



SIEMENS



Enabling Change

A Guide to Sustainable Development in Mid-sized Baltic Cities

Final Report



A partnership between City of Turku and Siemens



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Introduction

It takes two to tango – and these two should also share the passion. During the past three years we have had a very special experience of working together between a city and a company. We have had a similar interest and a shared passion: to build a better city for the future.

Improving the cities is essential for humankind and the good news is that we are well able to achieve better cities. Most of the solutions are either available or emerging. What is missing is mainly knowledge, cooperation and resources.

Cities are not always aware of the new solutions that are being developed by businesses. Companies on the other hand are sometimes struggling to really understand how to best approach cities and create solutions together. Both parties could learn from each other and achieve better results.

Building and developing cities is a long-term business. The current strategy of Turku aims at year 2029. This is fifteen years from the adoption of the strategy and will also be the 800th Anniversary of Turku. That's long-term. Cities are.

Also on this background, we have highly appreciated the interest and competence of our cooperation partner to commit to a far-ahead-looking journey with us. In our cooperation both parties brought in their


own resources, stakeholders like universities were invited to the table too, and all results were made public. There were no quick financial gains on the table.

The aim of this publication is to publicly share our findings and lessons learnt. I hope the results will be interesting reading for everyone who shares our passion of making better cities. Hopefully they will also encourage other cities and businesses to embark on similar journeys.

There were also other actors that made our journey with Siemens possible. I would especially like to thank the World Business Council on Sustainable Development and ICLEI for helping us to find a good starting point together. In Turku, our Urban Research Programme, the universities and many other stakeholders helped us to achieve good results. Warmest Thanks to each and every one of them!

However, my Greatest Thanks belong to Siemens and their teams in Espoo, Munich, Berlin and London for their engaged, passionate and resultful work with us.

Aleksi Randell
Mayor
City of Turku



A growing number of Finns will – and will want to live – in a city as jobs, services, leisure activities and events are there. The growth of urban areas is also a challenge. We will want to live in cities with an urban beat which are green, clean and safe.

Growing cities balance between quality of life and growth. A competitive city is born out of happy citizens and thriving businesses. Efficiency and flexibility needs to be supported without burdening the environment. New technologies and smart infrastructure solutions are the key when growing cities ensure sustainable future.

When we started our strategic cooperation three years ago, Siemens was offered a window seat to city development, challenges, processes. We have had an opportunity to use our broad technology offering to develop city solutions in this internationally unique cooperation.

The city of Turku has a will to look at city development outside of traditional models. Turku started bravely and without any prejudice to look for new ideas and experiences of good practices and future visions through the cooperation. We brought our broad technology expertise and experience from varied cities to the table.

Our cooperation with Turku has included different kinds of research projects with public results that can be used by everyone. The results of

the research show, that possibilities of technologies need to be considered early, in the design phase. Their adaptation at a later stage is difficult and expensive – even impossible.

Companies usually have more information about the latest technologies and using them than the cities do. Therefore it is good to discuss how private and public entities can have closer discussions without deviating from good business practices. Our strategic cooperation with public results is an excellent example of new ways of working being possible.

I am certain, that we have reached results, solutions and a vision that benefits us both. I am also certain that our cooperation will continue after this limited time project. We are also glad to share these experiences and learnings with other interested cities.

I would like to warmly thank the city of Turku for our excellent cooperation and the chance to be included in developing a progressive and well being Turku. I am sure that many of the development ideas from this project will become reality for the good of the citizens of Turku.

Janne Öhman
CEO
Siemens Osaakeyhtiö

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Executive Summary

Collaboration as key success factor for sustainable city development

In the winter of 2012 two parties from different background set on a challenging mission. The aim was to support the development of the City of Turku to most interesting city in the Baltic Sea region by 2029, when it celebrates its 800th birthday. Technology company Siemens and The City of Turku agreed on a three year strategic cooperation of which this report is about.

Climate change, resource depletion and the destruction of natural habitats are all issues which have been present for years. Governments, cities, non-governmental organization, civil society and the private sector have already invested heavily to mitigate the severe consequences of these challenges. An especially important means is the collaboration between different partners to generate new ideas, plan integrated solutions and to involve all relevant stakeholders from the beginning.

The City of Turku has given itself the target to reduce its net greenhouse gas emissions to zero during the 2040s. Turku pursues a sustainable growth strategy and is convinced that preventing climate change and creating a low carbon society present significant opportunities for businesses in the region. Siemens as technology company offers a wide variety of sustainable solutions to cities in, for example, building technologies, energy production and smart grids as well as mobility.

During the partnership Siemens experts have shared their expertise on the newest technologies and on how things have been developed around the world while Turku experts shared their knowledge on how a city works.

The unique cooperation has yielded new knowledge, collaboration models, best practice sharing from good examples around the world

and a strong recommendation to other parties to try similar approaches.

The start of the partnership between the City of Turku and Siemens dates back to 2011 and the Urban Infrastructure Initiative of the World Business Council for Sustainable Development. The City of Turku and Siemens continued the discussion even after the end of the WBCSD engagement and decided in 2012 to enter a strategic cooperation with regular, bi-annual meetings to identify new topics for joint concept work and to review the results of previous studies. Other expert and stakeholder groups such as the University of Turku were involved from the very beginning and accompanied the entire process.

Turku was an interesting partner for WBCSD and Siemens for its size and its openness to cooperation. Prior to the cooperation large and mega cities had been studied quite extensively. Midsized cities, however, had not been in the focus. WBCSD initiative and the Siemens Turku partnership have shown that a key topic to be considered is that the requirements of mid-sized cities differ quite significantly from large cities.

Open discussion of topics and exchange of information was a very important success factor for creation of holistic approaches, new methodologies and ways-of-working for all involved partners.

Throughout the partnership the City of Turku and Siemens set up many studies and initiatives to first evaluate specific options/solutions to create a sustainable and attractive city for the citizens. It is obvious that a meaningful, long-term strategic collaboration between a city and a private sector company needs a joint target, a process to collaborate, and transparency among the partners, to other stakeholders and the general public.

The tangible results of the cooperation have been reports, development models and researches. They include the Light Rail Impact Study, Turku Sustainable City Districts Skanssi and Linnakaupunki report, study on energy efficiency improvement in buildings and an eBuss concept. All of the studies, reports and concepts are public knowledge.

One of the main outcomes of the cooperation has been a toolkit for public private partnership to develop city districts. Although there are many toolkits available to support the development of sustainable city action plans and alike, little has been said about how to establish a collaborative approach between a city and a private company partner. Based on the experiences made during the last couple of years, a structured framework has been designed to support other city officials who aim to start a similar cooperation.

Publication and communication of all results of the cooperation are important to ensure that citizens can be assured that solution concepts are un-biased by company specifications or products but to ensure as well that companies which did not participate in the cooperation have a fair chance to win upcoming tenders by evaluating boundary conditions, methodologies and solutions concepts which have been developed before the publication of a procurement tender.

A partnership like the one between the City of Turku and Siemens is still a novelty for cities and the private sector alike.

Better decision making can result from cooperation by creating better ideas which are technically and financially viable and help cities to build a more sustainable future.

The fundamental issue behind the Siemens Turku cooperation has been a better life for the citizens of Turku. It can mean sustainable solutions for power production, better living environments or mobility solutions. This can best be achieved through cooperation. As Turku City Mayor Aleksi Randel says in his interview: "no city administration will ever create a successful city on its own."



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Impact on City Development in Turku

Aleksi Randell,
Mayor,
City of Turku



– Turku intends to be the most interesting city in northern Baltic Sea Region by 2029. How are you going to achieve this?

In fact we have many strengths to build on: vivid urban culture and rich heritage, active universities and high number of students, versatile economy and beautiful natural environment. However, this is not enough, as city development is a constant challenge. Currently we are undergoing an urban renaissance. Our inner city is growing strongly, as many brownfield areas are being developed. People appreciate this and there is a growing trend of urban lifestyle. Also our economy is being renewed.

– What are the roles of city administration, citizens and businesses in developing the city?

A good city is also a lively place and the life of the city are the citizens and their activities. Our administration is working hard to provide a good venue for this life and smart services for the citizens. However, no city administration will ever create a successful city on its own. We need all these stakeholders to create the city together. Businesses are the life blood of the city and their perspectives and experience are essential for successful development. Partnership with companies – in our case most notably the one with Siemens – bring useful knowledge and help us solve our development challenges in best possible and feasible ways.

– What does co-operation with businesses mean in practice?

Of course it has many different forms and can be tailored for many needs. Helping start-ups get going is quite different compared to building an investment-alliance with a leading multinational company. In practice we are doing both of these and everything in-between. In all cases the mindset for cooperation is key: businesses are our partners and we look for shared interests.

– Turku has carried out a three-year strategic collaboration with Siemens. Why was this co-operation started?

We saw how much effort Siemens had invested for RD on cities globally and were eager to tap into this pool of know-how! We wanted to check and analyze some of our challenges and rethink solutions together with such a leading global partner.

Our co-operation started in 2011 when both Turku and Siemens were involved in the global Urban Infrastructure Initiative project of the World Business Council on Sustainable Development. Analyzing city development challenges together proved to be useful for both parties.

– What did Turku get from the co-operation with Siemens?

We got many useful things: analysis, knowledge and ideas for solutions. We have become better informed of the solutions available and the extensive development work carried out by companies such as Siemens.

– What have you learnt from this cooperation and how has this impacted on Turku's future vision?

Our joint studies for example on urban mobility solutions and city district development have made us more aware of how interlinked the different city development objectives and actions are. As a result, we are better equipped to design our development projects from a holistic city development perspective. I think this is also visible in our new city strategy.

– Also the universities of Turku as well as other stakeholders took part in Turku-Siemens co-operation. What is the potential and motivation of such wide-based co-operation?

Involving our universities was part of the cooperation arrangement from the beginning. Creating knowledge together was at the core of our joint undertaking and we wanted to make the whole process very open and transparent. All results are publicly available.

– Based on your experience, what advice would you give to other cities and companies?

City-business co-operation based on the interest and competencies of both parties can be very inspiring and useful. Making a formal agreement, establishing a steering mechanism/group and breaking down the work-plan into concrete thematic projects will provide a solid framework for the operation.



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Turku's Sustainable Development Vision

Turku is the 5th biggest city in Finland and has around 180,000 inhabitants. The city is located in the South-West of Finland next to the Archipelago. Its economy can build on three universities and is particularly strong in research and ship building. Turku facilitates the development of smart city services such as IT solutions and applications in cooperation with the University of Turku. According to Turku's Structural Model, the population is expected to grow by 75,000 inhabitants by 2035 of which 80% will be living in the core urban areas and 20% outside the urban areas. 20,000 new jobs are also expected by 2035.

The City of Turku has given itself the target to reduce its greenhouse gas emissions to zero by 2040. It is unlikely that emissions will be able to be stopped completely, but the remaining emissions will be absorbed by the carbon sinks in the region. This ambitious target is backed by detailed plans such as the Sustainable Energy Action Plan published in accordance with the Covenant of Mayors or the Sustainable Urban Transport Plan. Turku pursues a sustainable growth strategy and is convinced that preventing climate change and creating a low carbon society present significant opportunities for businesses in the region.

During the 2000s, Turku has already achieved a relatively larger reduction in greenhouse gas emissions than the other large cities in Finland – total emissions were reduced by more than 20% and emissions per capita by almost 25%. Emissions were reduced particularly by increasing the share of renewable energy in district heat production, and emissions from individual heating and traffic were also reduced.

Guiding principles are defined and detailed with specific targets and indicators to track progress. This hierarchy is applied for all sectors such as transport, GHG emissions, energy efficiency, share of renewable energy sources, procurement, waste management, water, diversity of nature and environmental expertise.

For example, the City of Turku has given itself the guiding principle to reduce greenhouse gas emissions. As an intermediate step towards the target of becoming a zero emitter of greenhouse gas emissions, a target has been implemented to reduce GHG emissions by at least 30% per inhabitant from 1990 levels by 2020 and by at least 20% in total. The lead indicators to track progress towards this target are emissions calculated in a consumption-based manner in tons of CO₂ equivalents.

Another target covers the improvement of energy efficiency with a 20% improvement target from 2005 levels by 2020 which will be tracked in energy savings per year. At least 50% of district heating has to come from renewable sources by 2020 and electricity purchased by the city is generated completely from renewable sources since 2013.

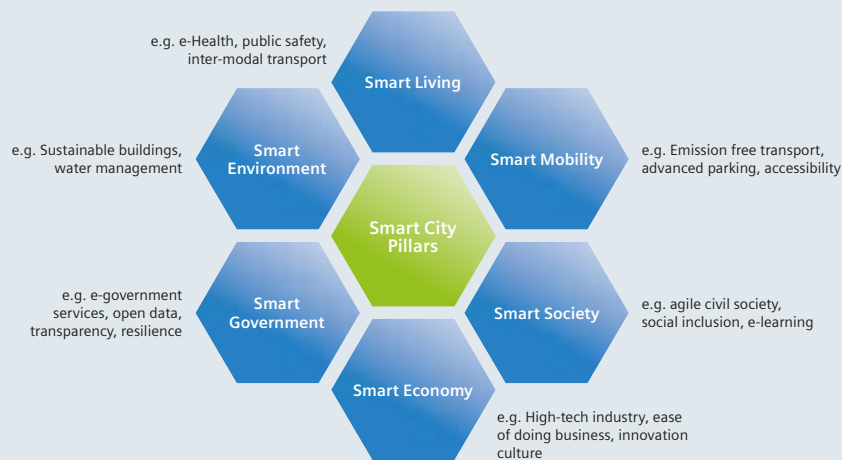
The promotion of sustainable modes of transport is another priority of the city. Key objectives for 2030 are the reduction of CO₂ emissions from transport by 30%, a modal split of max. 30% of cars and the remaining percentage for walking, cycling and public transport. To avoid trips by car in the first place, Turku is aiming to increase the share of population and work places in districts with high quality walking, cycling and public transport facilities. Given that Turku has a very comprehensive sustainability agenda and corresponding targets, only selected quantitative targets are displayed here.

To achieve these ambitious targets, Turku collaborates both with other cities and private companies to act as an innovation platform promoting the utilization of new technologies and new forms of collaboration between public administration and private economy. In collaboration with other cities via networks like ICLEI, Turku aims to share its own targets and measures as well as to learn from others. Targets are made public via the city's website as well as for example the Covenant of Mayors.

The smart city as a tool to achieve sustainable economic development and high quality of life

According to Caragliu, a city can be defined as 'smart' when social capital, traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic development and a high quality of life.

To achieve this, six main pillars need to be considered and integrated in the smart city strategy.



It is important to mention that although technology plays a vital role in smart city concepts, also socio economic factors, citizen involvement and good governance are indisputable parts which need to be adequately taken into account.

Smart City Concepts need to be focused on citizens as they are the main users and acting parts. Intelligent infrastructure which sends data but is also able to respond is the fundament of the smart city. On top of this, applications which are front-end to the citizen, give the opportunity to interact either with infrastructure or public and other services.

Intelligent infrastructure, applications, sensor and actor networks are tools to enable the smart city. Its potential however can only be realized if the citizens use the new opportunities and flexibility according to their needs. Whether this results in new transport sharing schemes, alternative ways to interact with the city government or to connect more easily with neighbors in the district, city governments will play a vital role to facilitate this process in collaboration with the citizens.

*Timo Hintsanen,
City Planning Director,
City of Turku*



– How do you define a good development initiative for a city?

A good city development initiative supports the city strategy in a sustainable way. The strategy spans from broad climate policy goals to matters impacting every citizen's daily lives. Growth, appeal and competitiveness are the key words.

– How do you set goals for good city development?

Cities and city regions set their most important goals in strategies, which are based on international and European policies. The goal hierarchy is quite clear. On the lower level the goals are implemented at a local level. For example, city planning goals are mostly set at that level.

– What is a good example of successful city planning in Turku?

The continuing renaissance of the river banks, which started in the 80s is a very good example.

– How do you ensure, that the citizen remains at the focus?

It is more vital in city planning than anything else to adhere to the legal requirements of participation and communication. New and interesting participatory methods continue to develop through, for example, digitalization and mobile solutions.

– How do you measure success?

Success is best measured in growth, proven well being and happiness.

– When can you say the development has been a success?

If the development brings change the first requirement of success is met. The other measurement in development is that old processes can be discarded. In general the measurements of success are the same as in any strategic work: competitiveness and quality of life increase.

– How do you get the partners to commit to city development projects?

Through its strategy, the city aims to strongly promote and favor partnerships. Varied stakeholder forums and preparational discussions about tenders are also normal process. It is also important, that the city promotes the role of the strategic city development projects as development and innovation platforms to which companies can join in order to develop and demonstrate their innovations.

The cooperation with Siemens is one excellent, and unique, example of a strategic partnership of the city and a corporation.

Business impact evaluation is included in all decision making.

– How is sustainable development taken in to account in city development projects?

In addition to strategy, the decision making and evaluation of all projects include impact evaluation on sustainable economy to nature values.



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Sustainable Development for Mid-sized Cities

Collaboration as key success factor for sustainable city development

Climate change, resource depletion and the destruction of natural habitats are all issues which have been present for years. Governments, cities, non-governmental organization, civil society and the private sector have already invested heavily to mitigate the severe consequences of these challenges. An especially important means is the collaboration between different partners to generate new ideas, plan integrated solutions and to involve all relevant stakeholders from the beginning.

The conventional planning process has proven to be feasible but not as efficient as it could be since project parties are only involved during “their” typical project phase. Planners and architects, for instance, are usually involved only at the very beginning while infrastructure suppliers usually are involved only during the implementation phase. Given the complexity of innovative and integrated solutions, such an isolated involvement cannot utilize and synergize the full competence of all partners for it would be helpful for e.g. planners to discuss at an early stage with infrastructure suppliers and future users to incorporate also their experience.

According to the International Energy Agency’s “New Policies Scenario” outlined in the World Energy Outlook 2012, only 40% of the economically viable long-term energy efficiency potential in transport has been realized already and only 20% in buildings. Quite often, conventional efficiency gains of isolated product parts of the system are hard to gain so a more systemic approach is required to reap additional optimization potentials. Partnering across the different steps of project planning and realization, preferably already during the strategy definition phase, is one promising way to tackle these issues and to come up with better projects to harvest the energy efficiency potential in all sectors.

Collaboration makes sense both vertical and horizontal. Horizontal partnering means cooperation between similar institutions e.g. city administrations via international organizations like ICLEI – Local Governments for Sustainable Development. Horizontal collaboration helps to exchange experience, re-enforce commitments in a like-minded group and combines the influence of cities in discussions with the European Union, governments or industry partners.

Vertical partnering stands for the cooperation between cities, the private sector and other institutions such as universities and non-governmental organizations. Both, bilateral partnerships like the one between the City of Turku and Siemens, as well as the collaboration of cities with private sector organizations like the World Business Council for Sustainable Development has shown to be an effective way to generate new ideas and evaluate existing concepts. Adding the research capabilities of a university like the one in Turku adds then even more competencies.

The start of the partnership between the City of Turku and Siemens dates back to 2011 and the Urban Infrastructure Initiative of the World Business Council for Sustainable Development which led to the collaborative conceptualization of ideas in transport, energy supply and buildings between the City of Turku and six involved companies. The City of Turku and Siemens continued the discussion even after the end of the WBCSD engagement and decided in 2012 to enter a strategic cooperation with regular, bi-annual meetings to identify new topics for joint concept work and to review the results of previous studies. Other expert and stakeholder groups such as the University of Turku were involved from the very beginning and accompanied the entire process.

The long-term commitment from both parties for the strategic partnership over 3 years helped to build the necessary trust to jointly find new possibilities to cooperate and to elaborate holistic concepts for sustainable development of mid-sized cities in the Baltic region. The open discussion of topics and exchange of information was a very important success factor for creation of new methodologies and ways-of-working for all involved partners.

Since collaboration is a critical success factor transparency about the true interests of each of the involved parties is crucial from the very beginning. Although cities are not in a very tough competition with other cities it still might happen that two cities try to attract the same company to invest in their city which might generate some friction in collaboration about sustainable development. Yet especially in vertical partnerships the different interests should be clearly expressed at the beginning, e.g. a company might not want to get involved in technical details of planned infrastructure projects to be not excluded from future tenders. Cities on



the other hand expect technical expertise from private partners to design suitable solutions which is a different way of working for the private sector compared to the standard sales process which is very much focused on the features of a specific product.

To make sure that the requirements of all parties are considered, the legal departments of all involved participants should be involved during the design of the cooperation framework agreement.

Publication and communication of all results of the cooperation are important to ensure that citizens can be assured that solution concepts are unbiased by company specifications or products but to ensure as well that companies which did not participate in the cooperation have a fair chance to win upcoming tenders by evaluating boundary conditions, methodologies and solutions concepts which have been developed before the publication of a procurement tender.

*Wolfgang Teubner,
Regional Director Europe,
ICLEI - Local Governments for
Sustainable Development*

– What is ICLEI and what is the objective of your organization?

ICLEI is an association of over 1,000 local governments representing their interests on international level in processes relevant for sustainable urban development.

At the same time ICLEI is movement driving positive change through projects, initiatives and programs and a resource centre offering information, tools, networking, training and consulting services for cities on local sustainability.

– What is the importance of collaborations and partnerships to support sustainable city development?

Sustainable urban development is a complex challenge that cannot be met by local authorities alone. In addition to the broad involvement of societal stakeholders and citizens, the necessary transformation of urban infrastructure needs the collaboration and partnership with many actors, particularly the providers of advanced technology and engineering solutions. They hold key knowledge about cutting edge technology and upcoming innovative solutions that is important to shape an optimal strategy for the future of cities. Also, providers will be able to present targeted and innovative technological solutions to support

sustainable development based on an improved understanding of needs of sustainable city development and requirements formulated by local governments and other stakeholders.

– Which advice can you give cities which want to start a similar partnership like Turku?

A City should explore and define beforehand what it expects from such a partnership and which developments and challenges it would like to focus on in order to make it efficient and output oriented. At the same time the City needs to have clarity about the boundaries of such a partnership process in order to avoid problems with public procurement processes that might result at a later stage from such a strategic exercise. Third, a city would best embed such development partnerships in a broader picture of their sustainable development objectives, e.g. an approved sustainable development program, which would also serve as baseline for evaluation the outcomes and achievement of partnership projects.

– How can ICLEI support cities in this field?

ICLEI can support cities in the development and evaluation of their sustainable urban development plans and help them to identify the key challenges that can be addressed with the help of the expertise of private sector technology providers. We can also facilitate the organization of initial dialogues and set-up of such a partnership process.



Successful cooperation is based on several factors:

- Clear communication of expected benefits and expectations
- Written framework agreement as solid basis for partnership
- High-level signing ceremony and steering committee to ensure commitment
- Involvement of legal departments during consultation phase before signing of agreement
- Joint strategic plan which areas and topics are to be jointly evaluated
- Regular (e.g. biannual) steering committee meetings
- Transparency about partners and partnership outcomes to ensure general acceptance

The City of Turku for example has initiated a collaborative approach with local companies to identify additional potentials to reduce resource consumption and to get support for the city's sustainability ambitions also from local private companies. The City of Turku and Turku Energia are also collaborating to investigate the potential benefits from smart grid applications to reduce energy consumption, improve quality of life for the citizens and to strengthen the economic sector.

But collaboration also means the integration of citizens in the decision making process. Citizens expect to be informed and heard when their tax money is invested into infrastructure. Current ways of involvement like town hall meetings, publications and working groups will be enhanced by Smartphone-based applications in the near future like the one being developed by the University of Turku. The app will allow citizens to share their opinion via an app and to give feedback directly to the city administration.

Creation & sharing of knowledge

The creation and sharing of knowledge between the stakeholders plays a vital role in making partnerships like the one between the City of Turku and Siemens a success. Knowledge assets are generated from the experiences made during the collaboration, triggered by new ideas which originate from the interdisciplinary discussions and can be turned into efficiency gains, better processes and even better products if used correctly. Typical knowledge assets created in partnerships like this one are:

- Methodologies and approaches which can be re-used, e.g. the approach which resulted in an e-Bus implementation plan for Turku
- Tools to evaluate the impact of measures, e.g. a tool to evaluate the impact of a planned Light Rail on ecological (CO₂, air pollution) and economical (real estate prices) factors
- Concepts which can be used under similar circumstances, e.g. a sustainable district concept for new districts which can also be applied to existing districts

Although the creation of knowledge assets often happens implicitly, it is crucial to apply a structured process in order to ensure the re-usability of the information. Even a protection of the created tools and methodol-

Key factors for collaborative +knowledge-creation

- Be aware from the beginning of the project and regularly check which items could be turned into a real knowledge asset
- Jointly decide if created knowledge assets are to be published undisclosed, owned by one or all participants or even protected with copyrights or even patents
- Consider the potential risks and possible mitigation measures
- Follow a publication strategy to inform all relevant stakeholder groups about the created tool, methodologies and studies

Matthew Lynch,
Director for Sustainable Cities,
World Business Council for
Sustainable Development

What is the WBCSD and what is the objective of your organization?

"The World Business Council for Sustainable Development (WBCSD) is a CEO-led organization of forward-thinking companies that galvanizes the global business community to create a sustainable future for business, society and the environment. The WBCSD aims to be the leading global voice of business that will support companies in scaling up true value-added business solutions and in creating the conditions where more sustainable companies will succeed and be recognized."

– What can the private sector do to support cities on their way towards more sustainability?

"There is no doubt that cities are at the leading edge of the global sustainability agenda. By 2050, 70% of the world's population will live in cities – this is where the battle for a sustainable future for humanity will be won or lost. Cities around the world are rising to this challenge by pursuing ambitious objectives that will make them more competitive, resource efficient, resilient and inclusive. Realizing these visions in practice is a complex challenge for city leaders. In particular, they will typically necessitate major transformations in the design, construction and operation of a city's infrastructure systems – including buildings, energy, mobility, telecommunications, water, sanitation and waste management services – and optimizing the inter-linkages between these systems. Businesses that are committed to sustainability and experienced in delivering effective solutions can help cities navigate these challenges and turn a high-level vision into practical and implementable action plans."

Business can play a vital role not only in providing specific infrastructure, technology, services and financing solutions, but also in contributing to the strategy that will support the overall optimization of urban systems to drive sustainability. Promoting this strategic contribution was a major focus of the WBCSD's Urban Infrastructure Initiative (UII)."

– How do businesses need to change to ensure that cities can benefit more from their knowledge?

"Through the UII experience, we saw a couple of common learnings for UII participants: a more detailed understanding of city decisionmaking, insights into the resource challenges and constraints cities face, and the value of cross-sector and cross-company approaches for addressing complex urban sustainability challenges. Based on these learnings, we made recommendations for how business can work in different ways to help further promote strategic engagement on sustainable development. We feel that businesses should be proactive in pursuing opportunities for sustainability strategy partnership with cities in the way demonstrated by the 14 UII companies. It should be noted that this will require time and resource commitments and modes of working that may differ from standard commercial interactions, involving broad-based problem solving, freely sharing knowledge and expertise, and working constructively with non-conventional partners and other companies (including competitors)."

– Which innovations will make creation and sharing of knowledge easier among cities and the private sector in the future?

"I would suggest there are two key innovations here. The first is process-related – We need to build city-business engagement processes that are specifically focused on creative, shared problem-solving. Here the UII model is definitely one that city leaders and business can learn from. The second area of innovation is the growth of smarter infrastructure systems that will have the direct benefit of producing a much more detailed quantitative understanding of the performance of the city's systems. This greater availability and quality of data will allow engagement processes between cities and business to be focus on identifying effective solutions."



ogies by patents or copyrights might be possible although this should not be the purpose of the collaboration and could even contradict the original purpose of the partnership.

Knowledge assets are typically created towards the end of a problem solving process. At first, a problem needs to be solved, e.g. measures to secure a small environmental footprint of a newly planned district needs to be defined which then can be applied during the construction phase. While working on the ideas to achieve this, a concept, methods and tools might be developed to solve the actual problem. These two steps are the typical procedure to solve problems but to create knowledge assets, the concepts, methods and tools need to be documented in such a way that they can be re-used in other situation and can be trained to other people so they can apply it, too.

Benefits for cities, private companies, universities and other stakeholder groups from the joint creation and sharing of knowledge can be:

- The reduction of costs for research and development of new products and services
 - Direct feedback from either the typical customer or supplier allows the city to optimize their processes and allows the private sector to optimize their offerings
 - Better products and services by incorporating city experts early on in the development process
 - Improved understanding of decision making processes on both sides
- The advantages typically outweigh the disadvantages. Nevertheless, they should be known to everyone involved:
- Risk to reveal sensitive information which might become public
 - Loss of competitive advantage if sensitive information becomes known to competitors via the cooperation
 - The more partners, the more complex to control the overall project which might slow down the collaborative process
 - Especially cities might be perceived as not independent enough when collaborating on a strategic level with individual companies. By being transparent about project results, this preoccupation can usually be mitigated

Dissemination of knowledge assets and publication of studies is an important factor which may attract other valuable partners once they read about the collaboration and its outcomes. The City of Turku and Siemens decided to publish their studies on a city website for the general public

and presented selected study results of special interest to the city board. In addition, communication via conferences and white papers can support the open distribution of knowledge created during the partnership. Infrastructure is a key area to achieve any city's sustainability targets. Infrastructure determines in many ways how people will behave and ultimately how much resources, energy and space they require. If a city invests in road infrastructure over public transport, people will adjust and rather use their car the bus or commuter rail. Challenges such as climate change force us to rethink the utilization and exploitation of resources and as a consequence turn to a more resource friendly way of living, both in terms technology and behavior.

City planners and developers are demanded to enhance the attractive-

Key Infrastructure Areas

ness of their city from various perspectives. One important factor is a prospering economy providing job opportunities for employees while it is equally important to provide safety and security, stable infrastructure as well as good opportunities for education and leisure time.

Throughout the partnership the City of Turku and Siemens set up many studies and initiatives to first evaluate specific options/solutions to create a sustainable and attractive city for their citizens.

Transport solutions

Given their cost for the individual owner, the society as a whole and the environment, private car traffic cannot be called a means of convenient and responsible travel. In Turku, since the year 2000, car ownership and traffic have increased faster than the population of Turku. In 2008, 37% of all journeys were made by foot in the walking zone, 65% of all journeys were made by car in the car-dependent zone, and in sparsely populated areas the share of journeys made by car was as high as 86%. The currently implemented solutions have mostly been based on utilizing the existing urban form and infrastructure. New residents and facilities e.g. working places and services have been located in zones with good preconditions for walking, cycling and public transportation. At least partly due to city centre development with its surroundings since 1990's, the population has begun to increase particularly in the central areas of the city.

The City of Turku will be further developed towards a pedestrian-, bike- and transit-friendly city to strengthen the use of transport modes other than the individual car. Until 2035 journeys made by bike per inhabitant are expected to increase at least by 50% from the level of 2006. The number of journeys made walking will remain at least on the level of 2006. According to the set goals of Climate and Environmental Program 2009-2013, the annual growth of journeys made by public transportation is forecasted to be at least 2% until 2030.

The goals in Climate and Environmental program 2009-2013 e.g. for modal split (33% car traffic, current 47%) are very ambitious and can be reached with innovations and additional developments in transportation policies. The aim is to achieve the modal split set goals of the Structural Model for Turku urban region 2035: the car traffic's share is reduced with 2.5%-units by 2035. Even this is an ambitious goal since much of the planned new landuse is outside the existing walking and cycling zones. The future vision shows an urban configuration which is merely car-free.

Avoid, shift and improve transport

The "avoid-shift-improve" (A-S-I) concept has proven to offer a viable approach to sustainable transport. While the supply side orientation of providing infrastructure, i.e. more streets to deal with increased traffic, has proven to be not sufficient to keep up with every increasing demand, the above mentioned concept approaches the transportation issue of cities from a holistic perspective. The idea is to provide a sufficient amount of efficient transport but at the same time reduce congestion, realize significant GHG emission reductions and reduce energy consumption intending to create cities which are attractive and offer a livable environment for their citizens. The concept consists of the three focus areas avoid, shift and improve.

"Avoid" refers to the idea of reducing the need of transport as a whole. This approach addresses the leading way of city development and design and differs from traditional development strategies: Polycentric structures of cities and increasing autonomy of city districts imply new ways of developing the districts' spatial planning. The widespread availability of high-speed internet connections and teleworking reduce the need for e.g. trip to and from the office.

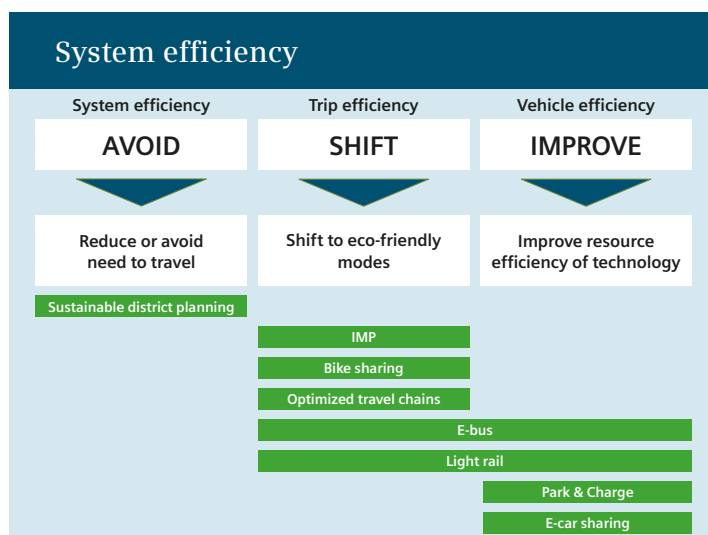
"Shift" refers to instruments, policies or solutions intending to improve the trip efficiency by shifting from resource consuming transport modes with high exhaust, i.e. private cars, towards re-source efficient and

eco-friendly modes of transport.

"Improve" refers to technological aspects of transportation. It strives to optimize vehicle and re-source efficiency as well as the transport infrastructure.

Thus, the A-S-I concept focuses on the promotion and implementation of feasible public transport solutions instead of private transport with a hierarchy of measures. For Turku, e.g., it was important that public transport additionally fulfills the following criteria:

- easily accessible, e.g. stations and vehicles
- convenient – comfortable, fast and frictionless travel on various levels, i.e. inner-city transport, inner-district transport and inter-city/regional transport
- affordable – reasonable priced tickets and pricing information available across all modes preferably in combination with a booking solution to simplify the trip planning
- eco-friendly – efficient and low
- emission public transport
- safe - both in terms of technical safety and a secure environment in public transport vehicles and at the stations



Transport solutions for Turku according to A-S-I concept



The implementation of technologies only will not suffice when truly aiming at reducing GHG emissions in the transport sector. A city needs to actively and constantly promote the use of non-motorized or public transport and enhance their effort by means of transport policies. The best and most efficient way of reducing emissions due to transport is to avoid travel at all meaning to offer as many as possible services etc. at walking distance (mixed use of districts) or, for instance, make services of city administration virtually available.

Solutions of a transport system of mid-sized cities have been conceptualized and evaluated throughout the partnership. All of them may be subsumed to the respective focus areas of the Avoid-shift-improve framework. The sustainable district study as an integral part of the “avoid” framework is one means of planning which aims at shaping the city (districts) in a way that unnecessary passenger km can be avoided. Optimized travel chains, IMP (integrated mobility platform) and the bike-sharing solution may be subsumed to the “shift” part of the concept as they are means by which passengers are enabled directly (bike) or indirectly (IMP) to switch modes from individual motorized transport to non-motorized or public transport. The optimized travel chains solution cares for trip efficiency and passenger convenience due to enabling fast and frictionless travel across all modes. The e-bus solution and the light rail system cannot be explicitly sorted to only one cluster, either “shift” or “improve”, as both solutions aim at trip and vehicle efficiency at the same time. Lastly, e-car sharing and the park & charge concept address vehicle efficiency.

All of the above mentioned solutions ensure that Turku can fulfill its self-set goals of being a pedestrian and bike friendly city. The comprehensive concept of different mobility solutions fosters the modal shift towards public transport solutions.

Avoid

The sustainable district study has elaborated solutions and a methodology to plan and develop city districts in a sustainable manner. Planning and developing a city polycentrically allows for preventing urban sprawl, applying efficient technologies, facilitating a change in the citizens’ attitude and behavior and additional job opportunities. By means of polycentric planning, city developers are striving to reduce the complexity of an

urban system and deal with the current challenges of city planning and development on a disaggregated level.

The shift towards polycentric structures instead of creating a mono-nucleus city, in which all activities are focused in the centre, offers a range of advantages. Polycentric planning combined with a mixed-use development concept does not only strengthen the city centre but the entire city by offering a multifaceted environment and adding to the city’s attractiveness. Additionally, a mixed use approach for city districts emphasizes contributes to a reduction of GHG emissions in the transport sector by reducing both the need for transportation as well as the trip length.

Sustainable city districts are a major lever of sustainable growth and as such both districts of Turku, Skanssi and Linnakaupunki, are developed as lighthouse projects. The sustainable district study aims at strengthening districts by selecting and evaluating suitable solutions for infrastructure areas and social topics. The main infrastructure areas which have been analyzed are buildings, energy and mobility. Furthermore, Smart Services have been evaluated which can be applied on both district and city level and provide solutions to tackle current and future social questions. The solutions offered in this study have been specifically prioritized according to the district profiles and the requirements of their future residents.

Shift

Integrated mobility platform (IMP)

– a means of end-to-end trip planning and booking

With an integrated mobility platform travelers have the opportunity to receive travel related information before starting a trip and even while on the move. They are enabled to take multi-modal travel decisions, considering real time traffic information via their smart phone or tablet application. An IMP makes travel information transparent and can be customized in a way that individuals may retrieve information according to their specific preferences and can be combined with attractive prices and bonus programs. Thus, the IMP serves as an enabler for shifting individual transport towards public transport and significantly reduces energy consumption in urban areas by changing the mobility behavior.

The city and the environment benefit from an optimized utilization of the transport infrastructure. Transportation can be regulated in accordance with the emission regulations. For example, when the concentration of particulate matter exceeds the limits, the IMP is programmed to solely offer transport solutions which are emission-free such as e-buses, bike sharing and e-car sharing. The city can utilize the IMP to communicate this directly to the travelling public as well as construction or road works which may affect transport. This makes it easier for the citizens to adapt to unplanned changes which could affect their regular travel behavior and contributes to a more attractive city.

Optimized travel chains – as a result of an optimized traffic management system

To ensure a smooth and well operated public transport system the available transport modes must not only be integrated into a smart and easy-to-use passenger frontend such as the IMP. A well working and operationally optimized backbone of the entire public transport system, an efficient and well planned travel chain, is needed.

By shifting mobility demand to public transport, the attractiveness of public transport services needs a boost in terms of journey times and timekeeping. The optimized travel chain serves as an enabler for convenient transport and thus fostering the modal shift from private to public transport. For an operator this means a higher number of passengers, less vehicles and thus less maintenance and less fuel consumption. Optimized travel chains reduce the number of involuntary stops for buses. Analyses have shown that a stop is the equivalent of 60 seconds waiting with a running engine. According to a study by Nürnberger Verkehrsbetriebe VAG, buses and trams waste up to 27% of their total travel time in waiting at intersections. Thus, a reduction in the number of buses stopping at intersections has a very positive impact on exhaust emissions.

A reduction of 10% in the total travel time on a given public transport route (provided that the service intervals are kept the same) can lead to a reduction of vehicles required to cover the public transport demand by about 9%, bringing with it an enormous saving potential in terms of equipment, staff and maintenance.

Bike-sharing

– Individual, carbon-free transport

Using the bike as a means of transportation within the city has a great tradition in Scandinavian countries. It is a generally accepted and appreciated means of cheap and healthy transport for trips within the city.

The bike-sharing solution takes this individual transport concept to the level of service provision. Individuals do not need to own a bike but benefit from a flexible usage, when and where they need it for short distances and/or last mile transportation. Easy access might even motivate non-bike users to change their transportation behavior. Elderly inhabitants can also be included in the customer and benefitted group by offering e-bikes that support the user or even make an active trampling unnecessary when wanted. “Use it as you need it” currently replaces the ownership model in many areas.

The latest systems operate with smart technologies and provide users with real-time bike availability information on the internet. These “smart” bike-sharing systems provide the missing link between existing points of public transportation and desired destinations, offering a new form of mobility that complements the existing public transport systems.

Shift / Improve

A city needs a cross district transport backbone connecting the outer areas of the city with the city centre and enable convenient travelling for citizens without being obliged to use the private vehicle. Two options of supplying inner-city transport, by light-rail or bus, have been jointly conceptualized.

Light rail

A light rail system offers comfortable travelling and a high passenger convenience. It usually has a high passenger capacity and therefore needs less frequency leading to lesser operating cost. It runs with low noise and the pollution occurs remote from the vehicle, it occurs in the energy supply side. When the light rail is run on electricity from renewable sources the emission value of a light rail is very low. The light rail is perceived as a benefit to the areas as part of a sustainable urban renewal scheme and a benefit to the property values.



The first series-produced, fully electric bus in service in Vienna

The light rail study has analyzed the benefits by reducing GHG-emissions and at the same time increasing the real estate value of the real estate located within the catchment area of the light rail tracks. For this evaluation an integrated system has been assumed, i.e. evaluating the benefits of the technology and of the enhanced utilization by citizens through target-oriented green transport policies.

E-bus

An e-Buses solution will contribute to the necessity of being accessible, convenient and eco-friendly in several ways. It serves to make districts and city centre accessible by connecting destinations along the track fast and resource-efficient and thus will lead to less car traffic within the districts and towards the city center. A bus system features low investment cost compared to a light rail system. In case of a breakdown of a vehicle ahead a bus system offers the flexibility of either overtaking or in severe cases a detour.

The concept has several variations, depending on the role of the combustion engine. Most common today is serial hybrid which has an electric motor as 100% power supplier to vehicle. Yet there is the need to ensure the adequate charging possibilities in the pit or turnaround places to ensure continuous service. An additional benefit is that e-buses can serve for supporting the smart grid as a means of energy storage.

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Twelve electric buses (e-bus) for the Austrian capital city of Vienna, supplied by Siemens and Rampini, have been brought into service by "Wiener Linien", the municipal public transit company. At the terminal stops at each end of the line, the electric bus draws in the power it requires through a roof-mounted pantograph, and stores it in its batteries within 15 minutes. The bus also recovers its braking energy, and has a range of between 120 and 150 kilometers. Siemens created the innovative solution and drive technology for the twelve electric buses. The first series-produced, electric design was realized in cooperation with the bus manufacturer Rampini. The entire energy requirement is stored in the onboard battery system. Siemens developed and supplied the drive and control system for the bus.

At each terminal bus stop, electricity is drawn in through an elevating, roof-mounted pantograph. The charger is installed in the bus. The batteries can be recharged within 15 minutes, and provide a range of between 120 to 150 kilometers. The energy regained from braking is regenerated through the three-phase motors, and fed back into the lithium ferrite batteries. At night, the batteries are recharged slowly with 15 kilowatts in the bus depot. The battery capacity is 96 kilowatt hours.

The compact low-floor bus can carry up to 40 passengers, and its top speed is limited to 62 kilometers per hour. The bus itself does not emit any CO₂, and is almost silent.



Improve

Park and Charge

– the electric car as one individual transportation means

Park and charge is a mobility solution which provides parking places in combination with charging poles in designated areas of the city or district.

In order to make using e-cars attractive for the inhabitants, investors and the city, e-car charging must be eco-friendly, affordable and easily accessible. Users must have the opportunity to charge their e-car at public charging poles. As a means of convenience payments must be made as easy as possible. Users should have the opportunity to pay for their charging by debit or credit card or phone or even use the charging stations for free. Malls and office parking could also offer their customers exclusive charging stations (semi-public). For private usage, the inhabitants would own a charging station, placed in their access lots or yards. The charging pole shall be directly connected to the house electricity system.

A complementary combination of public, semi-public and private charging contributes to a user-friendly, easy access to charging stations and enhances the acceptance and the dissemination of the e-car solution.

E-car sharing

E-car sharing is attractive to customers who only occasionally use a vehicle. It is a complement to existing public transport systems by providing the first or last mile of a journey. E-cars are re-served via an internet-based system which provides information about vacant cars and their charging level. The e-car sharing concept can be enhanced and promoted by giving some advantages to e-car users like free parking, the permit to use bus lanes or free charging. E-car sharing should be made easily accessible for the citizens by choosing car sharing locations which are close to public transport, malls or in walking distance from private homes.

The e-car sharing solution is beneficial in several ways. Investors may find feasible business opportunities with high paybacks due to an oligopolistic market structure. E-car sharing discourages the purchase of a second car. It helps saving money from travelling and promotes an environmentally friendly and green attitude. The number of privately owned cars, the number of passenger km and the amount of exhaust is reduced. Fossils are protected. Traffic flows, the use of infrastructure and means of transport are optimized in a resource-ef-

fective way. In the city less parking places are needed. The solution contributes to a positive city image and the modal share of individual transport decreases.

Overall potential and key success factors

The implementation of the mobility solutions lead to significant CO₂ savings and other benefits. The solutions described in the Sustainable district report (IMP, optimized travel chains, bike sharing, e-bus, park & charge, e-car sharing) have been calculated to lead to an adjusted cumulated result of CO₂ savings 7.138t per year (58%) in the districts of Skanssi and Linnakaupunki.

The light rail solution has been evaluated separately focusing on CO₂, NO_x and PM as well as on the impact on the real estate values. The impact (compared to 2011) of the integrated solution based on the reduction of travel kilometers due to the modal shift towards light rail is a reduction of 11% of traffic CO₂ emissions (=110,000 tons) in 2035 compared to the business-as-usual projections without a light rail solution. NO_x emissions will decrease by 12% (250 tons) in 2035. PM emissions due to exhaust will decrease by 8% and PM emissions due to winter sanding and spike tires will decrease by 7% in 2035.

In 2011 the real estate area amounts to approx. 13,5 m² in Turku, Kaarina and Raisio. Almost 60% of the total area, i.e. 8 million m², is located in the 800m catchment area along the rail tracks. Due to the integrated light rail system the real estate values are predicted to increase by approx. 480-850 million Euro in 2035, meaning an weighted average uplift of value by 3%. Of course, the decision making process in mobility schemes are complex and manifold. Emissions and real estate values offer only two of many important perspectives. Further research can be taken out on e.g. benefits for companies and their employees due to reduced commuting time and potential health benefits.

The nature of planning and implementation of a city's and city districts' mobility scheme is a complex and cross-functional long-term project. To set-up and implement the solutions successfully it is crucial to pay attention to the following key success factors.

- Integration of intermodal transport planning - Individual private transport should be limited by connecting it with the public transport system. The interfaces to other modes of transport should be well planned,



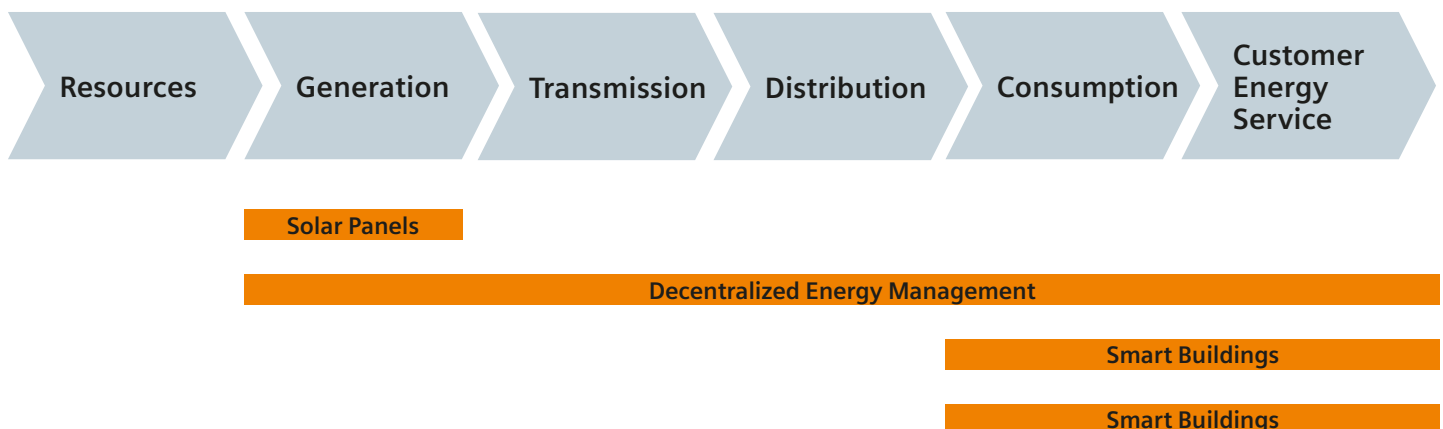
- frictionless and transparent to promote the modal shift towards public transport.
- Long term financing strategy - A crucial element for the successful realization and long-term operation of a public transport scheme is a thoroughly elaborated financing strategy.
- Monitoring and maintaining quality of system - Monitoring usage, acceptance, travel patterns and quality of the transport system will support optimizing the system across all modes.
- Continuous marketing, communication and transparency - Until the utilization of the public transport scheme has become
- an integral part of the residents travel pattern it is crucial to continuously remind the travelers of its benefits to achieve a growing number of users and to increase the modal share of public transport.
- Transportation Management - Actively influence the mobility behavior and travel patterns of the citizens by long-term urban planning, traffic management and traffic guidance systems, parking policies as well as company travel plans for employers and information campaigns is another key requirement.

Buildings and energy

The buildings and energy infrastructure area is essential to the attractiveness and sustainability of a city. It does not only shape the landscape to a great part but also gives the unique opportunity to save tons of carbon dioxide. According to the European Union, buildings alone are responsible for 40% of the energy consumption and 36% of the CO₂ emissions within the EU. Moreover, the European Union set the target of 9% energy savings in buildings to be reached in 2016 (Baseline is 2005)

The buildings solutions landscape in Turku is heterogeneous, different buildings use different building management systems and are not able to intercommunicate. Only central energy infrastructure exists. However, the city administration strives for the optimization of property specific energy production, the introduction of distribution energy sources in order to complement central energy production and the reduction of energy consumption.

Challenges in energy and buildings not only arise from the ambitious targets set on European and national level and from bridging the gap be-





Sirpa Korte,
Director of
Public Transport,
City of Turku



– What is the traffic system like in Turku's 800th birthday in 2029?

The share of walking, cycling and public transport has increased significantly from 2015. There are so good preferential methods (preferential lanes traffic lights) for public transport and such high service level, that it is natural for drivers to leave their cars to Park and Ride for a day.

– What kind of public transport solutions will Turku have then?

We will have a public transport system, which consists of trams, buses, one funicular and minor water bus traffic during summer periods. The tram is quite a new matter and it has become very popular in the whole city region. Electric busses will be favored in the bus tenders, but there will also be a large number of diesel busses in operation. The funicular will take inhabitants and tourists to the new fabulous Kakola citydistrict to enjoy the view. The water buses have started operation a lot earlier as the city is located in beautiful sea side environment.

– What is the share of these solutions?

The main parts of the system will be buses and tram. Over half of the buses will be e-buses.

– How do you see the plurality of transport modes developing?

I believe people will, on average, pay more attention to healthy choices than they do in 2015. The role of walking and cycling will grow. Public transport will also be a natural choice. The use of private cars will not stop, but I believe the share of devoted drivers – the ones who will only accept a private car – will diminish.

– How will the citizens be tempted to use public transport?

Public transport must support the citizens in making their everyday lives as easy as possible. Punctual and reliable public transport and as short as possible journey times are the keys. Naturally, the ticket prices must remain reasonable.

– How will Mobility as a Service develop in Turku and what is the role of public transport in it?

We are willing to try call and response in the parts of the Föli-area, where demand is low in the evenings and weekends.

– What are the most important development issues?

A more fluent public transport. That the customer knows, that the public transport vehicle will arrive at the exact time it is supposed to and the journey will be smooth whether it is peak hour or a quiet evening. The tram is in its own class in punctuality and fluency. If the decision on tramlines is not yet taken, nearly as good punctuality must be reached with preferential treatment of busses (bus lanes and traffic light control).

– Where should the development begin?

Preferential traffic light control for public transport and bus lanes.

– What is needed to reach the 2029 goals?

Most of all a common will. Money, of course, but without the common will the goal will not be reached.



tween the current energy and buildings infrastructure situation in Turku and its future vision. Apart from these targets, the city has defined specific characteristics and requirements for the future energy and buildings infrastructure:

- Innovative solutions
- Sustainable living
- Enabling smart services
- Reliable energy supply
- Low energy cost
- Versatile infrastructure

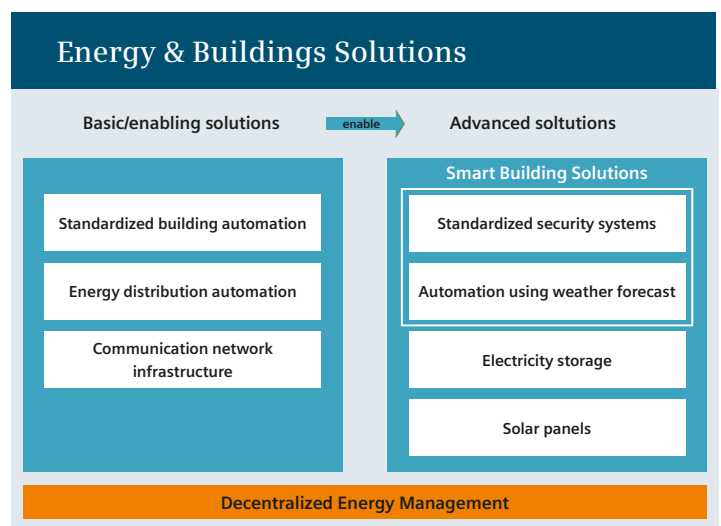
Obviously, the characteristics are multilayered and partly diverging, e.g. innovative solutions and low energy costs. Incorporating all of them into a comprehensive setting of solutions is challenging.

Innovation and eco-friendliness are the core values for a sustainable building environment. Innovation has been identified as the most important characteristic of the buildings and energy infrastructure. Innovative solutions will not only prepare the districts for the future and attract residents and businesses, but can also serve as pilots for wider rollouts, e.g. regional. Sustainability has been defined as the second most important characteristic focusing at resource efficiency and the protection of the environment. Smart Services are another important topic for the energy and buildings infrastructure and will be detailed in a separate chapter.

The energy and buildings solutions framework

The solutions which have been analyzed for Turku are very different in terms of scope, impact, addressed stakeholder groups and addressed requirements.

- Decentralized energy management
- Standardized building automation
- Energy distribution automation
- Communication network infrastructure
- Smart building solutions
- Standardized security systems
- Automation using weather forecast
- Electricity storage
- Solar panels



Interdependencies energy and buildings solutions

The interdependencies between the solutions are illustrated below. The solutions can either be characterized as basic solutions or advanced solutions. Decentralized energy management (DEM) is an overarching management solution enabling both steering and monitoring of the basic and advanced solutions. Basic solutions are a prerequisite to implement more advanced solutions. As energy and building technologies are closely interlinked, additionally, both solutions "standardized security systems" and "automation using weather forecast" are potential manifestations of the overarching group of "smart building solutions".

Four solutions thereof two building solutions and two energy solutions, address very different phases of the energy value chain as illustrated in picture 5 and will be explained in detail below. The energy value chain is a useful tool to receive a deeper understanding how energy efficiency is increased by the evaluated solutions.

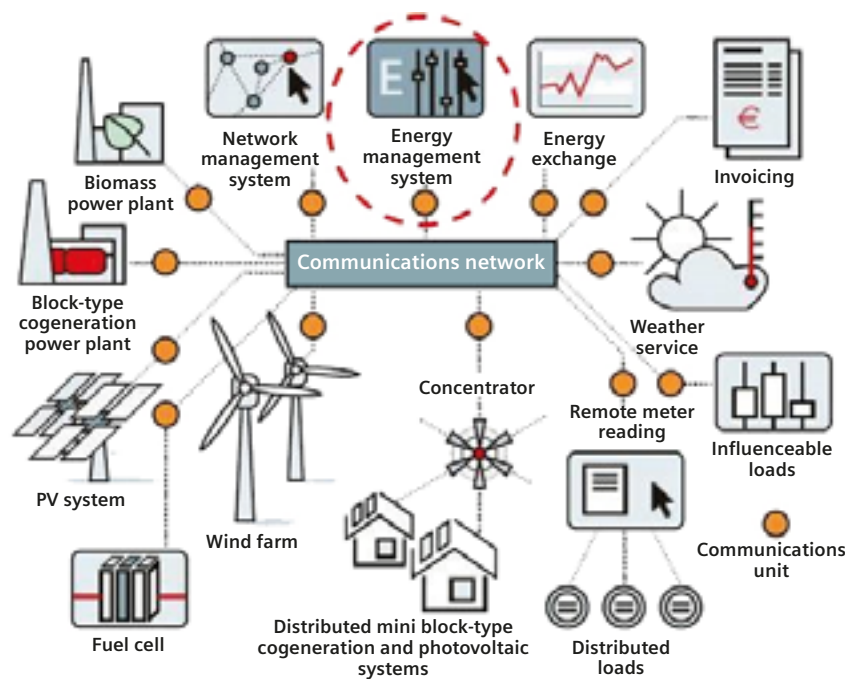
As a first step potential energy resources need to be utilized, e.g. sun light, wind etc. Secondly, the resources are used to generate energy, e.g. to produce energy via the photovoltaic effect. Successively, the so

produced energy is transmitted and distributed. Solar panels, for example, increase the amount of energy generated whereas Smart Buildings and Standardized Automation decrease the energy consumption through improved efficiency in buildings and services. Decentralized Energy Management is a general management solution and can be utilized for improved energy generation, less transmission and distribution as well as reducing energy consumption and enabling intelligent energy-efficient services. In the following all solutions are described.

Decentralized Energy Management (DEM) is a steering solution, enabling the user to network decentralized energy generating units

in a Smart Grid, control them centrally, and optimize their use both economically and ecologically. Distributed power generating units can be combined to form a large-scale virtual power plant. The system can use all important information, such as weather forecasts, current electricity prices, and the energy demands. This data forms the basis for creating and monitoring a generally optimized dispatch plan.

As DEM is merely a management solution for steering and controlling other parts of the grid, the concrete characteristics of a DEM depend on the characteristics of the rest of the grid. Possible components of a grid steered through DEM are depicted in picture below.





An implementation of a DEM in a city or district will lead to lowered total energy costs for residents and businesses because it is able to optimize the energy balance, energy storage, energy usage and it reduces grid losses. The solution offers a new and innovative way of combining local energy production with central needs management as well as managing fluctuating distributed energy production. New smart service business opportunities within the network are created, e.g. demand response management and optimized use of energy storage. By implementing such a solution the energy grid is not just optimized but even transformed as households are enabled to re-sell their produced energy to the grid.

Standardizing building automation means using the same standards in all buildings to ensure compatibility of automation systems from different suppliers. Today many different building management systems are available each of which run on own, distinct communication protocols. The interfaces are incompatible and thus, the buildings are not able to interact with other systems. In order to overcome these challenges, Standardized building automation has been developed based on the same, standardized protocols to overcome the challenges.

BACnet (building automation and control networks), for example, was designed to allow communication of building automation and control systems for applications such as heating, ventilating, and air-conditioning control, lighting control, access control fire detection systems and their associated equipment.

This trend yields immense advantages for the building and energy infrastructure and its stake-holders. As new solutions will be compatible to existing systems and the solutions are then easy to upgrade, the buildings infrastructure becomes more versatile. For Turku's future residents this means that by future-proofing their system, the security of investments is secured with reduced cost of ownership by simplified installation and lower integration costs. The European Norm 15232 recommends this solution in order to achieve the highest sustainability classification of buildings. This is even enhanced as additional energy efficient solutions are now applicable in the districts, leading to lowered energy cost.

Manufacturers and software vendors benefit from Standardized Automation through the solutions interoperability with other manufacturer's

products – without the loss of their own brand identity – and extended market opportunities. Real estate owners and constructors benefit due to the increased attractiveness of the buildings which are equipped with energy saving solutions to potential buyers.

Automated and intelligent control of the energy distribution network is realized by Energy Distribution Automation. Even a complete power-flow control by the secondary transformer substations becomes possible. This refers, for example, to the activation of reactive-power compensation or the management of decentralized power supplies by actively triggering the inverters. The various stakeholders of Turku will benefit from increased reliability of the grid, shorter outage times, increased power quality and safety. This solution improves the distribution stage of the energy value chain.

Communication Network Infrastructure means the equipment of districts with state-of-the art communication technology (fiber optic cabling, wireless communication 2G, 3G, 4G GSM modems and intercommunicating ring main units). This solution enables two-way communication, real time data sharing and intercommunicating Smart Grid elements and improves cyber security and easy access on data. It is a required solution for networking the different components of the energy value chain.

Smart Buildings solutions integrate intelligent, self-regulating and self-optimizing solutions into the overall buildings landscape enabling easy monitoring and steering of the solutions' functions, thus optimizing the energy consumption stage of the energy value chain. These solutions allow individual management of apartments as well as central management of complete buildings and buildings blocks.

The innovative solution enables the residents to influence, monitor and optimize their own energy consumption and thus lowering their energy cost and making use of Smart Services. Smart Building solutions have the potential to be an incubator for smart service business opportunities, e.g. advanced and remote access applications or self-optimizing / self-adapting programs. Citizens also benefit from Smart Buildings. They will experience increased comfort due to automated individualized room settings like heating, cooling, air regulation, etc.

One exemplary Smart Buildings solutions is "Green Leaf function". Unnecessary energy usage is automatically detected; the user is notified of this inefficiency and provided with suggestions to optimize the situation.

A potential add-on Smart Service could therefore be, automated optimization based on the individuals predefined preference.

In modern building management systems, the capability to include weather forecast into automation operation becomes possible. The weather data is gathered from a public provider via internet and is then distributed to the building automation devices. An exemplary application of this capability can be seen in pedestrian area heating: If the snow fall in the winter has already begun, it may be too late to start heating pedestrian areas, and it costs much more energy to melt snow at a later stage than when snow fall has started. To avoid this problem, it is possible to use weather forecasts to start heating earlier, so that when snow begins to fall, it melts immediately. Correspondingly, it is possible to stop heating earlier if the end of snow fall is known in advance. This solution makes the districts more versatile, self-adapting, and more secure. Moreover, the districts become more sustainable by saving energy at the consumption part of the energy value chain.

Electricity-storage systems are able to act as buffers against fluctuations in the output from re-newable energy sources in electrical power grids. As a result, there is no longer any need to adjust controls at power stations. The solutions reduces energy losses, enables effective storage of distributed energy, enables peak load management, has a black start capability for guaranteeing continuous power supply.

Introducing solar panels in large scales in both districts will make them more sustainable, innovative and it will lower energy costs as less electricity needs to be bought from the grid but can be produced autonomously. Not only do the citizens benefit from lower total energy costs, potential investors are also attracted by potential demand of installation, maintenance or Smart Services (e.g. monitoring applications, automated maintenance, etc.). As – in contrast to many other buildings and energy solutions – the solar panels are directly visible and would thus shape the landscape of the city and districts, they become evidence of sustainability. Turku's environment overall will become cleaner and the dependency from fossil power decreases.

Conclusion and key success factors

Three main factors need to be considered in order to implement the solutions described above successfully.

- Ownership and maintenance – In terms of ownership there are various options, e.g. the government owning and maintaining Building Management Systems in public areas. Alternatively, a private energy supplier could be responsible and charging users for this service. For each solution the choice depends on profitability and on how much control the city wants to pertain.
- Open Standards - Buildings, systems or single devices which are communicating with each other use open standards enabling them to “speak in the same language”. They are a crucial prerequisite for building automation.
- Data Protection: Along with open standards arises the risk of data protection. Sharing information on the one hand presents a necessity for smart services. On the other hand there are certain risks resulting from sharing information. The city is asked to agree on new regulations to protect the data of institutions and individuals.
- The solutions and studies on energy efficient buildings may be applied both on a small or extended scale and address the need of clean and energy saving technologies.

Waste water management

The innovative greenhouse waste water treatment solution brings sustainable wastewater management into the districts and the city centre. This solution offers a proven and economical solution to today's urban wastewater management challenges with its Food Chain Reactor (FCR) solution, a cost and space efficient facility for the treatment of sanitary wastewater. The water treatment reactors in the water processing unit utilize carefully selected plant root structures and bio fiber media to provide an ideal habitat for a unique and diverse bio film. This bio film contains 3-4x more biomass per cubic meter of reactor space than conventional solutions, ultimately meaning that reactors in this plant are less than half the size of reactors in conventional waste water treatment plant. The special media invites a much more diverse biology than those already in use in the industry. In addition to the bacteria found in traditional activated sludge systems, the treatment plants are populated by over 3,000 species of microbes, aquatic flora and fauna. Several reactors are used in sequence arranged in a cascade configuration to optimize the development of distinct ecosystems at each step of the treatment process.



Each facility is odorless with a botanical-garden like appearance that can be located anywhere, even in a city center. At the same time the advanced automation solutions ensure reliable and efficient operation of the waste water treatment plant, each with a simple, user friendly interface.

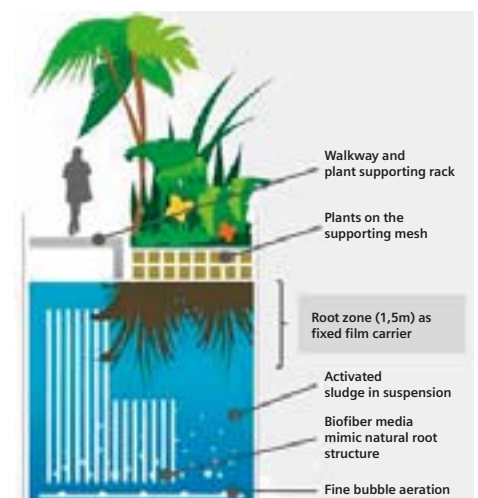
The solution combines several benefits. The solution is based on conventional waste water treatment methods, but significantly improves efficiency by adding new “real estate” for a more diverse and plentiful biology to thrive and metabolize the contaminants in wastewater. Its advanced automation combined with this proven and energy-efficient solution for wastewater treatment drives substantial OPEX savings.

The systems are exceptionally robust: in case of a dramatic change in flow rate or influent characteristics the system performs much better due to its diversity. These diverse ecologies are much less prone to damage than the limited diversity traditional systems.

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Smart services for social integration and resource efficiency

In addition to the solutions of the infrastructure areas Energy, Buildings and Mobility & Logistics, the City of Turku and Siemens also focuses on actions to build sustainable districts: the social issues. The overarching principle for Turku and its districts is to set a framework which enables and actively motivates sustainable behavior of the citizens aiming at creating a unique environment, in which individuals feel integrated and which offers a broad range of leisure activities and serves to satisfy the daily needs of its inhabitants while at the same time playing an important role in the reduction of CO₂ emissions.

A growing population combined with a significant increase of elderly citizens is challenging the society to develop new solutions in terms of healthcare, daily support in living and integration of elderly citizens in



Components of Greenhouse Waste Water Treatment

the society. Additionally, the City of Turku is eager to offer innovative solutions to today's questions of how to keep a good worklife balance, how to contribute to protecting natural resources and how to live in a green environment but enjoy the benefits of a city at the same time. The following four solution areas can tackle the challenge of a sustainable society best.

Social engagement in energy efficiency - By raising the awareness of inhabitants for their individual energy consumption behavior and by creating a shared understanding in the community of responsible resource utilization, energy savings will be achieved.

Community areas - The public areas will be a crucial part of the image of the city districts. Common indoor and outdoor spaces can provide a variety of services and foster the community feeling through special events such as concerts and market fairs.

Adapting to demographic change & future trends - Smart services take over tasks which have the potential to improve the quality of living, guarantee safety and use resources more efficiently. The future will be determined by connected devices and self-regulating systems helping older and handicapped people to live a comparatively independent life. Inclusion of all-age groups is the overarching target of this solution area.

Family orientation - The implementation of smart services will support young families in organizing their daily life and therefore provide high flexibility between private and business activities. Smart services concentrate on the successful organization of daily life and include a broad range of leisure time facilities tailored to family needs.

In these areas eight solutions are evaluated:

- Green building monitor
- living lab
- common saunas
- Market places
- Mobility guide and last mile car
- Assisted living
- Multi-functional school center

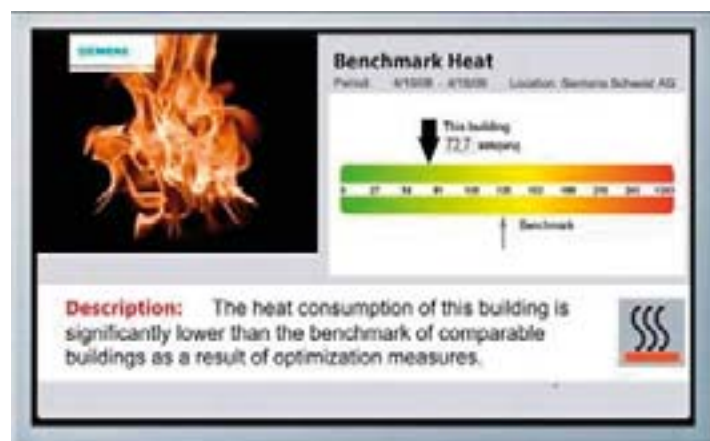
From the above mentioned eight measures, the Green Building Monitor and Assisted Living are explained in depth as they are the most promising ones with the highest impact.

Green Building Monitor

The Green Building Monitor is a system which can be implemented in commercial or administrative buildings. It collects a variety of data within a building and enables users to monitor them.

Picture 9 shows the user interface, in this case presenting information about the heat consumption of the building throughout the day and evaluating the performance of the monitored area compared to available benchmarking data.

One step further, the user is informed about potential improvement measures. The buildings could, e.g., recognize that a window is open which leads to an increased energy usage for heating the room until a predefined temperature is reached. The Green Building Monitor would indicate these kinds of "disturbing factors" and give advice on how to improve the current situation. Despite information on energy used for heating, the Green Building Monitor also collects, analyzes and provides the user with data about water consumption, temperature readings or green-house gas emissions. Monitoring services are the first step to control the system. Through its integrative approach, the Green Building Monitor enables the inhabitant to control and therefore actively influence their energy consumption via the same monitor.



The Green Building Monitor user interface



The installation in public buildings achieves high transparency and would give schools, governmental institutions or swimming halls the possibility to serve as a best practice example in terms of sustainable energy usage. A data center that collects and analyzes all data of the neighborhood or even district could provide the users with anonymized benchmarking data. The community would then motivate itself to act responsibly and keep their personal CO₂ footprint to a minimum.

The most obvious benefit of using such a system is that it makes the energy usage transparent and directly controllable for the individual. Additionally, once the Green Building Monitor is comprehensively implemented, it triggers a group dynamic which gradually decreases the energy usage of the area.

A successful implementation was achieved in the Crystal in London. The building is connected via the Energy Monitoring and Controlling to the Advantage Operations Center in Frankfurt, which constantly monitors the systems for efficient operation.

The current consumption information and performance indicators are automatically transferred to the Green Building Monitors in the Crystal. LED displays are integrated in the graphic to represent the data of nine KPIs which are:

- % of the electricity consumed up-to-the-minute which has been provided by the solar panels
- kWh of electricity have been consumed up-to-the-minute
- kWh of heat generated by ground source heat pump
- kWh of cooling generated by ground source heat pump
- kWh of heat which has been generated by the solar thermal systems
- Amount of water consumed per day
- % of the water consumed has been provided by the recycling system
- % of the water consumed up-to-the-minute which has been provided by the rainwater harvesting system
- tons of CO₂ which have been prevented from being emitted by the building's system

It needs to be considered that the Crystal is a knowledge centre promoting urban sustainability and therefore profits from a highly elaborated system which might be too sophisticated for the average citizen

of Turku. As a starting point, monitoring and controlling of consumed energy and water in general is enough to see first results in terms of decreased energy consumption.

Assisted Living

Enabling older (and potentially handicapped) citizens of Turku to live independently at home is made possible by the implementation of Assisted Living. Interconnected devices and services in a resident's home can support them in their daily life and more concretely in three different areas: safety, health management and social interaction.

A TV-integrated service portal presents the central access to the smart services available. It enables the user to monitor and control rooms, facilities and devices. An example of such a service is a sensor-based identification of typical situations at home which recognizes critical states and informs a center of assistance or the seniors directly. Critical situations might be

- that the window is open so that room temperature sinks below 15°C
- no movement in the house for more than 12 hours
- if a senior forgets to close the front door when leaving his apartment/house

Furthermore, the system can collect and transfer vital signs of user to a medical center. Seniors do not need to leave their home to do regular check-ups but communicate with their doctors via the service portal. Same applies to social contacts. With the concept of Assisted Living, video communication with friends and family is particularly meaningful for those people who cannot leave their homes easily (see figure on next page).

Features such as a calendar to remind the user to attend meetings or to take their medicine at certain times could assist the user and therefore make a significant positive difference in their life and those who are caring for them.

Assisted Living does not only serve the individual in terms of increasing their living quality but also concerning resource usage. That a building recognizes an open window and informs the senior, for example, improves the security situation and leads to a decrease of energy consumption at the same time.

Currently, several studies research on and test the concept of Assisted Living. One is the Smart Senior initiative which is developed and financed



Social interaction and health management via the TV

by 28 industrial firms and research organizations, including Siemens, BMW, Alcatel-Lucent and the Charité University Hospital in Berlin. Launched in 2009, it consists of nine subprojects for developing innovations that integrate information and communication technologies and services, including emergency assistance services, household safety solutions, social networking systems, and a telemedicine service centers. Standardizing and integrating various devices which are needed for the complex services is currently seen as the main challenge. Users are often nervous to use the technology or afraid that they are being watched which makes a sensitive marketing and transparency from supplier side indispensable.

New solutions, smart services and modern technologies enable people to live and move longer without helping hands. Use of smart services creates a safer environment especially for sick, handicapped and older inhabitants, but also for everyone in the area. Certainly, these solutions do not stand on their own, but a systemic approach is required to optimize people-, material-, and energy-flows across infrastructure areas to realize synergies in GHG emission reduction. Intelligently combined these solutions will add to Turku's endeavors in reducing GHG emissions and creating a sustainable and livable environment for their citizens. Even further efficiency gains may be realized by digitalization, automation and integration of solutions and services. Of course all solutions and efforts undertaken will generate benefits in terms of city image for tourist, investors and citizens, in economy and socioeconomy.

Target setting and performance measurement

Any sustainable city strategy needs realistic targets on a city wide level accompanied by sector specific targets. Only then consistent and goal-oriented actions are possible. Targets have to be concise, communicated and transparent so that all involved stakeholders have the same understanding and are enabled to follow up the disaggregated targets for their specific work package accordingly.

Just like Turku defined concrete targets to achieve its vision of becoming a carbon neutral city in the 2040s, many other cities already did the same. A target framework is usually composed out of several components:

- City vision or overarching target which reflects the long-term ambition of the city, e.g. to become carbon neutral at a certain date
- Targets which collectively allow to achieve the city vision, e.g. to increase the modal share of public transport by x% by the year 20xx
- Measures which support the achievement of the targets, e.g. lower prices for public transport to attract additional users
- Indicators to track the current performance and to monitor progress towards target achievement

While the indicator system is a necessity following the defined targets, the following three other components like city vision or overarching target, targets and measures can be defined according to the ambition level of the city. The city vision as the reflection of the overall ambition of the city should be jointly defined by various stakeholder groups and across different political parties if possible to build a solid ground on which targets and measures can be applied. The city vision should reflect a long-term target which is ambitious yet still realistic and incorporates the strengths of the city and builds on previous achievements.

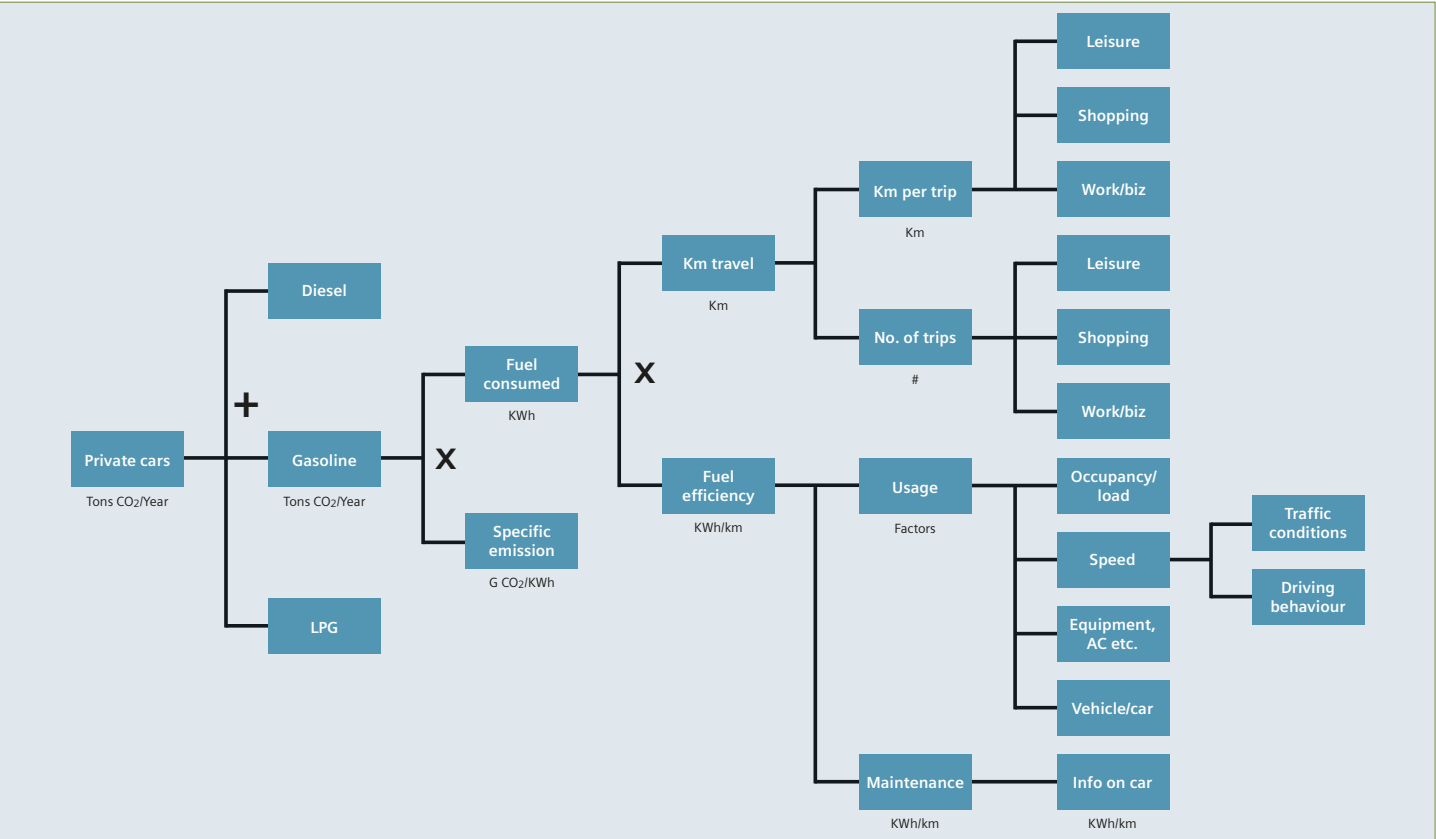
Targets should be defined on a city, sector level e.g. transportation and sub-sector level e.g. performance of buses. Thoroughly defined targets are:

- Specific: Concrete description of target using simple sentences and numbers to define the target.
- Measurable: To track the progress towards the target achievement, the required data needs to be easily available so that indicators can be calculated.



- Assignable: Somebody from the city administration needs to take responsibility for the target. It has to be clearly assigned to a department and person.
- Realistic: Although targets might be ambitious, they also need to be realistic so that the responsible persons know that they can achieve the target in the given time.
- Time-related: Each target needs a due date by when it has to be achieved in order to fulfill the city vision in the given time.

Driver trees are a useful tool to assign targets in relevant areas. As the example below shows, a driver tree shows the different contributors to e.g. the CO₂ emissions from private cars in a hierarchical order. Mathematical relations are also shown as well as units and qualitative factors. The driver tree below makes transparent, how emissions from gasoline cars can be influenced. It also allows a discussion about the right level of detail for target setting and indicators. Driver trees also give transparency about the required data for performance monitoring. At a later



Exemplary driver tree

Key recommendations for target setting and performance measurement

- City vision, targets, measures and relevant performance indicators need to be considered equally
- Defined targets need to be specific, measurable, assignable, assignable, realistic and time-related
- Driver-trees provide a framework to define targets on the right level of detail and for relevant performance indicators
- Select meaningful indicators which can be used to track changes in target-related areas
- Collect as few data as possible and only as much as needed to calculate the defined indicators
- Sustainable Energy Action Plans published by the Covenant of Mayors participating cities as well as ISO 37120 provide good examples

stage, driver trees can also be used to get transparency about the impact of measures in the overall system. To receive transparency about current performance in various areas, relevant performance indicators need to be defined. Ideally, the required data for calculating the performance indicators can be obtained automatically so that no manual labor is required.

Although many performance indicators can be defined and calculated, only a few are really relevant. Each indicator needs to be assigned to one or more targets to be meaningful. For example, the number of cars per 1000 inhabitants as an indicator can either be perceived as a positive sign of wealth or as a negative sign of congestion. Its meaning depends on the defined target. If the target is to increase the modal share of public transportation, a high number of cars per 1000 inhabitants is a rather negative sign.

Indicators need to be meaningful as well. Regarding buildings, for example, the energy consumption per square meter and year sometimes is used as an indicator to evaluate the efficiency of the build environment. However, this indicator should also include Heating Degree Days since the energy consumption is highly dependent on the difference between indoor and outdoor temperature. By normalizing the indicator with Heating

Degree Days, the energy efficiency of buildings in different climatic zones can be compared.

To further streamline the performance measurement process, an automated reporting system should be installed to provide the indicators to the right people in the city administration and the citizens. Cities like London publish various indicators on their website so that anyone can track the performance but also to allow developers to access the data and to make use out of it for new services and applications.

The Covenant of Mayors signatories, for example, provide a Sustainable Energy Action Plan which outlines how a city plans to achieve its CO₂ reduction target by 2020. Targets, measures, responsibilities and time frames need to be described and published on the Covenant of Mayors website.

IT-based performance measurement supports city optimization targets

Transparency is the key to achieve defined optimization targets. While this is long known and applied in industries as well as city administrations, it becomes also more and more important for individual infrastructure areas and entire cities.

Infrastructures are becoming more "intelligent" and automated to achieve more with less. Sensors are spread across the city, from temperature and rainfall sensors to traffic flow measurement and building monitoring system, which generate more and more information.

To make sense out of this ocean of information, meaningful performance indicators have to be defined. Once defined, they can be automatically calculated and presented to the responsible city administration departments. In this system, it is most important to define the right performance indicators across different city departments so that only required sensors are installed.

The next step is then to not only use the sensor network as a reporting tool but to complement it with actors so that an automated response can be started and the infrastructure systems become automated.

6

Toolbox for Collaborative Sustainable City Initiatives in Mid-sized Cities

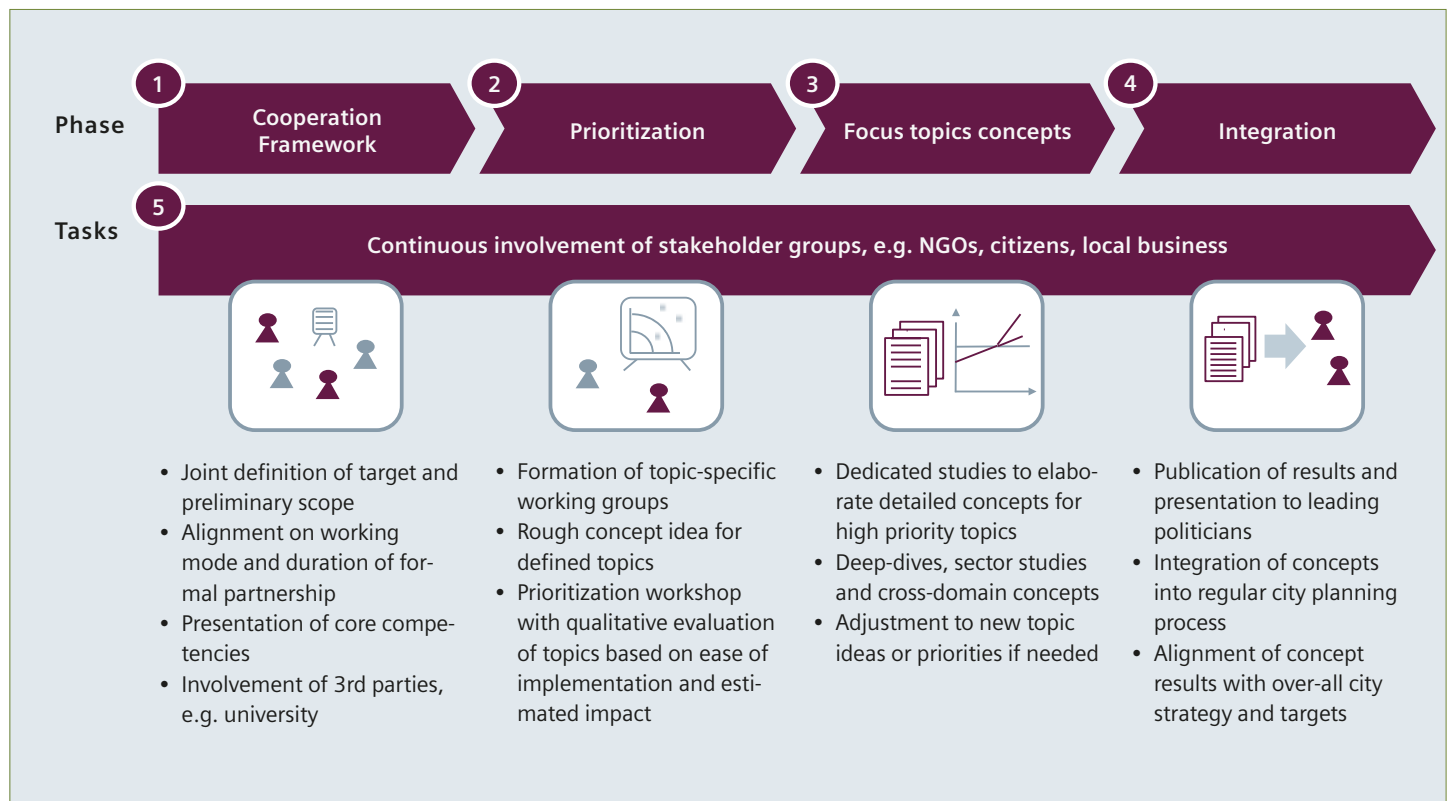
Although there are many toolkits available to support the development of sustainable city action plans and alike, little has been said about how to establish a collaborative approach between a city and a private company partner. Based on the experiences made during the last couple of years, a structured framework has been designed to support other city officials who aim to start a similar cooperation.

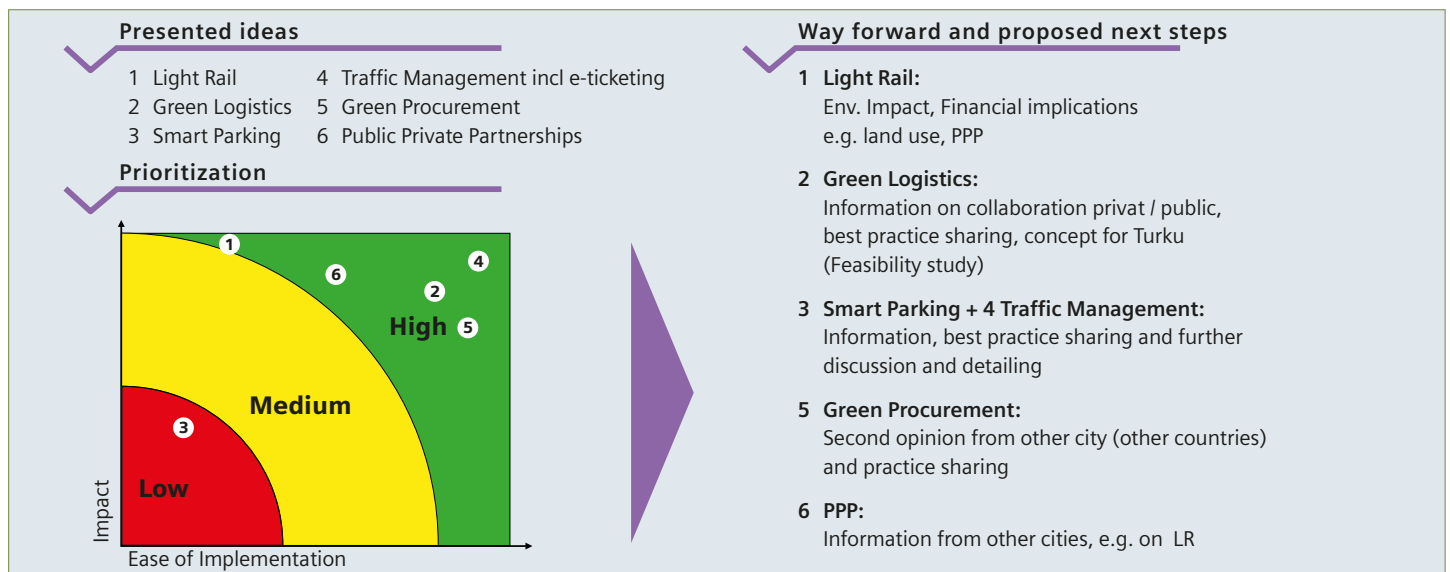
The framework acts as a supplement to the standard planning and decision making processes any city administration employs. It does not intend to replace these processes but it is a guideline for a separate work stream

which can enhance the decision making in the city by providing new concepts elaborated by new forms of collaboration.

The cooperation framework builds the fundament for the entire collaboration. Prepared by a working group, e.g. the sustainability officer of the city and experts of the private company, it eventually has to be signed by the mayor and senior management from the private sector as a signal of importance to both organizations.

The members of the working group jointly define the overall target of the cooperation, e.g. to contribute to the sustainable energy action plan





Phases of cooperation framework

of the city and the preliminary focus topics, e.g. public transport based on the core competencies of both partners. To complement the available skill set and to receive additional ideas, third parties such as the local university shall be involved right from the start. A suitable timeframe has to be selected, e.g. 3 years for the overall partnership. A biannual steering committee has proven to be a sufficient mode to gather the mayor, high level politicians and the management of the private sector partner to align on outcomes, provide guidance on future topics and to discuss possible new ideas. Although a single point of contact should be established on both sides as a permanent interface, topic specific project teams are to be formed additionally. The first phase ends with the signature of the framework agreement by the mayor and the senior management. Specific studies which are defined for elaboration at a later stage are described in separate statements of work.

Once the target and preliminary scope is defined, infrastructure area specific expert groups are to be established, e.g. for transport, buildings

and energy supply. They prepare project ideas (e.g. 3 to 5 ideas per infrastructure area) which are described on a high level including contribution to the cities sustainability targets, expected effort, required resources and competencies. Once the expert teams have described their set of project ideas, they are jointly prioritized by all expert teams during a prioritization workshop. Experts are asked to present their ideas to the audience so that everyone is given the opportunity to ask questions and to understand the idea. Special emphasis should be laid on synergies between the different infrastructure areas and ideas. To identify promising ideas for further detailing, all ideas are prioritized (qualitatively) according to

- Ease of Implementation: Summarizing factors such as estimated cost, legal requirements, technological factors, integration into overall system
- Impact: Summarizing factors such as estimated reduction of CO₂ emissions, operational expenditures, image, city attractiveness

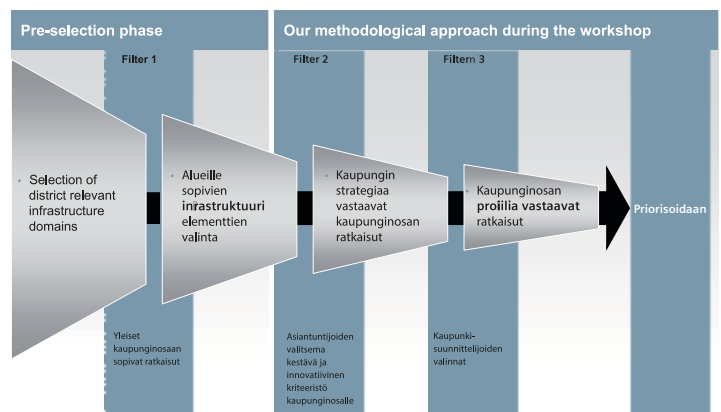


Although the prioritization is based on a qualitative evaluation, it nevertheless includes the judgment of experts from both the city and the private company partner and can therefore act as a guideline which topics should be elaborated in more detail. The following graph shows an illustrative example of presented ideas, prioritization and a potential way forward for transport related topics:

For high priority topics, expert teams are brought together to elaborate more detailed studies. It has to be mentioned, however, that the

Key recommendations for collaborative sustainable city initiatives

- Define how the partnership will benefit all involved partners so that everyone is aware why the different parties are engaged
- Select a partner from the private sector that can complement the cities own capabilities
- A reasonable timeframe is essential for the collaboration as trust can only be built over time but is necessary to discuss also sensitive topics openly to come up with helpful ideas and concepts
- Estimate upfront how many resources and time will be required to work on the defined topics and free up the necessary resources. Nobody will be happy to work on collaborative topics if regular work takes over
- Expect significant contribution from the city administration. Remember: The partnership is meant to establish a new collaborative way of working to create better results
- Be open for new partners and project ideas throughout the process.
- Involve all relevant stakeholder groups, also the citizens right from the start
- Communicate all results openly, e.g. via a website. This will in any case be a requirement of the private sector partner to avoid exclusion



Selection methodology

high priority topics set a guideline for the entire period of the collaboration. Therefore, in most cases no more than one topic will be elaborated in detail at a certain time. The focus topic concepts can cover either very specific topics or cover multiple domains with overarching concepts. Required competencies, methodology, timeline are all subject to the actual topic.

To take the light rail study as an example for a transport deep dive which the City of Turku and Siemens elaborated together. A three-step methodology was applied to calculate the impact on CO2 emissions, air pollution and real estate price development.

- Methodology and research: Starting with the creation of driver trees to understand important factors for emissions and real estate prices and the collection of relevant data, e.g. real estate volume development and light rail real estate impact factors from research. For the ecological impact calculation, the COPERT model was used and expanded using own Excel-based calculations. To ensure transparency, main assumptions are stated.
- Data gathering and modeling: Definition of integrated scenario input data and collection of impact values from case studies. Collaborative definition of accompanying policies to foster city development and public transport. Calculation of real estate volume

baseline and projection. Involvement of experts via panel to judge upon expected light rail price impact.

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- Data gathering and modeling: Definition of integrated scenario input data and collection of impact values from case studies. Collaborative definition of accompanying policies to foster city development and public transport. Calculation of real estate volume baseline and projection. Involvement of experts via panel to judge upon expected light rail price impact.
- Results: Calculation of traffic emissions using COPERT and own calculation tools. Comparison of business-as-usual and different light rail implementation scenarios. Calculation of real estate value uplift due to light rail implementation and differentiation of uplift per region and zone. Recommendations for policies and value capture mechanisms. Politicians and interested citizens are informed about the results if the project.

On the other side of the spectrum, a multi-sectored concept to make an entire district more sustainable requires a different approach.

Similar to a funnel, a large number of potential solutions are at first collected and a series of filters is then applied. The first filter is the

general relevance for the creation of a sustainable district. In a second step, the remaining solutions are then evaluated by city experts and judged up-on whether they support the city's sustainability strategy and are innovative. The last filter is then the match with the specific profile of the district done by the district planners themselves. Only solutions which fulfill all criteria are elaborated and can be integrated into the planning process of the city.

Once the collaborative concept is elaborated, it is up to the city administration to integrate the results in a responsible way into the overall planning process. Transparency is key to ensure that it is clear for everyone how and which parts of the results are used by the city to avoid e.g. potential procurement issues.

ICLEI and Siemens collaborate to advance sustainable urban infrastructure globally

This strategic and technical partnership between ICLEI – the leading cities network and Siemens – a leading technology provider integrates urban development and urban infrastructure projects. It brings together ICLEI's expertise in governance, policies and urban management processes and Siemens' cutting-edge smart technologies on urban infrastructure.

Tackling the twin challenges of rapid urbanization and climate change, ICLEI and Siemens are working together in the areas of sustainable urban development, adaptation and resilience planning of urban infrastructures, urban transport and mobility, smart city concepts including energy generation and smart grids, sustainable procurement and innovation, and commercial and industrial building development.

The partnership also promotes the much-needed bond between cities and the private providers of urban solutions, with ICLEI serving as the link as it has been pioneered together with the City of Turku.

Next Steps

Turku has set ambitious goals. The city strategy was launched in 2014 and during that work city board decided to aim for carbon neutrality by 2040. To achieve this goal a lot of concrete measures are needed.

With this cooperation it has been proven partnership between a public and a private entity can bring value to all cities with similar challenges. The partners will continue to contribute to the Turku Climate Roadmap.

The city has already initiated investments to turn the central power assets to renewable energy sources. Siemens delivers the turbine island to TSE Naantali CHP investments which enables 100% renewable energy in district heating in the future. The future energy system of the city will, however, require further measures in order to achieve of the ambitious goals.

Energy efficiency in buildings needs to be further improved. The city utility together with the University of Applied Sciences is involved with Siemens to develop the future energy efficient and effective building infrastructure.

This partnership developed a toolbox for developing smart city districts. Turku will implement Skanssi city district in a smart and sustainable way. The district will be a platform for a new energy system, which is piloted in an energy project.

With these projects a future ready energy system will be built. It will enable flexible energy use, where consumers can utilize smart demand and response models to respond to the energy market changes in a smart way.

The city has also clearly indicated it will develop electric public transport. After the piloting of e-Buses in 2013, the city has decided to start operation in 2016. The master planning for tram-operation is being prepared and is open for comments. When a decision to continue the development of this service will be made, Siemens can continue to contribute to the launch of the service.

The future transport system can include multiple forms of public transport to complement the existing services. These can be electric buses, rail solutions and also ferries.

The regional structural model 2035 defines over 100 areas which will need further development. Brownfield development of city districts is one of the future focus areas in Turku. Siemens expertise can help develop new functions for these districts.

The results of the partnership are available for all other cities. Turku and Siemens will continue to bring these concepts to use in other cities around the Baltic Sea region. The partnership has already fed input to the Baltic Urban Forum for Smart Cities and will continue to do so. City forums like UBC and ICLEI will be utilized to share these practices.



8

Conclusion

It is obvious that a meaningful, long-term strategic collaboration between a city and a private sector company needs a joint target, a process to collaborate, and transparency among the partners, to other stakeholders and the general public as well as the flexibility to adjust priorities during the journey. Bringing the different pieces of the puzzle together requires dedicated managers on both sides who can handle the different requirements and expectations and involve the right persons when needed.

A key topic to be considered is that the requirements of mid-sized cities differ quite significantly from large cities. Especially in Northern Europe, a dedicated and skilled city administration is a good starting point for such an initiative. Some solutions might be obviously irrelevant for mid-sized cities but other need careful evaluation to see if they would work under the specific conditions.

A partnership like the one between the City of Turku and Siemens is still a novelty for cities and the private sector alike. Many questions will come up, not only from the partners but also from other companies and

the general public. Questions about the general reason, potentially biased decision making processes and exclusion from future procurement processes are just some of them. That is why transparency is so important for the success of the endeavor.

Careful consideration of potential pitfalls and open discussion of expectations help to build the foundation of trust onto which truly new concepts, by bringing together expertise from policy makers and implementers, can arise. It is then possible to harvest the benefits of such a partnership by getting access to experts which have an alternative view on the same issue and can complement one's own solution approach. Better decision making can result from this by creating better ideas which are technically and financially viable and help cities to build a more sustainable future.

If you are interested in starting a similar initiative and found this report helpful, we would be glad if you would get in touch with us – the City of Turku and Siemens – to find a way that supports you in achieving your sustainability targets.



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