ECOCITIES

VTT's concept for sustainable community and neighbourhood regeneration and development

Pekka Huovila[1], Carmen Antuña Rozado[2,*]

[1] VTT Technical Research Centre of Finland, Tekniikantie 4 A, Espoo; P.O. Box 1000; FI-02044 VTT, Finland
Pekka.Huovila@vtt.fi
[2] VTT Technical Research Centre of Finland, Tekniikantie 4 A, Espoo; P.O. Box 1000; FI-02044 VTT, Finland
Carmen.Antuna@vtt.fi
[*] Author to whom correspondence should be addressed

ABSTRACT

VTT Technical Research Centre of Finland has done research on different aspects of sustainable building since decades. There's a continuous stream of international research projects related with sustainability metrics and building performance, indoor climate and energy efficiency, product development, sustainability assessment and decision support tools. The focus is nowadays increasingly stretched towards sustainable neighbourhoods covering also infrastructure and economic and social assessment. VTT has 50 to 100 experts doing research on sustainable built environment. The number is bigger if the areas of water and waste management, transport, energy systems, etc. are also counted.

Based on the wide expertise described, and building on recent experiences carried out in different parts of the world (China, Russia, Finland, Kenya) which can be somehow considered the origin of the new formulation of the concept developed by VTT in line with its Research and Innovation Vision 2020, EcoCities provides a framework for sustainable community and neighbourhood regeneration and development focusing mainly on developing countries and emerging economies. EcoCity Miaoufeng (China), EcoGrad in St. Petersburg (Russia), EcoDrive (Finland) or UN Gigiri in Nairobi (Kenya) are the main references prior to the launch of the EcoCities concept presented in this paper.

Among the main challenges addressed by EcoCities are: climate mitigation and adaptation, sustainable urbanization and affordable housing, integrated planning and funding availability, capacity building for local solutions and services, citizen empowerment and participation, crucial cross-cutting themes like gender issues and poverty. To respond to these challenges, EcoCities is built around a strong collaboration with local partners in order to answer to local needs previously identified and discussed with them. The flexibility of EcoCities' approach allows the implementation of expert solutions depending on local conditions and customized to varying socio-economic realities worldwide.

Ongoing projects in Egypt and Zambia, and planned activities in Libya, South Africa or Colombia will illustrate the main components of the concept. Both ongoing New Borg El-Arab EcoCity (Egypt) and EcoLusaka (Zambia) projects have a clear focus on capacity building. Another project currently under negotiation also in Zambia would include the construction of two sustainable demo houses. In South Africa and Colombia, VTT's local partners would be the municipalities. All projects within EcoCities framework cover the different aspects of sustainability (environmental, economic and socio-cultural).

KEYWORDS: sustainable community development, neighbourhood regeneration, sustainable building, citizen participation and empowerment, collaboration with local partners, developing countries, emerging economies

1. INTRODUCTION

VTT Technical Research Centre of Finland is the biggest multi-technological applied research organization in Northern Europe. VTT provides high-end technology solutions and innovation services to enhance its customers' competitiveness, thereby creating prerequisites for society's sustainable development, employment, and wellbeing. VTT can combine different technologies, create new innovations and a substantial range of world class technologies and applied research services thus improving its clients' competence.

VTT has done research on different aspects of sustainable building since decades. There's a continuous stream of international research projects related with sustainability metrics and building performance, indoor climate and energy efficiency, product development, sustainability assessment and decision support tools. The focus is nowadays increasingly stretched towards sustainable neighbourhoods covering also infrastructure and economic and social assessment. VTT has 50 to 100 experts doing research on sustainable built environment. The number is bigger if the areas of water and waste management, transport, energy systems, etc. are also counted.

2. VTT's ECOCITY CONCEPT

2.1. Background and references

As it is shown in the EcoCity roadmap below, the main examples from Finland that preceded the development of VTT's EcoCity concept were Tapiola Garden City (1950s, Espoo), Otaniemi High-Tech Park (1960s, Espoo) and Eko-Viikki (1990s, Helsinki). Tapiola Garden City is one of the most internationally recognized residential areas in Finland and was built *"in response to great social demand in the midst of post-war housing shortages and calls for social reform. It was based on a globally celebrated concept: Ebenezer's Howard's Garden City (1898-1902) and its first practical applications in England (Letchworth, Hampstead Garden Suburb and Welwyn Garden City)"* [1].

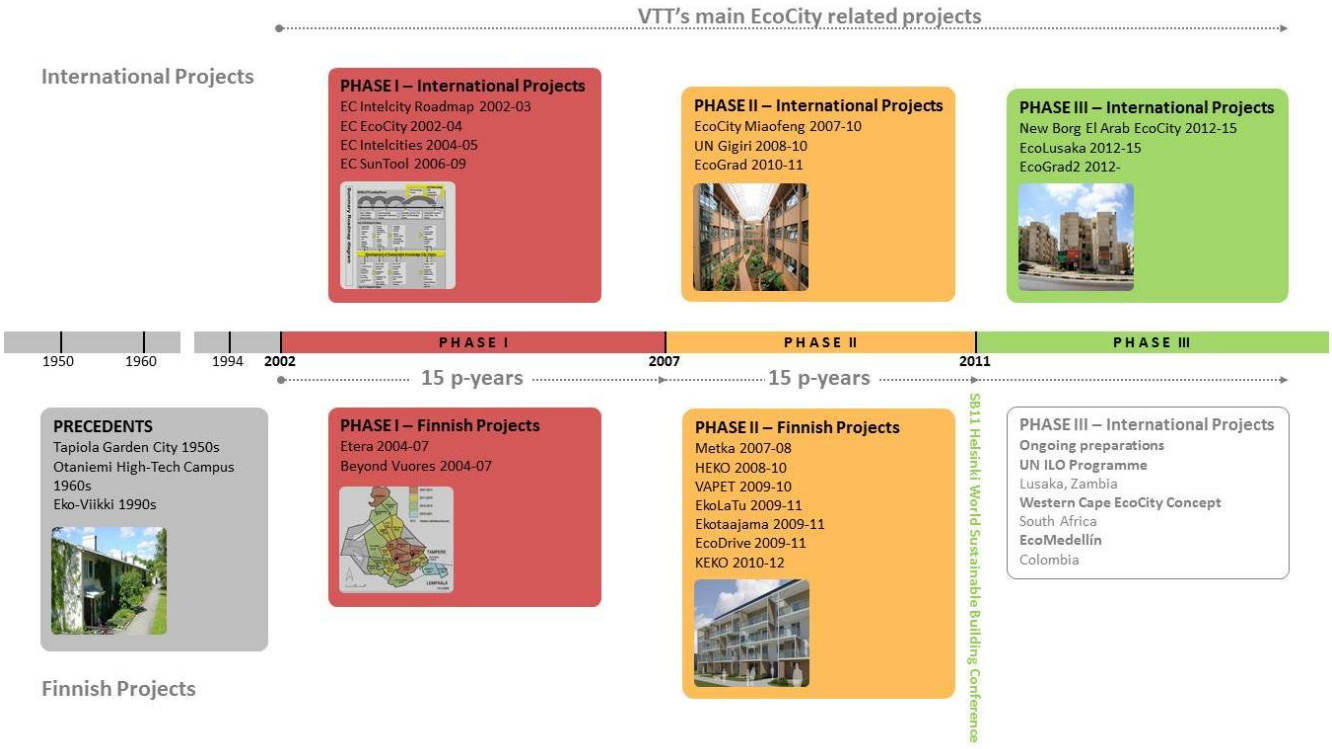


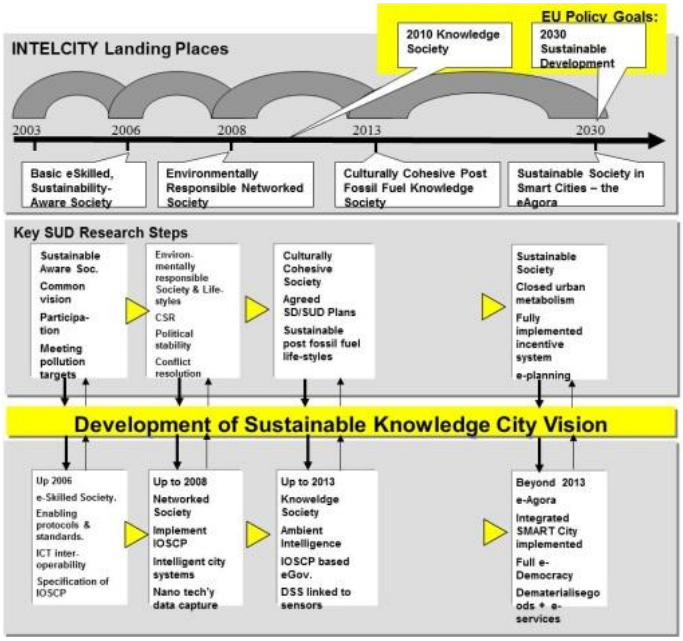
Figure 1 VTT's EcoCity roadmap showing the evolution of the concept through the main related projects. ©Pekka Huovila & Carmen Antuña, VTT October 2012

The development of Otaniemi High-Tech Campus was initiated in 1946 when it was decided to move the Helsinki University of Technology (TKK) and the Technical Research Centre of Finland (VTT) from Helsinki city centre to Otaniemi in Espoo. Gradually, different facilities were built and by the beginning of the 70s most departments of the TKK had moved to the new location. At present, Otaniemi is a technology cluster that brings together academia, research and high-tech companies [2].

Since it was built, Eko-Viikki has attracted a lot of attention both nationally and internationally. The local plan for the area was developed through an architectural competition (1994-1995) that specified that the proposals had to be ecologically sustainable through minimization of the use of non-renewable energy sources and rapidly diminishing raw materials; reduction of the levels of pollution, noise and waste; minimization of the strain on natural resources and local eco-systems; residents empowerment and awareness raising on ecological sustainability.

PHASE I

The first phase of VTT's EcoCity concept development started in 2002 in two projects under the EC 5th Framework Programme. EU Intelcity (Towards Sustainable Intelligent Cities) Roadmap 2002-2003 summarized research priorities by 2030 integrating the components from knowledge society and sustainable urban development in different time scales [3].



Time	Knowledge Society (IST)	Sust. Urban Dev. (SUD)	Integrating KS & SUD
3 yrs 2006	– Enhanced hardware and software usability and accessibility (including wireless access). – Advanced multidimensional databases – Integrated ICT standards and 'common' protocols; e.g. XML, GML, IFC, VRML, eGIF, etc. Forms of ICT infrastructure & interoperability requirements. – New data capture technologies. – City/society information availability, capture, format, conversion & transferability.	– Modelling cause and effect of human behaviour in cities (grounded in SUD concepts) utilizing enhanced information (environment, economic and social) from new data technologies – Modelling cause and effect of incentives (including new ownership models) – e-Participation (basic) – e-Administration in city authorities	– Demonstration projects, best practice case studies that link both KS and SUD (Phase 1) – Public/private partnerships for bridging the digital divide – Changing employment structures, flexible working – Social shaping of technology, transfer and e-learning + institutional changes – e-Security, safety & confidence – ICTs for planning process efficiency and effectiveness – Risk analysis modelling
5 yrs 2008	– How to work "virtually"? – Invisible (or attractive to use?) man-machine interface(s) – Information and model ownership "rights" and legal issues (e.g. digital signature) – Advanced analytical tools and evaluation (intelligent agents, DSS, ES) – Experiments in the smart city infrastructure in leading edge cities	– Barriers to implementation of clean technologies, PESTLI steps to dematerialisation. – e-Democracy, governance and empowerment (models, information quality, options, voting, tools) – New financial instruments (knowledge asset) and effects on urban structure(s) and society	– Integrated data models and knowledge management – E-spaces / workspaces – Group decision-support, e.g. integrated planning support tools – Cause and effects of public-private partnerships (in a broader sense than current interpretation) – New fiscal policy of/in the knowledge economy
10yrs 2013	– Device independent interfaces to provide 'feedback' (to modify citizen behaviour) – Data representation models – Intelligent products/devices, buildings and cities – Development of symbolic/ambient techs. – Integrated decision support - simulation, participation & sensor fusion	– Sustainable lifestyles based on advanced dematerialisation. – Virtual products and services – Social and technological aspects of access for all – Risk assessment in urban processes and developments	– Theories and tools for bridging KS and SUD and integrating research outcomes. – Long term implications of new flexible work patterns – E-identity linking virtual and real worlds – Demonstration projects for dissemination and implementation in "follower" cities (phase 2)

Figure 2 Intelcity Roadmap described the landing places for intelligent sustainable cities in 2030. © Curwell & Hamilton, 2003

EU Ecocity (Urban Development towards Appropriate Structures for Sustainable Transport) 2002-2005 containing an analysis of seven ecocity settlements in Europe described the vision for and features of an ecocity [4]. The work in Finland was based e.g. on earlier good experiences from the development of Tapiola Garden City in the 1950s and Otaniemi High-Tech Campus in the 1960s until Eko-Viikki in the 1990s where the City of Helsinki applied ecological criteria for the building permit [5] [6]. These ideas were developed further including citizen participation in EU Intelcities [7], neighbourhood level criteria in Beyond Vuores [8] and tool development in EU SunTool until 2007.

PHASE II

Experiences from and knowledge gathered in these activities led into second phase neighbourhood development projects in Finland and also in China, Kenya and Russia. Ecocity Miaofeng feasibility study

presented features of 17 socially, ecologically and economically sustainable villages in Miaofeng Mountain Town North-West of Beijing [9]. EcoGrad presented a design concept of eco-efficient districts in the city of St. Petersburg including dense city development, a minimal need for travel, a maximum use of public transportation and light vehicles, and minimum power consumption [10]. In Gigiri (Kenya), VTT studied how a new office building can become energy neutral in Nairobi. In Peltosaari (Finland), the value increase of a declining neighbourhood through sustainable regeneration was studied including social and economic studies. These projects, together with those containing leisure dwellings (EkoLaTu), sustainable communities in municipalities of different sizes in different regions in Finland (Ekotaajama) and tool development for city planners (HEKO, KEKO) enabled considerable progress in ecocities during 2007-2011 [11].

PHASE III

The third phase in the evolution of VTT's EcoCity concept starts after the 6th World Sustainable Building (SB) Conference that took place in Helsinki from 18th to 21st October 2011. Organized by VTT and RIL - Finnish Association of Civil Engineers, SB11 Helsinki addressed new opportunities for improving quality of life, mitigating the effects of climate change and making new business. One of the main objectives of SB11 Helsinki was *"to expand the international research community's focus to consider people and their needs, particularly those in the developing world. A large part of the world faces a variety of difficulties: environmental catastrophes, serious political conflict or war, natural disasters, hunger, poverty, etc. The solutions provided for these humanitarian crises must be also sustainable (in the broadest sense) because the population affected is so wide that not doing so would have a very negative impact globally. It would also diminish the meaning of 'sustainable development' if it were to be limited to a set of activities only plausible for the wealthy"* [12].

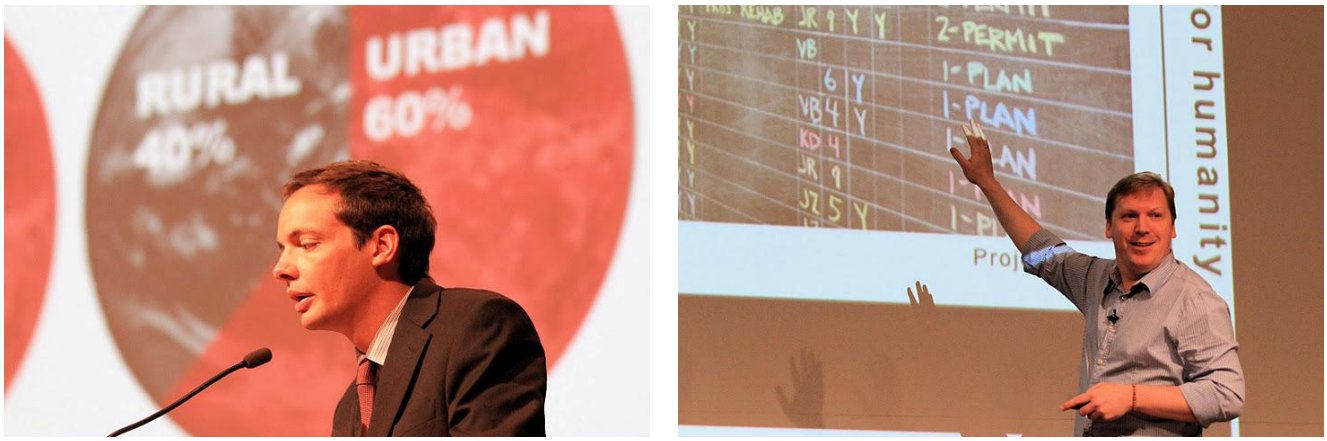


Figure 3 Christophe Lalande from UN-HABITAT (left) and Cameron Sinclair from Architecture for Humanity (right), keynote speakers at SB11 Helsinki World Sustainable Building Conference. ©Pekka Huovila

The wide network of experts from around the world established during the conference, and the knowledge gained then, served as a springboard for further development of VTT's EcoCity concept into an international framework for sustainable community and neighbourhood regeneration and development. In line with VTT's Research and Innovation Vision 2020, EcoCities focuses mainly on developing countries and emerging economies. This phase is the main focus of this paper therefore its main related activities will be commented more in detail below.

2.2. Challenges addressed by EcoCities

At present more than half of the world's population, over 3 billion people, is living in towns and cities. By 2030 this number will increase to 5 billion people, with urban growth mainly concentrated in Africa and Asia [13]. Urbanization is perceived as synonymous with modernization, industrialization and development, but it also presents a dark side: proliferation of slums and squatter settlements, inadequate infrastructure, poor access to

social services and environmental degradation among others [14]. In addition, climate change is related to urban models. As it is widely known, nearly 50% of CO2 emissions into the atmosphere are directly linked to the construction and operation of buildings. So, the conditions defined by urban planning can have a strong influence on the use of resources, energy consumption patterns… and therefore on the associated CO2 emissions. Over the years, climate change mitigation and adaptation issues, along with natural disaster risk management, have increasingly become part of the urban agenda. Very recently, the UN General Assembly has endorsed the outcome document of the United Nations Conference on Sustainable Development (Rio+20) where climate change is acknowledged as *"a cross-cutting and persistent crisis"* affecting all countries and challenging their ability, in particular that of developing countries, to achieve sustainable development, as well as threatening the viability and survival of nations [15].

Therefore, among the main challenges addressed by EcoCities are:

- Climate mitigation and climate adaptation
- Sustainable urbanization
- Affordable housing
- Integrated planning and funding availability
- Capacity building for local solutions and services
- Citizen empowerment and participation
- Cross-cutting themes: gender issues, etc.

To respond to these challenges, EcoCities is built around a strong collaboration with reliable local partners in order to answer to local needs previously identified and discussed with them. The flexibility of EcoCities' approach allows the implementation of expert solutions depending on local conditions and customized to varying socio-economic realities worldwide.

2.3. EcoCities' approach and main components

VTT's EcoCities' approach developed to respond to the abovementioned challenges in collaboration with local partners can be summarized as follows:

- Best combination of technologies and services that form sustainable solutions providing the users and inhabitants a high quality of life and indoor and outdoor comfort
- Applicable EcoCity solutions depend on local conditions and need to be customized to socio-economic realities
- There is not one solution that fits all, but a number of possibilities that need to be studied to find the right solution for each case
- Require knowledge of local traditions, perceptions, available materials and competent partners.

Within this approach, VTT's EcoCities main components should be customized to meet the local needs and conditions based on:

1. Sustainable city planning

Sustainable land use, use of geographical information systems, energy efficiency at a neighbourhood scale, developing participatory town planning and sustainability assessment of city plans, efficient management of natural resources

2. Citizen participation and empowerment

Citizen engagement, awareness raising on sustainable lifestyles, education and continuous learning, cross-cutting themes (e.g. gender issues)

3. Sustainable urban infrastructure

Energy systems, waste management, water supply, access roads, public transport solutions, smart traffic management guidelines for sustainable infrastructure, identifying available solutions and gaps

4. Sustainable housing
Local production of building materials, use of renewables, improving living conditions, solar cooking, natural lighting, regeneration and maintenance of cultural heritage, assessment of existing situation
5. Local businesses and employment around sustainable housing
Services, affordable housing, business opportunities: creating support systems for local businesses where locals can get help with developing their business ideas, sustainability assessment of the businesses
6. Coordination
Planning the pilot(s), e.g. new development, urban regeneration, informal settlement upgrading, assessment and monitoring, management
7. Pilot project
Chosen and implemented according to the local needs and in close collaboration with key local partners

3. ECOCITY PROJECTS

What follows is a more detailed description of both ongoing and planned projects and activities worldwide within VTT's EcoCity framework. Although the first projects of the recently started PHASE III are located in Africa, other activities are already under preparation in other parts of the world as it will be shown.

3.1. Ongoing projects and activities

GLOBAL NETWORK FOR SUSTAINABLE HOUSING, GNSH

Officially launched during the 6th session of the World Urban Forum that took place in Naples, Italy from 1st to 7th September 2012, it is oriented to the theme of *"local building cultures (principles, methods, application conditions, potential impacts and limits) with a specific focus on indigenous building materials and traditional building practices in the context of slum upgrading, affordable housing and post-crisis housing"* [16]. As a founding member, VTT attended the event and took part in the plenary discussion that followed on the scope and role of the GNSH in promoting sustainable housing practices globally. The GNSH Secretariat, which will coordinate the network, will be based at UN-HABITAT Shelter Branch, Narobi (Kenya).

NEW BORG EL-ARAB ECOCITY, ALEXANDRIA (EGYPT)

The overall objective is to improve the capacity on sustainable city development in Egypt. The purpose of the project is to improve the capacity of the local partner organisation staff in developing them as a top EcoCity expert body in northern Africa and to create a framework for transforming New Borg El Arab City (NBC) into an EcoCity.

Figure 4 New Borg El-Arab, Alexandria, Egypt. © Pekka Huovila

The approach is based on workshops, training seminars, study tours, awareness raising campaigns, competitions and research exchanges. The cooperation aims at detaching Egypt's sustainable urban development from aid dependency. Increasing attention is paid to support for the use of local resources for development purposes, the reduction of inequality and finding solutions for unsustainable use of natural resources and climate change. The proposed EcoCity approach empowers local people and provides employment together with environmental protection.

ECOLUSAKA (ZAMBIA)

This project will be carried out in collaboration with a construction training centre in Lusaka. The objective of EcoLusaka is to develop and pilot new educational programmes for the construction sector enabling a more environmentally, economic and socially sustainable construction process in Zambia. The main actions to be implemented are:

- Capacity building of the local partner
- New educational curriculum introducing principles of sustainable construction
- Update of current structure with the aid of ICT technologies
- Improvement of existing facilities and equipment
- Strategic Business Plan
- Links to UN Joint Pogramme on Enhancing Competitiveness and Sustainable Business among MSMEs in Building and Construction Industry (through ILO Office in Zambia)

Figure 5 Different views of the construction training centre facilities in Lusaka, Zambia. © Carmen Antuña

3.2. Planned activities

Different activities are being planned at present within the EcoCity framework in Northern Africa and the Middle East (MENA region), East and Southern Africa (Tanzania, Zambia and South Africa) and Latin America (Brazil and Colombia).

NORTHERN AFRICA AND THE MIDDLE EAST

Ongoing preparations in the Maghreb region deal with sustainable city development containing water and waste management together with affordable housing. The challenges vary from reconstruction of destructed areas to regenerating old medinas. In the Middle East, the EcoCity concept still needs formalization and establishment of transparent sustainability assessment schemes together with justification of its added value.

EAST AND SOUTHERN AFRICA

Tanzania

Along with Aalto University and the Institute of African Leadership for Sustainable Development and other key actors like UNEP, UN-HABITAT, the University of Nairobi and the Asian Institute of Technology, VTT is taking part in the preparation of "Managing Urban Futures – Workshop for Supporting Sustainability" that will take place in Dar es Salaam in spring 2013.

Zambia

VTT has been requested by UN ILO Office in Zambia to provide support to the "Joint Programme on Improved Livelihoods through PSD". VTT's contribution is focusing on the following main components: construction of two demo houses, productivity improvement programmes and training for SMEs, and new efficient technology and innovation to be introduced in the construction sector.

South Africa

In collaboration with a provincial government, a proposal including a municipality as a pilot has been recently submitted for funding. The purpose is to combine retro-fitting with new urban planning to achieve best results. Waste water treatment will be also an important feature of the project due to water scarcity in South Africa.

LATIN AMERICA

Brazil and Colombia are some of the fastest growing economies in Latin America. In Brazil, a member of the EAGLEs group (Emerging And Growth-Leading Economies, an acronym created by Spanish bank BBVA), around 35 million people have climbed out of poverty in recent years. In turn, Colombia is a member of the EAGLEs Nest group (also according to BBVA). From an urban perspective, both countries are facing enormous challenges with cities extending rapidly, very often in the form of informal settlements.

Brazil

Based in São Paulo, VTT Brasil LTDA R&D Center was created in collaboration with Kemira Oy as an answer to an increasing demand for biomass and sustainable development technologies. The center started operations in 2010 and provides high-end technology solutions and innovation services for the South American markets.

Colombia

In collaboration with a local research institute and a municipality, VTT is planning a project on capacity building of the local partners helping them on assessment, monitoring and management of the dynamics involved in informal settlements from the point of view of urban sustainability. The project is to be inserted in the framework of national policies, including the initiative "Misión Ciudades" led by the Department of National Planning and the Ministry of the Environment and Sustainable Development with the support of the Inter-American Development Bank.

4. DISCUSSION

- In Phase I VTT's EcoCity concept was still defined based on earlier experiences in Finland as part of European exchange of ideas
- In Phase II the concept was extended from environmental sustainability to better cover social and economic sustainability, and to adjust the content to a pan-European context
- In Phase III the experience and knowledge on ecocities accumulated by VTT's experts (over 30 persons-years) supports a further development of the concept towards awareness raising, capacity building and detaching sustainable urban development from aid dependency

5. REFERENCES

[1] Nieminen, J., Lahti, P., Nikkanen, A., Mroueh, U.-M., Tukiainen, T., Shemeikka, J., Huovila, P., Pulakka, S., Guangyu, C., Nan, S., Lylykangas, K., Ning, L., Dan, W., Yong, S. (2010). "Miaoufeng Mountain Town EcoCity". (2. State of the art, 2.1 Ecological town development, p. 11-30). VTT Research Notes, Helsinki, 2010, 249 p.

[2] Bindels, E. et al. (2007). "Campus and the City. Urban Design for the Knowledge Society". Edited by Kerstin Hoeger and Kees Christianse. GTA Verlag, March 2007, 328 p. ISBN 978-3-85676-218-6

[3] Curwell, S., Hamilton, A. (2003). "Intelcity Roadmap". University of Salford, June 2003, 30 p.

[4] Gaffron, P., Huismans, G., Skala, F. (2005). "Ecocity Book I. A better place to live". Facultas Verlags- und Buchhandels AG, Vienna, 2005. ISBN 3-200-00421-5

[5] Aaltonen, T., Gabrielsson, J., Inkinen, R., Majurinen, J., Pennanen, A., Wartiainen, K. (1998). "Ecological Building Criteria for Viikki". Helsinki City Planning Publications, 25 May 1998, 36 p. ISBN 951-718-092-6 http://www.hel2.fi/taske/julkaisut/2010/Pimwag_Ecological%20building%20criteria_report.pdf (visited 7 October 2012)

[6] Hakaste, H., Jalkanen, R., Korpivaara, A., Rinne, H., Siiskonen, M. (2005). "Eco-Viikki. Aims, Implementation and Results". City of Helsinki, Ministry of the Environment, 2005, 56 p. ISBN 952-473-455-9 http://www.hel2.fi/taske/julkaisut/2009/eco-viikki_en_net.pdf (visited 7 October 2012)

[7] Lahti, P., Kangasoja, J., Huovila, P. (2006). "Electronic and Mobile Participation in City Planning and Management. Experiences from IntelCities". (An Integrated Project of the Sixth Framework Programme of the European Union. Cases: Helsinki, Tampere, Garðabær/Reykjavik and Frankfurt). VTT, City of Helsinki, Urban Facts and Economic and Planning Centre, 2006, 78 p. http://www.hel2.fi/tietokeskus/julkaisut/pdf/Intelcity.pdf (visited 7 October 2012)

[8] Huovila, P., Lahti, P., Nieminen, J. (2007). "Performance Based Collaborative Planning in Neighbourhood Development". (Presented @ Multidisciplinary Scientific Workshop by Decomb & Opus & Beyond Vuores: Innovations in Urban Planning and Design). @ SimLab, Innopoli 2, 18 January 2007, 22 p.

[9] Nieminen, J., Lahti, P., Nikkanen, A., Mroueh, U.-M., Tukiainen, T., Shemeikka, J., Huovila, P., Pulakka, S., Guangyu, C., Nan, S., Lylykangas, K., Ning, L., Dan, W. & Yong, S. (2010). "Miaoufeng Mountain Town EcoCity". VTT Research Notes, Helsinki, 2010, 249 p.

[10] Nystedt, Å., Sepponen, M., Teerimo, S., Nummelin, J., Virtanen, M., Lahti, P. (2010). "EcoGrad. A concept for ecological city planning for St. Petersburg, Russia". VTT Research Notes 2566, Espoo, 2010, 75 p. app. 12 p. http://www.vtt.fi/inf/pdf/tiedotteet/2010/T2566.pdf (visited 7 October 2012)

[11] SITRA, Tekes, VTT (2011) World-class sustainable solutions from Finland. Sustainable Urban Development, Sustainable Buildings, Sustainable Solutions. October 2011. 46 p. http://www.tekes.fi/u/sustainable_solutions.pdf (visited 7 October 2012)

[12] Huovila, P., Antuña, C. (2012). "Lessons from SB11 Helsinki". Building Research & Information, Volume 40, Issue 5, August 2012, pp. 539-544 (Special Issue "Spatial and temporal scales in sustainability: SB11")

[13] World Urban Forum 6 (Naples, Italy 1-7 September 2012). “The Urban Future” (background document). 2012, pp. 1-2

[14] UN-HABITAT (2008). “State of the World's Cities Report 2008/2009. Harmonious Cities”. Earthscan, 2008

[15] United Nations General Assembly (2012). “The Future We Want”. A/RES/66/288, 27 July 2012

[16] World Urban Forum 6 (Naples, Italy 1-7 September 2012). “The Urban Future” (programme: Networking Event 21 on Monday 3 September 2012). 2012, pp. 16, 99
http://www.unhabitat.org/categories.asp?catid=672 (visited 9 October 2012)

6. ACKNOWLEDGMENTS

Special thanks to our colleagues Jyri Nieminen and Pekka Lahti for providing details for our EcoCity roadmap.