ECA cities face unprecedented transitional challenges and environmental legacy issues. Formerly thriving cities, once fueled by heavy industry, are suffering from declining industrial production that brings waves of high unemployment and leaves behind environmental contamination. The resulting demographic decline generates underused urban spaces and high concentrations of poor households in neighborhoods that are now largely abandoned. Cities throughout the ECA region are also struggling with the financial dry-out linked to economic and demographic decline: they have fewer resources but they must figure out how to maintain formerly subsidized municipal infrastructure that served more businesses and people.

Cities in the developed world (particularly in Western Europe) have already had to deal with some of the challenges that ECA cities are now encountering, and many have come up with innovative solutions. Copenhagen and Stockholm (which were the cities visited during the workshop) are a case in point. While in many respects these cities are idiosyncratic (e.g. local authorities enjoy a lot of discretion and power in shaping local policies and influencing development patterns), they have developed sustainable development solutions with universal application. These solutions can be particular to individual sectors, or cross-cutting:

- **Cross-sectoral** approaches have been fostered both through integrated planning and visioning (setting out sustainable futures for the cities), and through holistic development approaches. The City of Copenhagen plans to become carbon-neutral by 2025, by pushing policies and investments in a number of key areas. The Hammarby Sjostad development in Stockholm is an example of how the communities of tomorrow can not only become more environmentally friendly, but also more self-sufficient (by generating an important share of needed energy, heat, and cooling). In both cases, clear and coherent policies applied across sectors have been key success factors for integrated approaches to work.

- In the **Buildings** sector, both Copenhagen and Stockholm promote a policy of inward city development, taking advantage of land and space available in already developed area. Thus they encourage: *the redevelopment of brownfields; in-fill developments* (making best use of space available around existing buildings); *3D properties* (changing zoning and land-use regulations to allow the roofs of buildings to be used for further upward development); and *development over urban “dead” zones* (such as railway yards and above railway lines). In addition, the cities encourage dense developments around transit hubs (which in turn encourage people to choose public transportation more often, by having large office buildings and apartment buildings close to transit hubs), they promote energy efficiency in
buildings, and they actively invest in making municipal buildings more energy efficient.

- In the Energy sector, there has been a push to shift from using fossil fuels in energy production (particularly coal), to using renewable sources of energy (e.g. windmills, biomass, solid waste). These measures were doubled by a shift to district heating, by using biogas from wastewater treatment plants for energy production, and by improving street lighting.

- In the Transport sector, significant efforts have been invested in encouraging the efficient use of private cars (e.g. car pooling, and energy efficient cars – hybrids, electric), and in encouraging public transportation options, biking, and walking. Some solutions include the Green Wave in Copenhagen, which allows bikers to enjoy fewer stops at intersections and lower commuting times, parking restrictions, congestions charges, and the creation of environment zones (where only environmental friendly cars are allowed) in center cities. In addition, sustainable modes of transportation are encouraged through integrated metropolitan approaches, which allow for a seamless combination of trips on bus, train, metro, bike, and foot.

- In the Solid Waste sector, a major shift has been made to optimize waste reduction, reuse, and recycling. Waste disposal in landfills has been minimized and increasingly, residual waste is being used as fuel for generating heat and electricity. These efforts are accompanied by ambitious education campaigns aimed at instilling strong environmental consciousness and habits – particularly among the young generation.

- In the Water and Wastewater sector, Copenhagen has promoted environmental standards that make the discharge water safe for swimming (the inner city harbor has in fact public swimming areas). In Stockholm, sewage sludge is used to generate biogas – which is used to power part of the local bus fleet, as well as taxis and private cars.

- In terms of Urban Forestry, both cities have taken a string commitment to protecting urban green areas as much as possible from future development, and to increasing people’s access to green spaces and to the waterfront. Around 30% of Stockholm’s area is covered by green space, with unbroken green wedges extending to the heart of the city. In Copenhagen, cemeteries also function as recreational parks.

Overall, participants found the workshop to have been very enlightening. Presentations in Copenhagen and Stockholm, as well as field trips, showcased a number of best practices. Some of the principles and policies that resonated most with participants include:
- **Policy matters.** Achieving sustainable development across the economic, social, and environmental dimensions (the “triple bottom-line”) requires a deep interplay between market solutions and careful public sector planning and intervention. Policies and regulations, if crafted based on an extended platform (engaging all stakeholders and citizens), are critical to steer the market away from negative externalities, stimulate technological innovation, and cultivate cooperation among localities as well as social integration. It is essential that legislation and regulation are enforced evenly and forcefully across the board. Both Danish and Swedish governments have enacted tough legislation on environmental protection, backed by targeted taxes and subsidies to influence financial incentives, thereby forcing their private sector to think innovatively and dynamically. This in turn has put them among the leading league in tackling issues like sustainable generation of energy, energy efficiency, district heating, waste water treatment and waste management.

- **Local and national cooperation is key:** Local decisions are essential to shape development patterns which have lasting impacts on sustainability. Local authorities should have the levers (i.e. planning and zoning functions, and powers to devise and enforce local environmental standards beyond national standards) and resources (fiscal and human capacity) to effect policy changes. On the other hand, national policies and interventions are key to provide with localities an enabling environment, and to maintain a long-term, and cross-jurisdictional perspective for urban sustainability (see roles of National Environment Agency and Energy Agency in Sweden).

- **A clear city vision supported by cross-sectoral strategies.** Both Copenhagen and Stockholm organize themselves around clear visions, supported by multi-sectoral strategies, and time-bound action plans, as well as strong political will to implement those strategies. A city-based, cross-sectoral approach delivers greater efficiency and increased utility for each investment through a comprehensive approach that evaluates the contribution to the whole and creates synergy across sectors. This approach avoids the ‘lock in effect’ that often results from single-sector interventions.

- **Application of an investment framework and project appraisal methodology derived from the three pillars of sustainability:** economic, environmental, and social development. It values long term environmental and social benefits, rather than merely economic and financial returns (which may be negative in the short term).
**Objective.** The objective of the study tour was to bring together World Bank staff (HQ and country offices) and local authorities from ECA cities, and learn about best practices in sustainable development from two of the world’s most innovative and forward-thinking cities – Copenhagen and Stockholm. The study tour also provided an opportunity for World Bank staff to interact with potential clients (mayors, vice-mayors, and local and national representatives) and better understand future development needs of ECA cities, as well as avenues for continued Bank involvement.

**Background and program agenda.** ECA cities face unprecedented transitional challenges and environmental legacy issues. Formerly thriving cities, once fueled by heavy industry, are suffering from declining industrial production that brings waves of high unemployment and leaves behind environmental contamination. The resulting demographic decline generates underused urban spaces and high concentrations of poor households in neighborhoods that are now largely abandoned. Cities throughout the ECA region are also struggling with the financial dry-out linked to economic and demographic decline: they have fewer resources but they must figure out how to maintain formerly subsidized municipal infrastructure that served more businesses and people. Meanwhile, municipal per capita spending continues an upward spiral due to the high fixed cost; and low energy-efficiency only adds to the bill. Against this backdrop of turbulent economic and demographic transformation, cities are forced to confront pervasive and growing environmental threats. First, from the substantial legacy of industrial pollution from heavy industry that frequently operated in cities with inadequate environmental oversight; second, from flawed privatization processes during the early years of transition that rarely considered environmental liabilities; and third, from the rising trend of vehicle ownership among urban populations as economies have recovered, that now contribute to air quality problems.

Addressing these challenges will require both novel and old ideas from ECA cities. In many respects, these cities have been better equipped to address environmental challenges before 1989, than they are today. Many cities had functioning recycling networks, urban development was highly controlled and new dwellings tended to be high density, urban public transportation networks were fairly well developed and tended to cover the entire city space, district heating networks were the norm in most cities, and certain environmental amenities (e.g. urban parks) were accessible to most residents. However, many of these programs were not financially sustainable and relied on expensive subsidies. The transition to a market economy has confronted most of these cities with fiscal constraints and profound institutional change. Furthermore, in a haste to make the transition as swift as possible, practices that were deemed to be remnants of a by-gone era (e.g. strict land use planning, integrated service provision solutions, and any restrictions on private property) were quickly discarded, with a focus on decentralization and market driven solution.
As the examples drawn from Copenhagen and Stockholm will show however, achieving sustainable development across the economic, social, and environmental dimension (the “triple bottom-line”) requires a deep interplay between market solutions and careful public planning and intervention. Thus, while localities are better off competing with each other on certain issues, they are better served if they cooperate on others.

In what follows we will look at some of the sustainable development solutions these two cities have identified, and ways in which they have prepared themselves for the challenges of tomorrow. We will look in particular at best practices (in terms of policy and regulation, and investments) in a number of sectors: buildings, energy, transport, solid waste, water and wastewater, and urban forestry. First, however, we will do an overview of cross-cutting approaches that combined best-practices in two or more sectors.

CROSS-SECTORAL

These approaches allow synergies to unfold as benefits in one sector can spill-over into another sector (e.g. an integrated public transportation system can encourage high density buildings development around the main transit hubs, reduce commuting time, congestion, and contribute to better air quality and pedestrian environment).

Policy and Regulation

Innovations and investments in individual sectors can create synergies when done in a holistic manner, with an eye to the larger picture. The main way Copenhagen and Stockholm have achieved this is through integrated city plans based on agreed city visions, and through integrated model developments and redevelopments that encouraged synergies across sectors. For example, Copenhagen’s Climate Plan includes 50 intertwined initiatives in six major areas (see image below), which are hoped to contribute to making Copenhagen carbon neutral by 2025.

The largest share of GHG emissions in Copenhagen comes from the consumption of electricity and heating, with 73% of electricity in Copenhagen being generated by coal. Consequently, local authorities are looking to join forces with energy companies and jointly achieve a positive environmental impact by gradually switching from fossil fuels...
to renewable energy sources. Initiatives in this field include: the use of biomass in power stations, an increased reliance of wind turbines and windmill parks, the use of geothermal power, and renovation of the district heating network.

### A Scenario for Copenhagen as a Carbon Neutral City*

<table>
<thead>
<tr>
<th>Measures for 2025</th>
<th>Reduction Potential (tons CO2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Savings</td>
<td>230,000</td>
</tr>
<tr>
<td>Energy Savings in the Municipality’s Own Operations</td>
<td>19,000</td>
</tr>
<tr>
<td>Conversion of Biomass</td>
<td>300,000</td>
</tr>
<tr>
<td>Geothermal Power</td>
<td>25,000</td>
</tr>
<tr>
<td>Solar Heating</td>
<td>1,000</td>
</tr>
<tr>
<td>Heat Pumps and Electrical Elements</td>
<td>65,000</td>
</tr>
<tr>
<td>Improved Waste Separation</td>
<td>9,000</td>
</tr>
<tr>
<td>Increased Windmill Capacity</td>
<td>925,000</td>
</tr>
<tr>
<td>Urban Development</td>
<td>30,000</td>
</tr>
<tr>
<td>Reduced Road Traffic</td>
<td>150,000</td>
</tr>
</tbody>
</table>

*The Potential of these measures are calculated using 2005 CO2 emissions as the baseline. The combined effect of all measures is smaller than the sum of the individual contributions.

Source: The City of Copenhagen. 2009. Copenhagen Climate Plan

Significant emissions reductions are also expected from changes in the transport sector. Copenhagen is already known as one of the world’s most bicycle friendly cities, and plans are made to make it even more so. New investments are hoped to improve existing bike paths, extend green bike routes, create new pedestrian and bicycle bridges, and offer better bicycle parking near public transit stations. Public transportation options and service quality are also to be improved, while companies that operate buses are expected to reduce CO$_2$ emissions by 25%.

34 of the 50 initiatives have already been initiated, and there is quarterly follow-up and yearly reporting on the status of the City’s Green Accounts.

The Vision of the City of Stockholm is to become a World-class city. The newly adopted Strategic Plan lays out four strategies for achieving sustainable urban growth in Stockholm: 1) Strengthen central Stockholm; (2) Focus on Strategic Nodes; (3) Connect city areas; and (4) Create a vibrant urban environment. These four strategies, by nature, are spatial, and call for cross-sectoral interventions.

At the regional level, the County of Stockholm has recently completed its four year regional planning endeavor. Given the expected population growth, local authorities in the Stockholm metropolitan area have set out to create most attractive metropolitan region with a good living environment (with clean air and clean water), and a region that
is resource-efficient (with sound urban development, integrated transport systems, and green infrastructure).

**Investments**

The Swedish Environmental Protection Agency (SEPA) offers a number of grants for innovations that will help reduce GHG emissions. Thus, it is hoped that between 2008-2012 GHG emissions will be lowered by 4% compared to 1990 levels. Furthermore, by 2020, emissions from activities that are not included in the EU Emissions Trading Scheme are hoped to be reduced by 40%. Within Stockholm, SEPA funded 26 environmental projects from 2004 to 2008, offering more than $13.5 million in grants. Funded projects include the Hammarby Sjostad brownfield redevelopment and Biogas from Sewage Sludge.

**The Hammarby Model (Stockholm)**


The Hammarby Sjostad redevelopment includes a number of sustainability best practices, and is a good case for how cross-sectoral thinking has led to an integrated model that makes use of flows and synergies between different areas of the project (see image below). The site itself is a former brownfield, which was remediated to permit housing development close-in to the city.
To produce energy, combustible waste is converted into district heating and electricity. The heat from the treated wastewater is converted into district heating and cooling. Solar energy is converted into electrical energy or used to heat water.

To evaluate innovative water and wastewater treatment techniques, a pilot sewage treatment plant was built on site. Biogas is extracted after the processing of sewage sludge, and rainwater from streets is filtered locally (settled and then drained into lake Hammarby, rather than being funneled through the wastewater treatment plant). Green roofs (with sedum plants) on some of the buildings are designed to collect rainwater, delaying and evaporating it.

On waste management, an underground waste disposal system takes care both of waste sorting and waste transportation (a system of tubes takes the waste directly to district heating facility). All recyclable materials are recycled: newspapers, glass, cardboard, metals, etc. Organic waste is converted/digested into biosolids and used as fertilizer.

All of these improvements and innovations are hoped to reduce the environmental impact by half, compared to level registered in other newly constructed housing.

Hammarby Sjostad Redevelopment


Source: Yan Zhang
The planned North Harbor development, Copenhagen

The planned North Harbor development aims to incorporate a number of sustainability principles: developing compact neighborhoods around public transit hubs, making development bike and walk friendly, creating access to green areas and to water, using alternative sources of energy to power the community, reusing and recycling waste, reusing generated heat, using harbor water for cooling of buildings, and connecting the new “urban delta” to the rest of the city. By 2025 (when Copenhagen is to become carbon neutral) the development is hoped to be a net exporter of energy (see image below).

BUILDINGS

In many ECA cities, land development and construction was strictly controlled by the state before 1989, and suburban development was not an issue until recently. However, as ECA economies have started to develop, and as people have started to have more expendable income, there has been a shift in people’s housing preferences – many are not content with panel housing apartments anymore, and look to develop detached housing units in suburban areas. Furthermore, even if many ECA cities currently have declining populations (as a result of lower birth rates and outmigration), there still is a high unmet housing demand. Consequently, ECA cities are spreading outward – most often in an unsustainable fashion.

As these cities are expanding, many old communist neighborhoods are left to fall into a state of desuetude. They are poorly insulated and are served by old and degraded service networks (e.g. leaking water and wastewater pipes and under-scaled electricity networks). Their environmental coefficient is likely to suffer in coming years, as much of the heat produced will be lost to the elements through poorly insulated walls. ECA cities can take some good lessons from the two Scandinavian cities as to how their buildings (new or existing) have been developed to contribute to a more sustainable urban future.
**Encouraging dense developments around transit hubs.** In Copenhagen strict regulation guides new developments. New buildings not only have to meet certain energy efficiency requirements (exceeding EU respective requirements), but high density developments (e.g. large apartment buildings, or large office buildings) can go up only
This measure aims to curb reliance on private vehicle use, and encourage the use of public transportation, which in turn contribute to reduction of congestion, improvement of air quality, as well as a more pedestrian friendly environment (Inadvertently, transit oriented developments also encourage walking and biking).

**Brownfields redevelopment.** As can be seen on the last page, most new housing developments in Copenhagen will be close to the city center – closer to work place. In total, over 45,000 new apartments are hoped to accommodate the population growth over the next 25 years, and all housing units are built according to strict design and energy efficiency guidelines.

**Encouraging energy efficiency in buildings.** In addition to encouraging inward high-density development, an emphasis is also placed on energy efficiency in buildings. In Copenhagen, for example, local authorities regulate energy consumption more stringently than imposed by national legislation. Thus, all new buildings have to adhere to strict energy efficiency standards, and existing buildings have to be eco-refurbished. The City owns 5% of the buildings in Copenhagen, and energy efficiency standards in these buildings tend to be even higher.

**Energy fund.** Local authorities in Copenhagen encourage energy efficient buildings not only because of the benefits to the environment, but also out of a conviction that significant savings can be obtained from energy conservation in buildings. With this in mind, the municipality has established an energy fund, fueled by savings from climate upgrading, which will be used to finance upcoming projects.

**Energy efficiency information and education campaigns.** Local authorities in Copenhagen offer targeted training to building owners, renters, trade workers, and consultants on how energy efficiency in buildings can be achieved. They also engage businesses on how energy conservation measures could benefit their (triple) bottom line. The municipality’s homepage offers a ‘hotmapping’ tool, which can be used by interested parties to assess their building’s heat losses.

**Investments**

Land and housing development in Copenhagen and Stockholm are tightly controlled by local governments – through stringent regulation and through large public ownership of land. For example, land owned by the City of Stockholm is leased rather than being sold to developers. This ensures a steady income stream for the city and allows local authorities to steer future development patterns. In recent years the focus has been on

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1 It should be noted that such land use control in other cities with higher growth pressures and without a policy environment favoring overall supply of land sites for development could lead to undue escalation of real estate prices, to the disadvantage of many residents and businesses.
inward development, on reusing idled and underused land, and on increasing the use efficiency of existing land and developments.

Under socialism many ECA cities had (or still have) a dominant role of local or central government in urban land ownership and in direct control of land use (through leasing rather than sale); this legacy is problematic because the governments cannot ensure efficient availability of land for development purposes. ECA cities have been better advised to make the share of publicly owned and controlled land much more limited, but strategic, i.e. so this direct public role in the land market is retained only for essential public purposes. Local governments can still influence the urban land market and private land uses through public auctions, zoning, property taxation, and such measures, without retaining an extensive land portfolio.

**Havnestad Redevelopment in Copenhagen**

The photograph above highlights the adaptive re-use of two existing structures (and iconic representatives of the new developments on Copenhagen’s waterfront), and the redevelopment of former industrial sites (the buildings in the background). All along Copenhagen’s water front, which was dominated by industrial enterprises in the past, housing and office developments are going up – new or rehabilitated – accommodating a growing population in the city.

In Stockholm, future developments are planned to happen around a polycentric model, with high density developments going up around major transit hubs. Municipalities in Sweden have very strong local planning rights, and they often control a large share of the local land and housing markets. This allows them to encourage sustainable building principles. On the other hand, the fact that they control land and housing markets also translates into market backlogs and inefficiencies, with people having to often wait a long time (2 to 3 years) to access new housing in the center. Also, most of the city’s budget is fueled by local income taxes, whereas in other developed cities property-taxes
are the major source of income for localities. In Sweden, property taxes are collected by the central government, which, to some extent, prevents direct competition between individual municipalities.

Stockholm is expected to add 150,000-180,000 citizens by 2030, and it plans to accommodate the newcomers by building inward. In fact, the City Plan adopted in 1999 indicated the need for strategic development in areas near the city center and in areas close to public transportation hubs. At the same time, a strong commitment was made by local authorities to keep and extend urban green areas. Thus, most new developments (see image below) are expected to go on already developed land – through brownfields redevelopment, in-fill development, 3D properties, and development over rail areas.

**Strategic Development Areas in Stockholm’s 1999 City Plan**

![Strategic Development Areas in Stockholm’s 1999 City Plan](source)

Building inward does not only encourage economies of scale in public transportation, solid waste management, water provision, and heating generation, but also helps reduce GHG emissions (e.g. through lower car pollutions and lower energy usage).
**3D properties.** The City of Stockholm introduced an interesting concept – 3D properties, which turn real estate rules on their head by allowing the roofs of buildings to be used for further upward development, even if the additions have a different ‘land-use’. The picture below highlights one such development, where housing was built on top of an office and commercial building. Obviously, land-use and zoning regulations have to provide for “air rights”, to allow such developments to happen. The solution however is novel and interesting, as it allows the maximization of inner city land use, without necessarily changing land-uses (e.g. tearing down an office building to replace it with an apartment complex).

![3D Development in Stockholm](image)


**In-fill development.** Existing development can often accommodate higher densities, through innovative designs and carefully planned infill developments. The City of Stockholm plans to maximize available space in the inner city, while keeping the blocks on a human scale (e.g. skyscraper free). Local authorities in Stockholm acknowledge that allowing higher buildings can ultimately allow higher densities, but height caps are enforced nonetheless – for a variety of reasons (e.g. to keep the overall aspect of the city and because human scale buildings offer a better quality of life).
In-fill Development on a City Block in Stockholm (Before and after renditions)


Development over rail areas. Rail yards and railway lines take up large swaths of land, and prime real estate in center cities. In addition, these areas tend to be eyesores on the city’s landscape. Local authorities in Stockholm plan to utilize this real estate by redeveloping over the railway lines. Prime real estate is thus brought into productive use, and the overall image of the center city is improved (see image below).

Make municipal buildings energy efficient. Within Copenhagen, all of the municipality’s new buildings, as well as all new buildings financed by the municipality, are constructed based on rigorous energy efficiency principles. Furthermore, all of the buildings the municipality rents have to meet these principles, and an open dialogue has been started with national and regional governments about energy upgrades of their buildings in Copenhagen. It is hoped that all energy savings projects will have a pay-back time of less
than 10 years. In addition to energy efficiency principles, new public buildings often follow innovative design principles (see images below).

**Copenhagen Opera**

Source: Yan Zhang

**Copenhagen Theatre**

Source: Yan Zhang

**ENERGY**

Energy production and consumption are responsible for the largest share of GHG emissions. In both developed and developing countries, the transition from fossil fuel usage to renewable resources is an imperative for today, and for the future. Copenhagen and Stockholm are in many respects on the forefront of this transition, with a number of innovative projects.

**Policy and Regulation**

Denmark has a long history of energy policy, which stems from its lack of natural energy sources and the effects of the oil crisis of the 1970's. Denmark chose early on to prioritize energy savings and a diversified energy supply that concentrate on increased use of renewable energy. Under its national energy policies, since 1980, the Danish
The economy has grown by 78%, while energy consumption has remained almost unchanged, exemplifying how sustainable development can go hand in hand with increasing consumption and economic growth.

Both Denmark and Sweden, along with other Nordic countries, are the frontrunners in introducing energy taxes and carbon taxes to successfully put renewable energy sources such as wind, solar and geothermal on a more competitive footing, stimulating their growth.

Sweden has clear national energy policies that aim to create conditions for efficient and sustainable energy use, as well as a cost-effective energy supply with minimum negative impact on health, the environment and the climate. Over the past 30 plus years, Sweden has moved away from fossil fuels and towards renewal energy sources. The national Government set out clear energy targets for the country, including phasing out fossil fuels in heating (2020) and vehicles (2030), and 50% renewable energy by 2020.

Source: Tobias Malmgren, 'The Swedish Energy Agency - The energy system and the sustainable municipality program' PowerPoint Presentation, May 19th, 2010
Sustainable Municipality Program. The Swedish Energy Agency developed and implemented a Sustainable Municipality Program which aims at facilitating municipalities to produce and politically adopt a local energy strategy to integrate energy perspectives in city planning as well as day-to-day work. Furthermore, this program also helps build capacity at municipal level by forming networks and sharing best practices among municipalities. Under this program, subsidies are also available (5-year program, 30 million euro/year) for municipalities to enhance their energy efficiency performance.

Investments

Energy from windmills. Wind is an inexhaustible resource with a potential for reducing the CO₂ emission remarkably, and it is economically beneficial. Upfront investments can be recovered rather quickly, and energy costs for households and businesses can be decreased. Denmark is on the forefront of windmill energy generation, and in Copenhagen alone windmills with a combined output of 300 MW are being built.

Currently, wind energy is one of the most important renewable energy sources in Denmark, and the country was first to set-up an offshore wind farm. From an economic point of view, windfarms have prove to be very lucrative. There are now more than 5,100 wind turbines in Denmark, which produce a total of 3,200 MW (423 MW of which are produced offshore). Around 20% of the Danish electricity supply is provided by wind turbines, and wind energy exports amounted to around 7.2% of total Danish exports. Furthermore, the industry employed over 28,000 people in 2008.
Replacing fossil fuels. In addition to investing in renewable resources, many power plants in Denmark are being converted from coal to less environmentally harmful fuels (biomass, gas, waste). It is hoped that 75% of GHG emissions reductions will be achieved by changing energy supply from coal to biomass and wind-power. This target will be achieved in partnership with energy companies, as local authorities and power providers work closely together. Since municipalities don’t own power plants, and don’t have a direct influence over the choice of fuels, such partnerships are essential to meeting environmental goals.

District heating and cooling. Copenhagen has the world’s largest district heating system, which connects 98% of households. As a result of having a centralized heating system, overall GHG emissions in Copenhagen are thought to have been reduced by 20%, or 610,000 tones of CO₂. Stockholm has a large district heating system, and has introduced in selected areas of the city centre, district cooling systems.

Reuse of solid waste to generate electricity and heat. In both Copenhagen and Stockholm generated waste is used to produce electricity and heat. While GHG emissions are not completely erased by incinerating waste, the solution can generate economic benefits and reduce waste disposed of in landfills – especially where land is scarce, such as in Denmark.

Improving street lighting. In Copenhagen street-lighting was made less CO₂ intensive by switching to more energy efficient lighting and by using LED technology that cuts energy use for lighting in half.

TRANSPORT

While the loss of industrial infrastructure has allowed ECA countries to score well on environmental indicators (almost all ECA countries have registered GHG emissions
decreases from 1990 to 2007), the transport sector has been the main contributor to GHG emissions increases.²

The same is valid in developed cities like Copenhagen and Stockholm. Consequently, many sustainable development initiatives in these two cities have happened in the transport sector. Most of these initiative look to encourage the use of environmentally friendly transportation means – public transit, walking, and biking.

Policy and Regulation

In addition to key investments the municipality has also created a strong brand that portrays Copenhagen as the city of bicyclists (see below).

Other environmentally freindly measures in the transport sector include:

Congestion charges. Those are already successfully functioning in Stockholm (with charges being higher during peak commuting hours, relatively lower during high traffic time, and non-existent from 6:30 PM to 6:00 AM). Congestion charges are charged both for incoming and outgoing cars, at a number of entry points around the center city. Plans are made to introduce congestion charges in Copenhagen too.

Creating environment zones in center cities. The City of Copenhagen is lobbying the central government for the right to establish environment zones in the downtown area. In these areas, only environmentally friendly cars and trucks would be allowed.

² However, while GHG emissions from the transport sector have gone up significantly, from 1990 to 2007, in some ECA countries (e.g. The Czech Republic, Romania, Hungary, Croatia, Slovenia), they have registered decreases in some other countries (e.g. Russia, Ukraine, Belarus).
Parking restrictions. Parking restrictions are enforced within the center of Copenhagen. These restrictions encourage people to choose alternatives to car driving, and they are estimated to have reduced GHG emissions by 1%.

Encouraging effective car use. A number of partnerships and publicity campaigns in the City of Copenhagen promote more effective car use – car sharing, car pooling, and climate friendly driving techniques (e.g. less speeding). For example, there are free and specially assigned parking space for car pooling.

Encourage environmentally friendly vehicles. Private citizens and bus and taxi companies in Copenhagen are encouraged to use electrical and hydrogen powered vehicles. Many of those vehicles are expected to run on wind generated energy. The municipality’s vehicle fleet is already converted to hydrogen-powered and electrical cars. In addition, the administration has made provisions for ensuring environmentally friendly transport for its employees – both during working hours and for the commute to and from work. There are also plans to have buses in Copenhagen run on wind generated energy.

In addition, people who drive electric vehicles have access to free and specially assigned parking. Electric charging spots for vehicles and hydrogen fuel stations are available throughout the city.

In Stockholm, cars that run on biogas can take advantage of the biogas pump stations that are available throughout the city, and next to the wastewater treatment plants. Biogas is not only more environmentally friendly than conventional gas, but also more economical. A number of buses in Stockholm already run on biogas, and plans are made to increase their share.

Investments

Seamless combination of trips on bus, train, metro, bike. Both Copenhagen and Stockholm look to make it easier for people to make the transfer from one environmentally friendly mode of transport to the other.

Investing in infrastructure for bicycles. Copenhagen, a third of commuters use bicycles to come into the city, a third use public transportation, and a third use their private vehicles. It is hoped that by 2015, half of the commuters will use bicycles. To achieve this, the City invests aggressively in dedicated bicycle lanes.
One of the most important reasons for having dedicated bike lanes is to improve overall safety. In the inner city, bicycle street crossings are delimited by the color blue (see image above), so that car drivers know to be on the lookout for bicyclists. These blue lines are only placed at strategic locations so that drivers do not become too accustomed to them, diminishing their efficacy. Other measures aimed at increasing overall safety for cyclists include: low speed zones; redesigning intersections and streets; narrow cycle lane at intersections; and withdrawn stop lines for cars. While safety is still considered to be an important issue by almost half of all cyclists, bicycle use went up vertiginously in recent years. Thus, more Copenhageners commute by bike today than they do by car (see graph below).

The large majority of people who cycle in Copenhagen (54%) do so because it is easy and fast – 19% do it as a way of exercising, 7% do it because it is convenient, and 6% do it out of financial reasons. Only 1% use bicycles for environmental reasons. This is a clear example of how governments can encourage environmental responsibility by offering the right incentives to their citizens. One of the reasons why biking is easy and fast in Copenhagen is an innovative traffic management measure – green wave through traffic lights for bicycle users (see image below).
Green Wave through Traffic Lights. This measure sets the timing of traffic signals to the speed of bicycles, thereby allowing bicycle users to proceed with minimal delay from traffic lights, while car drivers have to wait. This simple innovation has allowed bicycle users not only to enjoy a ride with fewer stops, but to also increase their overall riding speed, and cut down their travel time. Thus, in many instances it is much more efficient to use a bicycle for commuting in Copenhagen, than it is to use a car.

The Benefits of the Green Wave
Other bicycle friendly features include bikeable promenades, and bicycle and pedestrian bridges. Plans are made to increase the number of such bridges across the harbor in the city center.

**Bikeable Promenade**

All new developments are also built so as to encourage the use of bicycles and public transportation. The planned North Harbor development is a case in point. As can be seen in the image below, public transportation stops are located at key intervals through the development, and all the small islets that make up North Harbor are easily bikable. On the other hand, car traffic is made harder by having one-way streets that zig-zag through the area.


WATER, WASTEWATER, and SOLID WASTE

Policy and Regulation

Both Copenhagen and Stockholm boast innovations in wastewater treatment. Copenhagen is so thorough in treating its wastewater that all of the discharged water is safe enough to swim in. In fact, a public swimming area has been established in the inner city harbor area, which is a crowd pleaser every summer.

Inner City Swimming Area in Copenhagen


A large majority of ECA cities rely on landfills for waste disposal. In the case of Copenhagen and Stockholm, enormous efforts were undertaken to reuse and recycle waste, thereby reducing the volume of waste sent to landfills, and to generate heat and electricity from the landfills. Other measures in this sector included:

Reduce energy from transport of waste. In Copenhagen, energy use from transport of waste is reduced by a third through strict procurement criteria, improved fuel efficiencies, and targeted waste processing.

Education campaigns to reduce and reuse waste. Local authorities in Copenhagen have targeted information campaigns that educate citizens about the short- and long-term benefits of recycling. An emphasis is placed on the young generation, so they will grow up with strong environmental consciousness and habits.

Investments

Generating Biogas from Sewage Sludge. The sewage treatment plants in Stockholm generate biogas from sludge. The gas can be used for heating, energy generation, or as fuel for vehicles. Several public transportation buses in Stockholm run on biogas, and plans are made to increase their share in the overall fleet. Generating biogas from
sewage sludge helps address two important challenges: sustainable wastewater treatment and reducing emissions from fossil fuel. Furthermore, the upfront investment costs needed to equip wastewater treatment plants are relatively small, and operating costs are low.

**Innovation in Sewage and Solid Waste Treatment.** The Hammarby Sjostat redevelopment in Stockholm includes a new sewage treatment plant that will test new treatment processes and technologies. The idea is to create an urban incubator that will allow the development of innovations, which will not only serve Swedish communities, but also become export generators (as the rest of the world will become more environmentally conscious). In Hammarby Sjostad, an underground waste disposal system takes care both of waste sorting and waste transportation (a system of tubes takes the waste directly to district heating facility). In effect, Swedish authorities are hoping to develop the technologies that will become the staple of tomorrow.

**URBAN FORESTRY**

Around 30% of Stockholm’s area is covered by green space, with unbroken green wedges that extend to the heart of the city. Although both Copenhagen and Stockholm have made a commitment to inward city development, the intrusion into existent green space is expected to be minimal. An interesting thing in Copenhagen is that cemeteries also function as recreational parks.
Annex 1 - City Fact Sheets
Annex 2 – Workshop Agenda and Participants