Tools Evaluation Report

This report covers the deliverable “Evaluation of potential tools” for Task 6.

POTENTIAL TOOLS EVALUATION

by Didier Deroy, ADD asbl, November 2006

1. Monitoring indicators: project considerations

A discussion was first initiated to reach a common understanding of the term and therefore develop the related outputs. "*Monitoring indicators*" could *de facto* mean a lot of things:

- Evaluating the quality of the of the indicator itself:
  - Selection of indicators: To set the list of indicators used within the project, a selection process has been applied assessing the quality and interest of choosing an indicator. **This has been achieved during the first part of the project.**
  - Controlling that the indicator is providing the requested information: This is obtained by reviewing regularly with stakeholders the needs of information and related tools. Does the formula correctly answer the issue to be managed? Does the information provide the right information facilitating the decision making process? **An agenda and a strategy should be set to regularly review the indicator set and the needs of the stakeholders.**
  - Controlling that the indicator is reflecting the reality: It is important to sample results and see if the value provided is reflecting the reality and therefore the information corresponds to the definition chosen. **A sampling procedure should be set allowing some verifications and identification of the measures taken.**
  - Identify if the indicator is transferable: We can see that some attempts to define standards or common indicators are developed within European countries, European Agencies and even EU Commission. It could be interesting to identify if we can compare the acquired data with other information taken by other stakeholders. This question exists at the local (*for instance, in between users*), city (*for instance, in between services*), regional (*for instance, in between municipalities*), country (*for instance, in between territorial management authorities*), eco-regional (*for instance, in the Mediterranean space*), European (*for instance, in between European countries*) or international (*for instance, in comparison with international targets*) level. So far, we can not consider that the standards exist as a lot of set of indicators are existing and that no real signed agreement are enforcing the development of a coherent set of data integrating all the strategic levels. Within Europe, an important work is achieved to develop a common set of indicators measuring environmental quality and SD. It is supported by the EUROSTAT Agency but it still under progress and mostly oriented towards national statistics department. It is also an important point that most data are at national level and are not necessarily fulfilling the needs of

local authorities managing urban space towards a more sustainable city. **Under the current project, we integrated data coming out from the key structures and reference authorities bridging local needs with larger scale strategy. The DTPH is also taking part in several initiatives as ESPON that are working on the standardisation of measures in the area of spatial planning and policies. The capacity building project makes them able to integrate such new data within the URBANGUARD project and update it as required to answer European challenges.**

- Evaluate the quality of the measure:
  - Developing a referential: The measure taken will be evaluated by using a reference value at a moment chosen as the initial value (T0). The trends can be then identified in comparison with this value. **This is developed under the pilot run test of the tool.** Another referential system can be placed and require futher development. It is the legal values or the strategic values that are used to framed an issue (e.g. legal values set by authorities as for SO_2 are presented below) or reduction of 50% of transit mobility by cars in secondary roads (target or strategic value). **This is not part of the current project.**

Legal values used as references for air quality control in terms of sulphur dioxide[1]:

Norms for SO2 (Sulphur dioxide)	
LIMIT VALUES	50th Percentile (*) of the daily averages measured during the meteorological year (**): • year 120 µg/m³ with P50 of suspended particles < 40 µg/m³ 80 µg/m³ with P50 of suspended particles > 40 µg/m³winter 180 µg/m³ with P50 of suspended particles < 60 µg/m³ 130 µg/m³ with P50 of suspended particles > 60 µg/m³
	98th Percentile of all the daily averages measured during the meteorological year: • 350 µg/m³ with P98 of suspended particles < 150 µg/m³250 µg/m³ with P98 of suspended particles > 150 µg/m³
GUIDE VALUES - EU	daily average: 100 to 150 µg/m³
	yearly average : 40 to 60 µg/m³
WHO GUIDELINES	daily average: 125 µg/m³
	yearly average: 125 µg/m³50 µg/m³
BENELUX GUIDELINE	daily average: 400 µg/m³

  - Accuracy of the measure: Does the indicator is well measured? It is important to identify if the procedure are correctly applied. This is why it is recommended to clearly identify on the "*data sheets*": date of measure, name of the operator, name of

[1] Sources: IRCEL-CELINE, website, March 2004[2] D. Altwegg, I. Roth and A. Scheller, "Monitoring Sustainable Development: Monet – final report, methods and results," 2004.

service providing the information, contact of the referent person, reference to the definition – *including special note if a change occurs in the definition or the formula* –, sources of information – *including time reference* – especially for totally or partially calculated indicators. **This has been taken into consideration preparing the *data sheets*.**

- Integrate the indicators within an information system: How to represent the results? How to compile them? Do we have ready made programmes to achieve such work? **This issue has been addressed at different stages of the project as it is also related with the set of indicators and the stakeholders needs.**

The common understanding set about the issue of "monitoring indicators" is the last one. At different stages of the project we have been looking and showing examples of monitoring tools integrating measures into a global information framework. We will give here some examples of monitoring tools and discuss it. This is a second and more elaborate report integrating researches and discussions that have been leading to the choice of the GIS tool.

2. Monitoring and assessment of indicators: the process adopted to build the list of indicators

Following the set of objectives presented in the introduction, in view with the current resources allocated to the project and considering the rising expectation of comparable data, the following orientation for the monitoring and assessment of the indicators have been given:

- Evaluation of set of indicators from different origins:
  - United Nations;
  - OECD
  - Common indicators research within EUROSTAT and the EEA
  - European and Non-European countries indicators set
  - European regional indicators sets
  - European and non-European city indicators set
  - Thematic indicators set
- The chosen indicators have to be implemented within the time frame of the URBANGUARD project, based on good quality, documented and trustable data.
- The indicators at this stage of development will provide a first vision about sustainability in urban areas.

The project aims to integrate the concept of Sustainability within the Town Planning strategy of Cyprus. It is a pilot project that will build capacity of the service and provide new tools for decision making. In this context, there is no reason to reinvent the wheel. It is for this reason that we have examined current experiences set by intergovernmental organisations as United Nations, but also different states, regions and cities, in Europe and outside Europe.

The existing models include example pressure/ state/ response (EUROSTAT, Belgium), needs/ activities/ pressure/ impact/ response (Germany), capital for future generations/ efficiency/ equality/ adaptability (Sweden), endowments and liabilities/ procedures/ current results (USA), here and now/ here and later/ elsewhere (Mexico) or pure capital stock models (Canada)[2]*.*

There are also considerable differences in the size of the sets of indicators used. This varies from a few dozen to as many as 307 (France). The vast majority of sets comprise between around 80 and 150. These numbers have to be relativised considering the stage of development of the sets, the type of indicators used, their aims and the context of application (for example a national set compared with a city set). *Most countries are happy with a sequential presentation of the results. For the moment, a numerical aggregation is not used for calculating a single "sustainability index"* but certain experiences as the "footprint" index are undergoing and are applied at national or city level*. There is also a degree of reticence regarding synoptic tables, although such proposals have been voiced by research institutes. In contrast, a few countries (e.g. UN, Germany and the UK) select particularly relevant indicators which they term headline or key indicators*[3]*.* Some cities (*e.g.* Brussels) are doing the same.

If we compare the different methods and approaches, we can see very heterogeneous picture. We can not consider so far that an agreement has been reached at international or European level to select a common procedure or at least evaluate the suitability of each of it.

The requirements of an indicator system:
As early as 1996 an international team of experts formulated basic rules for devising sustainability indicators which they called Bellagio *principles. They include: a clear idea of sustainable development and the aims involved, taking into account all important areas, choice of appropriate time-frames and area of study, limited number of indicators in order to guaranty a high degree of significance, publication of methods and results, a participative process for drawing up the indictors, the possibility of developing the indicator system further, and the creation of institutional means for producing indicators.*[4]

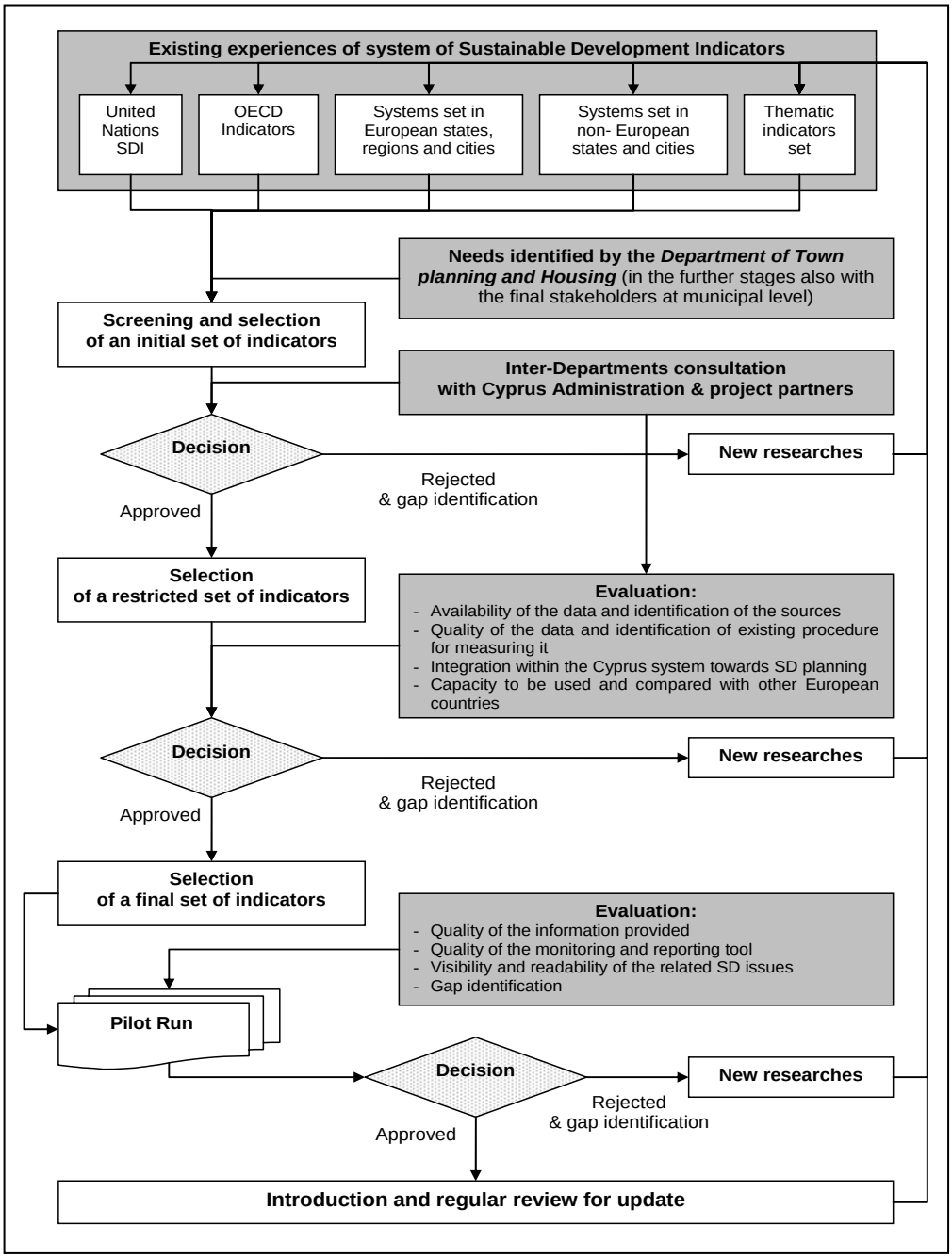
This view used to set the MONET system in Switzerland applies to the URBANGUARD project and assisted us to set some important requirements:

- The correspondence with the basic principles of statistics
- The flexibility
- An interdisciplinary and holistic perspective
- The consideration of existing indicators
- The possibility of creating sub-groups of indicators

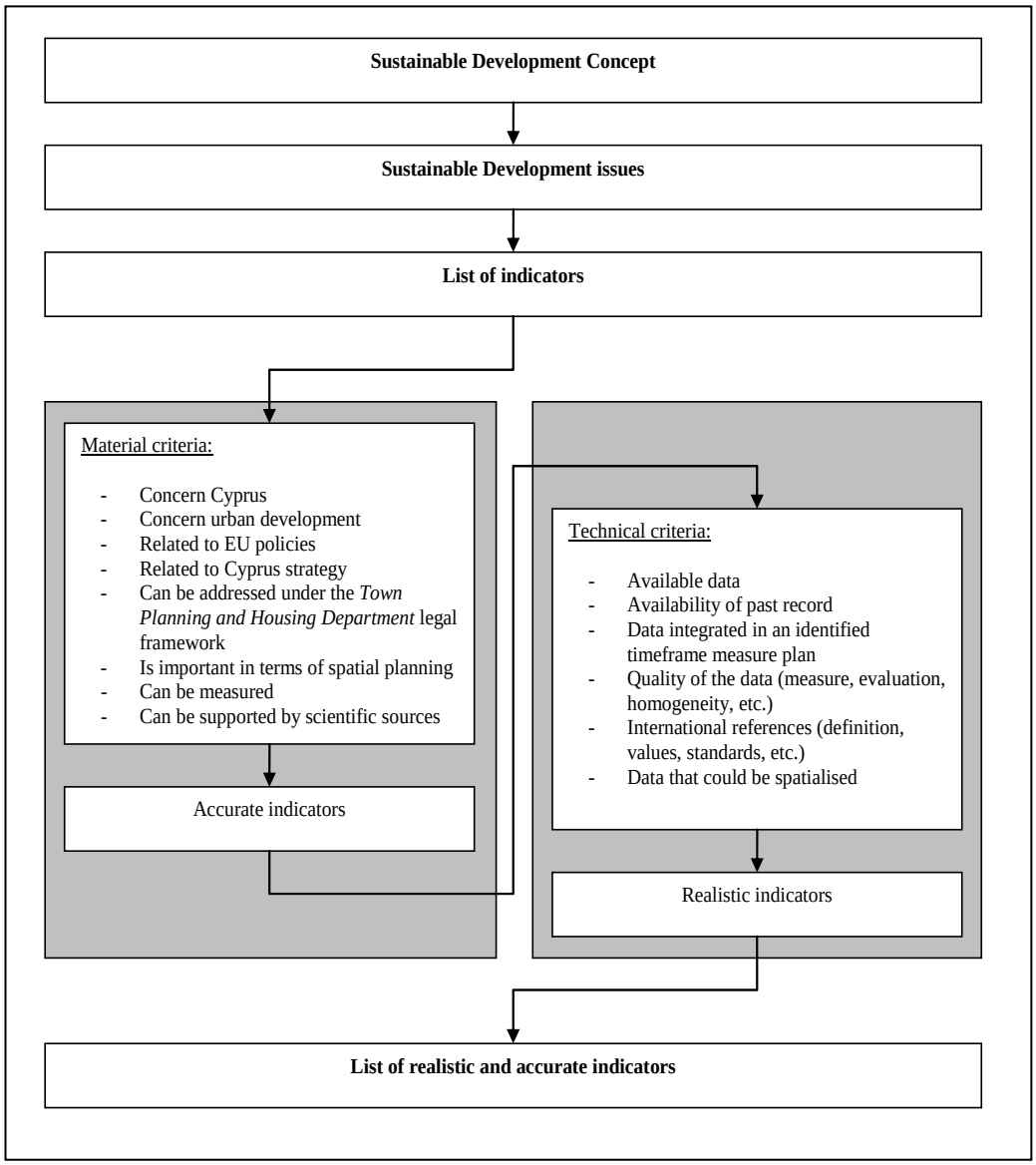
[3] ibid.
[4] ibid.

- The capacity of using the indicators in other spatial levels and contexts than the project ones.

Framework used to assess and monitor SDI within the URBANGUARD pilot project:



Assessment and monitoring of indicators:



3. From indicators to monitoring and reporting tools

The indicators are tools used to describe and facilitate communication about complex phenomena. The information that we manipulate can be from the simple data till indices. The indicators can present simple data or already combined information. Indicators can be aggregated and compose an index, meaning presenting a single value summarising a set of information. For instance, the index of "*human wellbeing*" set by United Nations is an index; this composite indicator is summarising the quality of living conditions of a human being within each country.

The development of indices are increasing but are still for most of them under development and even the current ones can generate controversial discussion on how they are aggregated.
If the evolution of a single index can easily answer the question often raised up by decision-makers "*but where could I see Sustainable Development within this analyses*", the fact of aggregating reduce the quantity and the quality of the information. It does not provide information on where to act to influence the human activities towards sustainability. It is also not sure that the formula or the model used to aggregate the simple indicators is correctly representing the mechanism of the phenomena as it will compare data measured by different values and required weighting each data.

On the other hand, the presentation of a large number of simple indicators can overflow decision makers and stigmatise the complexity of the concept. Too many indicators can reduce the transparency of the system. Simple indicators or sectoral indicators can be more useful for the stakeholders even if a general index could play the role of lighthouse. Results can be presented in different ways from rough material – *mainly list of values* – till table or graphics that are more easily readable. With a clear definition on the relationship with the SD issue, it can provide information on where to act, what to do. Gathering indicators under thematic boxes like "traffic" or "urban renewal" can give a better strategic vision towards SD planning. It can even be summarised in a kind of dashboard showing the key indicators under each box.

The information paradox:

Disaggregated indicators =		a set of indicators showing the complexity of the phenomena
	BUT	→ Where do I identify sustainability? Where can I easily see how things are evolving?
Aggregate indicator =		it is a mitigation of various indicators, a mix of different information not using the same values and often based on a "black box"
	BUT	→ What do I have to change? Where can I act? What is the problem?

Selected examples:

Part of the Sustainable Development process of a city is the issue of CO_2. This gas is partially responsible of the green house effect and participle to the earth global warming monitored trough the Protocol of Kyoto. It is therefore a key issue to control the sources of this pollutant in towns.

One of these sources is the heating system. This is of great interest as improving heat management means consuming less resources but also emitting less green house gas and also has impact on the related budgetary issue. Therefore, monitoring energy provides a double benefit and it is why a lot of municipalities are developing initiatives to improve energy management within public infrastructures.

Rochefort (France) has developed a strategy called "*Objectif Nature*." Part of the implementation is to reduce energy consumption within public infrastructures managed by the municipality. The monitoring tool is basic and applies classic statistical tools summarising results with graphics. Such kind of action could be combined with an interactive GIS providing data building by building on a map. By itself, it is a basic value but if efforts are generated to create a real building history mentioning efforts done to improve energy use it can start providing guidance for further action within the municipality.

In other cities, the concern about energy consumption as "global warming factor" has also been studied. Other pilot interventions have been made, both on public and private. One of these has been to realise aerial thermo-photography allowing the identification of "hot spots". Combined with the cadastral map, using GIS tool, public agents are able to inform citizens and municipal council about actions that have to be taken to limit energy consumption using good insulation. Such initiatives coupled with financial and legal incentives about house insulation can provide positive impact on both social and environmental sustainability of an area.

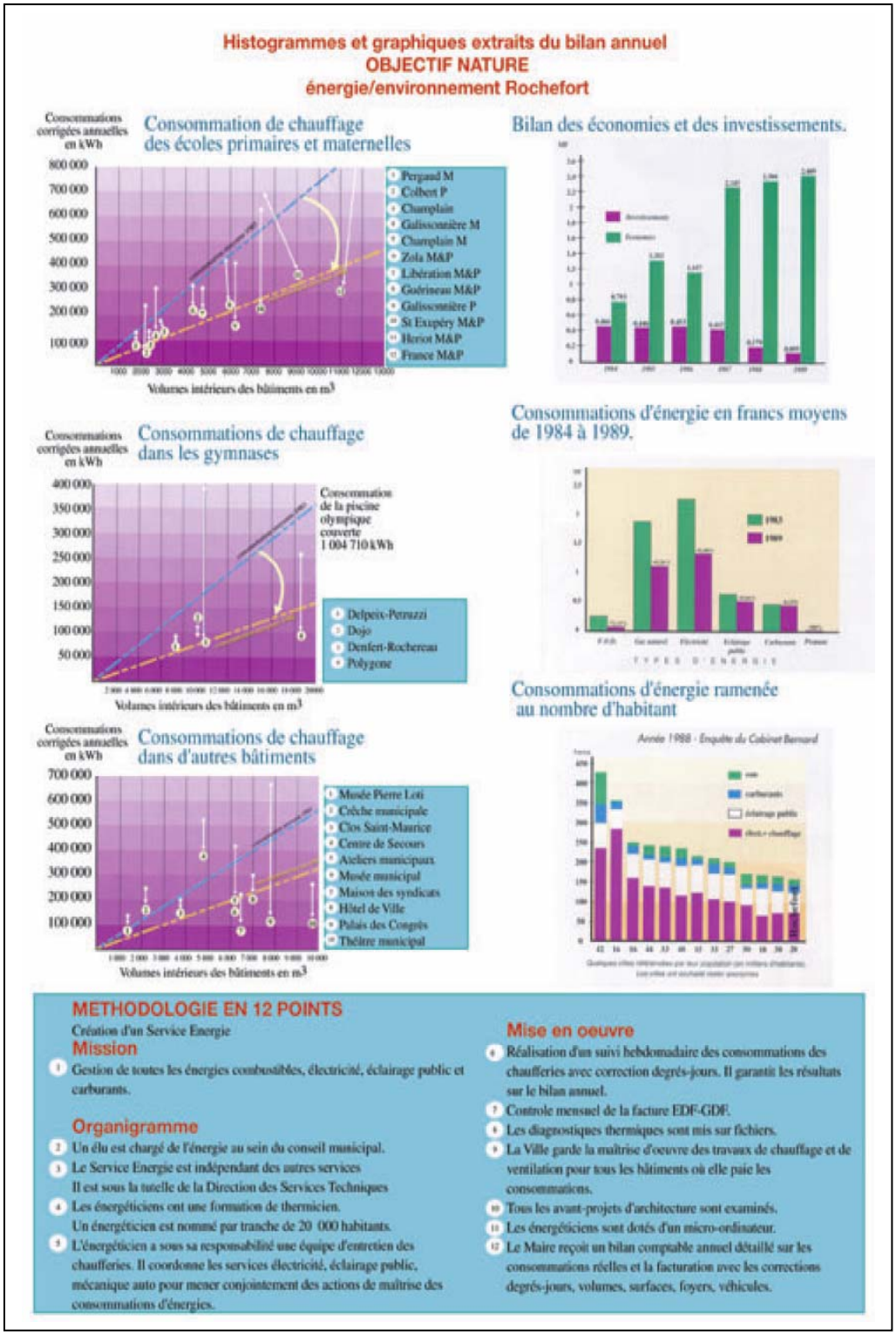
Some examples of thermographic studies with interactive maps available on internet

City of Marseille[5]:	http://sig.mairie-marseille.fr/scripts/gcis.exe?XgoPageName=Plan_thermo&ADRESSE=
City of Troyes[6]:	http://www.ville-troyes.fr/scripts/ENVIRONNEMENT/publigen/content/templates/show.asp?P=342&L=FR&SYNC=Y

[5] A visit on the website of the city of Marseille allows you to see in direct the energy emission from the city till the house level. This is based on the construction of an interactive GIS tool: http://www.marseille.fr/ + click on [à portée de main] "Ressources" → "thermographie"; you will then be redirected to the GIS unit of the city = http://sig.mairie-marseille.fr/scripts/gcis.exe?XgoPageName=Plan_thermo&ADRESSE=.

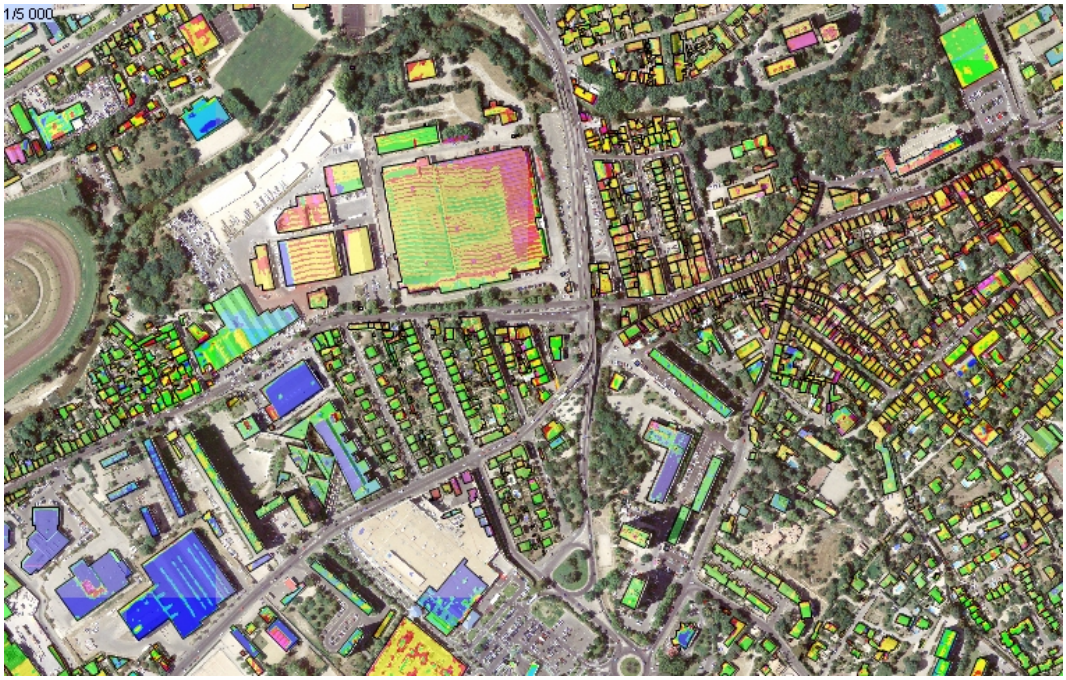
[6] A visit on the website of the city of Troyes allows you to see in direct the energy emission from the city till the house level. This is based on the construction of an interactive GIS tool: http://www.ville-troyes.fr/ + click on "Vie au Quotidien" → "environnement" → "étude thermographique" + click on this page on "voir résultat de l'étude".

Strategy of the city of Rochefort (France)[1]: Annual report on energy used coupled with the programme of reduction of the energy budget of the Municipality in public infrastructures.

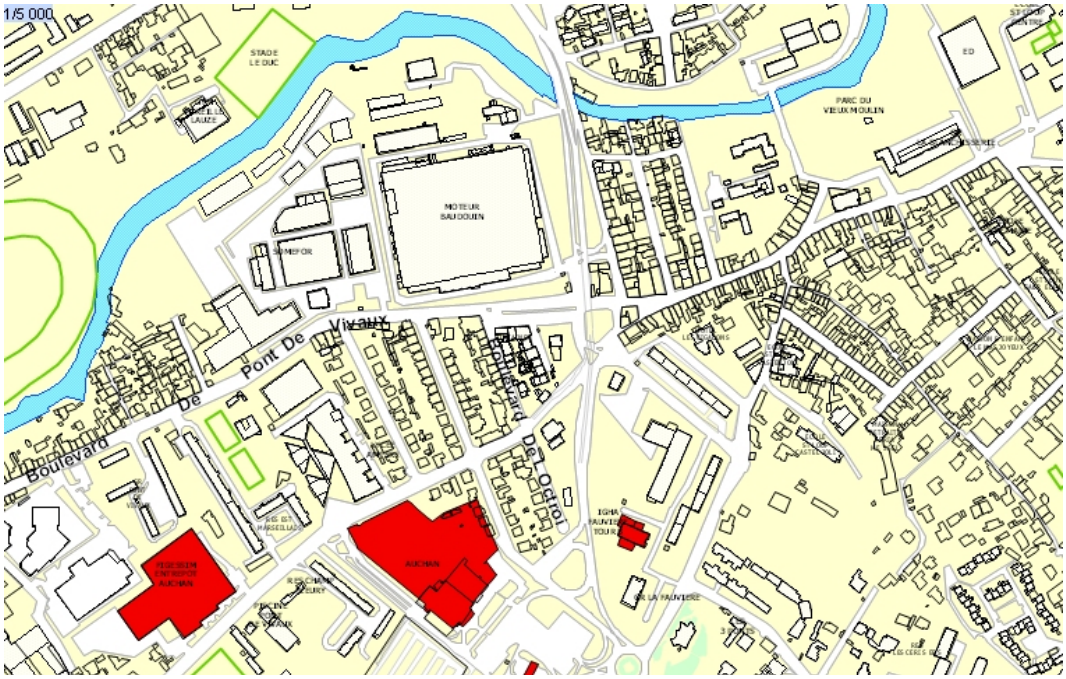


[1] "De l'intérêt de prendre en compte le développement durable dans les diagnostics de territoires", Ministère de l'Aménagement du Territoire et de l'Environnement (France), CERTU, Note méthodologique.

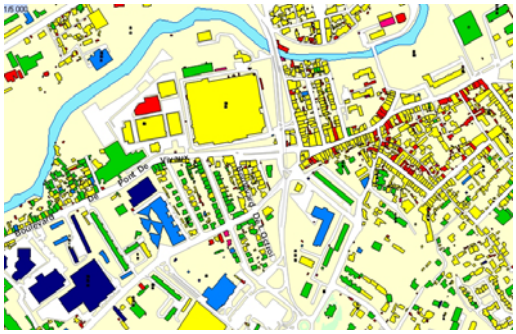
Thermographic Study of the City of Marseille (Copyright City of Marseille): Four visions in free access of the same element: 1) Combined GIS presentation of cadastral map, aerial photography and thermo-photography analyses; 2) cadastral map; 3) Thermographic analyses - average; 4) Thermographic analyses - details; 5) aerial photography



1) Photo/Thermographie



2) Plan



3) Thermographie moyenne

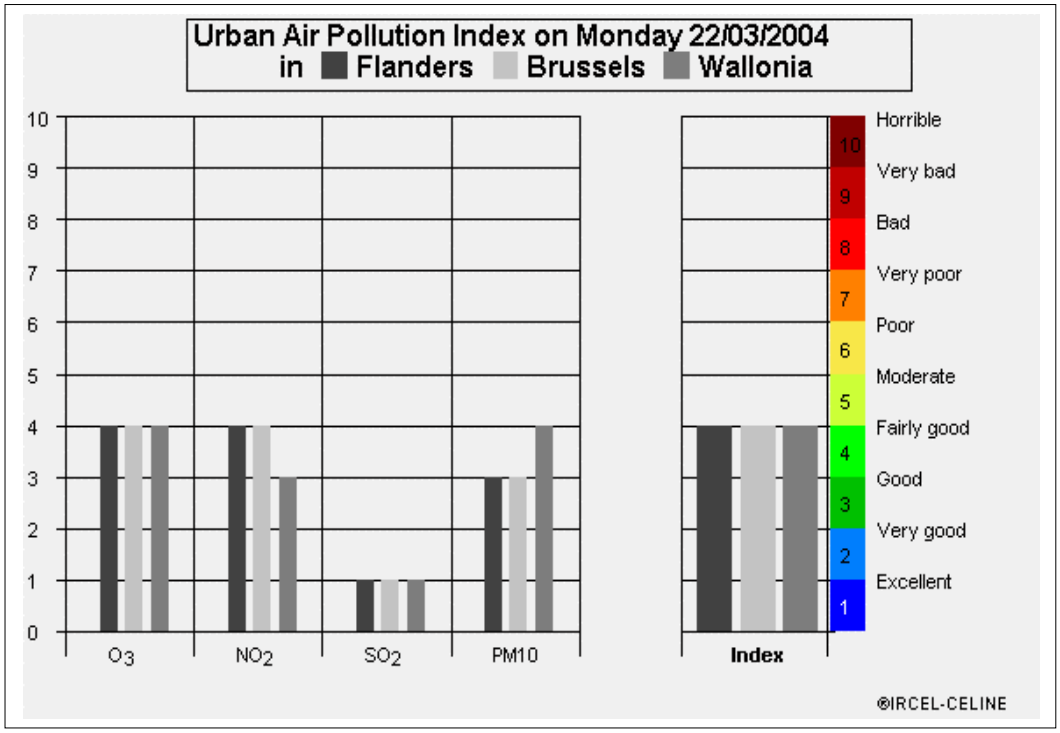
4) Thermographie détaillée

5) Photo aérienne

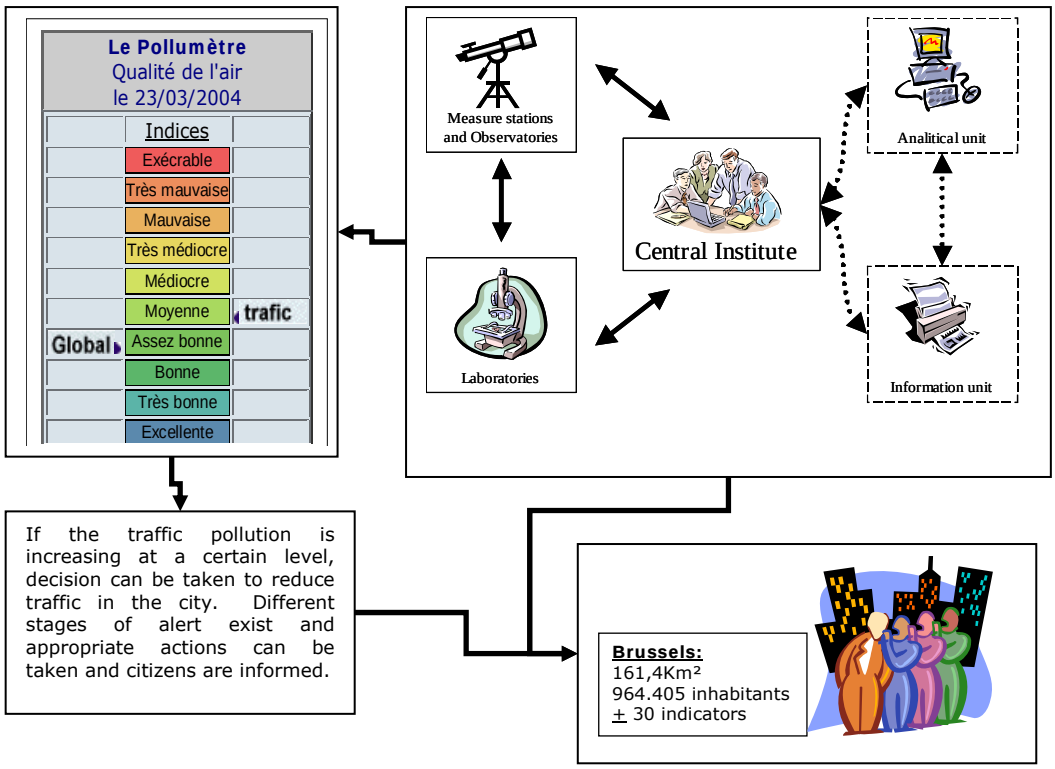
Air pollution monitoring in Brussels

Supported by a network of instruments located at key places in the city, the Brussels Institute for Management of the Environment (IBGE) is monitoring air quality. Within the Sustainable Development Strategy of Brussels, an air quality plan has been set and key indicators have been selected measuring level of O_3, NO_2, SO_2 and particles in suspension. A global pollution index has also been developed allowing the administration to provide easily accessible information. Coupled with pollution model and GIS, the unit is able to elaborate a map of the pollution.

The information is accessible to specialists as well as citizens through a website but also electronic public boards placed in the city. This material is part of a system allowing the IBGE to monitor the quality of the air, to inform decision-makers and citizens and, in case of problems, to take appropriate actions following a precise protocol.



Monitoring of urban air pollution in Brussels: presentation of simple indicators measuring level of O_3, NO_2, SO_2 and PM10 + the global pollution index[2]



From indicators to information and decision-making

[2] Source: IBGE – Brussels Institute for Management of the Environment IRCEL-CELINE, website, 23/03/04 / website: www.ibgebim.be

4. Land use planning

Land use is one important issue in terms of urban planning but representations can vary as the "use" expression can be multiple. Indicators related to land use can be simple as identifying the assignment of the soil (Natural, agricultural, industrial, etc.). For example:

- The Municipality of Chécy (France) is following the evolution of its Natural Zones using colours indicators delimiting zones within the cadastral map
- The Municipality of Dunkerque (France) has developed a similar approach allowing them to study scenarios for the industrial development of its harbour

Indicators representation can be more complex when integrating different levels of analyses as the TRANUS (Reference 2) combining results of mobility models and GIS maps. TRANUS studies land use and mobility in the urban system. In this programme, the basic concepts of the original input-output model have been generalized and given a spatial dimension. The activities generation location model is an input-output model with production and consumption relationships, built into a very general and flexible structure. On this basis it is possible to build a complex model to represent the economic and social system or a simplified model with only a few elements interacting with each other. The complexity of the model depends on the purpose of the application, of available resources and availability of information.

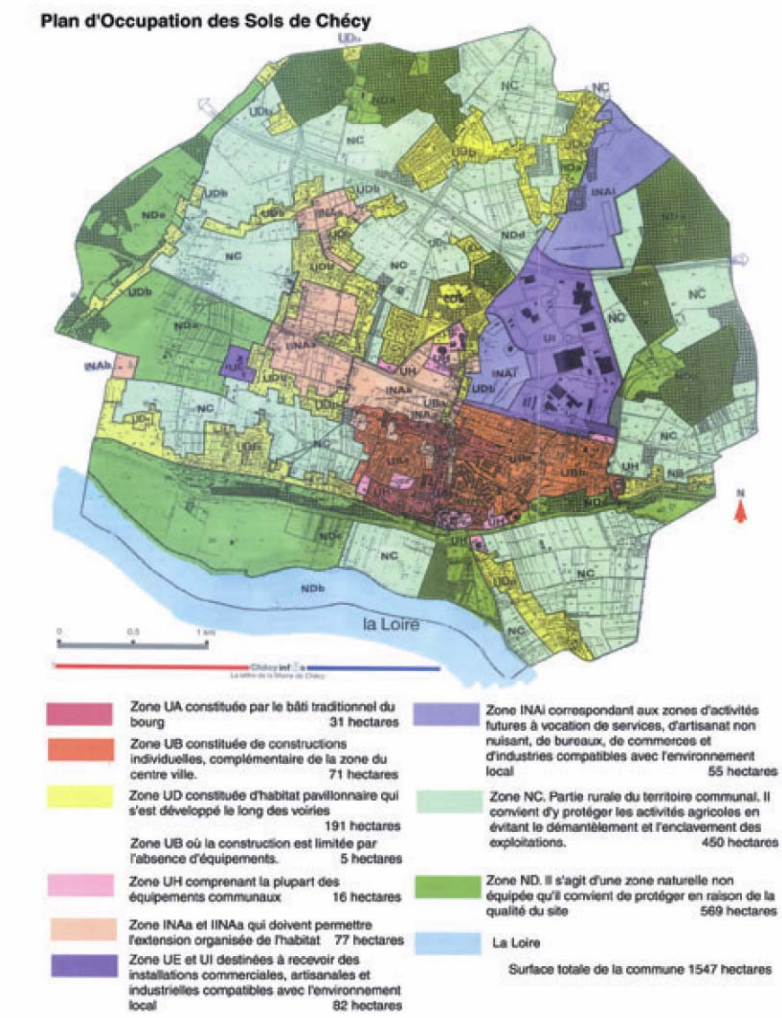
Industrial and harbour development scheme for the city of Dunkerque[1]:

A strategic planning description based on 3 visions in terms of land-use:

- Organisation of the industrial site
- Risk management and potential conflict in land use "economic versus human acceptance"
- Landscape planning

[1] "De l'intérêt de prendre en compte le développement durable dans les diagnostics de territoires", Ministère de l'Aménagement du Territoire et de l'Environnement (France), CERTU, Note méthodologique, 125pp.

Strategy for preserving capacity of city development for the future generations in the Municipality of Chécy[2]: evolution of natural zones in the areas affected to future development for housing, economic activities, rural development and equipped recreational and natural protected areas. [Population: 7.200 inhabitants; surface: 1.547hectares; location around Orléans]

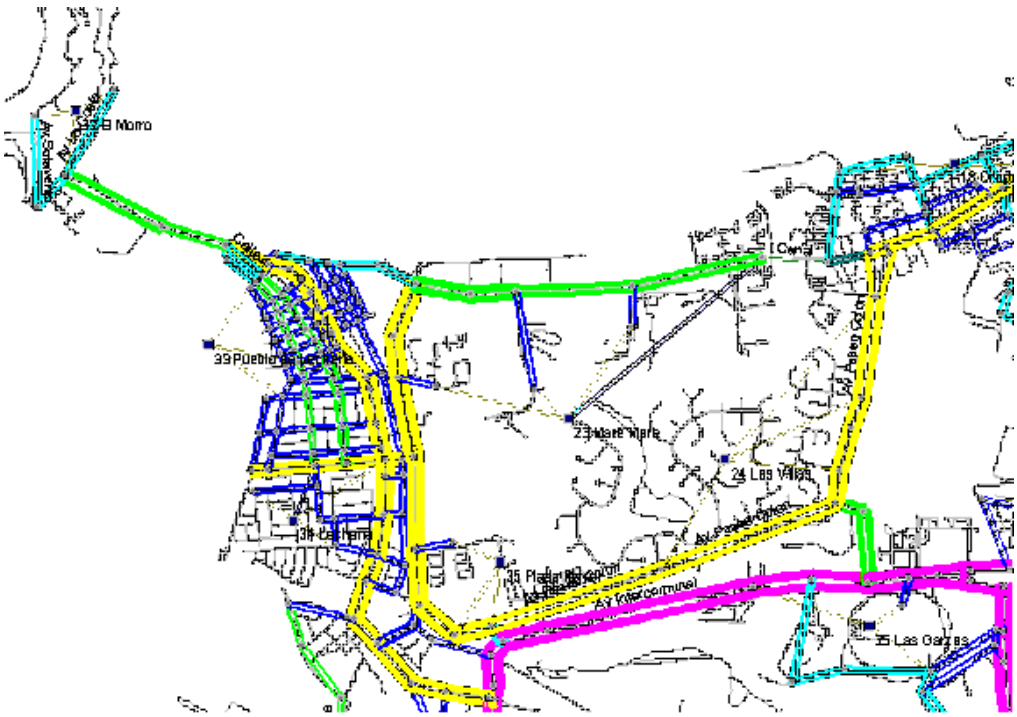


Évolution des zones naturelles du POS de la commune de Chécy

Zones	Surfaces (ha) POS 1999	Surfaces (ha) POS 1992	Variation
I NA a	36	80	- 44
II NA a	40	98	- 58
I NA i	0	6	- 6
NC	458	473	- 15
ND	568	412	+ 156

[2] "De l'intérêt de prendre en compte le développement durable dans les diagnostics de territoires", Ministère de l'Aménagement du Territoire et de l'Environnement (France), CERTU, Note méthodologique, 125pp.

Example of a network coded directly over a GIS background imported into the TRANUS interface



Another example of tools set to improve sustainable land use within cities is the one newly developed by the Regional Development Office of the Brussels Region (SDRB): "investimmo.be"[1].

One of the problems encountered within the city-region is the pressure set by offices on habitat. A lot of permits are requested to build new office spaces when a large number of offices are vacant. The region is quite fully urbanised at the exception of some major open-space, preserved natural spots and an urban forest. Due to the central position plaid at national, European and international level, there is an important increase in business spaces, mainly for services; this affect not only availability of housing facilities but also quality of life (e.g. the pressure and pollution related to transport; access to housing facilities at affordable price), public finance (e.g. taxes and urban drift) and public security (e.g. creation of areas only used during business hours).

To limit such problems, to regenerate urban multi-functionality, the region has developed an interactive tool combining analytical capacity and encountering business needs. Using a GIS system, they are providing through internet a free set of information corresponding to the availability of office facilities in the city. Data are qualitative and geo-referenced allowing potential interested users to locate and preview the facilities. In the mean time, they are able to evaluate the availability and repartition of empty office spaces within the city and therefore regulating the balance offices – workshops – business development spaces / houses. The information available on the net is updated based on

[1] http://www.sdrb.irisnet.be/fr/inventimmo.asp

information collected in the city by mobile public agent elaborating data sheets for each premises.

Out of the following selection criteria, the customer can have access to a large data base supported by a GIS information tool:

Use or functionality: Workshop/ Storage, Office, Land (to be valorised), Business Centre, Trade shop.
Type of expected financial operation: Sale, Rent
Extra information/ other criteria of research: Size in m², Municipality

The available facilities are described by pictures and a small summary of its characteristics. It includes financial terms, address and contact numbers. It also mentions the type of urban planning regulation effected to the concerned area and some other legal comments. In extra, the customer is able to locate the premise by using the multilevel GIS information related to its choice. The item can be identified based on the urban segmentation at the street level but also being centred on the property one. The boundaries are then located within the city urban plan, including information of the use of the land.

Two other types of representation are available to identify the facility:
1/ district: this vision provides information on access and facilities available in the neighbourhood of the property;
2/ aerial photography: this provides an additional angle of vision on the property locating it within the urban fabric but also contextualising the direct image of the place.

Geographic documentation of the premises:

Maison
Rue
Quartier
Photo aérienne

Maison
Rue
Quartier
Photo aérienne

Maison
Rue
Quartier
Photo aérienne

Maison
Rue
Quartier
Photo aérienne

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5. Conclusions and recommendations

During the study visit in Belgium, the "Stads monitor" development team and the Bruges Provincial Authorities have shown that a multilayer GIS system can provide a powerful tool for monitoring sustainable development issues, assist setting strategies and support policy and decision- making processes. The combination of analytical information with map under such interactive platform can provide key data to set and monitor sustainable urban development strategies provided that:

- data are available, qualitative and accurate
- maps are available, qualitative and accurate

As shown here above, with the TRANUS programme, it is possible to find ready made programmes and some are freely accessible for download. Unfortunately, no global evaluation exists to ranks such kind of programmes making it impossible to evaluate:

- compatibility & inter-compatibility
- accuracy
- flexibility
- progressiveness
- adaptability

Most of these programmes have been set for precise purposes as TRANUS (Reference 2) for mobility issues or SUREURO (Reference 3) for refurbishment and housing renovation process. Therefore, it could not answer all the questions related to the current developed project. They are also related to models and therefore choices. On one hand, they have not necessarily been validated or set as an official references, neither at local, European or international level; on the other hand, most of them are marketed worldwide trying to gain experiences, multiplying case studies; this could be considered a validation process allowing improvement of the tool by testing it in different situations.

It is also an important point that if the test version is free copyrights, support units and source codes remains the property of the development team – *often private company* – limiting autonomy at short, medium or long terms.

Some generalist approaches have been created as the "*Gigapolis project*" (Reference 1), the "Sustainable city: GIS for Urban Development" (Reference 4) or "Urban Sim" (Reference 5). Most of them are still under development and it is important to notice that they are highly dependant of the renewal of funding set for the initial pilot phase.

Quite appropriately, the European Environment Agency (EEA) has set a book of recommendations considering the use of GIS tools and related databases: "*Guide to geographical data and maps – EEA operational guidelines – January 2006*". These recommendations have

been seriously taken into consideration during the preparation of this document and pointed out to the project team.

The EEA recognise the need to strengthen the harmonisation of spatial data handling by different topic areas and to ensure improved quality control on spatial data and derived products, e.g. maps. They have set these guidelines for internal purposes but also to improve exchange of material with partners. Therefore, considering such recommendations will assist the stakeholders of the URBANGUARD project in case of future communications with the EEA.

The efforts of the EEA attempting to harmonise data started in 2001. The EEA has worked on developing guidelines and tools with the aims of:

- standardising the handling of geographical data by considering the following aspects:
  - projections
  - accuracy
  - formats
  - data structure
  - quality control routines;
- standardising maps for printed reports and Web applications in terms of:
  - map extents
  - colours
  - creating generalised data and template files for use with ArcGIS
  - creating ready-to-use maps for use with Adobe Illustrator;
- developing web services;
- developing standards and tools for metadata handling;
- improving quality of information delivered to and used by EEA.

This work has been deeply influenced by the running project INSPIRE that has provided some key reference under our current LIFE project. Part of the outputs provided by INSPIRE, the guidelines are linked as far as possible to standardisation agreements within the European Commission and also to the initial work developed by Inspire – Infrastructure for spatial information in Europe (http://www.ec-gis.org/inspire).

The current guidelines is the last version of a working document presenting guidance on spatial data handling to all GIS users who deliver material to EEA products. On page 6 of the manual, a table is summarising under which chapter the information is provided on a large set of topics: Datum; EEA map data; Geo-databases; GIS map templates; Grids; Latitude/longitude; Map extents; Map layout; Standards; Metadata on data; Metadata on maps; Postscript maps; Projection; Raster data; Vector data. This document is also clearly supporting the technological (software) choices that have been made.

There exists a variety of models and programmes to assist decision makers achieving urban sustainability. Unfortunately, none of them are, at our current knowledge, encountering all the needs of the URBANGUARD project. None have been set as a standard tool by European Commission or institutions. The answers provided by such programme correspond to specific targets and criteria set for each corresponding project. Some can even be downloaded from the internet free of charge but designers are disclaiming responsibilities on results obtained by using it.

The current overview concerning available tools and the construction of the URBANGUARD GIS one is confirming decision taken on the software choices. If we can probably regrets adding a new tool in the global basket, it was not possible to test all programmes available and elaborate an adapted package for the ongoing project. In extra, such option has not been privileged as it was not guarantying the capacity to compare or cross analyse data treated by each separate programmes and integrate it in a single system.

The current case studies that have been discussed during our meetings can give orientation to the URBANGUARD GIS creation. It shows what the potential of using geographic information is but also allows evaluating the needs in terms of data resources as maps. Option has been taken to set a pilot system base on the classic construction of a GIS system. It allows the final stakeholders to keep a control on and integrate the know-how related to the tools, limiting partially the "black box effect".

Therefore, the following points must be considered to develop the URBANGUARD GIS tool:

- The capacity to integrate different topics;
- The possibility to combine different topics obtaining new data;
- The use of maps that allows analysing data at different levels of the urban fabric (House identification, street, bloc, district, city, etc.);
- The integration of aerial photography[1] if possible and available could be an added value;
- The capacity to present results using different media forms as maps, table, graphic or figures;
- The development of a fully interactive and comprehensive tool;
- The evaluation of making some results available to a large public, potentially through internet[2].

It is important to note that developing Sustainability guiding tool is an iterative process. The process used under URBANGUARD is quite close to the one adopted by Switzerland authorities.[3]

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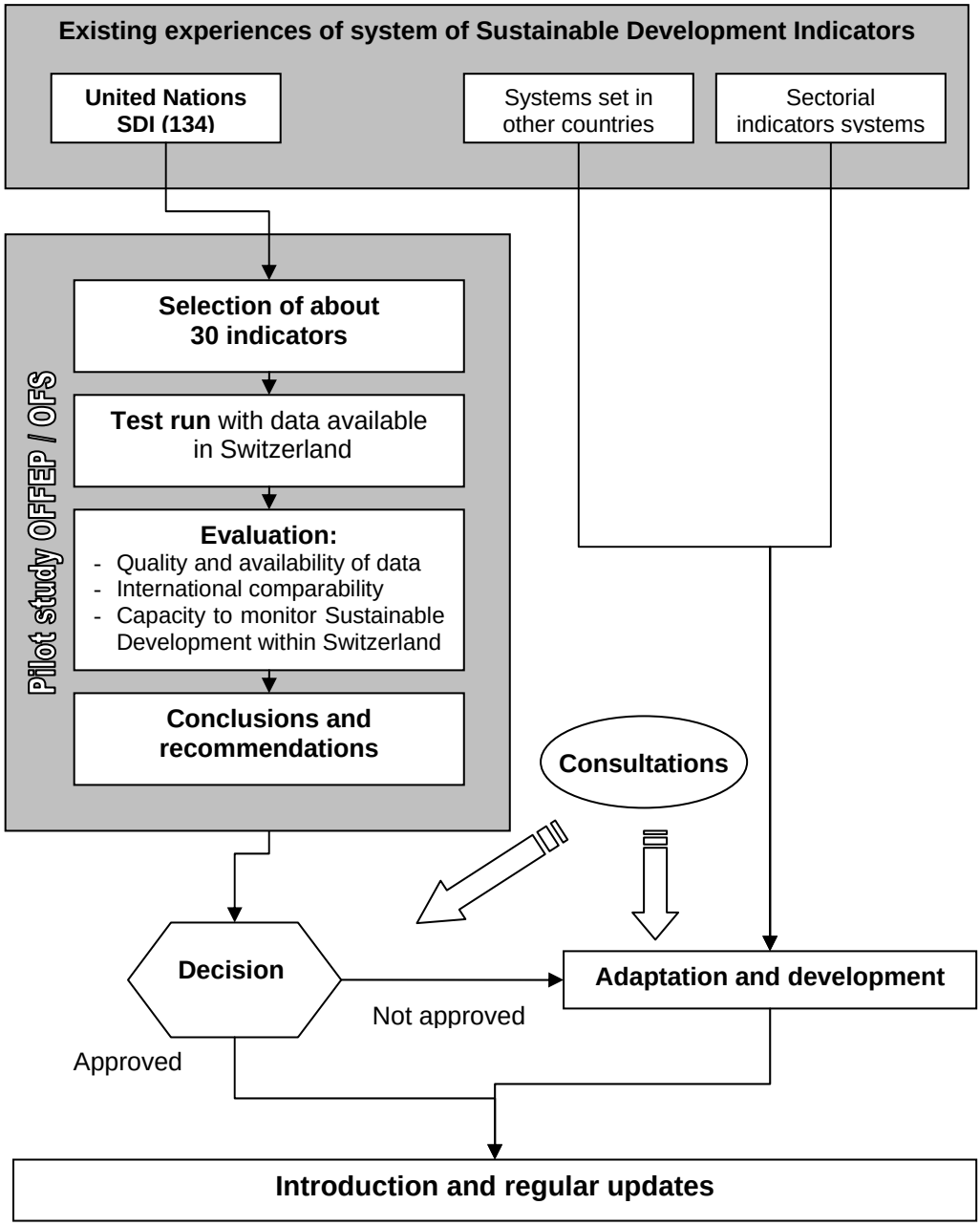
[1] This does not consist as a priority. It is an additional item that could provide a different representation of results provided by the URBANGUARD analytical process.
[2] This has to be evaluated not only in technical terms but also on a legal point of view.
[3] "Monitoring Sustainable Development: Monet – final report, methods and results", D. Altwegg, I. Roth and A. Scheller, 2004, 46pp.



Finally, it is interesting to underline the conclusion of the SUREURO project (Reference 3): *"Sustainability is a process of understanding and acceptance more than a simple implementation of techniques and technology."*

References:

1. Project Gigapolis
2. TRANUS: Integrated Land Use and Transport Model
3. SUREURO: Sustainable Refurbishment Europe
4. Sustainable City: GIS for Urban Development
5. UrbanSIM