Urban Energy Planning: A Fundamental Building Block Towards More Rational Energy Use

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City-University Partnerships:

Best Practices in Urban Sustainability

in Europe and the USA

Washington DC – 2011, January 25th and 26th

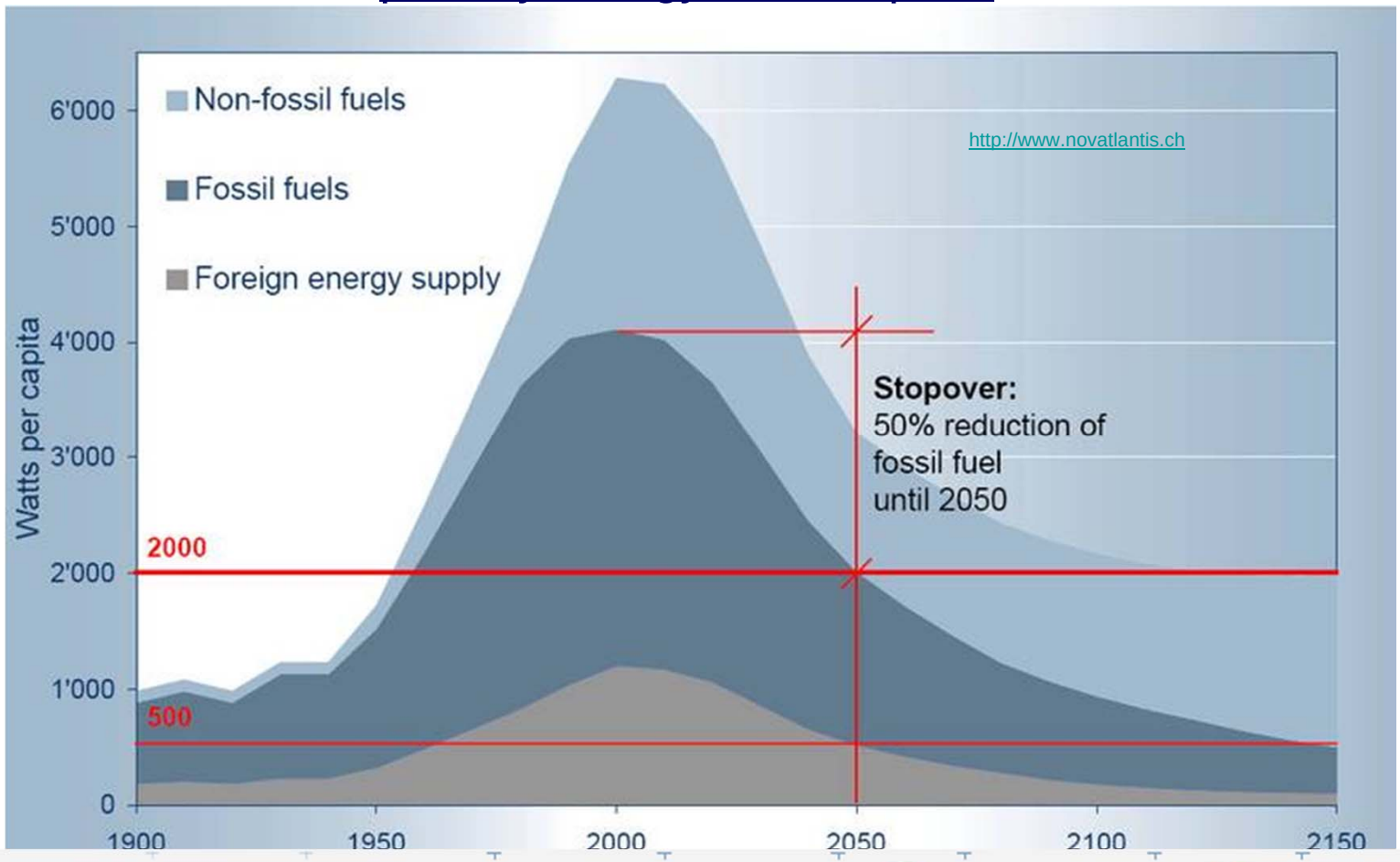
ENERGY IN URBAN AREAS:

1

A MULTI-FACETED PROBLEM

2000 Watts – society vision

Willingness to decrease primary energy consumption



ETH-RAT ETH EPFL PSI EMPA WSL eawag aquatic research ccem.ch cces

This vision as a global objective was adopted by many Swiss municipalities, cantons and the Federal state

Energy in urban areas - 1

- In Switzerland, approximately 70% of the primary energy consumption arises from urban areas, notably at the level of mobility and buildings.
- The population of urban areas is constantly increasing.
- The municipalities represent the closest administrative level to the civil society and have a major role to play in a federal system.

http://www.lausanne.ch

Energy in urban areas - 2

- One possible answer: (new) sustainable neighborhoods

An example (among many others in Switzerland and Europe) :

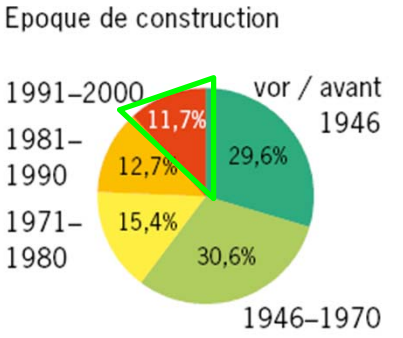
Project “Métamorphose” in

Lausanne

http://www.lausanne.ch/metamorphose

Open questions (at least for Switzerland):

- How to treat the problem of the remaining 90% of existing buildings ?
- Is it possible to avoid gentrification, notably due to higher construction costs ?
- How to perform performance measurements and monitoring ?



SFSO: “Census 2000”, February 2007

Energy in urban areas - 3

- In parallel, it is necessary (and urgent) to put in place programs towards the renovation and energy-wise improvement of existing buildings.

2009 LIBERTÉ ET PATRIE

PCAB – *Programme cantonal d'assainissement énergétique des bâtiments*

http://www.vd.ch/seven

Stiftung Klimarappen
Fondation Centime Climatique
Fondazione Centesimo per il Clima
Climate Cent Foundation

http://www.programmebatiment.ch

- Moreover, alternative energy supply sources forms should be implemented, notably in order to replace direct electric heating and oil-based furnaces

http://www.tridel.ch

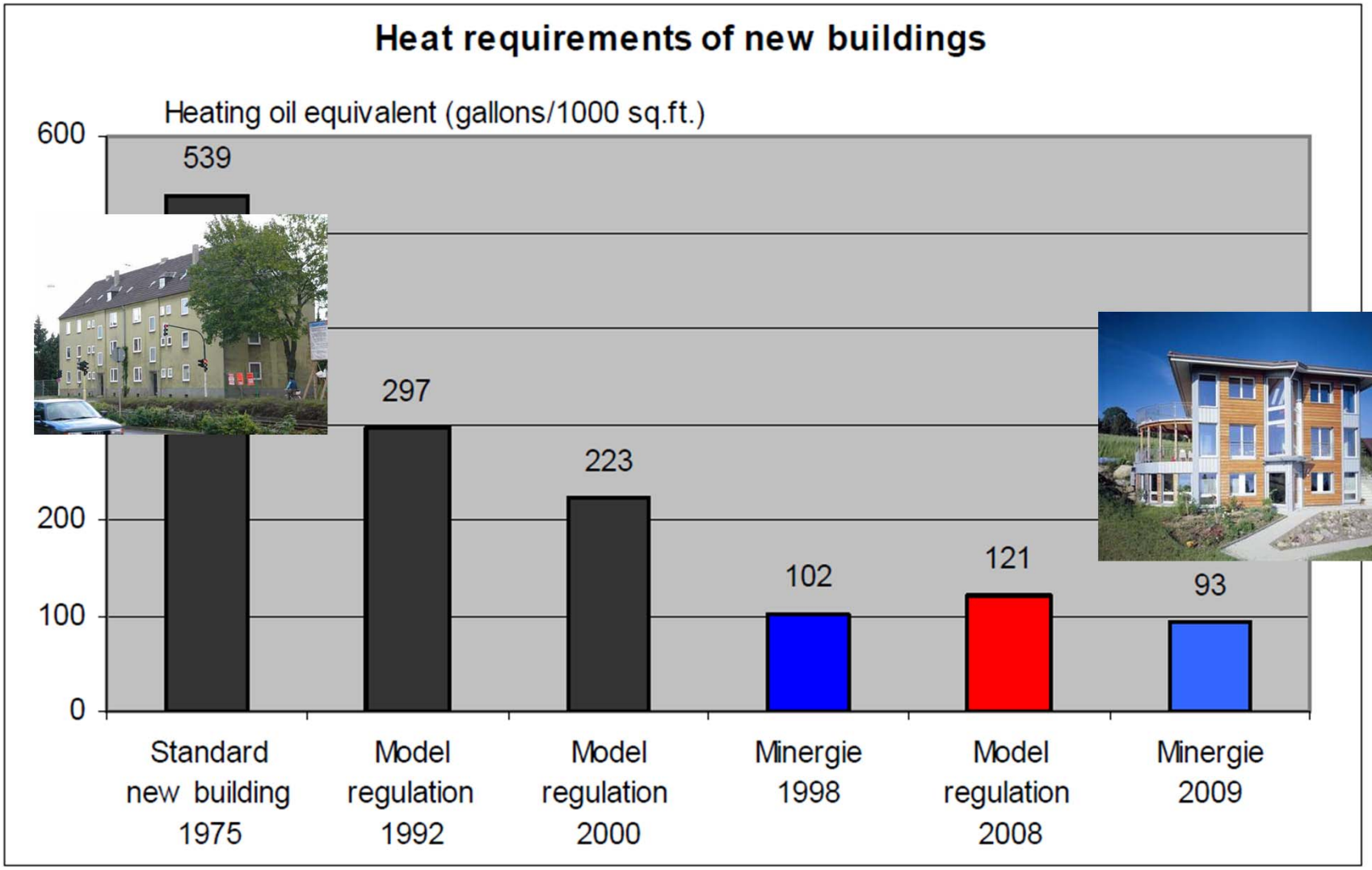
- All these actions, along with the increasingly decentralized and integrated nature of energy production require energy planning and monitoring tools based on:
  - Dynamic and detailed knowledge of the present situation
  - Demographic, economic and technological foreseen evolution

2

BUILDINGS:

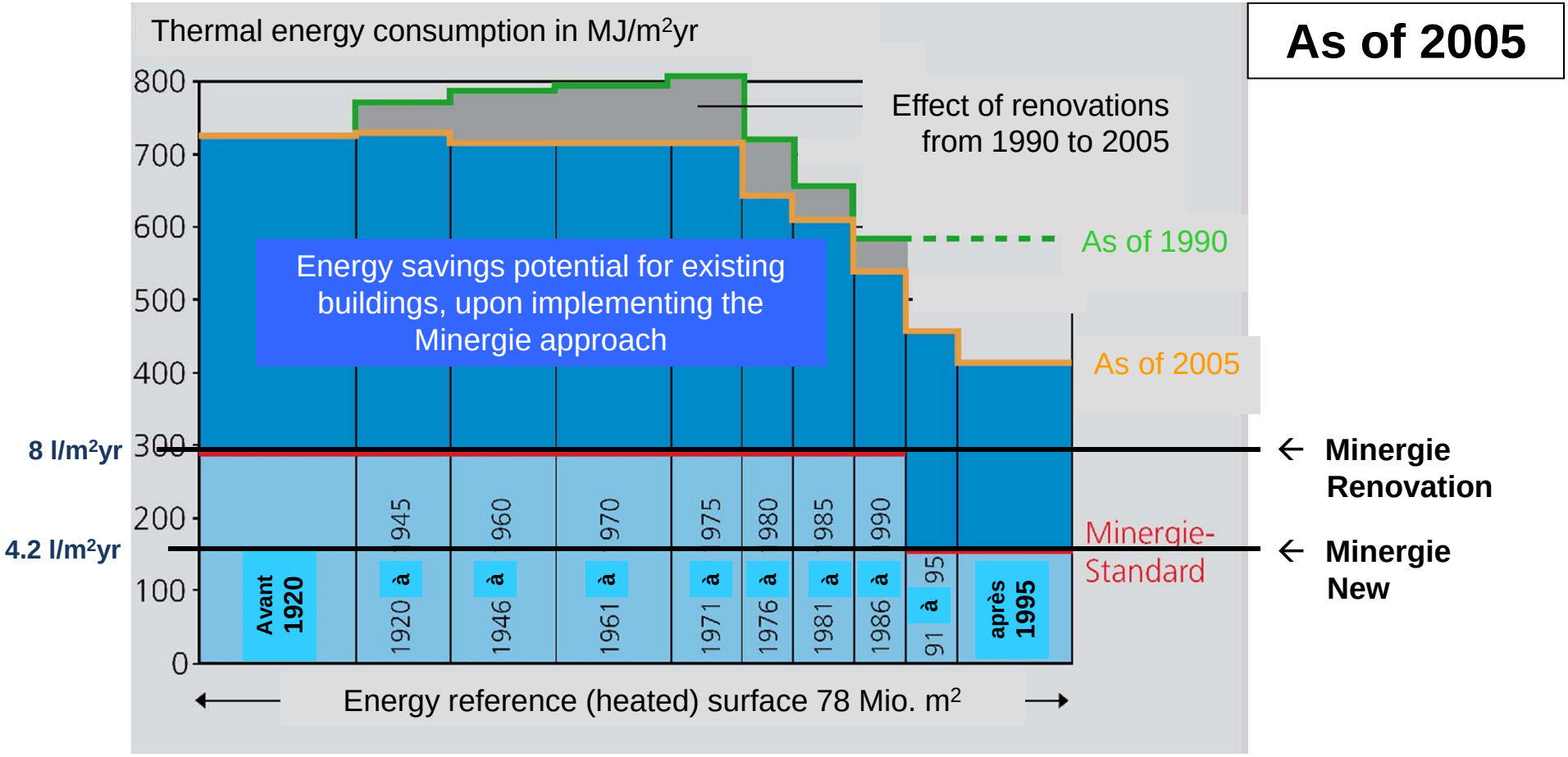
AN ENERGY CHALLENGE

Buildings – Comparing consumptions - 1



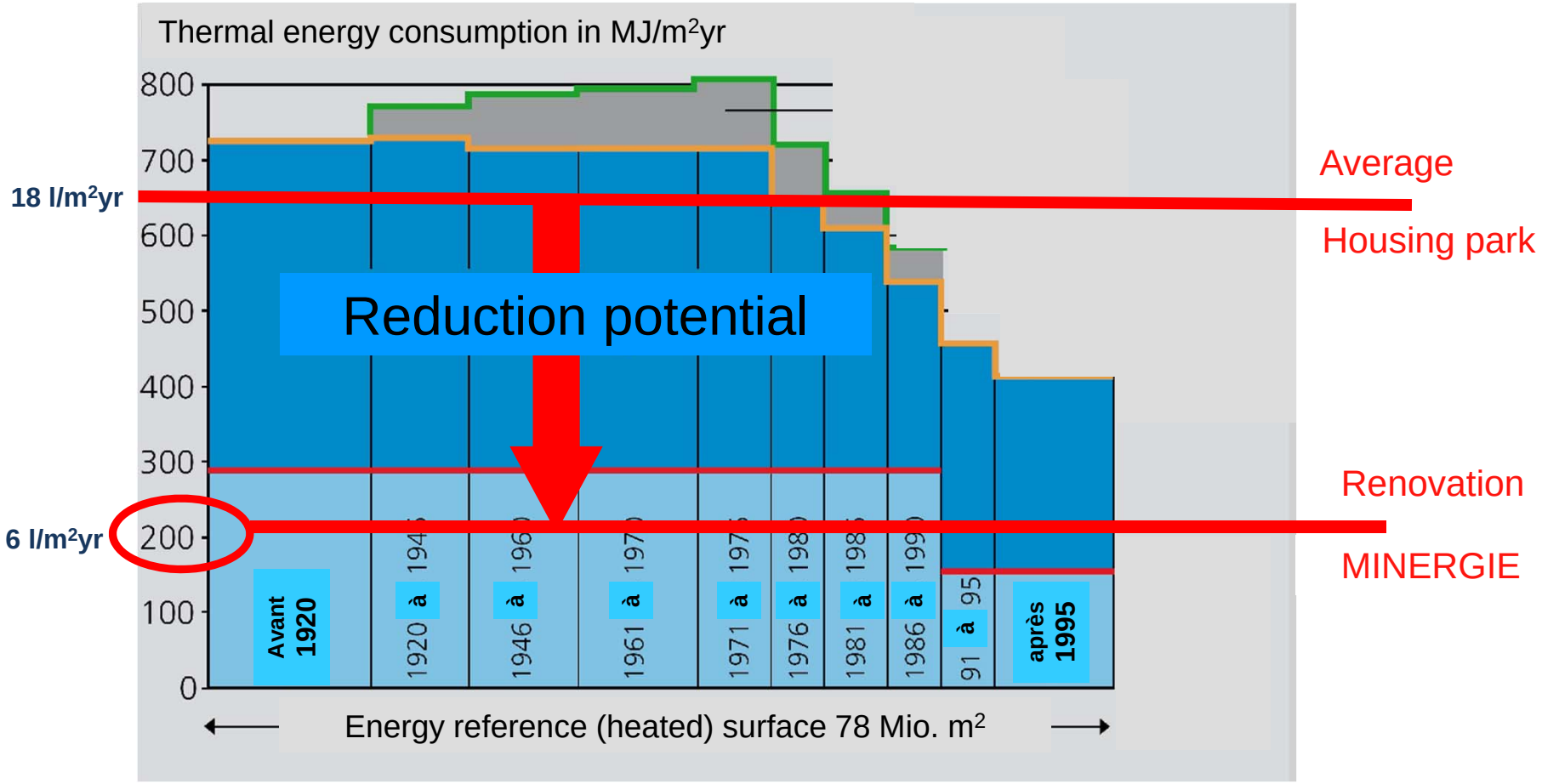
Source: Konferenz Kantonaler Energiedirektoren, 2009: http://www.endk.ch/kantone.html

Buildings – Comparing consumptions - 2



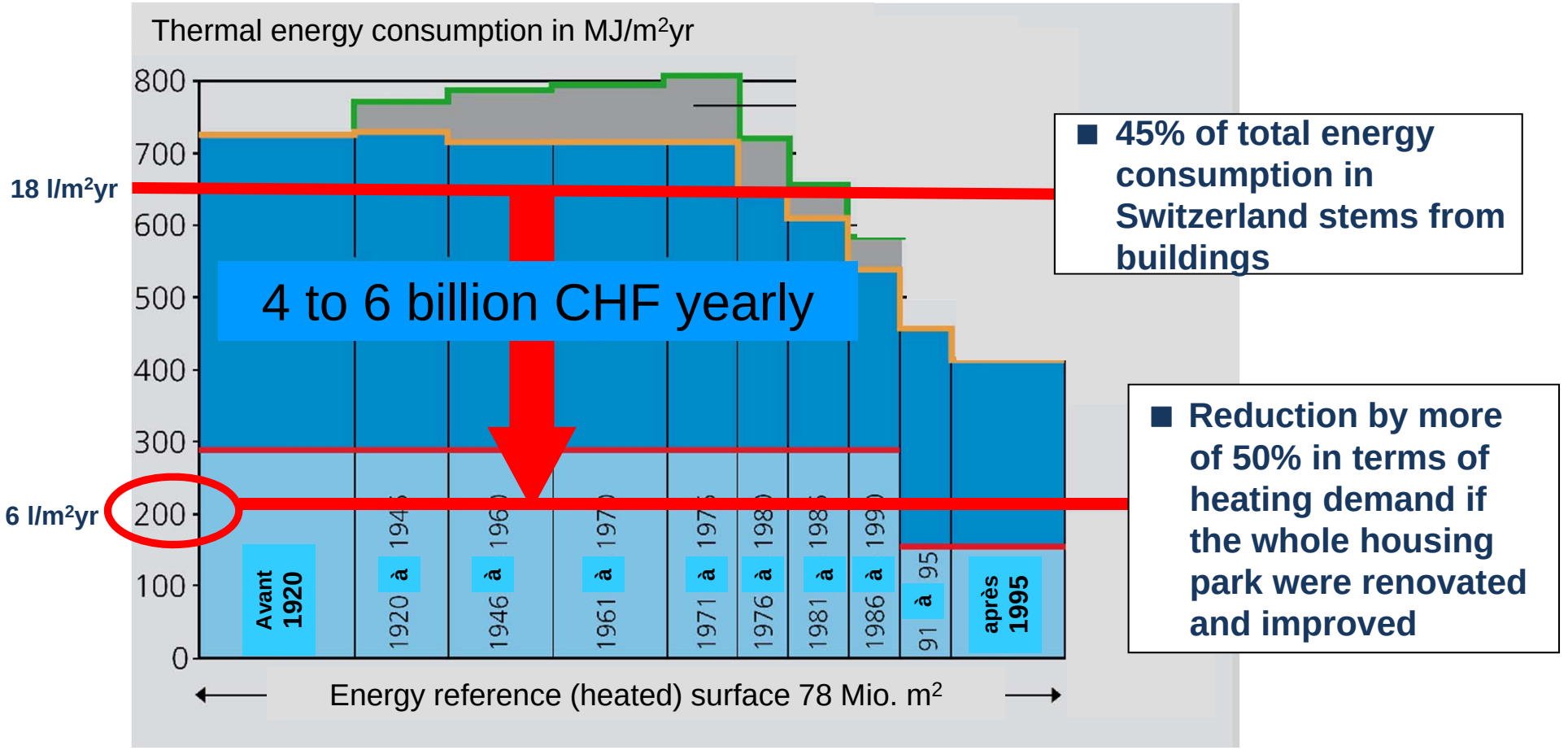
Source : Energy Department of Canton Zürich

Buildings – Energy potential of renovation - 1



Source : Energy Department of Canton Zürich

Buildings – Energy potential of renovation - 2



Source : Energy Department of Canton Zürich

Minergie - 1

MINERGIE building standard :

- Developed in Switzerland (~14'000 buildings already certified)
- Lower energy consumption at a higher level of comfort
- Consumption ~ 60 % less than a conventional building.
- Voluntary approach, supported at the local level

Energy efficiency is attained through an approach which considers a building to be an integral system. Only the amount of energy delivered to the site is relevant. Typical measures include :

- Compact building form
- Air-tight construction of the building shell
- Very good windows with coated double glazing
- Improved thermal insulation for walls and roof
- Heated and unheated parts of the building are always separated
- Controlled airing by means of fan-assisted, balanced ventilation
- Use of renewable forms of energy such as solar energy, wood heating, geothermal heat and waste heat
- Efficient household appliances and lighting

Minergie - 2

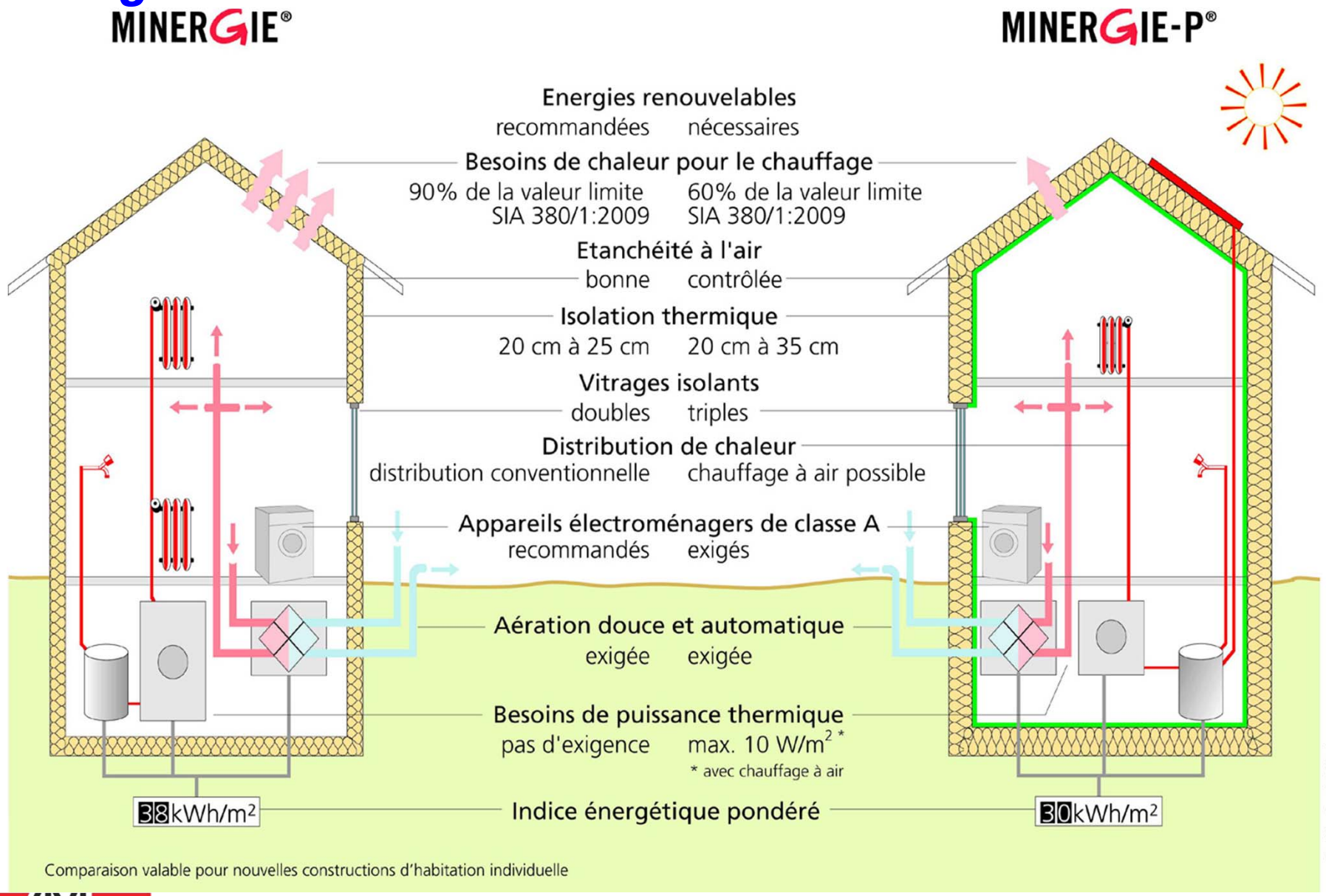
MINERGIE is continually being developed.

- Supplementary MINERGIE-P, MINERGIE-ECO, MINERGIE-P-ECO and MINERGIE RENOVATION standards have been developed since 2007, while MINERGIE standard also evolves.
- MINERGIE-P : energy consumption lower by 20 to 30 percent compared with a normal MINERGIE building.
- MINERGIE RENOVATION is an equivalent standard developed for existing buildings to be renovated/improved energy-wise.

- MINERGIE is designed to be economically competitive: construction costs of new MINERGIE buildings should not be more than 10% higher than the average conventional building.
- High number of buildings certified as MINERGIE -> feasible !
- MINERGIE standard has to be included into the planning from the very start.

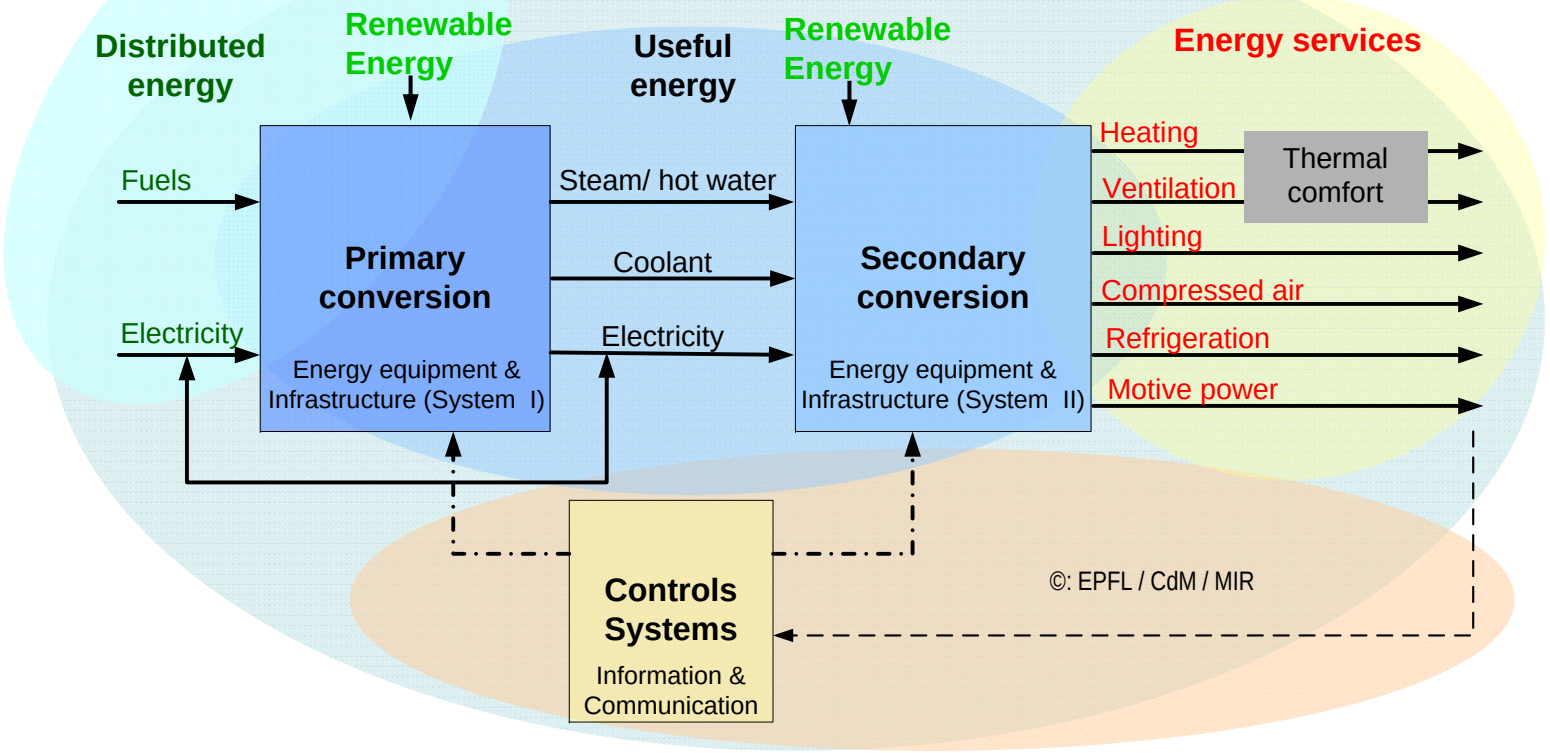
More information at : http://www.minergie.ch

Minergie - 3


MINERGIE®
MINERGIE-P®
Energies renouvelables
recommandées nécessaires
Besoins de chaleur pour le chauffage
90% de la valeur limite SIA 380/1:2009
60% de la valeur limite SIA 380/1:2009
Etanchéité à l'air
bonne contrôlée
Isolation thermique
20 cm à 25 cm 20 cm à 35 cm
Vitrages isolants
doubles triples
Distribution de chaleur
distribution conventionnelle chauffage à air possible
Appareils électroménagers de classe A
recommandés exigés
Aération douce et automatique
exigée exigée
Besoins de puissance thermique
pas d'exigence max. 10 W/m² *
* avec chauffage à air
38 kWh/m²
Indice énergétique pondéré
30 kWh/m²
Comparaison valable pour nouvelles constructions d'habitation individuelle
Grafik: Staubli/OeJ

3 SYSTEMIC APPROACH TO ENERGY IN URBAN AREAS

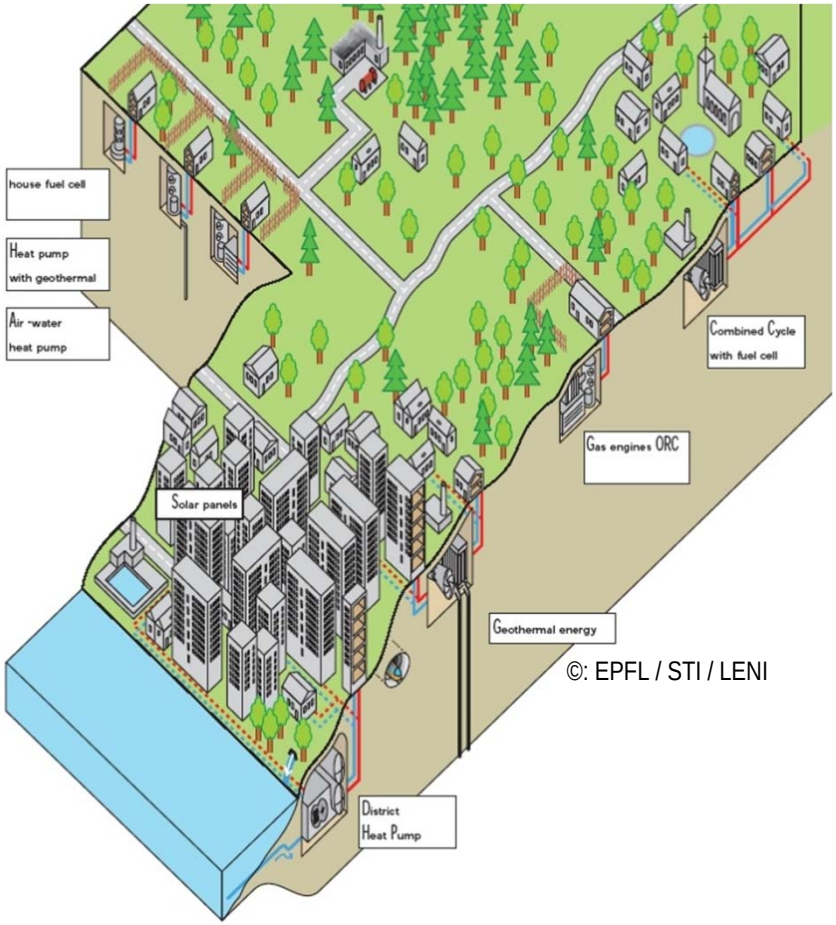
Analysis of the whole energy chain



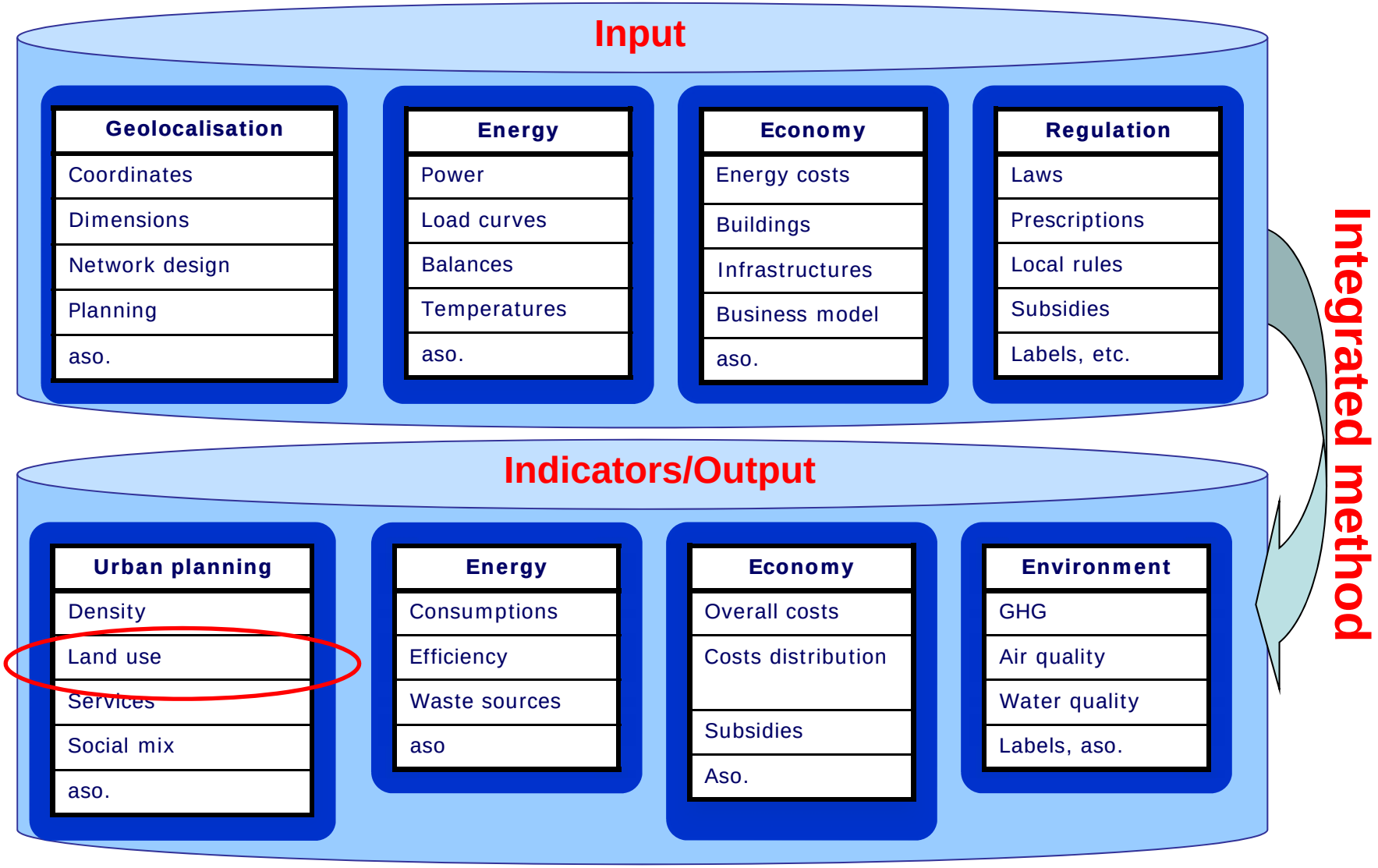
1. **Define and evaluate services :** uses, required power, temperatures, aso.
2. **Define and evaluate resources :** networks, renewables, thermal waste, aso.
3. **Determine technological options and their performances**
4. **Ensure long-term monitoring of results and performances**
5. **Definition of economic and regulatory policies**

Integrated Methodology at the Urban Scale

- Global and systemic approach to the energy supply and demand at the urban and suburban level
- Consider all action means:
  - Construction of new, as well as renovation and improvement of existing buildings
  - Increased use of local energy resources and thermal waste (e.g. industries)
  - Identification of synergies between various supply technologies, as well as developement of energy networks
  - Synergies between customers
  - Information systems: management and monitoring of energy demand/supply
  - Analysis and implementation of new regulatory tools (laws, subsidies, aso.) at all governance levels



Structuring information – Data Model



MEU Project – Three Complementary Approches for both energy demand and supply

- Systemic approach to the multi-energy planning and monitoring of urban zones, based on *demand* + *supply* scenarios
- Bottom-up-style approach, conceived to answer to the needs of municipalities and multi-energy utilities.
- Federating approach of the already existing methods and tools.

http://www.villedemartigny.ch

Development of a decision-aide computer-based tool for the municipalities and the local multi-energy utilities

http://meu.epfl.ch

A Project with and for Towns:

4 Innovative Instruments for Energy Management in Urban Areas (MEU)

MEU project – The partners

Project coordinator

EPFL ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Energy Center

4 Partner Towns

VILLE DE MARTIGNY

Lausanne

Ville de Neuchâtel

LA CHAUX/DE/FONDS
METROPOLE HORLOGERE
UHRENMETROPOLE
METROPOLI OROLOGIAIA
MATCHMAKING METROPOLIS

2 National Entities

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Département fédéral de l'environnement, des transports, de l'énergie et de la communication

Swiss Federal Office for Energy, SFOE

FOGA Swiss gas industry, Research and development fund

5 Laboratories and Research Institutes

Hes·so VALAIS WALLIS

cem

LESO-PB

MIR

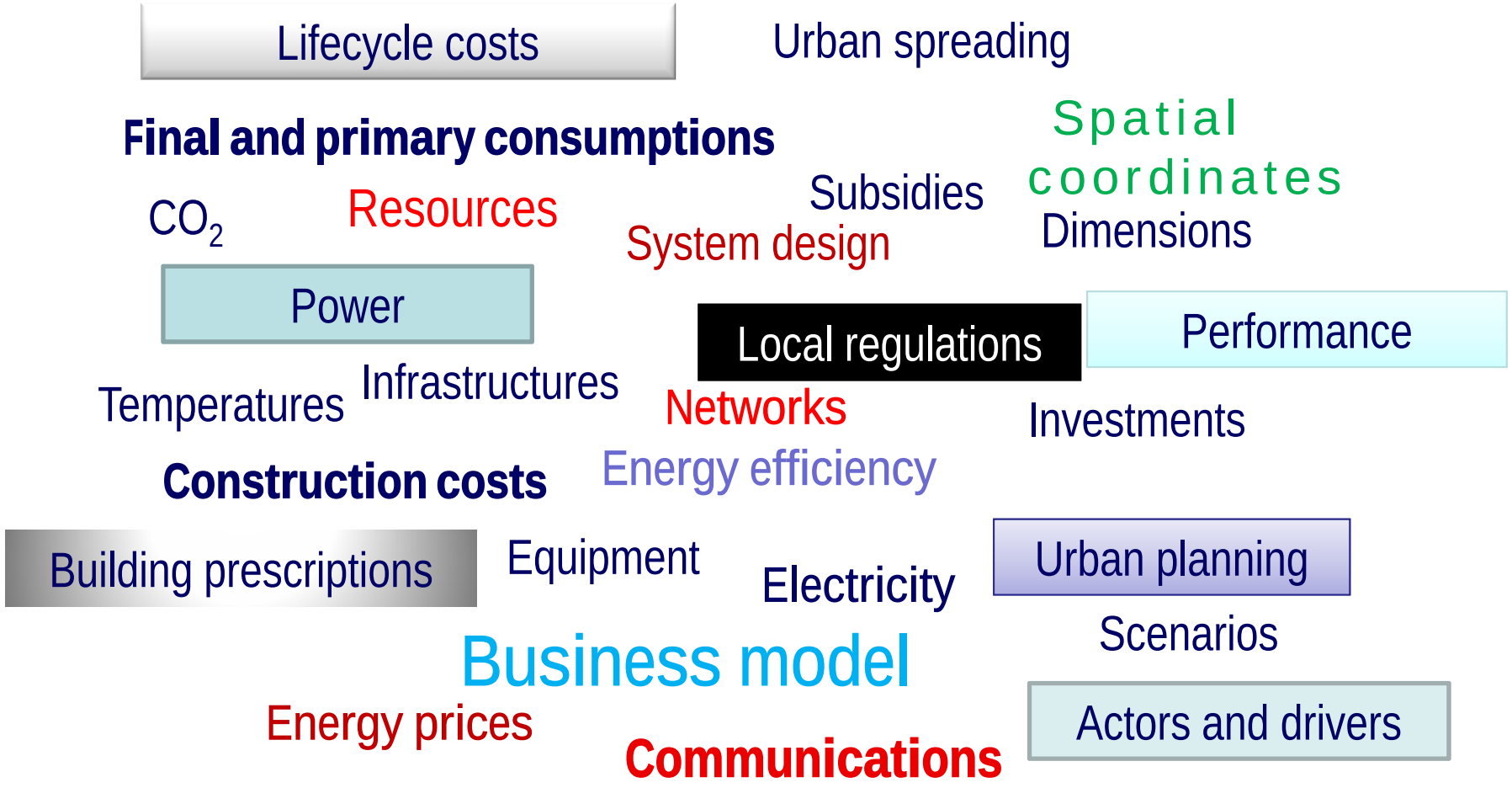
1 GIS Software Company

ESRI

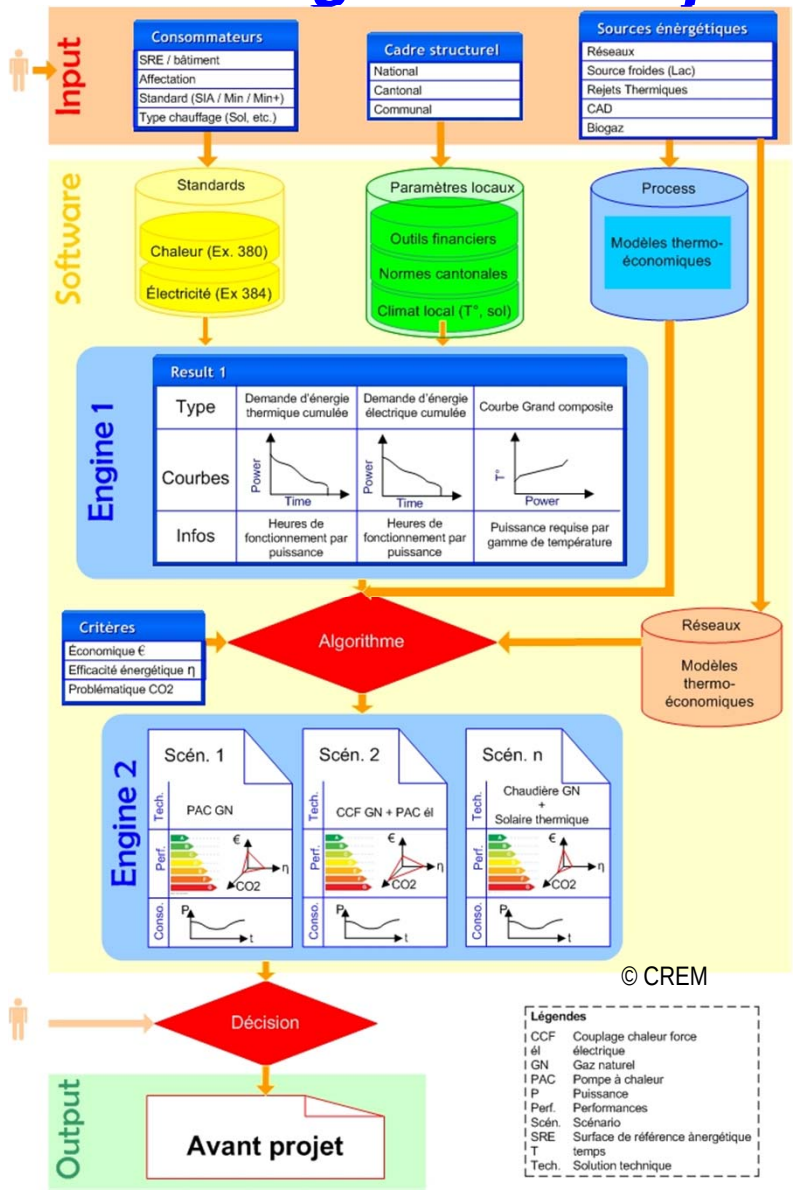
MEU project – Key figures

- Project proposed and headed by the EPFL Energy Center, sous la direction du Prof. Hans Björn Püttgen.
- Duration : 3 years - Beginning : October 2008
- Budget : CHF 650'000 (app. 620'000US$)
- Four partner towns, which are emblematic with regards to energy management in Switzerland (three of them already have the label « European Energy Award Gold ®», the last one is candidate to receive it this year).
- Within the global MEU project, one urban project per year takes place in each of the four partner towns, brought forward by M.Sc. students -> 12 parallel urban projects over 3 years.
- The software development team comprises 7 persons, among which one M.Sc. student and three Ph.D. students.

More and more data to be integrated …

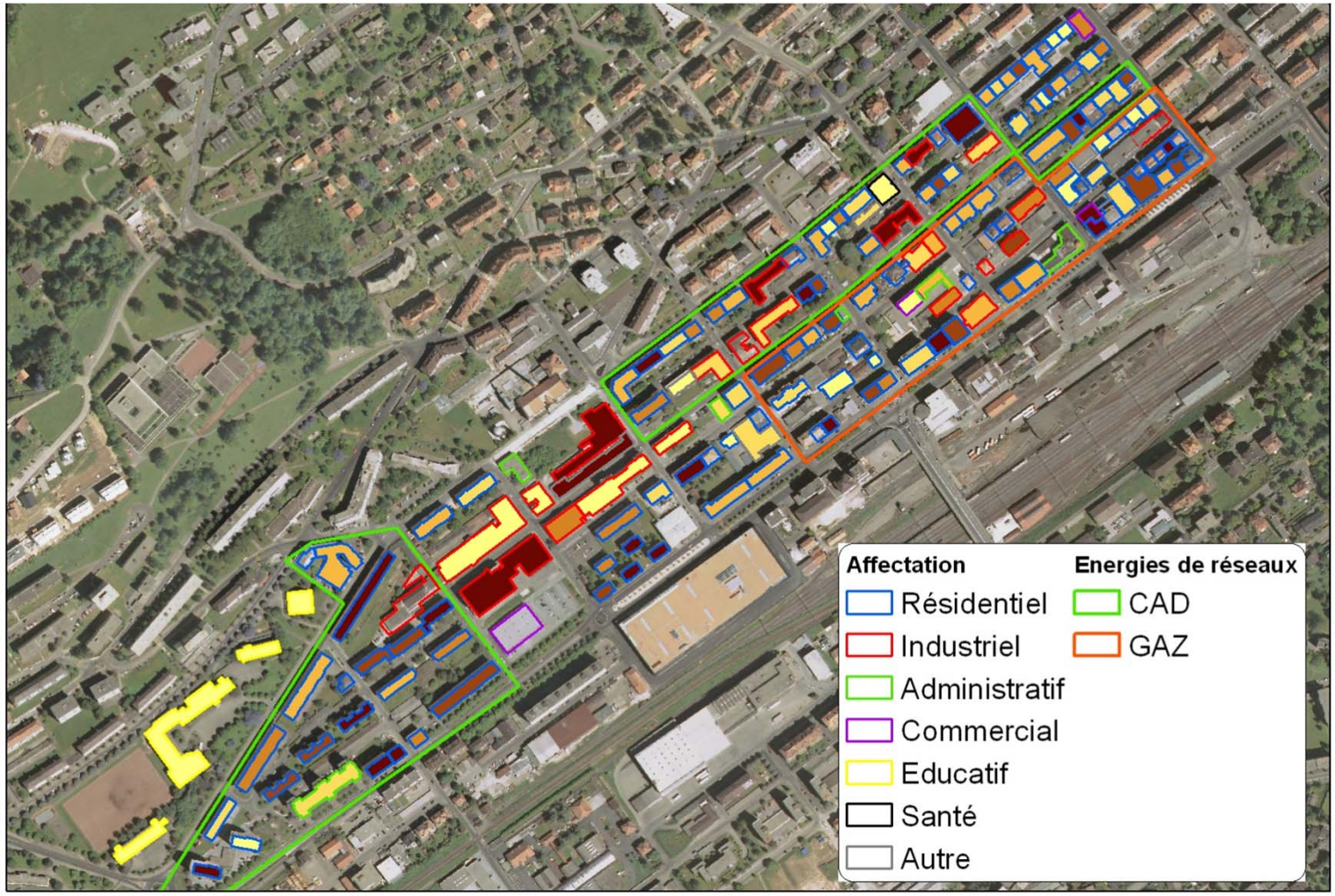


Etablishing and comparing energy scenarios



Test cases

Present energy configuration of an urban zone - Visualization on a cartographic basis



MEU: software system architecture

- The representatives of the partner towns in the project development team have expressed a clear willingness to be able to access the MEU platform directly from a web browser.
  - User-friendly and simplicity of use in the municipality services
  - No need for additional software licences
  - Accessible from any computer connected to the Web
- As a result: an innovative, albeit efficient and robust, architecture has been built and is currently being programmed
  - Architecture based on web services
  - On-line GIS
  - Multimedia and interactive technologies (Flash, Javascript, Silverlight, etc.) which allow to increase the functionalities and the content of standard web browsers.

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