

PROCEEDINGS

11 June 2014



A New Environmental Deal for Airport Regions



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A New Environmental Deal for Airport Regions



Edited by
ARC, Airport Regions Conference

Conference organised by
Akershus County Council
Airport Regions Conference

The New Environmental Deal for Airport Regions
Proceedings of Conference, 11 June 2014

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About the Airport Regions Conference

The Airport Regions Conference (ARC) is an association of regional and local authorities across Europe with an international airport situated within or near its territory.

The ARC brings together a wide range of expertise at the interface of air transport and local and regional policies. A common concern is to balance the economic benefits generated by the airports against their environmental impact, notably the effect on the quality of life of local residents.

The members exchange best practices through ARC network and reflect together on policy challenges ahead. As such the ARC also serves as a platform to express members interests to the European Institutions.

We were delighted to be hosted for our annual general meeting in Oslo Akershus, and we want to share with you the knowledge harvested on that occasion.

Sergi Alegre Calero – ARC president – Vice Mayor El Prat de Llobregat

About Akershus County Council

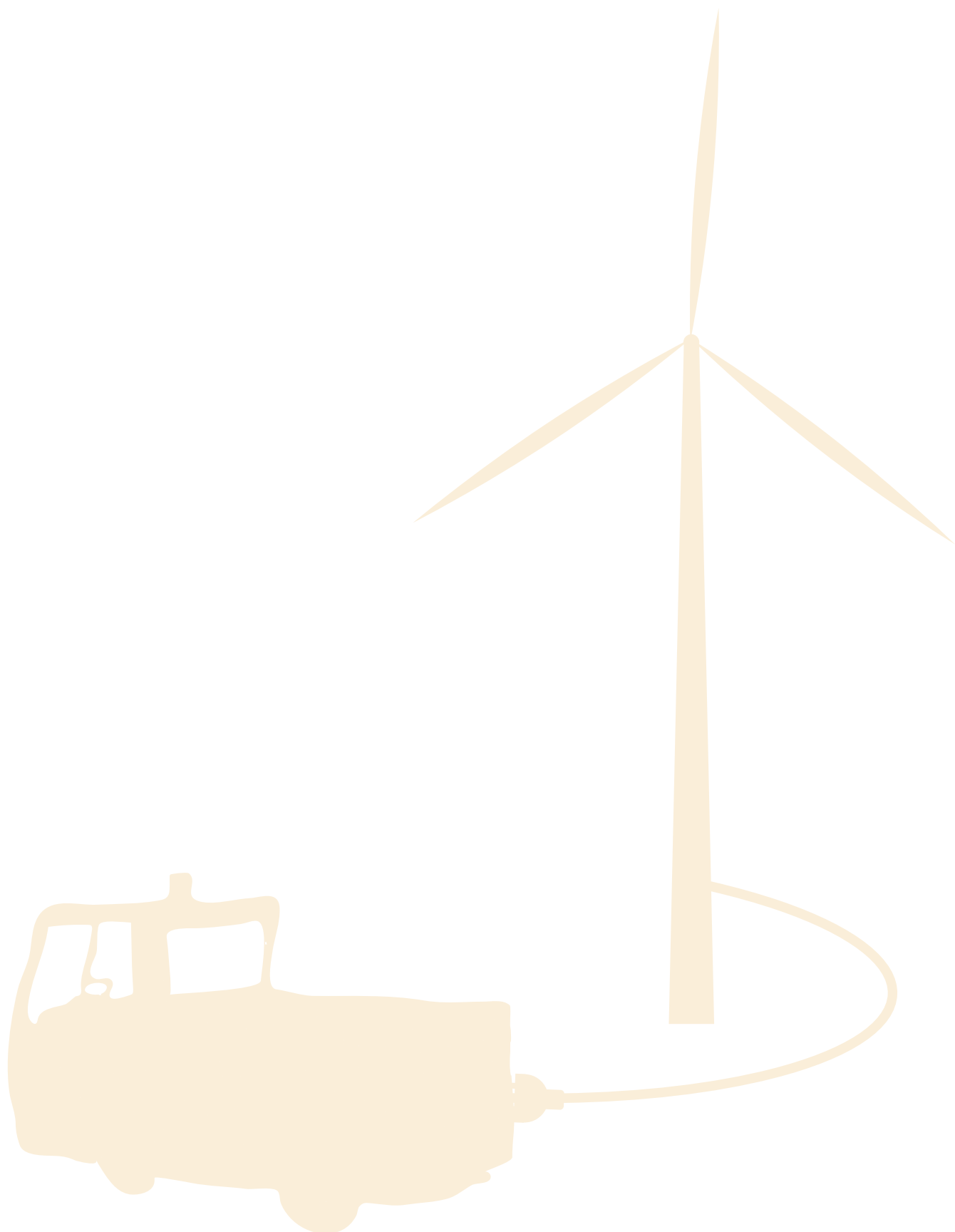
Oslo Airport is to further enhance its reputation as one of the world's greenest airports by opening a hydrogen station for vehicles. The latest initiative is in conjunction with Akershus County Authority, HYOP and Lillestrøm Centre of Expertise. Oslo Airport purchased its first hydrogen vehicle in 2014, and it is used on a daily basis for airport patrols.

The airport is a big fan of Hydrogen vehicles as they are so-called zero-emission vehicles, as they only release water locally. "It's exciting to be able to offer hydrogen at our airport," says the gateway's environmental manager, Tom Erling Moen. "We want to facilitate use of zero-emission vehicles locally, in the ground transport service, and for external users. "We will be phasing out use of fossil fuels in our own vehicles, which means that we have to test different technological solutions such as bio-fuel, electricity and hydrogen.

The hydrogen station opening at Oslo Airport is being moved from Kjellstad, outside Drammen. Akershus County Authority is providing financial support for the project.

This is great news for Akershus. It is in line with the county's hydrogen strategy for Oslo and Akershus, and with the commitment to reduce the greenhouse gas emissions to half of the 1990-levels by 2030. Oslo Airport is an important junction which allows many people in this region to use hydrogen vehicles. The car industry is now introducing new lines of hydrogen vehicles. If we are to encourage our citizens to buy them fueling stations also need to be provided.

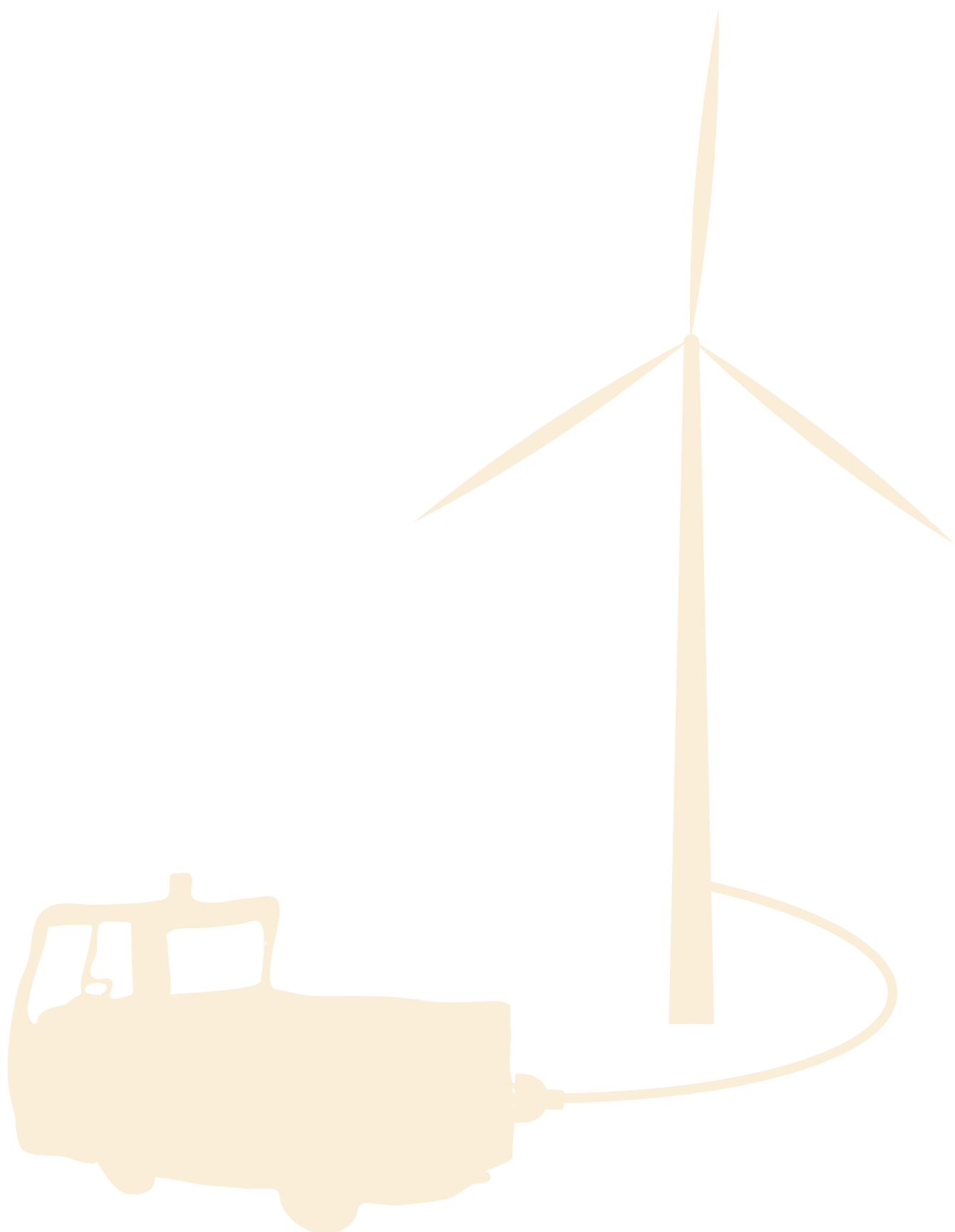
Lars Salvesen – ARC Vice-President – Vice Governor Akershus County Council





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Welcome words

Lars Birger Salvesen

Lars Birger Salvesen is the Vice Governor Akershus County Council

The transportation challenges for the Oslo – Akershus region revolve around the fast demographic growth of the region. 1,2 million people currently live in the Oslo – Akershus region, which accounts for almost a quarter of the total Norwegian population. This number is expected to grow with 350 000 inhabitants by 2030. Consequently, the goal is to set up a climate-friendly transportation and to cater for accessibility in the next 16 years.

At this stage, the public transport is a great success in the region as it has increased in the recent years more than the population has grown. In 2011

the public transport met the demand of 285 000 passengers daily, which will rise to 550 000 passengers in 2030.

The public transport system is taking market shares from the car traffic thanks to large investments that have been made in roads and railways. These investments are partly financed by the toll ring but also governmental and local spending. Old railroads are being renovated and structural solutions are implemented in order to cope with the increased demand. Moreover, road networks have been improved in order to also meet the increased volume.

Correlatively to the growth of population, the trade and transport industries are also on the increase. The Norwegian ministry of transport and communications expects an increase of 50% in freight transport in the region by 2030. If this increase would be to be met only by road transport, another ten lanes would have to be added to the E18 motorway however most of the new need should be met by public transport, in an environmentally sustainable way.



Oslo is also the logistical freight transport hub of Norway. 80% of the imported general cargo comes through the Oslo region and many large companies have their central warehouses in the area. The industry depends on performing transport systems in order to allow companies to be performing well. Without significant improvement, the current transport system would increase freight costs for companies to the double by 2030.

Currently, the average waiting time on the E18 between Asker and Oslo in rush hour is 45 minutes. A traffic index study comparing the situation in 169 cities all over the world showed that the Oslo afternoon rush hour traffic is the worst in northern Europe, even worse than in cities such as London, Paris and Rome.

The Norwegian rail company has improved its route map and has invested in new train sets which will increase its capacity and flexibility on the most popular routes. However, there is not more room for additional trains during rush hour until the infrastructure (such as new tracks) has been expanded. A new railroad tunnel as well as a new underground tunnel ought to be built by 2025.

The problem with public transport is also that buses are queuing alongside the cars on the roads. Bike lanes and pedestrian walkways need to be expanded but it's not just about building more. The traffic needs to be settled in a smarter way. While the capacity is stretched at rush hour, at other times the infrastructure is enough for the traffic demand. Is it possible to steer traffic and use the existing capacity in a better way? What about congestion charges similar to what is practiced in London and Stockholm? Or could the business week be organized in a better way to extend the time for transport to and from work, and thereby reduce the congestion?

The challenges encountered with public transport in the region are specifically well illustrated around the airport where most of these transportation issues can be found. One problem with the lack of airport intermodality¹ is the fact that the airport express train does not serve the surrounding communities, but only Oslo city and to some extent the region west of Oslo. This makes it difficult for airport staff to reach their workplace by public transport and therefore they need to go to work by car, which leads to traffic congestion. Being a large employer in the region, this issue should be addressed properly.

The same challenge regarding transportation from home to efficient public transport (and the other way round) apply for airport passengers: if the intermodality is weak, people prefer using private cars to and from the airport instead of public transport.

Oslo and Akershus are working together with local public transport company Ruter, the Norwegian road administration, and the Norwegian Agency for railroad services to solve these challenges. Oslo and Akershus are planning to work together to build local public transport hubs around new suburbs in Akershus in order to efficiently use the limited space around the capital. The local authorities are also inviting national agencies to cooperate in order to efficiently use the space and capacity at the same time as minimising traffic. They are also pressing for increased financial contributions to solve the problem. The goal is to ensure accessibility and functionality in the most populated areas of Norway.

Nevertheless, the presentations will show that Akershus has plans for alternative solutions and that the administration is working for a new environmental deal for a robust and sustainable capital region.

1 Intermodality = the connection of different transport channels – is increasingly been seen as one solution to the challenge of creating a sustainable and uncongested European transport network.



Collaborative Environmental Management and Local Authorities: from theory to practise

Sharon Mahony

Sharon Mahony works as an Aviation Environmental Analyst at EUROCONTROL, the European Organisation for the Safety of Air Navigation. EUROCONTROL is an intergovernmental organisation with 41 Member States, committed to building, together with its partners, a Single European Sky that will deliver the air traffic management performance required for the twenty-first century and beyond. Environment is one of the performance indicators of the implementation of a Single European Sky.

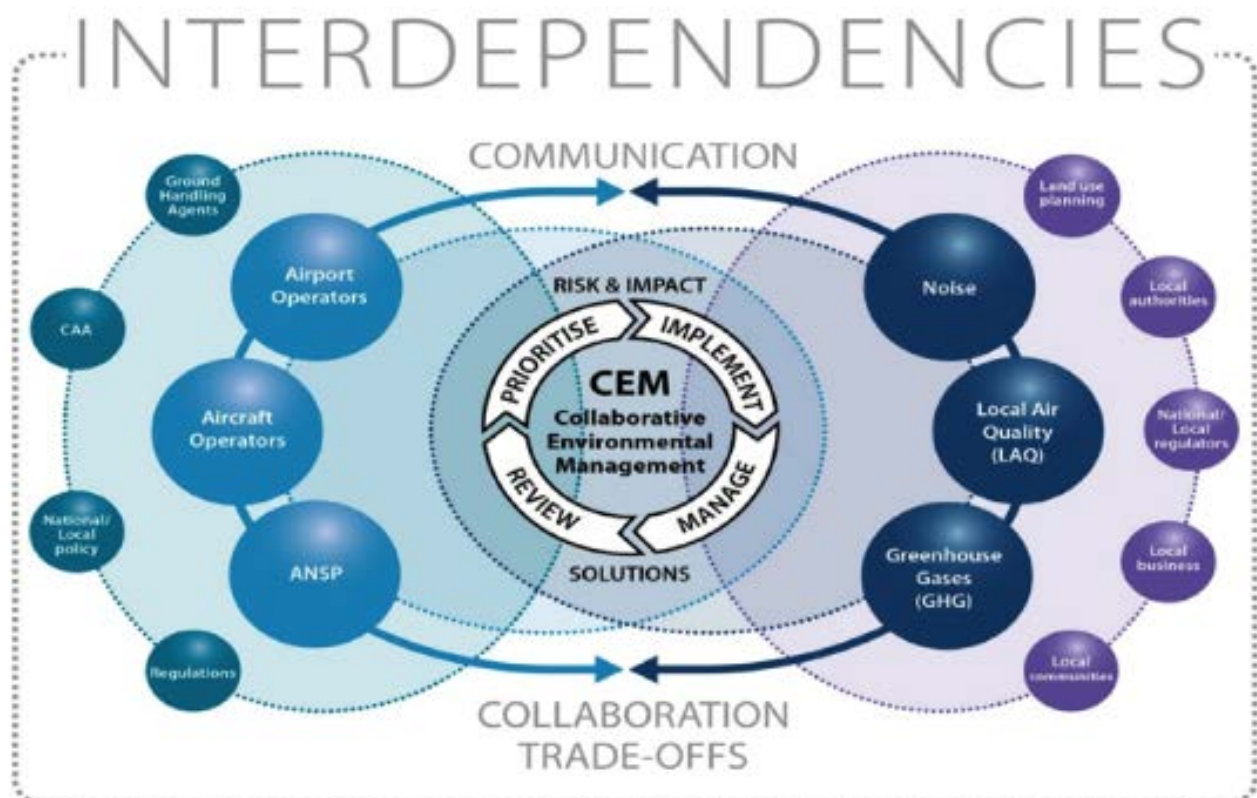
EUROCONTROL has been working on developing a specification for all stakeholders on Collaborative Environmental Management (CEM) at airports.

The CEM Specification, which was published in September 2014, has no binding legal value but it sets out a high level, generic protocol that will support core operational stakeholders in their efforts to deal with environmental impacts at and around airports. More specifically, the protocol promotes a collaborative approach by formalising arrangements between air navigation service providers (ANSP, in particular, air traffic service providers (ATSP)), airport operators and aircraft operators, and other stakeholders, amongst which are local authorities.

For those stakeholders wishing to implement CEM, the Section 7 in the specification provides a practical guide (in a check-list format), setting out requirements and recommended practices. See more on <https://www.eurocontrol.int/articles/collaborative-environmental-management-цем-specification>

What does collaborative environmental management (CEM) look like?

It is a process that takes into account the interdependencies between core stakeholders inside and outside the airport – airport operators,



aircraft operators and air traffic control (ANSPs) as well as local authorities and communities.

The collaborative process includes public consultations (such as public workshops) with the three stakeholder groups, to be held in a non-competitive setting. It is important to note that none of the stakeholders manage any of the others and that the central goal is to understand the interdependencies between activities of stakeholders.

The known challenges of noise, local air quality, land-use planning, encroachment, particulate matters and greenhouse gases impact local authorities, citizens and local businesses. There are for example different understandings of the meaning of land use planning, and the airport industry and/or ANSPs very often are of the opinion that “nothing is allowed”, while freezing land use in overcrowded areas is not an option... Sometimes, the issue is that the different stakeholders do not know whom to contact. The CEM Specification can hence facilitate the dialogue, if not a structured dialogue.

The Specification has been well received during public consultations by a range of stakeholders including regulators and ANSPs. Their positive comments indicate that the specification is fit for purpose and that its approach can be used for the wider sustainable development of the airport in general.

CEM and legislation

The specification is aimed to facilitate compliance with existing and future EU legislation such as the following directives:

- the Directive 2002/30/EC of 26th March 2002 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports;
- the Directive 2002/49/EC of 25th June 2002 relating to the assessment and management of environmental noise;
- the Directive 2008/50/EC of 21st May 2008 on ambient air quality and cleaner air for Europe.

In addition, a new noise Regulation (No 598/2014), replacing Directive 2002/30/EC, will come into effect in June 2016 and will force more collaboration between the stakeholders within the airport and with the stakeholders outside (local communities). The specification can also help facilitate compliance with the Single European Sky (SES) legislation on sustainability and effectiveness of air navigation services and the need to minimise environmental impact, as well as future support to achieve SES environmental related performance targets at airport level.

Benefits of CEMs

The benefits of the CEM specification are the following:

- A harmonised approach agreed at a European level to tackle environmental impacts at the local level, hence comparability for the implementation of level playing fields
- A framework to support understanding and awareness of environmental / operation interdependencies among internal core operational stakeholders (as mentioned airport operators, ANSPs and aircraft operators)
- A focus to identify the root causes of common environmental impacts / risks and facilitate solutions
- A working agreement to facilitate a robust and transparent dialogue that can harmonise relations with authorities and engagement with local communities and businesses.

Implementation of CEM working arrangements

National authorities may decide to employ the specification as voluntary material or to implement it as mandatory material within their own frameworks as it has the potential to become law if the national authorities so wish. As an example, France is adopting CEM in July 2015 by putting in place a representative of the local communities at the national level. ACI-Europe adopted the specification as best / recommended practise in November 2014.



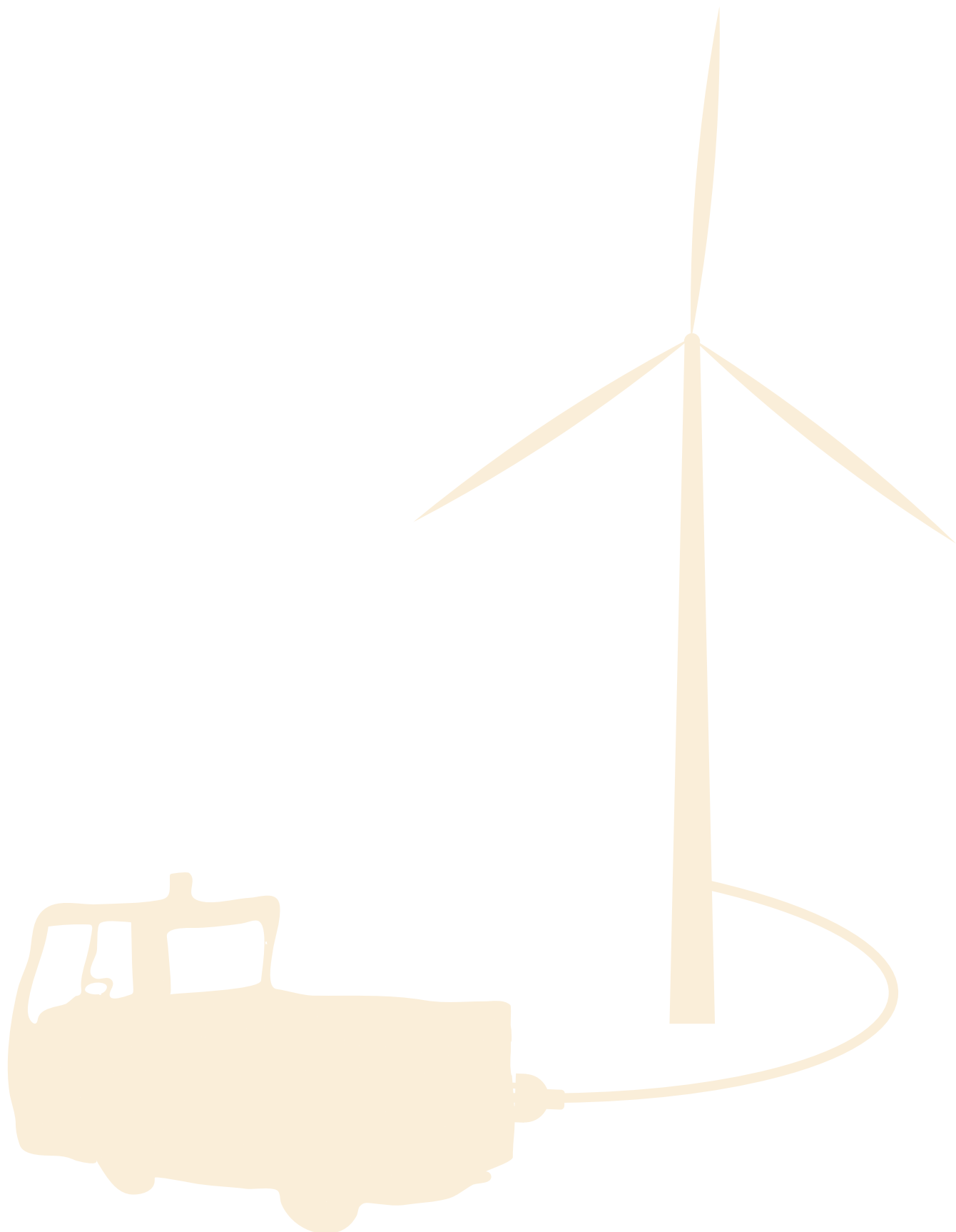
EUROCONTROL is working to implement the specification internally through peer workshops with operational stakeholders such as the ARC, through the establishment of a CEM portal for self-reporting (a voluntary scheme but following the principles of looking at the environmental challenges), as well as through presentations to national regulators. EUROCONTROL is willing to come and talk at national / regional level with authorities. It is suggested to take the CEM Specification to the local airport and propose it as an approved methodology in order to discuss. Is there an awareness of the CEM Specification? What can be done together? Etc.

Many airports have CEM-type collaborations, and this Specification is intended to formalise the existing collaboration and to make the airports conscious of this framework through the checklists and to allow comparison on what is being done.

Officially all airports in Bulgaria are using CEM, and airports in Manchester, Spain and France are starting to look at this methodology. Vienna airport is doing something similar but not calling it CEM.

EUROCONTROL could facilitate the relationship with the airports, and to simplify the dialogue and the creation of the framework for finding the solution. It is important to remember that EUROCONTROL cannot give orders on air traffic control as the authorities are the ones imposing restrictions on airports due to quotas on noise / emissions. The EUROCONTROL CEM team is happy to receive suggestions on how to improve the framework for the dialogue.

Contact: cem@eurocontrol.int or sharon.mahony@eurocontrol.int





The Swedish Example: CEM Key Performance Indicators used for the joint work between Traffic control, Airports and Airlines

Elisabeth Celsing

Elisabeth Celsing works as a Project Manager at Stockholm Arlanda Airport for Swedavia. Swedavia AB is a Swedish State-owned company, owning and operating the ten major airports of Sweden. All Swedavia airports are certified at the highest standard for climate work by the Airport Carbon Accreditation scheme. Swedavia's tasks include creating the access that Sweden needs to facilitate travel, business and meetings, develop the transport sector based on sound business principles and help achieve the country's transport policy objectives and to maintain the national basic infrastructure at the ten airports.

Carbon Neutral Growth by 2020

Swedavia has been working with the international aviation community, where IATA has set the goal of a carbon neutral growth by 2020 by

- operational improvements
- aircraft technology and
- sustainable alternative fuels and market based measures.

Swedavia's Operational Improvements to Reduce CO2 Emissions

The Swedish Civil Aviation Administration (Luftfartsverket), i.e the national air traffic control has as a target to provide conditions to reduce the emissions in Sweden with 1.000 ton CO₂ / year. They need to report the following Key Performance Indicators (KPIs) to Swedavia:

- Number and shares of CCO (Continuous Climb Operations),
- Number and shares of CDO (Continuous Descent Operations) and time in level flight,
- Number and shares of closed STAR (Standard Terminal Arrival Routing),
- Number and shares of RNP AR (curved approaches when available).

Swedavia's operational improvements include the "green approach" project, which was developed in 2006 at Stockholm Arlanda Airport in a collaboration between Swedavia², air traffic control and SAS. Today they are performed at all Swedavia airports. So far, at Stockholm Arlanda it has only been possible to perform green approaches in light traffic since green and standard approaches cannot be combined in heavy traffic.

A green approach means that an aircraft descends continuously from its cruising altitude to the runway. By descending continuously, the aircraft requires almost no engine thrust, thereby saving fuel and reducing emissions, up to an average of 150 kg fuel and 450 kg CO₂.

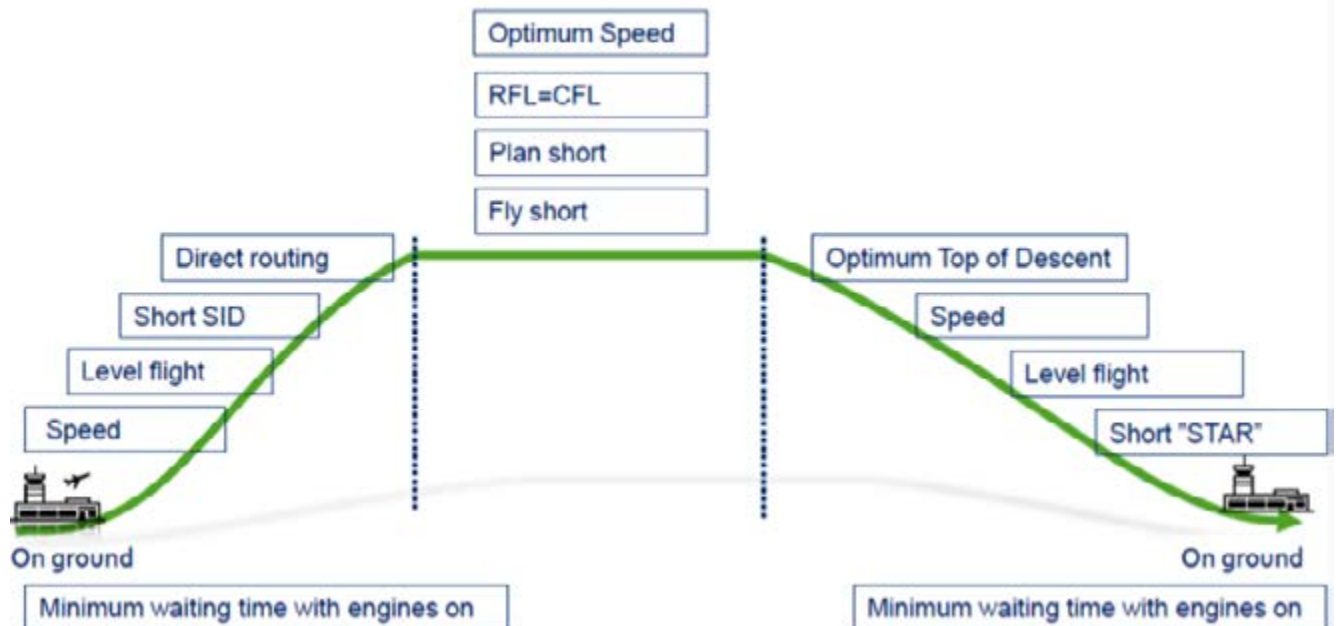
Nowadays, the project is no longer called green flights but "*fuel optimised flights*". This project is looking at what can be done on a whole to reduce CO₂ both on ground and in the air, and during the whole of the course of the flight. Factors include such as minimum waiting time with engines on (before departure and after landing), optimum speed, short approaches etc.

Fuel Optimised flights

The fuel optimised flights take into account the optimum top of descent and when to descend. It is a calculation of time versus fuel optimisation and sometimes airports, air traffic control and aircraft operators could have different short time goals. The new approach of continuous descent operation (CDO) implies maximum one level flight for 30 seconds per descent. A curved approach makes a shorter route when landing. However, which approach to be used also depends on noise reductions in densely populated areas.

² Swedavia was still both an air traffic control authority as well as an airport operator in 2006

Fuel Optimized Flights



Environmental permit application process in Sweden

The environmental permit application process in Sweden is a lengthy but democratic procedure. The airport operator applies for an environmental permit at the Environmental court. The permit includes conditions regarding maximum number of flights, flight paths, noise levels, CO₂-emissions, water protection, preventive actions, measurements, reporting etc. All local and national authorities, municipalities, and neighbours (noise abatement associations in nearby communities and private persons) give their opinion on the application. There are also other prerequisites to be met.

A Fuel Optimised Descent

The technical factors to achieve a fuel optimised descent include optimum top of descent, speed, level flight and short STAR (Standard Arrival Route) but there are also many organisations that need to collaborate in order to achieve a fuel optimised descent – see the picture below for the list of different stakeholders.

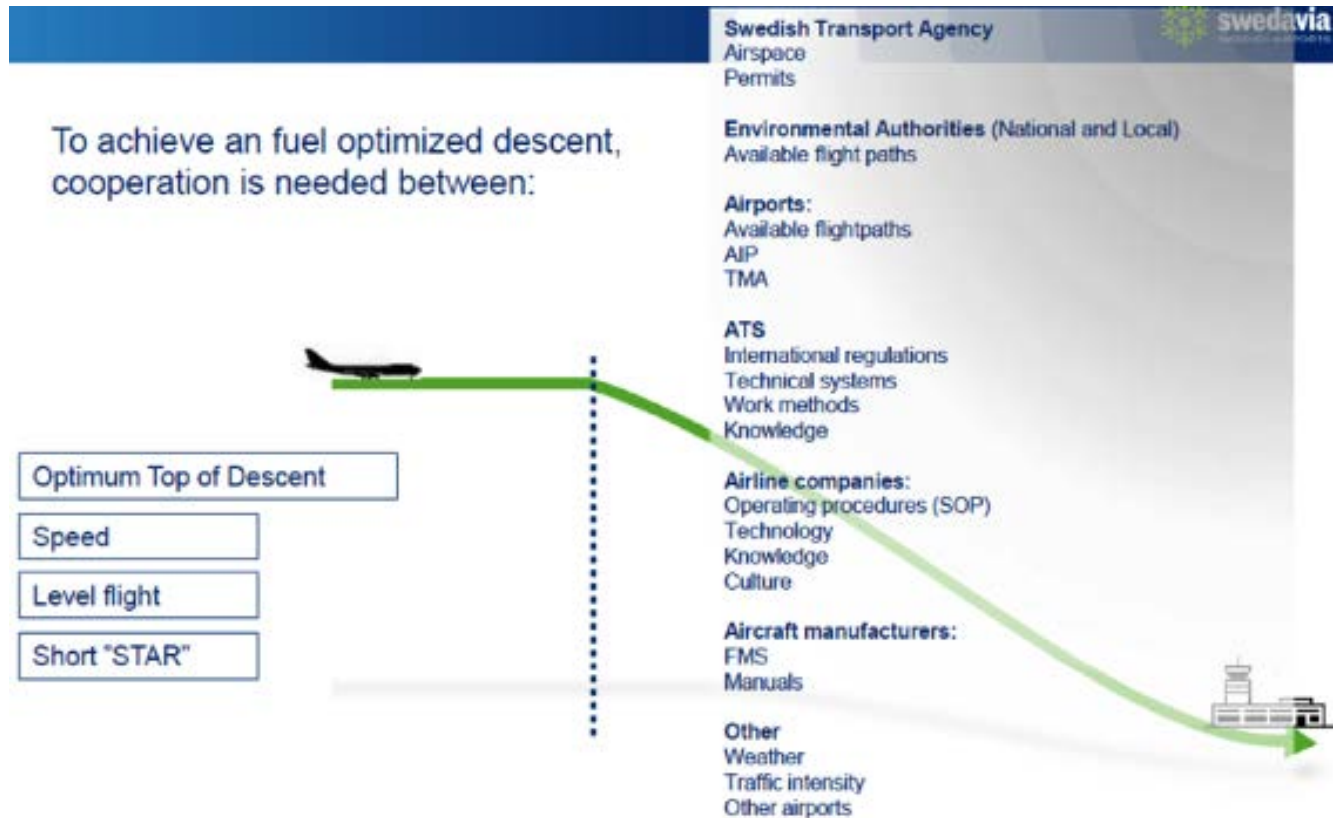
Swedavia has a new project called “EcoFly” with different stakeholders (including six airplane companies) within the airport, but also meeting with the airport neighbours, such as noise abatement groups, several times a year. The discussions concern changes in flight paths.

How can Air Traffic Control reduce CO₂ emissions?

As previously mentioned the Swedish Air Traffic Control (LFV) has as a target to provide conditions to reduce CO₂ emissions in Sweden with 1.000 ton / year. The outcome of the environmental target in 2014 was 1.185 ton CO₂/year. Some of the methods used were:

- Harmonized sinking speed (Gothenburg): 800 tons
- RNP AR (curved approach) (Gothenburg): 240 tons
- New Dep-E-position ATCC (Stockholm): 95 tons
- Education fuel management: 50 tons
- New airways
- CDM (Arlanda)

An example: To be allowed to start operating the third runway at Stockholm Arlanda airport, the airport first had to build the airport express train. The new runway application was submitted in the 1990's, and the third runway was built in 2003. A new permit was applied for in 2008 and Swedavia received the approval in May 2015.



Reduced Fuel Consumptions with new aircraft technology

Swedavia is applying lower take off charges for aircraft with cleaner and quieter engines. The emission charge takes into account the fuel consumption and NOx emissions, and the noise charge uses the ICAO certified noise levels. The reduction can be up to approximately 6% of total charge for an aircraft taking off (100 – 700 SEK / approx. 10 – 70 EUR per take off). The airline pays various other charges such as the over-flying-route charge³ and charges for approach and landing.

Curved approach:

The aircraft has to be technically equipped for the curved approach but it also depends on other factors. An aircraft needs to fly as safe as possible, and this depends on the laws of physics, weather, traffic situation (intensity) and other airports nearby. The specific airport needs to be equipped with a suitable runway available to fly such an approach. In addition, the air traffic control needs

³ At country level for each aircraft flying over national air space, EUROCONTROL bills on behalf of the member states, and airlines get each month a bill for this charge

to be trained and have published routes for the curved approach, as well as training of the pilots flying the aircraft. In other words it is a complex method with different important factors.

Continuous descent approach (CDO):

A very good technique to reduce noise and / or fuel but depends on the standard operating procedures (SOP) of the airlines. Ryanair has the best rate of CDO (95%) of all airlines, as they have it as a SOP. Low traffic volume is a prerequisite but a major hub like Heathrow has quite a lot of CDOs. When the aircrafts are in the "holding", the stack – the air traffic controller can bring them in by CDO. The definition of a CDO approach: as much CDO as possible when the conditions allow it safely. The pilot can request "distance to go" in order to land from air traffic control.

A very important subject for stakeholders to discuss together: the pilots, air traffic control, and airport operators. It is not so much a safety issue as an environmental issue.

Projects to Promote Sustainable Alternative Fuels

Another way that Swedavia is involved to reduce carbon emissions is to introduce more sustainable alternative fuels. The first regular flight from Stockholm Arlanda airport operated with 10% biofuel took place on 7 November 2014. The new Swedavia target is to reach 25% renewable fuel for aircrafts in 2025.

Fly Green Fund:

The Fly Green Fund is a Nordic initiative (initiated by Karlstad Airport and SkyNRG) that gives companies and organisations the opportunity to decrease their environmental impact by flying on bio jet fuel and has the aim to kick-start the market for bio jet fuel flights in the Nordic countries. This is achieved through co-funding the extra costs currently existing for bio jet fuels, relative to fossil fuels. Furthermore, the fund will support the development of sustainable bio jet fuel production from Nordic forestry residues and wastes. Swedavia was the first Nordic airport operator to join the initiative together with three airlines Scandinavian Airlines, Malmö Aviation and SverigeFlyg. The fund is selling tickets to fly with biofuel and the airlines will buy biofuel with these fees.

Nordic Initiative for Sustainable Aviation (NISA):

A Nordic association working to promote and develop a more sustainable aviation industry with a specific focus on alternative sustainable fuels for the aviation sector. Partners: Swedavia, Copenhagen airports, Avinor, Finnair, SAS, Boeing, Airbus.

Facts on Air travel and the environment

- In Sweden, domestic air travel accounts for about 1% of the transport sector's CO2 emissions.
- All flights at Swedish airports account for about 5% of total emissions
- Globally, air travel accounts for about 2% of all carbon dioxide emissions
- Has reduced total emissions by over 30% in the period 1990–2010
- 70% more fuel-efficient to fly over the past 40 years.

In Sweden:

- About 10,000 people are exposed to disturbing noise from aircraft
- About 1,600,000 people are exposed to disturbing noise from road traffic
- 400,000 people are disturbed by noise from rail traffic



The Danish example: Copenhagen Airports Air Quality Programme

Jesper Jacobsen

Jesper Jacobsen, who is a geologist, works as a Senior Project Manager on air quality in the Environmental Department at Copenhagen Airports. Copenhagen airports is a public limited company that operates two airports in Copenhagen, Denmark – Copenhagen Airport and Roskilde Airport.

Assessment of the air quality at Copenhagen airport

Copenhagen airport has three air pollution monitoring stations at the airport, which are constantly monitoring air quality. A thorough 2011 report on air pollution parameters showed that even if pollution parameters were all within the EU set limit values, there were very high levels of ultrafine particles (UFPs) compared to measurements made in central Copenhagen.

Moreover, measurements indicate a spreading of UFPs outside the airport boundary. This report caused substantial public concern and Copenhagen airports had to become a front-runner in terms of analysis and prevention of UFPs.

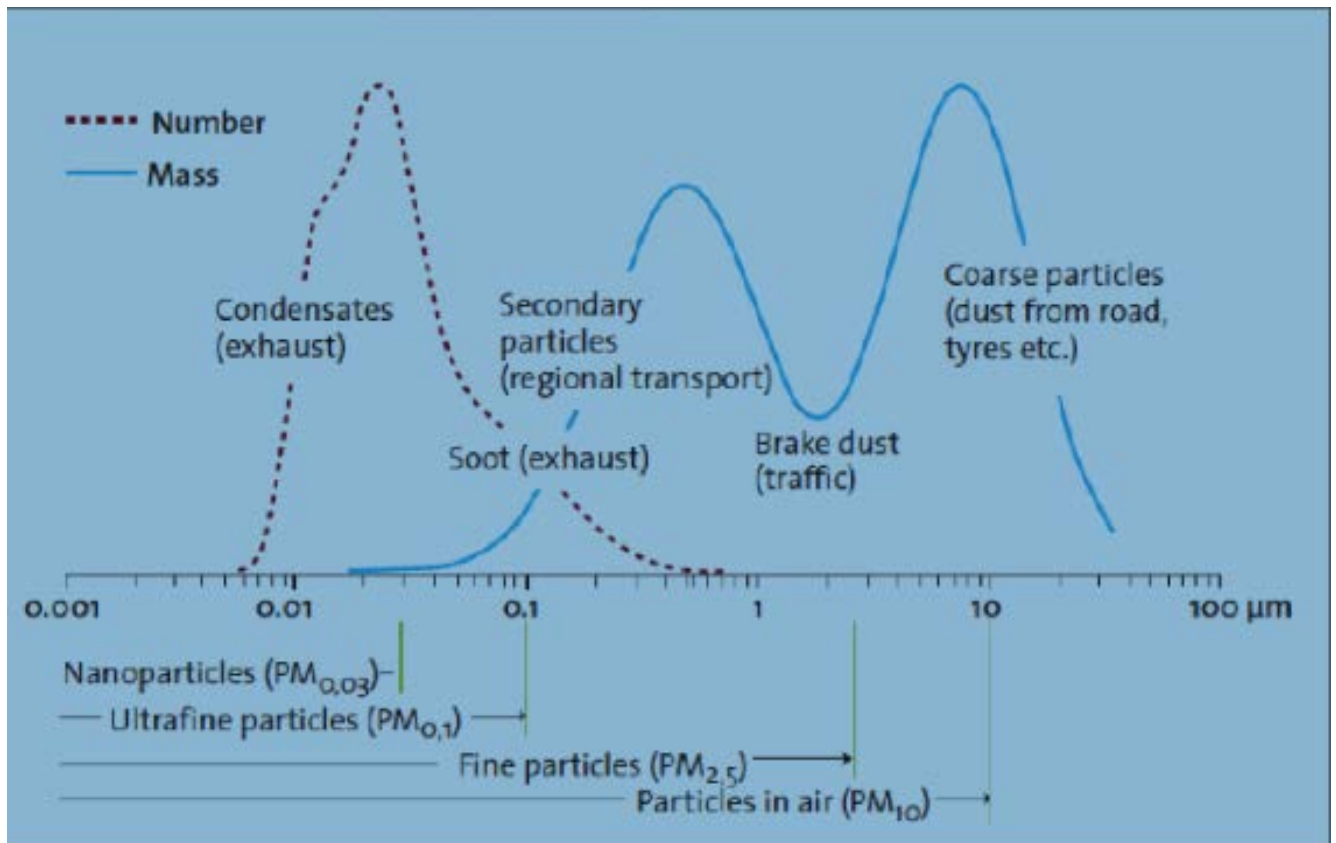
There were specific concerns from trade unions related to ground handling staff inhaling these UFPs daily as there are no set national limits. Certain engines, such as diesel engines have a limit but not for other types of exhaust producing machines.

Air pollution survey timeline:

- 1990: Copenhagen airport started air pollution surveys (financed by the Danish government).
- 1996-1997: Environmental impact assessment (EIA) and environmental approval for Copenhagen airport with demands on establishing Air Quality monitoring and conduct a survey on smell nuisance.
- 2000: Monitoring local air quality (LAQ) at 3 stations including NO / NO₂ / O₃ / SO₂ / PM₁₀ / PM_{2,5} / benzene
- 2002: Report on "smell" and air pollution sources
- 2007: Project to measure air quality on the apron following an Italian report on "Occupational exposure on airport personnel"
- 2009: Change in the LAQ monitoring programme from 3 to 2 stations - NO_x and PM_{2,5} is now part of the regulation
- 2010: Preliminary NERI report with results on ultrafine particles which leads to strong reaction from unions and media
- 2011: CPH thorough survey on air pollution parameters (24 different VOC and 9 aldehydes) – all were within limit values. High amounts of ultrafine particles
- 2012: Action plan and two new permanent UFP monitoring stations
- 2013: New emissions inventory and particle count inventory

It must be noted that the way pollution is measured can also give differing results, for example UFPs are high in number but low in mass. Ever since the beginning of the monitoring of the air quality at the airport, 25 years ago, there has been "no air pollution problem" according to EU set limits.

Facts: Ultrafine particles (UFPs) are particulate matter of nanoscale size (less than 100 nanometres in diameter). Regulations do not exist for this size class of ambient air pollution particles, which are far smaller than the regulated PM₁₀ and PM_{2,5} particle classes and are believed to have several more aggressive health implications than those classes of larger particulates. UFPs can either be carbon-based or metallic, and then can be further subdivided by their magnetic properties. UFPs are both manufactured and naturally occurring. UFPs are the main constituent of airborne particulate matter. Due to their numerous quantity and ability to penetrate deep within the lung, UFPs are a major concern for respiratory exposure and health.



However, with a health perspective, the consequences could be interpreted differently. Whilst the UFPs' impact on health is not yet documented, five staff members of the airport have been diagnosed with a cancer related to their work. At this stage, it is most likely due to inhaling exhaust from diesel engines.

High amounts of UFPs spreading to local communities?

The Air Quality Programme is using Collaborative Environmental Management (CEM) tool through its dialogue with stakeholders. The reference group include representatives from unions and local authorities who also are invited to participate in the working groups. The steering committee is made up of handling companies, ANSP and main carrier. Reduction of UFPs has become part of the airports' strategy and mission.

There has been certain reluctance by the local authorities to work with air pollution, as they considered not having the required technical expertise and they chose not to be an official part of the programme. Nevertheless, they requested to be informed of the outcomes, in order to be able to respond to the questions of local communities.

Newsletters are produced and circulated among stakeholders.

Working groups with 26 projects:

The actions to fight UFPs have been done through four working groups managing 26 projects:

Behaviour

Turn off engines! Auxiliary power units (APUs) are small engines that give electricity without using the aircraft engines providing cooling and electricity for the planes. They produce UFPs and in order to decrease the pollution as well as noise, the airport is targeting pilots and ground handling staff to decrease the usage of APUs.

Ground support equipment (GSEs)

A campaign on idling has been successful: *"Watch out for your colleagues, yourself and the environment: turn off the engines!"* The GSEs produce up to 200.000 UFPs, but when turning off the engines the level was decreased to 20.000 UFPs in 20 seconds.



Stand technology and operations

Dealing with how to operate the aircraft, to turn off as many engines as possible when taxiing etc. The airport is also using more and more electrical equipment to reduce pollution.

Another method is *environmentally-friendly pushback*: during which an aircraft is pushed backwards away from an airport gate by external power. By using other taxiways to use more start up points and thereby improving operational procedures and the environment. When pushing the planes a longer distance, the congestion at the terminal is also decreased and there is a better on time performance. More time spent on pushback is saved from waiting for the aircraft.

- Shut down main engines when “on-block” – Not every pilot turns off the engines when parked!
- Shut down as many engines as possible when taxiing – Aircraft can taxi on one engine!
- APU can only be used 5 minutes after “on-block” and 5 minutes before estimated “off-block” (with few exceptions).

Research and analysis

Improve the lacking knowledge, pushing for research on how to deal with the subject.

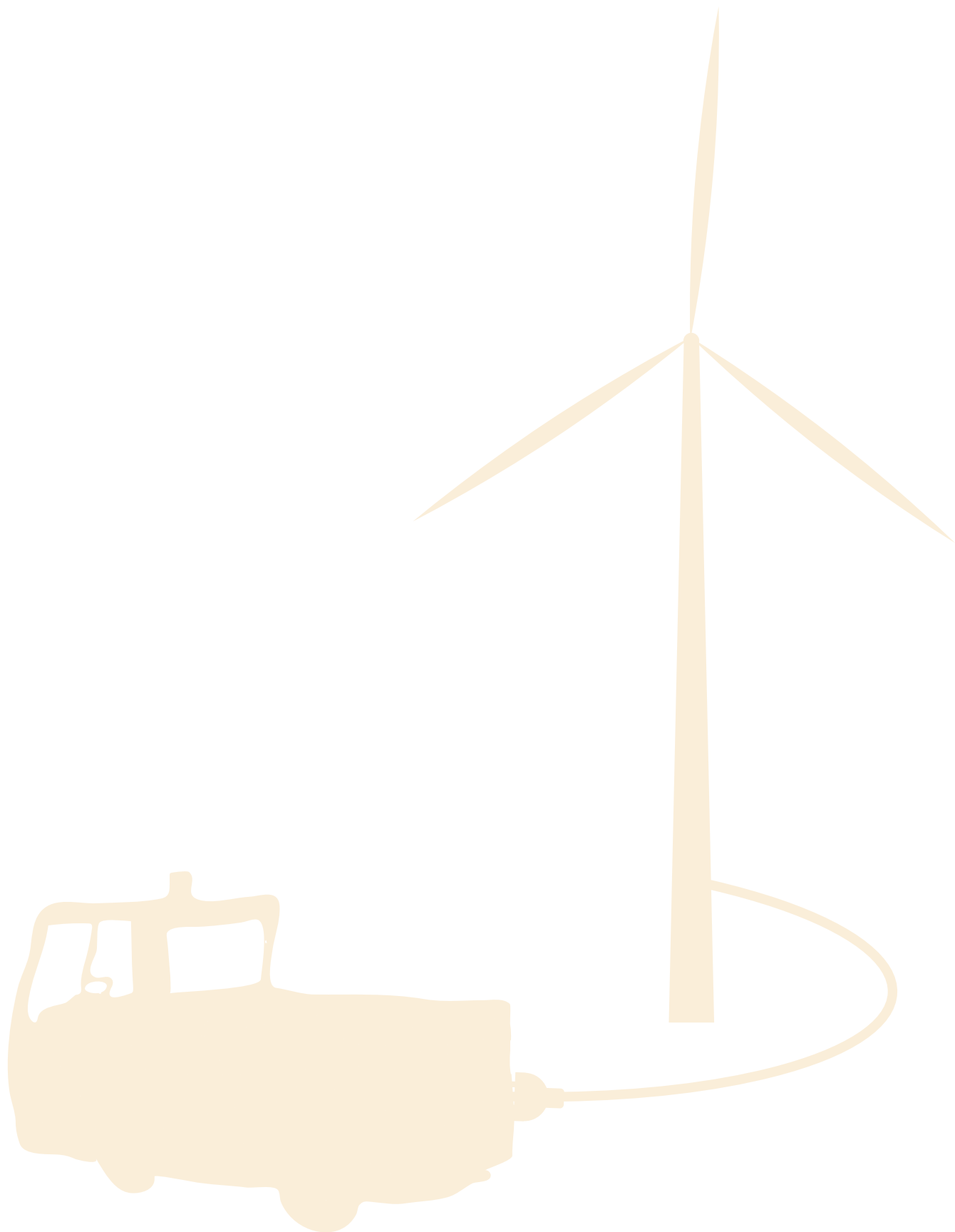
A hospital cohort study is currently reviewing the health of 5.000 persons employed at the airport from 1985 until now and the conclusions are expected in 2016.

Copenhagen is the ACI representative in the ICAO working group on emissions from aircraft engines. ACI published in 2012 a study called “Ultrafine Particles at Airports” with case studies from the airports in Copenhagen, Stockholm Arlanda and Zürich.

<http://dit.cph.dk/wp-content/uploads/2015/06/ACI-study-on-ultrafine-particles-at-airports.pdf>

Available material can be found on the CPH website:

<http://dit.cph.dk/en/a-responsible-company/improving-air-quality>





The Norwegian case: Adapting airports to a changing climate

Kristin Fjellheim

Kristin Fjellheim works as an energy advisor at Avinor. Avinor AS is a State-owned company that operates most of the civil airports in Norway. The Norwegian state, via the Norwegian Ministry of Transport and Communications, controls 100% of the share capital.

Why Adapting Airports to a Changing Climate and what does it imply for local and regional authorities?

Climate change is a fact, it is happening, and airports need to adapt, and so do airport regions.

The issues at stake for the airports are safety, regularity and punctuality, as well as financial as in reparation costs, cost of delays etc. Local and regional authorities are at stake as the access the region may be jeopardised; the sewage systems may be affected by what's happening at the airport, and the road access to the airports may be interrupted.

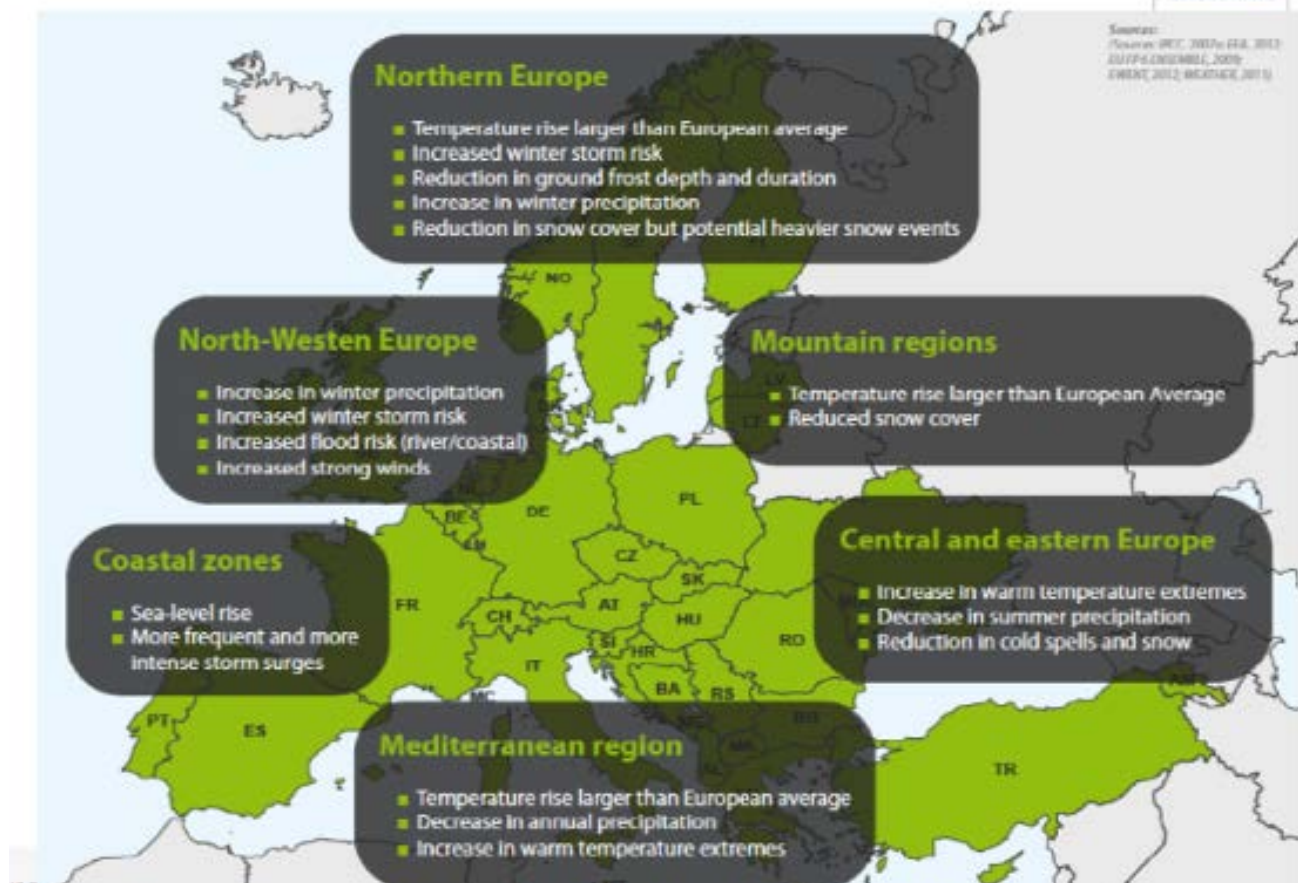
Weather will be more extreme. The overall impact of climate change can be summarised in three words: warmer, wetter and wilder.

Drainage issues at airports include removal of surface water in big flat sealed areas due to

Climate change by European climate zone



Source:
European MET 2007-04-10
EUROCONTROL, 2009
EWAS, 2012, METEOR, 2011



Norwegian examples:

Warmer: Svalbard airport at Longyear (Spitsbergen) is the northern-most airport in the world. It was built in 1973 on the permafrost level at 2.5 metres, but in 2009 the permafrost level had sunk to approximately 4.5 metres which has led to settling damages on parts of the runway.

Wetter: Stavanger airport's drainage was washed out under two areas of the runway, and half of the runway length had to be rehabilitated. Road access to some other airports have been flooded due to increased precipitation.

Wilder: Værøy heliport was shut down for a longer period of time due to major damages on landing platform, technical installations and buildings after the storm Berit hit in November 2011.

freezing / melting), and ground water levels, which can cause flooding of electrical man-holes and other infrastructure. Avinor has in its Airport Design Handbook included specific requirements for grooving (asphalt) in a way to address drainage issues. For the design of water mains and sewage systems, future climate factors also need to be taken into account when designing an airport. The sewage modifications affect the rest of the area as they need to fit in the overall regional sewage system.

How to adapt?

Avinor has been working on climate adaptation since 2001 through the national transport plan (including the road, railroad, maritime and airplane sectors). The plan involves the following steps:

- **Risk assessment** on different climate variables (temperatures, precipitation, wind, snow, freeze / thaw, waves, permafrost) that could affect infrastructure (runways, electricity and communication, radars and navigation, control towers, surface access).



Photos: NRK Nordland

AVINOR

Picture showing the damage caused by the storm Berit, November 2011, at Værøy heliport



Avinor has for example conducted risk assessments of all its airports and found that there is:

- Limited risk for avalanches and land slides
- Norwegian airports are, with a few exceptions, not vulnerable to floods
- **Risk analysis:** airport criticality (high or low) versus probability. The focus is on the 11 most critical airports in the country.

However, there is a need for incorporating risk assessments from different areas (road, railroad, communities and aviation) to see the whole picture. Therefore, it is essential with collaboration with the local communities and different sectors! It is also recommended to have a designated contact person for climate adaptation.

Example:

KLIMA 2050, a centre for research based innovation (see below) has a project on how to clean the water after usage of de-icing fluid at the airports. It has been found that sewage drainage is a matter for collaboration between airport and local communities since the waste water drains into local water supplies.

Examples of recommendations at one airport and its region

- Move all electronic equipment to water tight rooms – to avoid floods
- Installation of UPS (uninterruptible power supply) on all critical equipment
- Map drainage capacity and possibly increase dimensions – together with local communities

- Implementation of flooding protection
- Runways not to be built lower than 7 metres above sea level, which is the result of a risk assessment on how high the waves potentially could be.
- Improve flood warning system, in conjunction with local civil security systems
- Establish rerouting protocols
- Operational guidance for pilots
- Collaborate with local authorities as road access might get limited

Collaboration and information sharing

Avinor is working with KLIMA 2050, a centre for research-based innovation (SFI) financed by the Research Council of Norway and the consortium partners from the public, private and research / education sectors. The SFI status enables long-term research in close collaboration with trade and industry, as well as other research partners aiming to strengthen Norway's innovation ability and competitiveness within climate adaptation. The composition of the consortium is vital in order to being able to reduce the societal risks associated with climate change and enhanced precipitation and flood water exposure within the built environment.

Conclusion:

The lesson to be taken from the resilience plans implemented by Avinor is that there is no point of creating islands of resilience in an ocean of vulnerabilities! The interdependencies are very strong between all actions, and the cooperation with local authorities is a crucial part of the overall resilience of the system.





12 June Morning Session: A new environmental deal for airport regions

Akershus County Council: Visions and strategies for Alternative Energies

Solveig Schytz

Solveig Schytz is Chairman of the Committee for Planning, Economic development and Environment at Akershus County Council.

Background to the Akershus region

Oslo and Akershus is one functional region – both an urban and a rural one. It is amongst Europe's fastest growing capital regions with a 1-2 % annual population growth, which is expected to grow from 1.2 million inhabitants in 2015 to 1.5 million in 2030.

A vision of zero emission transport

Akershus County Authority works in close cooperation with Oslo Airport to implement a common vision of zero emission transport and the hydrogen strategy for the Norwegian capital region.

In the capital region 60-70% of greenhouse gas (GHG) emissions originate from transport. The focus of the work for sustainable transport hence is:

- To reduce car dependency,
- To increase and improve public transport, and
- To help introduce fossil free and zero emission alternatives.

Akershus County Authority has been a driving force towards reducing pollution and GHG emissions:

- In 1998 cooperation with the City of Oslo on climate issues,
- In 2003 agreement on a common climate strategy.
- A continuation of this was the common 2014-adoption of a strategy to help early introduction of fuel cell based transport in the Oslo capital region.
- Since 2005 hydrogen projects related to transport were developed.

Akershus and Oslo share the same goals of reducing GHG emissions by 2030 to half of the emissions from the UN reference year 1990, and to be completely carbon neutral by 2050. This is a great challenge because the region is one of the fastest growing metropolitan regions in Europe. Some 300,000 new residents are expected within the next 20 years. The projections are that the growth will be evenly distributed in Akershus and Oslo. Hence, there is a need for developing a common plan for a polycentric development that will help reducing car dependency and GHG emissions. Transport should contribute with at least 20% GHG reduction.

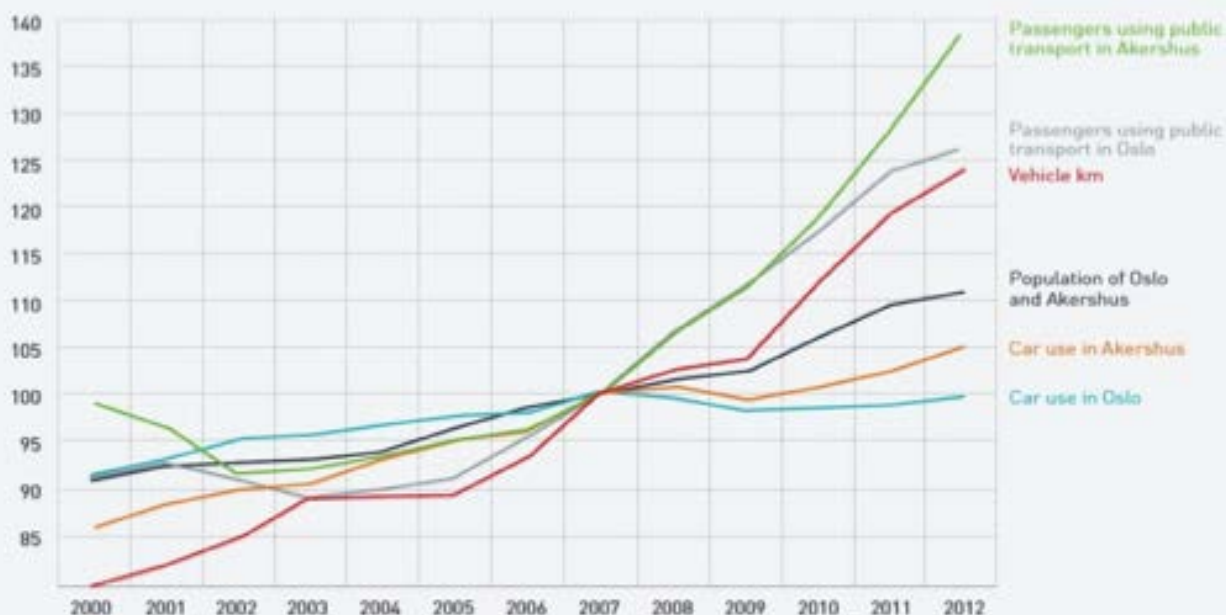
The above chart shows that use of public transport in the last four years has grown quicker than the road traffic in the region, and more than population growth.

The strategic goal is that the strong population growth should only lead to moderate growth in motorized transport and therefore to strengthen the use of public transport and to provide better opportunities for cyclists.

According to official statistics the three largest sources of GHG emissions are the oil and gas industry, the land-based industry and the transport sector. While land based industry has reduced its emissions substantially (-39%) since 1990, transport emissions have increased nearly as much (+30%). Norway's total energy use was in 2013 217 terra-watt hours (TWh) of which 126 TWh was fossil free energy and 90 TWh was based on fossil sources.

Trends in population, public transport and car use

Indeks; 2007=100



The capital region has little industry so the transport sector accounts for the far biggest GHG emissions here. It also causes health problems since the urban areas frequently have a smog problem during winter in periods with temperature inversions, because of air pollution from transport. The County Authorities of Akershus and Oslo therefore cooperate to reduce car dependency, to increase the share of public transport, and to help establish infrastructure for zero and low emission transport.

As regional developers the County Authorities of Akershus and Oslo take responsibility for the people's well-being in the region, the environment, important parts of education, logistics and transport, and the economic development. All these areas of society will benefit from an early investment in zero emission transport and technology.

An extensive partnership to lower emissions

The two counties, Akershus and Oslo, work together on land use and transport planning, public transport measures, on conducting change in energy use, and the early introduction of zero emission and carbon neutral vehicles. The preferred alternatives are battery and fuel cell

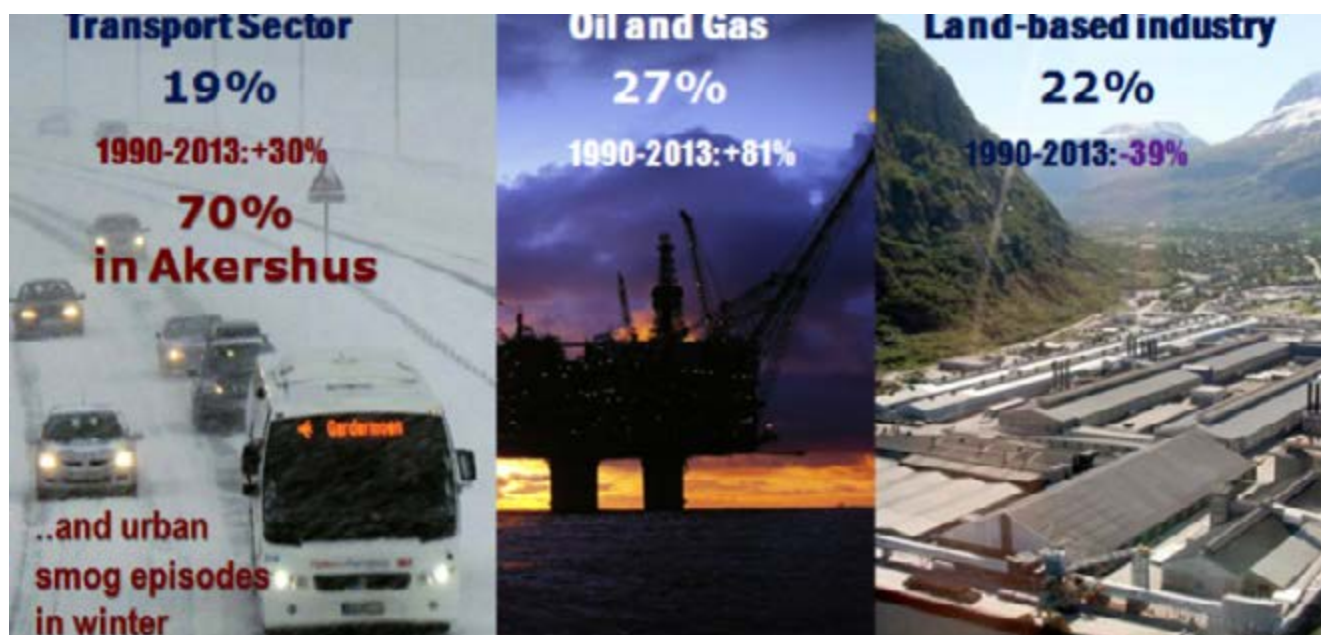
electric technology for private cars, and biogas and fuel cell electric for heavy vehicles. An important tool to achieve the goals is the public transport company in Oslo and Akershus, Ruter AS, which is owned by the City of Oslo (60%) and Akershus County Authority (40%).

There is a plan to develop a hydrogen refuelling stations (HRS) network:

- By 2018: 6-8 HRS: This HRS-network should provide fuel for at least 2000 passenger cars and 500 taxis.
- By 2025: 10-15 HRS in the capital region, and with another 10 HRS elsewhere in Norway and along the west coast of Sweden,

It is expected to cover the transport needs for residents driving fuel cell electric vehicles (FCEVs) with this infrastructure including the link to the rest of Europe.

The strategy is based on a projection of 300 FCEVs in 2018 rising to 10,000 vehicles at the end of the strategy period. This ought to be sufficient to operate the HRS network with profit.



An early introduction of hydrogen taxis and buses will aid the operational economy of the HRS network, and will promote fuel cell electric transport technology to the public. The ambition is to have 500-700 FC-taxis in the region by 2025; that is one fifth to one fourth of the total taxi fleet in the region.

As part of the European bus project, CHIC (<http://chic-project.eu/>), there are five FC-busses in regular use in the capital region. The lessons from this project will be used when the fleet of FC-busses expands. It is aimed to raise the number of FC-busses significantly, and the privately owned bus fleets supporting Oslo Airport to be part of the FC bus stock in the region.

Furthermore, Akershus also participates in the European post-CHIC initiative to establish HRS infrastructure and fleets in Europe of the total for 400 to 800 FC-busses within 2020.

Akershus' hydrogen action plan

The two year hydrogen action plan for Akershus County has three legs:

1. To secure and strengthen the station network and security of supply,
2. To stimulate fleet development, and
3. To develop a hydrogen infrastructure consortium of private and public partners.

The first year Akershus will support the establishment of one or two robust, modular HRS with good capacity south and north of Oslo, and in addition a first, smaller HRS close to Oslo Airport. The station south of Oslo will be opened in late 2015, and the one north of Oslo during spring 2016. In partnership with the taxi industry and with Hyundai Norway, taxi fleets connected to these HRS stations are being established.

A partnership with the Confederation of Norwegian Employers (NHO) is being established.

Advanced test centre for hydrogen and fuel cell based technology is supported with the aim to make it an effective tool to increase the pace of technological development towards a fossil-free society.

Fuel cells and battery electric driven vehicles

After five years of testing HRS and fuel cell cars, the Oslo region is well prepared for the commercial introduction of FCEVs. The CHIC-Oslo project, which includes a refuelling station and five fuel cell buses, has also proved successful. Today there are about 20 FC-cars and five FC-busses using the roads. Since 2011 the region has tested ten Mercedes FC-cars which responded well to the cold climate and endured temperatures down to -28 °C. The available Hyundai fuel cell car works excellently – the two County Administrations were

using it during the winter of 2014-2015.

There are already benefits from the experiences with the introduction of zero emission vehicles (ZEVs). The introduction of battery electric vehicles (BEVs) is a great success! It is probably at world level, the denser stock of BEVs. The two county authorities have been active in early rolling-out of charging infrastructure.

Almost all Norwegian electricity production and use is based on fossil-free, hydroelectric power. Therefore it can be claimed that all hydrogen production in Norway is green.

Implementation of the strategy will help stimulate technology and economic development in the larger capital region, and Akershus County Authority will be an active partner and will use a number of tools to promote regional economic development related to hydrogen. A regional plan for economic development in Akershus and Oslo focuses on research based commercialization, seed funding, new business ventures and cluster development, and will be followed up with relevant measures by the two counties.

In the larger Oslo region there is a growing network of companies and research institutions working with hydrogen related technologies. The network includes different fields: production from electricity and from gas with carbon capture, compression and storage technologies, vehicle components and station solutions and operation. These companies and institutions are developing cutting-edge technology that has global interest.

Environment high on the agenda for Oslo airport

The board and administration of Oslo Airport (OSL) have high environmental ambitions for the development and operation of the airport. They work hard to make Oslo Airport the airport with the least environmental impact of all major airports in Europe, and will implement the necessary measures to terminate use of fossil fuels on the airport within 2020.

Lowering carbon emissions

Oslo Airport has the best achievable carbon accreditation, the 3+ Neutrality level within the Airport Carbon Accreditation programme (<http://www.airportcarbonaccredited.org/>). The airport obtained in March 2014 the ISO 14001 certificate for good environmental leadership. This certificate has continual improvement as a precondition. The ongoing terminal project meets high environmental standards; a pre-audit confirms that the environmental certificate BREEAM with the rating Excellent is within reach.

High speed access: increasing the share of public transport in airport access

Environmental concerns were high on the agenda when the airport was planned for, and an express train (Flytoget) was built in parallel with the airport to take care of a substantial part of the transport needs of the airport. This has been a big success and Oslo Airport today has Europe's highest share of public transport, with a share of 68%, and probably also the highest share of zero emission (ZE) transport.





The 64 kilometres Gardermoen line opened the same day as the airport, and runs in a tunnel below the airport facilities with the airport station located below the terminal. The Airport Express Train has a 34% ground transport share.

The OSL 2020-goal is to raise the public transport share to 70 %, and to reduce OSL's fossil fuel needs to zero.

To help OSL with the goal to get rid of its GHG emissions Akershus is now supporting a project to replace fossil fuels with hydrogen fuel produced without fossil energy. Moreover, this is consistent with the policy of OSL's owner, Avinor, which is conducting a project to lower the fossil footprint by using wood-based biofuels in aviation.

Concept study for early introduction of hydrogen at Oslo Airport

For the last five years Akershus County Council has promoted a feasibility and concept study to examine the possibilities for early introduction of hydrogen at Oslo Airport. This may contribute to the OSL target of ending its use of fossil fuels, and can be an excellent showcase for the technology [paradigm] shift from the use of internal combustion engines to electric engines on the roads - which already has started with the battery electrical vehicles (BEVs).

The study states that Oslo Airport could be a major business case for early introduction of hydrogen, with many potential fleet actors and recommend

establishing hydrogen infrastructure that can serve both the airport, the outside transport connected to the airport, and the highway E6 which passes fairly close to the airport.

The study projects have been valuable for knowledge building and because they have helped to establish valuable cooperation with several airports that are at the forefront of fossil free-free solutions. The concept report was published in June 2015 and the Oslo airport board is to make a decision to follow up on the report's main recommendations.

Oslo airport bought its first FCEV last year and is now facilitating for a smaller hydrogen refuelling station to be set up during this summer. The HRS will be dependent on shipped hydrogen fuel, and will be connected to a national pilot project to test a concept for bulk transport of compressed (500 bars) hydrogen gas with composite tanks.

By the latest in 2017 a second, redundant and modular HRS with own hydrogen production will be necessary to serve FC-vehicles both landside and airside. Landside a FC-taxi fleet will be connected to the HRS and the first FC shuttle buses can already be in operation. Airside the concept study recommends several fuel cell based solution, among them articulated busses, baggage tractors, delivery and service trucks and some stationary applications (such as conveyors and mobile ground power units). During this period also efficient communication tools should be developed.



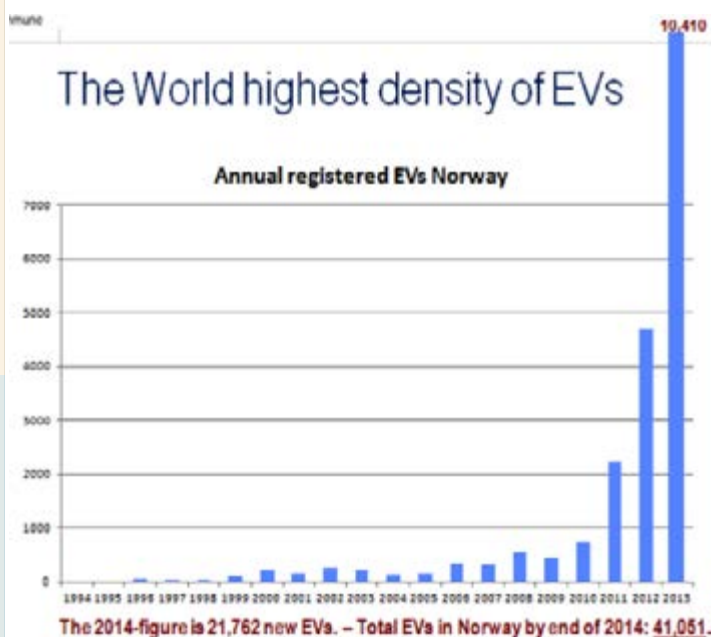
Flytoget – the Oslo Airport Express train



Implementation will take place in a public / private partnership, and in the first phase the public partners will contribute significantly both to the building of infrastructure, and to support the procurement of vehicles.

Highest density of electric vehicles in the world

The above graph shows the yearly development of registered electric vehicles in Norway from 1994 until 2013. In 2014 the number more than doubled compared to 2013, and the registration number passed 50,000 cars in April 2015. Approximately 20,000 of them use the roads in Oslo and Akershus. Today the region has the highest density of battery electric vehicles (BEVs) in the world.



The reason is simple: Since 1994 various governments introduced a variety of incentives including tax breaks for zero emission vehicles (ZEVs) and increased navigability. Norway has today the world's best incentives to buy and drive ZEVs, both fuel cell and battery electric vehicles. ZEVs are more or less fully exempt from the national car taxes, from parking fees and tolls, and have better mobility because they can use the public transport lane and park more easily. This is a sound environmental tool since the Norwegian society is based on renewable hydroelectric power.

The high Norwegian car taxation makes the BEVs relatively cheap to buy and to use. So when the variety and quantity of BEVs began to increase, not only the first movers but also common people started to buy BEVs. BEVs are however used mainly in, and close to, urban areas and in places with high road tolls – and there is a need for the FCEVs as a zero emission alternative for long range driving.

Early adopters of new technology

The citizens of Akershus and Oslo are early adopters of new technology and want to make environmentally conscious choices. This will contribute to making the capital region a frontrunner for climate sensible and zero emission transport, in order to reach the goal of becoming carbon neutral by 2050.



Ullensaker Municipality: Community Planning – Challenges related to being the host for the country's main airport

Erlend Eggum

Erlend Eggum is Chief Executive for the Department for Planning, Culture and Technical service at Ullensaker municipality, which hosts Oslo International Airport (Gardermoen).

Ullensaker - a booming municipality

Ullensaker which is a long-time member of the ARC, is a small community that has grown from a small rural village to a regional centre, and is still growing. The community is located 25 km from Oslo and has 33.000 inhabitants. Ullensaker has 24.000 workplaces, and while 17.000 inhabitants are employed (9.000 of these work within

municipal boundaries), some 15.000 persons commute to Ullensaker from other municipalities.

Jessheim is the regional centre and the centre in the municipality. It is a collective transportation hub (one out of six in the Oslo capital region) as well as the centre for public and private services, shopping and cultural activities.

Ullensaker has experienced an historic population growth after Oslo Airport Gardermoen was opened in 1998, the population has almost doubled from about 18.000 to 33.000 inhabitants and the population is expected to increase to 50.000 inhabitants in 2030. Roughly 500 new houses are built per year.

“Accessible, attractive and energetic” is the vision of Ullensaker – a booming municipality and the goal is to have compact urban development in the city centre and around the transportation hub. The objective is to maintain:

- Qualitative and safe public spaces
- “Walkability” around the urban centre
- Key public services concentrated in the centre
- Maintain and develop existing green structure

OSL – Oslo Airport

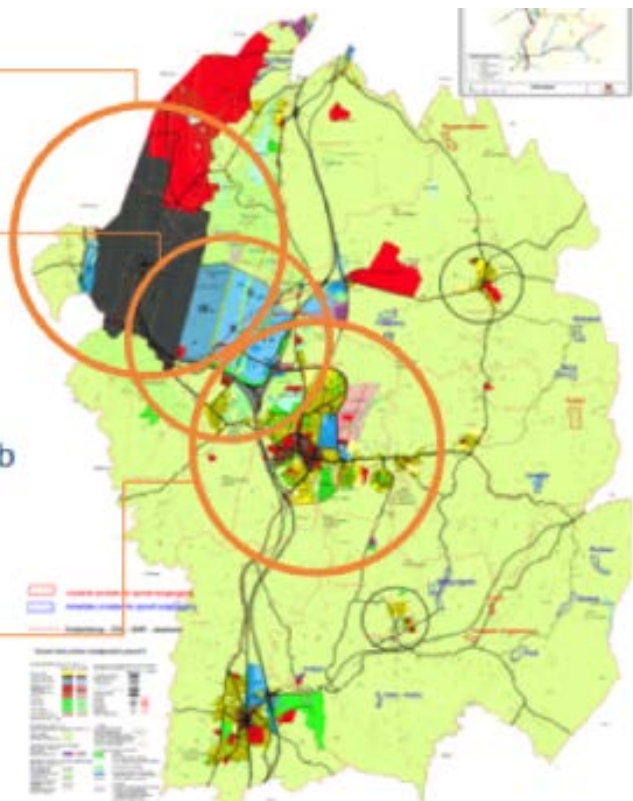
1.300 hectares
15.000 jobs

Gardermoen Business Park

Ca. 500 hectares
60 years perspective

City of Jessheim

Regional centre and collective transportation hub
18.000 inhabitants
Rapid urban development focused on good infrastructure and new housing



Oslo Airport and “Gardermoen city”

90% of the Oslo airport is hosted by Ullensaker municipality but there are several municipalities involved in the airport. The airport, Gardermoen business park and Jessheim are jointly denominated as “Gardermobyen” – “Gardermoen City” a future cohesive urban area.

Gardermoen business park is the biggest industrial centre in Norway, in many ways thanks to the vicinity of the airport.

- Planning regulation of the area allows a mixed commercial development with both knowledge-intensive businesses and logistics companies.
- So far there has been more interest among logistics companies to re-locate to Gardermoen, but this will most likely change over time.
- A new hospital is being planned for patients with cardiac and pulmonary diseases, which hopefully will be an important contribution to more knowledge-intensive firms wishing to establish themselves in Gardermoen Business Park
- Gardermoen business park has an important resource of national gravel reserves, which must be covered before the area can be built out.

Socio economic challenges:

There are challenges related to the public administration which hosts the airport on its territory: public security, infection control, acute emergency, child welfare services, social services and technical infrastructure.

Public Security

The public security responsibility entails readiness for challenges arising from an increasing threat internationally and nationally in terms such as preparations for accidents, infection control and terrorism. In relation to infection control the Ebola epidemic confirmed an increased threat to public health. Diseases that are due to socioeconomic changes internationally in relation to environmental issues, natural disasters and acts of war have changed character and have contributed to an increased threat locally. The municipality must for example be able to handle special emergency tasks such as the tsunami disaster and similar situations. The municipality maintains in these kinds of situations national tasks.

Child welfare services

The municipality is responsible for children who stay at the airport for some reason or another



Challenges for Ullensaker

However, there are several challenges for Ullensaker as the host municipality for Norway's main airport. The challenges for the municipality mean a significant responsibility on behalf of the nation and require the use of both staff and financial resources, which are not always covered financially by the state.

(detention for deportation, asylum-seekers etc). The municipality is responsible if there is reason to believe that a child has a missing parent or a bad care situation. In some cases the municipality must place children temporarily in care until the situation is clarified.

The child welfare service in Ullensaker is also responsible for children being deported from Trandum Immigration Detention Centre. This applies to children being detained along with their



parents for more than 24 hours. The child welfare service conducts inspections after 48 hours, considering the child care situation along with the parents' ability to care for their children in a crisis situation. Such control and assessment missions have increased since 2013.

Infrastructural challenges: Population growth should not mean increased traffic

The above illustration shows how the capital region with Oslo and Akershus, ought to develop to settle several hundred thousands of new residents over the next decades.

Oslo Airport is the main communication hub in Norway. Each year approximately 23 million passengers travel through Oslo Airport. Although approximately 65% of those traveling to and from the airport are using public transport, the land-based traffic density is high.

Ullensaker municipality has ever since the airport was opened in 1998 used its efforts to develop Norway's largest industrial park, Gardermoen Business Park, located between the airport and E6. The development of the industrial park is

a partnership between the municipality, the landowners and the industry. The same actors have been given the responsibility to plan and finance the new E6 crossover to the industrial park. The NPRA (Norwegian Public Roads Administration) has ordered the operators to build national infrastructure without compensating them completely economically. This has contributed to significant delays in efforts to develop the business park.

It is a national goal that population growth should not result in increased traffic; growth should provide a better basis for public transportation and making it possible for more people to travel by public transport. In our region, Øvre Romerike, it has been challenging to establish new bus routes across the region to the regional centre Jessheim and the new jobs at the airport. Most of the public transportation routes are still focused from the region towards Oslo and not connecting different locations within the region, for example the railway bypasses Jessheim from Gardermoen to Oslo. There is therefore no train accessibility for people living in Jessheim to Gardermoen even though many of the local residents work at the airport.







Hydrogen introduced as zero emission fuel at Oslo Airport Gardermoen

Kristian E. Vik

Kristian E. Vik is the Secretary General for Norwegian Hydrogen Forum and Project Manager for H2OSL, and Oslo Renewable Energy and Environment Cluster (OREEC)

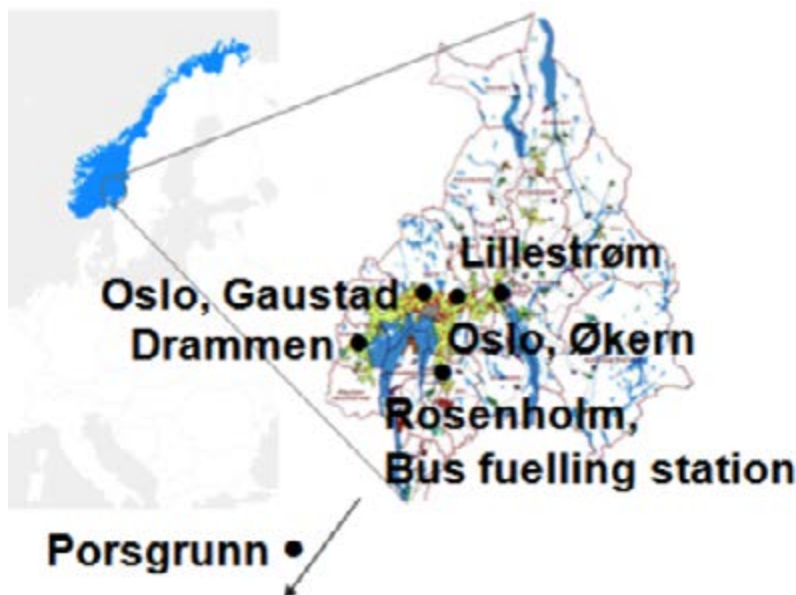
Oslo and Akershus capital region - a leader in zero emission mobility and hydrogen infrastructure

The zero emission mobility strategy is a true challenge as the Oslo capital region is one of the fastest growing metropolitan regions in Europe. It is predicted that about 300.000 new inhabitants will settle in the region within the next 20 years. The projections predict that the growth will take place equally in Akershus County and the City of Oslo.

The political decision to focus on a hydrogen infrastructure, has been taken as fuel cell electric vehicles (FCEV) have many advantages:

- Giving out zero emissions
- Range goes from 500 to 700 km
- Refuelling takes 3-5 min refuelling
- FCEVs have a superb cold weather performance, an essential factor in Norway. Actually, fuel cells vehicles have an excellent performance in all kinds of temperatures.
- They prove to be as safe as petrol and diesel cars in crash test performance:
- 700 bar storage tanks.
- There are several car models available on the market, such as Mercedes B-class and Audi A7. There are also plug-in vehicles provided by Toyota, Audi, Mercedes, Honda, Hyundai

There are currently six hydrogen refilling stations available in the Oslo – Akershus capital region and approximately 25 000 battery electric vehicles (BEV), as well as five hydrogen buses in Akershus. The buses have a range of 300 km per fuelling.



Six hydrogen refilling stations (HRS) available in 2015 in the Oslo – Akershus capital region



Bigger vehicles, bigger advantage

An electric and hydrogen fuel cells combination is available for buses, trucks and vans, and is for example used for garbage trucks.

There are currently international feasibility projects using FCEV for the railway and maritime sectors. The company Alstom have a contract on delivering 50 fuel cell trains sets to South German regions in 2017 – 2021 and Norway is also envisaging replacing classic (diesel-electric) trains with fuel cells trains on non-electrified tracks.

Both in Norway and in Scotland the focus is on replacing car- and passenger ferries with hybrid ferries (with fuel cell range extenders) for longer stretches.

The next step would be hydrogen in aviation but so far it has proven slightly more complex than trains but smaller planes have been tested with hydrogen fuel. There is hope of launching a seven-seater plane in the coming years.

H2OSL concept study

Kunnskapsbyen Lillestrøm is a centre of expertise, located east of Oslo hosting among other projects the Oslo Renewable Energy and Environment Cluster (OREEC), Norwegian Hydrogen Forum (NHF) and H2OSL for which Kristian E. Vik is working.





Prime Minister Erna Solberg inaugurating a hydrogen refuelling station at Gardermoen.
Photo by: Eirin Gjerløw

H2OSL was a concept study for the use of hydrogen for transport applications at Oslo Airport Gardermoen, which took place 2014 - 2015. It was financed by Akershus County Council, Oslo Airport, Transnova, Ullensaker Municipality, Lillestrøm Centre of Expertise and Hynor Lillestrøm.

The H2OSL Concept Study was based on the fact that the Gardermoen region in Northern Akershus, with Oslo Airport Gardermoen (OSL) comprised major logistics businesses. There is a large number of vehicles of various types at the airport. The many users, as well as employees and visitors, provided a great potential for obtaining publicity for the actions taken. The project ended simultaneously with the establishment of a small refuelling station, opened at Oslo Airport on 4 September 2015, by Prime Minister Erna Solberg.

Furthermore, Norway is internationally recognized for having a well-developed infrastructure for hydrogen for transport. A network of stations has been established during the last decade. This has made Norway a relevant country to test demonstration fleets of vehicles. This expertise and experience allow for further focus on hydrogen for transport, and

the potential to create new green jobs. The Gardermoen region provides a good business case for further hydrogen transport implementation in the Oslo region and may hopefully become a frontrunner within green aviation.

H2OSL - Recommendations

The H2OSL concept study confirmed the choice of Gardermoen region as a major business case for early introduction of hydrogen, with many potential fleet types. It recommended a two-steps implementation strategy:

- Setting up the refuelling stations: An upgraded refuelling station should be established in the near future to serve vehicles airside and landside, as well as the E6 freeway
- Development of suitable hydrogen fuelled vehicle fleets in order to stimulate the demand– shuttle buses, taxis, airport equipment vehicles - baggage/push-back tugs and other applications

During the implementation, cooperation was established between European suppliers and airports in Berlin, Hamburg, London, Frankfurt and Lyon – international collaboration should be strengthened further.

First phase: 2015 - 2018:

- The first hydrogen refuelling station (HRS) was put in operation during the summer 2015
- An upgrade of the station with redundancy by 2016-2017
- At least 50 fuel cells taxis:
- 1st batch: Hyundai +Toyota +Honda
- 2nd batch: Mercedes, Nissan (7-seater), Ford (Van)
- 6-10 shuttle buses to hotels and ~5 articulated buses
- Airport Ground Handling (AGH) equipment under assessment
- Rental cars from 2017

Planning of second phase:

- Cooperation, coordination and common procurement for deployment together with Hamburg, London, Frankfurt and others
- Possible EU projects for development and testing of ground support vehicles

Hydrogen strategy of Akershus 2014 - 2025

The strategy implemented at Gardermoen is mirrored in the actions undertaken at Akershus and Oslo counties. They adopted in 2014 a common hydrogen strategy for the next 11 years with three areas of priority:

- Maintain and develop the hydrogen refuelling station network
- Stimulation of demands (fleet development)
- Market communication and influence

Similarly, this will also be a two phase implementation strategy:

- Phase 1: Infrastructure build-up ahead of car development, demand-stimulation
- Phase 2: Scale-up and hydrogen to the gas station chains (→ energy stations)

The ultimate goal being that before 2025 the FCEV / HY refuelling station (HRS) market should be self-driven.

The first period, with very few FC-vehicles, is the most risky. During the second phase the fuel cells-vehicle stock will grow fast and the intention is to implement public private partnerships to have hydrogen fuels available (along with quick chargers and biogas) at ordinary petrol stations (and thus change them to energy stations).

A loose calculation suggests that a development to a self-sustaining market will require a total investment of some 120-125 million Euro. This investment has to be shared between the regional level, the state level, EU funding institutions and mechanisms, and late in the strategy period mainly by private sector.

Some milestones in the deployment and vehicle growth 2014 - 2025

- 8 HRS in Oslo-Akershus 2018 → 10-15 HRS in 2025
 - 3 FC bus-and-car stations in 2025
 - About 10 HRS outside the region
- At least 300 FCEVs in 2018 → 10,000 in 2025
 - The 2018-goal will depend on the supply
 - Somewhat 10,000 FCEVs should be sufficient to run the HRS network with profit
- Bus fleets growing to 100 FC buses
 - 30 buses in 2018, 50 buses in 2020, at least 100 buses 2025
- Only fossil free taxis in Oslo by 2025
 - 100 FCEV-taxis in Oslo-Akershus 2018-20
 - 500-700 FCEV-taxis in Oslo-Akershus by 2025

Including the existing stations, there are plans for eight hydrogen refuelling stations by 2018. This hydrogen refueling station network should provide fuel for at least 200 cars and 250-500 taxis.



By 2025 ten to fifteen HRS in Oslo and Akershus, and approximately ten HRS in Norway and along the main routes to Denmark and Germany, will be enough for the citizens to cover their transport needs. The strategy is based on a projection of 300 FCEVs in 2018 rising to 10.000 vehicles in the end of the strategy period. This will be sufficient to operate the HRS network with profit.

The valuable lessons learnt from the CHIC project will be used when the fleet of FC busses expands. As one of the owners of the public transport company Ruter, Akershus aims at raising the number of FC buses significantly. Also battery electric busses will be suitable in the bus fleet. The intention is that the bus fleets should support Oslo airport to be part of the fuel cells bus stock in the region.

Both Oslo and Akershus aim at getting the taxi fleet fossil free during the strategy period. The City of Oslo is now tightening its taxi regulations with the aim to get all taxis fossil free already by 2023. In the strategy period a growing FC taxi fleet will be important for the HRS economy. The ambition is to have 500-700 FC taxis in the region at the end of the strategy period.

Investments of approximately € 125 million until 2025

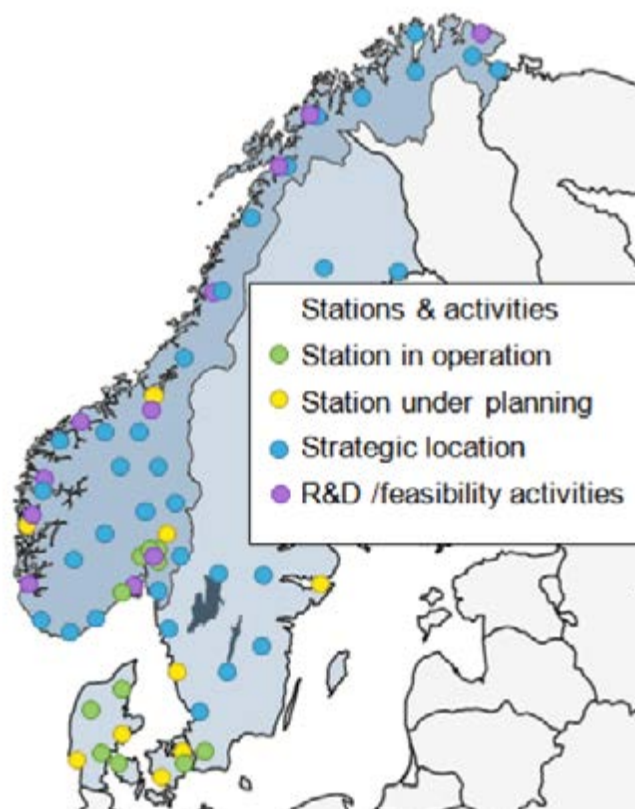
- With public contribution from Akershus and Oslo, other counties, state level (Enova) and possible EU funding (Horizon 2020 – FCH Joint Undertaking, Interreg)
- Private sector will play a major role in the last part of Phase 2

Hydrogen activities and infrastructure development in Scandinavia

Currently there are, as mentioned, in Norway:

- 6 stations in operation
- 4 under planning
- 1 bus station with 5 buses

However, the infrastructure is developing all over Scandinavia, and Denmark has a national development plan, as shown in the illustration below for the planned infrastructure development.



Hydrogen activities and infrastructure development in Scandinavia. Oslo Airport Gardermoen in Norway and Korsør, Denmark, opened September 2015. Also Gothenburg and Stockholm will get stations in Oct-Nov 2015.

Summary of Public transport and zero mission (ZE) transport

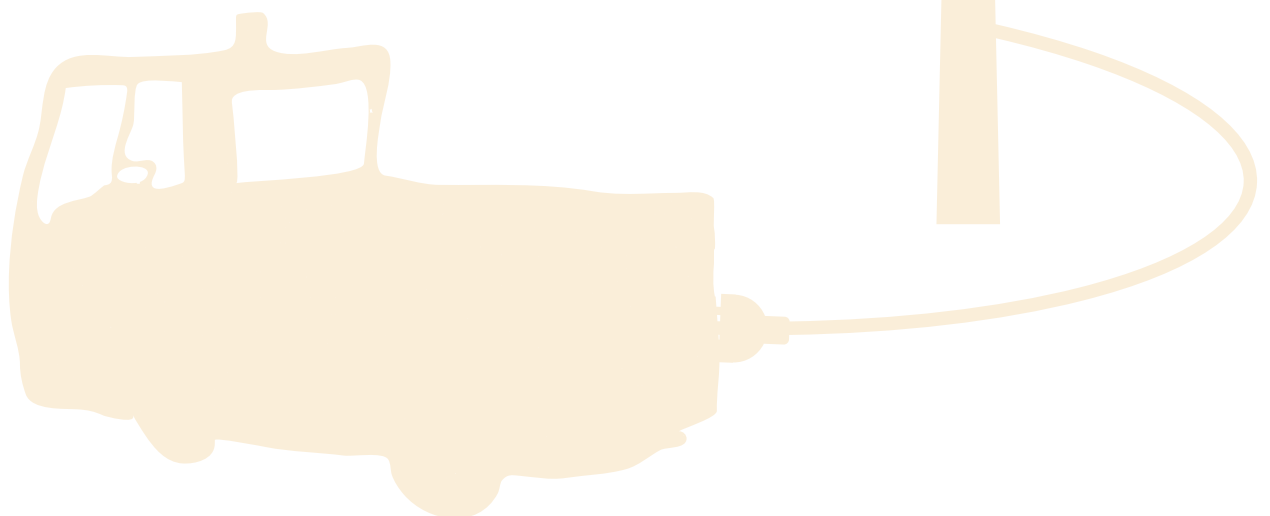
- Oslo Airport Gardermoen: currently 68% public transport of passengers, which is highest share in the world: Environmental concerns were high on the agenda when the airport was planned for, and the express train was built in parallel with the airport to take care of a substantial part of the transport needs of the airport.
- Airport Express Train (Flytoget) is 100% fossil free.
- To help Oslo airport with the goal to get rid of the airport's GHG emissions in 2020 there is now support for a project to replace fossil fuel with zero emission fuel cell technology on and in connection to the airport. This is consistent with the state airport owner (Avinor) which

conducts a project to lower the fossil footprint by using wood-based biofuels in aviation.

- The 64 kilometre long Gardermoen line opened the same day as the airport, and runs in a tunnel below the airport facilities with the airport station located below the terminal. The Airport Express Train has a 34 % ground transport share.
- Airport and regional bus network in Akershus is mainly diesel based, but FC might be feasible
- Oslo and Akershus and local transport provider Ruter to become fossil free in 2020.

- Political priority to take all local passenger growth by public transport.
- A fossil free (and zero emission) transport paradigm shift is of high complexity.
- The common regional 2020 goal is to raise the public transport share to 70 %, and to lower the fossil fuel needs substantially.

Contact kristian@oreec.no for further information.





Renewable energy and energy storage activities at Institute for Energy Technology (IFE)

Arve Holt

Arve Holt is Research Director at Department of Energy and Environmental Technology, Institute for Energy Technology (IFE). The Institute for energy technology is located in Lillestrøm, where 3,000 researchers and engineers work in the "Norwegian silicon valley". The institute is an independent foundation established in 1948 and has 600 employees. The turnover is 112 million EUR.

State of art infrastructure

The Institute for Energy Technology has a state of the art infrastructure for research:

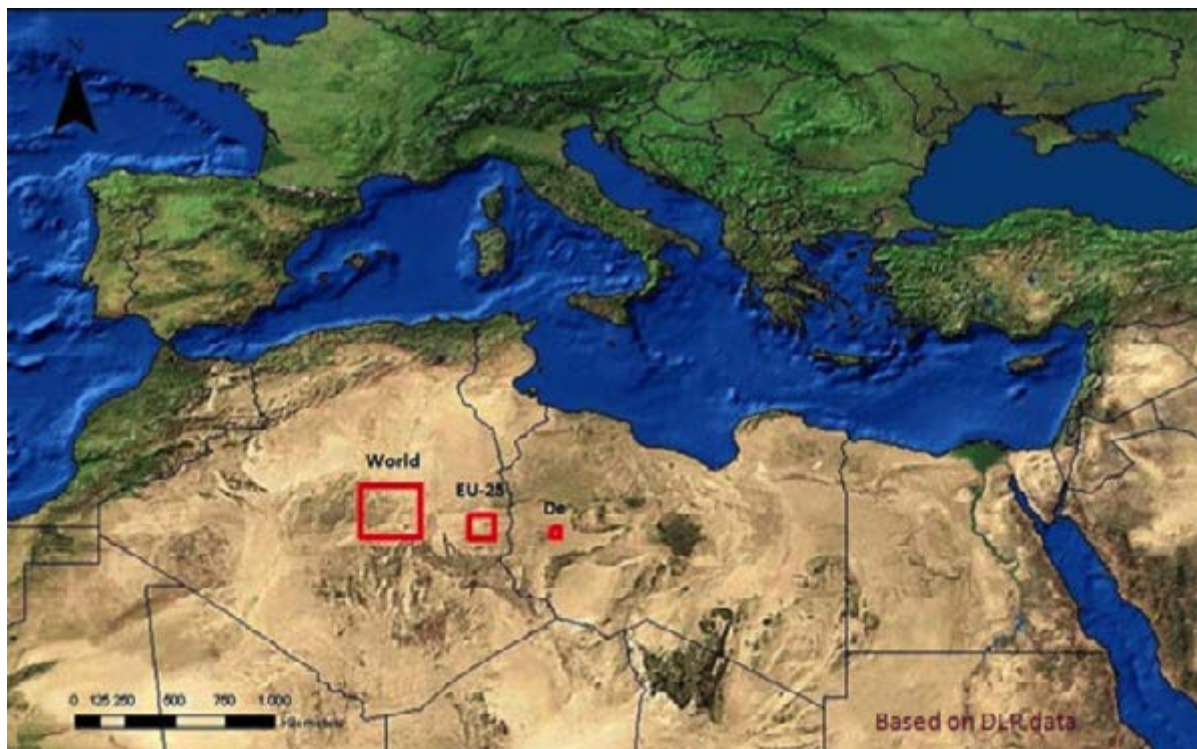
- R&D production line for crystalline silicon solar cells
- Advanced laboratory for optical and electrical characterisation
- Silicon production laboratory
- Hydrogen production technology laboratory
- Test stations for land based wind turbines
- Pilot floating wind turbine under construction

Energy and Environmental Technology

The main areas for the institute's 70 energy and environmental researchers are the following:

- Renewable energy; solar cell technology, wind energy, hydrogen as energy carrier
- Energy systems analysis
- Carbon capture and storage (CCS)
- Battery technology
- Silicon
- Radioactive waste management

The experimental capacity infrastructure includes two nuclear reactors. The renewable energy



A map of Sahara, showing the area that could respond to the total energy demand.



Picture from South Africa

section is focused on solar energy and wind energy. Solar energy is considered to be the dominant energy source in the future. The below map shows how the energy demand can be fulfilled by solar power.

Maybe surprisingly, solar energy can in fact be produced as north as Norway where solar cells have been placed on cabins in the mountains, and on boats in the fjords.

The solar panels in the photo above took one year to build. The solar panel installation is quite fast and its numbers are increasing every year.

A photovoltaic power station, also known as a solar park, is a large-scale photovoltaic system (PV system) designed for the supply of merchant power into the electricity grid. They

are differentiated from most building-mounted and other decentralised solar power applications because they supply power at the utility level, rather than to a local user or users. They are sometimes also referred to as solar farms or solar ranches, especially when sited in agricultural areas. The generic expression utility-scale solar is sometimes used to describe this type of project.

New installed power in Europe

In the European Union, the power production in the year 2000 was still mostly focused on coal (25%) while the alternative power production including waste, wind and PV only had only a few percent of the power production market.

Nevertheless, already in 2013 the share of

FIGURE 2.3: EU POWER MIX 2000

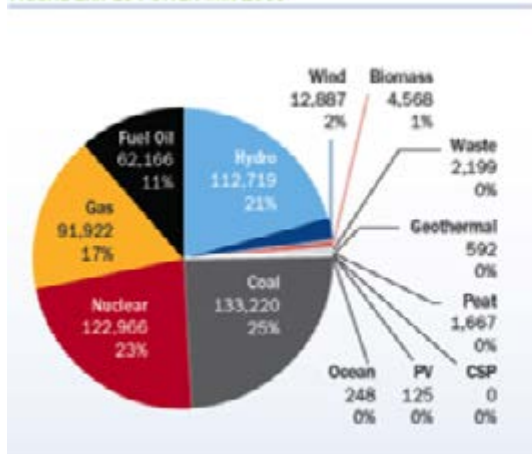
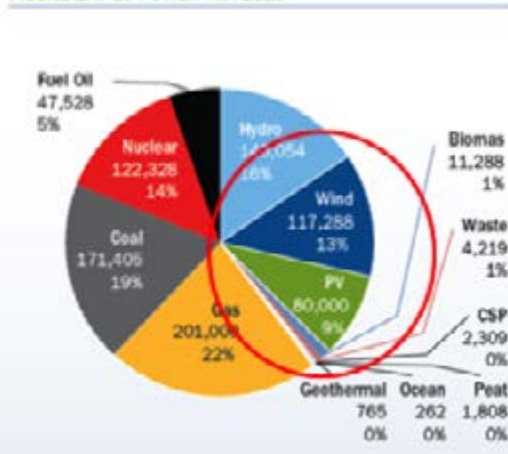


FIGURE 2.4: EU POWER MIX 2013





renewable energies such as wind power, biomass and photovoltaic (PV) production had increased substantially thanks to increased capacity, and thanks to major cost reduction, especially for PV (since 1977). In fact, there is no actual need for subsidies like in the past as the alternative energy production has become a self-driven market.

Solar cell technology research at IFE:

The main objective is to develop new novel cost efficient silicon based solar cells:

- Developing improved fabrication processes and concepts, including laser processing, and advanced light trapping
- Developing characterization methods
- Investigations of the effect of material quality upon solar cell efficiency

Offshore wind research at IFE:

The research focuses on:

- Modeling of behavior of offshore wind turbines
- Concept evaluation and development
- Design and advanced rotor aerodynamics
- Wind park wake simulations

Wind power is an important source of energy in Norway. The country has 3,000 km of coast.

However, investment is high on offshore wind turbines but prices for installations are going down. In the future it will become attractive for energy companies. At IFE research is done on simulation as well as concept evaluation.

Energy storage market at IFE

The research focuses on silicon and energy storage for solar cells and batteries. Currently part of the batteries is made of graphite, but it is possible to replace part of it with silicon and thus increase the efficiency of the batteries.

Testing is performed on commercial batteries of consumer electronics (such as mobile phones), which is the first market for graphite and the **second market is transport (buses, cars, boats) to ensure a smooth usage.**

The main objective is to develop new energy storage solutions for both transport and stationary sector, such as:

- Li-ion battery development
- Metal hydride batteries
- Testing of commercial batteries
- Hydrogen storage/compression

IFE is also performing research on hydrogen storage / compression. The institute is in fact the co-owner of a hydrogen recharging station in Akershus.

It is not probable that all cars / vehicles would be hydrogen fuelled in the future; it is more likely that most vehicles will be hybrid models, for example

Transport



Consumer electronics



Stationary



electric for short distances and for longer distances
hydrogen and therefore there is no shortage
envisaged for the production of hydrogen.





Renewable energy in public transport in Oslo and Akershus

Frode Hvattum

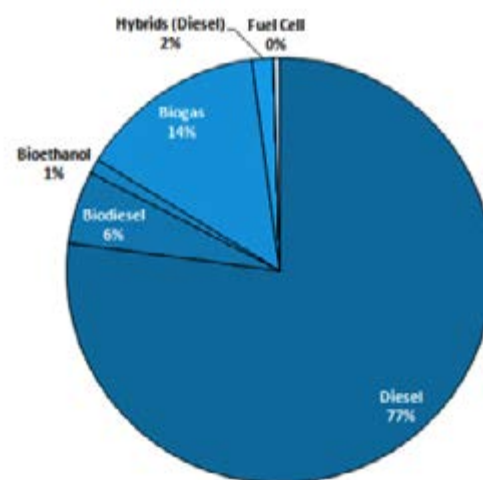
Frode Hvattum is Chief of Strategy, for the public transport company of the Oslo capital region, Ruter A/S. The publicly owned company is in charge of all public transport in Oslo and Akershus, and the fleet includes buses, trams, trains, and ferries.

Target by 2020

1. The Oslo capital region is the relatively fastest growing area in Europe but according to the 2020 target, the increase in motorised transport is to be covered by public transport, bicycle or walking.
2. All public transport is to run on fossil free by 2020. The objectives are to make all public transport use renewable energy

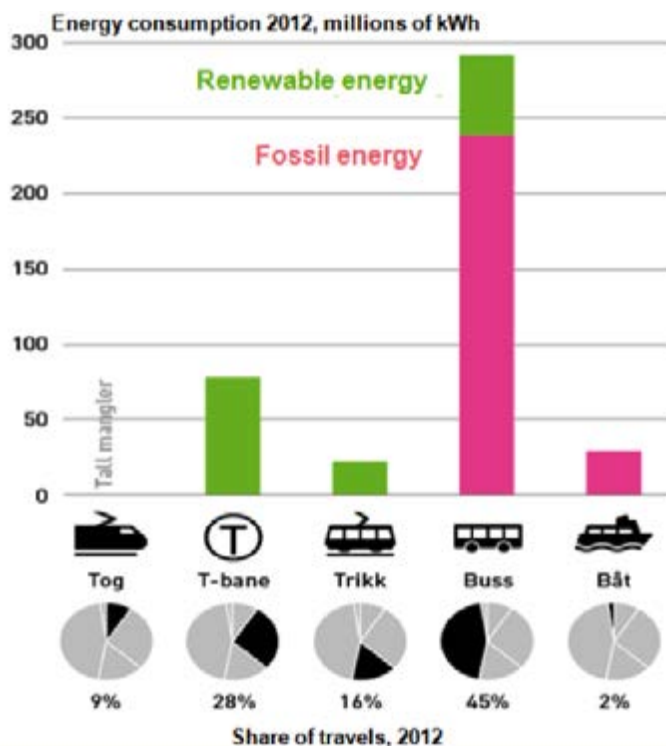
with a dynamic approach when choosing renewable energy sources. Ruter aims to introduce the most effective long-term solutions.

It is clear from the above graph that buses and ferries need to convert from fossil fuel to renewable energy in order to meet the 2020 goal. The main focus currently is on the buses since the ferry traffic constitutes such a small share of the total public transport. As seen in the picture above, buses use partly renewable energy today but diesel takes up 77% of the total fuel. Nevertheless, five hydrogen buses are being used despite 0% in the chart. These buses are part of the EU project, CHIC (<http://chic-project.eu/>).

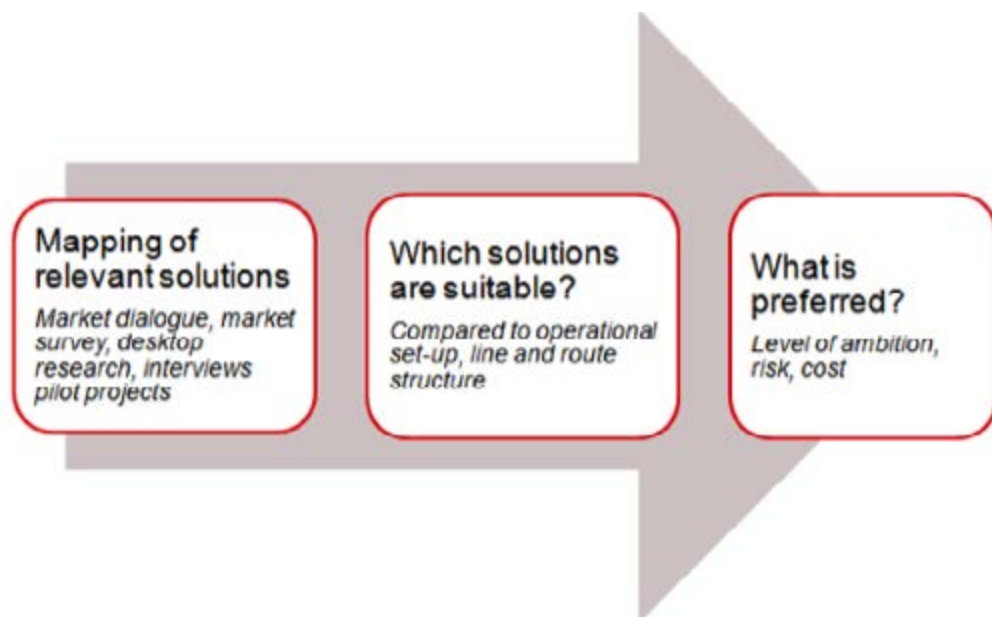


Fuels – as share of bus fleet in 2015

Ruter believes that fuel cells and battery driven vehicles will be the future. Nevertheless, biogas will continue to exist while a phasing out of traditional diesel will be done within the next five years.



Trains (numbers not available) – metro – tram – bus – ferries



The knowledge base for Ruter's strategy

How to reach the goal of only renewable energy by 2020

Ruter has been looking at how to reach the goal of only renewable energy by 2020 for the last five months and has concluded that firstly a definition of renewable energy was needed. Ruter is using the **EU definition** which has been accepted on a national level in Norway; that biofuels are fuels that comply with the sustainability criteria of the renewable energy directive, which is 50-60% CO₂ emission reduction. Also electricity with renewable energy certificates is acceptable.

Secondly, a mapping of relevant solutions was needed – which solutions are suitable, what is preferred when it comes to technology alternatives with different engines for the vehicles? For this

Ruter performed a market dialogue on different business models – who should own the new buses? The response was massive, all the bus operators and producers arrived, including a team from China. Ruter pointed out that they will be strict on the criteria – no buses which are fossil fuelled will be accepted by 2020.

The next step was the market survey – when will the new buses be available? There are pilot projects all over Europe, where different solutions are tested for suitability: existing operations, bus lines, types needed etc. The level of ambition has already been set for Ruter – a high level of ambitions for the environment.

Ruter's targets in 2025

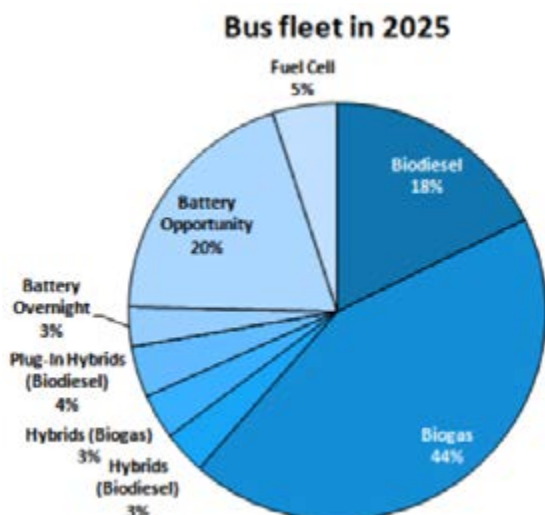
Ruter's targets for 2025 include the following:

- Environment: High level of ambitions
- Approx. 1/3 of bus fleet electric
- Large share of regionally produced biogas
- Costs (total cost of ownership (TCO)): + 2-10 % compared to today's fleet

Internal combustion engine with biofuels	• Biodiesel • Biogas • Bioethanol
Hybrid bus – combination of electric and combustion	• Biofuels + electric • Rechargeable electric + biofuel (= plug-in)
Electric bus	• Battery – recharge overnight • Battery - opportunity recharging • Fuel cell with hydrogen

Technology alternatives

However, the company obviously does not wish the environmental targets to have negative implications on quality of service for passengers. Also, there are restrictions such as the different bus lines and firm timetables, which restrict the options of vehicles. One example is that it takes on



average eight minutes to recharge an electric bus, but the buses usually stop for less amount of time at the end stop.

Key learnings - bus technology and operations

- There are a number of bus options available that can meet the needs of Ruter
- Electrification is part of the long-term solution, but not the only solution
- It is possible to have a considerable number of battery electric (including hybrids) buses around 2020, primarily in the inner city
- Charging system and infrastructure more uncertain than the bus technology
- Lines and timetables restricts the choice of bus options
- Various bus options have different impacts on operations and costs
- Trend towards opportunity recharging as

most efficient solution

- Infrastructure for recharging: Lacking standards and unknown life expectancy are main challenges
- Maintenance can be an issue on the new technology fleet but depends on the technology. Maintenance on bio-gas buses is not that complicated and the system with hydrogen runs quite smoothly. However, the overall systems of the vehicles are complex and interlinked and when the fuel technology is changed, other issues with the vehicle might arise.
- The EU project with hydrogen and fuel cell buses showed that there is high potential but the technology is still immature. These buses have higher flexibility than the classical electric buses since their range is longer (300 km) but the infrastructure needed is considerable and costly.

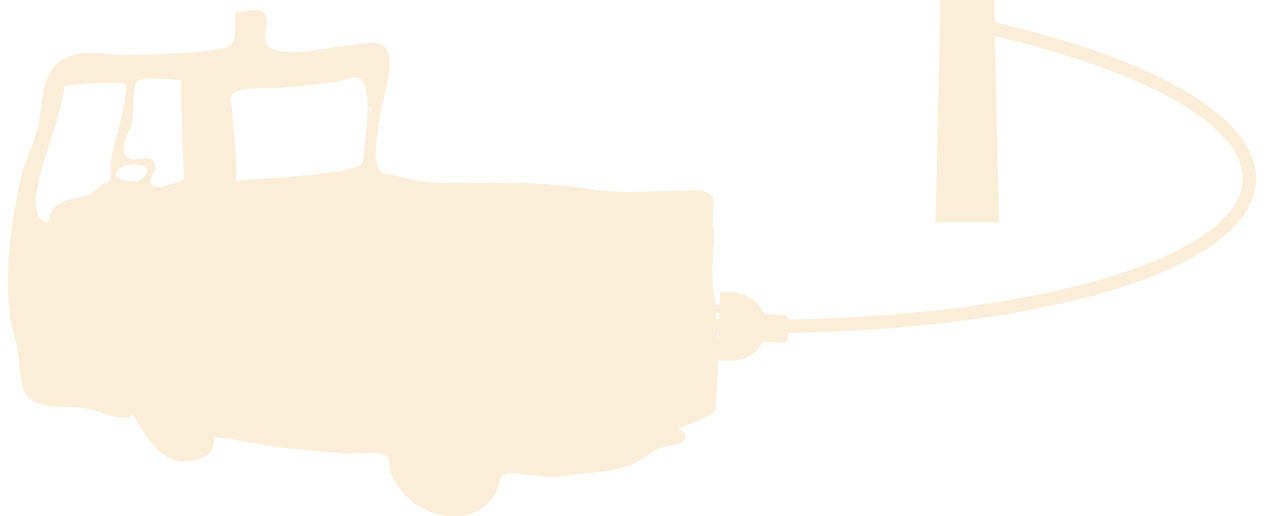
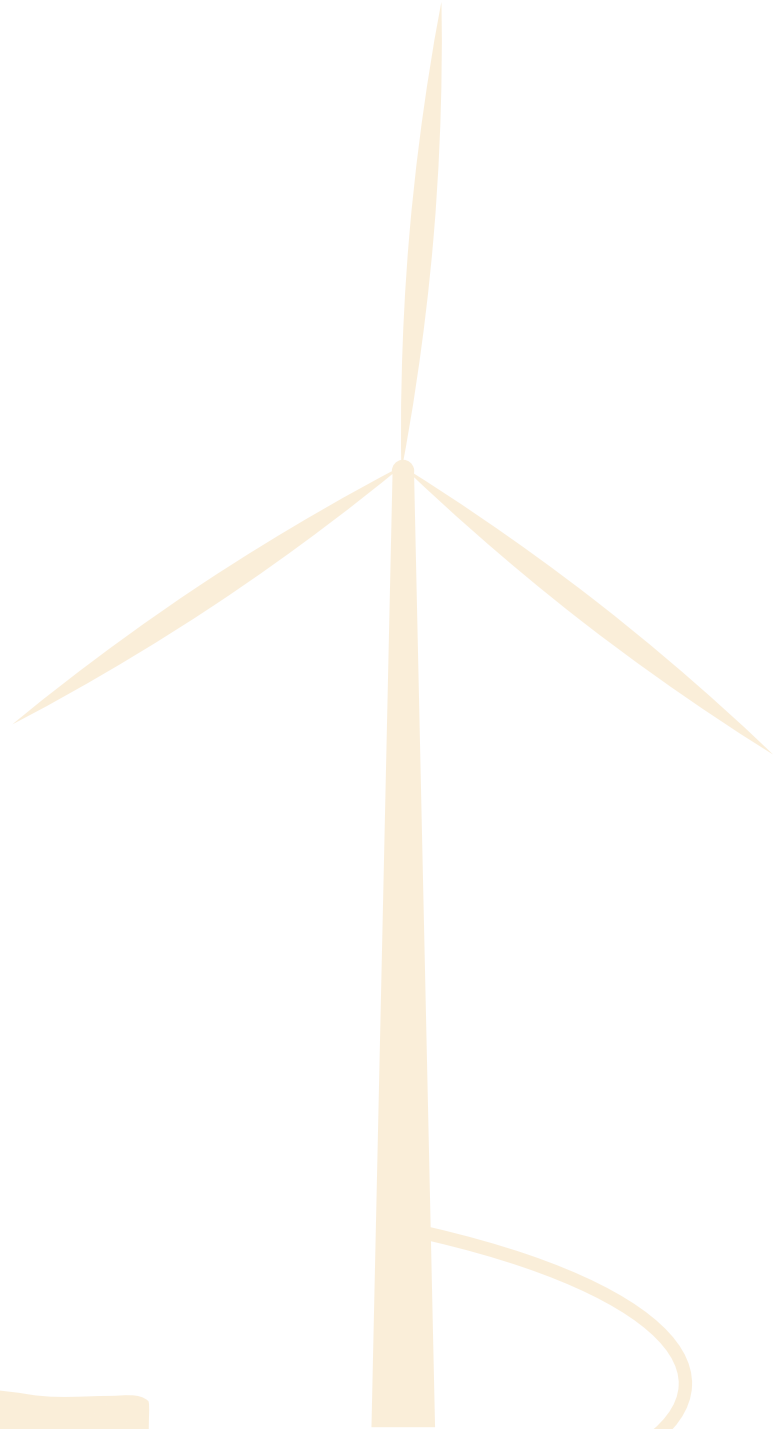


Electric boats?

Ruter is currently in the process of evaluating energy alternatives for the ferry traffic, such as biofuels, electricity or hydrogen but renewable



energy should be possible also at sea. The Norwegian maritime cluster is breaking new grounds for battery electric ships.





12 June Afternoon Session: Environment: Thinking Outside the Box

Groningen Airport Eelde – Feedback from the Green Sustainable Airports (GSA) project

Ben van Os

Ben van Os is Project Manager for Green sustainable airports and Programme Manager for Interreg North Sea and Interreg Europe for the Drenthe Province, which is the host of Groningen Airport Eelde in the Netherlands.

Towards sustainable airport management and passenger movements

Eight airports from six European countries participated in the Interreg IVB North Sea regional project Green Sustainable Airports (GSA). The province of Drenthe participated as a shareholder of the Groningen airport. Also, the province is the licensing authority and the responsible authority for public transport to the airport.

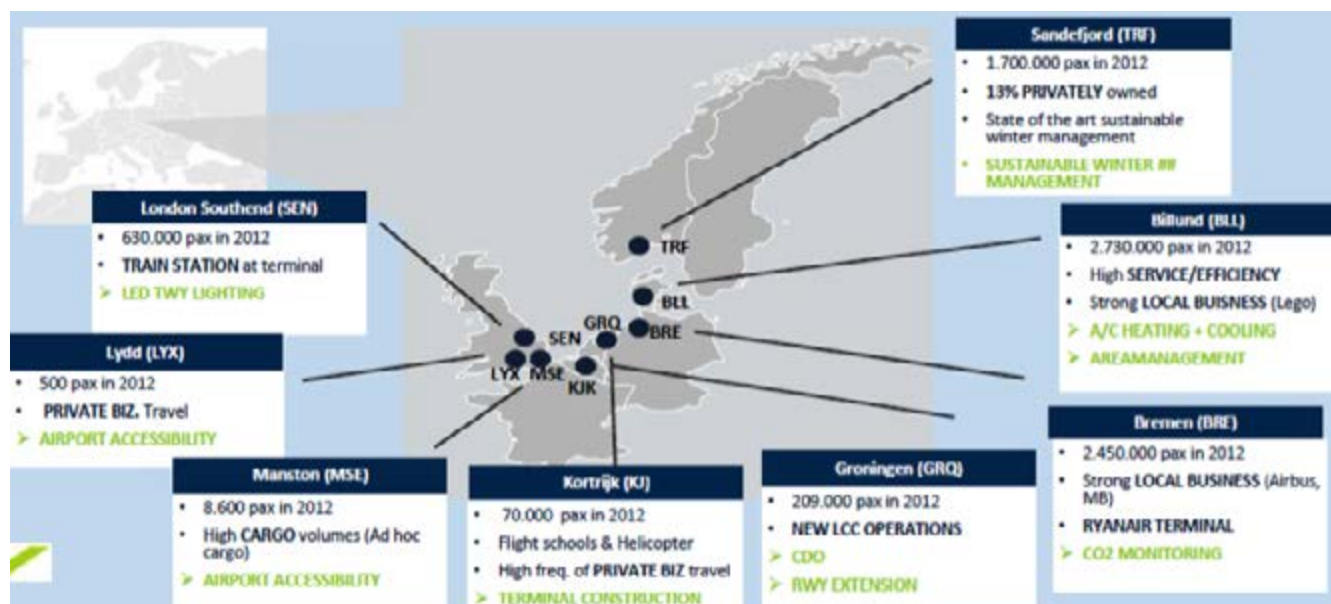
The challenges of European regional airports are caused by fluctuating demand, ever changing policies and opposition by the public. The project brought together several small and medium sized airports to cooperate jointly on various methods to make airport operations more sustainable. The focus has been on strategy, solutions and communication.

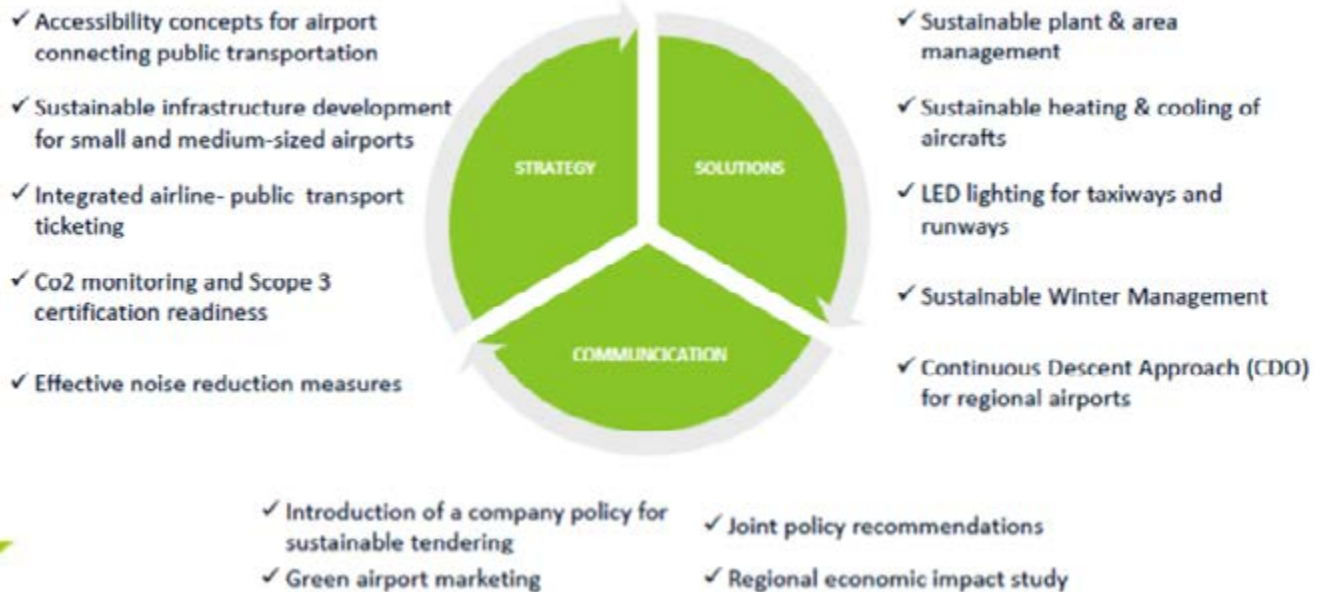
The sustainability project included solutions for infrastructure development such as noise, air pollution, and public transport, as well as solutions for greener approaches to the heating and cooling of aircraft.

LED lighting - aeronautical ground lighting

LED lighting was first tested at London Southend Airport, and thanks to its success there, it has now been implemented at Groningen airport, is being extended at London Southend and is currently tested at Billund airport (Denmark). The introduction of LED lights saved 30% on energy thanks to the change of lights.

- LED installations on taxiways can meet the current ICAO regulations and show better performance than halogen lights
- ROI for implementing LED highly depends on factors such as hours of operation, maintenance costs, staffing costs
- Potential to save around £1400 in electricity and 10 tons in CO₂ for every 1000hrs of use (of 370 LEDs on taxiways)





Runway extension

Groningen airport Eelde developed a framework for runway extension which ensures significant environmental benefits. The new runway layer was produced from recycled material and rolled out on the runway from rolls, which saved time as well as money and the environment.

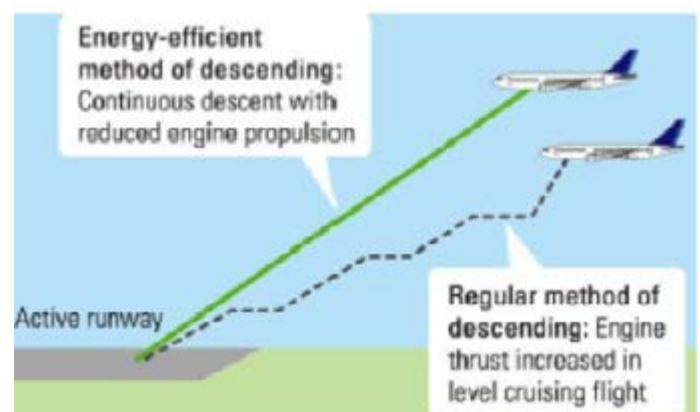
- RWY extension from 1.800m to 2.500m
- Company policy on sustainability required successful bidder to consider eco-efficient practices
- New RWY layer on recycled material (ground ash)
- Innovative tar free asphalt instead of the traditional tar layer
- LED at TWYs, turnpad and signage
- CO₂-savings by 25% (6900t) compared to similar projects
- Cost benefits 30 % on electricity (LED)

Continuous descent operations

Groningen Airport Eelde was the first regional airport in the Netherlands to introduce continuous descent operations. It took two years of discussions but the procedure is now operational, and is a benefit to attract airlines to the airport.

- Together with ATC Groningen Airport Eelde trialled and introduced Continuous Descent Operations (CDO)

- First CDO flight (gliding flight) hosted at 17 February 2012
- Higher for longer: Flying higher above ground for a longer period noise impact can be reduced, fuel and emission savings can be realised
- Challenges prevail in developing new arrival procedures (risk assessments, safety assessments etc)
- Project experience show strong support of EUROCONTROL.
- Experiences has been widely shared within the GSA partnership – other partner airports started to implement CDO locally





Electric Ground power unit (GPU) - Innovation

Part of the innovative solutions produced by the project, an electric ground power unit (GPU) was developed by Billund airport in Denmark. It has proved to be healthier for the ground handling staff to use than traditional diesel run GPUs.

- Own development at Billund Airport
- Shared with GAE
- Running costs only 10-15 % compared with diesel powered GPU
- Less noise
- Less CO2



Willows instead of grass surrounding the airport

The traditional grass surrounding the runways at an airport attracts birds, which can be a danger to aircraft taking off and landing. If the grass is replaced by willows, only smaller birds are attracted to flock there so less of a risk of bird damage.

Also, chopped willows, a fast-growing plant, can be used as sustainable fuel in district heating. At Billund airport in Denmark, the locally grown willows cover 25% of the energy needed at the airport. For the project the airport made a green marketing event together with a university and organised a contest for design students. An exhibition was held at the airport to show the world how the airport is going green in a surprising way.

District heating for heating and cooling of aircraft

The use of electricity for heating and cooling of aircraft means less emissions and less noise. Billund is now testing the application.

- Instead of using diesel powered units at terminal positions, aircraft are connected with a NILAN ventilation and heat recovery unit units
- Aircraft served by NILAN unit, providing heating and cooling via terminal infrastructure
- Provision of cooling by using electricity
- Provision of heating by local district heating, generated by biomass, solar panels
- Compared to use of A/C APU's potential to decrease CO2 emissions by 80%





Conclusions and achievements of the project

The Green Sustainable Airports (GSA) was a success story with proven benefits for partner airports which made their regions a better place to live, work and invest in. The project is over but still cooperating with the airport partners.

One of the conclusions of the project is that small and medium sized airports sometimes need a different approach than big airports. However, discussions are being held with bigger airports (e.g Copenhagen, Helsinki, Oslo and Frankfurt) and there is a real exchange of knowledge between the airports and as well as with European organisations (EUROCONTROL, IATA, EASA and the European Commission).

More information is available on the project website: www.greenairports.eu

Bird strikes: the role of local authorities

Albert de Hoon is volunteering for the World Birdstrike Association, the voluntary international forum and association of bird/wildlife strike committees and experts in aviation safety around the globe. Since 1998, Albert is working for the Ministry of Defence in The Netherlands and has been managing, auditing, training and advising the bird control units at the RNLA bases and various airports abroad.

Bird strikes cause fatal / non-fatal plane accidents

In January 2009, an Airbus had to make an emergency landing on the Hudson River when it lost power after ingesting geese in both engines above New York City – all passengers and crew survived. The first known fatality of a bird strike occurred in 1912 in the US, when a plane struck a gull and crashed. Many fatal bird/wildlife strikes have followed. See <http://worldbirdstrike.com/index.php/news/birdstrikes-in-the-news> for an overview of the most recent strikes.

Besides casualties, it is estimated that bird/wildlife strikes cost the aviation industry several billion EUR every year due to material damage and man hours to repair the aircraft. Furthermore, follow-up costs are re-scheduling of flights, paying hotel and food expenses for delayed passengers, etc. A bad safety record leading to a bad reputation is priceless.

enabling for sustainable ops	GSA airports became green – applying jointly tested solutions helped to cut energy consumption and CO2 emissions	✓
realising cost savings	Substantial cost-savings were realized by implementing energy efficient airport solutions at all partner airports	✓
driving innovation	Jointly developed and tested innovative concepts enabling reliable solution and multiplying of benefits	✓
ensuring cooperation	GSA developed a lasting cooperation platform for better exchange of knowledge and experiences in the field of airport sustainability	✓
developing an interest group	GSA became a strong self-driven and non-commercial interest group of regional airports to express positions to (European) rule-makers	✓



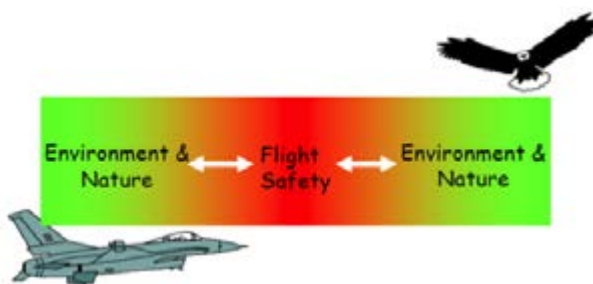
World Birdstrike Association

The World Birdstrike Association (WBA) aims to be a catalyst in improving flight safety by reducing the bird/wildlife strike risk for aviation in a cost-effective way, considering the need for a sustainable environment. This is to be achieved by encouraging and facilitating worldwide communication and collaboration amongst all stakeholders as well as rule makers and safety agencies.

Nature versus Flight Safety

Any landscape will attract wildlife, both at airports and in their vicinities. However, the numbers and species of wildlife vary per landscape and season. More important, some wildlife species are more hazardous for aircraft than others. Looking at age, young inexperienced animals are more strike prone than experienced adults.

EU and national nature protection laws may conflict with EASA flight safety laws. At the runway, flight safety has the highest priority, whereas further away from the runway/airport, nature, environment and agriculture are getting more priority. Working together will result in the most optimal priorities for all parties.



Bird migration

Many bird species migrate between breeding and wintering areas, sometimes covering half the globe. To prevent collisions with these migrating birds, radars are used to monitor their flight paths.

Some major migration routes from birds between Europe/Russia and Africa are over the Strait of Gibraltar, Italy and via the Middle-East.



Size does matter

Following Albert Einstein's law, the body mass of the wildlife and the square speed of aircraft define the amount of impact energy that is released during the collision. The body masses of European birds vary from 10 grams (Gold crest) to 10,000 grams (Mute swan) and animals like Roe deer weigh up to 25,000 grams. When aircraft are hitting a flock, the impact energy is multiplied with the number of animals that are struck.

When an aircraft at cruising speed of 800 km/h is hitting one bird with a body mass of 250 grams, the impact energy is the same as striking a 16 kilo block of concrete when travelling by car at the speed of 100 km/hour.

Aircraft manufacturers are balancing the strength of aircraft with the weight of aircraft. Making

stronger / sturdier aircraft means that the aircraft becomes heavier, which would lead to more fuel consumption and therefore more emissions and noise.

Solutions to avoid bird/wildlife strikes

All wildlife, like humans, need shelter, water and food, preferably in a safe location. As the number of birds/wildlife in the flight paths of aircraft determines the strike risk, it is necessary to know which animals are crossing when (date/time) the aircraft's flight paths. Animals like Roe Deer can be banned from the runways and airports by deer-proof fences, birds can't be stopped by a fence. Changing the actual flight direction of birds is more difficult than to influence the origin / destination of the flight. These are the location where they are looking for shelter, water and/or food. By either eliminating these, or by creating a landscape of fear, the birds will decide to move somewhere else.

Claustrophobic birds are birds that need an open view to see predators well in advance (geese, gulls, lapwings, starling for example). These are attracted to the openness of airports to rest.

For these birds, airports will be even more attractive if food is available. Most of these 'open landscape birds' are foraging on grass

(geese), earthworms and other invertebrates (gulls, lapwings, starlings).

These birds are not only hazardous when they are at airports, but also when they cross the airports when they fly from and to the adjacent farmlands. Especially during ploughing, sowing, mowing and harvesting activities by farmers, the food becomes easily available for them.

On their turn, earthworms and other invertebrates eat dead plants materials; the more vegetation there is, the more food available for them. And the amount of vegetation depends on the type of soil and ground water level. Poor, dry soils have less vegetation and hence less earthworms. Furthermore, they will attract less grass-eating geese and birds that are looking for seeds (pigeons). Therefore, the most pro-active way is to create a poor soil vegetation like heath land.

If birds are still available, they can be harassed by creating a 'landscape of fear'. Bird control units are teams of people in charge of scaring birds away from the runways. There are many harassment devices on the market, all claiming the silver bullet. Up to present, birds get habituated to them and the only real fear is still 'the man in the van', using pyrotechnics and loudspeakers to play distress calls.





International standards

ICAO and EASA have regulations for wildlife strike hazard reduction, which includes establishment of a national procedure for reporting wildlife strikes to aircraft as well as the setting in place of an ongoing assessment procedure. ICAO has a special database called IBIS (ICAO Birdstrike Info System) which collects bird strikes worldwide.

The European Commission has also adopted a regulation (No 139/2014) on requirements and administrative procedures related to aerodromes, which mentions wildlife activity harmful to aircraft operations (article 9(e)).

All stakeholders to be involved

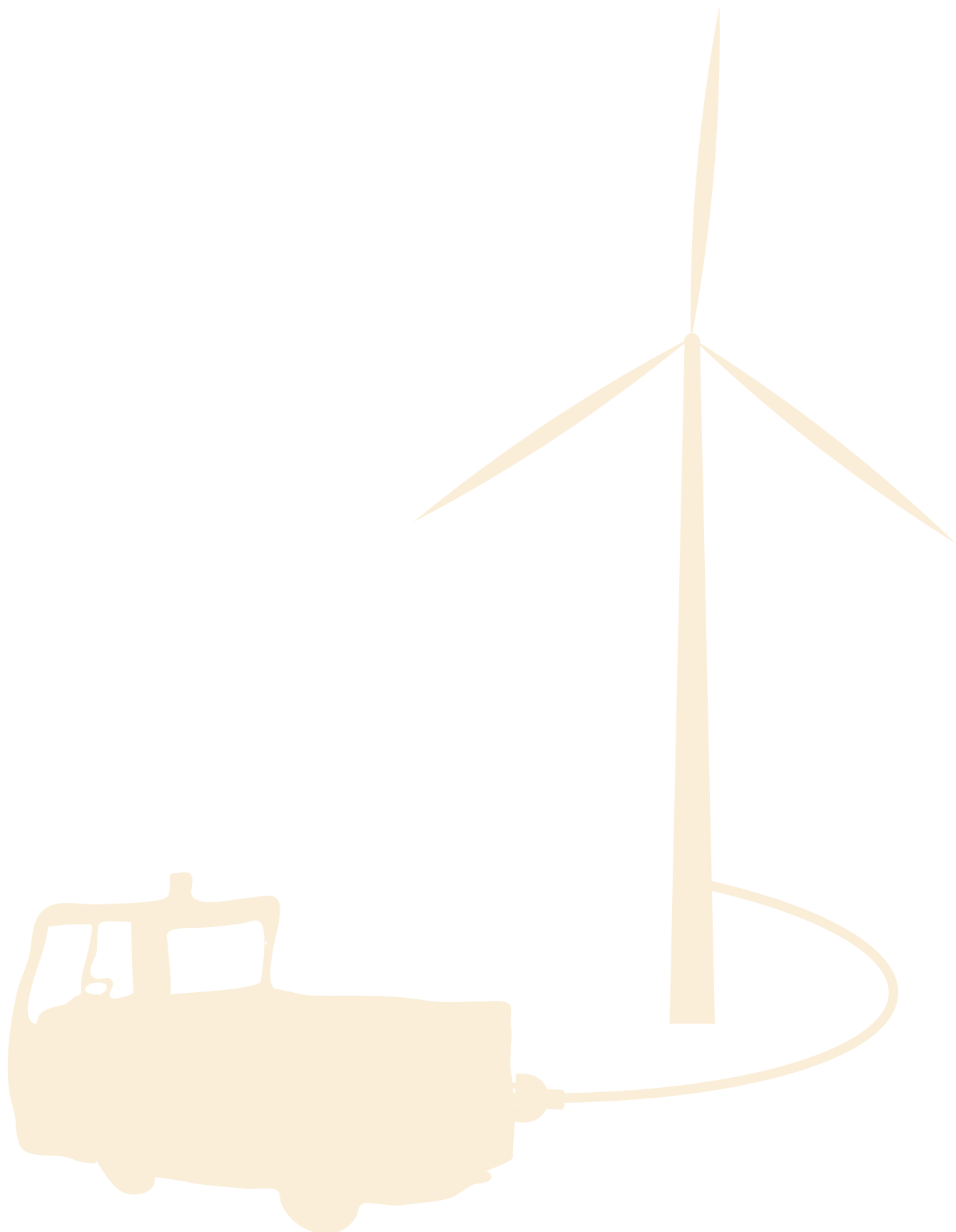
As stated before, it is important to get all stakeholders involved. National Bird Strike

Committees are the platforms for all stakeholders. Like for Amsterdam Airport Schiphol, the Dutch Bird Strike Committee is working with national, regional and local authorities, farmers, air traffic control, pilots, airlines and the nature conservation organisations to find the best solutions for all. Together they are trying to reduce the number of birds (especially geese) that cross the runways at Schiphol. The bird strike with a Royal Air Maroc Boeing 737 and at least seven Canada geese at the airport in June 2010 stressed once more the danger that hazardous birds pose towards aircraft.

Read more in the official report from the Dutch Safety Board:

http://www.onderzoeksraad.nl/uploads/items-docs/1777/Rapport_Royal_Air_Maroc_EN_aangepast_web_10012012.pdf







Eco-taxi system at Stockholm Arlanda Airport

Elisabeth Celsing

Elisabeth Celsing works as a Project Manager at Stockholm Arlanda Airport for Swedavia. Swedavia AB is a Swedish State-owned company, owning and operating the ten major airports of Sweden. All Swedavia airports are certified at the highest standard for climate work by the Airport Carbon Accreditation scheme. Swedavia's tasks include creating the access that Sweden needs to facilitate travel, business and meetings, develop the transport sector based on sound business principles and help achieve the country's transport policy objectives and to maintain the national basic infrastructure at the ten airports.

Emission cap of Arlanda Airport

Stockholm Arlanda airport is the leading airport in Scandinavia with 22.4 million passengers in 2014 (15.8 million international passengers) and 81 airlines serve 181 destinations. 17.500 employees work at and around the airport.

The vision "Arlanda 2050" envisages an extensive re-construction and extension of the airport,

as well as building of an airport city. Swedavia predicts that the airport has grown to 40 million passengers per year and that with the completion of the Airport City Stockholm the workforce would be around 50.000 employees.

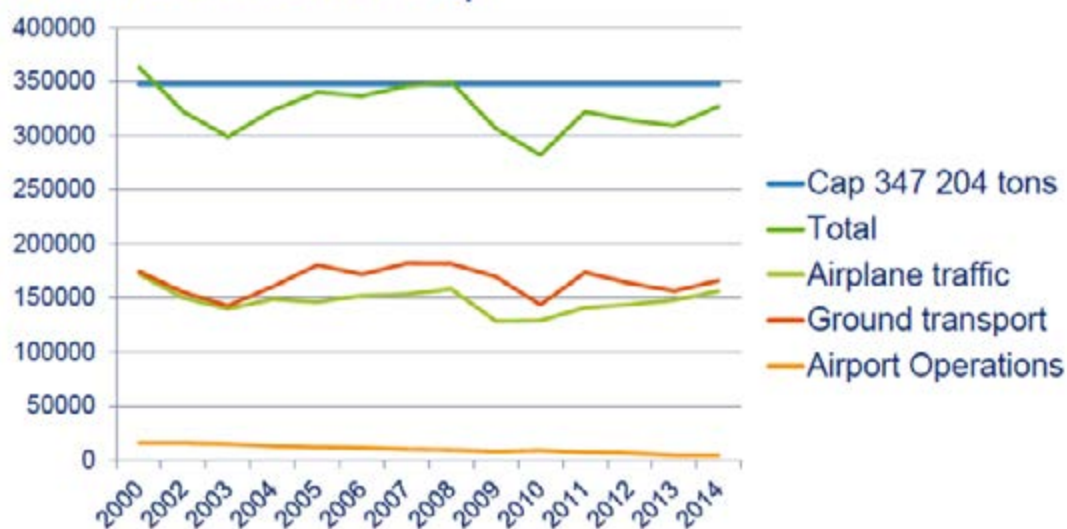
However, the extension of the airport is to be done with sustainability as both strategy and basis of operations. In practise this means that in 2020 there should be zero tonnes of fossil carbon emission from the airport's own operations. Arlanda's emission cap is probably among the world's toughest environmental requirements. There are to be no more emissions than in 1990⁴ for the energy used for ground transport (passengers starting their journey in the city centre = emissions included!), airport operations and airplane traffic (landing and take-off operations (LTO)), even though the number of passengers has risen from 14.8 million / year to 22.4 million (2014).

The Arlanda emission cap will be removed from 2016 as Arlanda received a new permit in May 2015, which combines environmental responsibility with the mission to provide much needed flight infrastructure. The airport obviously cannot control how people come to the airport and despite the legal obligations of the emission's cap, the CEO cannot be held personally responsible for the passengers' choices. However, it has the responsibility and ability to encourage different means. However Swedavia will continue to work with a plan to reduce the CO₂-emissions.

The below illustrated so-called hierarchy of preferred transport choices shows that "Kiss and fly" is the most popular choice which means a

⁴ The year when the previous airport permit was submitted

Arlanda Emission Cap





The hierarchy of preferred transport choices

maximum of road traffic and emissions (drop off and pick up = 4 trips back and forth).

Arlanda is working on reducing emissions from the different alternatives of ground transportation through eco-taxi, and the establishment of a hub for public transport. The airport has one of the biggest railway stations in Sweden with three different kinds of train services (intercity, commuter, airport express train). Also, the aviation fuel used to be transported by lorries from the harbour, but is now carried by train.

- 4.000 – 4.500 taxis / day
- 9.000 – 10.000 taxi drivers
- 4 million passengers to / from the airport per year
- Revenue of the local taxi market: 140 million EUR

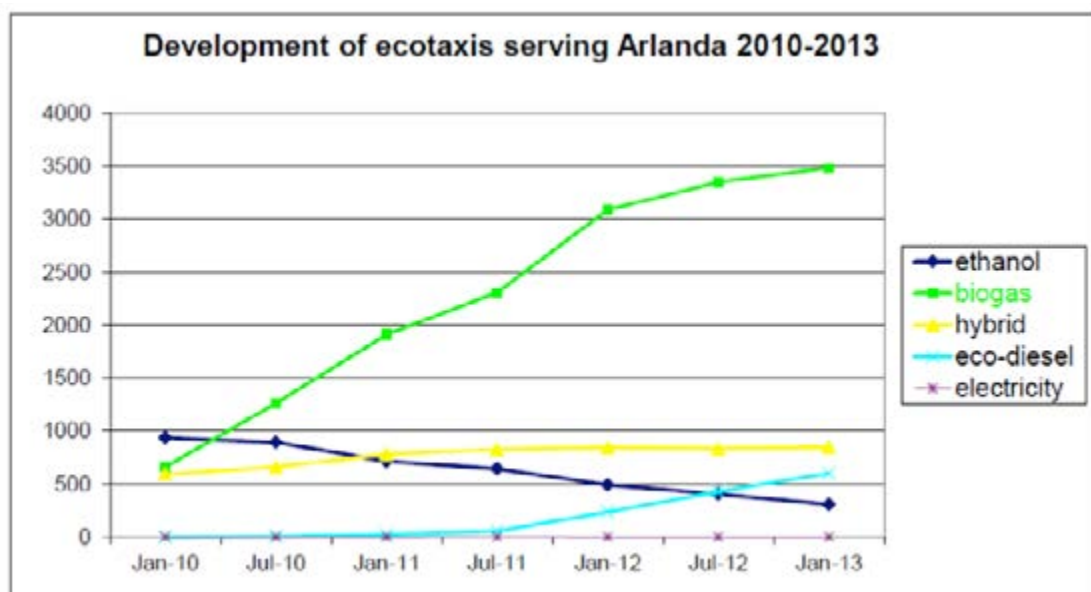
The definition of an eco-taxi is governed by the regulation on environmental cars, which means that a car has to be officially classified as an environmental car as per Swedish law⁵ to be able to participate in the eco-taxi system at Arlanda.

5 The new law on environmental vehicles from 2013 stipulates that no vehicle tax is required for the first five years if the emissions do not exceed a calculated maximum in relation to the weight of the vehicle. In other words, a heavier vehicle may give out more emissions than a lighter one.

Eco-taxi system

Some facts regarding the taxi system at the airport:

- 6.500 eco-taxis (are able to) operate at the airport





The eco-taxi system at the airport means that only eco-taxi are allowed access to the airport, and the priority to pick up passengers depends on the environmental efficiency of the individual car. For example: a biogas car gets less waiting time and priority over an eco-car that is using petrol (sent to the back of the queue). The “dirtiest” car can have to wait up to two hours for a customer. Electric cars and biogas cars will have the least waiting time. Unfortunately, so far there are no electric taxis operating regularly at Arlanda due to the distance to the city centre (approx. 50 km).

Biogas is the most common eco-taxi at Arlanda with a market share of 89% in 2014. A bio-gas station was built in 2010 just outside the airport and it is open to the public. It was necessary to provide the infrastructure to make the fuel available.

In 2005 the eco-taxis had a mere 1% market share at the airport but thanks to the eco-taxi strategy this market share has increased rapidly to 100% in July 2011. The strategy has had an enormously positive effect on reducing emissions for the taxi market in the whole region.

Challenges for the eco-taxi system

A control system has to be developed together with a partner as it is absolutely needed to perform audits by checking both the cars used as taxis as well as the fuel used in the cars. A large number of audits are performed each year. Currently a procurement process is taking place for an eco-taxi system provider, for a 4-years contract with a two year option.

The taxi market in Sweden is completely liberalised but a driving license and a taxi license are still needed. Nevertheless, each taxi company and taxi that wishes to be connected to the airport eco-taxi system needs to sign an official agreement and is given a transponder for each car. There is a remote station for the taxis waiting, with three pickup places at the three terminals, and a special queue system has been created outside the terminals with different lanes for different companies.

Similar projects are now being developed at Göteborg Landvetter airport and Malmö airport but those are not yet fully implemented. Also, the central train station in Stockholm is looking into an eco-taxi system.

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