance engineers	X	X
3	Secretariat	X	–
	All Auditors/engineers	–	–
	Assigned Auditors/engineers	X	–
	Quality assurance engineers	X	X

Chat forum

The website should contain a Q&A section where the auditors can post general questions about the audit work and the project in whole. This section is for information exchange between the auditors, the head of auditors and the project secretariat. The purpose of this is to let the auditors take part of other auditors' questions and reduce the burden of the head of auditors having to answer the same questions numerous times.

Common documents

This library should contain general information about the project; documents such as methodology descriptions, manuals and time schedule that are of interest for all involved in the project. After project completion result and analysis documents can also be stored here.

Calendar and meetings

A web based calendar where the project secretariat post time schedules and meetings is a practical way to spread information to all project members.

Feedback documents

When all audits are performed and the analysis is made, feedback documents are created and stored in this library. The access structure of the feedback library can be the same as for the protocols' library.

3.3.2 Update the web-page

After the web-page has been set up, one member of the secretariat will be responsible for updating the web-page. This activity will go on throughout the entire project.

3.3.3 Elaborate printed information material

Printed materials that need be developed include e.g. brochures or facts sheets. These can be used for the general public and be distributed at for example the hearing. Brochures are also nice to bring when auditing the building so that those tenants and others who are visited feel well acquainted with activities.

It can also be important to create BEE ID-badges or other similar printed cards that the engineers can bring when visiting the building.

3.3.4 Hearing

It is recommended to arrange a hearing at a very early stage, before sampling but after the category and frame is proposed. This should be an opportunity for the general public, professionals in real estate management, and specifically for those managing buildings of the kind included in the sample frame.

The Hearing can be a half day meeting with an introduction to the prevalent energy efficiency ambitions in the Indian building sector and why the STIL2 statistics will be instrumental. An introduction to the current situation and trends of energy use in the Indian building sector.

The motivation for starting with the specific building category and other potential categories to come. This is where BEE can probe for engagement and that building owners are prepared to contribute. It can be a forum to briefly inform about:

- the sampling aspect, and that it will not be possible to change buildings;
- the secrets of being involved as an building owner – no results from individual buildings will be published
- the opportunity to be involved as an entrepreneur and perform inventories

3.4 Sample

Sample

First sample and list

Complement from list if required

Calculate statistical weights

3.4.5 First sample and list

Pareto-pps is the recommended sampling method and it selects objects from e.g. a list of well-defined and demarked objects in a certain order. The first sample will aim to select as many objects as required for the expected statistical confidence and will regard that both over coverage and fall offs are expected, thus oversizing the sample size accordingly.

It is recommended to sample based on the building size but with “cut-off”, i.e. not including the extreme cases of building sizes. Recommended cut-off sizes are buildings smaller than 200 square meters and buildings not larger than 15,000 square meters. Other delimitations can be for example not more than 10 different tenants.

If available, the sampling can also be based on the annual electricity use per building or even the quota electricity per square meter. However, it must be recognised that in this first list, the population frame from which a sample is made, can include faulty values for as well building size and electricity use. After the audits have been carried out, these values can be corrected for the objects that have been but not for all the others, which complicates the calculation of statistical weights.

Based on the assumption that building sizes are normal distributed, the required sample size for each building category can be estimated as:

$$n = \left(\frac{z \cdot s}{E} \right)^2$$

Where:

z is the square root of the confidence interval, i.e. 1.96 for a 95% confidence interval;

s is the standard deviation of the population (regarding for example building size);
and

E is the acceptable error.

Example: For a population with an estimated standard deviation of 1,160 square meters, and with an acceptable error of 200 square meters, the sample size to acquire a 95% confidence interval will have to be not less than 130 objects:

$$n = \left(\frac{1.96 \cdot 1,160}{200} \right)^2 = 129.2$$

It is recommended to assign the decision of sample size to a statistical analyst with full understanding of how the strata and clusters have been designed. However, your project budget and other practical limitations do also influence how to do sampling. It is therefore recommended that sampling and sampling size is allowed some time and perhaps including a steering group meeting. This process can be ongoing in parallel with the general information and outreach activities.

3.4.6 Complement with new objects from the list if required

If during the preparation of background information, it is concluded that more objects still are required, new objects must be drawn from the same list. More objects can be required because the objects were not accurately falling within the pre-defined category (over coverage), because the building is not possible to audit with sufficient accuracy (fall off), or because the building owner or tenants did not cooperate to allow for an inspection (fall off).

3.4.7 Calculate statistical weights

It is recommended that the statistical analyst do the sampling and complementary sampling because, it will be important to keep track of the statistical weight for each object. This weight is based on the probability of being selected and has to do with the sampling but also the foregoing design of strata and clusters. The calculation of weights cannot be finalized until it is clear what objects were actually inventoried, and if not – why they were not inventoried (fall off or over coverage).

The statistical weight can only be calculated after all inventories have been carried out and quality assessed. This is an important message to the contracted entrepreneurs, since it will challenge the whole project if one building that is thought to be OK from the point of view of category and quality of background information is late or completely fails to deliver any results.

3.5 Hire entrepreneurs for inventories

Hire entrepreneurs for inventories
Invite to tender
Evaluate tenders
Sign contracts with ceiling budgets and hourly rates
Appoint quality assurance experts (QAE)

External entrepreneurs will be required for the implementation of a full scale STIL2 since a large number of inventories shall be performed in a concentrated period of 6–8 weeks. It is recommended that each engineer have no more than two buildings per week. A regional allocation of responsibilities can be made in beforehand, but the individual agreements must be possible to adjust since the sampling can alter how many and how complex building that are actually selected in a specific region. BEE will need a model to estimate appropriate time resources

for different buildings in order to be able to budget for the inventory and hiring of external resources. Such a model can be as presented in Appendix time allocation.

3.6 Fine-tune the method and planning

Fine-tune the method and planning

Perform pilots

Decide indicators to be measured

Establish climate data

Review and update time requirements and schedule

3.6.1 Perform pilots

The QAE should perform a few pilot inventories. The pilots give input to take decisions about specific aspects before conducting the training with all engineers. Also the pilot inventory helps to estimate time requirements for separate buildings and this will be the basis for agreements with entrepreneurs.

It can be wise to do at least some of the pilots before sampling, because experiences from the pilots can help in estimating practical “cut-off” values, and it helps estimating the actual time requirements, i.e. how big a sample size can be covered within a given budget.

3.6.2 Decide indicators to be measured

Through Reference group meetings, indicators shall be selected that refer to the actual building category. This can be useful indicators that link to other information and classification standards that are widely used, e.g. for restaurants “energy use per portion”. The reference group is instrumental here because they know what the praxis in their branch is and also what trends may be interesting to follow up.

3.6.3 Establish climate data

In the protocol, climate data is required for a normal year and for the year that energy data has been compiled for. This is input in the form of hourly outdoor temperatures. This is a task that the secretariat can prepare before audits. If regional clustering is used, climate data compilation can be commenced as soon as these regions have been chosen. In India there are five climate zones.

Climate data for normal years is normally provided by the meteorological institute, alternatively a building research institute can have such data.

How to fill in temperatures and calculate degree days is presented in the protocol.

3.6.4 Review and update time requirements and schedule

Before finally launching the audits and bringing on board the hired entrepreneurs, it is advisable to adjust the time requirement per building with respect to its size, number of tenants and any other information that may have arose during

preparations. The time schedule shall be designed so that each engineer has no more than two buildings a week and fewer in cases of very large buildings or when long travelling is required.

3.7 Specific information to selected building managers

Specific information to selected building managers

Contact building managers

Support and complement

Prepare protocols with information and climate data

3.7.1 Contact building managers

The secretariat contacts selected building managers following a specific routine as outlined in the list below. There are a set of useful templates that shall be in place when this activity is launched. These are for example:

- Letter to building owners (Template letter)

The letter specifies the selection criteria and the wanted material.

Selection Criteria:

- Ongoing activities in at least 200 m² and less than 15,000 m².;
- At least 80% of the building shall be used as office;.
- 12-month median statistics with existing installations and activities should be. With electric heating, statistics must be on monthly basis;
- Current activities should continue throughout the investigation;
- Buildings with an onward supply of electricity and heat to other units should be avoided.
- Buildings with many tenants (e.g. more than 10) who have their own reading of electricity should be avoided.

Checklist for Preparation:

- Blueprints: Plan, design and façade;
- Media statistics for the fiscal unit from the 12 consecutive months during the last 18 months (electricity, heating, cooling and water), or the reference of your subscription and power of attorney so that we can retrieve this information from the respective suppliers;
- Contact person in the form of operating technicians and office tenants.

The secretariat prepares a list of buildings, data collected and other data of relevance. This list is a development of the register from which the buildings are sampled. Basically, the sequence of tasks that the secretariat performs in order to organise the buildings are (also supported the auditors and QAE in the end) as presented in the below list.

List of tasks that the secretariat does to prepare for audits:

1a) Prepare register/list for sample (which is already discussed in earlier paragraphs);

1b) Prepare wanted indicators and in-data parameters for these; define parameters and indicators carefully together with reference group (which is already discussed in earlier paragraphs);

1c) Prepare normal climate data for foreseen regions (which is already discussed in earlier paragraphs);

2) Ask a statistician to sample and provide numbered list of sampled buildings including over coverage (columns 1–6 below to be included in list), (which is already discussed in earlier paragraphs);

3) Contact building managers based on list, strive to have them accept to be involved in the study and ask for a contact person (total max 1 hour per building, Main messages at the first contact:

- A concise presentation BEE and STIL;
- You are selected – accept?;
- This is what we want you to prepare;
- This is when we plan to visit your building (period/ range);
- Who will be our contact person for this project?);

4) Contact given contact person, talk over phone, email and send a traditional letter and ask for specific information as specified in the list columns 7–12 (total max 5 hours per building). Add information to list (columns 7–12). Create a separate diary file for each building ID in the list;

5) Secretariat’s preparation of material and protocols, checklist for each building continues in columns 13–20. Make annotations for buildings that shall not be included! Why?

Table 1 Simple guide to annotations for buildings that cannot be included in the sample

Reasons not to be included:	Statistical note:
It turns out not to be a building any longer, or not the expected type of building. If it is called office in statistics, at least 80% of the building should be used for office purposes, including normal office complementary spaces. (To be defined by reference group and QAE)	Over coverage
The building activities have changed significantly over the last year, e.g. new type of tenants has come, or major refurbishments have been performed. This means the energy statistics will not be relevant to allocate based on the inventory.	Over coverage
The building area is less than 200 m², more than 15,000 m², or has more than 10 tenants.	Fall off
The building owner/manager cannot provide sufficient data about the building, although is otherwise a building that could have been suitable for the study	Fall off
The building owner refuses to cooperate in the study, although is otherwise a building that would be suitable for the study.	Fall off

6) If there are still data missing for an otherwise useful building, it is transferred to the auditor to suggest how to complement apriori data. The auditor can as well consult the QAE, refer to next paragraph.

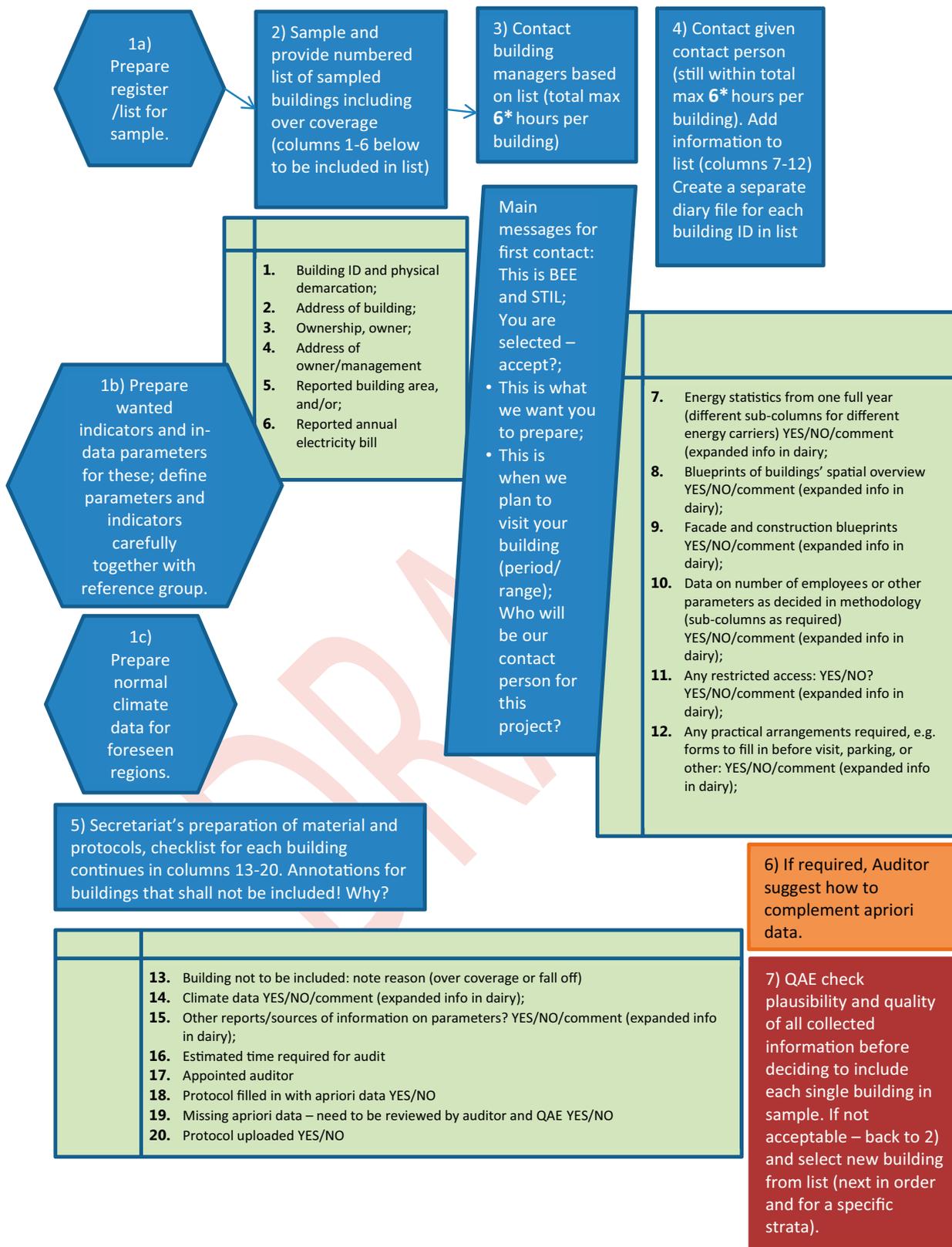
7) QAE check plausibility and quality of all collected information before deciding to include each single building in the sample (refer to next paragraph).

If it is not acceptable – go back to 2) and select a new building from list (next in order and for specific strata).

It is the secretariat that fills in the list of buildings. This list is a simple table prepared to keep track of progress with preparations and audits. There should only be one list and others cannot edit this list. It can however be displayed on the internal web-page. Each row is a building and with data in the following columns, see below.

Master list of buildings to be audited:

Data that can be specified before contacting the specific building owner.	<ol style="list-style-type: none"> 1. Building ID and physical demarcation; 2. Address of building; 3. Ownership, owner; 4. Address of owner/management 5. Reported building area, and/or; 6. Reported annual electricity bill;
Data that is specified based on contacts with the building owner.	<ol style="list-style-type: none"> 7. Energy statistics from one full year (different sub-columns for different energy carriers) YES/NO/comment (expanded info in dairy); 8. Blueprints of buildings' spatial overview YES/NO/comment (expanded info in dairy); 9. Facade and construction blueprints YES/NO/comment (expanded info in dairy); 10. Data on number of employees or other parameters as decided in methodology (sub-columns as required) YES/NO/comment (expanded info in dairy); 11. Any restricted access? YES/NO/comment (expanded info in dairy); 12. Any practical arrangements required, e.g. forms to fill in before visit, parking, or other: YES/NO/comment (expanded info in dairy);
Administrative data.	<ol style="list-style-type: none"> 13. Building not to be included: note reason (over coverage or fall off) 14. Climate data YES/NO/comment (expanded info in dairy); 15. Other reports/sources of information on parameters? YES/NO/comment (expanded info in dairy); 16. Estimated time required for audit 17. Appointed auditor 18. Protocol filled in with apriori data YES/NO 19. Missing apriori data – need to be reviewed by auditor and QAE YES/NO 20. Protocol uploaded YES/NO



3.7.1 Support and aim to complement material

The quality assurance engineers together with sampling experts at the secretariat shall decide whether there is enough known parameters about the building up front audit.

If not, the building should not be audited but be substituted and noted in the sample list as “fall off due to unsatisfactory in data”.

3.7.2 Prepare protocols with information and climate data

Further to preparing the list of buildings, the secretariat will prepare each protocol with the in-data that has been collected up front, i.e. building data, energy data and climate data.

3.8 Harmonize the team of auditors

Harmonize the team of auditors
Training
Instructions
Templates
Timetable

3.8.1 Training

One day training is compulsory for the hired auditors. Only well merited engineers are hired for STIL2 audits. However, no matter how good they are they will have to sit for a day together and settle a common way of performing the audits. Estimates on installed effect for certain appliances, operating hours, on load factors and on air flows are essential for the results of the inventory. Since it is a statistical study, the discrepancies between inventories due to individual methods shall be minimized.

The training is proposed to cover the following elements at the least (a proposed training agenda is enclosed):

- Background on STIL
- Messages from the reference group on important indicators
- The protocol, how to fill in
- Specific additional thematic sessions for specific technologies; e.g. medical equipment if buildings in health sector.

Moreover, the training is an exceptional opportunity for the full auditing team to meet and talk. By socialising, the auditors learn about each others experiences, strengths and weaknesses. They also meet the project management.

3.8.2 Instructions

Instructions regarding the code of conduct; how to approach as a BEE sub-contractor, how to present the project. ID if required. The list of auditors is on the web-page and building managers may want to refer to it to see that this is the expected audit.

Instructions regarding the sampling process and that you cannot replace buildings on site.

Individual login details for the web-page and instructions regarding how to use the web-page for downloading and uploading information.

Individual adjustments to the contract with the BEE; e.g. number of hours, number of buildings and time plan.

3.8.3 Material and templates

The Auditor shall be given access to material and templates such as, short description of the project (to bring with them at audits). All the collected material in file for the building. Templates for contacting the building manager in place with specific date and time for audit. The building manager in turn may want pre-printed information in order to prepare its tenants, announcing what is going to happen and ask them to cooperate.

3.8.4 Timetable

The auditors will be given a firm timetable to follow, when to perform what audits and when deliver filled in protocols. In practice, the secretariat and the QAE can specify on a weekly basis (around two buildings per week), but then for booking specific times and when to do what in terms of logging electricity etc., the auditor will need to make the final decision.

3.9 Auditors' preparatory work

Auditors' preparatory work

Check material

Suggest possible methods for complementary material

Book time

Check accessibility to whole building

Communicate plans to QAE and secretariat

3.9.1 Check material

After the training, the auditors can start checking information about the object that has been made by the project secretariat, and that you can find on the project web-site:

Check monthly statistics for electricity. If possible, ask the electricity supplier if they also can provide hourly readings from one week consumption. Some companies only charge for kVA, in that case you need to make a conversion into kWh.

Check drawings/blueprints of floor plans, if possible also facades. A scheme of electricity feeders might also be useful.

If earlier audits of good quality have been performed, it can be useful to study these.

- Read material.
- Measure area from blueprints or if required consider to bring laser pointer for some rooms.

Refer to previous paragraphs as regards complementing the material if required. Structure how to fill in protocol, extra sheets? Pages for calculations, comments etc. – no new cells should be added in existing template form!!

Bring soft version or prepare notebook, printouts or any arrangement that you find convenient. Some auditors prefer to bring a printout if the blueprint for noting directly on the blueprint while walking; no. of tube lights, no. of computers, etc. in every room.

3.9.2 Suggest possible methods for complementary material

Refer to previous paragraphs. Any suggested methods must be communicated to the secretariat and the QAE. (List of tasks that the secretariat does to prepare for audits, no. 6).

3.9.3 Book time

Within the given timespan/week, it is finally the auditors' responsibility to book a time for the visit, walk through and interviews with building manager and tenants.

3.9.4 Check accessibility to whole building

Communicate to the building manager that you wish to see the entire building, including installations rooms, server rooms, garage, etc. If appropriate, take time to contact the tenants personally, rather than only relying on the information they get centrally from the building owner/manager.

3.9.5 Communicate plans to QAE and secretariat

The auditor communicates back to the secretariat and QAE any solutions or problems that he/she have encountered regarding the audit preparation and quality of in-data, timing of audit etc.

This should be communicated in beforehand since it can be the case that the QAE decides that quality will not be sufficient and that another building must be selected. A new sample may result in that a completely different auditor will be asked, and payments will not be executed for the building that fall off the sample.

3.10 Audits

Audits

Interviews

Walk through audits

Measurements

Professional estimations

Enter data into the STIL2 protocol

3.10.1 Interviews

Interview representatives about how the building is managed: working hours, how lighting, heating and A/C is controlled. Find out operating times both on hourly basis but also monthly. Ask to see the lamp-storage to find out what types they use. Note the data for transformers to calculate losses (if the building buys high voltage).

3.10.2 Walk through audits

Perform the inventory. Use copies of floor plans; it is often time efficient making notes directly in the drawing.

All electric installations shall be noted: type, numbers and power. Make notes for remembering running times, cycles or other that helps estimate annual energy use. Take photos to help you remember. If you don't have complete drawings check type of windows, how walls and roof are built up (insulation, air gap etc.), orientation. Bring a copy of a STIL2 audit to help you remember all aspects.

3.10.3 Measurements

Bring a meter for instantaneous measuring. You might have to perform instantaneous measurements for cooling compressors, office equipment, servers etc.

Bring an electric logger and measure total electrical energy, at least you should log for 24 hours (or you can do hourly readings manually, but you have to include a night). Most interesting is the base load, when A/C and heaters are off. At night time is usually only electricity used to servers, process cooling and possibly lighting in stairs and outside.

3.10.4 Professional estimations

In the worst case you are allowed to make "professional estimations". For instance, a water cooler that is not in use during winter, you can read the electric power and ask for/estimate the running time. An A/C has a slightly different electric effect depending on temperatures outside and inside, if you measure it you also have to make an "average estimation" over the year.

3.10.5 Enter data into the STIL2 protocol

Enter data into the protocol using the detailed instructions presented at the auditors training (enclosed). The sheets that shall be filled in are:

1. Building data (partly filled in in beforehand by the secretariat)
2. Energy data (partly filled in in beforehand by the secretariat)
3. Data
4. Inventory
5. Output
6. Savings Potentials
7. Degree-hours actual year (filled in in beforehand by the secretariat)
8. Degree-hours normal year (filled in in beforehand by the secretariat)

The auditors up-load the in the project web-page protocol as they have been instructed at the training and in due time for quality check. Auditors shall be available for clarifications if required by the QAE.

3.11 Quality assurance

Quality assurance
Support in auditors suggested estimates on material
Judge if material for each building is satisfactory for statistics
Communicate decision to secretariat
Control quality of separate protocols
Control sample audits (10%)

3.11.6 Support in auditors suggested estimates on material

Refer to “List of tasks that the secretariat does to prepare for audits, no. 7”

3.11.7 Judge if material for each building is satisfactory for statistics

It is the responsibility of the QAE to finally judge if the selected building and the data that can be found about it is satisfactory for the statistical survey.

3.11.8 Communicate decision to secretariat

It is the responsibility of the QAE to communicate this decision and other details to the secretariat for proper follow up and track keeping of the statistical material.

3.11.9 Control quality of separate protocols

It is the responsibility of the QAE to quality assure all the performed inventories through reading and quality assuring each protocol before accepting it to be part of the statistical analyse.

3.11.10 Control sample audits (10%)

More than reviewing all protocols, the QAE shall perform sample audits in around 10% of the selected buildings.

3.12 Compile results

Compile results
Create a file with all protocol-data
Adjust parameters with weights
Create indicators
Prepare separate full files for various potential calculations

3.12.1 Create a file with all protocol-data

When all protocols are quality checked, a simple visual basic macro can be designed to *compile* results from the various protocols approved into one file. The logic structure will be to create a file that includes the same sheets as the protocol but with relevant key figures listed in one column per building.

The macro easily finds these values from the various protocols if they are placed in the same server as the source file name is changed for every new column, but the cell addresses are unchanged. This is the main reason why it cannot be accepted that auditors add a new cell, a new row or a new column into the protocol. Doing so will distort the compilation process and cause delays.

See for example the print screen below, where the building ID in the top row is equivalent to the filename of the final protocols, and the values below are picked from the respective protocols.

ID	Sa1001883	Re1000314	Sa1003375	Sa1001921	Sa1000997	HR1004095	Re1001748	Sa1003856	Re1003017	HR1002745	Sa1002640	Sa1003955	Ky1004209	Ky1002275	Sa1007537	Sa1003385	Sa1002460
Energy supplied to the building																	
Latset period, MWh																	
Electricity, Totalt	44	281	74	71	87	30	147	310	135	105	25	36	38	13	156	54	15
District heating	205	203	266	152	192	65	81	235	36	481	38	0	0	42	76	80	0
Steam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil boiler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
City gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waste gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pellets/briquettes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood chips	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
District cooling	0	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	249	509	340	223	279	94	228	545	171	676	63	35	35	55	232	135	15
Normal corrected, MWh																	
Electricity, Totalt	44	281	74	71	87	30	147	310	135	105	25	36	38	13	156	54	15
District heating	237	215	279	161	201	65	84	217	36	515	40	0	0	44	88	85	0
Steam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oil boiler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
City gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waste gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pellets/briquettes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.12.2 Adjust parameters with weights

Calculating statistical mean values for the different key parameters requires that each value of relevance (each value in the compilation file) shall be multiplied with the statistical weight before any quotas and means are calculated.

That means a ‘weighted’ compilation file shall be produced which is a copy of the protocol compilation file, but with each value multiplied by the statistical weight; including building area, number of staff (or other as decided), annual energy use etc.

3.12.3 Create indicators

When calculating means of quotas which is the case for e.g. specific energy use (kWh/m², year), it is important to do as below:

$$E_1 \cdot w_1 + E_2 \cdot w_2 + E_3 \cdot w_3 \dots + E_n \cdot w_n$$

Where:

E is the normal corrected annual energy use in kWh/year for each building object 1,2,3...n

A is the building total inner area for each building object 1,2,3...n

w is the statistical weight for each building object 1,2,3...n

3.12.4 Prepare separate full files for various potential calculations

Lastly, for the estimates of potential national energy savings, separate files shall be designed in which the considered changes can be exposed and tested. Normally, it will be changes in lighting devices, changes in operating hours for lighting and other equipment, replacement of ventilation or AC systems. It is recommended to work in separate files since calculations in several steps can be required, and those will all have to be corrected with respect to statistical weights before any estimates can be made regarding the national effect. Especially for the ventilation systems it is important to keep affinity laws in mind (that fan power changes versus air flow changes are not linearly linked).

3.13 Analyse results

Analyse results

- Create diagrams of mean values and energy allocation
- Create frequency diagrams
- Design relevant tables
- Comment on results
- Calculate potential savings

3.13.1 Create diagrams of mean values and energy allocation

Create staple diagrams for each building category. Below is an example from the Swedish implementation.

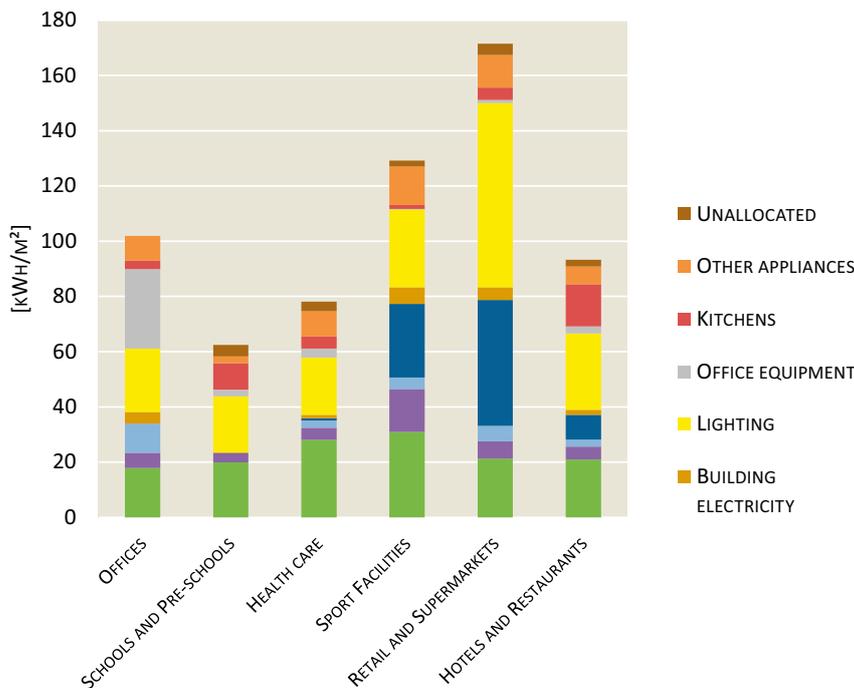


Figure 3 Specific electricity use per different end use categories in Swedish premises

3.13.2 Create frequency diagrams

More than the statistical mean, it can be valuable to have an illustration of the spread of results. It can for example be illustrated with frequency diagrams. Note however, that in the case of indicators defined as quotas, such diagrams will be based on quotas for each building alone – thus not calculated as in paragraph 3.11.3 above. Such frequency diagrams can therefore only be for illustration and the calculated mean from such a diagram will be misleading. See below an example of a frequency diagram.

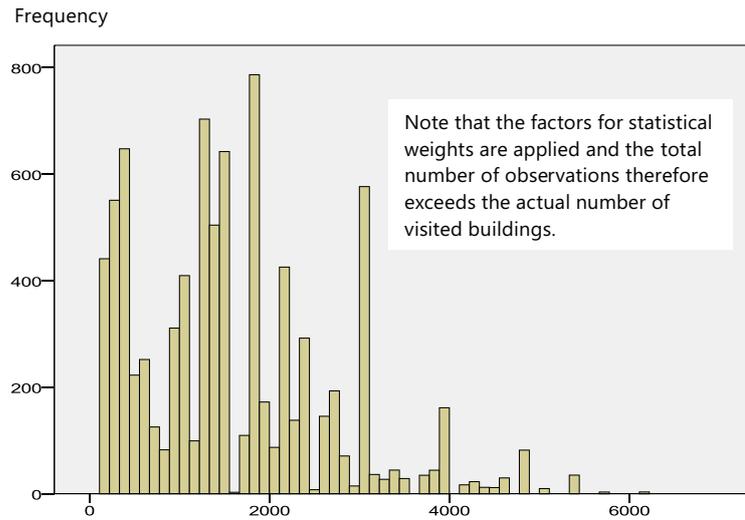


Figure 4 Annual hours of operation for lights in Swedish hotels, distribution frequency.

3.13.3 Design relevant tables

Tables can be descriptive for part of results, also other than specific energy use. For example it can be an exposé of the various types of AC-systems that are applied and how common they are, or as below: Installed lighting power in different room types (only pilot values that are not statistically significant).

Table 2 Indian Pilot Buildings: Lighting Power Density (Installed power per area, m²)

Room type	W/m ²	
	Building A	Building B
Office rooms, single officer	11.8	16.3
Office room, multiple officers	12.7	16.6
Office landscape	15.3	12.6
Corridors, passage, stairs	3.6	4.8
Maintenance rooms	5.5	3.6
Conference room	12.6	4.8
Reception	11.1	9.7
Toilet	6.8	7.7
Storage room	9.8	4.4
Library	–	–
Server-, computer room	14.1	4.9
Outdoors	–	–
Other room type	9.4	11.0
TOTAL	10.4	8.2

3.13.4 Comment on results

More than figures, diagrams and tables, the report shall include comments on results. Are there any common explanations to the situation; are there any trends or generic observations?

3.13.5 Calculate potential savings

Potential savings can be estimated on a national level for some straight forward hypothetical changes, e.g. that lighting operation hours are adjusted to follow opening hours in retail premises such as illustrated below. In the leftmost diagram, the prevailing light operating hours are illustrated in a staple diagram for each visited building together with a line showing their respective opening hours. In the rightmost diagram, those staples exceeding opening hours are 'cut' to a value of about + 20% of opening hours per visited building. The change in energy use for lighting can then be calculated for each visited building and scaled up to a national estimate through multiplying each observation with its statistical weight.

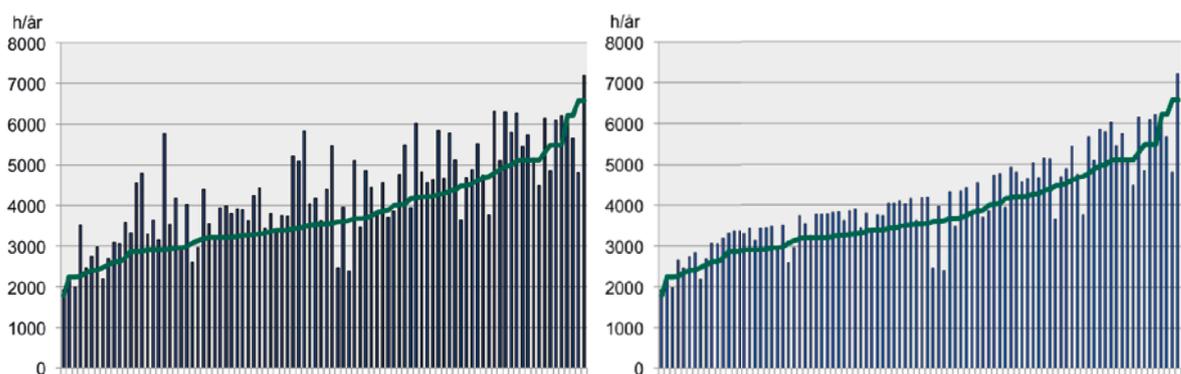


Figure 5 Illustration of estimated potential savings when adjusting lighting operation hours to better comply with actual opening hours.

3.14 Report results

Report results

Create feedback to building managers

Write report

Summarize for press release and presentation at conferences

Upload press-release with report and summary results

3.14.1 Create feedback to building managers

Create result for individual buildings and compare the individual building with the national average. This is a way of giving some feed back to the building owner. It can also be complemented with a free advice from the BEE-entrepreneurs on how to enhance the buildings energy performance.

3.14.2 Write report

Provide written report with background, a presentation of the methodology, results and comments to the results. It shall be the BEE that decides at an early stage whet to include, if for example specific tables, maps or other result presentations. It can also be well placed to have more illustrative presentations and examples of important energy end use categories, such as lighting or other.

3.14.3 Summarize for press release and presentation at conferences

The project management shall support the BEE to formulate text fir public outreach, press-and a release. Together with the BEE, it shall be discussed how to let others access data for further analyses and follow up: what is confidential information, what is acceptable statistical accuracy.

3.14.4 Upload press-release with report and summary results

The project management together with the project secretariat shall upload agreed information on the project web-page for public access.

4 Time schedule

The time schedule stretches over one year in the preliminary plan.

A time schedule is enclosed in excel format and includes all the activities as presented in this manual. Below is a snapshot.

Months		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Week		1	2	3	4	5	6	7	8	9	10	11	12
Activities	Location (weeks)												
0,01 Project management													
0,01 Steering group meetings													
1 Create a base structure													
1,1 Appoint staff at EDC													
1,2 Steering group: formation and meeting schedule													
1,3 Reference group: formation and meeting schedule													
1,4 Create a reference library and a list of ongoing projects of relevance													
1,5 Write inception report													
2 Select building category													
2,1 Decide type of building and geographical limitation													
2,2 Define frame for statistics													
2,3 Appropriate register													
2,4													
2,5													
3 General information and anchorage													
3,1 Create a web-page													
3,2 Update the web-page													
3,3 Elaborate printed information material													
3,4 Hearing													
3,5													
4 Sample													
4,1 First sample and list													
4,2 Compartment from list if required													
4,3 Calculate statistical weights													
4,4													
4,5													
5 Hire entrepreneurs for inventories													
5,1 Invite to tender													
5,2 Evaluate tenders													
5,3 Sign contracts with ceiling budgets and hourly rates													
5,4 Appoint quality assurance experts (QAE)													
5,5													
6 Fine-tune the method and planning													
6,1 Perform pilots													
6,2 Decide indicators to be measured													
6,3 Establish climate data													
6,4 Review and update time requirements and schedule													
6,5													
7 Harmonize the team of auditors													
7,1													
7,2													
7,3													
7,4													
7,5													
8 Specific information to selected building managers													
8,1 Contact building managers													
8,2 Support and complement													
8,3													
8,4													
8,5													
9 Auditors' preparatory work													
9,1 Check material													
9,2 Suggest possible methods for complementary material													
9,3 Check accessibility to whole building													
9,4 Book time													
9,5 Communicate plans to QAE and secretariat													
10 Audits													
10,1													
10,2													
10,3													
10,4													
10,5													
11 Quality assurance													
11,1 Support in auditors suggested estimates on material													
11,2 Judge if material for each building is satisfactory for statistics													
11,3 Communicate decision to secretariat													
11,4 Control quality of separate protocols													
11,5 Control sample audits (10%)													
12 Closing results													
12,1 Create a file with all protocol-data													
12,2 Adjust parameters with weights													
12,3 Create indicators													
12,4 Prepare separate full files for various potential calculations													
12,5													
13 Analyse results													
13,1 Create diagrams of mean values and energy allocation													
13,2 Create frequency diagrams													
13,3 Design relevant tables													
13,4 Comment on results													
13,5 Calculate potential savings													
14 Report results													
14,1 Create feedback to building managers													
14,2 Write report													
14,3 Summarize for press release and presentation at conferences													
14,4 Upload press-release with report and summary results													
14,5													

5 Staffing

Staff from BEE or externally hired consultants shall be proposed for all positions as presented in this manual. The suggested number of people required is around 30. A list for entering positions and names is given in the enclosed excel-file. Below is a snapshot.

Insert name:	Insert position:	Insert name:	Insert position:
Name 1	Project manager	Name 17	Auditor_8
Name 2	Secretariat_1	Name 18	Auditor_9
Name 3	Secretariat_2	Name 19	Auditor_10
Name 4	Secretariat_3	Name 20	Auditor_11
Name 5	Secretariat_4	Name 21	Auditor_12
Name 6	Secretariat_5	Name 22	Auditor_13
Name 7	Quality Assurance_1	Name 23	Auditor_14
Name 8	Quality Assurance_2	Name 24	Auditor_15
Name 9	Quality Assurance_3	Name 25	Auditor_16
Name 10	Auditor_1	Name 26	Auditor_17
Name 11	Auditor_2	Name 27	Auditor_18
Name 12	Auditor_3	Name 28	Auditor_19
Name 13	Auditor_4	Name 29	Auditor_20
Name 14	Auditor_5	Name 30	Other_1
Name 15	Auditor_6	Name 31	Other_2
Name 16	Auditor_7	Name 32	Other_3

6 More reading

- STIL2 India Pilot Study;
- Article about Pareto- π ps sampling;
- Results from the Swedish STIL2 implementation (www.energimyndigheten.se).

Appendix 1

Instructions for STIL2 India protocol

Compiled by ÅF-Infrastruktur AB, Energy Management in 2013.

Welcome to STIL2!

The aim of the STIL2 project is to produce national statistics. It is of highest importance that the data collected is compatible and uniform. Therefore this inventory protocol is developed, which standardizes the data collection from the performed inventories. This short manual describes the principle of how to fill in the protocol.

A1 Before the audit

Remember that it is mandatory to get an introduction to how to perform a “STIL2-audit”. After that you can start gathering information about the object, this is often made by the project secretariat:

Check monthly statistics for electricity. Ask the electricity supplier if they also can provide hourly readings from one week consumption. Some companies only charge for kVA, in that case you need to make a conversion into kWh.

Check drawings/blueprints of floor plans. If possible also facades. A scheme of electricity feeders might also be useful.

If earlier audits of good quality have been performed, it can be useful to study these.

A2 During the audit

Interview representatives about how the building is managed: working hours, how lighting, heating and A/C is controlled. Find out operating times both on hourly basis but also monthly. Ask to see the lamp-storage to find out what types they use. Note the data for transformers to calculate losses (if the building buys high voltage).

Perform the inventory. Use copies of floor plans; it is often time efficient making notes directly in the drawing.

All electric installations shall be noted; type, numbers and power.

Bring a meter for instantaneous measuring. You might have to perform instantaneous measurements for cooling compressors, office equipment, servers etc.

In the worst case you are allowed to make “professional estimations”. For instance, a water cooler that is not in use during winter, you can read the electric power and ask for/estimate the running time. An A/C has a slightly different electric effect depending on temperatures outside and inside, if you measure it you also have to make an “average estimation” over the year.

Bring an electric logger and measure total electrical energy, at least you should log for 24 hours (or you can do hourly readings manually, but you have to include a night). Most interesting is the base-load, when A/C and heaters are off. At night time is usually only electricity used to servers, process cooling and possibly lighting in stairs and outside.

Take photos to help you remember.

If you don't have complete drawings check type of windows, how walls and roof are built up (insulation, air gap etc), orientation.

Bring a copy of a STIL2 audit to help you remember all aspects.

A3 Entering data into the STIL2 protocol

A3.1 “Building data” is sheet number 1

Write only in cells with a green background.

Row 2: This ID is provided by the secretariat.

In cells that have a drop down menu it is important that you choose from the menu.

Row 79 and onwards:

Some of these data about building envelope are not a part of the STIL2 audit, but could be useful if you want an overall grip of that too. It seems time efficient to look at these aspects at the same time. And if someone wants to do more profound calculations regarding the building envelope in the future it might be very useful.

The data from “Building envelope” are included in simplified calculations in sheet “Output” **row 64** and downwards.

Row 91 and 93: Tells at which outside temperature you allow the A/C:s and heaters to start.

Row 92: Calculation includes ventilation air and moist production from people in the building.

Row 95: The ventilation airflow can be difficult to estimate. More outside air means more cooling and condensation alternatively heating. It is possible to get a very rough estimation by using a CO₂-meter. The people in the building cause an increased level of CO₂ compared to outside. If you measure the level in the exhaust air in the afternoon it is possible to convert into airflow. Adjust the cell for “airflow” until the cell “ppm CO₂” corresponds to your meter. If CO₂ is below

1,000 ppm it means that air quality is good, but sometimes you have to consider odours too. It is energy saving not to exaggerate airing. Saving potential can be estimated by comparing sheet “Output” cell K66 at different “Airflow total l/s”. If there is no centralized exhaust air it is possible to measure in many places during the audit and get a “mean value”, but it will increase the error margin further.

A3.2 “Energy data” is sheet number 2

Fill in bought energy in column B. Per month. Some companies only send bills every other month. In that case you have to separate the amount into two. Depending which months, the share could be quite different of course.

Also DG-energy calculates from diesel to kWh_{electricity} and allocates monthly.

If you have any graphs, store them here together with comments.

A3.3 “Data” is sheet number 3

In this sheet are the backgrounds to all drop-downs. If you want to add another alternative, feel free, but keep alternatives within the marked boundaries, otherwise you have to change the boundaries as well.

In the “key figures of installations” it is also possible to change the power (W) if you find it necessary. If for instance the voltage is different the lightings use less power, maybe computers or A/Cs are of a different kind. Please fill in if you have M (Measured) or I (Inventoried/estimated).

For A/C:s it is also required to add COP. Many items in the “Misc” column are unique and must be measured.

Complete this sheet before you start with “Inventory” since changes are not done automatically afterwards.

A3.4 “Inventory” is sheet number 4

This is the sheet where you input the results from the inventory. Start in **row 16**.

Room number:

Sometimes there are numbers in the drawing, and then you can use them. Otherwise, invent a number. It is good if the first figure tells which floor and 1 is at ground level and 0 is basement. Also it might be useful to mark the number in the drawing. If the room is not in the drop down menu, use “Other room type” and make a note in the Z column, there you can also make other notes that can be interesting.

Area:

If you have a correct drawing it is easiest to measure in the drawing. If not, the reality counts. Make a simplified drawing on paper and measure.

Lighting:

Lighting can be supplemented and modified in the sheet “Data” as well as all other electric outfits. If the right type exists you choose it from the drop down menu. Write in numbers. The column “h/year” is the most difficult column. In the audit the interviews are supposed to clarify the running time. Sometimes the running time is the same as office hours; the light turns on centralized, but often it is not. In some offices there can be automatic presence control. Data for inaccessible rooms must be estimated.

Columns for specific equipment:

The columns “Computer”, “Printer”, “Copy”, “Fan” and “A/C” are entered in the same manner.

Miscellaneous:

The column “Misc” can be difficult, it is easy to miss for instance hot cases and electric heaters in the inventory. Ask during the interview how many there are. These outfits are not easy to spot; the heaters can be kept in drawers when not in use. Pump use and transformer losses have to be calculated. Outfits like these, which are not connected to a special room, use “Other room-type” in column C. Note that there is no column for numbers after the “Misc” column, instead write in the actual total power and running time.

Process cooling:

If you have cooled processes in the building, like telephone switchboards or server rooms, this cooling should be separated from comfort cooling. Determine the heat load; sometimes it can be more exact to regard transmission losses and infiltration/ventilation also. These inputs can be made at cells X2–X7. There you also can get some help with savings potentials by changing for example the air flow.

Adjusting/tuning:

If you have spotted the correct running times you do not have to adjust anything.

If the office is closed for a period you can adjust the number of days in the cells in the Y-column under the input rows.

During November–February there is no comfort cooling (required) in northern India.

In the O-column below the input is a calculated basic load for a year monthly. Beside, in L-column are the weather depending energies calculated, allocated to each month. M-column is the sum of O and L. Compare M and the actual readings in N-column.

Adjust the running times for Lighting and Computer until M is close to N. (there are no loops in this file).

Adjust the running time for A/Cs and input for process cooling to further approximate M to N during hot months. Remember that total process cooling have to be changed manually when you do changes in input for process cooling.

A3.5 “Output” is sheet number 5

This sheet needs no manual input.

There is a simplified calculation for transmission of heat and cold from row 64 and down. If you want to make more accurate calculations for energy savings on the building envelope, use a more advanced program like eQuest. Bear that in mind at the audit so that you can grip the shape of the building more careful.

A3.6 “Savings Potentials” is sheet number 6

By now you know a great deal of the building and inventories and probably have a lot of ideas. From your audit it is possible to list the amount of different types of fittings and their yearly energy use, compared to the best available with the existing and calculate the required number (sometimes less than existing). It is also possible to calculate the energy saving by replacing Desktop with CRT to laptop. During the cooling season this will save electricity to ACs as well. Exchanging the existing ACs with five star is also possible to calculate. Such calculations must be clearly presented and possible to follow.

A3.7 “Degreehours actual year” is sheet number 7

This is normally already made by the STIL2 secretariat. If not, replace the C and D columns with temperature and humidity from the same period as the Energy data.

A3.8 “Degreehours normal year” is sheet number 8

Normal year is the average for a great number of years. It can be used to compare actual year with. For instance if you have 10% more degree hours actual year you are likely to use 10% more cooling. This should be prepared already by the STIL2 secretariat.

Appendix 2

Example of time allocation for audits

Example of time requirement guide for entrepreneur plan and contract

Building size	Total number of tenants with own electricity	Base requirement, hours	Additional hours, related to building's total area	Additional hours related to building's total number of tenants with own electricity	Total Hours
200–5,000	< 5	10			10
5,000–10,000	< 5	10	3		13
10,000–15,000	< 5	10	6		16
200–5,000	5 < 10	10		3	13
5,000–10,000	5 < 10	10	3	3	16
10,000–15,000	5 < 10	10	6	3	19

Appendix 3

Proposed agenda for training of STIL2 auditors

Proposed agenda for training of hired entrepreneurs

08.30 – 09.00	Gathering and coffee/tea	
09.00 – 09.05	Welcome to the BEE	BEE Director
09.05 – 10.15	<ul style="list-style-type: none"> • The STIL2 project introduction and objective • Messages from the reference group about important indicators 	BEE Project Manager
10.15 – 10.30	PAUS	
10.30 – 11.30	The protocol, 'Building data' part and 'Energy data' part	Quality Assurance Engineer (QAE)
11.30 – 12.00	A presentation of the selected buildings – sizes, geographical locations, other facts in summary.	Secretariat member
12.00 – 13.00	LUNCH	
13.00 – 15.00	The protocol, parts: <ul style="list-style-type: none"> • Data; • Inventory; • Outputs; • Savings Potentials • Degree-hours actual year; • Degree-hours normal year. 	Quality Assurance Engineer (QAE)
15.00 – 15.30	PAUS with coffee/tea	
15.30 – 16.00	General instructions: <ul style="list-style-type: none"> • ID; • Web-page; • Building envelope; • Photography's; • Metering equipment; • Information material – templates, checklists 	BEE project manager
16.00 – 16.30	Lighting – specific thematic presentation of relevance for the building category	Invited Speaker
16.30 – 17.00	Computers and servers – specific thematic presentation of relevance for the building category	Invited Speaker
17.00 – 17.30	Finalisation and distribution of personal instructions: <ul style="list-style-type: none"> • web-login; • list of buildings etc. 	Secretariat member
17.30 – 20.00	Dinner	

Appendix 4

Template for letter to building owners/manager

Here follows an example of a letter about STIL2 that is addressed to building owners or managers:

Dear Manager,

“Name of building” that you own has been selected as one of the official offices in India to be included in the project “ STIL2 “ organized by The Bureau of Energy Efficiency (BEE). See a brief description of the project at the bottom of this letter and on the BEE website under the heading Statistics.

Your participation means that an energy audit will be performed in the building in order to map energy use and in particular the allocation of electric energy in different end-user categories.

The timetable for carrying out the inspections will run from late September until mid-November and it is during this time you will be visited by a qualified surveyor.

Before an energy audit can be commenced, a set of selection criteria need to be fulfilled, see below. *(Add if the selection criteria already been reconciled in the conversation “ These criteria have already been sued in phone calls with nn nn”)*.

Selection Criteria:

- Ongoing activities in at least 200 m² and less than 15,000 m²;
- At least 80% of the building shall be used as office;
- 12-month median statistics with existing installations and activities should be. With electric heating, statistics must be on monthly basis;
- Current activities should continue throughout the investigation;
- Buildings with an onward supply of electricity and heat to other units should be avoided.
- Buildings with many tenants (e.g. more than 10) who have their own reading of electricity should be avoided.

Prior to the inspection, we need additional help with the development of specific information about each office, see “ Checklist for Preparation “ on the next page. This information can also send to xxx@xxxxx. Please specify which building the information regards in the mail subject field.

Checklist for Preparation:

- Blueprints: Plan, design and façade;
- Media statistics for the fiscal unit from the 12 consecutive months during the last 18 months (electricity, heating, cooling and water), or the reference of your subscription and power of attorney so that we can retrieve this information from the respective suppliers;
- Contact person in the form of operating technicians and office tenants.

About the project:

STIL2 is a project organized by the Bureau of Energy Efficiency.

The aim of the project is to obtain improved energy statistics at the national level with emphasis on the use of electricity through detailed energy audits in a statistical sample.

On BEE's website you can read more about this project and other projects that run in parallel. When all energy audits have been conducted, you will be able to take part of the results obtained. This can in turn help you to take steps to reduce your energy costs as well as general Indian future energy performance of buildings. If any queries, please contact xxxx, Project Administrator for STIL2.

Thanks in advance !

Yours sincerely

BEE Project Manager

Indo-Swedish collaboration on energy efficiency, 2011-2014

The Swedish Energy Agency and the Bureau of Energy Efficiency (BEE) cooperates within the field of energy efficiency. The overall objectives are to establish agency cooperation, to facilitate business cooperation and to enhance capacity building. The project focuses on energy efficiency measures and management in industry and in buildings, and on minimum energy performance standards and labelling. The agencies also share experiences on communication strategies and outreach activities for more energy efficient behaviour.

The Indian and Swedish governments signed a Memorandum of Understanding on Indo-Swedish cooperation within the field of renewable energy in 2009.



Bureau of Energy Efficiency
Government of India, Ministry of Power
www.beeindia.in



SWEDISH INTERNATIONAL
DEVELOPMENT COOPERATION AGENCY

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