DEEP CITY project : a new philosophy for a sustainable urban underground resources management (NRP 54)

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The horizontal expansion and increase in population that have characterised urban growth and development patterns of the last few decades have produced cities that are inconsistent with the principles of sustainable development. Due to the high rate of global urbanisation, the consequences of problems such as greater traffic congestion, higher levels of air pollution, lack of green space, and insufficient water supplies not only affect the cities in which they occur, but extend around the world. Cities that maximise the use of the third dimension are seen as a possible path to sustainable urban form.
The urban underground possesses a large untapped potential that, if properly managed and exploited, would contribute significantly to the sustainable development of cities. The use of its four principle resources (space, water, geothermal energy and geomaterials) can be optimised to help create environmentally, socially and economically desirable urban settings (fig 1). For instance: space can be used for concentrating urban infrastructure and facilities, as well as housing parking facilities and transportation tunnels; energy from geothermal sources and thermal energy stored in the underground can be used for heating and cooling buildings, thereby reducing CO_2 emissions; groundwater can be used for drinking water supply; and geomaterials from urban excavation can be used within the city to minimise long-distance conveyance.

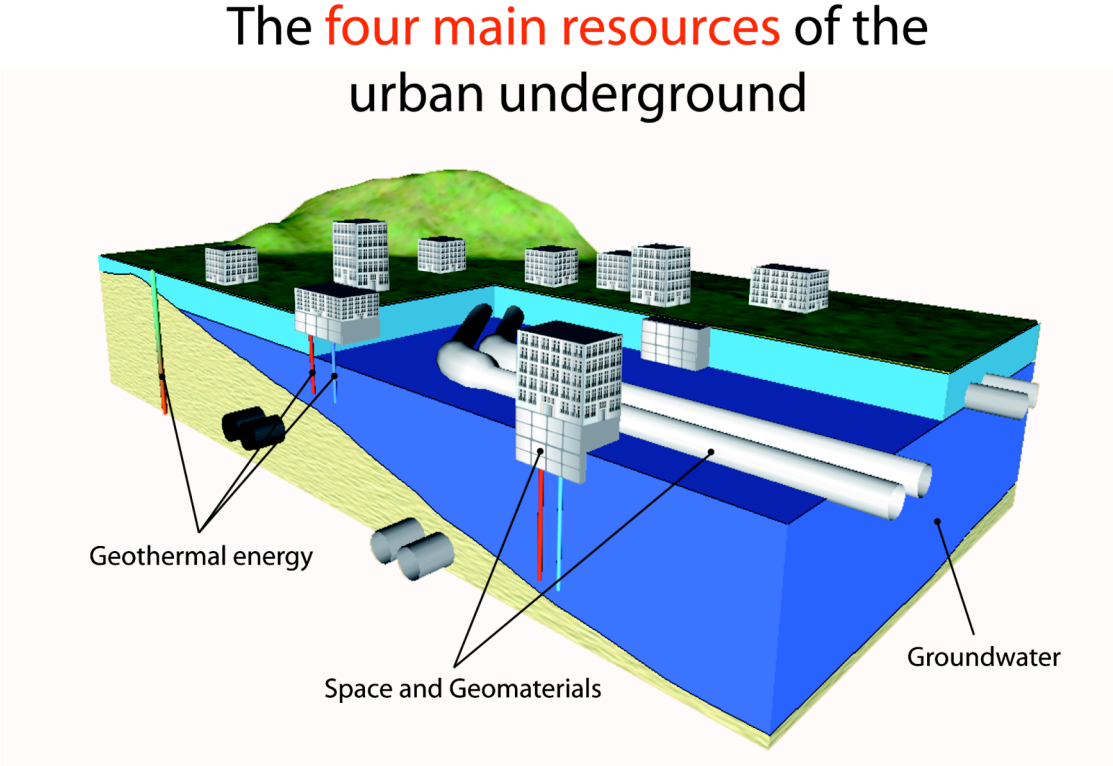

Figure 1 : geology of urban underground as a high resources potential

Traditionally, planning of underground works is done on a single-project basis with little consideration of other potential uses of the same space. This approach often produces interference between uses (e.g. road tunnels interfering with geothermal structures), causes negative environmental impacts (e.g. groundwater contamination), and restricts innovative opportunities for sustainable development (e.g. using waste heat from metro lines for heating buildings).
The present research creates a methodology that will help planners consider and integrate the full potential of the urban underground within the larger context of city planning. Since the way in which the use of the urban underground varies in accordance with a city's specific natural, social and economic circumstances, this research is trans-disciplinary, incorporating both the physical and social sciences. The development of the methodology is based on the results of key research activities. Constraints and opportunities for underground use are identified by establishing the complex linkages between existing underground development and the variables that shape it in cities worldwide. Space, water, energy and geomaterials resources are studied in terms of their interaction and combined use, to optimise their benefits under various geological, legal, economic, environmental and social conditions (fig 2).

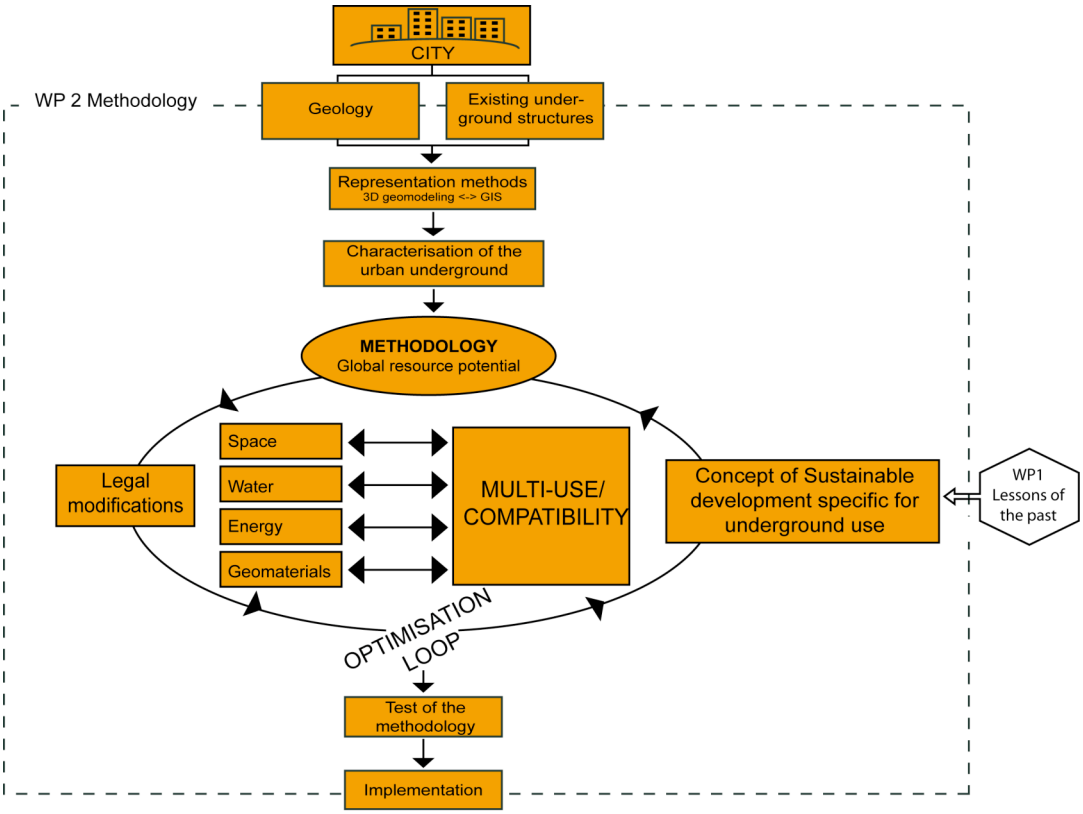

Figure 2 : the multiple-use approach for a sustainable underground planning

This methodology is going to be tested on and refined during a case study on the city of Geneva. Once the methodology has been validated, it will be applied to other Swiss cities to provide general assessments of their underground potential.
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