Constructing Sustainable Cities: Vienna's Sustainable City Implantation

RICHARD S. LEVINE
University of Kentucky

HEIDI DUMREICHER
Oikodrom, Vienna

INTRODUCTION

The movement toward sustainability has been plagued by incomplete or inconsistent definitions and by the dominance of quantitative approaches which are strong on restrictions, but weak on process: strong on rhetoric, but weak on how and where sustainability can happen.

The main thrust of the movement has derived from scientific analyses which insist that we must commit ourselves to do more with less, and less and less. While this approach has successfully accomplished some notable initial programs, (recycling aluminum, changing to fluorescent fixtures) subsequent steps are likely to become successively more difficult, more expensive and less effective, until a point of diminishing returns is reached long before sustainable balances have been approached. Equally troubling, this pervasive quantitative approach is a top down approach starting at the global level (Earth Summit Rio) and working its way down to regional and national programs of restriction and regulation. Such an approach is fraught with the inevitability of controversy and conflict (Who is to make which sacrifices and on what basis? How much must we sacrifice the way of life we have become accustomed to? Do we really believe such sacrifice is necessary, or if necessary will it really make a difference?). In any case as the "Rio plus Five"conference has indicated, the record so far has not been promising.

THE AALBORG CHARTER

There is an alternative approach which has been less visible in the US, but which is gaining momentum in Europe. A key document of this approach is the European Charter of Cities and Towns Towards Sustainability, negotiated and ratified at a conference in Aalborg, Denmark in May 1994 and since endorsed by more than 200 of Europe's most progressive cities. In contrast to the quantitative, reduction-ist approaches which have arisen elsewhere, the Aalborg Charter presents a place-centered (i.e., the city) program to create a local, participatory, balance-seeking process. This puts the Charter squarely in the realm of architecture and urban design and promises to extend both the nature and influence of the design disciplines. The Westbahnhof Sustainable City Implantation is a study aimed at the implementation of the Aalborg Charter on a real site and a real project.

THE CITY-AS-A-HILL: A NEW URBAN MODEL

This paper presents the results of a series of studies commissioned by the City of Vienna, Austria through its Division of Urban Development. The Sustainable City Implantation approach is being considered by the city as a solution to a long standing urban problem through the overbuilding of a major train yard at the Westbahnhof. Developed conceptually through numerous architectural design studio projects and field studies the Sustainable City Implantation (SCI) is inspired by the historic medieval Italian hilltown. This City-as-a-Hill prototype, rendered through a sophisticated and flexible computer systems dynamics model called the Sustainability Engine©, presents a new holistic, people centered, urban vision. In the SCI sustainability is non-negotiable. This means that all major material flow processes are regenerative and the implantation is to be powered solely by solar/renewable resources.

The proposed SCI combines some of the most compelling aspects of the medieval European hilltown with the best of modern processes and technology. Instead of the medieval city on a hill, the proposal is for a City-as-a-Hill whose outer surface in scale and texture resembles the pedestrian scaled medieval towns built to a human measure. Using advanced computer modeling software which allows for the possibility of generating many varieties or models of such SCI's in an interactive and participatory manner, this new urban configuration creates many opportunities not possible in the modern unsustainable city. In our City-as-a-Hill model the outer (upper) surface of the city contains all of the dwellings and neighborhoods, the smaller scaled commercial and institutional activities and the network of public buildings and public spaces—that is, the streets, walkways, stairs and squares which give historic medieval towns their life affirming, pedestrian character. Inside the City-as-a-Hill, daylit by courtyards and light wells, is a series of concourses and gallerias along which are located the large scale commercial, institutional, and industrial spaces as well as the infrastructure and other activities necessary to support a modern sustainable economy.

Over the years that these models have been developed, their structure and complexity have increased at many scales. A new

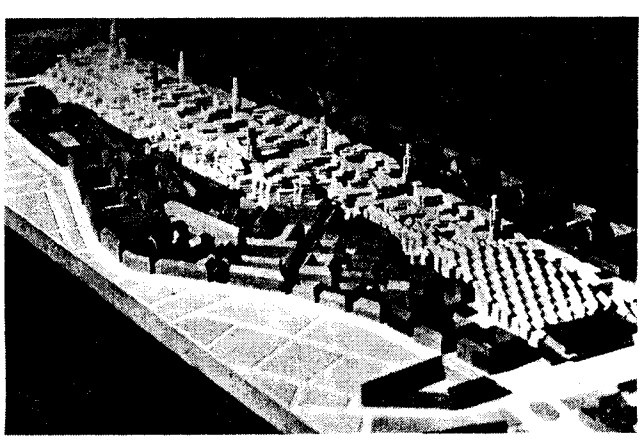


Fig. 1. Aerial view of Westbahnhof Sustainable City Implantation from the southeast (model).

Fig. 2. Plan view of model showing sloped streets running east-west and piazzas.

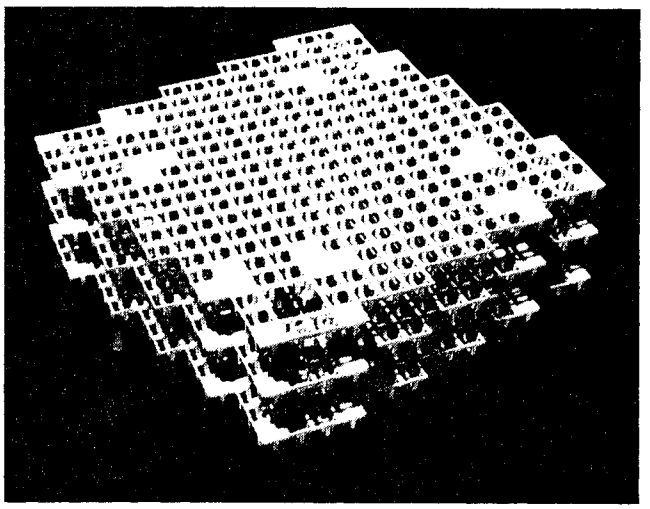
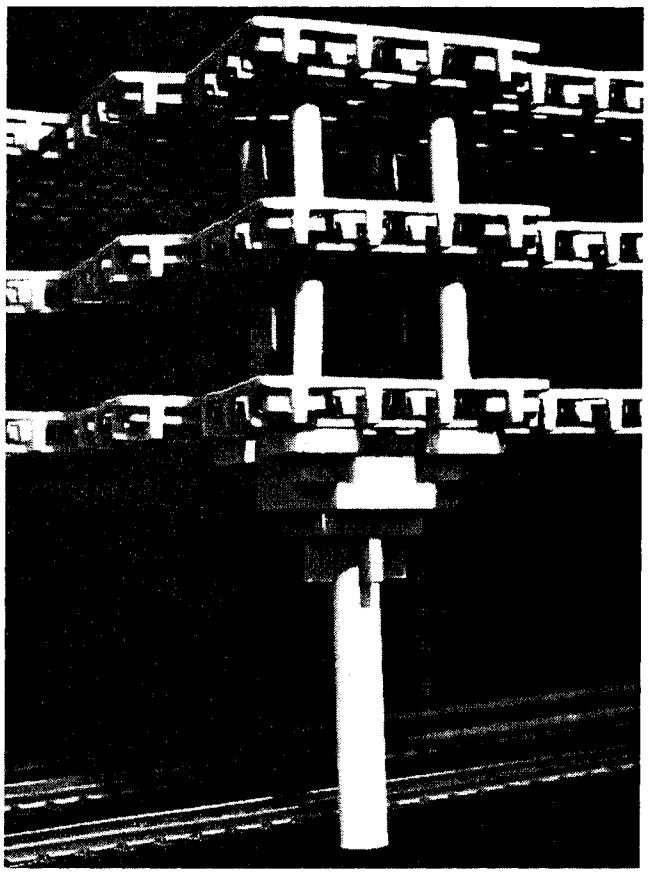


Fig. 3. Coupled Pan Space Frame Construction System: offset grid aligns to both the site and to South.



concrete structural system with unusual flexibility which generates a complex family of building geometries is being used as the framework for both spanning the train tracks below and for creating the inner hill and the urban fabric above. This Coupled Pan Space Frame permits the negotiation of both level and sloping streets on the constructed hill, giving it the sort of three dimensional, organic character rarely seen in modern architecture and modern cities. More recently, the use of computers to assist in converting theory into practice has made it possible to increase both the flexibility and the complexity of the urban models.

VIENNA'S SUSTAINABLE CITY IMPLANTATION

Behind the Westbahnhof, one of Vienna's main rail terminals, lies a train yard 1.5km long by 200m wide. For many years this yard has been a wound within the city, dividing a neighborhood and creating near slum conditions on either side of the yard. There have been many proposals to overbuild the yard but none has been either a suitable economic proposition or a sufficient urban contribution to be acceptable the city. The present proposal builds a glazed, vaulted train shed behind the terminal building at the east end of the site. It is in part in the tradition of the early glass train sheds still to be found in many major European cities, except that at the Westbahnhof the hectares of glazing contain integrated photovoltaic collectors which deliver a substantial percentage of the Implantation's energy requirements while modulating the climate and quality of light entering the terminal. A pedestrian street starts from the terminal and runs the length of the site to the west, parallel to the tracks, rising up the constructed City-as-a-Hill at a gentle six percent slope. As it rises it crosses other horizontal floor levels and at every third level (levels 4,7,and 10) it passes through a public square or piazza. A streetcar runs along this otherwise pedestrian street and after passing through the main piazza (Hauptplatz) at level 10 it descends through piazzas at levels 7, 4, and 1 to join an existing trolley track at ground level. On the surface of the constructed hill is a human-scaled town with networks of streets, and stairs- piazzas and paths, weaving between three to five story neighborhoods of dwellings and a full variety of shops and services. Also on the hill's surface is a winter garden, growing food year round, and a network of south-facing greenhouses. At the west end of the village is an east-west technology and education exchange center which is roofed by a large terraced

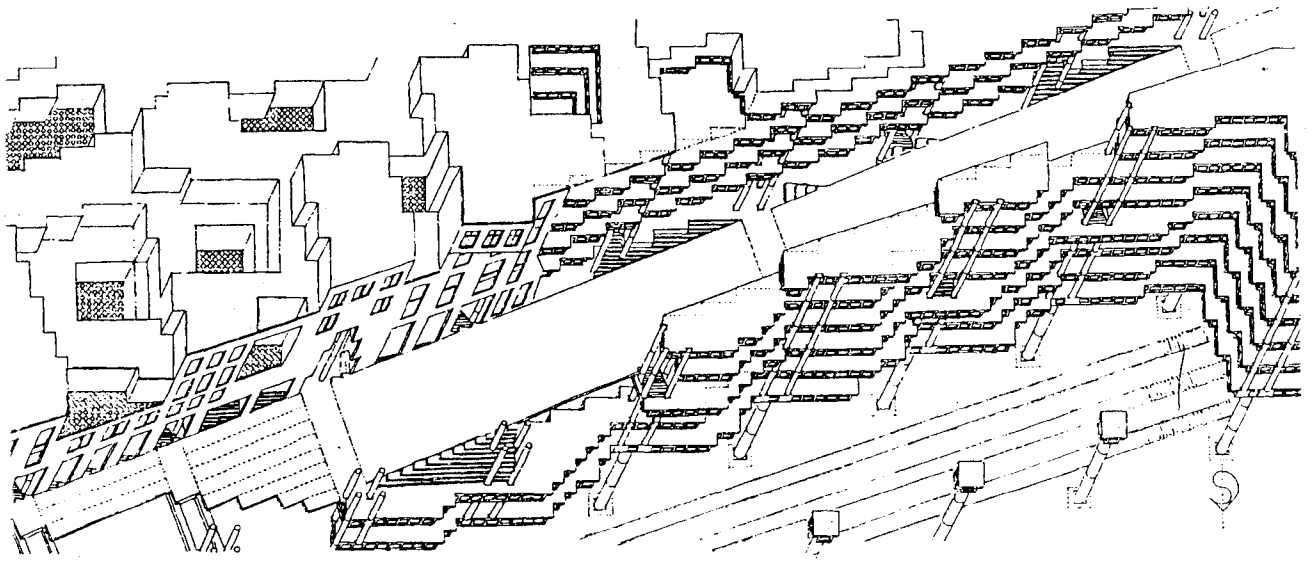


Fig. 4. Cutaway view showing coupled pan space frame and sloped street.

ecological park, connected to the existing technological museum. At this end of the site another sloping street begins from an existing park. It is developed as a linear park culminating at the level 10 Hauptplatz. In the Hauptplatz is an "energy fountain," which is also an energy gnomon; that is, the height of the fountain is an indicator of the rate at which the Implantation is exporting renewable energy to the larger city of Vienna. Overflow from the fountain trickles down through the linear park, feeding various ponds and other green areas along its course. The roofs of the outer city are either glazed greenhouses or flat roofs which are all utilized either as private or semi private terraces, gardens, courtyards, public parks, playgrounds or piazzas.

Running almost the length of the site a three-story-high galleria runs within the hill at level 4 and another shorter one runs at level 7 connecting the piazzas at those levels. Along these gallerias, daylit through courtyards and light wells from above are all the large major institutional, commercial, and industrial activities as well as infrastructure, service, parking, tracks and transportation; activities whose large scale often disrupts the integrity of a traditional urban fabric, but which are necessary to sustain a modern urban economy. By their location within the hill they provide maximum accessibility without compromising the small scale, village character of the city above.

The Sustainable City Implantation as a totally urban construction multiplies value, in part by multiplying real estate. Railroad services occupy almost the entire site at the original ground level, but there are a number of additional layers of developable real estate in the framework above with their own appropriate functions and activities. Because it is completely urban, and has no open ground of its own, the Implantation is to be linked with a rural partnerland which is dedicated to its sustainability rebalancing process. On this land most of the agriculture and energy from solar/regenerative sources will be negotiated with its urban counterpart. The urban implantation together with its rural partnerland will constitute a contained ecological footprint (appropriated environmental space). That is, the combined land area would provide all the major energy and resources needs of this territorial partnership while resolving any ecological imbalances on site.

THE SUSTAINABILITY ENGINE: THE AUTONOMOUS NERVOUS SYSTEM OF THE CITY

In subsequent stages of the work, the city models and their parts will become the framework for the integration of other systems including: mechanical, electrical, material and infrastructural systems, facilities management, information, energy and material flow models, economic activity, imports and exports (input/output) to the city, and the modeling of the ecological balances within the city and between the city and its partnerland. This will be done with a systems

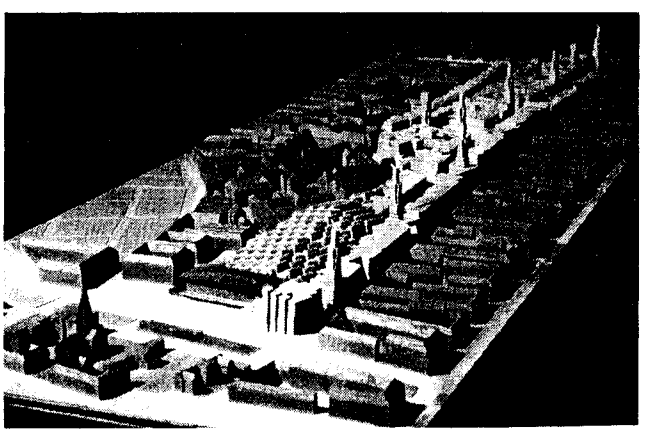


Fig. 5. Sustainable City Implantation proposal seen from the northeast.

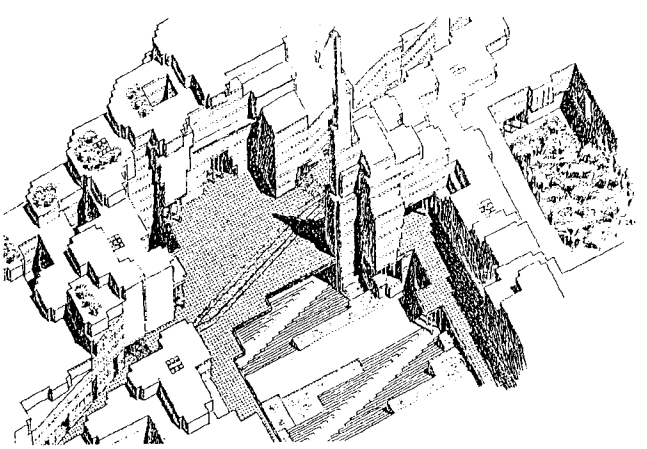


Fig. 6. View of the Hauptplatz: the main square at level 10.

dynamics program called the Sustainability Engine©. Our operational definition describes the Sustainable City Implantation as one which exports no problems to its larger environment or to the future and absorbs some of the larger city's problems while exporting to the city a positive sustainability quotient. Thus sustainability is established as the one fixed, non-negotiable characteristic and all other determinations and negotiations begin from there.

The Sustainability Engine© is the autonomic nervous system of the Sustainable City Implantation. Both during the design process and in the governance and management of the city the Sustainability Engine© houses both the architectural and urban modules of the city as well as the energy, material flow and process models that are studied and experimented with in the development of the city. As the city, its processes and industries are studied, the Sustainability Engine© provides frequent feedback on the ongoing state of the system and indicates the sectors which are in need of rebalancing. It is also intended to provide many utilities to facilitate the balance-seeking and negotiation, of the design process.

SOLAR ENERGY AND ARCHITECTURE

As the focus in architecture and urban design broadens and deepens to become the movement for sustainable cities, new and often surprising opportunities will emerge. As attention shifts from providing energy to buildings from solar means, to using renewable/regenerative energy and other resources as part of a larger sustainability balancing process at the urban scale, it is no longer a primary issue to maximize the utilization of the sun at the scale of the single dwelling. For example investment in solar energy may be more valuable for high temperature applications at the urban scale, using energy cascading through several applications before the final stage where energy as waste heat is used in the space heating of buildings. If as in our urban model, dwellings are wrapped over industries, which would likely include recycling, reprocessing and energy from waste product applications, then as the urban organism "looses" heat through its skin, the dwellings and neighborhoods that constitute the skin receive their heat as a by-product of these processes.

In early solar work an often stated objective was to make the individual dwelling as energy autonomous as possible. While an autarchic house may have been theoretically possible, the financial costs would have been prohibitive, not to mention the social costs. We live in communities, in cities and to isolate a dwelling and thus remove it from the larger equation, at the same time prevents the diversity of its interaction from benefiting the larger city. The city as an organism is the appropriate scale for people, dwellings and systems to interact to negotiate their dynamic balance. Solar energy will be the catalyst for such a balancing process, but at the scale of the city solar means a great deal more than it could mean at the scale of the dwelling. Incorporating the necessary partnerland concept for its food, biomass energy, forest products, carbon dioxide rebalancing, water resources, solar conversion area, recycling of biowaste, recreation, and nature, creates an ecological footprint region where the city can be demonstrated to be sustainable. The rural partnerland program will give new economic and cultural vigor to rural regions while providing the cities with a sustainable economy. This is the future of renewable energy.

Since the end of the Modern period, architecture has experimented with many short-lived tangential movements. Most of these have been stylistic exercises with little connection to society or its problems. Form and function have become increasingly alienated. The advent of this new design problem, the sustainable city, leaves one breathless for both its scope and its wealth of possibilities. It is a challenge to both the highest creative, as well as integrative skills of the best of our architects. This is the future of architecture.

CONCLUSION

The Sustainable City Implantation is seen as the minimum scaled project for the negotiation of sustainability. Together with its rural partnerlands, the SCI will constitute a complete ecological footprint. This means that the SCI will obtain all its major material and energy requirements from on-site sources and from renewable/regenerative means. It will do this without exporting any material or resource problems beyond its boundaries or into the future. It will create these internal balances in a dynamic, on-going, participatory process through which many scenarios of resource use are modeled and selected. Through this approach, Sustainability then is understood as a process by which the stakeholders decide how they will afford to live within the limits of their land, resources and creativity.

At the moment that the first SCI is completed and is shown to work on a sustainable basis a significant threshold will have been crossed. At that moment the only cultural or economic endeavors that will be seen to be acceptable or even possible will be those that operate on a sustainable basis. The fundamental challenge of our generation is to forge a sustainable way of life for the cities of our planet. It is a cultural problem, not a technological problem. It is a design problem not just an analytical problem.

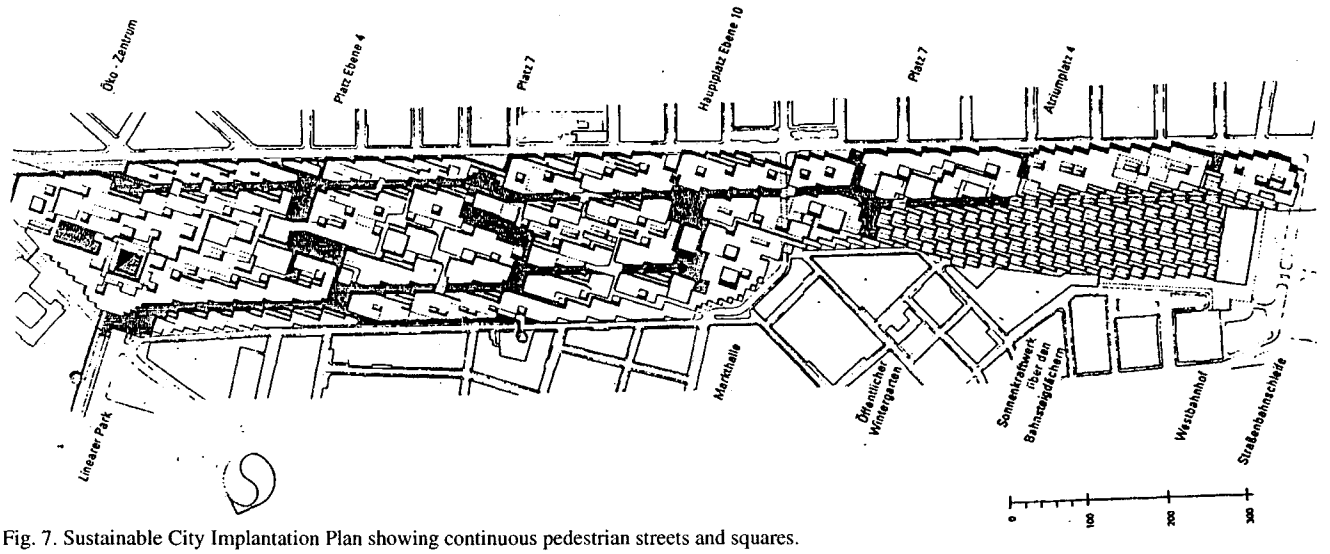


Fig. 7. Sustainable City Implantation Plan showing continuous pedestrian streets and squares.

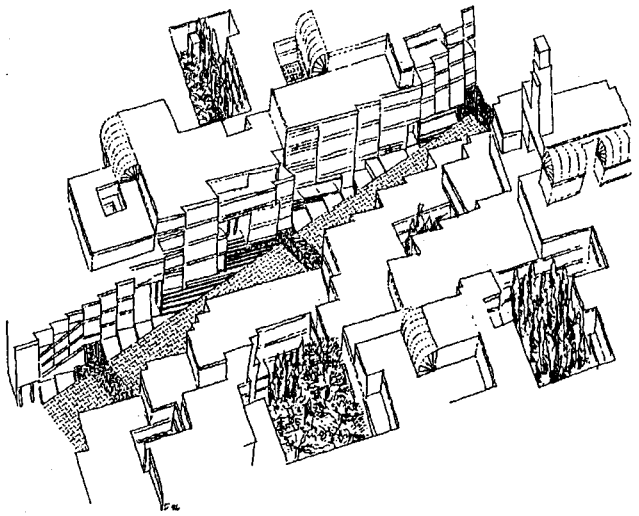


Fig. 8. Sketch of street with six percent slope.

REFERENCES

Dumreicher, Heidi, Richard S. Levine, et.al., Stadthügel Westbahnhof: Ein Kostprobe, Vienna (1995).

Dumreicher, Heidi, Richard S. Levine, et.al., Stadthügel Westbahnhof: Die Dridimenzional Stadt, Vienna (1996).

ICLEI, The European Charter of Cities and Towns Towards Sustainability (1994).

Levine, Richard S., Ernest J. Yanarella, "Don't Pick the Low-Lying Fruit: Sustainability from Pathway to Process," *American Solar Energy Society* (1994).

Yanarella, Ernest J., Richard S. Levine, "Does Sustainable Development lead to Sustainability?" *FUTURES* (October 1992).

Yanarella, Ernest J., Richard S. Levine, "The Sustainable Cities Manifesto," Ernest J. Yanarella, Richard S. Levine, *BUILT ENVIRONMENT.* (May 1992).

PROJECT TEAM

Florentina Astleithner, Heidi Dumreicher, Harald Fenz, Scott Flemming, Frederike König, Christian Krotscheck, Richard S. Levine, Michael Narodoslawsky, Rob Nichol, Reinhard Paulesich, Richard Perfler, Claudia Pichl, Veronika Prändl, Taghi Radmard, Fredrich Schneider, Otto Schütz, Claudia Schwab, Nathan Smith, Horst Steinmüller, Ernest J. Yanarella.

PROJECT SPONSORS

Magistrat Wien MA18/21, Oesterreichische Nationalbank, Jubiläumsfonds, Bundesministerium für Wissenschaft und Verkehr, Bundesministerium für Land und Forstwirtschaft, Land Niederösterreich, Urban-Büro Wien, University of Kentucky.