Smart City Concepts in Curitiba
innovation for sustainable mobility and energy efficiency

Project NEWSLETTER, January 2016
Workshop “Smart City Concepts” held in Curitiba, Brazil, 16-20 March 2015

The Swedish project partners visited Curitiba to meet with stakeholders and strengthen the collaboration under the Smart City Concepts project. A workshop was held in March 2015 to discuss the project tasks. The project team also had the opportunity to present the project to the mayor and a wider audience at the city hall (see photos).

In addition to the mayor Gustavo Fruet, the team had meetings with UTFPR’s president, Professor Carlos Eduardo Cantarella, the president of Volvo Buses in Latin America Luís Carlos Pimenta, the head of URBS Gregorio da Silva Junior, and the head of IPPUC Sérgio Póvoa Pires. On-site observations were done along the Green Line (Linha Verde) areas as well as other transport corridors in Curitiba.

Assessing the potential of fuel saving and emissions reduction of the bus rapid transit system in Curitiba, by Dennis Dreier

Immediate opportunities exist to reduce emissions through the adoption of new bus technologies. Dennis Dreier developed a master’s thesis project in Curitiba, making a Tank-to-Wheel analysis of energy use and carbon dioxide (CO2) emissions in conventional, hybrid-electric, and plug-in hybrid-electric city buses including two-axle, articulated, and bi-articulated chassis types. A total of 6 bus types operating in Curitiba were analyzed. The results show that hybrid-electric and plug-in hybrid-electric two-axle city buses consume 30% and 58% less energy per distance (MJ/km) compared to a conventional two-axle city bus (i.e. 17.46 MJ/km). The energy use per passenger-distance (MJ/pkm) of a conventional bi-articulated city bus amounts to 0.22 MJ/pkm, which is 41% and 24% lower compared to conventional and hybrid-electric two-axle city buses, respectively. Energy use of city bus operation depends on traffic conditions, driving cycles and occupancy rates of the buses. The study concludes that advanced powertrains with electric drive capabilities can contribute to reducing energy use and CO2 emissions of city bus operation in Curitiba but operational aspects are key to high performance. The master’s thesis is available in KTH database at DiVA. Click here to download the document.
Presentation of the project at the conference “Smart City Business America Congress & Expo”, 19-21 May 2015, Curitiba, Brazil

A presentation about the rational and current research of the project was given at the congress Smart City Business America Congress & Expo. The congress explored business opportunities arising from efforts to develop sustainable cities.

More than 1500 people attended the three-day congress including mayors from other capital cities in Brazil, CEOs of major multinational companies and presidents of national important entities.

Semida Silveira (KTH), Prof Keiko Fonseca, UTFPR, and Rafael Nieweglowski at the congress Smart City Business America Congress & Expo in May 2015

Keiko V.O. Fonseca (Professor at UTFPR and coordinator in Curitiba) presents current research at the UTFPR at the congress Smart City Business America Congress & Expo in May 2015

Gustavo Fruet and Semida Silveira

Tube station along the Green Line

Semida Silveira and Jaime Lerner, former Curitiba mayor and planner, designer of the BRT system
Workshop “Smart concepts for the innovation of cities” in Stockholm, Sweden, 24-28 August 2015

In August 2015, colleagues from Curitiba visited the Swedish partners in Stockholm to discuss topics within the cooperation between KTH and the city of Curitiba, and share experiences and knowledge with public sector entities and industrial partners in Sweden. The division of Energy and Climate Studies (KTH-ECS) at KTH hosted an open seminar “City Sustainability – the experience of Curitiba in Brazil” attended by KTH President Professor Peter Gudmundson and the Brazilian Ambassador to Sweden Marcos Vinicius Pinta Gama. The delegation from Curitiba had the opportunity to present on-going work in Curitiba and discuss the role of joint initiatives between public, private and academic sectors, as well as international cooperation with KTH and other Swedish partners. At the occasion, a panel discussion highlighted the different but decisive role of various stakeholders in building the sustainable city. Among other topics, the panel discussed the future of public transport. Urbanisation and densification in cities imply new challenges but also opportunities to think the city differently so as to promote a creative environment for citizens and companies to thrive. The project team visited the Environment and Health Administration in Stockholm (SLB Analys), the Optical Networks Laboratory (ONLab) located in the KTH campus of Kista, attended the seminar on the topic “Renewable Energy – International trends and challenges” organised by the Royal Swedish Academy of Engineering Sciences (IVA). Discussions took place with representatives from the Swedish municipality Linköping about open data policies and development of local ICT sector, as well as with SMHI, the Swedish Meteorological and Hydrological Institute about air quality measurements. Click here for more details.
Poster presented at “Systems Analysis 2015” at the International Institute of Applied Systems Analysis (IIASA), Laxenburg, Austria, 11-13 November 2015 and during visit of President Dilma Rousseff to KTH, 19 Nov 2015.

Energy use and CO₂ emissions of city buses in Curitiba, Brazil

Dennis Dreier *, Semida Silveira *, Dilip Khatriwada *, Keiko V.O. Fonseca I, Rafael Nieweglowski I, Renan Schepanski

*Department of Energy and Climate Studies, KTH Royal Institute of Technology, Stockholm, Sweden
IIBE (Institute of Bioeconomy and Ecosystem Services), University of Gothenburg, Göteborg, Sweden

Energy and Climate Studies Unit
KTH Royal Institute of Technology
S-100 44 Stockholm, Sweden

www.eecs.kth.se

How do advanced powertrains in city buses affect energy use and CO₂ emissions during operation in Curitiba?

Energy use (MWh/km) vs. CO₂ emissions (g/km)

City buses

How do passenger carrying capacities affect energy use and CO₂ emissions of city bus operation in Curitiba?

Energy use (MWh/p) vs. CO₂ emissions (g/p)

Click here for more about IIASA and the conference. | Click here to download the poster.
Visit of Her Excellency Dilma Rousseff, President of Brazil to KTH on 19th October 2015

On the 19th November 2015, the Brazilian President Dilma Rousseff visited KTH to promote collaboration between Brazilian organizations and KTH. Dilma Rousseff highlighted the big success of the scholarship programme “Science Without Borders” and thanked KTH for its strong engagement in developing research and education with Brazil. At the moment, 40 Brazilian students are studying at KTH. Two posters of the project *Smart City Concepts in Curitiba* were presented to the President at this occasion.

![Image](image_url)

*Peter Gudmundson (KTH President), Semida Silveira (Professor at KTH-ECS) and Dilma Rousseff (President of Brazil) at KTH, 19th Nov 2015*

![Image](image_url)

*President Dilma Rousseff (President of Brazil) autographs the poster “Energy use and CO₂ emissions of city buses in Curitiba, Brazil”, 19th Nov 2015*

![Image](image_url)

*Group photo of President Dilma Rousseff with KTH representatives and Brazilian students in the Science without Borders program*

![Image](image_url)

*Swedish Minister for Higher Education and Research, Helene Hellmark Knutsson, Prof Semida Silveira, President Dilma Rousseff and Prof Peter Gudmundson*
Poster presented at the visit of President Dilma Rousseff to KTH, 19 November 2015

ICT Infrastructure for Smart Cities: Curitiba, Brazil

Lena Woinska *, Paolo Monti *, Matteo Fiorani *, Dennis Dreier b, Semida Silveira b

* Optical Networks Laboratory (ONLab), KTH Royal Institute of Technology, Stockholm, Sweden
b Division of Energy and Climate Studies (ECS), KTH Royal Institute of Technology, Stockholm, Sweden

The importance of connectivity in cities

High capacity infrastructure

Development of applications

Improvement of life quality

Application in Sweden and Brazil

• Access to broadband connectivity is considered as a commodity nowadays.
• End users are expecting to be able to have access to high bandwidth services regardless of their location and mobility conditions.
• Need for very high capacity wireless broadband connectivity is quite advanced.
• Boost own traffic only if the right step is taken.

In the Smart City Concepts in Curitiba project, ICT focuses on efficient ways to deploy and manage an ICT infrastructure able to answer this need.

Future scenarios for Curitiba

• Example: Smart networked systems for road traffic
  > Optimized and cognitive decision-making systems
  > Runs virtually in milliseconds to detect and prevent accidents
  > Build on ICT infrastructure
  > Support of the road agency's requirements: Reaction time and robustness

The involved systems consist of:
  > Networked road users (vehicles and pedestrians)
  > Road decision-making systems controlling the situation on the road

Functional principle of ICT system for road traffic

General framework

• Providing powerful computing and communication resources on the fly
• Designing fast, intelligent, and robust decision-making methods
• Building a common artificial intelligence-based information and communication system platform

Unified control plane and data plane architecture design

Click here to download the poster.

www.ecs.kth.se
Other initiatives initiated in Curitiba in synergy with this project Meteorological and Hydrological Institute (SMHI) starts project:

**Air Quality in Curitiba – today and tomorrow**

The project **Smart City Concepts in Curitiba** has helped catalyse other initiatives among Swedish and Brazilian partners. The need to ensure the equilibrium between Curitiba’s rapid urbanisation and massive transportation needs on one side, and the preservation of human health and well-being on the other, has motivated the start of a new effort involving several government agencies and research centres. The project, under the leadership of Dr. Lars Gidhagen from the Swedish Meteorological and Hydrological Institute (SMHI) and the local coordination of the Federal University of Paraná (UFPR), shall bring new insights about air pollution and air quality in Curitiba metropolitan region. The focus is on pollution of particulate matter – including the black carbon part - with special attention to mobile sources. Emission inventories including regional and local dispersion modelling, and hot-spots field monitoring will provide a more comprehensive picture of present conditions. Modelling of scenarios of new technologies for improved mobility and energy efficiency – e.g. formulated within the Smart city concepts in Curitiba project - will allow for effective planning to reduce emissions impacts and to improve air quality and health.

The project is in line with the Swedish-Brazilian agreement for “Cooperation in the fields of environmental protection, climate change and sustainable development”. Close synergies are envisaged with the project Smart city concepts in Curitiba.

**Forthcoming activities**

Swedish ministerial delegation to visit Curitiba 15-17 March.

Workshop to be held in Curitiba 28-31 March 2016 with the participation of Swedish and Brazilian partners. Also SMHI and the Swedish Environmental Protection Agency will attend.
About the project Smart City Concepts in Curitiba

Transport and IT-based technologies open opportunities to rethink the development of cities. A consortium between Swedish and Brazilian stakeholders is exploring the deployment of these technologies together with new concepts for urban planning in Curitiba. In particular, the project explores opportunities for electrification of public transport. The consortium includes KTH - Royal Institute of Technology, Volvo Bus Corporation, Combitech, CISB (Swedish-Brazilian Research and Innovation Centre), UTFPR (Federal University of Technology – Paraná), the city hall of Curitiba, URBS (Urbanisation Company of Curitiba), and IPPUC (Urban Planning and Research Institute of Curitiba). The project started in October 2014 and ends in June 2017. This newsletter aims at informing stakeholders in Sweden and Brazil about activities carried out in the project.