03
Keynote Speakers

G. Habert, A. Schlueter (eds.): Expanding Boundaries © 2016 vdf Hochschulverlag AG an der ETH Zürich
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Koen Steemers
University of Cambridge

Koen Steemers was recently named in *Building Design*'s inaugural list of the "50 most influential people in UK sustainability". He studied Architecture at the University of Bath and subsequently joined Energy Conscious Design, (now ECD Partnership, London). His PhD work at the University of Cambridge developed new insights into the links between urban design and energy consumption. He acted as consultant on various projects; became a Director of Cambridge Architectural Research Ltd (1991) and of architectural practice CH+W Design (2015). He has been Director of the Martin Centre (2003-08) and Head of Department (2008-14).

Koen Steemers's expertise is based on being a registered architect (CH+W Design); environmental design consultant (Director of CAR Ltd); consultant to UN-HABITAT; President of PLEA (Passive & Low Energy Architecture international association); Fellow of Jesus College, Cambridge; Guest Professor at Chongqing University, China and at Kyung Hee University, Korea. He has extensive research assessment experience, including two stints on the UK Government's research reviews and as deputy Chair of the Hong Kong Research Assessment Panel 2014. He is currently on the UK Green Building Council *Healthy Homes* task group.

Koen Steemers heads a team of 14 researchers in the *Behaviour and Building Performance* (BBP) Centre. He coordinates the MPhil course in Architecture and Urban Studies and supervises PhD students. He has produced over 200 publications (with over 4000 citations), including 10 books ranging in subject matter from *Sustainable Urban and Architectural Design* (2006) to *Daylight Design of Buildings* (2002).

See opposite page for an abstract of Koen Steemers's keynote lecture. This lecture has been recorded and can be viewed **online**.

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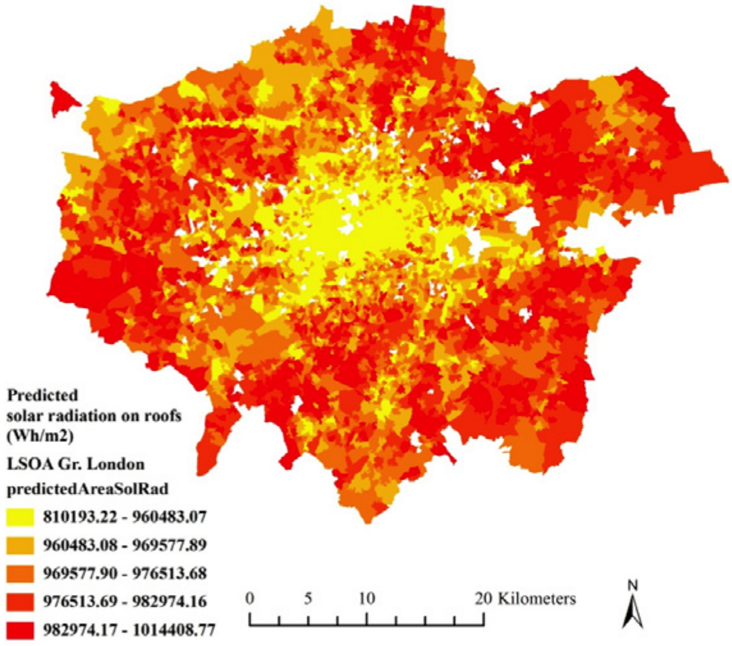
right:
The map illustrates the distribution of the predicted values for roof solar renewable energy potential in London.The results show that ca. 70% of the solar potential for both roof and façade areas can be explained by a combination of urban form descriptors. Using spatial data and a GIS platform, these descriptors are relatively easy and quick to compute, which makes this approach a good contender for rapid analysis of urban solar potential at the neighbourhood and city scales.
From: J.J. Sarralde, D.J. Quinn, D. Wiesmann, K. Steemers, (2015), 'Solar Energy and Urban Morphology', *Renewable Energy*.



below:
Variable heights and spacing at a high density (FAR=7.2) achieves the same sky view factor (SVF=0.3) as a regular array at one-fifth of the density (FAR=1.44).
From: V. Cheng, K. Steemers, et al. 'Urban Form, Density and Solar Potential', *PLEA 2006*

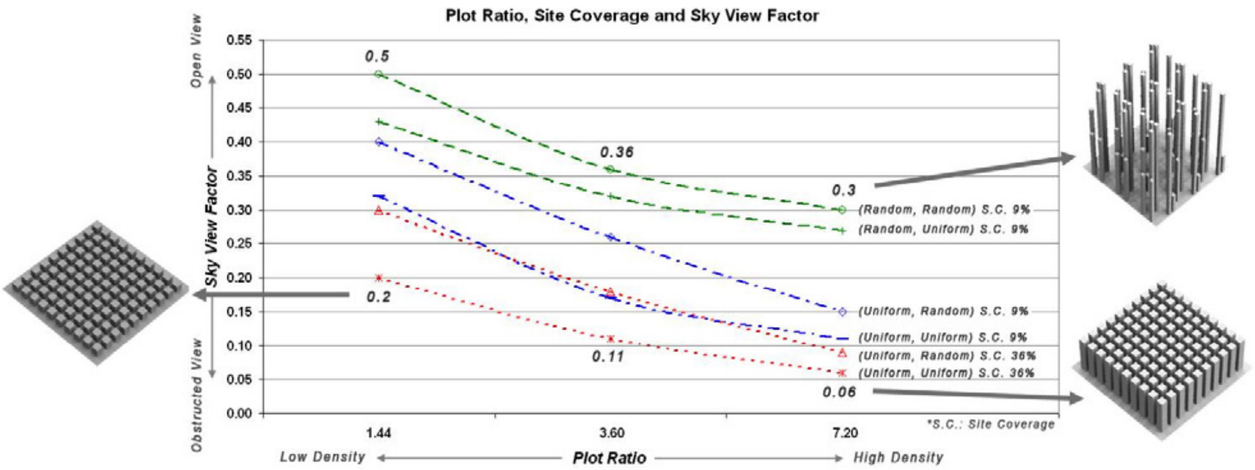
'Urban Form and Energy:
Systems Thinking and Environmental Diversity'

Through the lens of 'systems thinking' (the theme of SBE16 Zurich) this presentation explored the environmental performance of urban form. It reviewed analytical techniques ranging from simplified strategies to integrated simulation. Although simple rules have been influential, they are often too simplistic to reveal complex, real-world, interconnected or diverse strategies. More sophisticated and dynamic analysis of urban form, particularly in relation to energy performance and outdoor comfort, has revealed the value of environmental diversity. In place of thinking about optimal solutions, the notion of spatial and temporal diversity improves environmental performance. This is demonstrated through the analysis of urban form where diverse designs outperform regular urban arrays in terms of energy use and outdoor comfort. Finally, using a systematic integrated modelling approach that assess urban form with respect to socio-economic, land use, transport and building design was presented.

The approach is to test current and future development scenarios (e.g. compact form versus sprawl) over the longer term and to identify the relative energy consequences. Key results are:

- At an aggregate and regional level, urban scenarios have a modest relative impact on energy.
- The scenarios change the spatial distribution of energy demand which has implications for energy supply (e.g. compact form - CHP, ground source systems and networks; versus sprawl - solar and wind).
- The uptake of retrofit technologies, occupant behaviour and expectation, and the rate of new-build have a large impact on energy demand for all scenarios.

'Systems thinking' reveals complex and diverse strategies regarding: a) social v. technical solutions, b) individual behaviour v. urban systems, and c) static v. dynamic characteristics. Such richness of systems thinking can be explicitly embraced for sustainable urban design.



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Peter Edwards
Singapore-ETH Centre for Global Environmental Sustainability

Peter Edwards took the natural science tripos at Cambridge University, specializing in botany, and graduated in 1970. In 1973 he obtained his Ph.D. degree, also from Cambridge, for a thesis entitled *Nutrient cycling in a New Guinea montane forest*. He was a lecturer/senior lecturer in ecology at the University of Southampton, England, from 1973-1993. Since 1993 he has been professor of plant ecology at the Swiss Federal Institute of Technology (ETH), where he has also served as chairman of the Department of Environmental Systems Science.

Peter Edwards has always had a strong interest in the application of science and technology for better policy. He was a founder and first executive secretary of the Institute for Ecology and Environmental Management, a professional organization for environmental practitioners. At ETH he was faculty coordinator and member of the executive board of the Alliance for Global Sustainability, a research partnership between several leading universities.

He is author of around 300 refereed scientific papers and author/editor of several books covering a wide range of environmental topics including ecosystem processes, insect–plant interactions, environmental management and biodiversity. His recent research has focused particularly on large-scale processes in terrestrial ecosystems, including interactions between large herbivores and vegetation, the dynamics of vegetation on the flood plains of large rivers, and the role of biodiversity in agricultural landscapes.

See opposite page for an abstract of Peter Edwards's keynote lecture. This lecture has been recorded and can be viewed **online**.

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right:
Aerial view of the Ciliwung River in Jakarta, Indonesia.

below:
Visualization tools in 'Value Lab Asia' at the Singapore-ETH Centre.

Images © FCL, Singapore-ETH Centre.

'Future Cities Laboratory: Innovative Research for Sustainable Cities'
Asia's urban population will grow by more than one billion people by 2050. ETH's Future Cities Laboratory (FCL), which forms part of the Singapore-ETH Centre, was established to provide knowledge and ideas to make these rapidly growing cities more sustainable and resilient. This lecture presented examples of the kinds of problem-oriented research undertaken at FCL, and the challenges of putting new knowledge into practice.

One FCL study set out to quantify the materials used to transform Singapore into a modern city, and examined the environmental and other impacts. In total, some 2000 million m^3 of material were required for land reclamation, which was obtained by importing sand from other countries, topping of hills in Singapore and dredging.

A second study developed a new approach to urban river rehabilitation. The river studied was the heavily polluted Ciliwung River in Jakarta, which floods regularly, causing untold misery to residents. The multi-disciplinary research team used a combination of hydrologic, hydrodynamic and 3-D landscape modelling to assess the consequences of potential interventions in the urban landscape. Working closely with stakeholders, they developed design scenarios aimed at restoring the riparian ecosystems and improving the quality of life for local communities.

A third example focused on the extensive areas around many Asian cities where urban and agricultural forms of land use coexist (a settlement form known as *desakota*, which can easily develop into an extended urban sprawl). The aim of this project was to develop new forms of urban design that provide the benefits and quality of an urban life-style while preserving agricultural communities.

An important part of the 'glue' holding these projects together are the superb facilities provided by the 'Value Lab Asia' for modelling and presenting 3-D and more-dimensional data. These provide not only an essential research tool, but also a means for translating research into solutions that practitioners can use. We argue that this kind of transdisciplinary research, engaging stakeholders at all stages of the prcoess, will be essential for achieving a sustainable urban future.

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Chrisna du Plessis
University of Pretoria

Chrisna du Plessis is a Professor in the School for the Built Environment, University of Pretoria, South Africa. She was formerly Principal Researcher at Council for Scientific and Industrial Research (CSIR) Built Environment in Pretoria, South Africa. Her work focuses on sustainable human settlement and the application of sustainability science in the built environment.

Chrisna du Plessis is known for her work on the evaluation of policy and research strategy for sustainable building and construction in developing countries, and is currently concentrating on urban sustainability science at both theoretical and technical levels. Her main expertise is the development of trans-disciplinary research and development programs that follow a complex systems approach to the development of human settlements as sustainable social-ecological systems.

She studied architecture at the University of Pretoria, South Africa, obtained a PhD in Urban Sustainability from the University of Salford, UK, and was awarded an honorary doctorate in technology from Chalmers University of Technology in Gothenburg.

Chrisna du Plessis represented South Africa in the Earth Charter drafting and consultation process and contributed to several national and international policy and strategy initiatives on sustainable settlements. She was lead author of the United Nations Environment Program's *Agenda 21 for Sustainable Construction in Developing Countries* and is Theme Coordinator: Sustainable Construction for the International Council on Research and Innovation in Building and Construction.

See opposite page for an abstract of Chrisna du Plessis's keynote lecture. This lecture has been recorded and can be viewed **online**.

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'Thriving in the Symbiocene: A Message of Hope'
We are living through the end of the world as we knew it. Everything that has been familiar about our planet and our world is changing and we will need to change with this, or become extinct. This is not a bad thing. In the breaking down of old systems, we have been given an opportunity to change. And the biggest change we need to make is in the stories we tell ourselves. We can remain stuck in old stories of separation and denial, or start telling new stories of collaboration, cooperation and symbiosis in which humans are restored to their natural place as members of the community of life whose purpose is to create an abundant and thriving future in which all species can flourish for all time. We can do this if we do more than slow down the degeneration of our systems, and start working on developing regenerative systems that can adapt and transform to meet the unknown conditions of our future world. If we understand that what needs to be sustained is the functional integrity of the global social-ecological system; and what needs to be developed is the adaptive capacity and evolutionary potential of this system. If we shift the basis of our relationship with planetary systems and other members of the web of life, including other humans, from exploitation to adding value, doing more good, instead of less bad. If we shift to improving and enriching our relationships with each other, with nature, with our neighbours and future generations; focusing on contributing, adding to and giving back.

As designers and engineers our role is to become the matchmaker, mediator and facilitator of the dialogue; the narrator constructing the story of a different future; and the mentor leading the stakeholder team to another way of being. But to do this, we need to start with self, becoming impeccable warriors who come to the table with a soft and open heart, with compassion for the fears and failures of ourselves and others, yet fierce in our determination to create a better future.

left:
Lecture by Chrisna du Plessis,
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Serge Salat
Urban Morphology and Complex Systems Institute, Paris

Serge Salat is an urban planner, a scientist in the science of complexity, an art historian and an internationally recognized architect/artist. He is the founder and President of the Urban Morphology and Complex Systems Institute based in Paris.

Serge Salat has been seminal in applying the science of complexity to cities. He has authored more than 20 books on art and architecture, as well as more than one hundred publications and communications. He has opened the way in introducing physics far away from the equilibrium, fractals, as well as network analysis and complexity science to a better understanding of cities.

He is a practicing architect and city planner and advises international organizations such as United Nations, The World Bank, AFD (French Agency for Development) and CDC (Caisse des Dépôts et Consignations), on strategic transitions of urbanization in particular in China, where he brings a unique integration of scientific skills, economic, financial and governance competence with his experience of designer of large scale projects to advise on national policies as well as on specific projects. He is one of the authors of the Fifth IPCC assessment report.

Born in 1956, he graduated from École Polytechnique with a master of mathematics and physics (Paris, 1979), from Institut d'Études Politiques (Paris, 1982), and from École Nationale d'Administration (Paris, 1984). He obtained a Ph.D. in Economics (Université Paris IX Dauphine, 1979–82); a Ph.D. in Architecture (École d'Architecture de Paris La Villette, 1989); and a Ph.D. in History and Civilizations (EHESS, Paris, 2010).

See opposite page for an abstract of Serge Salat's keynote lecture. This lecture has been recorded and can be viewed **online**.

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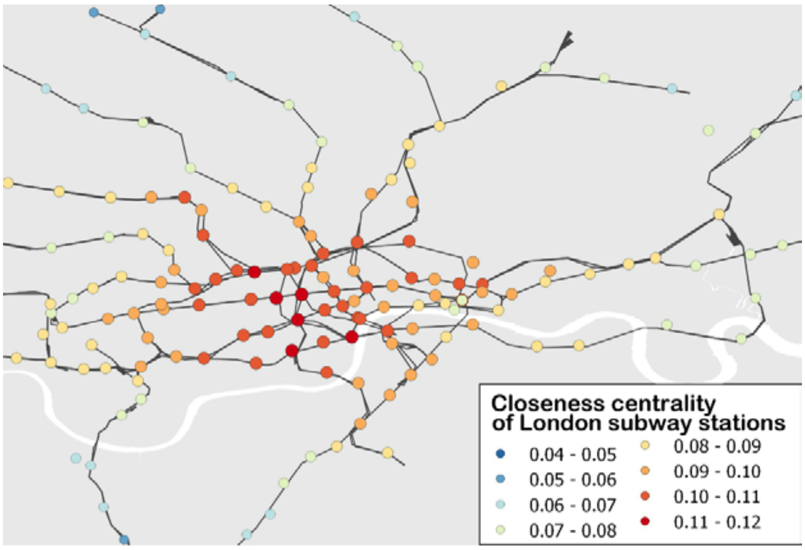
right:
London subway closeness centrality map of subway stations (topological distance in the network of a given station to all the others).



below:
Greater London jobs density peaks at 150.000 jobs per km² in the City of London and is aligned with transit accessibility.

London Gross Value Added per km² ranked from the most economically productive urban land to the less productive shows an inverse power law where 20% of London urban land produces 67 % of the city's GDP.

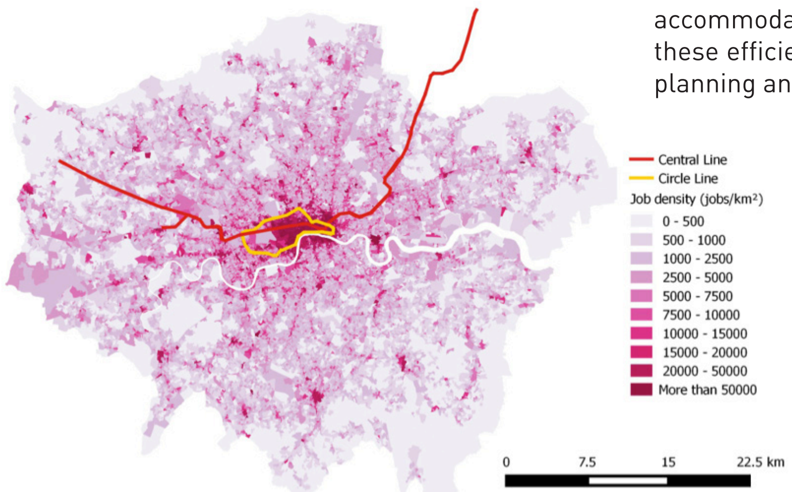
Images © Urban Morphology and Complex Systems Institute.

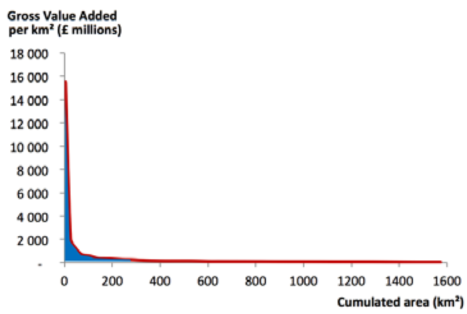
'Systems Thinking for Integrated Sustainable Urban Planning'

Systems thinking and integrated spatial planning are key for achieving resource efficiency. Articulated densification and strategic intensification of cities reduces the need for resources while increasing economic growth and social inclusiveness through enhanced access to jobs opportunities.

Scientific evidence derived from cross analysis of dozens of cities shows that resource efficient urban forms create cities that are more competitive, with lower transport and housing costs, with high quality neighborhoods, with lower infrastructure costs and lower CO_2 emissions, cities that are resilient to natural hazards. Doubling jobs density increases by 5 to 10% economic productivity; e.g. 60% of New York office space is on 9 km² (1% of NYC land area). Enhanced access and mobility lowers transport and housing cost: e.g. in Hong Kong, 83% of jobs are within 1 km of mass transit; in USA, residents near Transit Oriented Development (TOD) stations spend 37% of income on transport and housing against 51% for other people.

These resilient and efficient cities share common features of self-organized complex systems. They are networks of relations from which locations emerge. They have no characteristic scale but show wide variations of sizes, densities, concentrations, strengths of connections (e.g. volume of commuting flows in transit lines), and centralities in their subway networks across urban space. Ubiquitous power laws order the frequency of sizes, densities, connectedness, and, in some cases, centralities with common exponents across different cities that are referred in physics as universality classes. For example, the frequency of plots of a given size follows in NY, Paris, Hong Kong a power law of exponent – 0.5. The size of parks also follows power laws in Paris, NY, Rome, Barcelona. GDP creation is highly concentrated following a Pareto principle where 20% of the urban land produces 80% of the city GDP (e.g. London, Zhengzhou). Jobs densities are highly concentrated with a hierarchy exponent of the power law of -1, e.g. 1.5 million jobs in 15 km² in London and NYC. A long term vision of the city shape, and highly granular planning with wide variations of FARs at small block scale, like in NYC and Singapore, completed by flexibility to accommodate market changes, allows shaping these efficient city forms with a delicate balance of planning and market.





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Jens Feddern
Siemens Building Technologies

Jens Feddern is heading the Center of Competence Building Performance and Sustainability for South and West Europe. This organisation is acting as a service provider with the specific knowledge and experiences in the different regions and is assuring the proper risk management especially for energy efficiency and modernization projects.

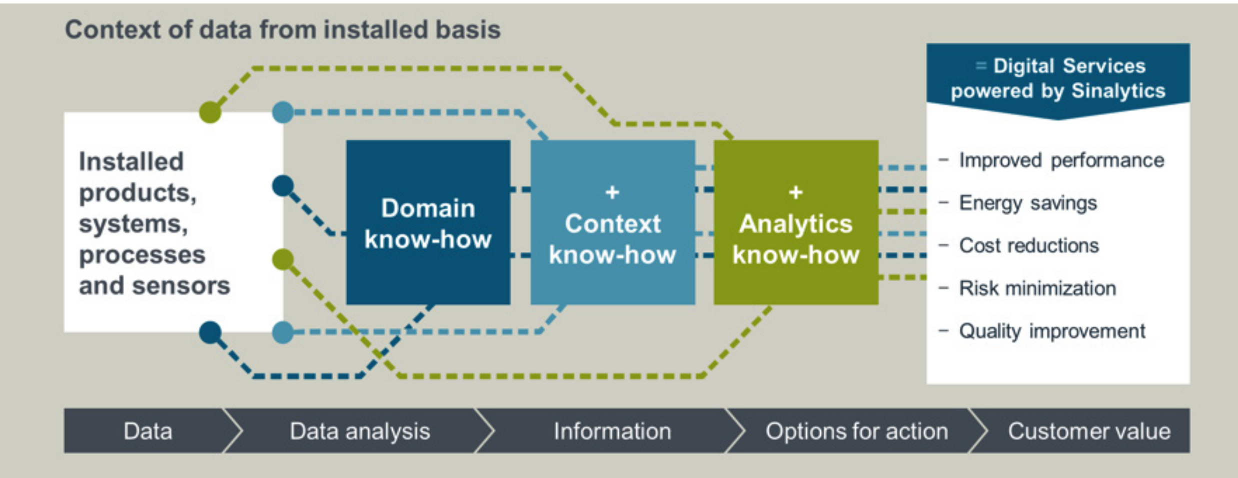
He holds a degree in electrical engineering and executive master in business studies. Jens Feddern has been working for Siemens since about 16 years in various functions in product development, business development and global account management with a specific track record of more than 10 years in the life science industry.

See opposite page for an abstract of Jens Feddern's keynote lecture. This lecture has been recorded and can be viewed **online**.

below:
Digitalisation in buildings – how to transform data inform data into meaningful information and into customer value.

opposite page:
Comprehensive data analytics for optimisation tasks – detect the potential and supervise the results.

The path to maximise building performance – holistic view on the entire building infrastructure and beyond.



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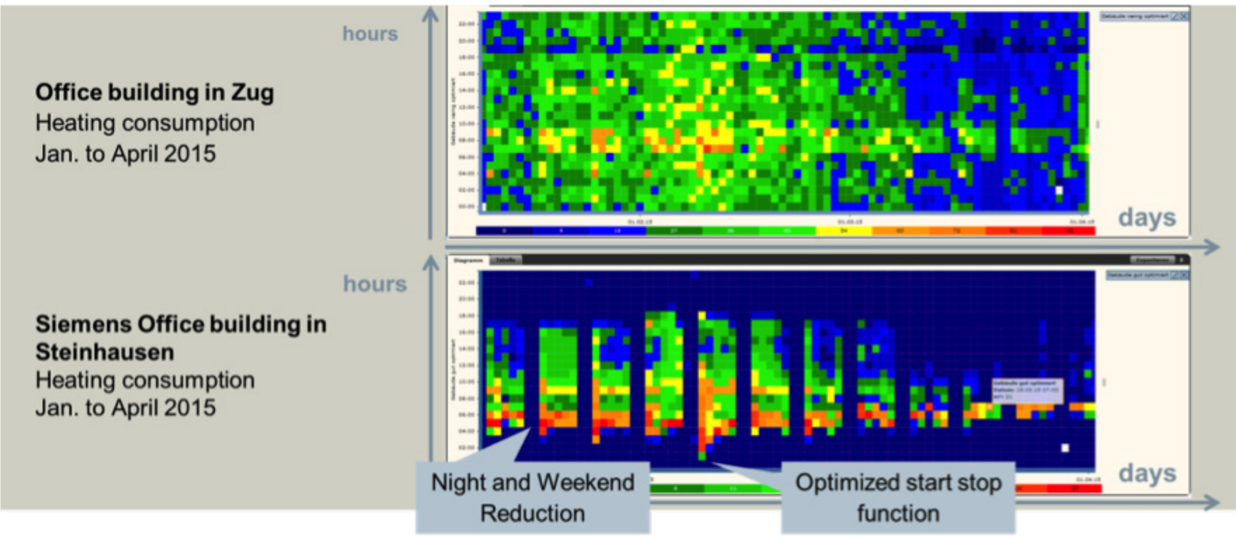


'Expanding Boundaries:
Systems Thinking for Building Performance'

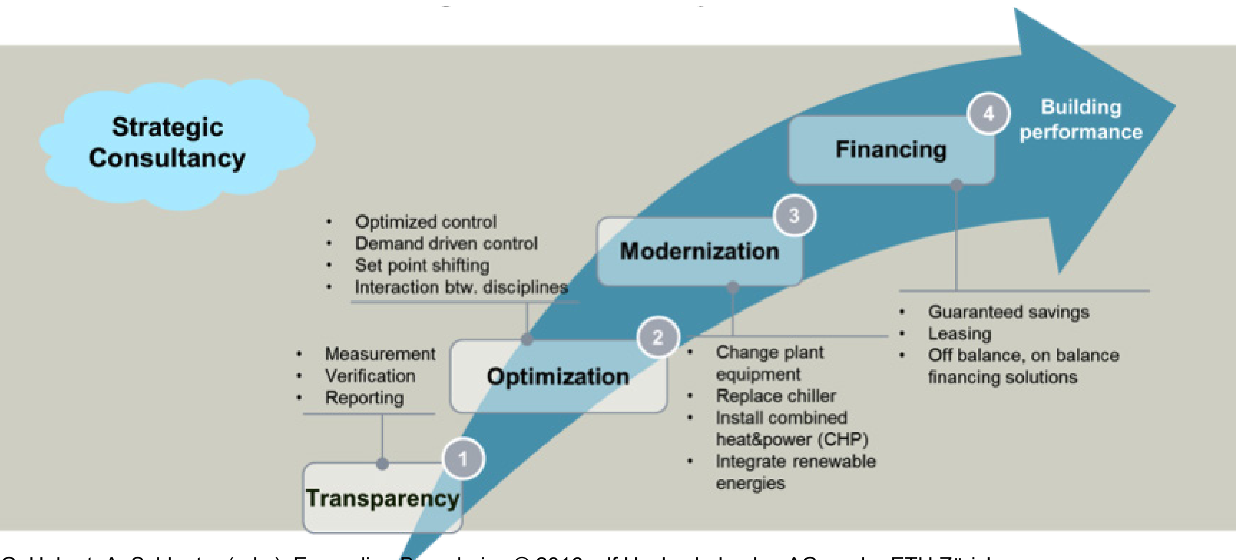
Europe's building stock has a significant modernisation potential, but less than 1% is explored year over year. The key to success is not a one-to-one replacement of equipment that is at the end of the life cycle or even broken, but a holistic analysis and modernisation of the entire building infrastructure whilst considering actual user needs.

80 % of a building's life cycle costs occur during ongoing operation but significant decisions are already made during construction. The planning must rely on numerous assumptions about the future use and operation and technical innovation is increasing while the buildings are getting older.

To get to know exactly the current and future needs comprehensive data collection provides a solid foundation to maximise the building performance during ongoing operation.

Big Data or even better Smart Data provide the foundation for systematic analysis and predictions. This analysis is based on thorough technical understanding, detailed knowledge about the individual application and comprehensive analytic methodologies.

This keynote lecture has shown the Siemens path to maximise building performance from transparency, over opimisation to comprehensive modernisation. The digitalisation in buildings was highlighted and as a consequence the digital transformation of services was explained. Several examples and case studies have demonstrated the successful application in practice.



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