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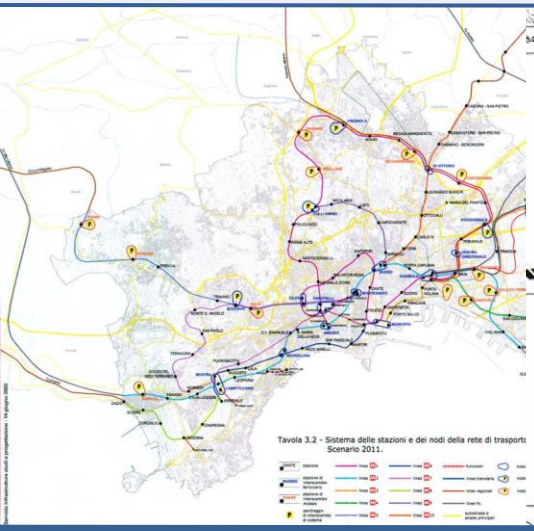

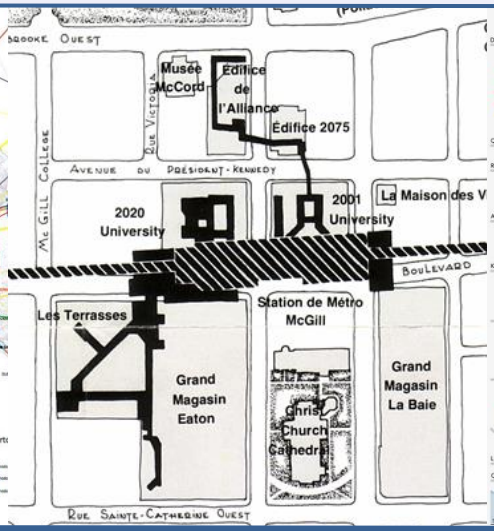

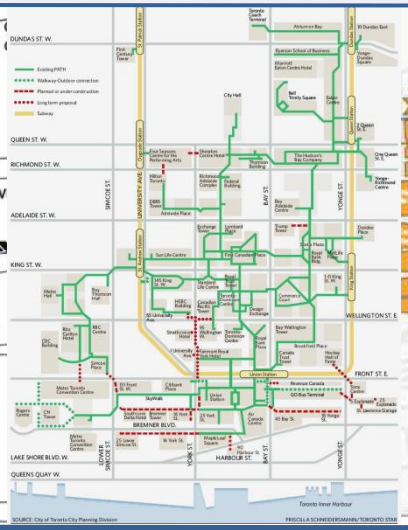

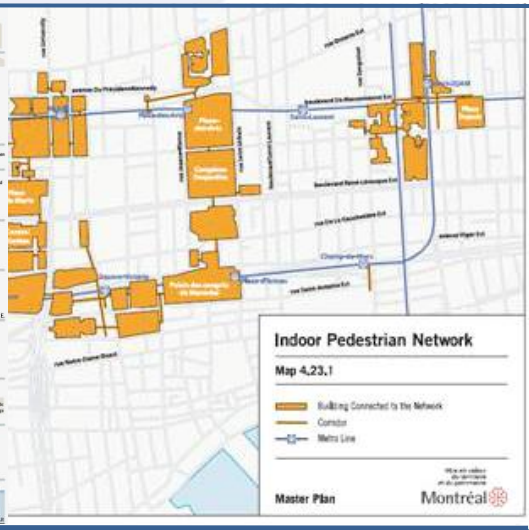

Advanced Local Energy Planning and underground Space utilizations: suitable and feasible solutions for future sustainable and resilient cities

Delmastro C., Schranz L.

LAME Lab.
DENERG- Politecnico di Torino

The City We Need: Urban Lab Session
Caserta, 15-18 October 2014

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Advanced Local Energy Planning and underground Space utilizations:

suitable and feasible solutions for future sustainable and resilient cities

In 2050, it is expected that more than two-third of global population will be living in cities. The expansion of urban areas together with the growing expectations for better quality services/infrastructures will drive demand for ***smart city solutions***. Energy planning is an effective solution towards these goals. For a municipality, an ***Advanced Local Energy Planning*** approach is able to assess, in a mid-long term, the optimum mix of measures for minimizing energy consumptions/environmental impacts/ economical expenses by analyzing meaningful scenarios.
For better representing the local situation, both ***above and under ground space*** must be considered. Constructions in underground have a central role in the development of the city structure. The covered topics are:

- Underground Space as a Resource for Metropolitan Areas
- Integrated Master Plans for Above- and Under-Ground
- Local Energy Planning for Low-Carbon Cities
- Energy - Buildings - Urban Forms

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Agenda

1. Introduction & Agenda (5 min)
2. LAME, ACUUS & MoU Presentation (10 min)
3. Main topics (80 min):
    1. **Underground Space as a Resource for Metropolitan Areas (15 min)**
    3. **Integrate Master Plans for Above/Under ground (15 min)**

    Questions and debate (10 min)

    2. **Local Energy Planning for Low-Carbon Cities (15 min)**
    4. **Energy - Buildings-Urban Form (15 min)**

    Questions and debate (10 min)
4. The city we need inputs (15 min)

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LAME : Energy Analysis and Modelling Laboratory

LAME is a research group working in the **DENERG** (Energy Department) of Politecnico di Torino.

It represents the reference laboratory for "***models and scenarios for energy planning and for energy systems analysis***". It promotes academic and research co-operations in both local and international frameworks.

The main research fields of the Lab are:

- technological, economic and environmental analysis of *integrated energy systems*
- the development and use of *simulation and dynamic models*
- the development of methodologies and databases to:
  - draft Environmental and *Energy Territorial Plans*
  - perform energy cycles evaluations
- perform *LCA* in the field of the energy technologies
- develop and use *GIS (2D and 3D)* applications in the urban context

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- What is ACUUS?
- The MoU
- US as a resource for metropolitan areas
  - Awareness of the UNDERGROUND SPACE
  - US a resource for METROPOLITAN AREAS
  - UG for PEOPLE
  - UG for UTILITIES, STORAGE & ENERGY
  - UG for INFRASTRUCTURE AND TRANSPORTATION
- Integrated MASTER PLANS (above & under ground)

Open discussion

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What is ACUUS?

Associated Research Centers for the Urban Underground Space

ACUUS is an international, non-governmental organization dedicated to partnerships amongst experts who design, analyze and decide upon the use of our cities' underground spaces

ACUUS was formally established in the fall of 1996 at Sendai (Japan) whith members from Canada, France, Japan, United States and Canada.

The ACUUS secretariat has been inaugurated in October 1997 in Montreal, at the end of the 7th International Conference "Underground Space: Indoor Cities of Tomorrow".

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What is ACUUS?

Mission

Promoting international exchange among the world community of planners, architects, geo-engineers, lawyers, builders and investors, scholars and researchers, decision-makers, stakeholders, public (government) and private agencies, and other professionals involved or having the interest in the urban underground space.

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What is ACUUS?

Objectives

- to facilitate the exchange and the expert knowledge worldwide the urban underground;
- to raise the awareness of the private sector, the governments at all levels and the general public on the specific issues related to the sustainable use of the urban underground;
- to provide support and services to members of national organizations and research centers conducting similar activities.
- Independent and Financed only by our members

An international 'Think Thank' for the underground space

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What is ACUUS?

Activities

- International biennial conferences;
- Academic and professional exchange;
- Consultation on the issues of urban underground development;
- Support to initiatives aiming at expanding and enhancing the public use of the urban indoor and underground networks;
- Support to members and associated organizations.

Institutional & Individual Members (from 15 countries)

Australia, Canada, China, France, Greece, India, Iran, Italy, Japan, Korea, Russia, Singapore, Sweden, Switzerland, USA

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What is ACUUS?

Activities

- Coordination, planning and/or organization of international events: biennial conferences, exhibitions, competitions and others;
- Organization of academic and professional exchange on UG;Consultation on the issues of urban UG development and identification of critical issues of local, urban and regional importance and appropriate solutions;
- Support to the initiatives aiming at expanding and enhancing the public use of the urban indoor and UG networks (tourism, community gatherings sports, or others);
- Promotion of strategies and actions for the integrated planning and management of the urban UGS;
- Support to members and associated organizations

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What is ACUUS?

Past Conferences

1983	Sydney (Australia)	1st	Energy efficient buildings with earth shelter protection
1986	Minneapolis (USA)	2nd	Advances in geotectural design (earth shelters)
1988	Shanghai (China)	3rd	New developments of underground space use
1991	Tokyo (Japan)	4th	Urban underground utilization
1992	Delft (Netherlands)	5th	Underground space and earth sheltered structures
1995	Paris (France)	6th	Underground space and underground planning
1997	Montreal (Canada)	7th	Underground space: Indoor cities of tomorrow
1999	Xian (China)	8th	Agenda and Prospect for the turn of the Century
2002	Torino (Italy)	9th	The Underground Space: a Resource for the Cities
2005	Moscow (Russia)	10th	Underground Space: Economy and Environment
2007	Athens (Greece)	11th	Underground Space: Expanding the frontiers
2009	Shenzhen (China)	12th	Underground of Cities: For a Sustainable Urban Environment
2012 and 2014	Singapore Seoul (Korea)	13th 14th	Underground Space Development – Opportunities Challenges Underground Space: Planning, Administration and Design Challenges
2016	St-Petersburg (Russia)	15th	Underground construction for sustainable development of the cities

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What is ACUUS?

Issues that ACUUS can address

- Advantages and costs of UG space development
- Legal issues in terms of subsurface property rights
- Impact of the UG development on the overall urban context and the value and the planning of future overbuild
- Protection of the archaeological heritage
- Mapping, presentation and 3D modeling of the urban UG
- Design and construction methods/techniques of UG expansion
- Psychological and social effects and impacts of the UG space use
- Measures of assessing wellbeing of people using the UG space
- Protection of the existing urban UG space from the effects of global warming, and planning for the future urban underground space use to minimize their impacts

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What is ACUUS?

Board 2013-2015

Americas region:
Mrs. Sanja ZLATANIC (USA), Prof. John Zacharias (Canada)
Asia and Oceania region:
Mr. Takayuki KISHII (Japan) , Prof. YUAN Si (China), Prof. ZHOU Yingxin (Singapore)
Europe region:
Mr. Sergei ALPATOV (Russia) , Prof. Dimitris KALIAMPAKOS (Greece) , Prof. Evasio LAVAGNO (Italy)
Invited Director (organizer of the next Conference) Prof. RHIM Hong Chul and Mr. Jacques Besner, General Manager, (Canada)

ACUUS Secretariat: 34 Seville, Dollard-des-Ormeaux (Quebec), CANADA H9B 2S5
Att.: Jacques Besner, General manager; info@acuus.org
www.acuus.org

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The MoU

MEMORANDUM of UNDERSTANDING

between

THE UNITED NATIONS HUMAN SETTLEMENTS PROGRAMME

and

THE ASSOCIATED RESEARCH CENTERS FOR THE URBAN UNDERGROUND SPACE
to

RAISE AWARENESS OF THE SUSTAINABLE USE OF UNDERGROUND SPACE FOR URBAN DEVELOPMENT

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The MoU

Scope and Purpose

Article I

to facilitate cooperation to raise awareness of best practices of the sustainable uses of underground space for urban development (urban drainage management, city planning, and sustainable mobility solutions).

The target audience are:

decision-makers, local authorities as well as UN-Habitat staff working towards promoting socially and environmentally sustainable towns and cities with the goal of facilitating adequate shelter and urban basic services for all;

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The MoU

Specific Responsabilities the Parties

Subject to Article II, 5
The specific responsabilities of UN-Habitat are:
Consult ACUUS on issue related to policies, best practices, lessons learned, strategic consulting or technical advisory on matters of Urban U Space;
Information excange with ACUUS about new and evolving knowledge on urban UG space development;
Promote the development and use of UG space cities, particular for urban drainage and water management, mobility and energy solutions, within the United Nations' policies and programmes.

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The MoU

Specific Responsabilities the Parties

Subject to Article II, 5
The specific responsabilities of ACUUS are:
Participate by invitation at relevant UN-Habitat meetings and contribute to the debate and output concerning UG space for adequate urban drainage management, city planning, energy issues, and sustainable mobility solutions;
Co-operate and consult when possible with UN-Habitat on urban issues concerning urban UG space development in terms of best practices;
Provide the required technical assistance and advice to Un-Habitat on sustainable development of urban UG space.

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Underground Space

Interest areas

Infrastructure for traffic and transport (tunnels for trains, cars, parking, bicycles and pedestrians)

Infrastructure for utilities and communications (electricity, water, natural gas, sewers, telephone)

Underground storage of materials (oil or natural gas, industrial materials and waste)

Subsurface buildings (industry, commerce, working and recreational purposes)

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Awareness of the US

unhealthy living conditions in cities

Ebenezer Howard (1898)
a visionary plan – the Garden City: "overcrowded big cities are condemned"

Eugène Hénard (~1900)
denounces the anarchic congestion of the underground

Frank Lloyd Wright (~1930): dreams to replace traditional cities with low-densi boroughs linked by highways

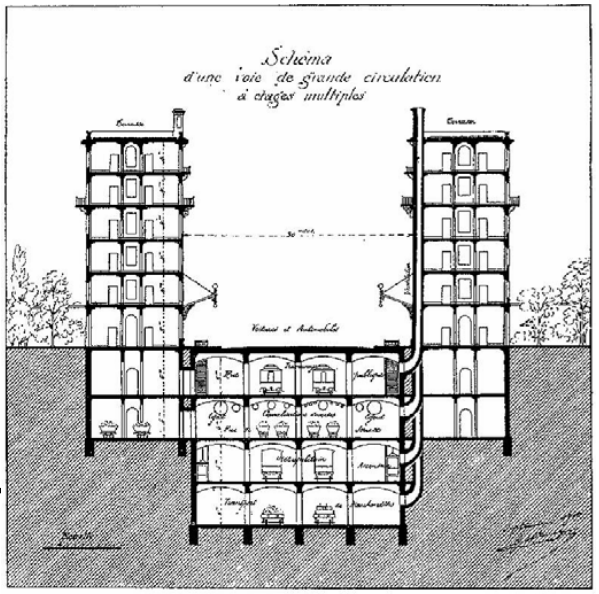

Fig. 3.

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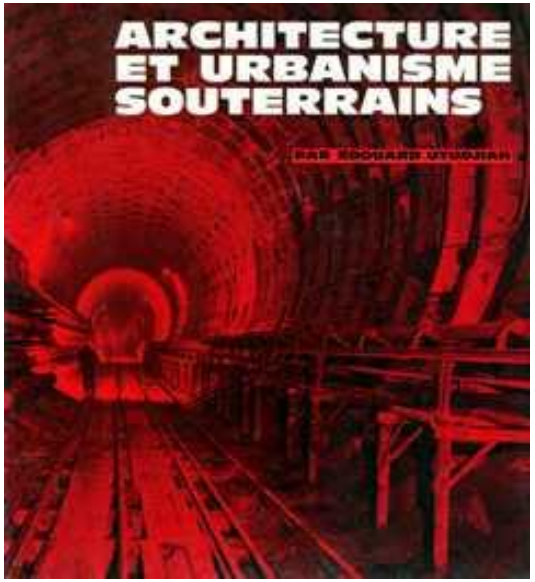
Awareness of the US

unhealthy living conditions in cities

Edouard Utudjian (~1933): birth of the underground space planning & promotion of an underground space better usage (GECUS - Groupe d'Etude et de Coordination de l'Urbanisme Souterrain)

Le Corbusier (~1947): 'Radiant City' favouring high-rise geometric blocks in open parkland



Howard, Wright, Le Corbusier,...: more green spaces (outside cities) and segregation of human functions

Hénard and Utidjian: vertical segregation of the urban functions

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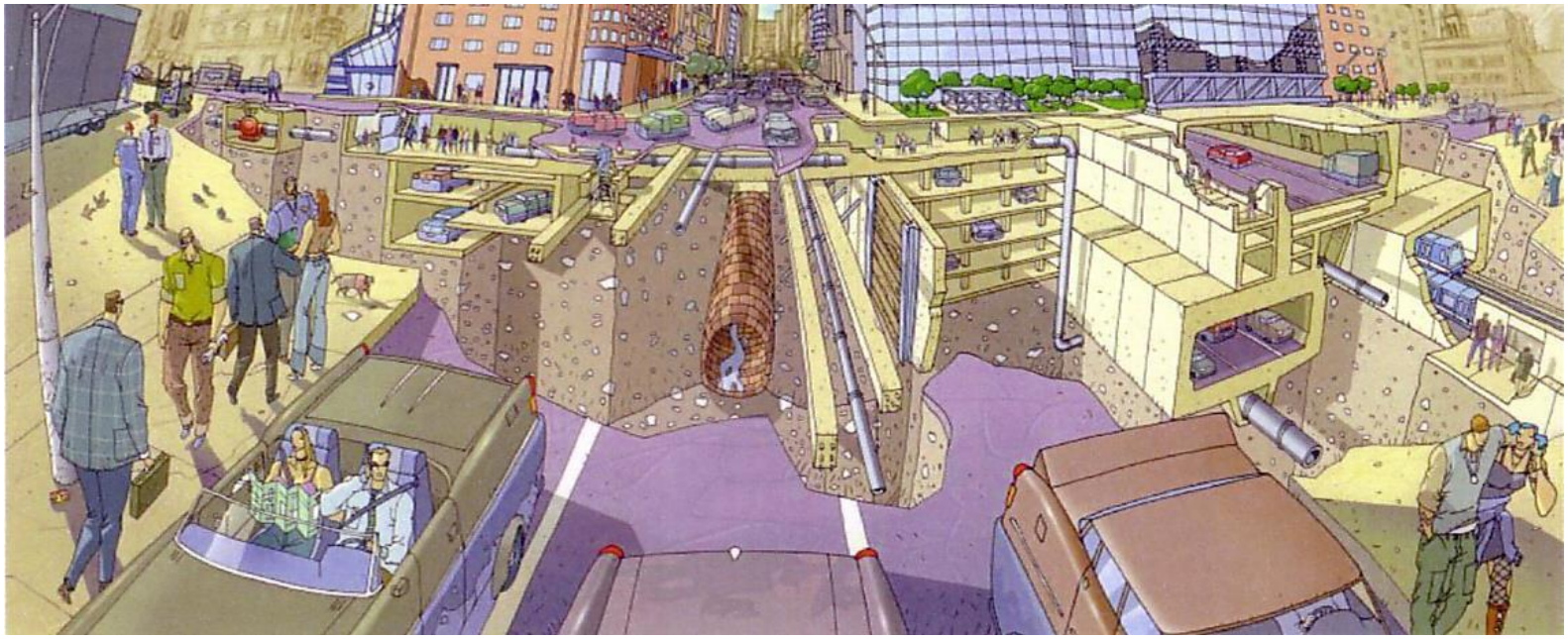
Awareness of the US

unhealthy living conditions in cities

The underground space is not a renewable resource and its use should be made in a sustainable manner



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Awareness of the US

unhealthy living conditions in cities

BUT
the urban underground space is …

- **Not so well known (lack of accurate and updated information)**
- **Often poorly perceived by the population (safety, disorientation,…)**
- **Generally undervalued (not visible)**

And too often …poorly planned and regulated

Awareness of the US

Main interest areas for using the US

For people:

Industry, commerce, parking, public and recreational purposes (often in building basements, sometime in man-made caverns)

For infrastructure, storage and facilities:

Infrastructure for traffic and transport (tunnels for trains, cars, pedestrians,…)

Infrastructure for public utilities, energy and communications, military,… (electricity, water storage & treatment, natural gas, sewers, telephone)

Underground storage of materials (oil, industrial materials, waste, …)

Research & development industry, laboratories, data centers

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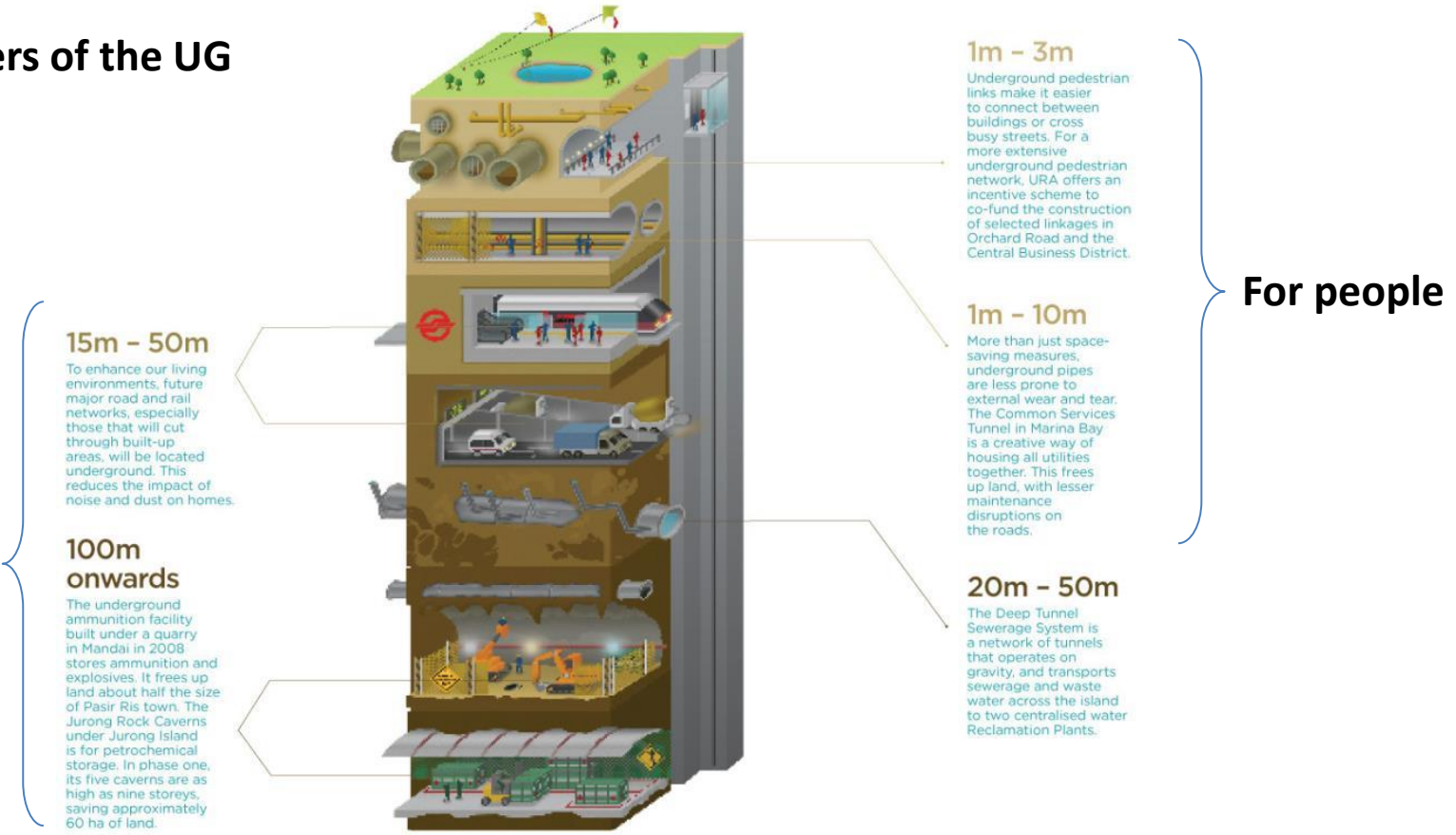
Awareness of the US

Main interest areas for using the US

The layers of the UG



For people

For infrastructure, storage and facilities

Source: URA, Singapore

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Awareness of the US

Advantages / disadvantages of going in the underground

advantages	disadvantages
Limited visual impact;	Limited view and natural light;
Preservation of surface open space;	Access and circulation limitations;
Efficient land use (compact city);	Limited visibility inside tunnels/corridors;
Efficient transportation;	Negative psychological reactions;
Constant temperature;	Site restrictions (geology);
Energy use reduction;	Water (aquifer) problems;
Protection from natural disasters;	Increased structural requirements;
Civil defence & security;	Energy-related limitations;
Isolation from noise and vibration;	Increased construction cost
Lower maintenance requirements	Harder advance estimation of costs (contingencies during construction).
Higher durability (longer life).	

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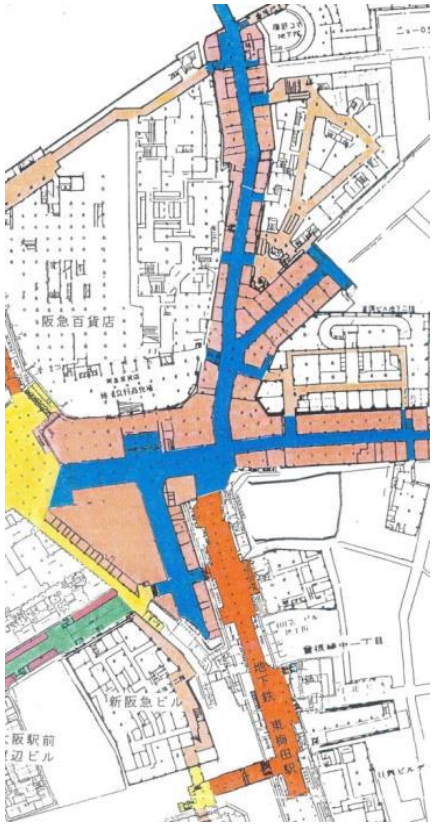
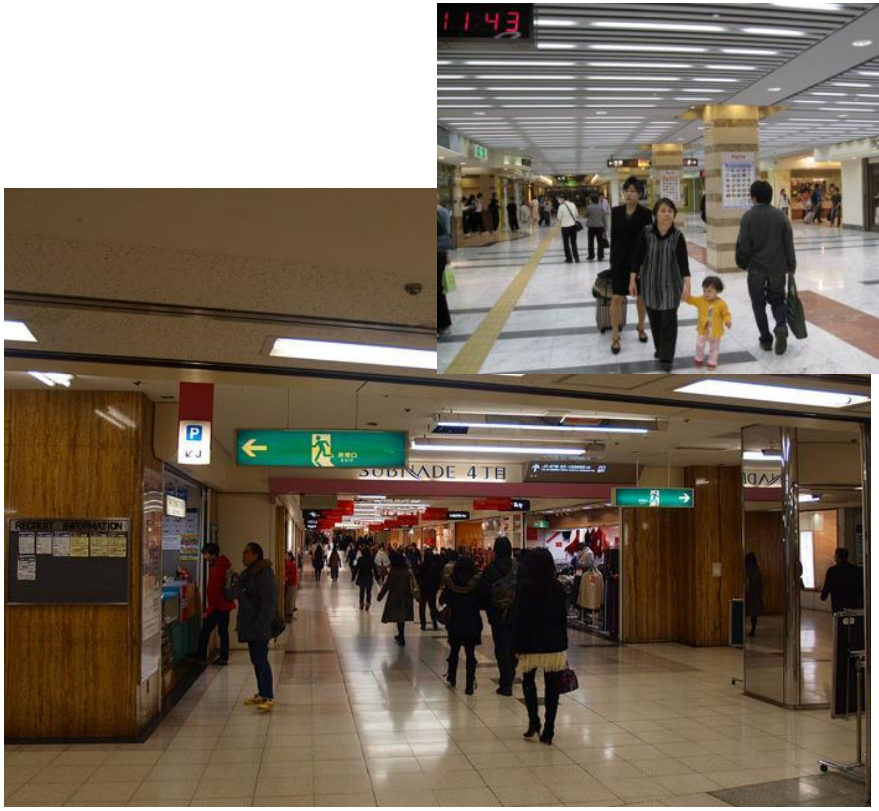
Examples

Osaka



Tokyo



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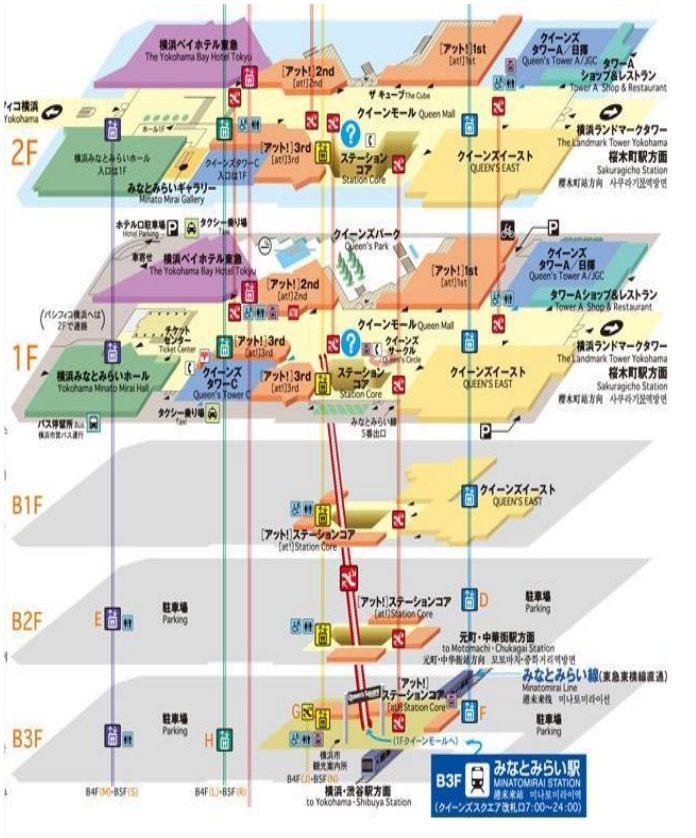
Examples

Yokohama



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Examples

Seoul

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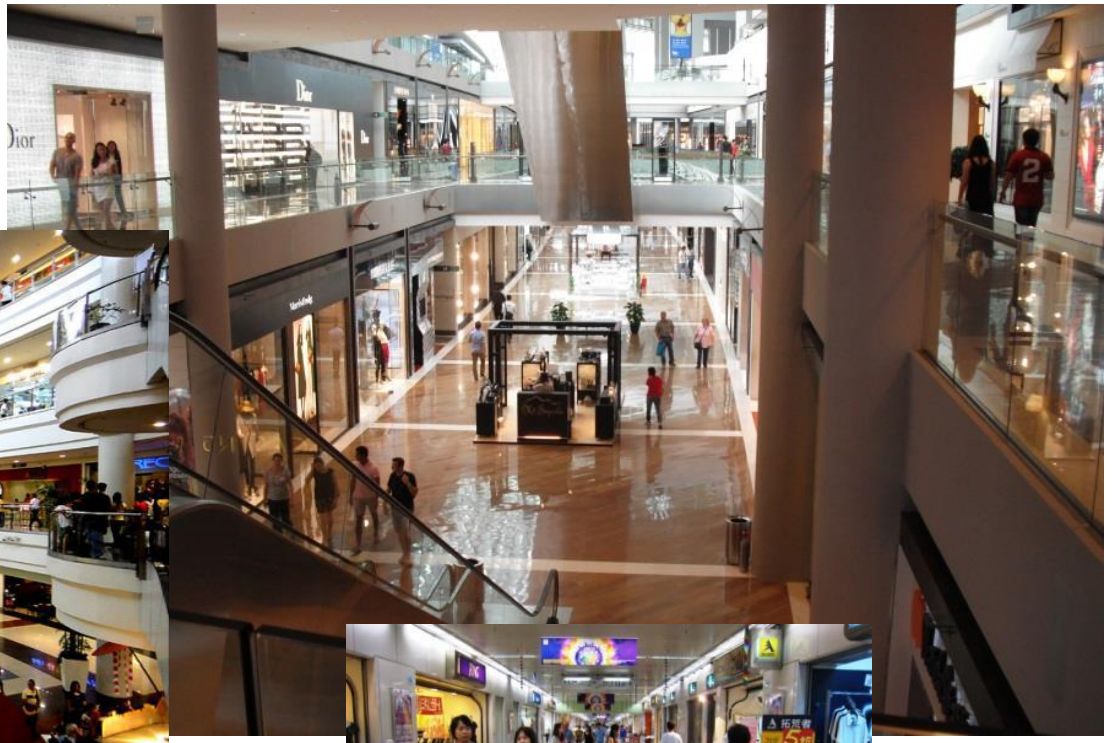
Examples

Manila



Taipeh

Singapore

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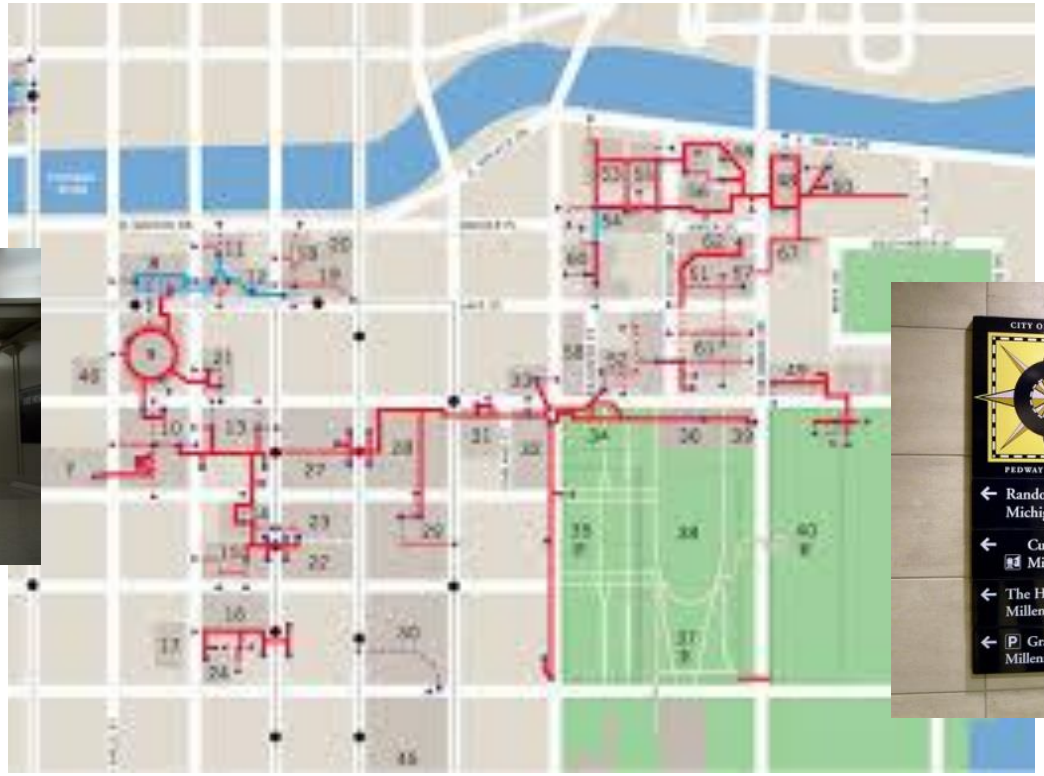
Examples

Chicago (Pedway)



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Examples

Helsinki

Underground swimming pool in Itäkeskus

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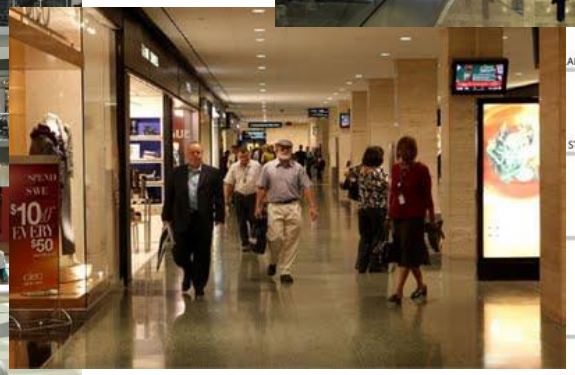
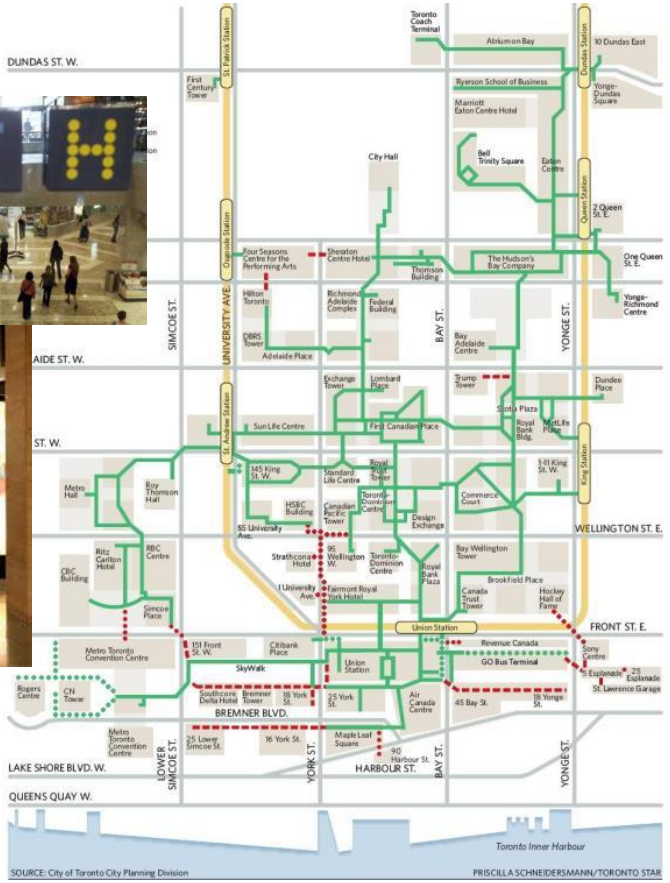


Toronto



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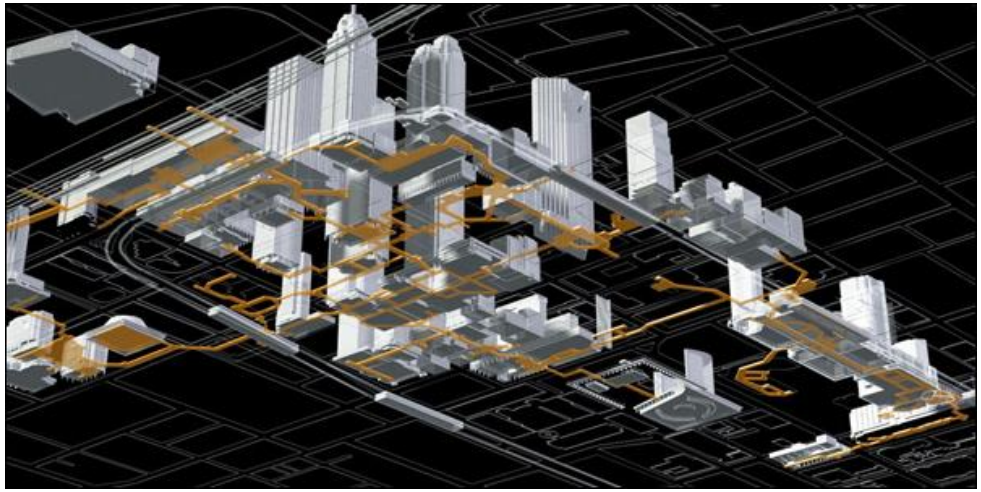
Examples

Two different realities, in term of scale and complexity:

- **Stand-alone realizations (ex.: traditional commercial malls),**
- **Indoor pedestrian networks (buildings connected to the downtown above, linked to subway stations, with corridors opened at the same hours than the subway).**



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Indoor pedestrian networks

Montreal (Underground city or RESO)

An Indoor Pedestrian Network of 32 km (started in 1962, one of the largest in the world)

10 subway stations
2 railway stations & 2 regional buses terminals
more than 62 linked buildings,
indoor public places and commercial galleria
representing more than 4.0 millions m^2 of floor spaces
1060 dwellings
14 university and college pavilions,
…and soon a mega-hospital
14500 indoor public parking spaces
accessible through 155 entrances
on street level (500,000 pedestrians/day).

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Examples

Montreal (*Underground city or RESO*)

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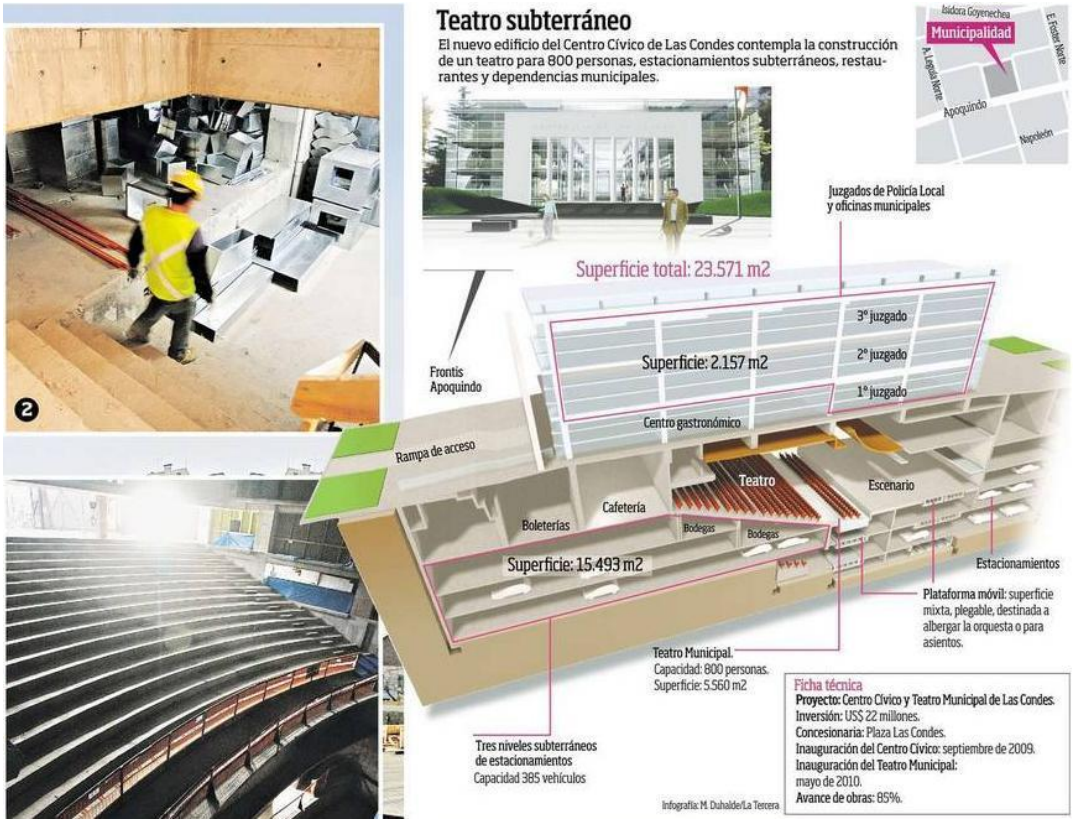
Stand-alone realizations

SANTIAGO: TEATRO MUNICIPAL LAS CONDES



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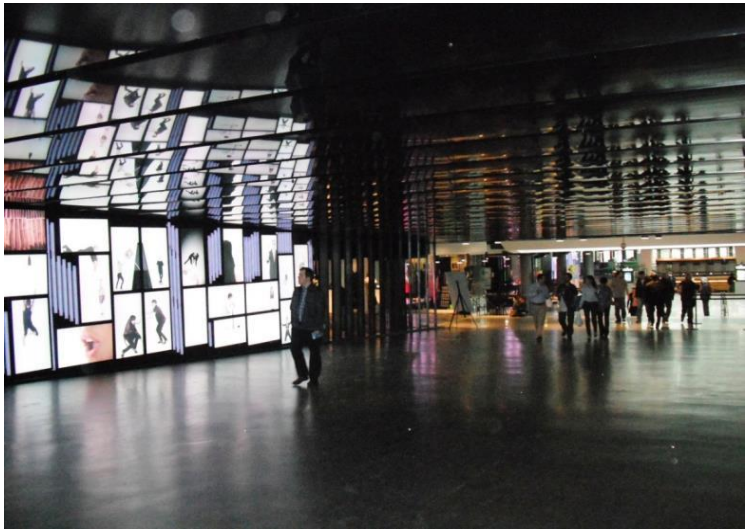
Measures to "humanize" US

Successful underground cities needs multifunctionality and interconnected buildings, with well-planned safe public spaces and corridors.

ART & CULTURE to introduce inside

Montreal has a long track record in that last field since 1962, with interesting experiences of "humanization" of its Underground city



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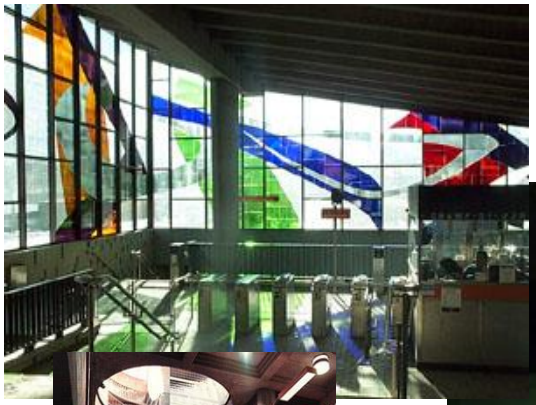
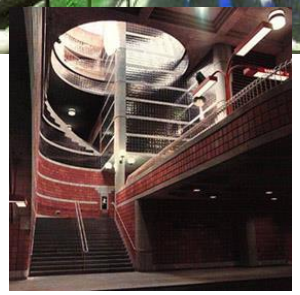
UG for people

Measures to “humanize” US

ART & CULTURE





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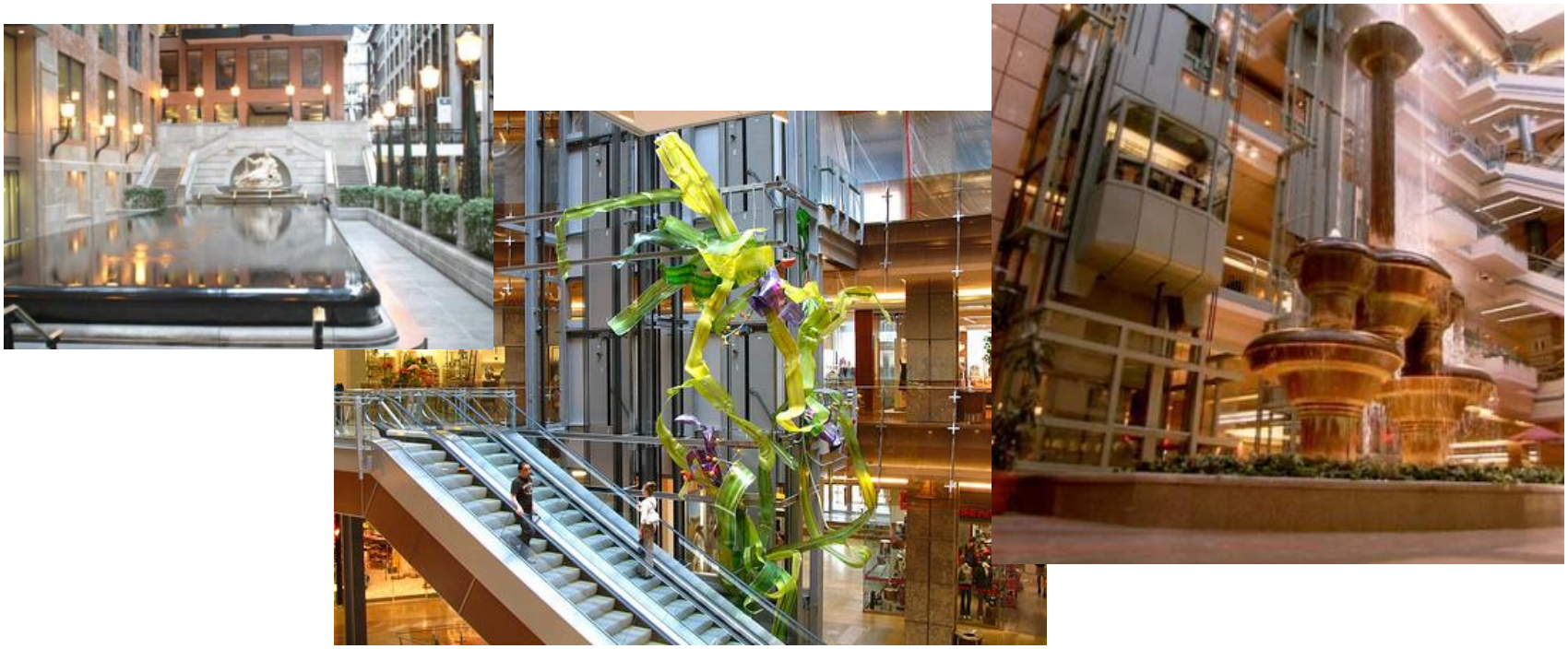

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CULTURAL ACTIVITIES in the Underground City

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UG for utilities

UTILITIES, STORAGE & ENERGY

Since many years, electricity and natural gas distribution systems are usually located under city streets; in cold and temperate climate regions, also district heating networks are laid U; district cooling systems start to compete with the previous ones.

Cables, pipes and auxiliaries constitute very complex systems, that frequently interfere, as far as their management and development are concerned. Sometimes, very critical conditions are reached, with a resulting lack of safety, in addition to relevant economic penalties.

Traditional planning techniques are mainly focused on two-dimensional representations of regions and urban areas. This approach is generally adequate for surface and aboveground construction, but not for structures in U.

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UTILITIES, STORAGE & ENERGY

Subsurface planning must be an integral part of land use planning processes. The need of an underground urbanism, as an implementation of the traditional urban planning approach, is promoting new technical solutions (e.g. multi utility tunnels for energy network systems) and regulations (e.g. Master Plans for Underground Services).

The following figures show some multi-utility tunnel examples in Geneva, Stockholm and Copenhagen, where energy networks (electricity grids and district heating pipes) are located with TLC cables and water supply services. The advantages for operation, maintenance and safety are evident.

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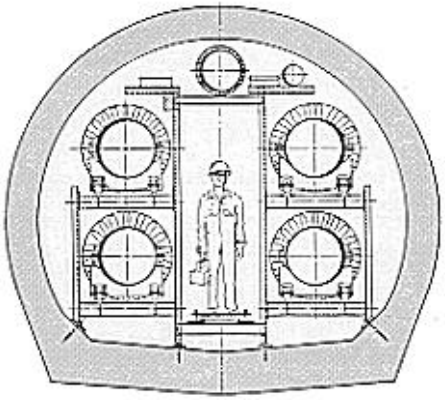

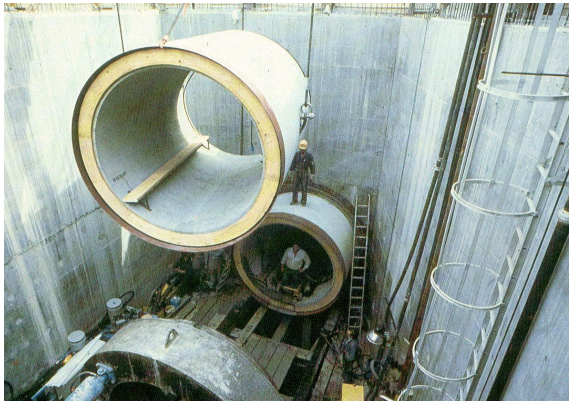

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UG for utilities

UTILITIES, STORAGE & ENERGY

UG for energy infrastructures

Two significant example of underground solutions for energy production plants are the heat pump installation in Zurich (Switzerland) and the heating plant in Imola (Italy), both belonging to local district heating schemes.

The Imola plant, that supplies the local district heating system, is located in the middle of a city park, surrounded by leisure facilities.

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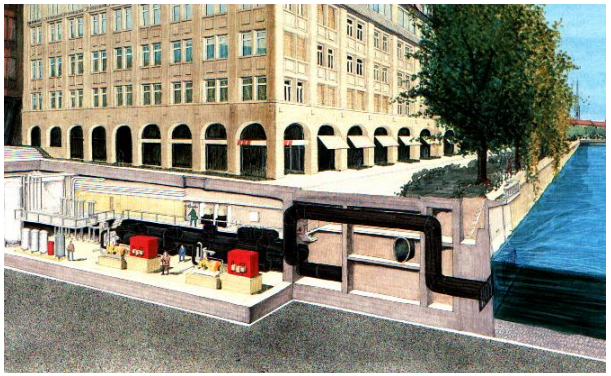
UTILITIES, STORAGE & ENERGY

In Zurich, the heat pump plant is located under a garden, close to the bank of Limmat River (from where the "environmental" heat source is taken) and hosts two heat pumps, heat exchangers and auxiliaries. It has been in use since 1937.



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UG for utilities

UTILITIES, STORAGE & ENERGY

UG for Thermal Energy Storage

UTES represents one of the most sustainable and environmentally friendly approaches, with great future potential: it saves power, reduces the size of distribution units and hence lowers the cost and environmental impact of energy systems.

In addition to storage applications, underground itself can play the role of a direct energy source, like in heat pump installations using the heat content of groundwater or soil, or when an high temperature gradient allows the exploitation of geothermal energy.

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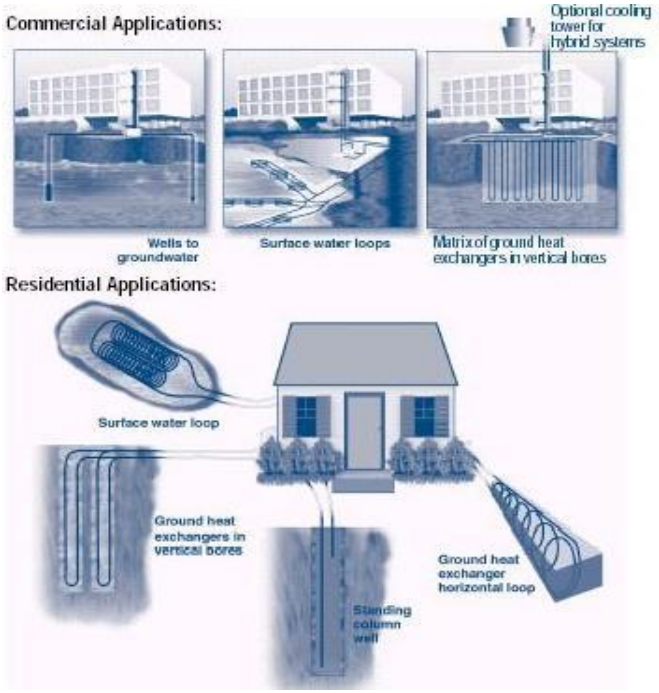

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UG for utilities

UTILITIES, STORAGE & ENERGY

UG for Energy saving solutions

Energy saving solutions:

i) an higher thermal insulation, in comparison with external buildings

ii) a better efficiency of the installations, like for passenger and goods transportation systems, because they do not interfere with other surface traffic modes.

Moving infrastructures to UG, moreover, results in a relevant contribution to the achievement of higher sustainability and liveability in overcrowded and congested today cities.

Example of such solution at a Shanghai Shopping Mall and an innovative application of an “old” technology: the Pneumatic Capsule Pipeline infrastructure for freight transportation.

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UG for transportation

infrastructure and transportation

Underground Urban Infrastructure:

- Important part of UG sustainable development
- Physical infrastructure beneath the surface that allows urban system functioning
- Consists of utilities, facilities, transportation, building foundations, improved land use, safety and security, residential, manufacturing, recreational and other UG structures

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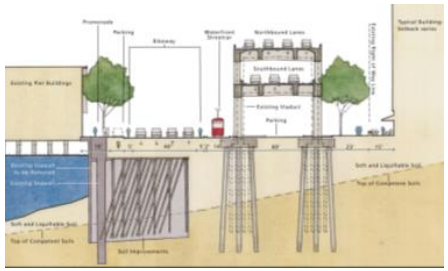
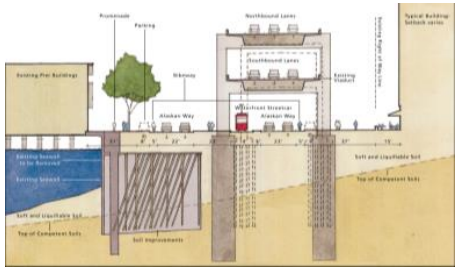
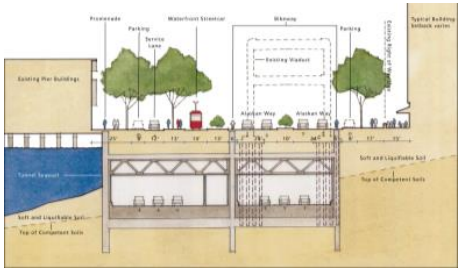
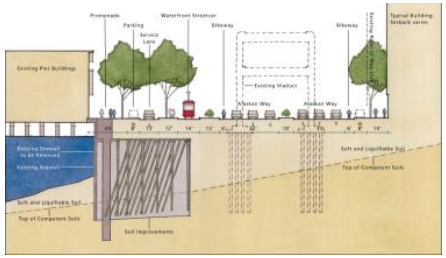
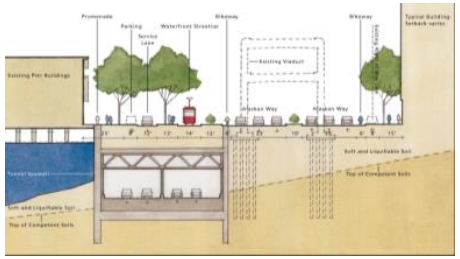
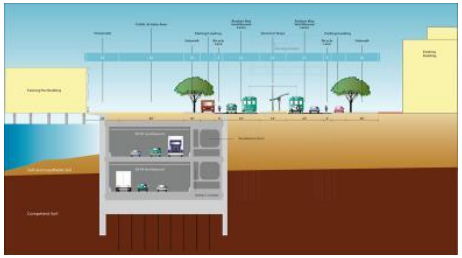
Seattle new waterfront

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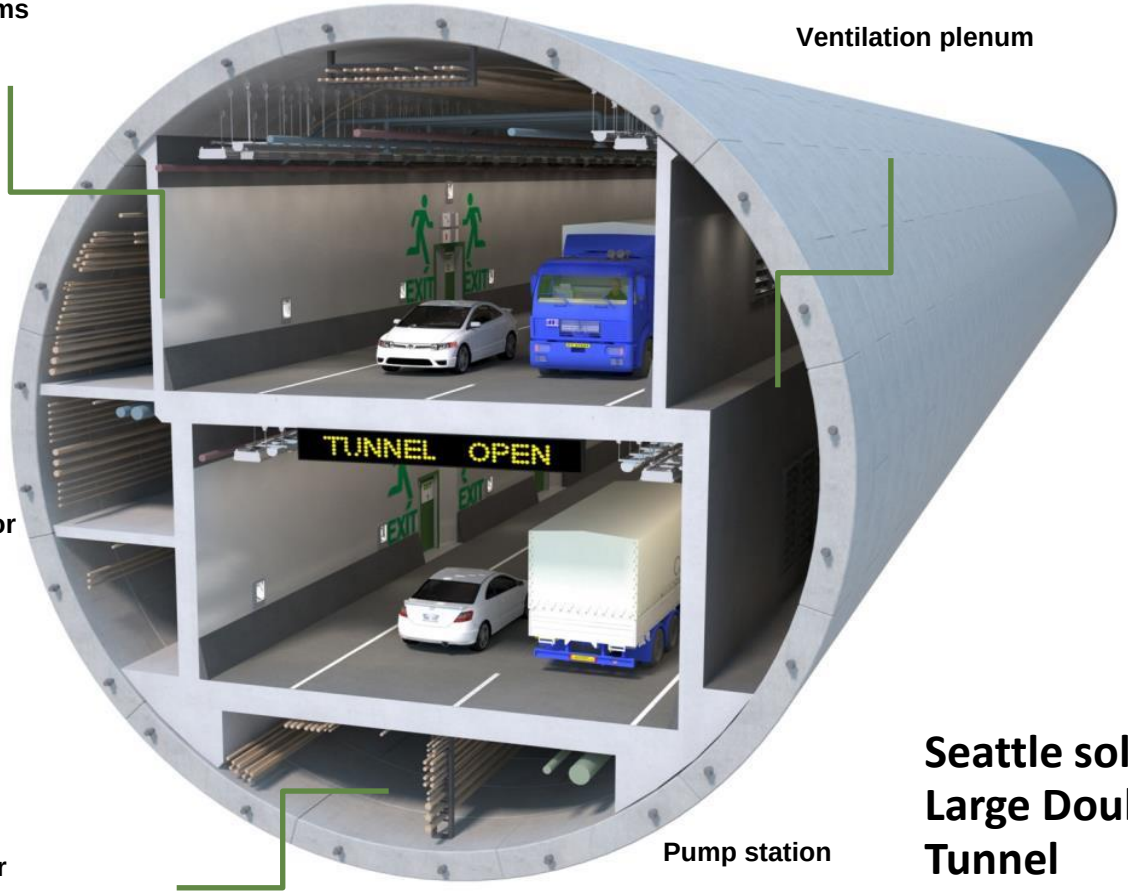

Seattle solutions: Large Double Deck Tunnel

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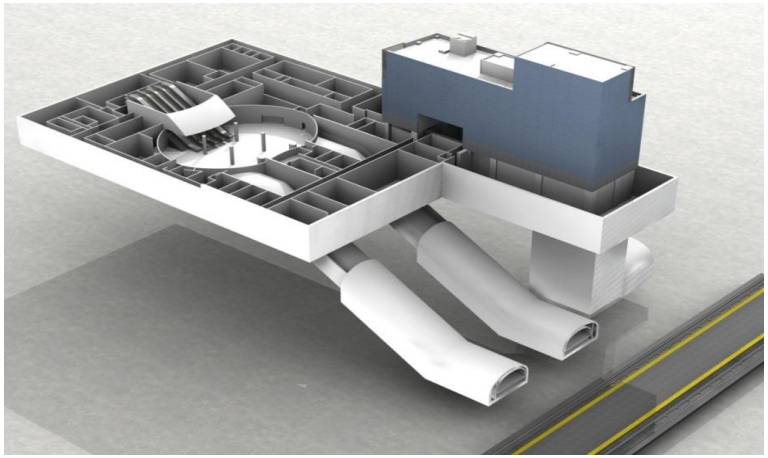
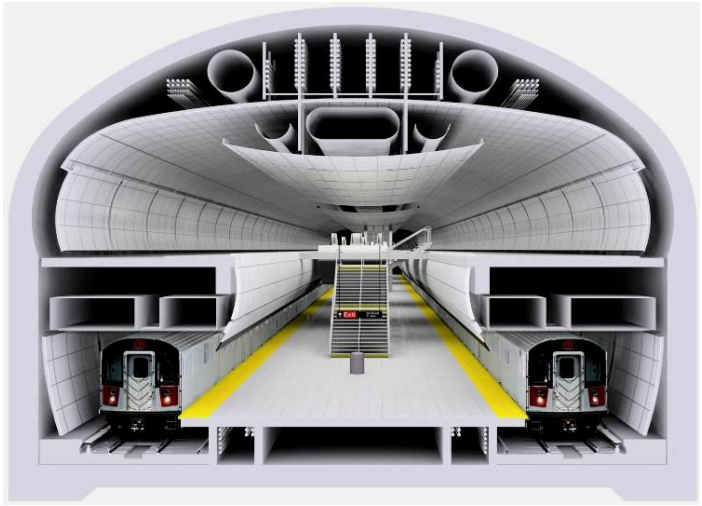
Modern Transportation Projects in New York





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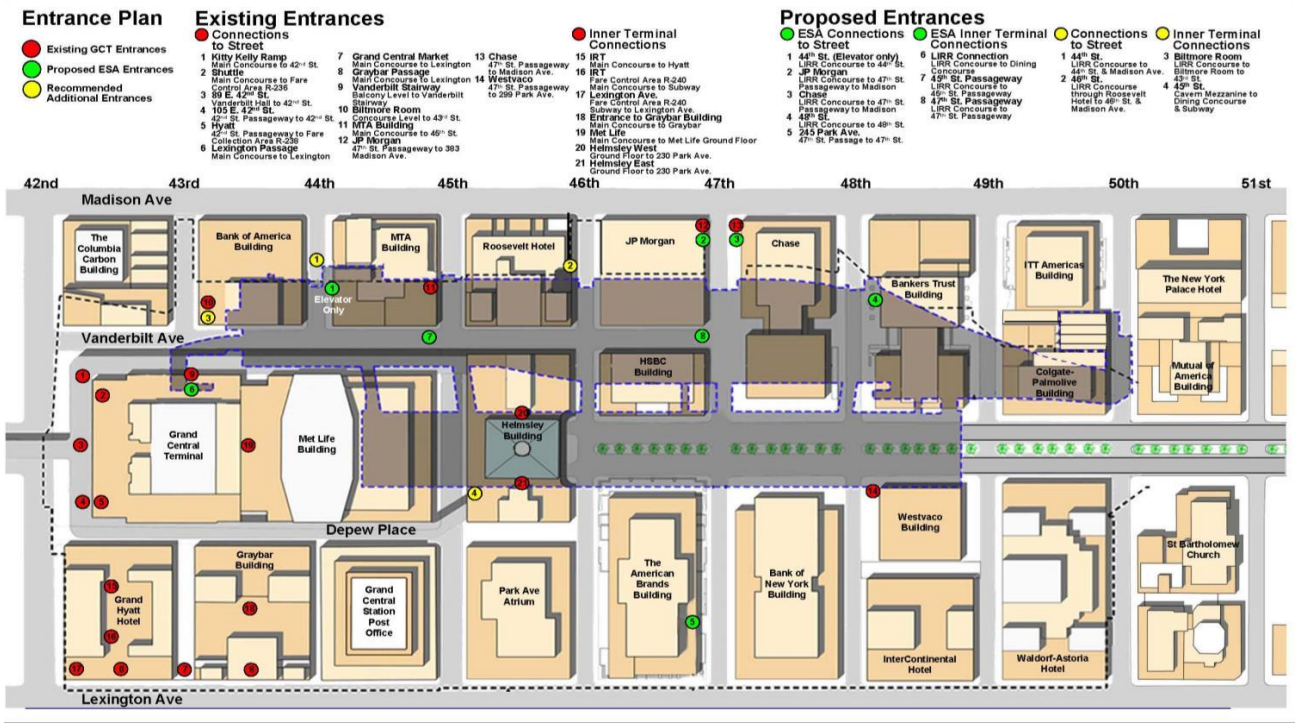
New York



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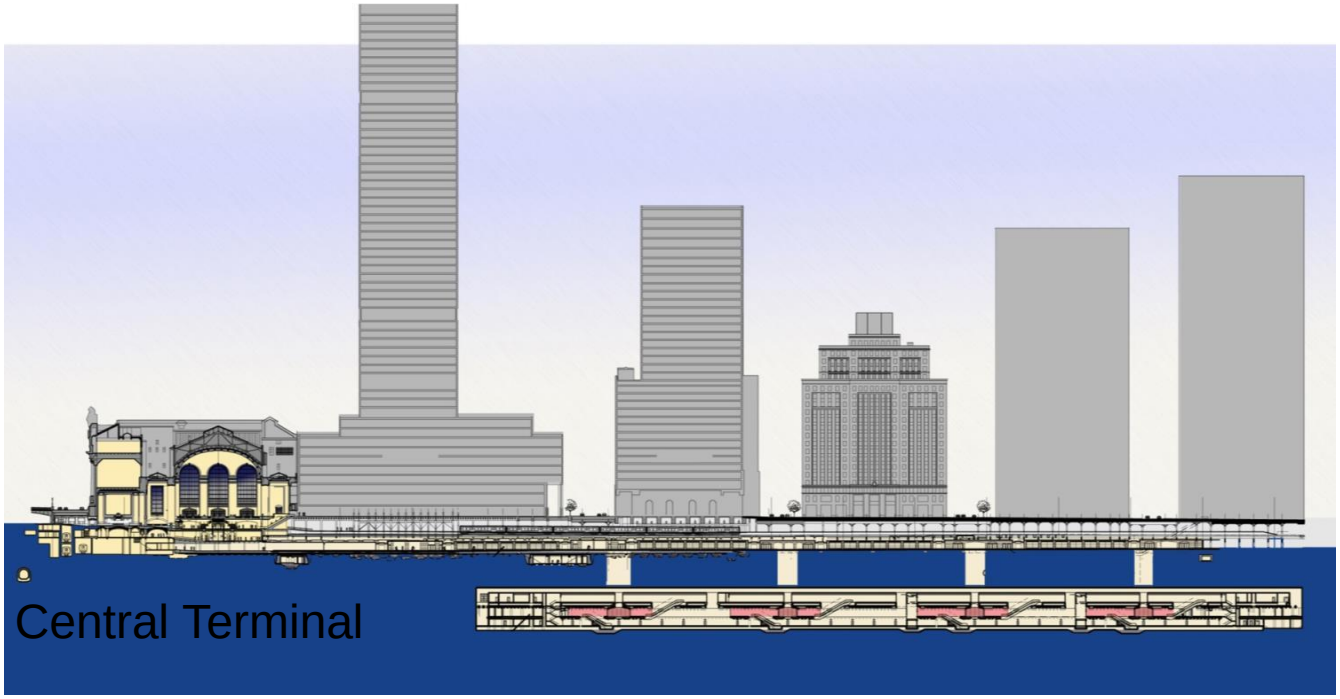

Grand Central Terminal

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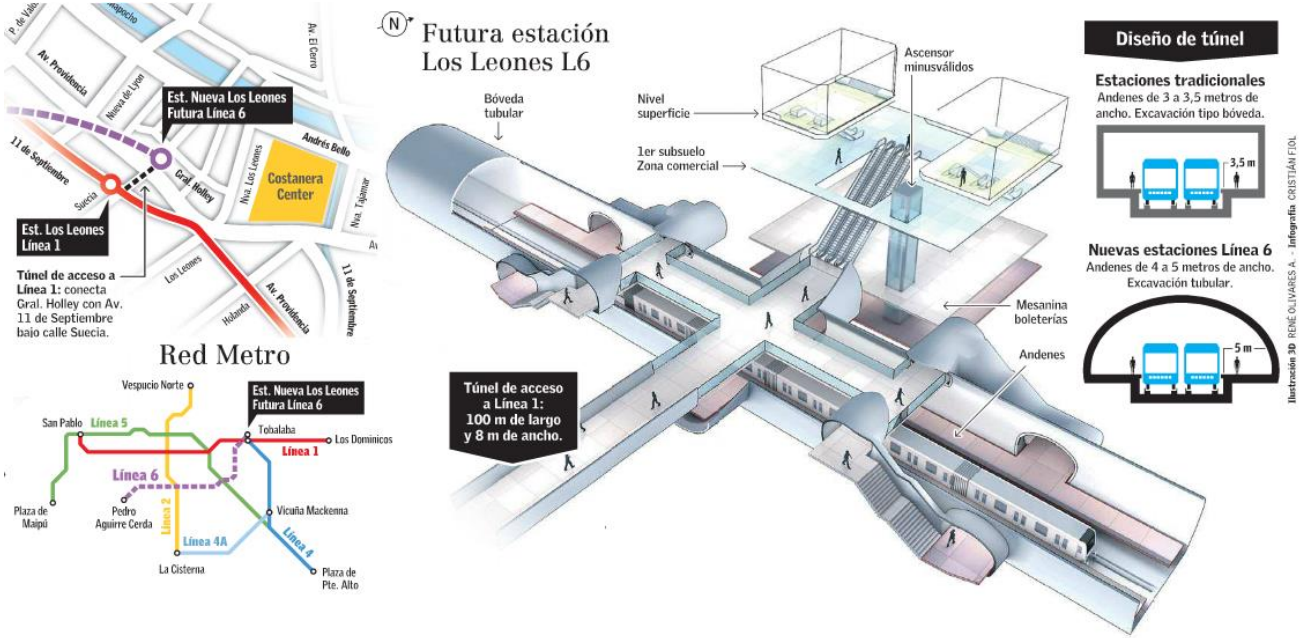
LOS LEONES NEW STATIONS LINEA 3



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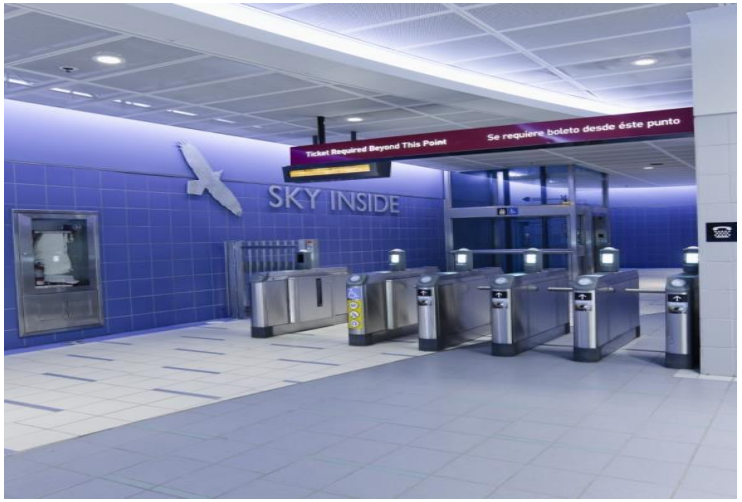
Los Angeles Metro Extension



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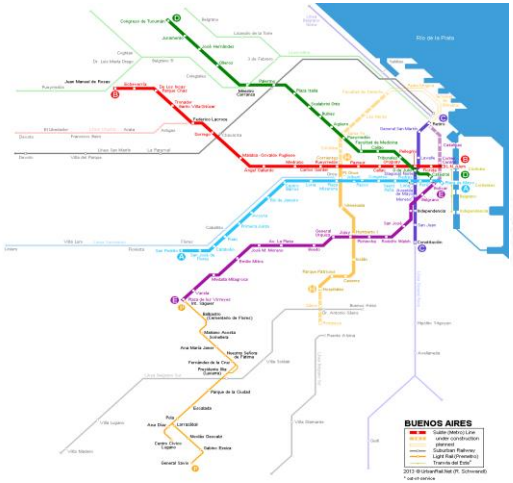
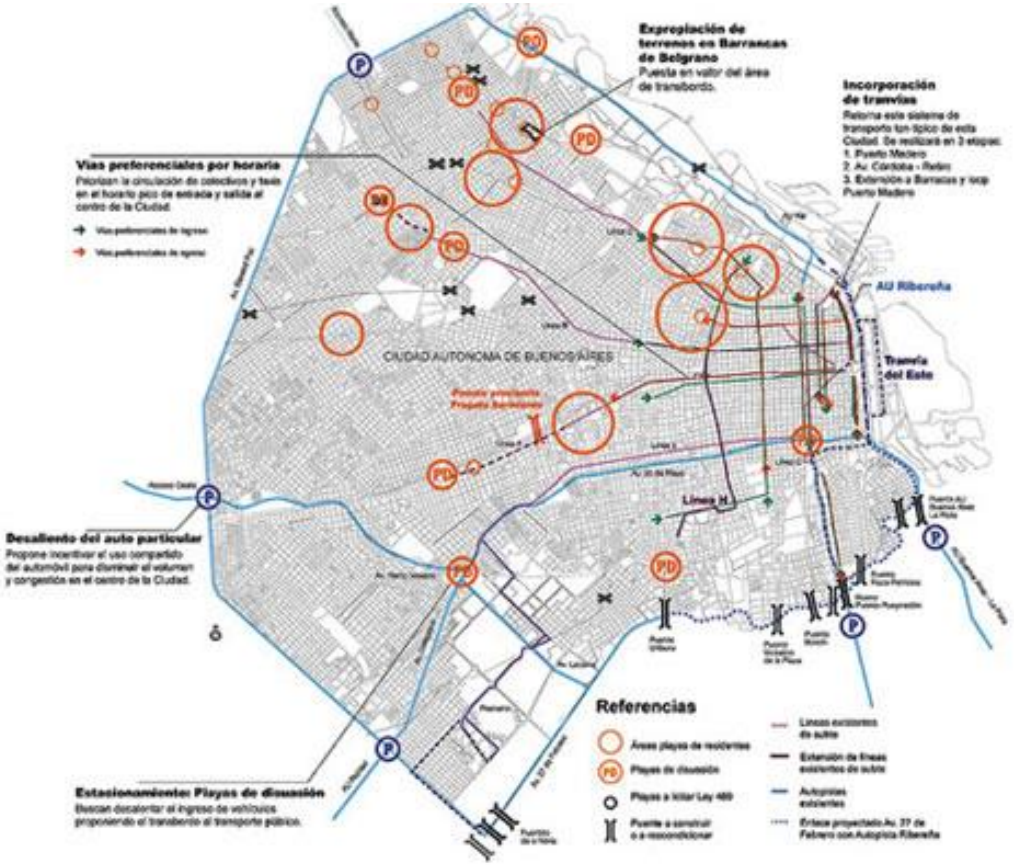
BUENOS AIRES: METRO





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BUENOS AIRES: NEW TRANSPORTATION TUNNEL

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Istanbul Eurasia Tunnel

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THE CITY WE NEED

UG open points & ideas

development of underground space
priority actions
suggestions for long-term policies & coordinated actions
development of 3D GIS tools

tips and tricks?

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MASTER PLANS

for above & under - ground

Some general considerations upon Underground Urbanism, Master Plans and Sectoral Plans

Comments on some Underground Master Plan's examples (Helsinki, Brisbane, Singapore, Beijing, Shanghai, Istanbul)

Comments on some Sectoral Plan's Examples
Installations for commerce and leisure
Systems related to the mobility (people and goods)
Technical systems

Concluding remarks on Planning Guidelines and Tools

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Awareness of the US

for above & under - ground

With the growth of the world's population and the worldwide urbanization process, the urban future increasingly depends on the urban underground potential

CONSEQUENTLY:
many governments and municipal governments have abandoned the out-of-sight-out-of-mind approach, typical of past practices regarding the UG.
An increasing number of metropolises subscribe to long-term policies & coordinated actions as regards the development of the urban US
More and more professionals and research centers are better trained and aware of the challenges to use the underground, including in developed countries

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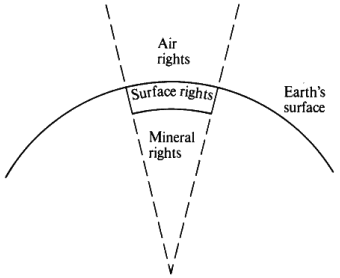
Awareness of the US

Things to consider … in the urban underground space

Land property & 3D cadastre:

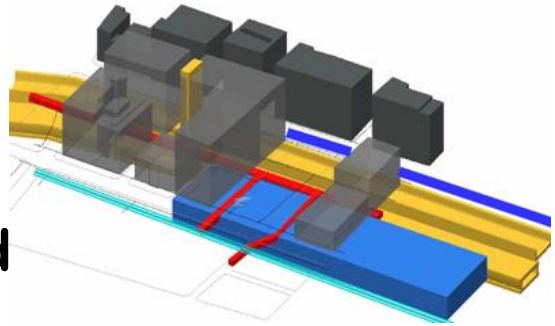
It depends of each country



- air space overhanging the ground level
- ground level (surface rights)
- subterranean space (to a fix depth, or to the center of the earth except if the government claim sub-soil for its mineral resources)
- property can be divided in layers

& volumes
(vertical cadaster)

- governments can expropriate if required (with or without financial indemnity)



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Awareness of the US

Things to consider … in the urban underground space

Limitations of the private rights:

Limitations to build on a private property:

- by rules of municipal zoning
- by public interest (public hearing)

Limitations to build in the underground of a private property:

- by various national and local jurisdictions:

  if mineral resources (national jurisdiction) are found or expected
  if archaeological artifacts are discovered
  if the development in the UG is planned and regulated (as on the surface)

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MASTER PLANS

UG Urbanism

The rationalization of the use of the subsoil is possible only through an effective urban planning approach that may result, at the higher level, in a Master Plan (with rules and design guidelines) or, at least, in self consistent specific Sectoral Plans.

The planning approach must consider the full three-dimensional interactions between the built subsurface and the supporting underground infrastructures.

There is also the issue of land rights to consider and particular attention must be devoted to the financing aspects (public/private partnerships, project financing, ..).

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MASTER PLANS

Planning Guidelines and Tools

Among the strategic, policy and statutory documents associated to a Master Plan, the Guidelines give rules and instructions for any type of undertaking related to the land use (surface and underground). In many urban areas a dedicated Service is devoted to the management of the issues associated to the underground space utilization, including incentives to favour rational and coordinated development.

Especially in urban area, the geological data must be standardized, structured, archived and properly used through suitable systems and applications: the Geographic Information Systems (GIS) are very important in order to maximize the sharing of geological information and to solve problems related to the urban planning.

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MASTER PLANS

Planning Guidelines and Tools

Referring to the quality of the underground urban landscape, recent projects provide clear evidence of increasing change and interest in a better engineering and architectural design, with the objective of improving the wellbeing and comfort of the people living, working and moving in these spaces.
The city's Urban Design Departments must play a leadership role in giving Guidelines, coordinating the projects and solving the problems.
Design guidelines and dedicated management services must also be devoted to ensure the spatial control and surveillance, improving the spatial «legibility» of the hyper-accumulation of signs, media, symbols, lights, materials and displays disseminated amongst tunnels, openings, shops, and courts.

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MASTER PLANS

Planning Guidelines and Tools

Guidelines for the underground city expansion:

- Ensure that buildings connected to the network maintain street interaction and maximize openings and direct access from the sidewalk
- Define and apply standards to harmonize the form and the business hours of the network
- Introduce a signage system throughout the network in order to improve user orientation
- Aim to provide universal access for mobility impaired persons.
- Determine directions and development guidelines that encourages public transportation use

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MASTER PLANS

Planning Guidelines and Tools

Some examples of cities where this system has already been adopted are the historical center of Leon, Zaragoza and Pamplona in Spain, or in Wembley, UK. Recently, in Bahrain, a National Master Plan identified the investment requirements for a complex of underground infrastructure.

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MASTER PLANS

UG Urbanism

Helsinki has been the first city to develop a dedicated Underground Master Plan.

"Subterranea Helsinki" represents one of the largest and complete systems in the world (occupying around 10 million cubic meters), with 600 facilities (existing and planned) and single and multi-purpose service tunnels.

This Plan reserves designated space for public and private utilities in various underground areas and provides the framework for managing and controlling the city's underground construction works.

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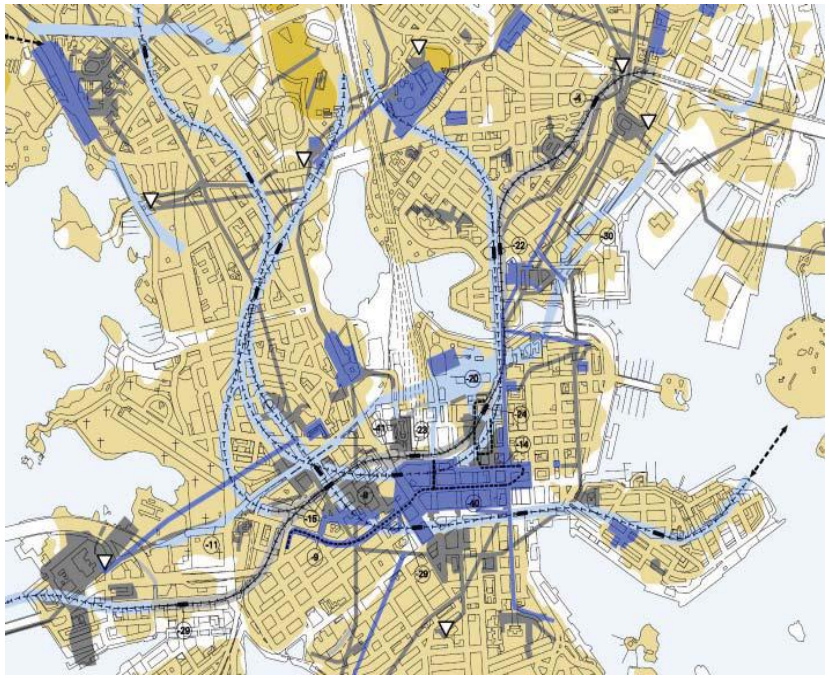
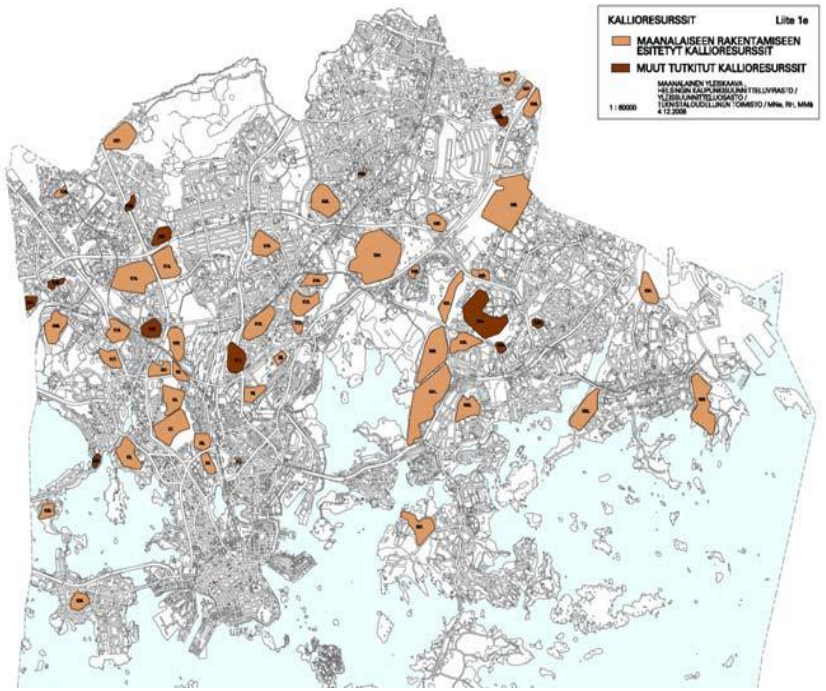
MASTER PLANS

UG Urbanism





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UG for utilities

UG Urbanism

Italy: Tools for working (GIS)

The Lombardia SIT

This project produced a Regional Spatial Data Infrastructure (SIT) with the objectives of sharing information among the public organizations and facilitating the access of private operators to this service. Through this open SIT it is possible:

- **to combine reliable spatial information from different data sources across the Region**
- **to share data among many users, by means of different SW applicationsto collect information at each level/scale and**
- **to share it with all levels/scales.**

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MASTER PLANS

Planning Guidelines and Tools

Planning the underground space: 2 approache

a) Dedicated master plan of the underground

For a pedestrian network (ex.: Toronto PATH)

This MP establishes a vision framework, planning objectives and recommendations to shape the growth and enhancement of the PATH pedestrian network over the next 25-30 years

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MASTER PLANS

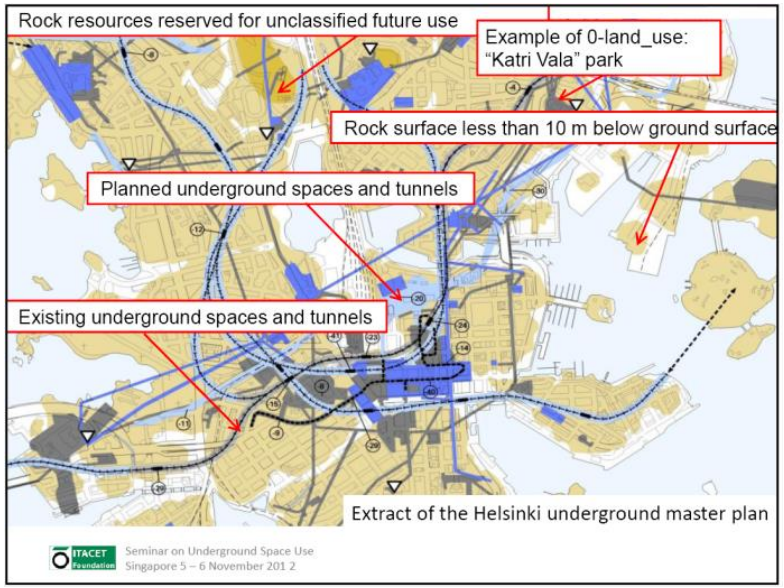
Planning Guidelines and Tools

Planning the underground space: 2 approaches

a) Dedicated master plan of the underground

For preserving and using (publicly) the UG for various uses (Helsinki, but also Hong Kong, Singapore,…)

Helsinki MP: includes space allocations for transport, civil defence, sports, various installations and establishments, water and energy supply, parking, storage, waste management and similar



MASTER PLANS

Planning Guidelines and Tools

b) Development orientations of an UG pedestrian network built-in into a city-wide master plan (ex.: Montreal Underground City)

Reasons why:

A city can't force an investor to build its project on a land, even less in the underground

A dedicated & detailed long term master plan of the underground space is not needed:

- **when the legislation gives power to a municipality to use and develop its underground space**
- **when a municipal comprehensive plan includes the underground spacewhen the underground is well known and ruled by guidelines**
- **when a municipality can give favorable conditions or incentive measures to push investors to develop in the underground**

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MASTER PLANS

Planning Guidelines and Tools

Zoning by-laws & building codes

- have to be conformed with the city master plan
- sets standards: lot size, building height, density, setbacks, parking places, …
- gives enforceable appeals against property owners
- problems: rigid approach, municipalities have to wait for the developers

… it's a passive approach

Totally unadapt for the underground

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MASTER PLANS

Planning Guidelines and Tools

Development agreements & incentives

- possibility to negotiate a better project with developers (implies flexibility on both sides)
- used for major development or in central areas
- sets out the standards and conditions under which development are to take place
- includes the responsibility for the developer to construct public facilities (like tunnels) or mitigation measures to assure that a project does not have unacceptable impacts
- provides assurance to the developer that the project is subject to the rules and regulations in effect at the time of approval (not be subject to zoning changes)

Fully adapt for developing the underground

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MASTER PLANS

Montreal UG masterplan

Since 52 years, the 32 km pedestrian network of the Montreal Underground City was planned at the beginning with a dedicated (non-official) master plan and later as an integral part of the City Master Plan, but

…. it is much more the regulatory tools & incentives the City used which allowed its harmonious growth, from the Ponte master plan until now

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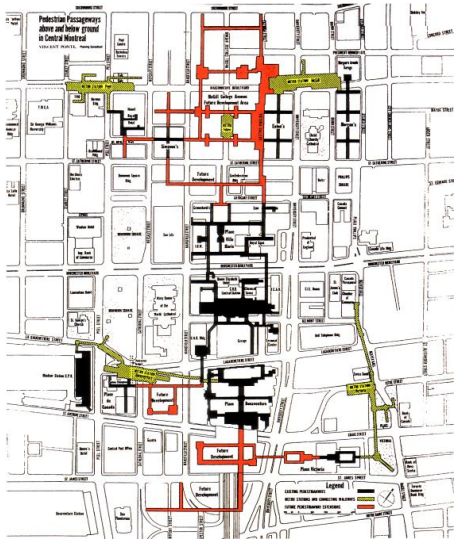
MASTER PLANS

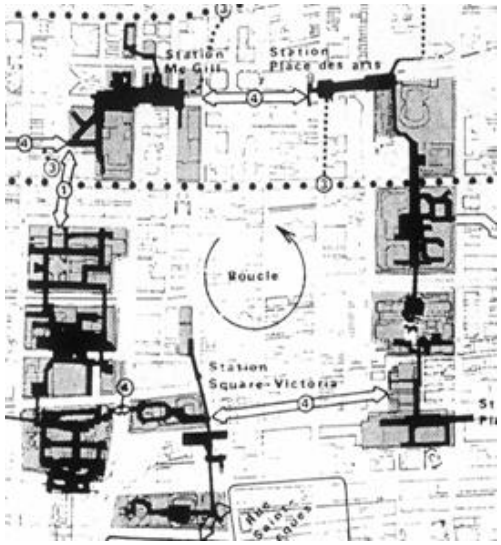
Montreal UG masterplan

1964



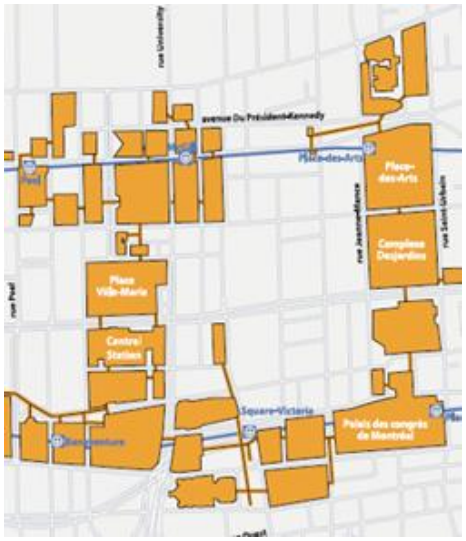
By Vincent Ponte, urban planner

1984



By the Planning Dept. of the City

2004



Guidelines in the City Master plan

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MASTER PLANS

Montreal UG masterplan – results (I)

- A city is not able to force an investor to build its project on a land, even less in the underground
- Dedicated plan of the underground space + integration in the city master plan
- Too detailed (and rigid) plan is risky – need flexibility to improve projects
- Long term plan should not prevent adaptation to the rapid changing reality & competitiveness of the city

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MASTER PLANS

Montreal UG masterplan – results (II)

- A municipal government should give favorable conditions or incentive measures (not financial) to attract investors to develop in the underground…
- The shallow layer of the underground space (0 to -15 m) should be well regulated with guidelines & zoning by-laws
- Increase the demand for underground facilities (good publicity)

and keep in mind that

Users of the underground spaces should be the priority number ONE

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THE CITY WE NEED

UG planning open points & ideas

development of underground masterplan
planning guidelines
priority actions
suggestions for long-term policies & coordinated actions
development of 3D GIS tools

tips and tricks?

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Montreal UG masterplan – results (II)

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MASTER PLANS

Montreal UG masterplan – results (II)

Thans for the attention

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Energy Planning for Low-Carbon Cities:
how to reach an integrate smart city planning approach?

C.Delmastro, L.Schranz
LAME Lab.
DENERG- Politecnico di Torino

Caserta, 15-18 October 2014

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General issues

Megacities *suffer of scarcity of resources, pollution, traffic congestions, inadequate infrastructures; this situation creates technical, physical, and material problems.*

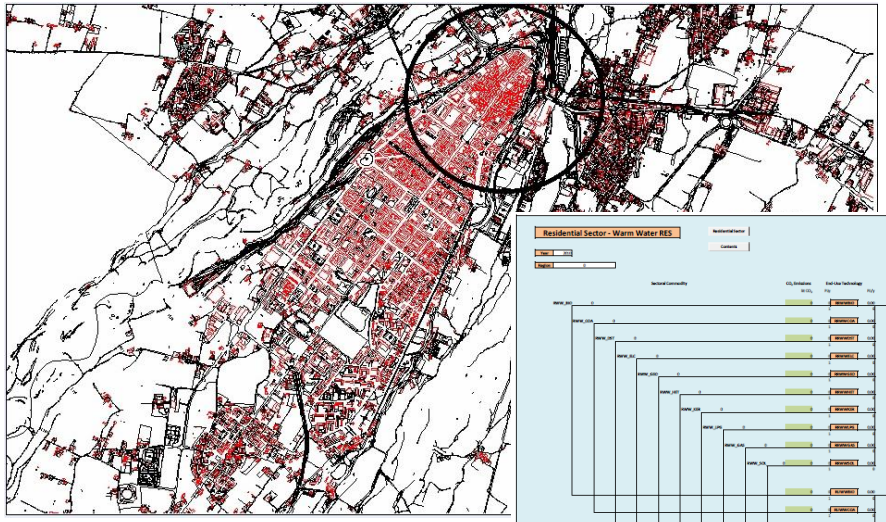
General issues

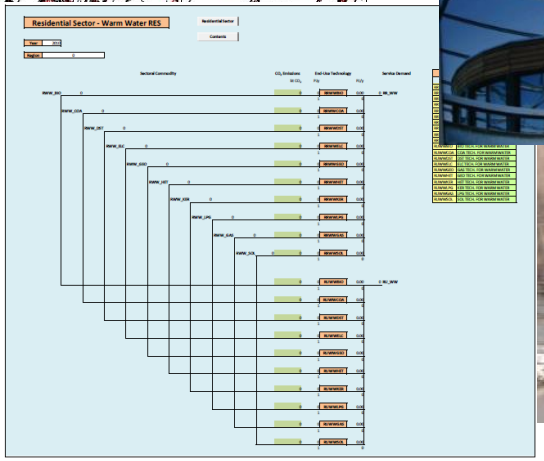
***Cities need to change**: making a city "smart" - more efficient, sustainable, resilient, equitable, and liveable - is emerging as a strategy to mitigate the problems generated by the urban population growth and rapid urbanization:*

- *Sustainable urban mobility (low carbon vehicles, public transport, efficient logistic..);*
- *Sustainable Districts and Built Environment (energy efficient buildings, increase the share of renewables etc.)*
- *Integrated Infrastructures and processes across energy, ICT and transport (connecting infrastructures, smart grids etc..)*

General issues

In order to chose the right (environmental, social, economic) actions one of the solutions is to develop ***tools for simulation and multi-criteria optimisation*** *to enable analyses of different spatial and sectorial scenarios.*





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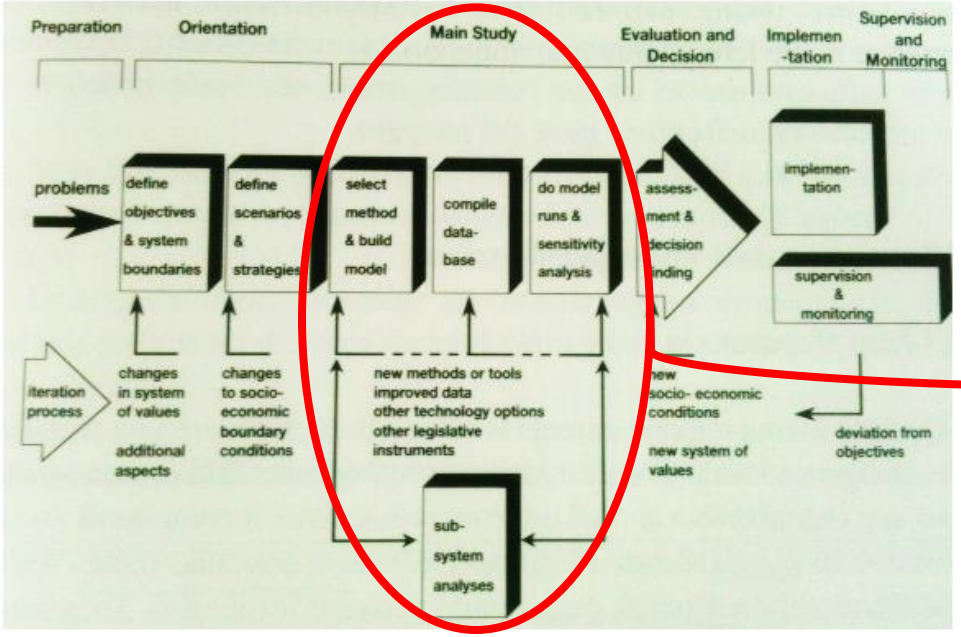
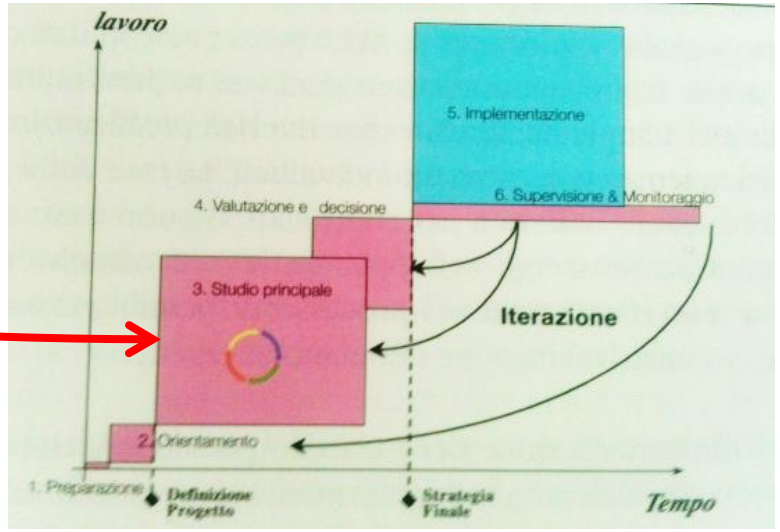
LAME activities:

How to produce a multidisciplinary/integrate energy plan?

The urban planning procedure moves through different phases (involving several actors): preparation, orientation, ***main study***, evaluation and decision, implementation, super-visioning and monitoring.





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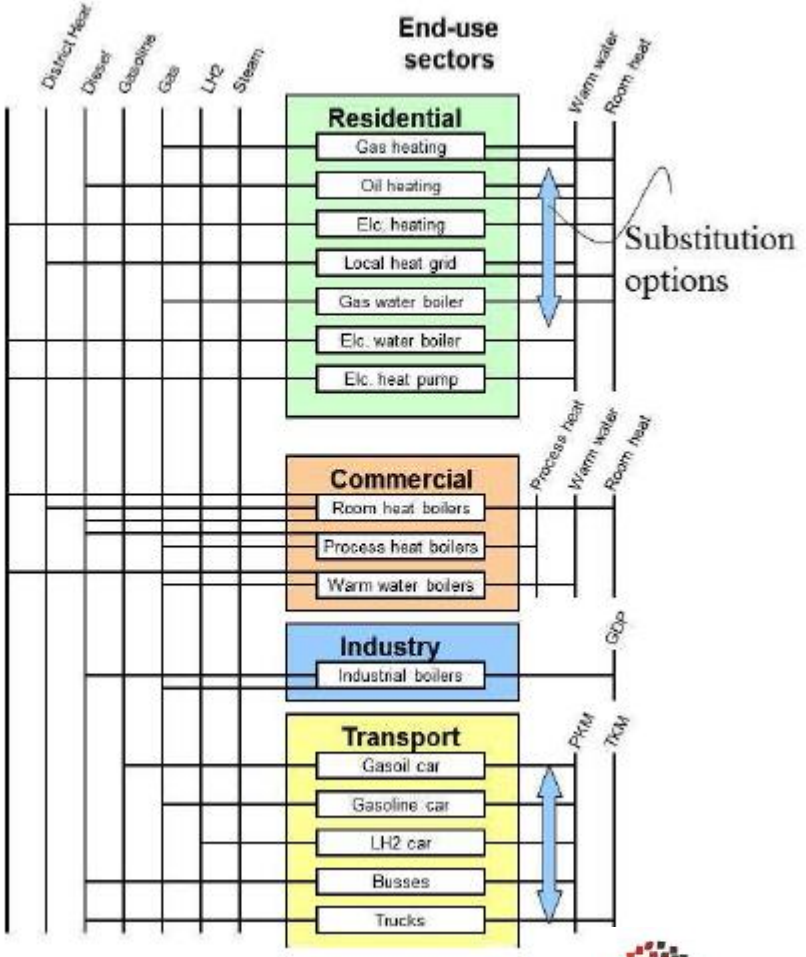
LAME activities:

How to produce a multidisciplinary/integrate energy plan?

We are developing a new bottom-up modeling methodology for enhancing energy planning addressing the current and future ***city energy needs*** through multidisciplinary approach.

The tool will point out the ***cost-optimal mix of measures*** by considering both technical (low carbon technologies, renewables etc.) and social/urban issues (occupant behavior, urban form, land use etc.) and by settings environmental target and economic constrains.



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LAME activities:

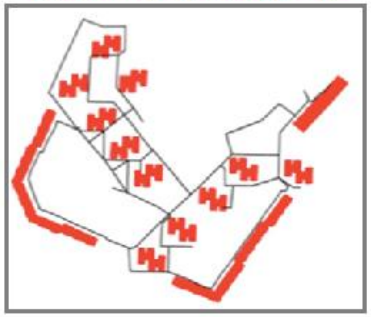
Main study of the planning process

MOBILITY STOCK

WASTES & UTILITIES

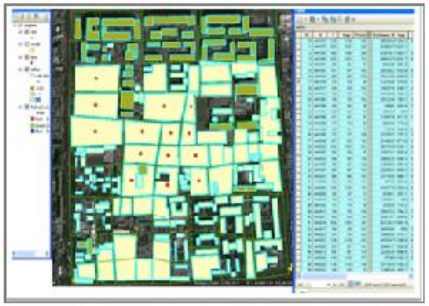
BUILDING STOCK

ENERGY INFRASTRUCTURES



DEFINITION OF THE
REFERENCE ENERGY SYSTEM

CREATION OF A GIS DATABASE



TARGET AND CONSTRAINS:
environmental targets, city expansion, budget constraints

SCENARIOS DEFINITION

OPTIMIZATION PROCEDURE
Technical factors (Bottom up energy Models)
Non technical factors (MCDM)

RESULTS:
optimum mix of short, medium and long term measures toward a smart city plan with regards to both energy efficiency and socio-economic aspects

DEFINITION OF THE POLICY STRATEGIES AND CREATION OF THE ENERGY PLAN

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City We Need Inputs

" Develop a comprehensive methodology - involving both sides of land use (over and under ground) - for a strategic energy planning is fundamental for assisting decision maker/city stakeholders to achieve environmental/sustainability targets and to reduce GHG. "

- Which is your concept of "smart city"?
- Which are priority actions? Which is the role of energy planning? How to deal with existing settlements?
- How to self-evaluate the results of your actions? Which are the most important "smart" indicator?
- How to actively include citizens in the planning process?

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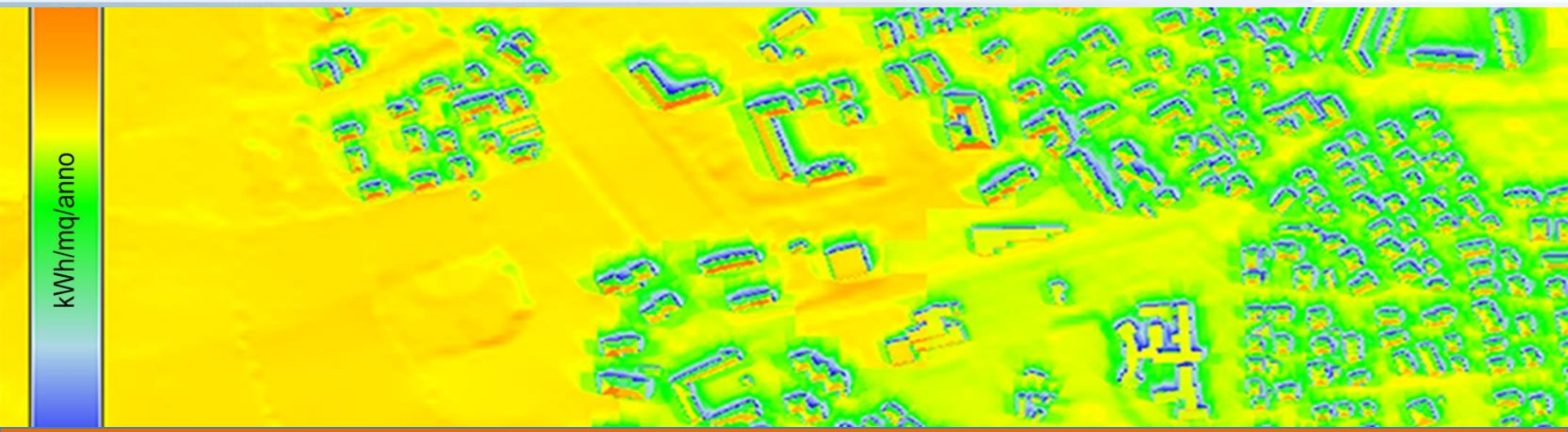

Buildings Energy Savings Potential and Renewable Energy Sources:

how to save energy and use the local available renewable energy sources in the building sector?

C.Delmastro, ***G.Mutani***, L.Schranz
LAME Lab.
DENERG- Politecnico di Torino

G. Vincentini
Provincia di Torino

Caserta, 15-18 October 2014

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Cities on power

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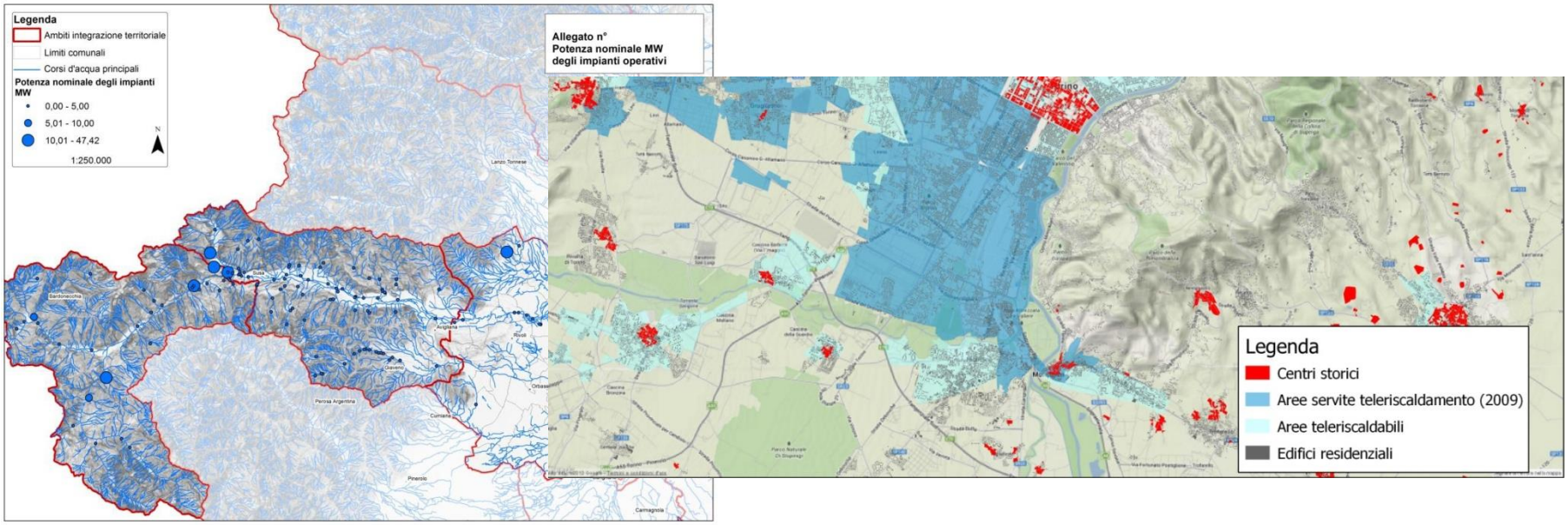
General issues

In high populated places there is a close correlation between *spatial planning*, the use of *renewable energies* and *energy saving strategies*.



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Cities on power

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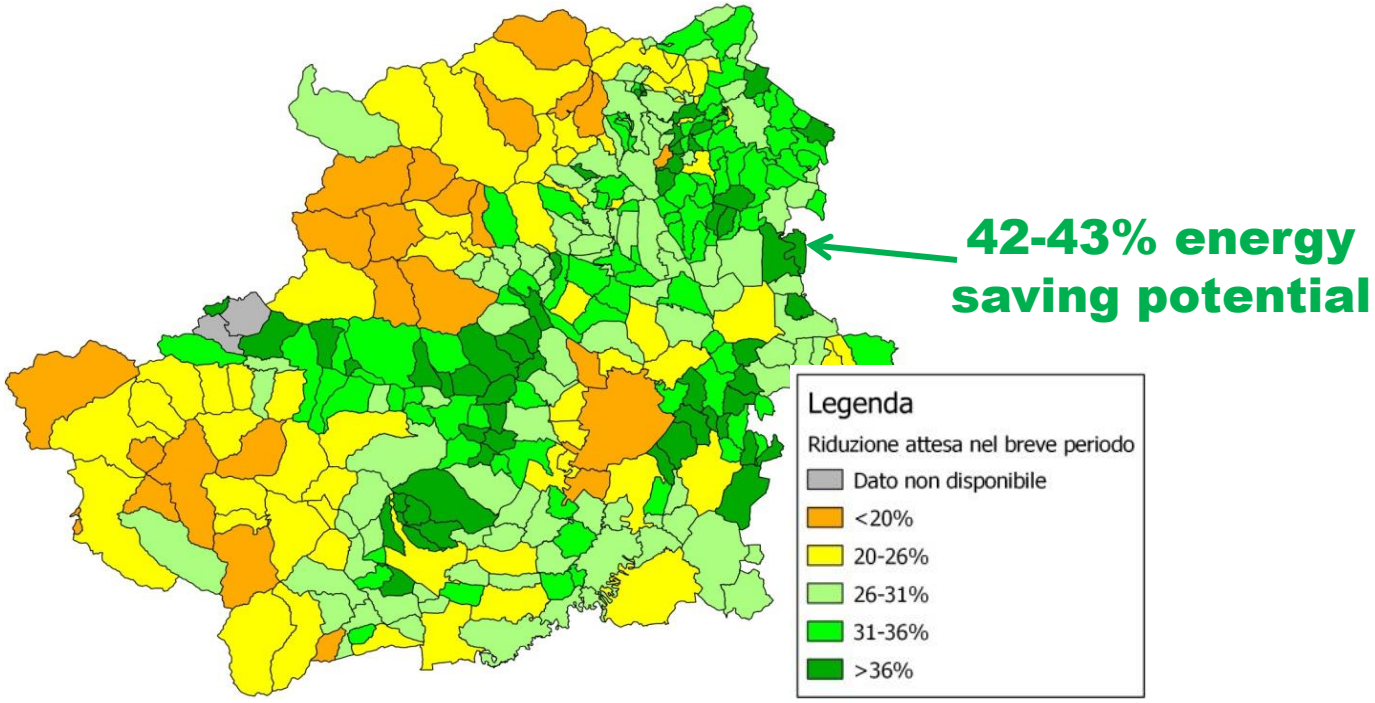
General issues

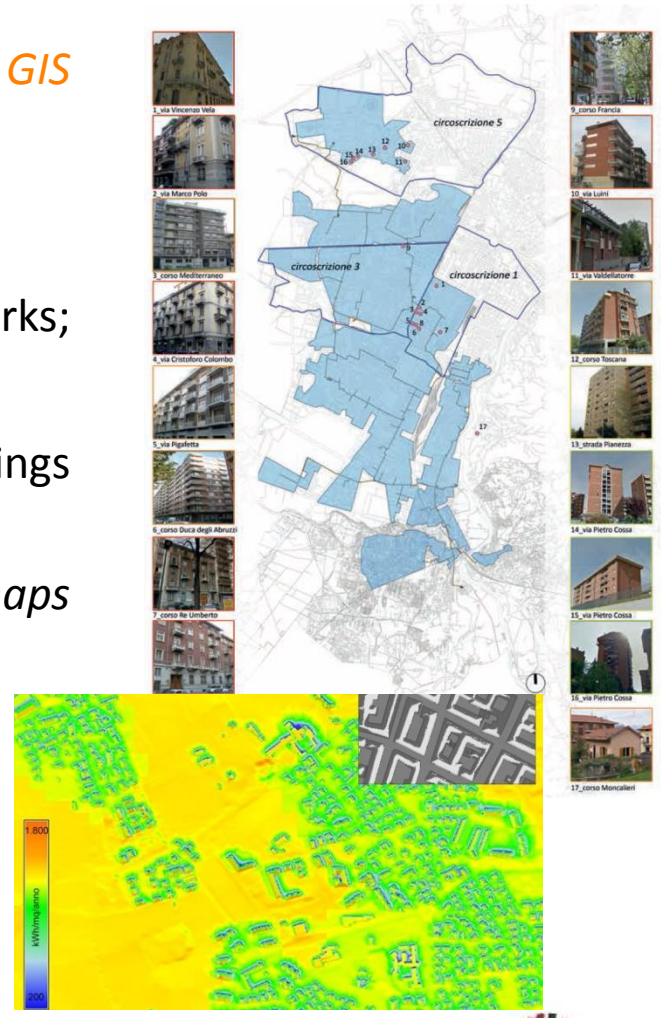
The use of energy, the buildings' form and the public urban areas in our cities could be crucial for a *sustainable urban environment*.



General issues

The implementation of spatial information through *GIS tools* are important for:

- assists the *siting* of new generation *facilities*;
- represents the *buildings distribution* and the *city* networks;
- identifies *criticalities*, barriers and *local resources*;
- describes the renewable energy sources/energy savings potential;
- represents the main results through *thematic maps (*thermal maps, emission maps,etc.*)* ;



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Activities:

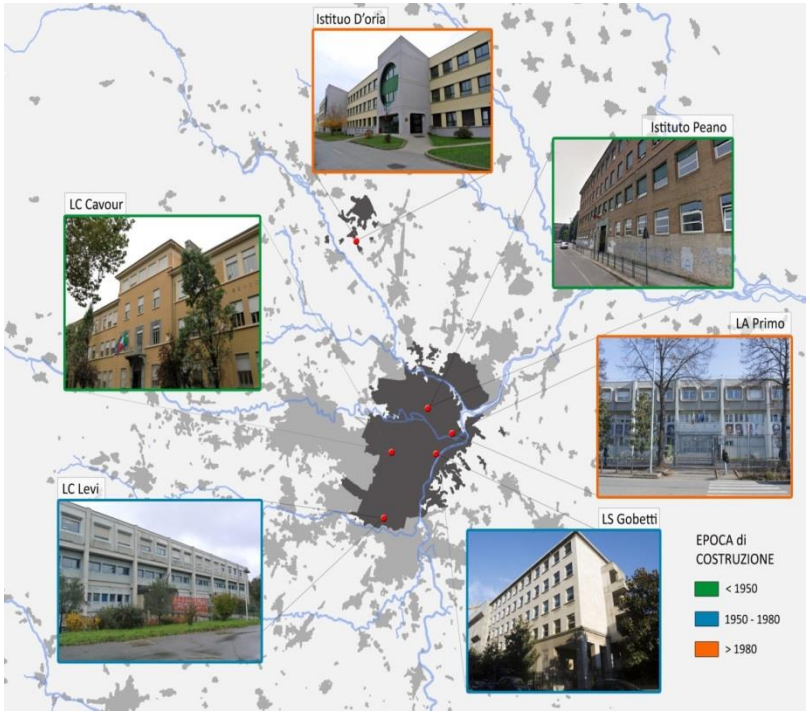
Thermal energy consumption models and evaluation of the available renewable energy sources

The implementation of a thermal model to evaluate energy needs of residential and public buildings to district/city scale with the support of GIS applications.

The evaluation of energy savings potential considering socio-economic factors.

Renewables energy savings potential: solar, biomass and hydroelectric

The goal is to create an open source online platform where citizens, municipalities etc. could be able to understand which are the suitable solutions for reducing energy bills.



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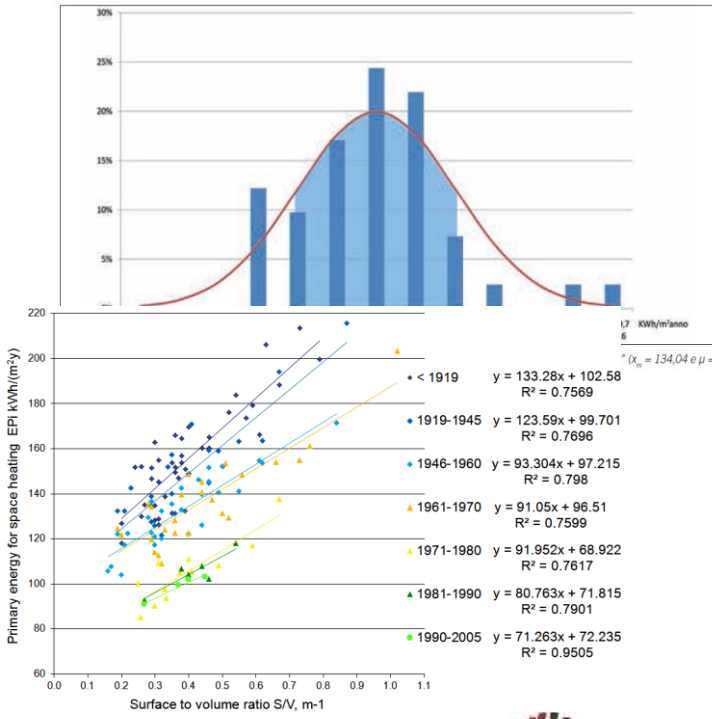
Activities:

Thermal energy consumption models at city level

Among the major contributors to GHG emissions, buildings occupy a key place with *high savings potential.*

Buildings energy consumption depend from the climate, construction period, shape factor and occupation rate. In order to correctly represent the building stock is necessary to:

- survey a great amount of buildings
- identify which are the *reference buildings*
- characterize them (EnergyPlus etc.)
- exclude the atypical behavior buildings
- create the *thermal model* representative of whole city building stock behaviour



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Cities on power

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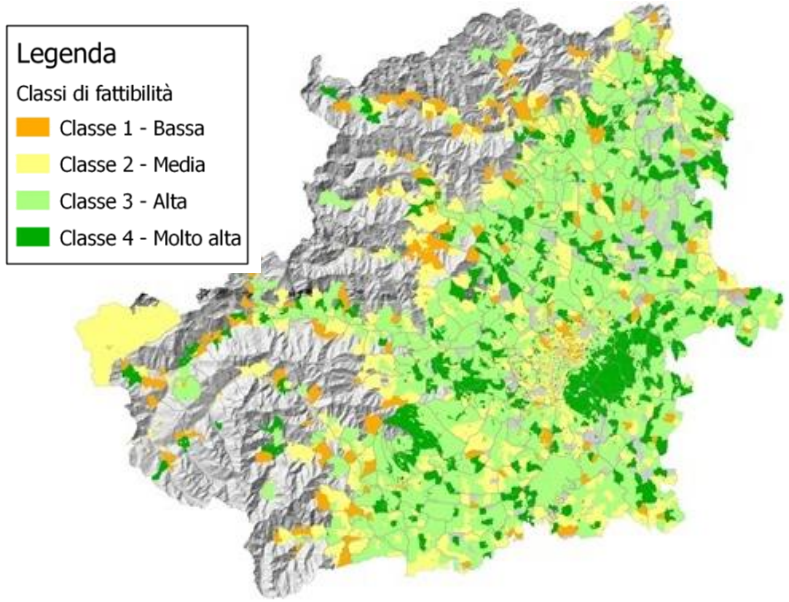
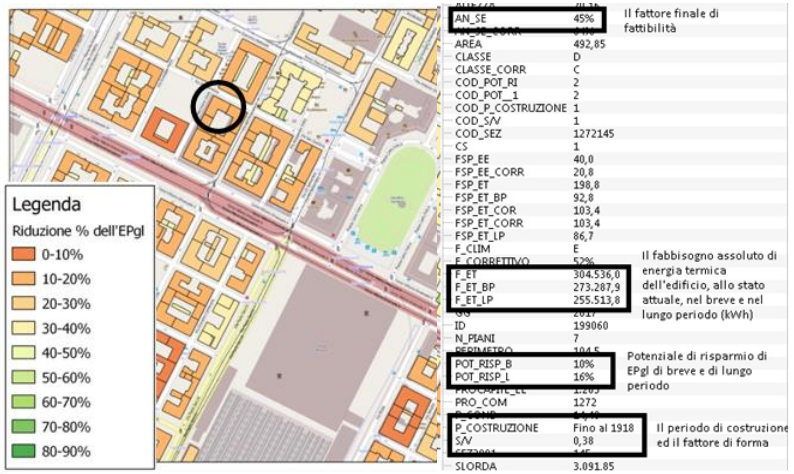
Activities:

Socio-economic feasibility

To simulate energy savings potential you must consider, not only the building stock retrofit potential, but also the socio-economic feasibility of measures. The feasibility index allows to individuate the "*Feasibility Classes*" (low, medium, high, very high), and is evaluated in two steps:



- Definition of socio-economic variables affecting feasability of energy savings measures:
  - ✓ Average age of inhabitants < 24 year or > 64 years
  - ✓ Labour force and dissocupation
  - ✓ Property of the building
  - ✓ Multy.apartment buildings or single family house
  - ✓ Study level
- Individuation of the weight of each variable



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Cities on power

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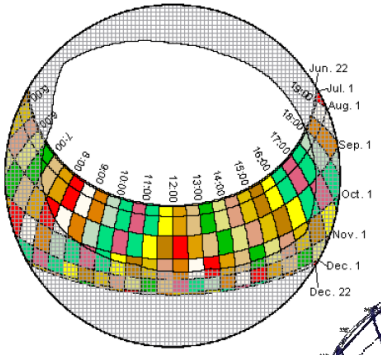
Activities:

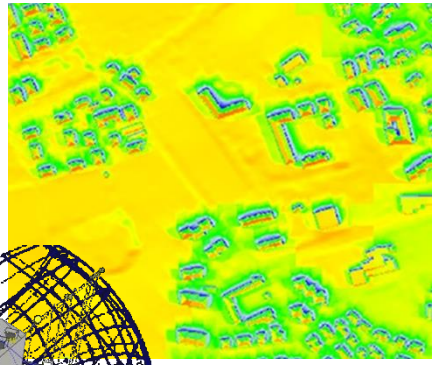
Renewables potential: solar, biomass, hydro, geothermal

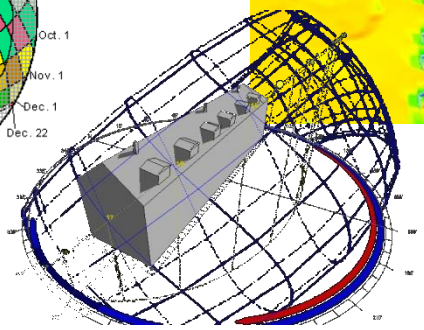
The importance produce energy in loco is more and more important (f.i. Nzeb). Thanks to GIS (2-3 D), DTM etc. is possible to extimate the potential renewables energy generation.

The project *Cities on Power* generate, as a result, a solar web open source portal in which citizens can geo-reference their building, extimate the surface of their roof and evaluate the PV potential.

Similar projects are ongoing for biomass, hydroelectric etc.







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City We Need Inputs

"Providing web open data source in which is possible to extimate the building stock energy saving potential and the renewable energy sources potential helps municipalities to understand the local sustainable development potential and to raise the citizens awareness"

- Are **energy consumption model** depending by other variables? Or is sufficient to consider only buildings characteristics?
- Is the buildings saving potential influenced by **socio-economic factors**?
- Is **renewable energy technologies use** influenced by socio-economic factors?
- Which are **priority actions**? Energy savings or renewable energy technologies?

Thank You

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