# TYPES OF TOOLS


**Annex 31**

Energy-Related Environmental Impact of Buildings

International Energy Agency

Energy Conservation in Buildings and Community Systems Programme

ANNEX 31

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# TOOLS AND INSTRUMENTS AS AIDS TO THE DECISION-MAKING PROCESS

Tools are the interface between the environmental framework and the decision-making framework. They inform the decision-making process by helping actors understand consequences of different choices. In this way the tools ultimately serve to improve environmental performance.

To be effective, a tool must be tailored to the planning phase, the knowledge base of the user, and the concerns of the actors – including the applicable assessment criteria and standards. Accordingly, either a wide variety of tools are needed, or each tool must be scalable and capable of adapting to the users needs and knowledge.

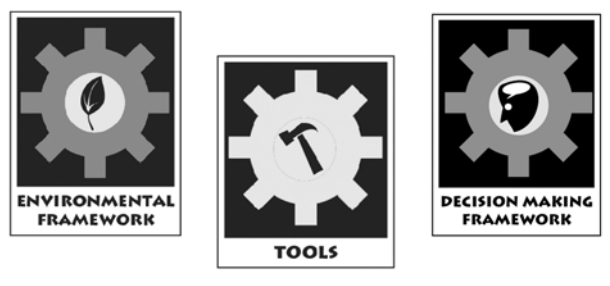


**Figure 1** *Tools are the interface between the environment and the decision-maker*

This report describes every category of tool, and their information requirements. The report identifies key features that make tools effective.

## CATEGORIES OF TOOLS

Assigning tools to categories makes it is easier for potential users to identify tools most appropriate for their needs. Annex 31 Tools are categorised as follows:

### Interactive Software

LCA TOOLS FOR BUILDINGS AND BUILDING STOCKS
LCA tools help to unravel the relationships between building specifications and potential environmental impacts. They explicitly address one or more stages in the life cycle. They help users collect and analyse data on the energy and material flows. They translate design and management choices into meaningful statements about environmental effects and impacts. Because of the complex interrelations between life cycle states, resource flows and environmental consequences, all LCA tools are based on computer models and databases. Hence these tools employ interfaces that increase potential for interaction between the user, the model and the associated databases.

ENERGY AND VENTILATION MODELLING SOFTWARE
Many micro-models have been made available as tools for designers who wish to optimise aspects of building performance. These simulation models may be educational and predictive models primarily, although some are also designed as decision-support for planners, engineers and designers. They also may be required or embedded into LCA tools. Unlike LCA tools, they focus on the operating phase of a building only, and the results do not explore the potential environmental impacts at local, regional or global scales.

## Passive Tools

A broad range of passive tools exist for decision-support, including, in order of complexity:

- Environmental Assessment Frameworks and Rating Systems;
- Environmental Guidelines or Checklists for Design and Management of Buildings
- Environmental Product Declarations, Catalogues, Reference Information, Certifications and Labels

Passive tools can be especially well suited for application within the fast-paced processes involving design professionals. Consequently they have broad market potential, if their use adds value to the end product. Each type of passive tool is described later in this report.

## Key Features of Effective Tools

Decision support tools for environmental assessment must integrate environmental criteria into the existing design process. This is a challenge. Architects and others involved in the building design process already must juggle many conflicting criteria to arrive at a satisfactory solution, be it for new buildings or for renovation. Every new layer of concern adds unwanted complexity to the design process. The application of tools always requires additional economic resources, time, knowledge, and access to specialised information.

It is essential therefore that decision-support tools minimise complexity and costs. In this context, tools should be:

- **honest**, in that issues to be measured truly have a deleterious effect on the environment,
- **easily adaptable** to specific buildings and locations,
- **capable of quickly ranking results**, so that trivial issues can be dismissed, and
- **transparent in their assumptions**, and especially in regards to the weighting given to different environmental issues like human health, ecological health, resources consumption.

## All Tools are Not Equal

The application of various methods and tools for environmental assessment of buildings will lead to results that are often not directly comparable. Differences are most often a result of the system boundaries – what is included and excluded from the analysis – established for the object (technical system) and the environment. Other common reasons for variations in results include:

- The intended user, his role in the decision making process and how choices are framed
- How the cause and effect chains are constructed in the model
- Data sources, quality and format
- How results are aggregated and presented

# A TYPOLOGY OF TOOLS

Every tool is comprised of a similar set of elements, organised in a sequence that allows users to make decisions. The range and order of these elements is illustrated in Figure 2. The most sophisticated tools allow for the user to interact with this process at each stage in the circle. Simple tools, like checklists and guidelines, will use standardised default assumptions to reduce the amount of choice and interaction at specific places.

Regardless, the flow of work and information follows the stages shown in Figure 2. Information flow originates with the actor; the tool then models the technical system and analyses the consequences for the environment. Models are refined to correlate with the actor's interests (evaluation criteria, functional units, etc.) and needs. Finally, the outputs are communicated back to the actor, who may then incorporate the information into the decision making process. Each decision leads to new questions, and so on round the circle.

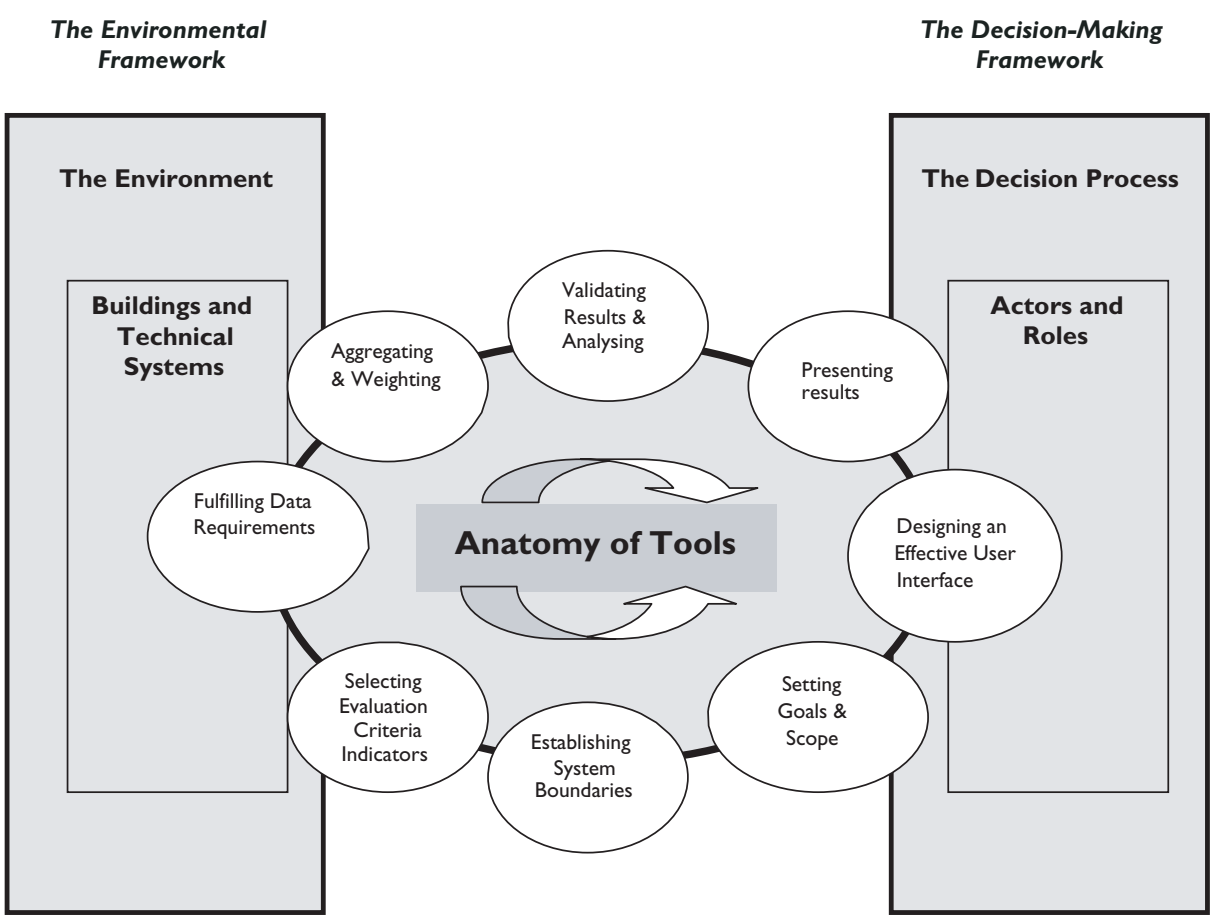


**Figure 2** *An Anatomy of Tools in relation to the Environment and the Decision-making Process*

Every tool emphasises different elements in this circular process, and achieves its results in different ways. By examining each step in this process, it is possible to create a typology of tools:

USER INTERFACES

A tool is designed for specific target audiences and for specific work-flow scenarios. A typology of tools can be created from such questions as: "What is the target group?" And "What are their preferences and abilities?" A distinction may be made between ***active users*** of methods and tools and more ***passive users*** of the information. The more actively involved groups include architects, consultants, clients, material producers and financiers; more passive groups include policy makers, future occupants, salespersons, and so on.

SETTING GOALS AND SCOPE

The goals and scope setting address ***when*** and for which ***purpose*** a tool is used. Tools may be intended for use at certain stages in the planning and decision-making process. The purpose is related to the ***field*** of application, and the ***type of problem*** or ***question*** that the tool can answer or solve.

ESTABLISHING SYSTEM BOUNDARIES

Differences in the ***object*** analysed by the assessment method may also be in focus for a typology. Here aspects related to the ***scope*** of the assessment, the ***system boundaries*** for the technical system included in the assessment or the ***environmental model*** that is operationalised can be used to derive a typology. System boundaries define the ***scale*** at which the object is analysed, e.g. the ***system level*** such as material, component, building, building stock. Another consideration is the definition of ***functional units*** that form the basis for the assessment. Special focus of assessment methods, for example on an assessment of the interior environment of a building, or the inclusion of "all" environmental aspects and additional monetary costs, are examples for scope-related criteria for a typology. Assessment methods may also specifically target existing buildings, and they may reduce scope by excluding certain life cycle stages.

SELECTING EVALUATION CRITERIA

Concern for environmental themes can be used to differentiate tools. For example:

- Impact categories of interest (land use, indoor environment, human comfort and health, Global Warming,..)
- the geographical scale of the included environmental themes
- the temporal scale of considered impacts
- the basis on which the environmental impacts are modelled and assessed
- the ultimate step of the impact assessment

FULFILLING DATA REQUIREMENTS

Environmental assessment tools require information to be inserted by the user. Depending on the applied methodology, scope and character of the tool, this ***input requirement*** varies in ***amount, quality and format***. For certain assessments it might even be necessary to insert information that is gathered by other tools, e.g. detailed calculations of the building's thermal energy demand. Depending on the ***user*** and the ***stage*** in the planning process this information may be at hand or not. The ***amount of work*** necessary to gather the desired information

can be estimated and hence, the applicability of the tool at that stage of the decision making process can be determined. Criteria for such a typology would consider e.g. the character, amount, level of detail and required data quality of input information.

AGGREGATING AND WEIGHTING

Translating copious amounts of data into useful summary information requires aggregating and weighting. Aggregation refers to simple summary of a number of similar values to achieve a measure of total value. Frequently the sub-quantities need to be normalised to permit aggregation. As part of normalization it is often necessary to weight values to ensure that definite difference in report data sets are properly reflected in the total.

VALIDATING AND ANALYSING RESULTS

Validation can include a variety of techniques intended to reduce error and minimise uncertainty. Sometimes historical records can be used to calibrate outputs. Reference values can be used to set boundaries on the results, and highlight implausible results. A sensitivity analysis can be conducted to set priorities, and simplify the process. Data quality can be used to qualify the level of certainty.

PRESENTING RESULTS

A typology can also be organised according to the presented outputs. Criteria in this field can be such as

- the level of aggregation
- the presented final result as a rating, total score or label
- whether or not a comparison is based on references (reference values or entire reference buildings)
- whether information is given as such (e.g. "raw" LCI data)
- to what extent possible directions of interpretation are supported
- the transparency of the presented results and the possibilities for the user to trace the assessment back to the origin

## Categories for Describing Tools

Tool users define the objectives for conducting a study. These objectives, in turn, define the information required during the decision-making process. Since the objectives vary greatly by user, outputs from tools must reflect user's specifications. Moreover the outputs may be invalid if methods and tools are used for purposes other than what is intended.

The definitions of the goal and scope of an assessment have especially strong influence on choice of method. In fact the level of detail established by the goals and scope can be used as a screening technique for categorising tools, and facilitating selection of tools. In this way objectives become a basis for creating a 'typology' of tools.

A second basis for creating a typology is the overall approach used to analyse and assess the loadings, effects and impacts. A third basis for creating a typology is the type of results produced by a tool, and how these results are formatted. All three typologies are outlined in Tables 1, 2, and 3 below. Key terms used to define tools within these tables are defined below:

## Life Cycle Stages

The life cycle of the product building can be divided into sequences, called Life Cycle Stages. These stages are e.g. material production, building construction, occupation and so on. The term Life Cycle Definition has to be introduced in parallel, as it is possible that a building product or a single life cycle stage (or a set of Life Cycle Stages) of the building is addressed. Meanwhile these studies will not consider the entire life cycle of the building, they may however consider the entire life cycle of the products utilised for that analysed product or life cycle stage. It is thus possible to not include all life cycle stages, but to have a cradle to grave approach for the included stages.

## Internal or external use of calculation models

Tools may consider information that has to be specifically gathered for the assessment process. These calculations may be related to data inventories of the analysed products or processes, or they may concern building properties. While some tools may perform these calculations internally, based on some key information provided by the tool user, others may require the use of other tools to provide that information.

## Actor versus User

An actor is defined as a person involved in the decision making process. The actor may use a tool for environmental assessment himself, or he may consult a specialist, who is referred to as the user of the method.

## Adaptability

Some assessment tools allow the user to change certain preconditions or methodological choices. By such features the tool may be adapted to the actual situation and intentions of the user.

## Scenario

Whenever real life information for a certain aspect is not at hand, such information may be found by defining a scenario. In environmental assessment of buildings, scenarios are frequently defined concerning aspects related to the long service life time of the building, such as recycling, waste treatment, environmental impacts from the in use phase, maintenance and refurbishment intervals.

## Transparency and disaggregation

If the presented results allow the user to find where the result comes from, such transparency can allow disaggregation of the presented results and to reach back to the causal factors. Hence the sources of environmental impacts can be traced and considered in improvement options for the product.

## Special Focus

An actor or decision maker may have a special focus when performing an environmental assessment. Such special focus can be related to his preferences, priorities and constraints in decision-making.

| Application in the decision making process | |
|---|---|
| Decision making process stages | o Preliminary study<br>o Design process<br>o Preparation of building contracts / execution<br>o Execution<br>o Use<br>o Refurbishment / reconstruction<br>o Deconstruction / demolition |
| Actor | o Product manufacturer<br>o Building designer / consultant<br>o Contractor<br>o Building owner<br>o Financier / stake holder<br>o Tenant / user / manager<br>o Service provider<br>o Authority |
| **Actor's objectives** | |
| Aim / Goal | o Choice of products or technical solutions<br>o Improvement of overall environmental building performance<br>o Leaving environmental information to customer / authorities<br>o Marketing / product comparison<br>o Project comparison<br>o Assessment of environmental quality (compared to reference product / building)<br>o Labelling / certification<br>o Meeting standards |
| Scope | o Actual decision scope<br>o Overall product performance<br>o Overall building performance<br>o Building in its context<br>o Building and use of building |
| Special focus | o Influence of own decision in the above scope<br>o Certain life cycle stage<br>o Certain product<br>o All / none |
| **Tool appearance** | |
| Addressed tool user | o Product manufacturer<br>o Building designer / consultant<br>o Contractor<br>o Building owner<br>o Financier / stake holder<br>o Tenant / user / manager<br>o Service provider<br>o Authority<br>o Researcher<br>o Special consultant |
| Appearance | o Software<br>o Manual method<br>o under development? |
| Adaptability | o entirely<br>o partially<br>o none |
| **Table 1** | *Actor Objectives* |

| | |
|---|---|
| Time requirement | o significant<br>o negligible |
| Documentation | o enables detailed understanding of the approach<br>o enables understanding of the assessment<br>o enables use of the method |
| **Scope Scale Functional Unit of interest / Object of the assessment** | |
| Functional Unit | o product related<br>o surface / area<br>o cubic measure<br>o functional operation |
| System level | o service<br>o building stock<br>o building<br>o component<br>o material<br>o other product |
| Life Cycle Definition | o gate to gate<br>o cradle to gate<br>o cradle to grave |
| **Table 1** | *Actor Objectives (continued)* |

| | |
|---|---|
| **Object of the assessment** | |
| System Level | o Building services<br>o Building stock<br>o Building<br>o Building component<br>o Building material<br>o Other product |
| Life Cycle Stage(s) | o Raw material excavation<br>o Material production<br>o Energy production<br>o Component assembly<br>o Transportation<br>o Building construction<br>o Use and maintenance<br>o Refurbishment<br>o Deconstruction<br>o Waste and recycling |
| **Requirement of input information** | |
| Tool-internal calculation models | o Energy demand<br>o Mass flow<br>o Human comfort<br>o Human health |
| Tool-external calculation models | o Energy demand<br>o Mass flow<br>o Human comfort<br>o Human health |
| Building data | o Standard assumptions<br>o Building surveying<br>o Energy demand calculations |
| **Table 2** | *Analytical Approach* |

| | |
|---|---|
| **Delimitation of the technical system** | |
| Life cycle definition | o Cradle to gate<br>o Gate to gate<br>o Cradle to grave |
| System boundaries | o Cut off criteria<br>o Exclusion of process types |
| Geographical scope | o Global<br>o Regional<br>o Local |
| Technology Scenarios | o Constant / frozen<br>o Technology development scenarios |
| **Technical system** | |
| System model | o Infrastructure considered<br>o Side-streams followed<br>o Upstream downstream cut-off's |
| Data | o Average<br>o Specific<br>o Marginal |
| **Assessment Method** | |
| Environmental Impact Assessment | o Full LCA<br>o Simplified LCA<br>(see delimitation)<br>o Indicator LCA<br>(see environmental issues) |
| Energy and Mass-flow assessment | o Inventory |
| **Assessment MethodAssessment Criteria for Environmental Modelling** | |
| Environmental Issues | o Environmental Impacts<br>o Environmental Effects<br>o Key issues<br>o Top Down Issues |
| Environmental Scale | o Global<br>o Regional<br>o Local<br>o Indoor<br>o Work |
| Valuation | o Application of established valuation method<br>o Specifically developed for the tool |
| Time Horizon | o Long term<br>o Medium<br>o Short |
| Character | o All quantitative<br>o All qualitative<br>o Combination of the above |
| **Table 2** | *Analytical Approach (continued)* |

| Output format | |
|---|---|
| Aggregation | o Detailed data presentation<br>o Key effect categories<br>o Aggregated to set of key effects<br>o Aggregated to assessment score |
| Presentation | o Table<br>o Certificate<br>o Label<br>o Audit<br>o Reference comparison<br>o Graphical presentation / profiles<br>o Hypertexts / graphs<br>o Reports |
| Transparency level and possibility for dies-aggregation | o High<br>o Partly<br>o None |
| **Intended use of results** | |
| Intended user | o Decision maker<br>o Policy maker<br>o Product user<br>o Authority / consumer information |
| Intended application | o Labelling<br>o Product comparison<br>o Product choice<br>o Design choices<br>o Decision support<br>o Product assessment |
| **Table 3** | *Results and Outputs* |

| Phase | Energy and environment related activity | Tools and instruments |
|---|---|---|
| 1 Preliminary study | | |
| 1a Basis information | Checking of possibilities concerning new construction/rehabilitation/surrender | Tools for the evaluation of scenarios about rehabilitation/renewal<br>Cases |
| 1b Study of feasibility | Selection of site, analyses of site, orientation<br>Checking of possible impacts to the environment (EIA)<br>Checking of energy supply systems, servicing options | Environmental impact assessment |
| 1c Determination of purpose | Formulation of geometric boundary conditions (e.g. use-surface, ceiling height)<br>Formulation of user requirements (e.g. temperature, light)<br>Formulation of user conditions (e.g. moisture production, heat release)<br>Formulation of limit and target values (e.g. energy & water consumption, comfort)<br>Identification of special problems (e.g. allergies, smog) | General and intern guidelines<br>Legal standard, default values |
| 2 Design process | | |
| 2a Development of concepts | Concept of the rooms/of the building<br>Concept of energy systems (e.g. determination of facade construction)<br>Pre-selection of energy systems and building control systems<br>Simulation of energy use by calculation | Complex tools to assess general building variants (coarse)<br>Catalogue of building components (macro-level) |
| 2b Design phase | Selection of construction principle, main building materials<br>Design of building control components<br>Simulation of life cycle (energy and material flow, costs) | Complex tools to assess general building variants (fine)<br>Catalogue of building components (components-level)<br>Design Software for building control<br>Cases |
| 2c Preparation for approval | Submitting of supporting documents | Tools for calculation (complex/specific - e.g. programs to predict the demand) |
| 3 Preparation of building contracts/execution | | |
| 3a Preparation of execution | Selection of materials for surfaces and finishing elements where appropriate: studies of indoor air quality and comfort at a level of single rooms and consideration of special problems like allergies, ... | Raster, positive/negative lists, recommendation, label, cut-off criteria<br>Tools to simulate a room, ecological „roombook“<br>Catalogues of building components (layer-level)<br>Environmental optimisation tools |
| 3b Description of specifications | Formulation of ecological requirements for specification, for building site and building site equipment, for products and quality checks and for | construction processes Ecological texts for specification<br>Legal conditions (e.g. Verdingungsordnung VOB) |
| 3c Elaboration of tenders | Examination of risks for the environment & for health due to products/processes<br>Selection of environmentally friendly construction and transport processes<br>Selection of environmentally friendly and healthy products | GIS, Databases<br>R-Sets (Risks); S-Sets (security advise)<br>Laws and guidelines for work, environment and health care<br>Raster, positive/negative lists, recommendation, label, cut-off criteria<br>Label for products and processes |
| 3d Comparison/ Tendering | Checking of offers using ecological criteria<br>Comparison and checking of offers concerning technical & physical compatibility | |
| 4 Execution | | |
| 4a Organisation of building site | Organisation of environmental protection and health care<br>Preparation of separation of various wastes | Guidelines |
| 4b Construction | Guarantee to meet commitments for environmental protection and health care<br>Self-control of quality through enterprise | Checklists |
| 4c Control/inspection | Quality checks | Measure and control procedures |
| 4d Documentation | Elaboration of a building certificate/energy consumption certificate/...<br>Preparation of use manual for building control systems<br>Organisational and technical preparation of controlling and of consumption coverage, identification of target values<br>Instruction of operators of the building control systems | Building certificate and tools to generate building certificates<br>Energy certificate and tools to generate energy certificates<br>Certificate systems and tools to generate them |
| 5 Use | | |
| 5a Utilisation | Constant control of resource consumption (e.g. energy, water)<br>Bill for heating costs<br>Constant control of conventional use and of the building state | Checklists, use guidelines |
| 5b Maintenance | Management, execution and quality of maintenance/renewal<br>Periodical maintenance of building control systems<br>Use of best available technologies if parts of the building control system have to be replaced. | Checklists, maintenance guidelines<br>Maintenance and operation instructions<br>Documentation of the building (able to be updated) |
| 6 Deconstruction, Demolition | | |
| 6a Design of retreat/ de-construction | Basis decision about rehabilitation or demolition<br>Selection of deconstruction technology | Tools to simulate scenarios |
| 6b Preparation of deconstruction | Selection of enterprises considering also ecological aspects | |
| 6c Deconstruction | Execution of deconstruction, separation of construction elements<br>Disposal and Recycling | Proof of disposal |
| 6d Disposal/Recycling | Respect the recycling potential of different construction elements or materials | |

**Table 4** *Classifying Tools by position in decision making processes*

Dr.-Ing. Thomas Lützkendorf, Bauhaus-Universität Weimar, 7/1998 and Annick Lalive, ETH Zürich, 10/1998

# LCA TOOLS

LCA Tools specifically address one or more stages in the lifecycle of a building. The most important decisions are made during the preliminary study and design phase, and at this time it may be necessary to use a comprehensive LCA Tool (i.e. a single tool addressing all stages) or a series of LCA tools that can be integrated for decision-support purposes. The remainder of this section describes how LCA Tools can be applied to each stage in the life cycle.

## LCA Tools For Embodied Energy

The use of LCA methods is especially helpful for assessing embodied energy and environmental impacts, since the tools can conveniently analyse the extensive product assessment data generated by other sectors. In fact, due to the extensive data manipulation, it can be argued that tools are essential when assessing the energy and mass flow involved in both manufacture of building products and provision of technical services like heating.

According to the environmental themes and to the choices made by the tool developers, LCA may be strictly applied according to standardised procedures, or only applied in its general principles. In the building sector, strict application of LCA methods is very difficult, and a more principled approach is common.

It is generally assumed that the initial data on products already exists and can be directly applied. This includes data on energy and mass flow information regarding energy transport and production, the extraction of raw materials, the manufacture of base materials and disposal processes. Information sources are typically national data banks. Because it is difficult to follow a particular building product back to a specific manufacturing plant when planning a building the use of averaged values is normal.

The use of process chain analysis or input/output tables, or a mixture of the two, are typical methods used for determining the relevant values. In the interests of better understanding and comparison, the values are given together with the bounds of the analysis and system limits, the balance period, the date and the quality of the information. Typically quoted are the material and energy outlay in the pre-construction phase (energy input, material input including delivery to plant), the direct energy outlay for the manufacture and the indirect energy outlay for running the plant and machinery. The energy outlay for the labour element and for the initial provision of the machinery and plant building are usually disregarded. These are commonly agreed principles for establishing embodied energy and inventory analysis.

Data banks, which on the one hand use uniform basis data for energy, base material and processes, and on the other, link these to the individual production processes have become proven in the field. Only through such standardised sources is it possible to correct, expand on and update the data for building products and technical services.

The result of assessment is to quantify the energy and mass flow as a result of the manufacturing process for building products and systems. The data can be presented as the result of an inventory analysis and/or in an already evaluated form such as an embodied energy value

for later use. Depending on its later use, the values can be established for individual building materials (e.g. cement, oil etc.), composite materials (e.g. concrete), building products (e.g. a window) or entire building elements (for instance a complete wall construction consisting of several layers). Data for technical systems such as heating, electrical and sanitary installations are also provided. The raw or evaluated data must be related to specific functional units.

## Resources

Information

- Energy and mass flow in the manufacture of building products
- Energy and mass flow in the manufacture/provision of technical services

Methods

- Process chain analysis
- Input/output-method
- Hybrid method (Process chains in combination with input/output-tables)

Tools

- Tools for creating product-based ecological balance assessment
- Information sources / data banks
- DB energy and mass flows for the provision of end / use-energy
- DB energy and mass flows for transport services
- DB energy and mass flows for obtaining raw and base materials
- DB energy and mass flows for disposal processes

## LCA Tools for Assessing Construction and erection of the building

The construction phase is often overlooked but can be important for some aspects of environmental impact. Short-term interventions to the ecology can be significant – for example silting of streams. Transportation of materials and workers is also a potentially important source, and is worker health and safety. A rigorous assessment must include description of all building products and services employed (including supporting materials, waste and the proportional usage of temporary materials e.g. shuttering) as well as of the transport costs and construction processes. The accounting is complete when the building is approved for occupancy. As with cost controlling, analysis methods and their accuracy depend to a large extent on the construction progress of the building and therefore the availability of information and completion.

Establishing the quantities of building products in the building, the transport necessary and the direct energy outlay for building machinery and processes is usually only possible in an advanced planning stage and is connected with intensive (manual) work. Establishing the raw or evaluated energy and mass flow resulting from the construction of a building is dependent upon connecting the building-specific quantities of building products, services and processes with information in a national data bank. Both this working approach and the use of data banks is not typical of planning offices - this approach has been used only for research reasons. As a result of the high degree of work involved it has not found acceptability in practice.

An easier and more rational approach is the assessment of the energy and mass flow involved in the construction of a building based upon the element method, as used in cost planning. All information (raw or evaluated) regarding the energy and mass flow involved in the manufacture of the product, its delivery on site and its usage in the building is assigned to an equivalent functional unit. The element represents a portion of the building as built (for example 1 $m^2$ exterior wall, 1 heating system). The planner need only establish type and quantities of elements in the building. The elements can be adapted to the level of detail required (macro, general, fine...) and are therefore applicable for early design stages too. This presupposes the existence of data banks or catalogues detailing the relevant information for building elements. The data can be processed, either with the help of simple tools (Excel-tables independent of geometric building models) or with complex integrated planning tools with CAD-connectivity.

## Resources

Information

- Type and quantity of building products and systems used
- Average transport cost for delivery to the building site
- Type & extent of building construction processes / use of machinery
- Type and quantity of building elements used

Methods

- Mass quantification
- Element method (as used in cost planning)

Tools

- Quantifying tools
- Complex CAD-based planning tools using the element method in conjunction not only with economic data but also with energy related and ecological data
- Information sources / data banks for energy and mass flow associated with:
- the production of building products
- the provision of technical service
- transport services
- the provision of end / use-energy
- building processes and machinery
- disposal processes (building waste material)
- the building of complex building elements

## LCA Tools for Assessing the Occupancy phase of Buildings

The assessment of environmental impacts associated with the occupancy phase are based on numerous assumptions (scenarios) and calculation methods. The process involves inventories of energy usage and/or the amount of end-energy and energy carrier necessary to run the building when in use, including heating / cooling, water heating, lighting, ventilation, lifts and other technical services and auxiliary energy usage.

Scenarios forecast the type and duration of usage, the user requirements and standards of thermal comfort, location of the building, climate, and intensity of use. These types of assumptions are usually calculated according to predetermined nationally uniform default values and calculation methods. In the interests of better understanding and flexibility of use it is recommended to determine the energy usage separately according to purpose and energy carrier and not summarise it at the level of end energy.

The energy usage, for instance for heating, is determined as a function of heat loss via transmission and convection minus any useful exterior or interior heat gain. This energy demand (net) is converted using an efficiency index for the heating system into energy consumption (gross). The resulting quantity of energy carrier required (i.e. $m^3$ natural gas) can be converted into the mass and energy flow required to provide the energy. The emission of, for example CO2, resulting from providing the energy and the heating system can then be estimated with the help of data banks (database on provision of end-energy, and emission factors for heating systems).

It should be borne in mind that the energy demand for heating and cooling systems is heavily affected by user-dependent influences such as waste heat from technical services or computer systems, from the frequency of the heating/cooling installations and the intensity and density of use etc. – all factors which can change over the building's lifetime. A reduced heating energy demand may primarily result from the by-product warmth produced by the computer system, and not from good insulation! Good information and guidelines for the occupants is essential.

Further energy-use indices, for example for lighting etc. are calculated with the help of typical values or through the use of complex simulation programs. Energy demand resulting from auxiliary services, for example electricity for the fans in the ventilation or circulation pumps etc. should likewise be included.

Predicted values are calculated by specialists using complex simulation programs, or estimated through the use of complex planning tools. The result: raw and/or evaluated information regarding energy and mass flow resulting from the running of the building in the use-phase – including the energy and mass flow for the provision and conversion of the energy source. The values are typically given both as a total for the expected duration of the use-phase, and as a per annum value.

## Resources

Information

- Type and quantity of energy necessary for running the building
- Methods
- Calculation and simulation of energy demand

Tools

- Calculation/simulation programs for energy-usage of heating, lighting, ventilation
- Complex integrated CAD planning tools with modules for estimating the energy required in running the building

Information sources / data banks

- national/regional climatic data
- standard-usage scenarios
- thermal performance of building products (alternative: elements)
- technical/energy-related/ecological values for services (for example efficiency, system-specific emission factors)
- energy and mass flows for the provision of end-use energy

## LCA Tools for Urban Systems during the Use phase

The investigation of energy usage and environmental pollution created by a building's demand on urban systems can be an especially challenging - and yet important - function for LCA Tools. Especially of concern is the location analysis for housing schemes, and the resulting impact on the use of public and private transport. Other issues include:

- Energy demand for cooking, household appliances etc.
- Energy demand for technical services, office appliances etc.
- Water requirements and amount of waste water/sewage
- Type and volume of rubbish
- Location-dependent goods transport

Values can be calculated using statistical data linked to information from data banks. The result: raw and/or evaluated information regarding the energy and mass flow for user-specific running costs according to source.

## Resources

Information

- Type and quantity of energy necessary – user-specific portion
- Type and quantity of other user-dependent energy and mass flow (for example volume of rubbish)
- Possibly type and volume of person and goods transport to & from location

Methods

- Statistical
- Tools
- complex planning tools

Information sources / data banks

- DB energy use of household and office appliances
- DB energy and mass flow for the provision of end-use energy
- possibly DB use-specific volume of waste material
- DB energy and mass flow for disposal processes
- DB energy and mass flow for traffic / transport

## LCA Tools For Maintenance and Refurbishment Activity

Cleaning, servicing, maintenance and refurbishment work are necessary to maintain the usefulness of a building during its lifetime. The resulting energy and mass flow can be determined as part of a life-cycle analysis. The data can be significant; for example cleaning costs can exceed energy costs in some facilities. Different methods can be used for assessing such activities:

*Cleaning* (e.g. wall and floor finishes, windows etc.) is influenced by the type and wear of finish. The relatively low energy usage is countered by a proportionately high mass flow – water and cleaning agent. A possible calculation method could involve the consideration of a proprietary cleaning method, for which values already exist, and a periodic cleaning cycle.

*Servicing* (e.g. the technical services) generally results in relatively low energy and mass flow and is often neglected. It should, however, be taken into consideration by life-cycle-costing.

*Maintenance and refurbishment*, is based on a forecast. This necessitates assumptions regarding the useful lifetime of the building and the lifetime of the individual building components. The difference between the useful lifetime of the building and the lifetime of the individual building components results in a maintenance period. The energy and mass flow is determined by the building and disposal processes necessary for the removal and renewal of individual building layers, elements or systems as well as the flows involved in their manufacture and delivery. Maintenance and refurbishment differs from new building – it involves extra outfitting and disposal processes.

Rough estimates typically split the extra flows for the manufacture, delivery and installation of a building product or system across the expected lifetime of the component as an annual maintenance and refurbishment outlay. Specific maintenance issues (replacement with newer technology...), the removal and disposal of worn components etc. are here neglected. More detailed analysis determines the specific outlay for individual maintenance measures at the time of execution with reference to a necessary maintenance period. The results are then superimposed within the useful lifetime of the building. The renewal of building elements is handled as a special case.

Complex planning tools contain detailed information concerning new and refurbishment elements. These can be linked with a maintenance period and used as a basis for calculation.

The result: raw and/or evaluated information regarding the energy and mass flow resulting from cleaning and maintenance of the building. Values are typically given both as a total for the expected duration of the use-phase, as a per annum value or – by detailed analysis – as exact values for the individual years where cleaning or maintenance have occurred in the lifetime of the building.

## Resources

Information

- Method and extent of cleaning, cleaning interval
- Method and extent of servicing
- Method and extent of maintenance, maintenance interval

Methods

- Statistical analysis
- possibly element method

Tools

- complex planning tools

Information sources / data banks

- for cleaning agents and processes
- for the production of building products
- the provision of technical service
- for transport services
- for the provision of end / use-energy
- for building processes and machinery
- for disposal processes (building waste material)
- for the lifetime of building products and technical services

Scenarios

- cleaning cycles

## LCA Tools for Decommissioning and Disposal of Buildings

At the end of the useful life of a building an energy outlay is incurred for the demolition and disposal of the building. The energy and mass flow involved in the demolition, removal and possibly also the disposal processes needs to be predicted. The long lifetime of buildings makes such predictions necessarily approximate – the longer the lifetime of a building the less exact the prediction.

Determining the energy and mass flow involved in a demolition requires the planning of the demolition process under the assumption of a particular demolition or decommissioning method. The energy expenditure results from the demolition or dismantling process taking into consideration the type and volume of material. The removal and transport to a dump, re-use or recycling centre is usually included in the calculation. The energy flow for the actual disposal of the building substance, although theoretically possible using data banks, is not included. Instead the space, which the dumped material occupies, is usually determined, according to the type of material.

The possible positive effects resulting from the re-use or recycling of material is not counted within the lifetime of the building as these first come into effect with the manufacture of new building products or the construction of new buildings. Offsetting the returned energy and mass flow against the energy and mass flows involved during the lifetime of the building would not be correct. Instead the additional declaration of a re-use and/or recycling potential is to be recommended.

An alternative to the aforementioned approach could be the inclusion of all the necessary information as demolition-elements in a complex planning tool.

The outputs from LCA tools can include raw and/or evaluated information regarding the energy and mass flow involved in the demolition, decommissioning and disposal of a building. In addition, a declaration of re-use and recycling potential is conceivable.

An alternative definition for the end of a particular life-cycle as opposed to the demolition of the building, could be the re-use or conversion of the building for a new purpose. The resulting energy and mass flows are then assigned to the new (following) life cycle.

### Resources

Information

- Type and volume of building substance to be demolished including removal and disposal and according to the demolition process chosen
- Type and extent of possible re-usable material / systems
- Type and extent of possible recyclable material / systems

Methods

- Prognosis
- Possibly element method

Tools

- Special programs for simulating the demolition/decommissioning and disposal process
- Complex planning tools

Information sources / data banks

- for building processes and machinery
- for transport services
- for disposal processes
- waste coding and dump allocation
- percentage values on recycling potential
- demolition elements

## PASSIVE TOOLS

Passive tools support decisions without much interaction with the user, and typically lack the degree of customisation and computer support provided by LCA tools and simulation models. Rather than applying the tool to conduct calculations, passive tools tend to contribute static information to the process. Depending on their type and purpose, passive tools:

- aid formulation of design objectives;
- convey results of pre-cooked assessments based on proxies or references;
- assist in directing the planning and decision making processes; and
- provide outputs of assessment results completed by third parties.

Each of these types of passive tools is described in more detail in the following pages:

1. Laws, Regulations and Conventions
2. Guidelines
3. Checklists
4. Ecological and quality assessment for buildings
5. Case-studies / Best practice / Example buildings
6. Building passport / documentation
7. Energy passport
8. Element catalogue
9. Ecologically oriented specification aids
10. Product labelling – ecological and quality grading
11. Product descriptions
12. Recommendations and exclusion criteria
13. Plus and minus lists

## 1. Laws, Regulations and Conventions

Laws, as legally binding requirements, are particularly suited to formulating and enforcing thresholds. Threshold levels are, however, often a trade-off between scientific views and political and economic interests.

In addition to legally binding threshold levels, the declaration of above-standard objectives can lead to improved guidelines and orientation. Such recommendations are often introduced at a local or communal government level as part of grant schemes or as part of conventions drawn up by professional bodies for the purpose of influencing choice of:

- Materials - chemicals
- Building Products
- Buildings
- Environmental protection

International, national or regional governing bodies promulgate laws and regulations. They usually are justified by social consensus on objectives. Their form is often determined as much by political and economic interests as by their scientific basis. In addition to laws, which are binding, conventions developed and applied by professional bodies can also apply in certain areas.

Users

- Planning approval authorities – approval criteria
- Funding bodies – approval criteria for public funding
- Planners – legally binding guideline / orientation
- Clients – legally binding guideline / orientation

Advantages

- Legal status ensures enforcement

Disadvantages

- Requirements can be diluted by political compromise
- Drawn out development process means a slow reaction time
- Few incentives are provided to exceed the legal requirements

Examples

- European building product guidelines
- Thermal performance regulations
- Air pollution regulations
- Noise regulations

## 2. Guidelines

General guidelines are drawn up and published by international, national or communal committees or by trade organisations. Guidelines typically provide basic approaches and future objectives depending on the topic, degree of detail and the strategic-political level. They usually take the form of a written manifesto and can be understood as a declaration of intent. In addition to general and specific objectives, guidelines can also indicate suitable realisation methods.

For the corporate sector, general corporate guidelines and objectives can provide potential clients with guidelines that can be interpreted and integrated into their own building projects. Guidelines as general political or corporate objectives, conditions and intents provide a general approach for future progress. They inform the formulation of concrete planning objectives and work programmes.

User / Situation

- Client – formulating personal objectives (personal developments)
- Client – help in establishing basic approaches
- Planner - help in establishing work procedure

Advantages

- Establishes general approaches and basics for discussion

Disadvantages

- Too general for specific planning tasks

Examples

- Environmental handbook for architects - Germany
- Ecological building handbook, Ministry for the Environment – Germany

## 3. Checklists

Checklists help structure activities and decision-making processes. They serve to determine the individual activities to be undertaken (checklist leaflet) and to check that all have been carried out. They provide practical help as opposed to theoretical approaches and are an effective planning resource. For example:

- building type specific – Checklists for housing planning
- criteria/objective specific – Checklists for energy efficient building
- activity specific – checklist for heating maintenance

Checklists can be used for establishing planning requirements (space programme, specific user requirements), for making the optimal use of active and passive solar gain, for the regular maintenance of technical services to sustain their efficiency or for establishing and controlling the running energy usage.

Development / Publication

- Checklists are typically developed by corporate firms or trade organisations. Generally applicable checklists are published.

User / Situation

- Planner – in all planning phases
- Client – when establishing programme
- Builder – preparation and execution of the building activity
- Client – during the running of the building
- Service organisation - during the running of the building

Advantages

- Structures the process and helpful in formulating individual stages
- Ensures completeness
- Good foundation for further education

Disadvantages

- Poor help answering further questions

Examples

- Checklists for energy efficient, ecological planning & building - Switzerland
- Dutch packages of sustainable building measures – Netherlands

## 4. Ecological and quality assessment for buildings

Building assessment programmes are closely connected with building passports (see later). They represent an evaluated version of the object documentation and usually take the form of a label or certificate.

The use of a certificate helps inform potential buyers or tenants background understanding and their choice criteria, and provide both an incentive and marketing instrument for investors and construction companies.

The certificate is based on a series of assessment procedures (see methods) and involves the use of different tools (see tools). The emphasis on the certificate as a resource lies in the use of the document. Essential to the 'worth' of the certificate are clarity and neutrality in the choice of criteria, information capture and evaluation methods.

It is possible to record not only the energy-usage for running the building but also the energy required for the construction and maintenance of the building. This is normally only possible with the help of specialised planning tools and cannot generally be achieved manually by planners or surveyors.

Development / Publication

- Building assessment programmes are typically based on a catalogue of criteria and requirements. The criteria are developed by independent and/or organisation-affiliated committees, for example research institutes or industrial trade organisations.
- Assessment programmes are carried out for specific buildings or standardised solutions, typically through a third party survey or else self-surveyed using pre-defined assessment methods, for example by the planner or manufacturer of prefabricated housing.
- The results, in the form of a certificate, represent a combined 'all-in-one' collective evaluation. The use of evaluation criteria and appropriate weighting is fundamental to this process.

Intended User and Decision

- Buyer / tenant – help with purchase or rent decisions
- Client / owner – commercial benefit when selling the building

Advantages

- A publicly accepted 'total-evaluation' is possible
- Good marketing instrument

Disadvantages

- Sometimes unclear evaluation criteria and methods
- Sometimes open to manipulation

Examples

- GBC'98 assessment manual – international
- BREEAM assessment method – Great Britain
- AKÖH-Building certificate – Germany

## 5. Case-studies of best practice or exemplary buildings

Exemplary case studies often indirectly influence the development of model solutions in the public eye (and so also politicians, planners and clients too). They are best suited for highlighting positive examples in the public eye and in furthering knowledge and education – they represent the passing on of experience. As examples they prove the feasibility and practicability of new solutions. They often form the basis for the development or re-assessment of characteristic values and objectives.

Case studies can be already built positive examples, selected after their realisation, or sponsored demonstration projects under construction or still to be built. When case studies or demonstration projects are published they should include the actual energy usage (adjusted according to climate).

A differentiated declaration of energy usage according to energy carrier and its purpose (e.g. electricity for lighting) helps further illuminate the choice of solution and the results achieved. An assessment over several years is recommended. A representative energy usage is often reached only after the second or third year.

Development / Publication

- Case studies are selected by communal, national and international committees or trade organisations according to their exemplary value and are published. Although they are usually entire buildings, sometimes-individual components or solutions can be selected for a case-study (for example systems exploiting alternative sources of energy). Selection, usually by a jury, is according to a catalogue of criteria.

Intended User and Decisions

- Planner – help in developing a conceptual approach
- Client / owner – help in determining the nature of the task
- Client / owner – in operation (comparison with "best-practice" values)

Advantages

- Good publicity
- Proof of feasibility and practicability

Disadvantages

- Often not enough detail in the description of the case-study – too general
- Induces transplantation of the solution (a copy) without taking into account local issues

Examples

- GBC'98 – Example building – international
- Best Practice Programme – Great Britain
- SEV/ Novem examplar projects green building – Netherlands

## 6. Building passport/object documentation

A building passport can consist of a number of modules and contains amongst others an energy passport (see later). Some building passports are additionally subdivided in descriptive and assessment portions (see building assessment).

The issue of building passports is closely connected with questions regarding systematised building description, the development of descriptive and assessment criteria and issues of quality assurance in the planning and execution of buildings.

Development / Publication

The building passport is based upon regulations set out by trade organisations or communal or national authorities. These determine content and appearance. The objective is a complete description (and possibly evaluation) of the building with regard to its constituent parts and their properties. It is analogous to a user handbook and product specification.

A building passport is drawn up by the planner, surveyor or engineer and handed over to the owner to be kept with the remaining building documents.

Intended Users and Decisions

- Planner – for the final documentation of the building
- Planner – for later renovation, modernisation or demolition
- Owner – when letting or selling
- Owner – when the building is in use

Advantages

- A complete and specific documentation of a building in one document

Disadvantages

- High degree of work involved when drawing it up manually – computerised tools are still in the development stage.

Examples

- The BM Bau building passport concept - Germany

Relevant issues in the context of Annex 31
It is recommended to include the energy passport as a constituent part of a building passport. Of particular benefit is the possibility of encouraging sensible usage and regular maintenance and the complete description (and localisation) of all the materials contained within the building. This facilitates easier maintenance work and an environmentally conscious demolition and recycling of the building and its constituent parts.

## 7. Energy passport

The energy passport should enable owners, clients, buyers and/or tenants to judge the energy efficiency of buildings and to include this as a valid and relevant judgement criteria. Furthermore this should encourage a general public sensitisation towards efficient heating and water-heating energy requirements over the lifetime of the building.

The issue of energy passports is closely connected with calculation methods and methodological principles for obtaining, interpreting and evaluation of energy coefficients.

Development / Publication
The energy passport is based upon regulations set out by national, communal or European authorities. The regulations determine content, appearance and calculation method. It includes (and assesses) the yearly values for use-energy and/or end-energy for heating and water-heating. Some include further information regarding the external skin and/or technical services as well as general building particulars. An additional evaluation of the yearly values is possible by comparing them with threshold or objective values based on the primary energy input and/or the resulting pollutant and CO2 emissions.

The planner, surveyor or engineer draws up the energy pass, which is handed over to the owner and kept with the remaining building documentation.

Intended Users and Decisions

- Planner – for the final documentation of the building
- Owner – in operation (comparison: actual consumption - predicted values)
- Owner – when letting (proof of energy efficiency)
- Owner – when selling (proof of energy efficiency)

Advantages

- Recognisable measure of the buildings thermal performance in an official document for owner, tenant or potential buyer.

Disadvantages

- Updating of the document as a result of changes or improvements is not regulated
- Open to manipulation by the author of the document

Examples

- Energy Demand Pass according to WSVO'95 - Germany
- EC SAVE-Guidelines
- Energy performance advice for existing buildings by energy companies - The Netherlands

Relevant issues in the context of Annex 31
It is recommended to include an energy coefficient in the energy passport, calculated at the level of end-energy (gross) – a prediction of the expected energy consumption instead of energy demand. This can be converted into primary energy input required to provide the energy source, and its resulting impact on environmental resources can be judged, in particular through air pollution and CO2-emissions.

## 8. Element catalogues

Element catalogues contain raw and/or qualitative/quantitative-evaluated information about functional elements in a building (e.g. 1m_ exterior wall incl. all layers and finishes, or 1 unit heating system etc.). They provide the basis for the development and application of complex planning tools using object-oriented CAD-approaches (see tools).

Element catalogues also serve as reference books. They are particularly suited to comparing design variations based on different building elements. The 'building-block' description of a building enables the evaluation of entire buildings.

Development / Publication

- Element catalogues were originally developed by research projects for scientific purposes. Through being published they became accessible to planners. At present uniformity of information content and interpretation has not been agreed upon.
- In recent times commercial distributors of computerised planning tools have begun developing and expanding element catalogues based on catalogues for costing according to the element method.

Intended Users and Decisions

- Planner – design stage (macro and general elements)
- Planner – work planning (fine-elements)

Advantages

- Facilitates and simplifies an object-orientated planning
- Enables straightforward comparison of different variations
- Saves time
- Presentation of results in a form that is easy to interpret

Disadvantages

- An element catalogue in paper form cannot address every specific situation (the use of computerised systems makes it possible to adapt elements to suit particular situations)
- The element method is not typical in all countries

Examples

- SIA D0123 Building construction according to ecological principles - Switzerland
- F 2249 Primary energy content in building – Germany
- Element Catalogue – Editions AUM to LEGOE – Germany
- Handbook of sustainable building – Netherlands
- Green guide to specification – Great Britain

Relevant issues in the context of Annex 31
Element catalogues have the potential to include object-oriented information regarding the embodied energy as a result of the manufacture of the product, the construction processes as well as the necessary direct and indirect energy requirements for its maintenance within a specified period of time. In addition to this, data detailing environmental pollution levels could be included, for example in the form of CO2 and SO2 equivalent levels.

## 9. Ecologically oriented specification

The availability of ecologically oriented specification aids is seen as a primary way of introducing energy and environment related requirements and information into the planner's workplace. In practice, it also has the potential to be an effective means of ensuring ecological standards as specification requirements are generally binding for the construction company.

The use and further development of ecologically oriented specification aids could lead to a binding specification and use of long-lived recyclable building products containing low embodied energy and involving energy conscious building processes.

Development / Publication
Ecologically oriented specification aids have been developed by individual communal or national authorities for in-house use, and by commercial developers of computerised specification systems. They take the form of an add-on module for existing specification systems and support

the integration of energy, health and environment related requirements in the specification text. Ecologically oriented specification aids are usually not product specific and instead are based on recommendation or exclusion criteria (see below).

Intended Users and Decisions

- Planner – when drawing up the specification

Advantages

- Timesaving and work simplification through the use of ready-to-use text passages

Disadvantages

- Often first utilised in the work planning stage

Examples

- Ecological submission documentation – Switzerland

## 10. Product labelling – ecological and quality grading

Labels are often applied to specific products within a product area. It shows that the product in question is of above-average ecological quality in comparison to other comparable products in the product area.

It is important to point out that ecological and quality labelling differ from warning and supervision labels. The large number of different labels confuses the issue.

Development / Publication
Grading and labels are generally awarded by an impartial independent commission (jury) on the basis of agreed quality criteria and guidelines for specific products or systems, typically for a limited application area and time-span.

Some product labelling is awarded by industrial umbrella organisations whose impartiality and independence cannot be guaranteed. Choice criteria and methods have to be clear and understandable.

Intended Users and Decisions

- Planner / authorities – specification criteria
- Planner / client – criteria in the work planning
- Construction company – basis for product choice and usage
- Do-it-yourself builder - basis for product choice and usage
- Authorities - basis for product choice

Advantages

- Simplicity of use
- Good basis for choice-decisions

Disadvantages

- Loss of detailed information
- Loss of information regarding award criteria

Examples

- Environment mark "Blauer Engel" (Blue Angel) - Germany
- EC Environment mark - European Community
- Wood with FSC mark (Forest Stewardship Council) - worldwide

Relevant issues in the context of Annex 31
Labels detailing good energy or ecological properties are of particular interest, for example:

- energy-saving and low-emission heating systems
- efficient solar and photovoltaic systems
- high performance glazing and insulation
- sustainable recycling properties
- water-saving taps
- low-emission and pollutant free paint and building materials

## 11. Product descriptions (not evaluated)

A complete description of the contents of a product can be of particular use for specific groups (for instance people suffering from allergies). Without the necessary background knowledge they are of limited use for the planner.

It should also be noted that the product contents can change with time and according to use (for instance sand, cement, concrete). Some product descriptions include information regarding an eco-balance or the cumulative primary energy usage from 'cradle to gate'.

Development / Publication

- Criteria lists, usually drawn up by architectural / engineering institutes or trade bodies, detail the properties and characteristics of building products. Technical characteristics, declaration of (chemical) contents and their sources, information about manufacture, use, and disposal of the product and possibly also energy, health and environment related information are typically included. Occasionally further (evaluated) information regarding embodied energy is also included.
- The details are usually provided by the manufacturer either in the form of technical documentation, or by the filling out of the criteria list. In some cases a central data bank or information system for architects is envisaged including a verification of the plausibility of the details.

Intended Users and Decisions

- Planner / client – resource in the work planning

Advantages

- Detailed information to different criteria

Disadvantages

- Difficult for the layman to interpret
- Not all manufacturers' information is verified

Examples

- Criteria for product declaration SIA 493 - Switzerland
- Product declaration - Bavarian Architectural Institute - Germany
- Dutch MRPI-page -Netherlands

## 12. Recommendations and exclusion criteria

No risk of legal consequences, as with plus/minus lists (see later), as the criteria do not specify specific products. Exclusion criteria in current practice are typically used to reduce the health and environmental risk resulting from the implementation of certain building products and processes.

Development / Publication

- Product impartial recommendation and exclusion criteria can be developed and agreed between planner and client or between public authorities and organisations or specialists (often in the form of a work-group). Exclusion criteria often have the objective of avoiding toxic substances or using only sustainable resources.
- Typical exclusion criteria prohibit asbestos or formaldehyde content in products.

Intended Users and Decisions

- Planner / client – developing project objectives
- Planner / client – criteria in the work planning
- Planner – specification criteria
- Construction company - basis for product choice and usage
- Do-it-yourself builder - basis for product choice and usage
- Authorities – basis for product choice
- Funding bodies – criteria for granting of funding

Advantages

- Simplicity of use
- Signifies a clear direction
- Product neutrality in the specification

Disadvantages

- Presupposes an exact product description which does not always exist e.g. exact types and amounts of binding agents and solvents present etc.

Examples

- Schwarz: Ecology in Building (handbook)- Switzerland
- Dutch instructions for environmentally sound do-it-yourself builders - The Netherlands

## 13. Plus and minus lists

Plus and minus lists are favoured by the layman because of their clear and easily understandable message. Plus / minus lists drawn up on the basis of reasoned criteria are preferable. It should be noted that products with a comparatively high cumulative primary energy usage in its manufacture 'from cradle to gate' can lead to its inclusion in a minus list – for example aluminium. One solution for this is the re-use of recycled material. A particularly low cumulative primary energy usage in a products' manufacture can be a reason for including.

Development / Publication

- Plus and minus lists of specific recommended or excluded products can be individually agreed between planner and client. Occasionally communal or government authorities, or associations and magazines draw up specific lists with recommended products or products to be avoided. Typical of these are the exclusion of aluminium, PVC and tropical woods.
- Drawing up minus lists necessitates an estimate of the health and environmental risk associated with not only the use of the product but also its manufacture and disposal.

Intended Users and Decisions

- Planner / client – developing project objectives
- Planner / client – criteria in the work planning
- Construction company – basis for product choice and usage
- Do-it-yourself builder – basis for product choice and usage
- Authorities – basis for product choice
- Funding bodies – criteria for granting of funding

Advantages

- Simplicity of use
- Signifies a clear direction

Disadvantages

- Product neutrality is not guaranteed, for example by specifications
- High risk of legal consequences from the manufacturers of negative rated products
- Background reasoning for choice not always clear
- Impossibility of including all products in a list

Examples

- Test results in magazines such as "Öko-Test", Germany