A solutions landscape for Turku

The Urban Infrastructure Initiative I UII

Full Report

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Content

Summary

In the first engagement of the UII cities project, business and city experts identified six areas for immediate action and three longer term ideas to advance Turku's sustainability program. The ideas offer new solutions and enhancements to existing activities that will accelerate and promote the city's sustainable development.

The solutions range from technical developments – such as traffic management and building control systems – to organizational approaches, such as municipal energy management. Some are immediately actionable while others will require research, consultation and funding. Next steps include promoting the city's existing, substantial action as well as putting the most promising ideas into effect.

These conclusions emerged from a series of workshops held in Turku City Hall in March 2011. UII members and city officials had previously identified an issues landscape with three key areas for action, based on the city's Climate and Energy Program and the Sustainable Energy Action Plan. In the workshops, UII experts presented six ideas for each theme. Following discussion, the city representatives prioritized the ideas based on their impact on the city and applicability to Turku.

The week-long engagement demonstrated the value of providing business input to city thinking early in the planning process. It allowed city officials to consider a variety of ideas and to engage with businesses collectively in a broad context rather than in relation to specific tenders.

Table 1: Summary of the most promising ideas and the next steps in each case

Actionable immediately	
Green logistics	▪ Consider how to combine private with public logistics ▪ Learn from others, especially failures ▪ Include logistics in city traffic plan now being prepared
Traffic management systems	▪ Provide information about routes, current conditions at bus stops etc as well as on internet, including screens in major buildings ▪ Consider a car sharing scheme
Green procurement	▪ Clarify what the city is going to do and what is for the private sector ▪ 'Peer reviews' by cities in other countries
Biogas	▪ Exchange information on best practices ▪ Research the potential market and solutions
Building control and management	▪ Check specifications for new build and renovations ▪ Develop policy requirement
Municipal energy management	▪ Review models in other cities and apply to Turku
Material flow analysis	▪ Consider if there is an appropriate model
Longer term action	
Light rail	▪ Research relative environmental impacts compared to other modes ▪ Study financial implications, especially re land values ▪ Investigate public-private partnership potential
Public-private partnerships	▪ Look at examples elsewhere, including Australia
Smart grid	▪ Research practices of other cities

Introduction:

Combining business and city expertise

The Urban Infrastructure initiative (UII) worked with the city of Turku in a week of intensive workshops in March 2011 to identify priorities for advancing sustainability. Turku is the first city to take part in the UII program, which provides a unique opportunity for business to provide input early in the planning process. UII aims to work with cities in all continents over the duration of the project.

Experts from six UII member companies came together with city officials (see the appendix for participants) in Turku City Hall. UII presented ideas for tackling the key issues. The city participants used their expertise and local knowledge to prioritize the opportunities. Together they identified the best ideas to support Turku's sustainability targets and the next steps for the city in each case.

Dialog, issues and solutions

The workshops followed a dialog session with the city in December 2010 which identified the city's sustainability issues landscape. This dialog considered three broad topics for the UII engagement, covering city center development, land use and energy. It concluded that Turku's Sustainable Energy Action Plan would be the focus for UII's involvement as this meets one of Turku's key requirements and best fits UII's aim of acting between vision development and detailed planning.

The key areas identified where business input could help to develop new solutions, enhance and accelerate existing action, were grouped in three broad themes:

- transport and logistics
- energy supply
- energy use

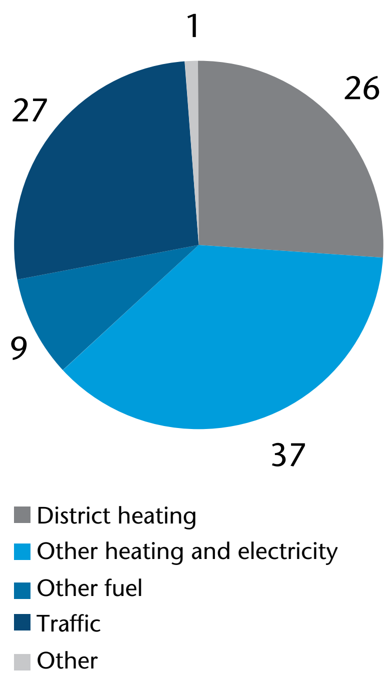
These areas represent the major sources of greenhouse gas emissions in the city and the major opportunities to achieve sustainable energy targets as well as improving the quality of life for citizens.

Following the dialog the six UII member companies working with the city considered how their combined expertise could be applied to bring a new dimension to Turku's sustainability program. They presented six ideas to a workshop on each of the three themes and the group jointly explored each option to develop a solution landscape.

The Turku officials participating were the directors and senior team members from the city and other experts from the region relevant to the day's theme. At the end of each day-long session, they prioritized the six ideas that had been discussed, based on their potential impact and feasibility in Turku.

Each workshop concluded by identifying next steps to advance each of the ideas discussed during the day. The following sections deal with each thematic cluster in turn. The final section summarizes the next steps for the city in the most promising areas.

Figure 1:
Turku emission sources in % (2007)



Turku:

A sustainability leader

Turku is one of Finland's leading cities with a population of approximately 180,000. Sustainable development is a core value and Turku has been internationally noted for its efforts (for example ICLEI Honorary Award 2006). The city signed the European Declaration of Sustainable Cities, the Aalborg Declaration, in 1996. Turku is a signatory to the Covenant of Mayors.

The Climate and Environment Program launched in 2009 targets greenhouse gas emissions per capita 30% below the 1990 level by 2020. The Program is supported by detailed targets and resource budgets and has already achieved significant progress in areas such as renewable energy. A Sustainable Energy Action Plan focuses especially on buildings, equipment and transport, but also on influencing markets and citizens' consumption patterns.

The greatest cuts in greenhouse gas emissions are expected to be achieved by increasing the share of renewable energy in district heat and electricity production, enhancing energy efficiency in all operations and furthering sustainable transport.

The city believes that preventing climate change and creating a low-carbon society present significant opportunities for businesses in the region. Seizing the opportunities is a feature of the city's Expertise and Businesses Programme.

Table 2: Greenhouse gas emissions in Turku

	Year 1990 (000 t CO_2)	Year 2007 (000t CO_2)	Goal 2020 (000 t CO_2)	% Change 1990-2020
Emissions total	1703.61	1639.31	1339.24	- 21 %
Per inhabitant (tCO2)	10.70	9.35	less than 7.50	- 30 %
Population/ prognosis	159.180	175.286	178.627 *	

*Source: National Data and Statistics Centre

About UII

The Urban Infrastructure Initiative (UII) is a business contribution to urban sustainability. It is a project of the World Business Council for Sustainable Development (WBCSD), launched in 2010 to help cities implement more effective and affordable solutions to the inter-connected challenges of sustainable development. It is a multi-company initiative that brings business expertise to identify practical, cross-cutting solutions for cities. The aim is to engage early in the process to help cities achieve their sustainability vision effectively. See the appendix for membership.

Theme 1:
Transport and logistics

The issue for the city

Transport supports business growth and prosperity for the 180.000 inhabitants of Turku. However, it is responsible for 27% of the city's carbon emissions (2007 figures). Other negative impacts include noise and air pollution, accidents and congestion. The goal is to reduce these negative impacts by making the best use of all transport modes – known as co-modality. This includes introducing cleaner vehicles and combining private transport with a significantly higher share for public transport, walking and cycling.

Turku's Climate and Environment program envisages co-existence of all transport modes. Travel by bicycle is expected to increase by at least 50% from the 2006 level and travel by public transport increasing by 2% per year from 2010 to 2030. It sees public transport as the priority for any increase in traffic from the suburbs to the center.

The city aims to reduce the need for travel by locating employment close to where people live. Better traffic safety and the promotion of co-modality will encourage use of the most effective mode. More accessible services will offer equal transport opportunities to different age and population groups.

Private cars currently have a high share of total transport and the use of public transport has been growing slowly. Public transport has a good image but expanding the network is costly. The cycle route network currently fails in the city center but should be completed by 2015.

A Bus Rapid Transit system is under development and the city council has agreed to create a light rail system, subject to funding and land use constraints.

A political consensus backs the growth of public transport but this also requires greater public support.

Transport targets

- Carbon dioxide emissions from traffic are at least 20% below the 1990 level by 2020
- 10% reduction in internal city transport from 2008 to 2013
- The share of light and public transport in Turku is over 55% in 2013 and over 66% in 2030
- A bicycle route network through downtown Turku will be completed in 2015
- Full implementation of public transport trunk route network by 2020
- The share of travel by private car is no more than a third by 2030

The UII response: Potential solutions

Turku is experiencing the same megatrends as other cities:

- urbanization: creating a growing population in the city region
- demographic change: increasing life expectancy resulting in more older people and single households
- consumer trends: especially the rise of internet shopping creating more local deliveries
- climate change: bringing pressure to reduce emissions substantially

These trends create and are in turn influenced by the desire for greater mobility of people and goods. *Mobility 2030*, a joint study by WBCSD, the International Energy Agency and CRA International, foresees passenger traffic in Europe growing by an average of 1% a year to 2030 and freight growing by almost 2%.

In the past the typical response has been a combination of building more roads and imposing restrictions on where and when traffic is allowed. Achieving sustainable mobility requires a different approach. Cities need to apply co-modality to achieve the most effective mix of transport modes. Integrating traffic and supply chain management will also reduce traffic. Combined with innovations in energy use, including hybrid and electric vehicles, this will create sustainable and efficient transport.

CASE STUDY

Public-private partnership model

Almada, Portugal

The new transport system connects the towns of Almada and Seixal south of Lisbon and links up with the railroad line and ferry link to Lisbon at several points. The route covers 13km, has 19 stations and 24 trains and was completed in November 2008. The average frequency is six minutes. The project used a public-private partnership model and is run by a concession company.

Ideas from UII for sustainable transport

1. Light rail

A flexible and expandable form of electrically powered rail transport, light rail fills the gap between bus services and conventional or underground railways. It works alongside both systems to fill the gap in distance and capacity of these other modes.

It can be developed in stages from a tram operating on mixed streets alongside cars and buses, to a Pre-metro system running on a dedicated right of way.

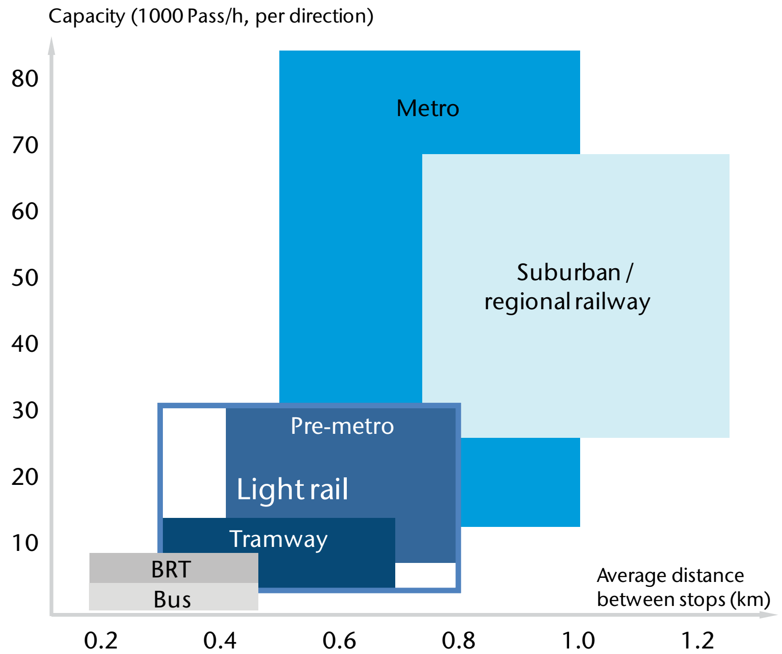
Light rail requires huge investment but can be the backbone of the transport network for medium sized cities, operating in main corridors where higher capacity is needed than can be achieved with buses.

Although the trains are costly, they are quieter than motor traffic and produce no local air pollution. They use a quarter of the energy of a bus and a tenth of average car consumption per passenger/km.[1] A light rail system can stimulate social and economic development by opening up or regenerating districts, attracting people and businesses without traffic congestion.

2. Logistics

Turku wants to increase the use of sustainable modes of transport and mobility, and innovations in "Green logistics" can help by cutting congestion as well as reducing greenhouse gas emissions. While the growth of public transport can reduce passenger vehicle numbers in city centers, goods vehicle traffic is likely to increase along with commercial and retail activity. Internet shopping increases traffic in residential areas.

Figure 2: Light rail fills the gap



1. Zahlen und Fakten: Bahnindustrie und Klimaschutz, Verband der Bahnindustrie in Deutschland (VBD), 2010 (www.bahnindustrie.info)

The most successful green logistics solutions have three key components;

- innovative technology such as electric tricycles and intelligent traffic systems
- innovative supply chain features such as micro/mobile depots
- innovative collaborations such as subcontractor arrangements and training for cyclists

The UII "Green logistics" proposition integrates sustainable modes of transport in innovative supply chain solutions. This will not only improve liveability in Turku, because there will be fewer vehicles and less pollution, but also reduce total costs of transport.

The key levers to improve supply chains in Turku are:

- Increase vehicle utilisation through bundling deliveries (e.g. city consolidation)
- Collect and deliver goods 24 hours a day
- Downsize vehicle fleets and infrastructure in the city center and upgrade vehicles to zero emission technology (e.g. electric vehicles)
- Build tailored solutions for customers that require zero emissions for their products or services

Such "Green logistics" solutions have been implemented or demonstrated in various European cities. The following examples show that a collaborative approach will achieve better and more sustainable results.

- Utrecht and London – city consolidation centers around the city center will keep heavy goods vehicles out of the center. Shipments from several carriers will be consolidated into a single delivery using clean vehicles. Economies of scale and tailor-made city regulation enable the city consolidation center to operate successfully.
- Milan – logistics providers and retailers have co-operated to consolidate deliveries, avoiding multiple vehicle trips to the shopping center.
- Brussels, Geneva and Paris – electric tricycles are used to deliver in the city center, collecting from logistics micro-depots linked to the road and air network.
- Berlin, Lyon and Turin – a versatile collection and delivery point in a public place acts as a depot where consumers can collect shipments at a time that suits them best.

3. Smart parking

Many cities have tried to manage congestion by limiting private car access in central areas. This can damage the vibrancy of the central district but a smarter approach can combine congestion and emissions goals with support for the downtown area. It can also work with efforts to boost public transport to change citizens' behavior.

Three possibilities could be explored in Turku:

1. Modulate parking places according to CO_2 and pollutant emission levels – provide the most favorable parking places for low-emissions vehicles, penalizing others with inconvenience and possibly providing no parking spaces for the highest emission vehicles. This will encourage people who drive into the city to choose cars with lower emissions.
2. Differentiate the parking fee – adding to the incentive to drive low-emission vehicles by charging lower parking fees.

CASE STUDY

Traffic management systems

Halle, Germany

Car drivers in this city in eastern Germany now get up to the minute information on conditions on the roads and in public transport. The example shows how many parking places there are at a Park and Ride location and how long drivers will have to wait for the next tram.

Halle now has up to 50% more use of parking spaces and public transport as a result of this kind of information, which encourages drivers to combine private and public transport. In total, the city has reduced travel distances by about 10km for each car parking transaction, saved more than 32 tonnes of CO_2 emissions and 13,000 liters of fuel a year.

CASE STUDY

Ecological requirements for cars

Flanders, Belgium

Flanders has introduced ecological requirements into its public procurement criteria for cars. Eco factors carry a weight of 10% in the total assessment, with cost remaining the most significant at 50%, followed by quality and with 5% weighting for the warranty.

Eco factors to be considered are eco-technical innovation, recyclability, re-use of recycled materials and compliance with EU emissions standards.

3. Provide smart parking at the main rail and bus stations – encouraging the combined use of public and private transport. By providing parking spaces at the station for chargeable electrified vehicles, shoppers can take the train into the city but still have a vehicle available to move round the center. This will encourage co-modality.

Finance for such ideas can be available under the European Union's Civitas initiative, which helps cities to achieve a more sustainable, clean and energy efficient urban transport system with a mix of technology and policy-based measures.

4. Traffic management

Improved management of the transport network can reduce bottlenecks and congestion and can encourage people to change some journeys from private to public transport. Providing better information makes bus, train and light rail systems easier to use and helps drivers to find parking spaces.

Traffic management systems collect dynamic public and private traffic and parking information. This can be used to provide real-time information to car drivers with advice on the best route and parking options, and possible links to public transport. The information can be conveyed using roadside information displays, in-vehicle displays, portable signage and the internet.

Once the traffic information is available, Turku could use it in many ways to cut congestion and emissions and stimulate more sustainable transport use:

- Encourage Park and Ride by displaying information on travel and waiting times
- Guide drivers to the best parking places
- Charge for parking based on CO_2 and pollutant emission levels
- Charge for entry to congested areas, possibly with variable rates depending on emissions and/or the time of day
- Make car and bike sharing easier, possibly linked to public transport and parking facilities and an electric vehicle rental fleet

Systems for collecting traffic information can also support a common payment system for all personal transport, including parking and public transit, using electronic ticketing and payment systems. New technologies also make it possible to operate traffic light preemptions for public buses and trams.

5. Green procurement

Turku is a major buyer of a wide range of goods and services. The city can use its purchasing power to choose goods and services with lower impacts on the environment, making an important contribution to sustainability. City requirements will also influence other purchasers as well as vendors, influencing the market and providing incentives to develop more favorable technologies and products.

Environmental requirements can be introduced for the city's car fleet, other public vehicles, transport construction and maintenance operations and support services.

6. Public-private partnerships (PPPs)

Collaboration could be the key to success for Turku in achieving transport targets. For example, in the example of consolidation centers around Utrecht and London (page 7) the public sector is providing the regulatory framework and political support, while the private sector contributes the physical infrastructure of warehouses, vehicles and ICT as well as the people to run the operations. Each partner benefits: the public sector gets lower emissions and reduced congestion while the private sector makes a return on its investment. The sum of the benefits should be greater because the two sectors work together to achieve success.

Parma in Italy is also benefitting from a similar arrangement. The logistics provider operates a consolidation warehouse to meet the city's desire to reduce the number of heavy vehicles downtown. The warehouse operates a fleet of electric vehicles which take the consolidated loads into the city center. They reduce the number of vehicles as well as eliminating emissions.

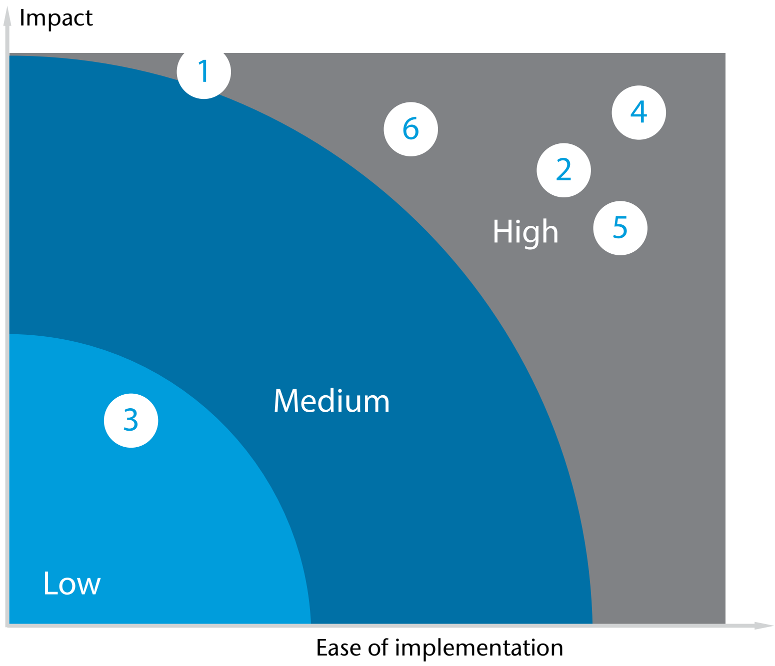
Transport and logistics: Discussion, prioritization and next steps

The city participants considered that all the six ideas would contribute to Turku's sustainability ambitions. Most would have a relatively high impact on the city and several would be relatively easy to implement. Smart parking is the only idea considered to have low priority, because car parks are privately owned so the city has no control over their operation.

Some high priority ideas can be implemented with little difficulty but light rail, which would have the biggest impact, clearly needs substantial work in addition to the existing feasibility study. On the other hand, some aspects of a traffic management system can be developed easily by adding to the existing website. Other components of a traffic management system would be more complex and this combination of ease/difficulty, high/low impact is also true of the elements in other ideas.

The chart below shows how city officials prioritized the six ideas, based on their overall impact on the city and how applicable or practical they would be. The table summarizes the discussion and the next steps for the city in each case.

Figure 3: Prioritization of the six ideas on transport and logistics



Note:

Impact summarizes factors such as expected reduction of CO_2 emissions, costs and other environmental and social factors

Ease of implementation summarizes factors such as expected implementation costs, regulatory and political hurdles, implementation timeframe

Table 3: Transport and logistics – discussion and analysis summary

Opportunity	Considerations	Next steps
Circled numbers refer to the prioritization chart above		
High priority		
Light rail	▪ Already not enough capacity on some bus routes ▪ Should be backbone of the transport system ▪ Maybe the city doesn't know enough about travel, especially non-work which represents 60% of travel ▪ Important for city attractiveness ▪ Finance difficult, but some investment from the state ▪ Land use part of regional agreement	▪ Research relative environmental impacts compared to other modes ▪ Study financial implications, especially re land values ▪ Investigate public-private partnership potential
Green Logistics	▪ Can start small to learn and grow ▪ Important impacts on noise and pollution ▪ Can link to biogas project ▪ Especially important for city center noise and pollution	▪ Consider how to combine private with public logistics ▪ Learn from others, especially failures. Share best practice and tailor it to Turku ▪ Possible feasibility study ▪ Include logistics in city traffic plan now being prepared
Traffic management	▪ Could be combined with smart parking ▪ Some aspects relatively easy, such as information for travelers, ▪ Park and Ride is difficult because of land availability ▪ Possible common ticketing – but subject to regulation	▪ Provide information about routes, current conditions at bus stops etc. as well as internet – real-time information, including screens in major buildings showing when next bus is due ▪ Consider car sharing scheme
Green procurement	▪ Already happening but need to do more ▪ Need to move further, faster	▪ Clarify what the city is going to do and what is for the private sector (how many cars does the city itself need?) ▪ 'Peer reviews' by cities in other countries
Public/private partnerships	▪ Essential for green logistics ▪ Could be simpler than in some cities but might have to work regionally – more difficult but bigger impact	▪ Look at examples elsewhere, including Australia
Low priority		
Smart parking	▪ Parking not under city control, especially as much parking is in private buildings (under offices) ▪ Could link to traffic management	▪ Could the city influence private sector parking companies ▪ Consider parking at stations.

Theme 2:

Energy supply

The issue for the city

District heating, electricity and other fuels generate almost three quarters of Turku's carbon emissions (see the chart on page 3). Reducing these emissions is a key goal of the Climate and Environment Program. Reliability and the cost of supply are also important and must be seen in the context of the Turku region, especially as district heating is organized regionally.

The city owns Turku Energia which is responsible for heating and electricity supply and has an ambitious environment program for renewable supply and efficient use.

Key goals are:

- 100% carbon free electricity
- 60% of heat is produced with renewable fuels by 2020
- Reduction of the city's energy consumption by 9% by 2016 and 20% by 2020
- Reduction of customers' energy consumption by 9%

Renewable sources are already well developed – approximately 60% of electricity and 30% of district heating comes from renewable energy and the first phase of the Kakola heat pump plant using waste water came on stream in 2009. A biogas project is also underway, generating fuel from sludge, organic waste and landfill for use in public transport vehicles.

The city has made less progress on decentralized energy production and the potential for a "smart grid" to harness small-scale generation and provide information to drive energy savings.

The UII response

Turku already has significant renewable energy supplies but this is an area that will have to develop, not least because of the European Union's Renewable Energy Sources (RES) Directive.

The Directive targets 20% renewable energy across the EU by 2020, to meet energy security goals as well as emission reduction targets. While Finland is already ahead of this average level, each country has committed to a target – which is 38% renewable sources for Finland. This will require nearly 10% additional renewable energy, which will not be achieved based on existing actions.

Finland needs to reduce total energy consumption as well as increase renewable generation to meet the target, and Turku must contribute to those goals.

Ideas from UII for more sustainable energy supply

1. Micro combined heat and power (micro CHP)

Combined heat and power (CHP) plants are common at large scale, achieving improved efficiency compared to conventional units because the heat generated is used rather than being wasted. Micro CHP can provide the same benefits for small scale production.

Organic Rankine Cycle (ORC) is a mature and robust technology suitable for units generating les than 3MW. It can produce electricity from heat at low temperatures (even below 100 °C) using a fluid such as silicon oil instead of water.

ORC can use waste heat from other sources such as a furnace or biomass plant or from a district heating network at temperatures between 100-160 °C. The unit uses the temperature of the district heating to generate electricity and heat. It is cost efficient when electricity is more expensive than heat, and saves CO_2 emissions when the CO_2 content of electricity from the grid is higher than from the district heating generation.

CASE STUDY

Municipal solid waste treatment plant

Botarell, Spain

The plant produces methane from domestic waste and garden waste, adding up to more than 90,000 tonnes a year.

Three digesters produce biogas as well as 11,000 tonnes of compost a year.

The plant's two generators produce 1200 kW which is fed into the grid.

CASE STUDY

Automation of the existing grid

Malaga, Spain

This four-year project in Malaga demonstrates the potential of the technologies to reduce energy and emissions. Automation of the existing grid, together with new generation, serves 300 industrial clients, 900 service clients and 12.000 houses.

Energy consumption at 70 GWh a year resulted in 6000 tonnes of CO_2 emission savings.

2. Ground source heat pumps

Ground heat is stored in soil, rock or water systems. A heat pump can use it for space heating, based on boreholes with heat exchanger pipes. At depths greater than 15m the surface temperature has no effect and boreholes are typically 200-300m deep.

The ground heat is transferred to a water-based heating system, which can be district heating. Using the energy in the ground means the energy supplied is several times greater than the input energy to the heat exchanger. Typical efficiencies (described as Coefficient of Performance or COP) are in the range 3-5, depending on the relative temperatures of the evaporator and the hot water temperature required.

3. Biogas

Decomposing vegetation and garbage, animal and human manure all produce methane. Burning this gas not only captures the energy but prevents the methane from entering the atmosphere where it is a potent greenhouse gas.

Sewage treatment plants and landfill sites can be sources of biogas, which can also be produced in dedicated plants using material sources for the purpose. Biogas can be piped for use directly as a burnable gas or used to power an electricity generator. The process produces compost as a by-product.

4. Heat machines and chillers (see also Energy Use)

These machines capture heat that would otherwise be wasted, either from cooling equipment or heat production in boilers or power plant. Typically they take heat extracted by air conditioning, for example in a data center, and use it to warm water for district heating or other purposes.

This approach requires a balance between the source of heat (usually a need for cooling) and the demand for heat. This is not always possible in a city such as Turku where heat sources dominate in summer – when there is little need for heating.

5. Smart grid

Electricity grids have traditionally been based on centralized power generation, with one-way power flow from the grid to users. The growth of renewable energy, generated from many distributed points, is challenging this model. It means power companies need to be able to manage a more complex grid, including power entering the grid from users' small-scale production as well as from the main power producers. This demands more sophisticated communications and options for storing energy.

The smart grid concept brings together the electricity and communications infrastructure to help match supply and demand. Information and communications technologies (ICT) can also provide users with information, through smart meters, that helps them manage energy consumption. Users can reduce total consumption and shift it to lower-cost times of day to take advantage of variable tariffs if they exist. This also helps power companies because it smoothes the peaks in demand.

ICT is crucial to manage the smart grid, providing real-time communications to enable management by individuals and power companies that will reduce energy wastage.

CASE STUDY

Ground heat in a school

Turku, Finland

The school building previously used 1200 MWh per year. Using ground heat means this has now dropped to just 0.7 MWh per year.

The system consists of one heat pump with a capacity of 200 kW, heating water to 45 °C. It has 16 boreholes which are 200 meters deep.

6. Material Flow Analysis (MFA)

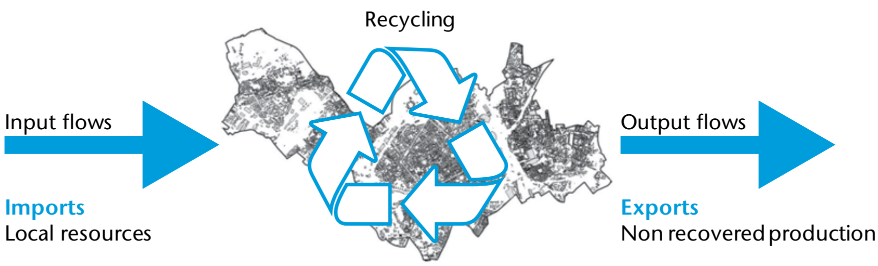
Turku could use this kind of analysis to:

- analyze the environmental performance of a geographical or functional area
- assess the effectiveness of a policy
- compare alternatives
- communicate environmental policies and performance

Material flow analysis is similar to a lifecycle analysis but applies to an area or activity rather than a process or product. It quantifies inputs and outputs in the area studied to understand the flows and identify possible improvements.

Examples of flow analysis have identified the importance of people's behavior in determining environmental outcomes, as well as the potential to create a recycling loop for wood and other materials which were currently being wasted.

Figure 4: Material Flow Analysis (MFA)

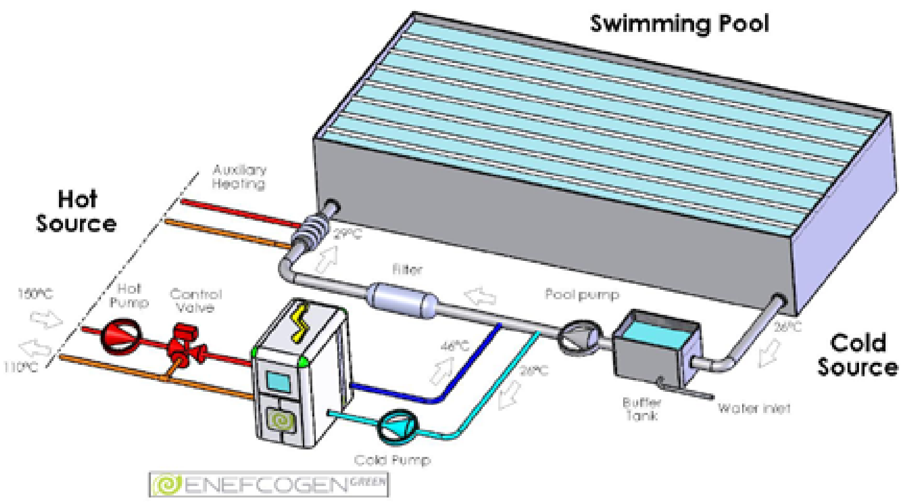


CASE STUDY

District heating for a swimming pool

Lausanne, Switzerland

District heating is the heat source for a unit installed in October 2010 which generates 15 kW electricity and 150 kW thermal energy to heat the pool water. It operates at 90% efficiency and is effective because of the high temperature difference between the input from the district heating system (150 °C) and the low temperature required to heat the pool (30 °C). The installation replaces pool heating direct from the district heating system.



Energy supply: Discussion, prioritization and next steps

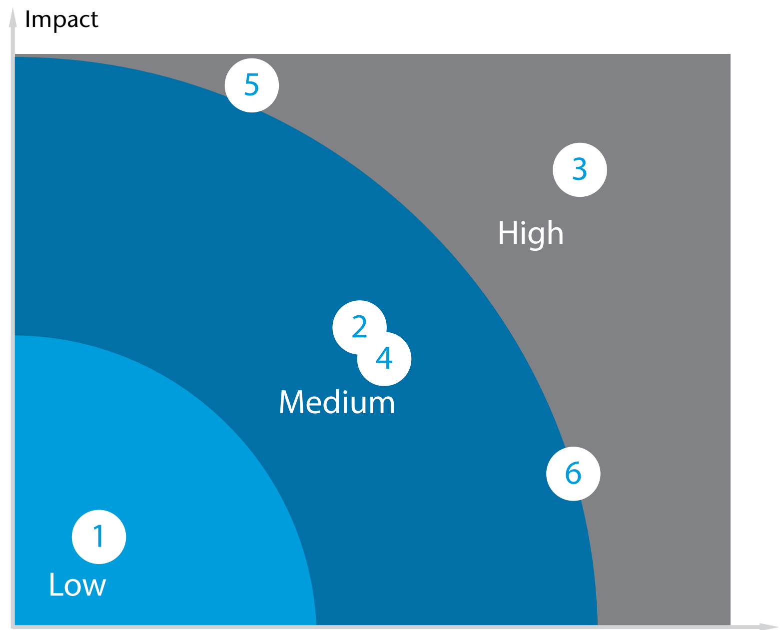
Biogas is the most promising of these ideas, and Turku is already exploring the potential, with the aim of producing fuel for public transport and other vehicles. A smart grid for Turku would have a high impact but will require extensive investigations, but the energy company has begun to install smart meters which are an important component of a smart grid. Carrying out a material flow analysis, perhaps on one of the City's own departments, seems quite practicable but may not have a huge impact on environmental performance.

These were the three ideas with the highest priority. The potential for ground-source heat pumps may be limited by housing densities but the city needs to develop policies on drilling bore holes, given the impact of drilling on one property affecting the potential on neighboring land.

Micro CHP cannot be used in conjunction with district heating in Turku because the water temperature is not high enough.

The chart shows how city officials prioritized the six ideas, based on their overall impact on the city and how applicable or practical they would be. The table summarizes the discussion and the next steps for the city in each case.

Figure 5: Prioritization of the six ideas on energy supply



Note:

Impact summarizes factors such as expected reduction of CO_2 emissions, costs and other environmental and social factors.

Ease of implementation summarizes factors such as expected implementation costs, regulatory and political hurdles, implementation timeframe.

Table 4: Energy supply - discussion and analysis summary

Opportunity	Considerations	Next steps
circled numbers refer to the prioritization chart above		
High priority		
Biogas (3)	▪ Project already underway	▪ Exchange information on best practices ▪ Research the potential market and solutions
Smart grid (5)	▪ Tough to do but would have a big impact ▪ Meters already being installed	▪ Research practices of other cities
Material flow analysis (6)	▪ Could be appropriate to city's own operations or specific area such as biowaste	▪ Consider if there is an appropriate model
Medium priority		
Geothermal /ground heat (2)	▪ Extending district heating to single family homes is more important	▪ Develop policy governing boreholes
Heat machines and chillers (see also Energy Use) (4)	▪ Pattern of heating and cooling demand in Turku limits applicability ▪ Turku Energia is studying the potential	▪ Need to understand full potential
Low priority		
Micro CHP (1)	▪ Inapplicable due to district heating water temperature	▪ none

Theme 3:

Energy use

The issue for the city

Turku aims to improve the energy efficiency of its own operations by 9% by 2016 and 20% by 2020. An agreement with the Ministry of Employment and Economy commits the city to advance energy efficiency and the use of renewable energy sources.

The city is already making progress towards these goals. For example, energy service company (ESCO) agreements cover energy efficiency investments financed by the savings made. Changing people's behavior is a big challenge but co-operation with other cities is producing communications on energy efficiency which are beginning to change attitudes and behavior. The energy company is also promoting energy saving actions and there is plenty of interest in new technical solutions, which will also support behavior changes.

The UII response: Ideas for more sustainable energy supply

1. Heat machines and chillers (see also Energy supply)

As explained earlier, these machines capture heat that would otherwise be wasted and use it to warm water for district heating and other purposes.

While there is generally an imbalance of demand for heating and cooling, several types of activity and installation require continual cooling, including data centers, industrial activities, cold rooms and other refrigerated areas, hotels and spas.

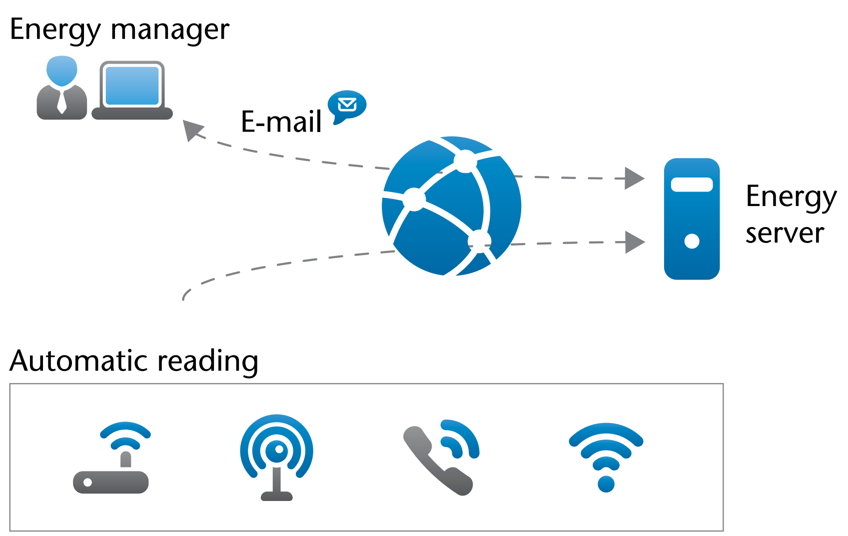
Turku Energia has estimated 200GW potential for energy recovery in the city and preliminary studies are underway.

2. Heat metering and management

Information is power and that applies when it comes to managing power and saving energy. Many organizations find that collating information on energy use is difficult because the data comes from different sources and systems that do not communicate with each other.

A metering and management system brings together all relevant data and makes it available in energy reports that can be retrieved with a standard internet-connected PC or can be emailed as necessary.

Figure 6: Metering and management system



Data collection can be automated, especially with new smart meters and the system can be proactive in alerting users when usage is approaching and exceeding desired limits.

3. Building control and management

Building Automation and Control network (BACnet) enables electronic communication between equipment from different manufacturers so that building and energy managers can collect and report information across different systems.

It is an open communication protocol for the management and automation of systems such as HVAC, lighting, security and fire safety. It has been developed through co-operation between users and manufacturers of building management systems, under the auspices of ASHRAE, the American Society of Heating, Refrigeration and Air-Conditioning Engineers.

The consortium has more than 500 members worldwide and 80 in Europe, including Vacon and VTT in Finland. Leading manufacturers include ABB, Honeywell, Siemens and Johnson Controls.

BACnet is currently used to manage comfort and lighting controls but with internet links to weather forecasts it will be possible to incorporate a more sophisticated approach to save energy. For example, overnight heating or cooling could anticipate the expected conditions on the following day, avoiding unnecessary energy consumption. It is unlikely to be practical to install in existing buildings except as part of a major renovation.

4. Municipal energy management

Some cities have realized that a management focus on energy is necessary to achieve policy goals.

Cities such as Turku perform a range of functions – as policy-maker, supplier and consumer. They own a diverse collection of buildings and other energy consuming operations, which are controlled by a variety of decision-making bodies. Energy budgets may not be consolidated.

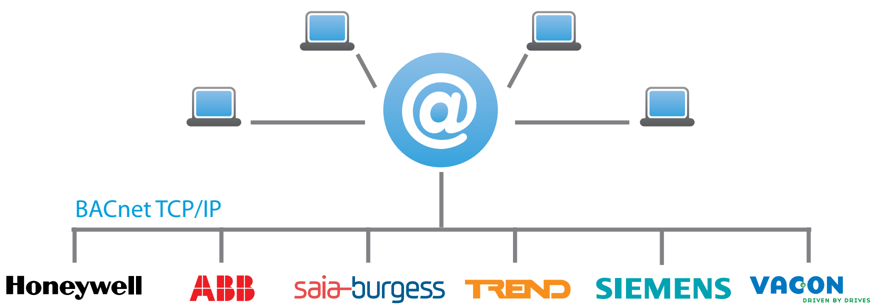
A coherent management approach can help to achieve effective action across these different structures. It can improve understanding, planning and control of energy consumption in each of the city's consumption centers – public lighting, public buildings and municipal facilities.

CASE STUDY

Use of BACnet

Tampere, Finland

TAKK, the Finnish training and development service, is using BACnet at its Tampere training center to link equipment from five manufacturers. Data from all the equipment can now be monitored on one terminal, with common, consolidated reporting.



An energy management structure is overseen by an Energy Committee of the city council with members from finance, technical services, environment and other relevant functions. The Energy Committee determines the municipal energy policy, sets objectives and monitors progress.

This committee appoints an energy manager responsible for day-to-day management across the city to achieve the policy goals. This will include proposing energy saving projects, coordinating action across departments, reporting progress and running public awareness campaigns on saving energy.

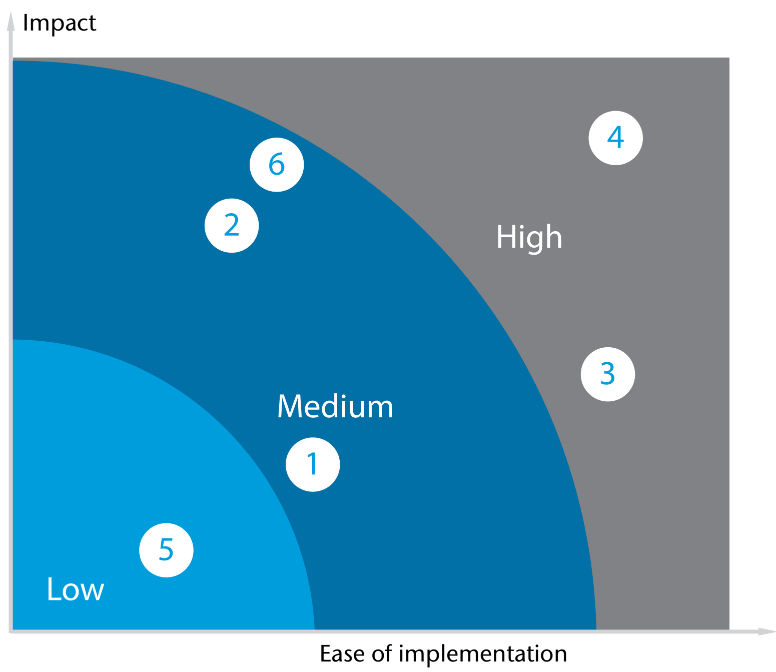
The energy manager can use special software to analyze and report performance. For example, the regional energy agency in Catalonia provides free energy accounting software called WinCEM. Users have achieved energy savings between 3% and 7%.

5. Public lighting

Turku aims to reduce energy consumption of public lighting by 32% by 2020. Several technical and operational options can achieve this goal, including:

- Substitution of mercury-vapor lamps with more efficient sodium-vapor lamps, achieving typical energy savings of 22%
- Introduction of LED technology, optical fiber or metal halide lamps, which are more efficient than mercury-vapor and produce similar white light
- Substitution of the on/off switching systems with modular clocks which respond to local daylight times, typically saving 5% energy
- Remote centralized control of the public lighting system, which can be expected to save between 3% and 7% of energy
- Reduction of reactive energy, which is wasted because it is not directly linked to producing light

Figure 7: Prioritization of the six ideas on energy use



Note:
Impact summarizes factors such as expected reduction of CO_2 emissions, costs and other environmental and social factors.

Ease of implementation summarizes factors such as expected implementation costs, regulatory and political hurdles, implementation timeframe

6. Performance contracting (with ESCOs)

Energy Service Companies (ESCOs) agree on a contract with the city to manage specified sites or activities, such as public buildings or lighting. The contract stipulates a maximum energy consumption and any savings below that level are shared between the ESCO and the city. The ESCO incurs the additional energy cost if consumption exceeds the maximum.

The ESCO contract may include improvement targets as well as an initial consumption limit. In that case the maximum contracted consumption will reduce over the contract period. To achieve this reduction the ESCO will need to engage users (in the case of buildings and other facilities) to inform people about energy-saving activity and encourage changes in behavior.

Table 5: Energy use - discussion and analysis summary

Opportunity	Considerations	Next steps
Circled numbers refer to the prioritization chart above		
High priority		
Building control and management (3)	▪ Possible link eventually to smart grid development ▪ Appropriate for new buildings and renovations ▪ Operated by ESCO	▪ Check specifications for new build and renovations ▪ Develop policy requirement
Municipal energy management (4)	▪ Individual parts of the system are in place but not in a coherent structure ▪ Currently no feedback to building users	▪ Review models in other cities and apply to Turku
Medium priority		
Heat machines and chillers (1)	▪ Maybe heating and cooling demand don't match sufficiently ▪ Turku Energia estimates 200 GW potential and pilot study is underway ▪ Possible opportunity to encourage use in private sector	▪ Link with ongoing activities of Turku Energia company
Utility metering and management (2)	▪ Monthly monitoring of city property already happens – will be online ▪ Need more management information and feedback to building users ▪ Variable pricing is necessary to make it worthwhile for users to respond	▪ Conceptualize how to maximize effectiveness
Performance contracting (6)	▪ Turku has pioneered ESCO contracts in Finland	▪ Communicate existing activity ▪ Encourage use in private sector ▪ Consider for rented apartment blocks ▪ Clarify impact achieved so far
Low priority		
Public lighting (5)	▪ Plans already in place to phase out mercury, including ESCO contract	▪ Communicate what is already being done

Energy use: Discussion, prioritization and next steps

Building controls and a municipal energy management structure are the most promising of these ideas for Turku. The city could benefit from a clear policy on building-control systems for new buildings and major renovations, and could achieve more coherent management of energy issues by creating clear governance and management for energy across the city's many activities. City officials believe such a coherent approach would have the greatest impact of all the six ideas UII presented.

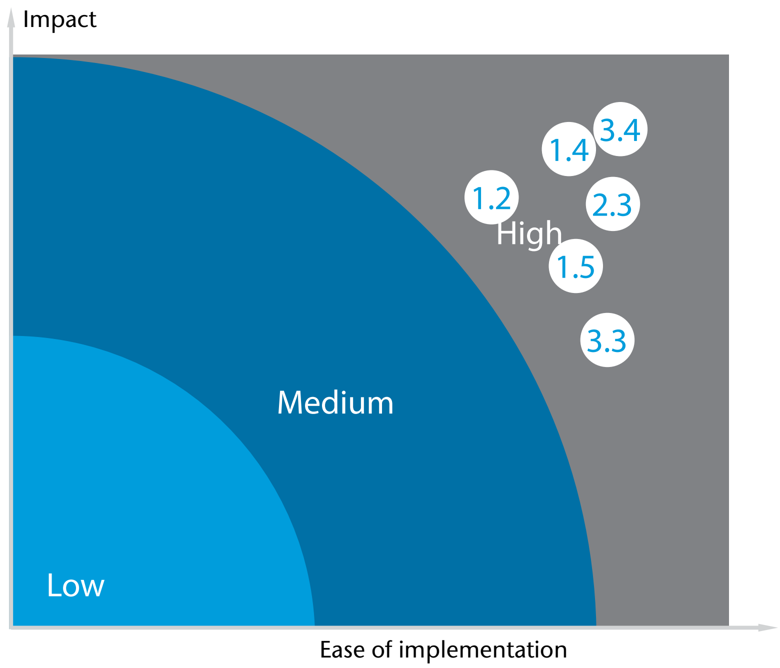
They also value performance contracting but this is only a medium priority because Turku has pioneered the use of ESCOs in Finland. The significant action already taken also explains the low priority given to public lighting. The energy-saving potential is recognized but there is limited potential to do more than is already underway. In both these cases the city could step up communications of what is being achieved.

Of the other medium priorities, utility metering and management is likely to have the greatest impact. Reporting is already quite advanced but better feedback to users could help to increase energy savings. The potential for heat machines and chillers is relatively limited but a pilot study is underway.

The chart shows how city officials prioritized the six ideas, based on their overall impact on the city and how applicable or practical they would be. The table summarizes the discussion and the next steps for the city in each case.

The opportunities for Turku

Figure 8: The six most promising short term ideas for Turku



The chart on the right illustrates the most promising ideas for Turku based on the analysis above. It shows the ideas from each of the three thematic clusters judged by city participants in the workshops to have the most impact and greatest applicability to the city.

Action relating to all these ideas can begin now, without the need for in-depth studies, lengthy consultation, political or financial negotiation. The next steps identified during the workshops are summarized below for each idea.

Green logistics – 1.2

- Consider how to combine private with public logistics
- Learn from others, especially failures
- Include logistics in city traffic plan now being prepared

Traffic management systems – 1.4

- Provide information about routes, current conditions at bus stops etc as well as on internet, including screens in major buildings
- Consider a car sharing scheme

Green procurement – 1.5

- Clarify what the city is going to do and what is for the private sector
- 'Peer reviews' by cities in other countries

Biogas – 2.3

- Exchange information on best practices
- Research the potential market and solutions

Building control and management – 3.3

- Check specifications for new buildings and renovations
- Develop policy requirement

Municipal energy management – 3.4

- Review models in other cities and apply to Turku

Longer term action

Some ideas discussed in the workshops would achieve a significant impact on the city but are not immediately actionable. They require substantial further study, extensive debate and/or require major funding. The next steps for each of these items are shown below.

Light rail – 1.1

- Research relative environmental impacts compared to other modes
- Study financial implications, especially re land values
- Investigate public-private partnership potential

Public-private partnerships – 1.6

- Look at examples elsewhere, including Australia

Smart grid – 2.5

- Research practices of other cities

Conclusion

We have presented these ideas singly but there are linkages between several. For example, public-private partnerships and performance contracting could be relevant to light rail, smart grid and traffic management systems. Indeed, one of the aims of the UII is to create cross-cutting initiatives that bridge conventional "silos" or functional specialties.

The most promising ideas cut across several themes. Some, such as public-private partnerships, are enabling factors. Some are primarily concerned with applying ICT to city energy efficiency. Some are more politically oriented while others are primarily technical or organizational. Many are concerned with the city's own action but opportunities also exist to promote sustainability and change citizens' energy use.

Taken together, these ideas can help Turku to accelerate its journey to become a more sustainable city.

Appendix – workshop participants

From Turku	From UII
All sessions	
Risto Veivo, Office of the deputy mayor (organizer for the city) Jouko Turto, Infrastructure and real estate Mikko Jokinen, Environment Paula Väisänen, Valonia	**Siemens:** Volker Hessel (moderator) **WBCSD:** Sophie Paul, Roger Cowe (consultant)
Transport and logistics	
Public transport: Sirpa Korte, **Sustainable Mobility:** Juuso Puli, Paula Välsänen **Traffic planning:** Jaana Mäkinen, Matti Salonen **Town planning:** Christina Hovi **Union of Baltic Cities:** Björn Grö **Valonia:** Juuso Pulli	**Siemens:** Dimitrios Andrikos, Mathias Hoffman, Torsten Kleiss, Pekka Kuronen, Pekka Moilainen **TNT:** Petteri Aaltonen, Are Blomqvist, Perry Heijne, Arja Kallio, **Toyota:** Didier Stevens
Energy supply	
Building supervision: Reima Ojala **Sustainable Energy:** Anne Ahtiainen **Turku Energia:** Minna Niemelä, Risto Vaittinen **Union of Baltic Cities:** Björn Grönholm	**Acciona:** Loredana Donatelli **GDF SUEZ:** Charles-Emile Hubert, Bertrand Porquet, Anne Prieur-Vernat **Siemens:** Marku Vasara **UTC Technologies:** Teppo Tuijula
Energy use	
Energy efficiency and ESCO: Juhani Korte **Facilities:** Mikko Lehtinen **Sustainable Energy:** Anne Ahtiainen, Liisa Harjula **Turku Energia:** Minna Niemelä	**Acciona:** Carlos Basté, Loredana Donatelli **GDF SUEZ:** Charles-Emile Hubert, Bertrand Porquet, Anne Prieur-Vernat **Siemens:** Marku Vasara **UTC Technologies:** Teppo Tuijula

Other UII companies (not participating in the UII Turku workshop):

AECOM, AGC, CEMEX, EDF, Honda, Nissan, Philips, TEPCO

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Co-chairs

CEMEX — A global building materials company that provides high-quality products and sustainable solutions to customers and communities in more than 50 countries throughout the world

GDF SUEZ — Provider of highly efficient and innovative solutions to individuals, cities and businesses in the sectors of electricity, natural gas as well as energy efficiency and environmental services

SIEMENS — Global partner for cities when it comes to the sustainable development of urban infrastructures with green, efficient products, solutions and financing models

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Members

acciona — A leader in the creation, development and management of renewable energy, sustainable infrastructure and water services, contributing actively to sustainable development

AECOM — A provider of professional, technical and management support services, working to enhance and sustain the world's built, natural and social environments

AGC — A global materials and components supplier based on core technologies of glass, fluorine chemistry, ceramics and related fields

eDF — A leading player in the energy industry, active in all areas of the electricity value chain, from generation to energy supply, trading and network management, with expanding operations in the natural gas chain

HONDA — The world's largest motorcycle manufacturer and a leading automaker, providing a wide variety of products, ranging from mobility to power and clean energy production products

NISSAN — A global manufacturer of automotive products and marine equipment, and provider of related services

PHILIPS — A diversified health and well-being company, serving professional and consumer markets in healthcare, lifestyle and lighting

Schneider Electric — A global leader in energy management that provides solutions to make energy safe, reliable, efficient, productive and green in homes, buildings, industrial facilities, data centers and across the electrical networks

TNT — A leading company in the transfer of goods and documents around the world with a focus on time- and day-definite service

TOYOTA — A global vehicle manufacturer contributing to the sustainable development of society through manufacturing and provision of innovative and quality products and services

United Technologies — A provider of high technology products and services to the commercial building and aerospace industries worldwide including Carrier, Otis, Fire & Security, UTC Power, Pratt & Whitney, Hamilton Sundstrand and Sikorsky

About the WBCSD

The WBCSD is a CEO-led, global coalition of some 200 companies advocating for progress on sustainable development. Its mission is to be a catalyst for innovation and sustainable growth in a world where resources are increasingly limited. The Council provides a platform for companies to share experiences and best practices on sustainable development issues and advocate for their implementation, working with governments, non-governmental and intergovernmental organizations. The membership has annual revenues of USD 7 trillion, spans more than 35 countries and represents 20 major industrial sectors. The Council also benefits from a network of 60 national and regional business councils and partner organizations, a majority of which are based in developing countries.

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Disclaimer

This publication is released in the name of the WBCSD. Like other WBCSD publications, it is the result of a collaborative effort by UII senior executives and members of the secretariat. UII members reviewed drafts, thereby ensuring that the document broadly represents the perspective of the WBCSD membership.

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