Project Proposal in response to VINNOVA call 2014-01762

Smart city concepts in Curitiba
– innovation for sustainable mobility and energy efficiency

Project leader: Professor Semida Silveira, KTH (semida.silveira@energy.kth.se)
Swedish partners: ECS-KTH; OnLab-KTH; SAAB AB, Volvo AB
Brazilian partners (support letters): UTFPR, Volvo Bus Latin America AB, URBS, CISB, COPEL

Executive summary

A consortium of Swedish and Brazilian stakeholders will promote system innovation, combining information technology and smart grids to develop electro-mobility, and energy efficient and low-carbon transport services in the city of Curitiba aiming at sustainable urban development. The project includes demonstration of technological solutions by VOLVO and SAAB to provide smart mobility and a platform for information monitoring and sharing. Research work is carried out by KTH and UTFPR to test and adapt concepts to the context of Curitiba; design the configuration of infrastructure systems; monitor operations, energy and emissions balances; and design scenarios for up-scaling smart concepts and solutions. Well-articulated urban mobility will help improve the quality of services in the urban area, reduce environmental impacts and open new areas for development. The ambition is to become an international reference, and to pave the way for enhanced cooperation between Swedish and Brazilian actors in Curitiba. The project results from the Swedish-Brazilian MoU between KTH, City of Curitiba, universities and Federation of Industries of the State of Paraná to promote innovative solutions for urban challenges The total project budget is MSEK 186,477, most of which covers the investments in the VOLVO demo. We are applying for MSEK 5 from VINNOVA. The project duration is 33 months starting Oct 2014.

Background and relevance of the cooperation with Curitiba

Urban areas are under ***enormous pressure due to the rapid pace of urbanization*** and the need to provide efficient services for growing populations. Urban mobility and energy services are key functions to make modern cities liveable and attractive to both business and citizens, and at the same reduce their footprints on the environment. Brazilian cities are densely populated and suffer from increasing congestion. The City of Curitiba is not different in this respect. However, the city has a long tradition of sustainable urban planning and innovative urban concepts. Presently, Curitiba has ambitious targets to improve urban life quality, reduce the city's carbon footprint and build upon its historical legacy as a sustainable city. Also in Sweden, attempts have been made to develop new urban concepts for provision of quality urban services in a context of increasing environmental stringency. KTH is involved, for example, in SymbioCity (http://symbiocity.org/), ElecTriCity (http://hs2020.se/electricity/), Swedish smart grid (www.swedishsmartgrid.se/english/), and implementation sites such as Hammarby Sjöstad

(http://www.hammarbysjostad.se/) and the Royal Sea Port in Stockholm (http://stockholmroyalseaport.com/).

The complexities of urban development require that technological innovations be developed in cooperation with multiple stakeholders. In this project, a consortium is established between ***Swedish and Brazilian stakeholders to develop innovative solutions*** for Curitiba. The cooperation has been developed under the MoU signed in November 2013 by KTH, the City of Curitiba, local universities, FIEP (Federation of Industries of the State of Paraná) and CISB (Swedish Brazilian Center for Innovation) aimed at promoting research and innovation in the urban environment. The MoU[1] supports knowledge and experience sharing aimed at sustainable and innovative solutions for solving urban challenges. The cooperation enables the utilization of the respective comparative advantages and capacities of the parties to maximize the effectiveness and benefits of initiatives for sustainable development. Since the signature of the MoU, the parties have held various meetings, including the Curitiba-Sweden Workshop for Sustainable Urban Development 9-11 April, to identify the needs of Curitiba, and define initiatives for joint collaboration.

This consortium will collaborate to adapt and apply Swedish technology concepts in Curitiba, and develop critical transport infrastructure to improve urban mobility, reduce energy use and greenhouse gas emissions, and catalyze innovation. The solutions proposed include transport and information technologies to innovate urban mobility, improve resource efficiency and promote sustainable urban development, and are well in line with the goals set by the City of Curitiba, and the objectives set by VINNOVA for supporting collaborative research and innovation projects with Brazil.

In the next sections, the goals and actions of the project are presented, together with the partners, implementation plan and deliverables for the 33 month project. The total project budget is MSEK 186,477, most of which is the cost of implementation of the VOLVO technology demonstration. We are applying for MSEK 5 from VINNOVA. Contributions from the partners are MSEK182,280 from Volvo, MSEK3,070 from SAAB and MSEK1,027 from KTH.

Goals and rationale of the project

The ***overarching objectives*** of the project *Smart city concepts in Curitiba – innovation for sustainable mobility and energy efficiency* are (i) to develop sustainable urban mobility and improve services for citizens, and (ii) to use these solutions as catalysts to improve energy efficiency and reduce greenhouse gas emissions. The project enhances the benefits of on-going development of urban infrastructure in Curitiba, innovating urban functionalities, improving the city's energy balance and reducing ghg emissions.

The project has a ***system approach*** and is ***interdisciplinary***. We combine expertise of multiple stakeholders to evaluate innovative technologies (e.g. electric vehicles, ICT for improved planning, operation and monitoring) for achieving sustainable urban development in Curitiba. The latter is primarily defined in terms of improved energy efficiency and reduction of greenhouse emissions, though other parameters may be added later depending on data availability and local priorities. Beyond that, the project aims at demonstrating and monitoring new technological solutions, identifying priority areas and concrete actions for up-scaling the innovative solutions, and incorporating research findings in planning processes.

[11]The "MoU was signed in the presence of His Majesty King Carl XVI Gustaf of Sweden, the Mayor of Curitiba Mr. Gustavo Fruet, and a distinguished delegation from Sweden. The MoU was the result of a previous project supported by VINNOVA and led by Prof Semida Silveira, KTH (http://www.kth.se/smartgrid-brazil)

More specifically, the activities and analysis in the project focus on smart mobility. The project is being developed based on improvements of urban mobility in Curitiba, which includes concepts for mass transport, multi-modal transport systems, land-use change and creation of green areas. In addition, Curitiba is testing concepts related to electro-mobility aiming at low-carbon solutions, and improved comfort for the citizens. In this project, we evaluate the application of such concepts along the ***Green Line,*** introducing innovative technological solutions at system level, meeting the demand for mobility as well as for more efficient monitoring and operation of the system. The *Green Line* consists of a new development axis crossing the city of Curitiba from North to South. Other axes of mass transport exist in the city which can become subject to new developments in the future.

The *Green Line* and other mass transport axes can become catalysts for urban transformation and innovation. The idea is to plan for functional, cost-efficient and environment friendly mobility in the urban area using new technologies. Densification along mass transport axis is a tested concept in Curitiba, but there is reason to review the concept in face of new technological solutions and priorities. The project combines information technology and smart grids to develop electro-mobility infrastructure and environment-friendly transport services. In addition, it establishes a platform for monitoring mobility, enhancing information flows to operators and users, and improved total system efficiency. The opportunities created by technological advancement in the transport sector provide the basis for a multi-modal planning effort, helping improve services in the urban area.

Sustainable solutions require the alignment of local stakeholders with national government strategies and policies. The project offers a rare opportunity to bring together city management, energy and ICT companies, industry, research and development institutes and education institutions in Sweden and Brazil to develop smart city concepts for Curitiba. The ambition is to become a reference in the national and international context, adding stringent sustainability targets to the city's planning tradition.

Challenges in Curitiba

The city of Curitiba has approximately 1.74 million inhabitants and a long history of planning for sustainable development. Curitiba aims at transitioning to a low-carbon transport system in consistence with its historic legacy of sustainability. The electrification of the transport system holds enormous potential for carbon abatement and can contribute to Brazil's voluntary commitment to reduce CO_2 emissions by at least 36% by 2020. Electrifying Curitiba's trunk lines would offset 20,000 tons of CO_2 every year.

Curitiba has developed and implemented urban concepts that have shaped the city landscape. These include the creation of mass transport corridors, densification of land-use along these corridors, and mobility solutions using BRT systems. Presently, the city is opening the *Green Line* integrated with a linear part which, in turn, opens areas for urban expansion. This serves not only to accommodate present development pressures, but also to facilitate integration and guarantee continued environmental quality. Meanwhile, there is reason to rethink the urban evolution in face of technological developments such as smart grids and electro-mobility; environmental requirements such as reduced footprint and greenhouse gas emissions; and social demands such as urban safety, comfort and life quality. Likewise, the management of smart grids will allow improved provision of information for better integration of urban functions. Demarcated areas can be transformed into learning labs for demonstration of technologies and urban solutions.

The project is conceived within the framework of Curitiba's plan for sustainable development, devised by the government of Gustavo Fruet. The plan is to place Curitiba as a leader among the most innovative cities of the world. The development of the city shall

break the isolation of many areas, open new living public spaces, and channel the dynamics of urban investments and development towards ambitious environmental and social goals. The municipality is putting together efforts to create a framework for technological innovation, investments, and sustainable development. The project *"Smart city concepts in Curitiba - innovation for sustainable mobility and energy efficiency"* is aligned with these objectives, thus supporting the overarching sustainability goals of the municipal government. The project brings technological system innovation to enhance the quality of services provided, enhancing the modernity and sustainability of the city.

Curitiba has recently received large resource allocations from the national government not least as it is also hosting games in the world soccer championship 2014. In addition, R$ 300 million (approx. € 100 million) have been allocated by the federal government, and added to the municipal budget aimed at projects to be developed along the *Green Line*. Further resources will be obtained through auctions for land-use expansion along the *Green Line*, a scheme that has been used previously by the city. These auctions are scheduled to take place in coming months and will bring new resources for projects. This indicates the commitment of Curitiba to the development of projects along the *Green Line* and hints about transformations that will evolve in the coming years.

Innovation for sustainable mobility and energy efficiency – project tasks

While integrated concepts are being tested worldwide to improve the energy efficiency of cities and mitigate climate change, there is still much to do before energy is fully integrated into urban planning. The functional changes required to make cities more efficient are both at the system and operational levels. While the former requires both vision and mobilization of resources for infrastructure development, the latter requires broad cooperation among urban actors and society. Planning and adaptive management is required to deal with urban transformation as well as immediate needs. Maintaining a dialogue with the citizens is an effective way to guarantee engagement and continuity.

This project revolves around demonstration of new technological systems by VOLVO and SAAB, and applied research to plan and monitor urban change towards sustainability. The project is developed in cooperation between Swedish and Brazilian universities, the public and private sector and civil society. Various master's students, as well as PhD candidates and post-docs will be involved along the process. The idea is to cooperate in a triple helix model that can provide a joint platform for all stakeholders involved, promote development and create synergies that will last beyond the project. This section outlines the tasks planned for 33 months, from Oct 2014 to June 2017. The tasks shall generate results in the form of demonstration of technological solutions for Curitiba, further development and adaptation of concepts, and system configurations.

TASK 1 Defining, planning and monitoring innovative solutions

The partners will collaborate to define technological solutions for implementation and demonstration along the mass corridors, having the *Green Line* as starting point. The introduction of electro-mobility solutions along mass corridors will open opportunity for other vehicles, for example, electric taxis and motorbikes. Therefore, the infrastructure should be considered in a multimodal system approach. The provision of a smart grid capable to deliver the new services with security and reliability is necessary. In addition, services related to information provision for planners and users shall be implemented. While prospection for provision of these services is already on-going, it requires further work to detail demand and supply of products and services and definition of priorities and phases of implementation. The project team will develop a plan for demonstration of technologies and services which will be deployed and monitored along the whole project.

Coordinator: KTH-ECS, Professor Semida Silveira
D 1: Coordinating meeting with all partners to detail project activities. Follow up meetings in Curitiba and Stockholm/Sweden, as well as virtual meeting along the project.
D 2: Final project workshop in Curitiba.
D 3: Final project report containing project results and recommendations.

TASK 2 Demonstration of new technology for mass transport corridors

Electric hybrids are predominantly battery electric vehicles with a hybrid back-up that compensates for restrictions on battery weight, charging time, and operational requirements. Electric hybrids take electricity from the grid via charging points located at regular stops and bus line terminals taking advantage of stop and layover times. Electric hybrid technology is a perfect fit in the Brazilian context, given the country's clean electricity generation and biofuel development, which will result in high carbon performance. In order to introduce, validate and deploy electric hybrid technology in high-capacity BRT operation in Curitiba, Volvo will collaborate in this project. Curitiba will become a demonstration showcase for cutting-edge sustainable transport systems. Curitiba is a natural partner as the home for Volvo in Latin America. This partnership will bring innovation, development and benefits to the local economy.

Volvo's City Mobility program has a holistic view of public transport. Among other initiatives, Volvo is participating in ElecTriCity together with KTH and other Swedish stakeholders. This concept demands an optimized solution including vehicles, infrastructure, charging infrastructure, fare payment, and intelligent support systems. This implies also multiple stakeholders and requires new business models for operation of the solution. Volvo will part with COPEL (Concessionaire for Electricity in Curitiba) to install the necessary infrastructure (2015) to be able to put two busses running in Curitiba (2016-2017). The impact of electro-mobility adoption over the local energy distribution system and its energy quality will be investigated as well as the charging stations role in a smart grid scenarios (energy storage, load shedding, load balance, load transfer, etc.). This investigation has already started in collaboration between COPEL, VOLVO and UTFPR in Curitiba and will be further developed in the various tasks of this project. The present project allows the insertion of Volvo technologies in a broader context that goes beyond understanding public transport. Multiple expertise is needed from ICT to energy technologies. The results of this project will bring information about how to operationalize the technology and will serve as benchmark for implementation of the system in other axis of Curitiba and other cities in Brazil and worldwide.

Coordinator: Volvo Buses Latin America (Rafael Nieweglowski – City Mobility Regional Manager) and Volvo Buses Corporation (Jessica Sandström – Senior VP City Mobility)
D3: A demonstration of the technology by VOLVO (2 busses in the *Green Line*) will serve to test and validate the electro-mobility concept in Brazil.

TASK 3 Demonstration of operations center platform – basis for the City Cooperation Center

The City Cooperation Center (CCC) is a control center for the city, which links together societal sector/domains and creates an information platform for advanced decision support, efficient dialogue and better resource utilization. This concept is now being implemented in Linköping, a city in Sweden, to demonstrate better information exchange between government and city stakeholders and deliver real time environmental information. This concept is indicator-based to make it easy to achieve an overview of the situation especially when different systems are integrated, making it easy to extend the

system. The control center displaying and processing unit may be the Saab SAFE system. In the demonstration of the concept in Curitiba, the focus will be on environmental monitoring based on existing traffic, weather (forecast and emission models) and other pollution sensors in the city. This will help to evaluate the *Green Line* corridor in terms of environmental progress, for example. In addition, traffic management capabilities, inherent to the Saab SAFE system, may add more value to the demonstrator. The demonstrator will be initially linked with the new technologies introduced by VOLVO in Task 2. In addition to traffic flows, information related to energy use and environmental impacts will be monitored and communicated to city managers and users.

An initiative in line with this CCC concept is the open data guideline devised at Fruet´s plan to a smart city, which opened many databases of the city to local universities, common citizens and private companies as web services. With data available, many service providers have been developing new applications aimed at improving the life of citizens in Curitiba (e.g. bus timetable online, taxi search, bus line information, etc.). Although presently, the city communication infrastructure provides a wide range of access points and enough bandwidth to its several systems (traffic control, public transportation monitoring and control, health center units, schools, public administration centers, etc.), they are not fully integrated. This platform provides the basis for such integration in the future.

Coordinator: SAAB AB, Bengt O. Andersson and Dr. Thomas Grannlund
D4: A demonstration platform installed by SAAB to monitor mobility and environmental functions and communicate these to the citizens and city operators.

TASK 4 Definition of connectivity along mass transport corridors

The infrastructure envisioned is based on the reasoning that mass corridors such as the *Green Line* will become a vital transportation artery, but it will also be surrounded by green areas for the citizens. In such scenario, we can expect a huge concentration of users along and around the surrounding area using portable connected devices while commuting to and from work (e.g., remote office applications), or while relaxing in parks (e.g., music/video streaming). This translates to the need for very high capacity wireless broadband connectivity. Sweden can be used as a model, where ubiquitous wireless broadband connectivity is quite advanced.

The above mentioned scenario requires an efficient wireless and backhaul/fronthaul infrastructure able to support the users both moving along the *Green Line* and resting in the recreational areas. The work for the design, deployment and management of this infrastructure (at least for the wired network) will be closely related to the infrastructure deployment work when it comes to the wired network. The tool used in the design phase will be based on Integer Linear Programming (ILP) formulations with the objective to minimize the total deployment cost for the wired aggregation network. The presence of high capacity wireless broadband connectivity will enable a number of mobile services more directly related to transportation (e.g., traffic monitoring including traffic violation, smart parking application in the area served by the green line, etc.)

Coordinator: KTH-OnLab, Professor Lena Wosinska and Assistant Professor Paolo Monti
D5: Preliminary deployment strategy for the aggregation network along the Green Line. This material will be presented in the form of a report or conference paper.
D6: Fiber-based aggregation network deployments for ubiquitous urban wireless broadband connectivity. This material will be presented as a journal paper.

TASK 5 Energy and climate scenarios in a context of improved mobility

The definition of infrastructure and services need to be based on environmental and socio-economic evaluation of the solutions proposed including impacts and benefits that can be expected from technological improvements. In Curitiba, 86% of the ghg emissions are related to energy (www.c40.org/cities/curitiba). Yet the city has little control of the energy supply and is not an actor in energy markets. However, the city has a strong tradition in city planning and has the capacity to continue innovating transport systems. Smart mobility provides ways for improving energy efficiency and reducing greenhouse gas emissions in the urban context. The municipality has a central role to play, coordinating strategic actions, promoting infrastructure development and adoption of innovation to improve city functions. Here it is important to take advantage of the dynamic development of the city and to channel towards sustainability to maintain an attractive and livable city. The analysis in this task will be carried out with the objective of providing insight to city planners and policy makers when it comes to the opportunities for reduction of energy demand and emissions. The study provides a unique combination of approaches that relate smart mobility and ICT infrastructure with impacts on energy use and emissions in the urban context. Understanding energy efficiency and ghg emissions reductions potentials is important for strategic decisions that will determine the future of the city.

Coordinator: KTH-ECS, Professor Semida Silveira. Licentiate candidate.
D 7: Analysis of energy efficiency and ghg emissions reductions in different scenarios for the *Green Line* areas and Curitiba and policy recommendations. The results will be presented in a licentiate thesis.

TASK 6 ICT infrastructure for CCC concepts and interactive information sharing

A complex ICT ecosystem is needed to provide the necessary support for collecting and managing the collected data and trigger the actions controlling certain functions in the Smart City environment. City Cooperation Centers (CCC) can provide the basis for the interaction among organizations and/or between the municipality and citizens. A huge amount of data from different sources has to be processed safely to generate usable information for various stakeholders. In this context, the ICT infrastructure becomes the basement of a CCC operation, supporting its processes. Optical networks are the best alternative for high capacity data transport, while cloud computing is the best option for high capacity data storing and processing. Their combination is often referred to as “optical cloud”. Activity wise it will first be important to understand and define the service requirements and the design constraints posed in the context of a CCC in Curitiba. At this point, it is also essential to develop accurate Total Cost of Ownership (TCO) models to quantify both the Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) levels for a deployment solution.

A design work will follow with the objective of minimizing the deployment cost. A fiber deployment is proposed to accommodate the needs of the services identified. This may include new infrastructure or incremental upgrades of the existing infrastructure. The tool used in this part of the work includes Integer Linear Programming (ILP) formulations to get optimal deployment results with respect to the cost function chosen. This dimensioning work will be based on traffic (i.e., number and type of smart city services) models derived directly from the city of Curitiba. Once the optical cloud infrastructure is designed and deployed, we will find the best way to assign networks and cloud resources to each service envisioned for the smart city. Solution for these studies will be mostly based on conventional and/or meta-heuristics able to guarantee a balanced tradeoff between

optimality of the solution and execution time. The objective in this part of the study will be to minimize the number of optical could services not being able to be provisioned while guaranteeing the required level of performance of the cloud services (e.g., setup delay, jitter, energy consumption, resiliency) identified in the service requirement phase.

KTH is currently involved in a joint activity with SAAB related to the dynamic provisioning of cloud services for the CCC concept and applications in Brazilian cities. In the particular context of Curitiba, significant amounts of data have been made available but still need to be coordinated. An urban wireless broadband connectivity needs also to be made available to the users. The increase on the number of mobile services over the open data servers will surely impact the server and the network performance. We aim at developing innovative solutions for wireless networks (particularly those related to vehicular networks) to increase the overall system performance supporting Curitiba's open data policy. Overall the implementation models shall also indicate procedures for promoting the actual implementation of the various services envisaged.

Coordinators: KTH-On Lab (Professor Lena Wosinska) and UTFPR (Professor Keiko Fonseca); one sandwich PhD candidate on the topic "Design and management of Smart Cities based on Optical cloud" (funded from Brazil) and one Postdoc with focus on optical fiber-based aggregation networks for ubiquitous urban wireless broadband services (funded by SAAB).
D 8: Report on cloud and network service requirement definition and Total Cost of Ownership (TCO) models.
D 9: Design strategies for the optical cloud and the wireless network infrastructure (conference paper also addressing disruption tolerant networks and bio-inspired solutions)
D 10: Green and resilient dynamic provisioning strategies for optical cloud services (j.paper)
D 11: Routing algorithms and strategies for green and disruption tolerant wireless data services (journal paper)

Task 7 Planning for electro-mobility in Curitiba

Several parameters shall be considered when planning for urban mobility and prioritizing among options, including energy efficiency, environmental impacts, topography, safety, convenience, etc. If a city is inclined to shift its transportation system to electro-mobility, what should be the basis for decision-making? This is the question that guides this section. Curitiba has been aware and prompt to answer locally to the challenges of climate change, pollution and depletion of non-renewable resources not least when it comes to its transportation system. Curitiba has a legacy of transportation planning in which a diversity of determinants is considered. Curitiba is part of the C40 and known as *Sustainable city*, a title that is largely related to urban planning concepts, and implementation of innovative urban transport systems. This compels Curitiba to think a step ahead and consider how electro-mobility could be integrated in its current transportation system. While aspects that are commonly considered when planning a mass transportation line are known to the city (eg. current transportation system network, existing road system, origin-destination information, densities, and road safety), there are new aspects to be considered when the vehicle is electric. These aspects are both environment-related such as the absence of noise and pollution reduction, as well as technical such as possible implications due to slopes, configuration of current electricity grid etc. Mapping these aspects and analyzing them systematically will inform about the most suitable places for investing in electro-mobility.

Coordinator: UTFPR, Professor Tatiana Gadda.
D 12: Analysis of parameters for planning sustainable urban mobility (journal paper)

Communication and dissemination plan

We propose, therefore, a strong focus on communication along the project implementation, also liaising with other urban initiatives at KTH (e.g. ElecTriCity, SymbioCity) and worldwide (e.g. C40). Five key items are proposed:

C 1: Homepage for informing about the project and partners activities in Curitiba

C 2: Internal newsletter for Swedish and Brazilian partners every six months

C 3: Executive summaries once a year aimed at policy makers (in English and Portuguese)

C 4: Presentation of the project in international conferences, e.g. C40, CISB annual meeting

C 5: Final conference with policy makers and stakeholders in Curitiba

Time schedule for project implementation

	2014	2015				2016				2017	
	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun
Defining, planning and monitoring innovative solutions	X		X		X-E	X		X		X	R/E
Demonstration new technology for mass transport corridors											
Demonstration of operations center platform											
Definition of connectivity along mass transport corridors					R					R	
Energy and climate scenarios with improved mobility					R					R	
ICT infrastructure for CCC concepts and info sharing		R			R			R		R	
Planning for electro-mobility					R				R		
X = meetings											
R = report, conference paper or journal paper											
E = executive summary											

Budget

The total budget for the project is MSEK 186,477. Most of that is the cost for implementing the technology demo by VOLVO which is at the core of the activities. This project adds value to the VOLVO demonstration by adding an information platform linked to it (by SAAB) and development of research to explore synergies within the city, as well as to evaluate the energy and climate benefits of the new technologies. Contributions from the partners are MSEK182,280 from Volvo, MSEK3,070 from SAAB and MSEK1,027 from KTH. We will pursue further funding on the Brazilian side to cover costs that could not be accommodated in this proposal.

Project Partner	2014	2015	2016	2017	SUM
KTH-ECS	**370**	**1 437**	**1 207**	**683**	**3 697**
i. Requested from VINNOVA	370	1 100	1 100	500	3 070
ii. Own input	-	**337**	**107**	**183**	**627**
KTH-OnLAb	**150**	**300**	**300**	**150**	**900**
i. Requested from VINNOVA	50	175	175	100	500
ii. Own input	100	125	125	50	400
SAAB	**500**	**1 360**	**1 590**	**550**	**4 000**
i. Requested from VINNOVA	80	300	440	110	930
ii. Own input	420	1 060	1 150	440	3 070
VOLVO	**28 115**	**70 325**	**57 325**	**27 115**	**182 880**
i. Requested from VINNOVA	-	250	250	-	500
ii. Own input	28115	70 075	57 075	27 115	182380
TOTAL PROJECT COSTS (kSEK)	**29 135**	**73 422**	**60 422**	**28 498**	**191 477**
i. Total requested from VINNOVA	**500**	**1 825**	**1 965**	**710**	**5 000**
ii. Total own input	**28 635**	**71 597**	**58 457**	**27 778**	**186 477**

The Swedish-Brazilian partners and their role in the project

KTH Royal Institute of Technology (www.kth.se)
KTH-ECS (www.ecs.kth.se): Professor Semida Silveira (semida.silveira@energy.kth.se): Project coordinator, expert energy systems planning and climate policy
KTH-OnLab: Prof Lena Wosinska (wosinska@kth.se) Prof Paolo Monti (pmonti@kth.se): experts ICT systems

Volvo Buses (www.volvo.com)
Volvo is a global actor in the development of products and services for transport with high energy efficiency. Volvo is located in Curitiba and has a long history of collaboration with the city.
Rafael Nieweglowski, City Mobility Program Manager (rafael.nieweglowski@volvo.com)
Jessica Sandström, Senior VP City Mobility (jessica.sandstrom@volvo.com)

SAAB AB (www.saabgroup.com)
Organisationsnummer: SE 556036079301
Tomas Granlund (thomas.granlund@saabgroup.com)
Bengt O. Andersson (bengt.o.andersson@saabgroup.com)

City of Curitiba (http://www.curitiba.pr.gov.br/)
Fabio Doria Scatolin, Secr.of Planning and Management (fabioscatolin@smad.curitiba.pr.gov.br)
Rosane Kupka, international affairs (rkupka@sgm.curitiba.pr.gov.br)
URBS – Urbanização de Curitiba S.A. (transport operations) (http://urbs.curitiba.pr.gov.br/)
Gregorio da Silva Junior (gregorio@urbs.curitiba.pr.gov.br)

UTFPR – Universidade Tecnológica Federal do Paraná
Federal University of Paraná (UTFPR) (local coordinator: Professor Keiko V. Fonseca (keiko@utfpr.edu.br); expert electrical and computer engineering
Tatiana Gadda, Professor Urban Planning (tatianagadda@utfpr.edu.br)

CISB (Swedish Brazilian Innovation Center, www.cisb.org)
CISB builds cooperation between Brazil and Sweden to address the challenges of Brazilian society. It works by creating innovation platforms of communication to disseminate initiatives from both sides. CISB will help develop the communication plan of the project and disseminate the results.
Alessandra Holmo, CEO (alessandra.holmo@cisb.org.br)
Juliana Miura, international relations and communication (juliana.miura@cisb.org.br)

COPEL (www.copel.com)
COPEL is a concessionaire electricity company operating in Paraná. The company is directly involved in the automation of electric grids to improve its robustness all the way from sub-stations to final distribution of electricity. The company will contribute to the project through established collaboration with UTFPR and Volvo.
Julio Omori (julio.omori@copel.com)