Examples of adaptation to climate change in Europe

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Norwegian Climate Agreement

Norwegian Climate Agreement was initiated in agreement of six parties and it provides adoption of new guidelines independently of possible changes in the government

Thus, the Climate Agreement provides a long-term perspective of climate policy, even taking into account that new elections are held every four years

The first compromise was adopted in 2008 and included the Norwegian climate policy and measures to achieve the objectives

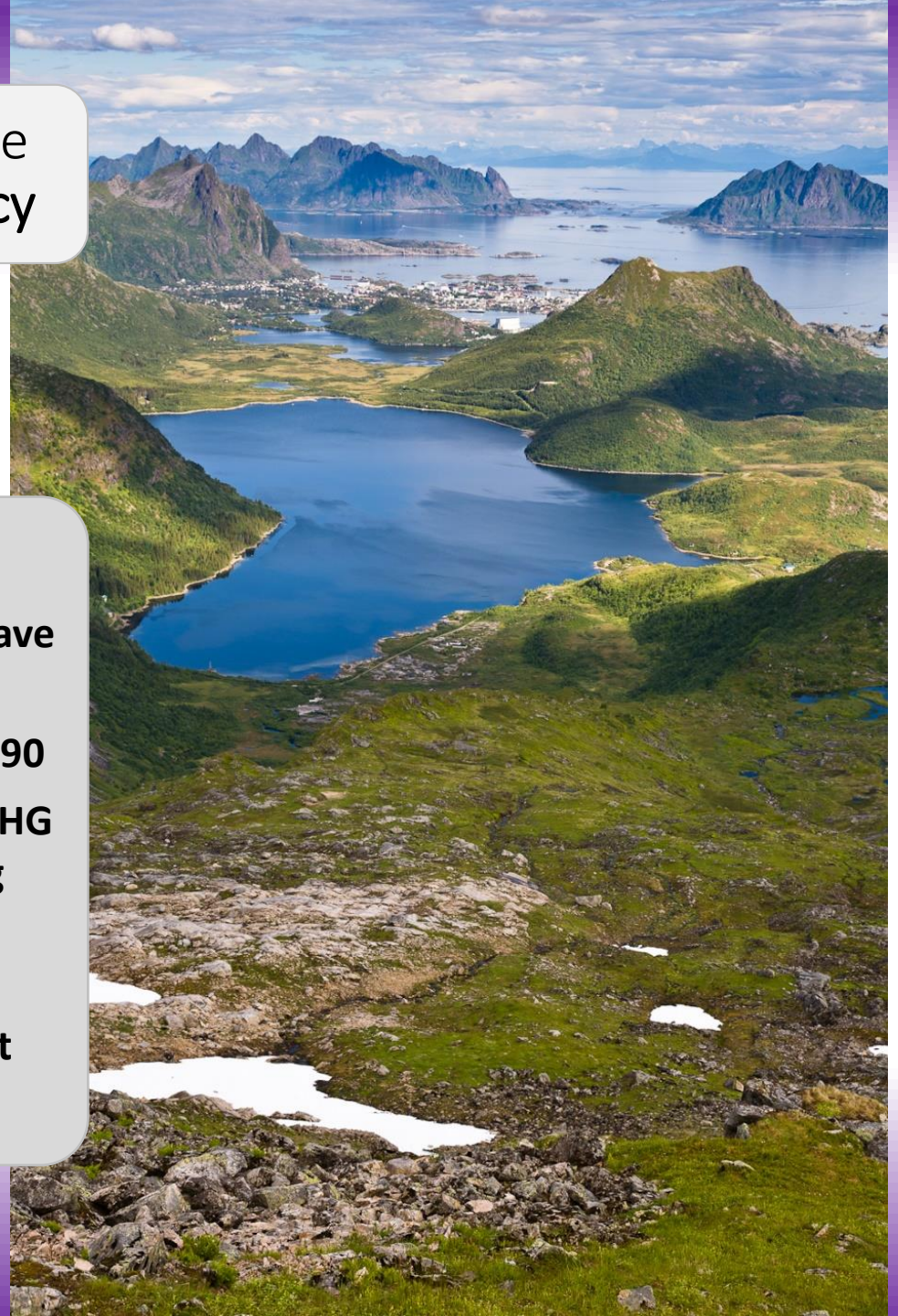
A compromise was reached among the opposition party, the Conservatives, Liberals and Christian Democrats, as well as the tripartite coalition which included the Socialist party, Labor party and the Centre party

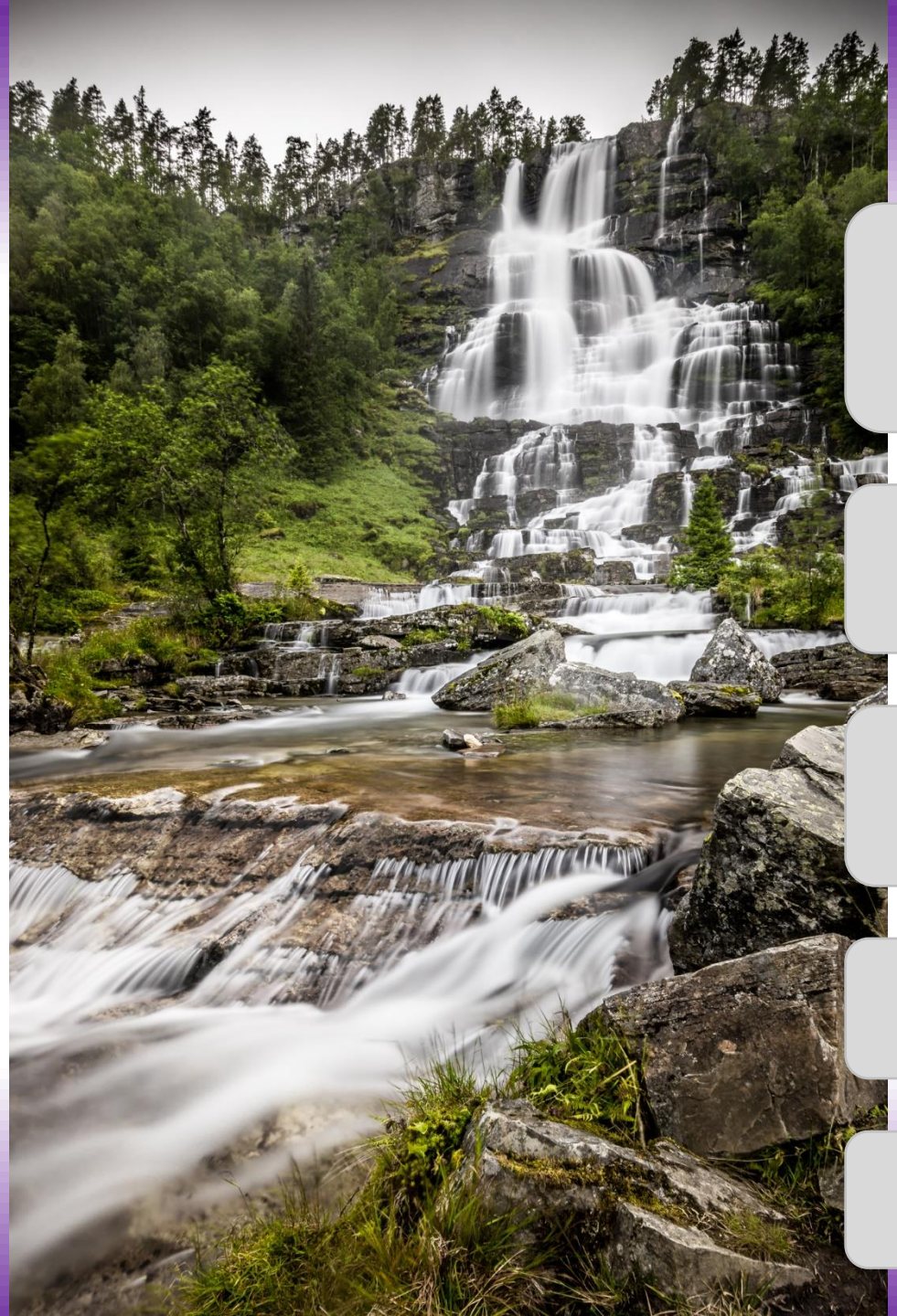
Although several of these parties had more ambitious climate policy targets and they will continue to fight for the broader climate policy objectives and measures, a compromise have set common objectives, agreed by all six parties

The agreement was updated in 2012, at the same time publishing **the White Paper on Norwegian climate policy**

The updated Climate Agreement includes following main objectives:

- **Norway will be climate neutral country in 2050**
- **Norway will be carbon neutral before 2030, if other countries will have a similar commitments**
- **Norway will reduce GHG emissions by 30% to 2020, compared to 1990**
- **Norway's climate targets will be increased up to 40% reduction of GHG emissions in 2020, compared to 1990, if the main pollution-emitting countries will commit to comparable commitments of emission reduction**
- **About 1/3 to 1/2 of emission will be reduced in Norway, but the rest will comply purchase of carbon quotas in international trade**





Some specific measures to be taken are as follows:

To provide additional financial resources for the fund of climate and technologies for the next four years to promote development of emission reduction technologies, providing increase to 50 billion Norwegian krones (5.3 billion euros) in 2020

To achieve a ban on use of crude oil products in residential and public buildings for heating during the next eight years, with a condition that households will be motivated and supported

To increase the funding for centers of clean energy research, including a new research center for wider use of geothermal energy

To create at least one demonstration equipment of full-scale carbon capture and storage demonstration during coming eight years

To increase CO_2 tax in the crude oil industry to NOK 400 (EUR 42) for 1 ton CO_2 equivalent

Fee for carbon emissions in Norway

The principle that **the pollutant have to pay for the hazardous emissions** is important element of the climate policy in all Nordic countries

Approximately 80% of Norway's GHG emissions are covered either by taxes or emission trading system, or both types together

In all the Nordic countries taxes are attributed to the energy consumption and CO_2 emissions

But it is important to not suppress the economics by increasing costs too quickly for some sectors – it is better to facilitate the transition to low-emission solutions gradually increasing the cost of pollution, as well as to provide targeted subsidies

Since 1991, in Norway, the CO_2 tax is applied for:

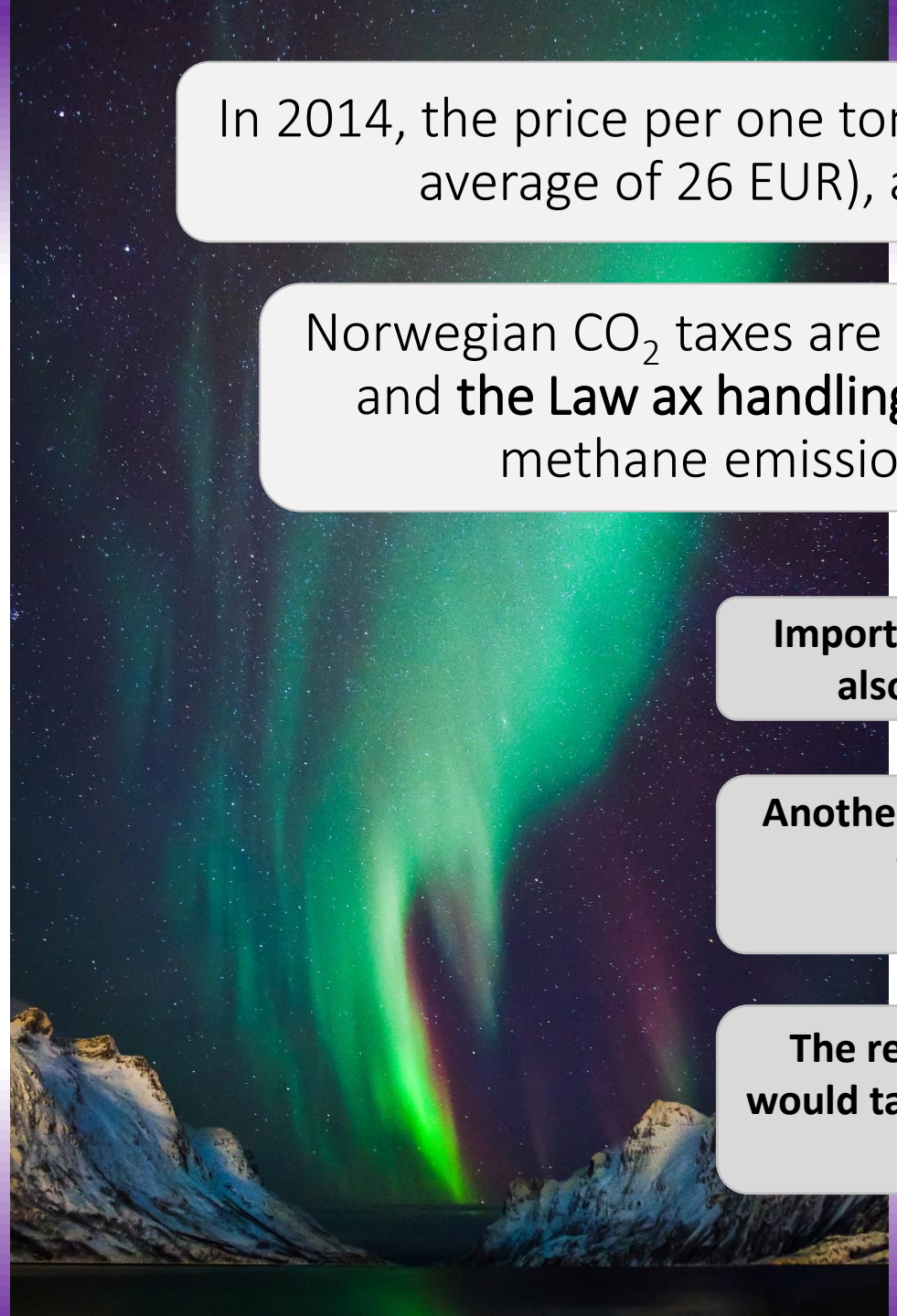
- **Fuel**
- **Light and heavy oil fractions**
- **Oil extracting in the North Sea**
- **Production of celucosis and paper**
- **Fish products**
- **Domestic aviation and shipping**

In some industrial sectors such as fishing in far and coastal waters, the industrial processes, international shipping and aviation is discharged from this tax

Emissions from international shipping and aviation are not listed in the Norwegian register of emissions because they do not release contamination within Norway

In Norway tax of CO_2 significantly varies among the economic spheres, sources and use of fuel

Crude oil platform in the North Sea



In 2014, the price per one ton of CO_2 equivalent ranged from 4 to 65 EUR (an average of 26 EUR), according to the fossil fuel type and use

Norwegian CO_2 taxes are determined by two different laws – **the Law on sales tax** and **the Law ax handling of oil in the continental shelf**; there are also taxes on methane emissions from waste disposal and emissions of freons

Important is an attitude to CO_2 payments – not just subsidizing emissions, but also to provide that governmental spending lead to increase of income

Another important reason to apply a CO_2 tax, instead of just giving subsidies, is that the market mechanism of sorts by itself where reduction of emissions is the cheapest

The result, at least in theory, should be such that the reduction of emissions would take place at the lowest possible cost to the public; a precondition for this is the same cost of emissions in all sectors of society

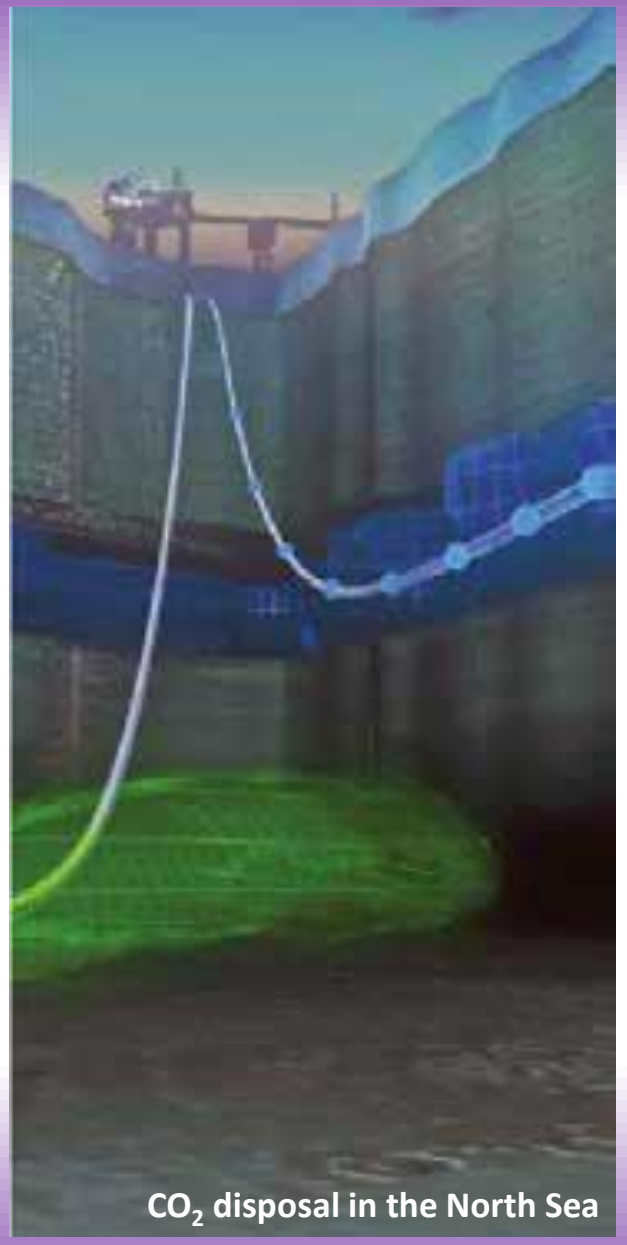
In Norway, in 2005, the system for trade of CO_2 emissions permits was introduced only in 42 companies in following sectors:

- **Central heating**
- **Wood processing**
- **Fish processing**
- **Petrochemical processing**
- **Gas processing technologies**
- **Steel and mineral production**
- **Oil rectification**
- **Energy equipment**

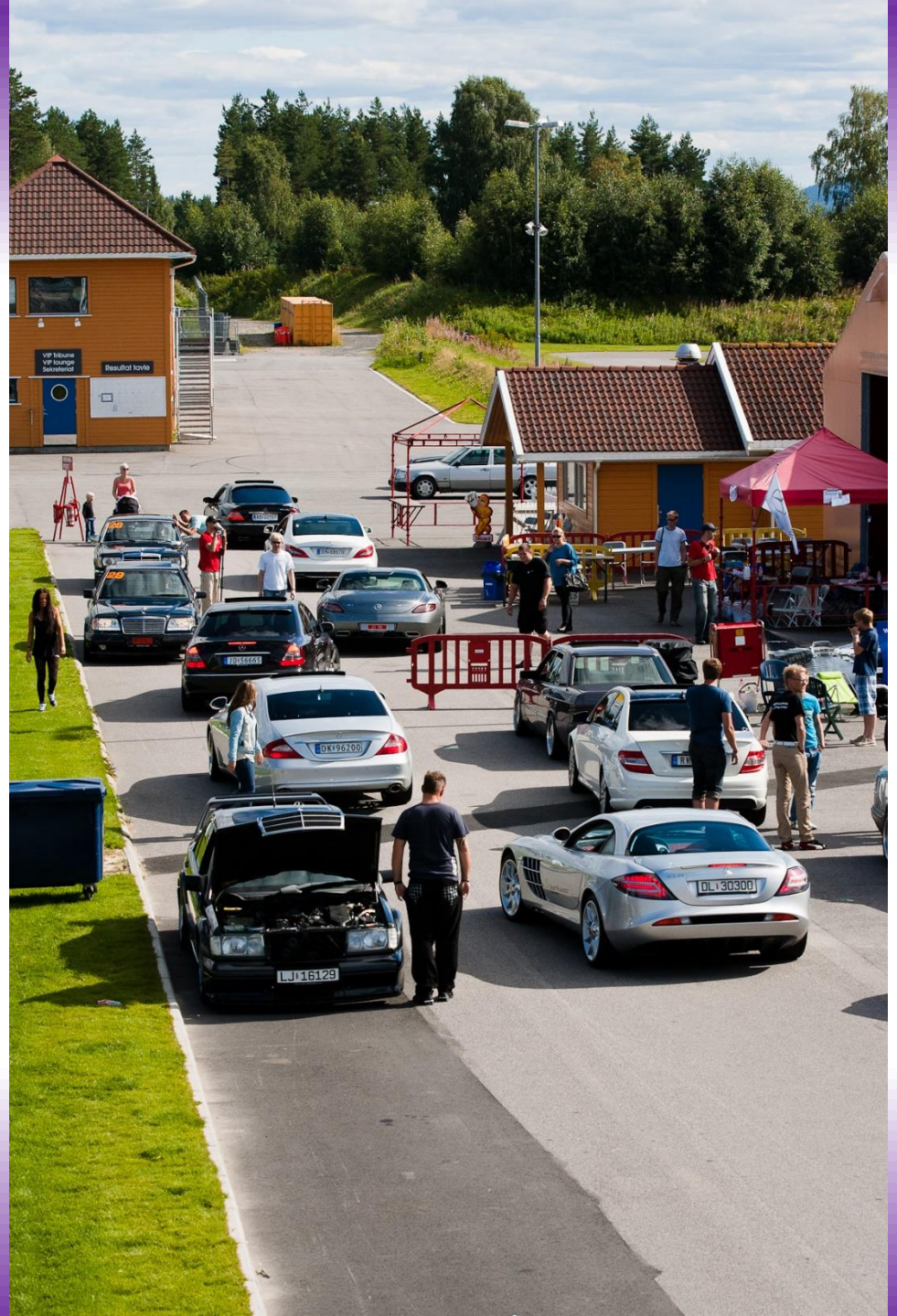
These enterprises emitted 17.8 millions tons CO_2 a year

Already more than 13 million tons of CO_2 are disposed in the North Sea

Every year since 1996 ,1 million tons of CO_2, separated during the extraction of natural gas, were disposed into appropriate structure of porous sandstone rocks more than 800 m below the sea bed



CO_2 disposal in the North Sea



Norway has a relatively high **transport taxes**, and it ranks among the world's countries with the highest taxes of this kind

Transport taxes are differenced, favoring vehicles with low emissions

Electric vehicles are exempt from the charge, but some have to pay VAT; in addition, in Norway there is a relatively high price for gasoline

Sustainable eco-village in Norway

Vision all eco-villages is similar – to practice a simplified way of life for individuals and community with the aim to reduce the carbon footprint

Only by a carefully designed structure and architectural solutions it is possible to create a truly «clean» energy houses – from the beginnign of the building up until the time when people start to live

Hurdal is a local commune (administrative unit), which is located in the east of Norway Akershus region

«Filago» is a company which for already ten years is developing projects of eco-villages with an average of 200 residential buildings

Hurdal model differs from other «green» housing development methods because the calculation includes the emissions and resources used at production and transport chain, as well as the environmental impact of the use of buildings, including necessary quality control

In addition, an indoor air quality and minimal use of artificial materials is emphasized; but properly selected infrastructure contributes to the sustainable way of life of the community and population and their resources-saving attitude

The idea originated in 1990, when a group of Norwegians came together to discuss their vision of a new and more sustainable way of life

Hurdal is the first eco-village in Norway and there are 200 houses; it is designed as «Sustainable Valley»

The local authority has set a target to make the village CO_2 neutral until 2025

Every year the use of solar panels is extended until the required energy production for all village will be achieved

In Hurdal there is designed official point of contacts between citizens, landlords and vendors – all the society has to be involved in the implementation of the common goals of the eco-village

Samso – island of renewable energy in Denmark

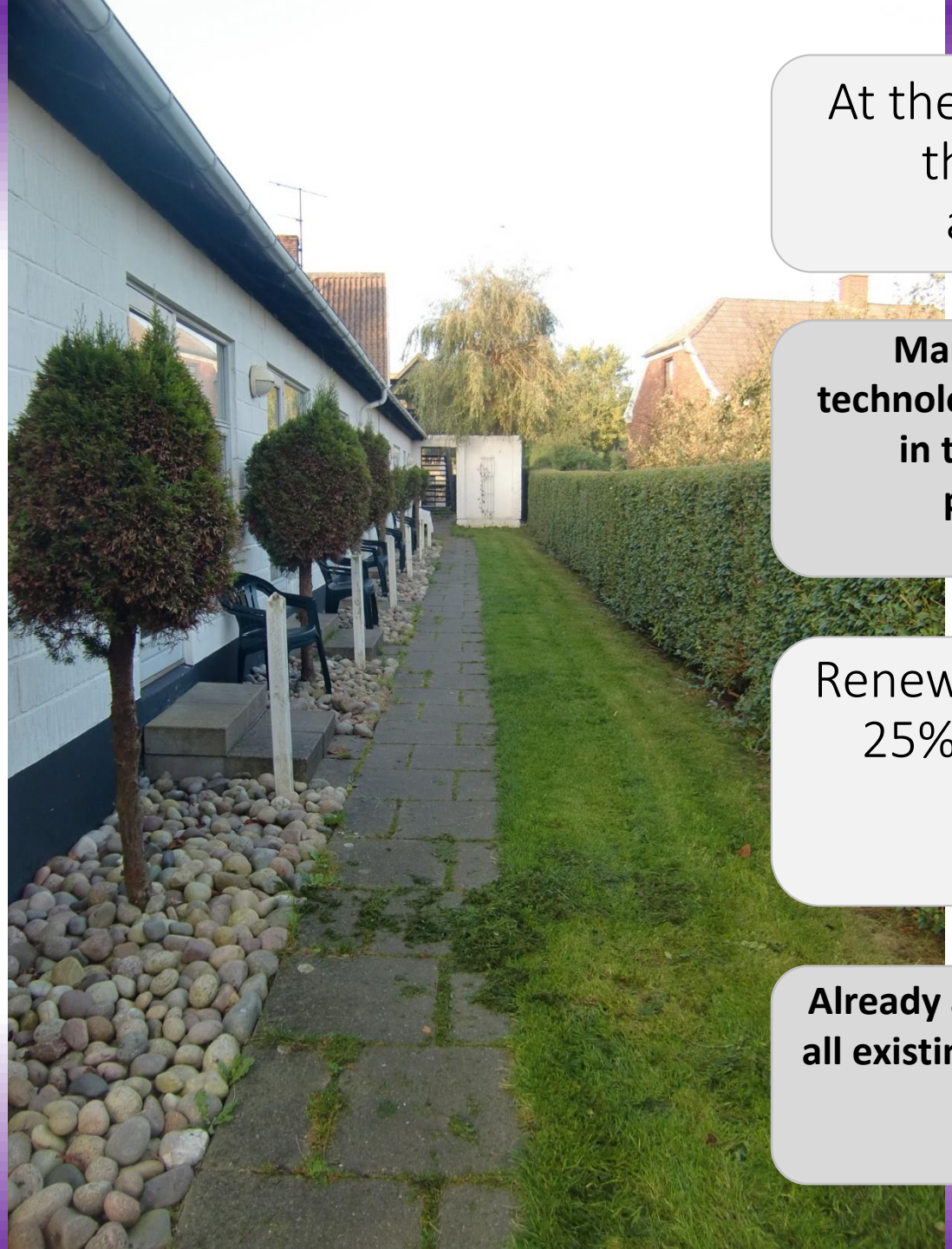
The Danish island Samso is located approximately 120 km west of Copenhagen, in the Kattegat bay in the North Sea

The island covers only 114 km^2 and there are 3800 people who are living as a model of the Danish public self-sufficiency

In 1997 Samso Island won the competition «The Danish renewable energy island» – it meant that it was expected that the island will become 100% energy self-sufficient within a decade

The plan to change the entire energy production and consumption in ten years was surprisingly spacious as the island until that time has no conventional energy sources and it was totally dependent on fossil fuel energy transported by tankers, as well as the electricity obtained through connection to terrestrial networks

To achieve the goal various participants were involved in the project , including the staff of the island of renewable energy project, inhabitants and local municipality, the Danish government, as well as domestic and foreign enterprises



At the beginning, the company «PlanEnergi» developed the island energy development plan taking into account the resources available on the island

Many local inhabitants were involved in the selection process of technologies, and later they had a chance to make a financial investment in the technologies which they had chosen – it corresponded to philosophy of the project «think local and act according to the local environment»

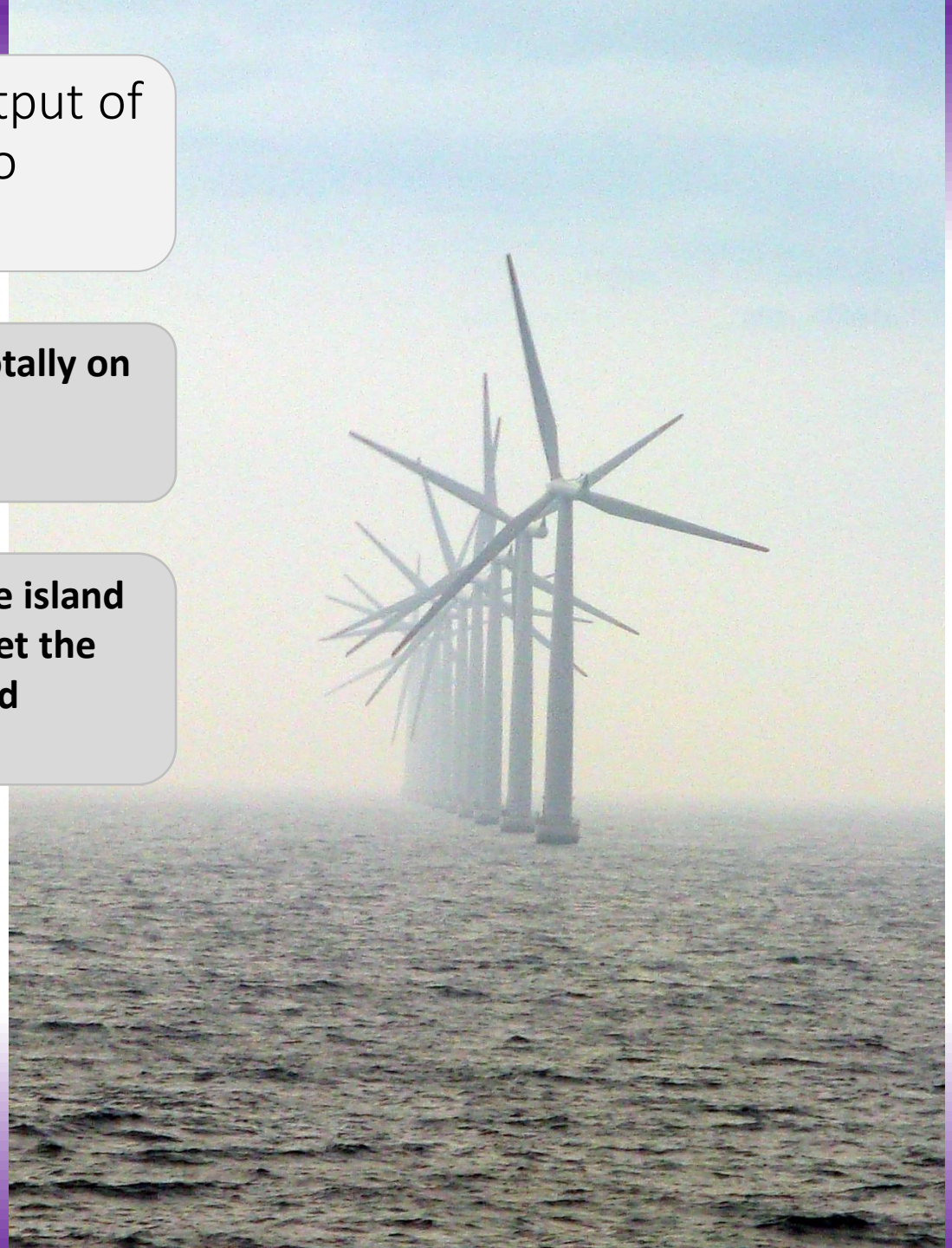
Renewable energy percentage for heat rose from around 25% in 1995 to 65% in 2005; during the same period the total heat consumption decreased by about 10%

Already at the beginning of the project the local municipality decided that all existing households either approve or reject the opportunity to connect to the central heating system, as well as all newly built buildings were connected to it

Studies have confirmed that the total electricity output of 11 MW is needed to make the island of Samso energy self-sufficient

On the land belonging to farmers wind turbines were installed: totally on the island eleven 77 meters high 1 MW wind turbines were installed divided in three groups

The installation of solar panels was subsidized and in 2005 on the island of Samso more energy was produced than it was needed to meet the needs of the island, thus, the excess of energy was exported to the mainland of Denmark



On the island of Samso during the 10-year period **following initiatives to improve the transport system** were implemented:

- **Large buses are replaced with small ones before or after peak hours**
- **Bus traffic lists are made more flexible**
- **Free public transport is expanded (savings of 10-25%)**
- **Decreased energy consumption for tractors (saved about 30% in agricultural sector)**
- **Gradual transition to electric cars has begun**

In overall, this is an example of a very successful project with 100% sustainable results, because GHG emissions and energy consumption was reduced, increased employment opportunities were increased and general socio-economic situation was improved

Consumption of oil products decreased by 15% during the period 1997-2005

Use of fossil fuels (petrol, diesel) for transport (ferries, cars) remained almost unchanged

«Green» island of Denmark – Bornholm

Bornholm is a small the Danish island in the Baltic Sea, to the east of the Denmark mainland, inhabited by 41,000 people

The island has launched a project «Bright Green Island», and it aims to create a sustainable, carbon-neutral society until 2025 which should be self-sufficient with renewable energy

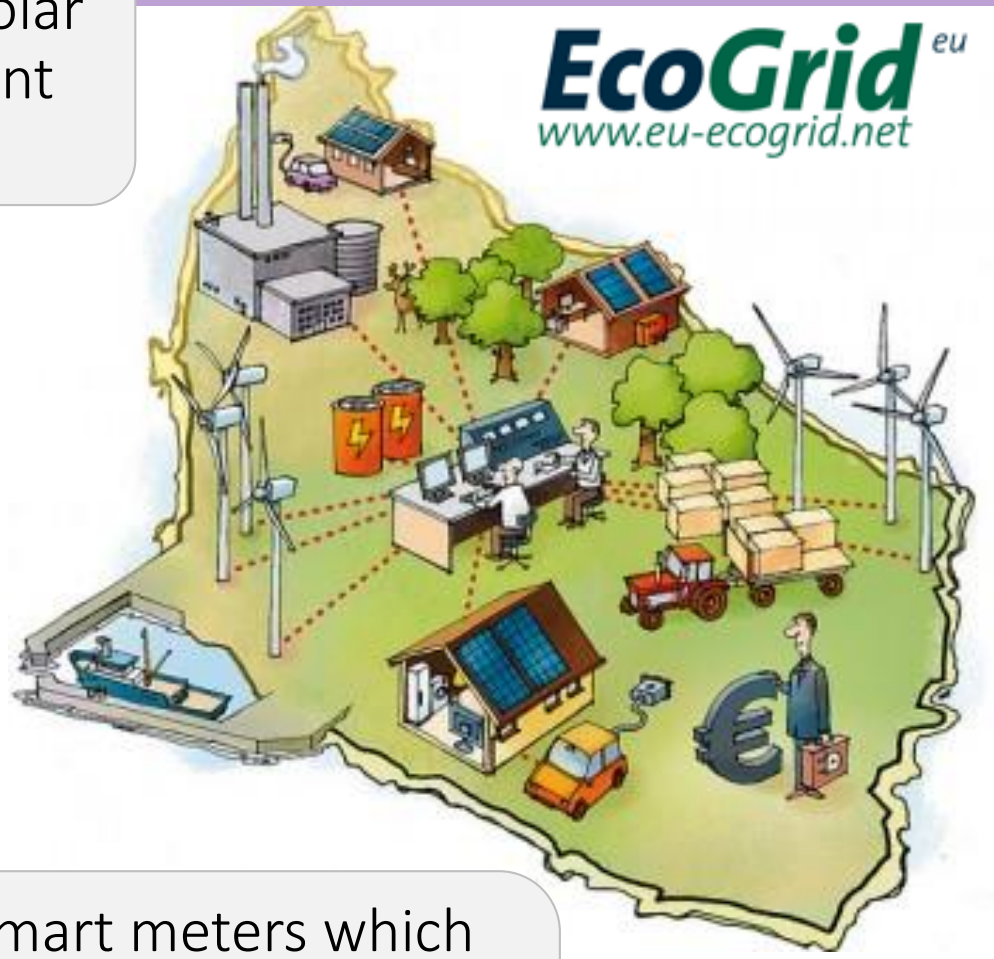
Inhabitants of Bornholm agreed on that the solutions should not be too large or conducted by big companies –

This would encourage local, integrated solutions with comprehensive support in the local community, as well as give an opportunity to test a number of different projects in the conditions of island

64% of energy in Bornholm is produced by wind, 1% by solar energy and 10% from biomass, which together represent 85%; the remainder relates to coal 18% and oil 7%

With the goal of «good life» the project is achieving much more than one would get from the use of new technologies

Inhabitants of Bornholm are effectively prepared for the use of new energy system and are well-informed that a flexible electricity consumption contributes to preserving a balance in the electricity market



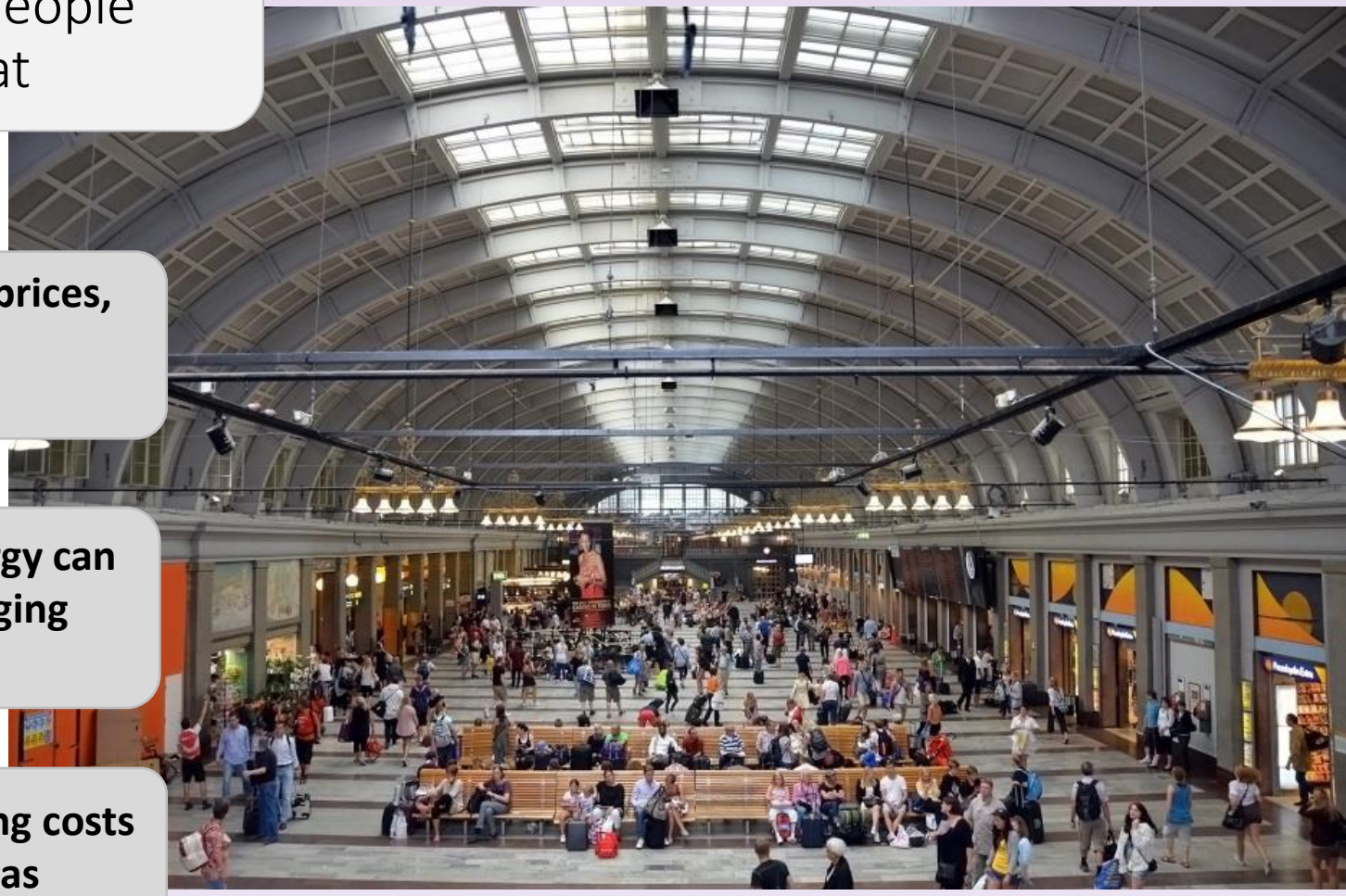
Participants of the EU EcoGrid project have received a smart meters which show the price of electricity every five minutes - it allows direct participation of end-users in the electricity market, adjusting consumption increase or decrease depending on the price

Other implemented technical projects in the island of Bornholm:

- **Full implementation of test equipment for smart R&D networks using Bornholm as a test network**
- **In Bornholm placed solar panels units starting with 2 MWp**
- **200 individual households are equipped with automatic frequency control devices**
- **250 private households are equipped with a full automatic control of all electrical equipment**
- **In 150 private houses fuel oil boilers are replaced to heat pumps with remote control**
- **The preparation for a project with five fuel cell micro-cogeneration installations in private houses**
- **Electric vehicle project in Denmark with demonstrations in Bornholm, which provided an opportunity to clarify if electric vehicle, which has been plugged in, can reload electricity back to the grid when network power demand is high**
- **Bornholm has been selected as an energy laboratory in a project to carry out the research on the intelligent charging of electric vehicles using wind energy**

Heating of office building with body heat in Sweden

Through the **Stockholm Central Station** each day to are passing more than 250,000 people releasing a large amount of heat



Taking into account cold winters and high energy prices, Sweden is looking for alternative ways to heat the buildings

Instead of body heat is diffused in the air, this energy can be used to heat an office building nearby, belonging to the state property company

This solution for the certain building reduces heating costs by even 25% compared to the use of natural gas

Stockholm Central Station is the largest and most active railway station in Sweden

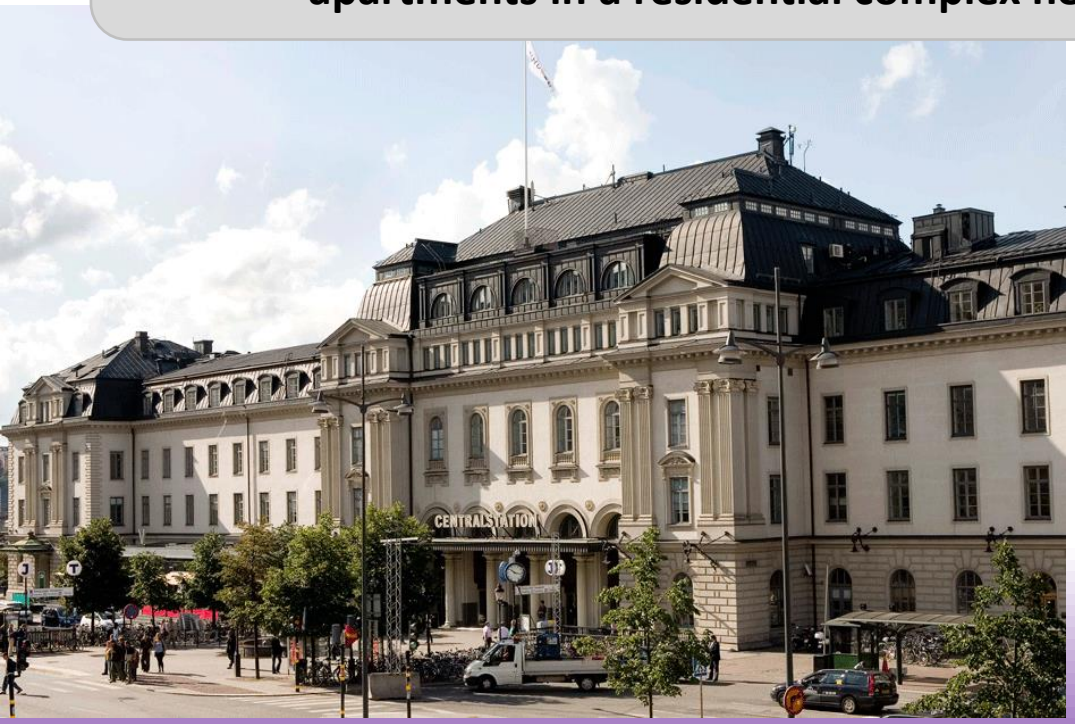
Trains, shops and people at the station are releasing enormous amount of heat that is usually ventilated to the outside

Although the heat exchangers are not re-invented technology, but a challenge to transfer heat from one building to another requires a long-term cooperation between the two building owners

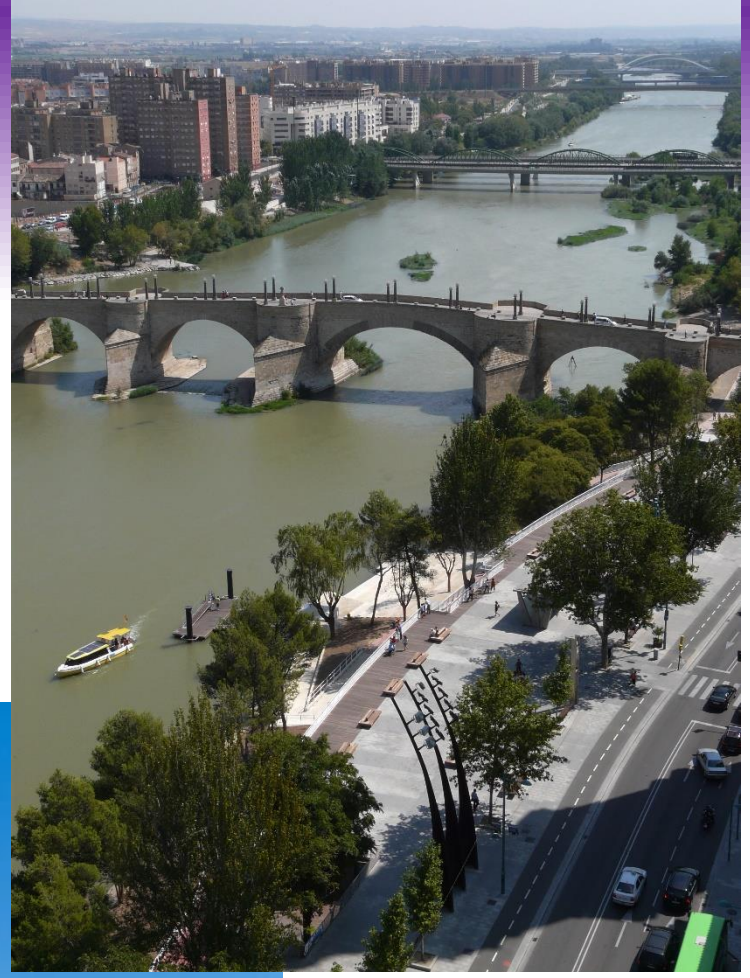
Now the excess heat from the central station is transmitted to a nearby office building Kungsbrohuset

The area of the office building (Kungsbrohuset) is 40,000 m^2; heat transfer is a better solution than the use of lake water for cooling of the station

This project of Stockholm has inspired a similar initiative in Paris, where heat from the metro station is used to heat the apartments in a residential complex nearby



«Water Saving Program» of Zaragoza in Spain



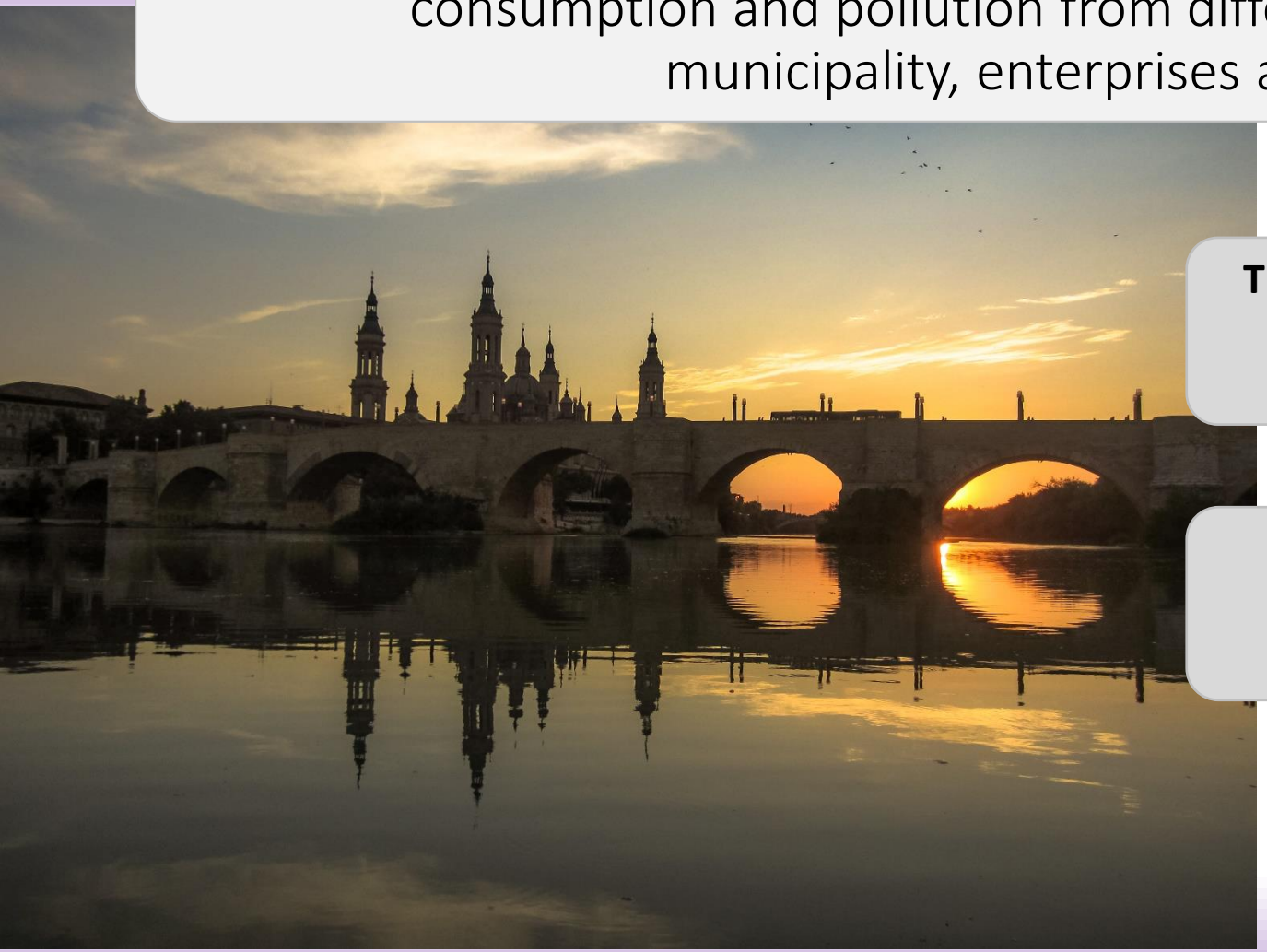
Zaragoza city is located in semi dry climate zone, north east of Spain where average precipitation amount is only 314 mm per year and, therefore, most of the water supply is taken from the largest river of Spain – Ebro

Due to the fact that the river level is changing depending on the season, but the water quality is low and also due to the extended drought, the «Water Saving Program» was started in 1996 to solve the water scarcity problem in the city of Zaragoza

Urban population growth and rapid economic development were additional factors which even more strengthened the need for a water-saving program

In addition, the program should increase the stability and flexibility in relation to climate change in the 21st century

The main objective of the «Water-saving program» of Zaragoza was to reduce water consumption and pollution from different consumer groups, local municipality, enterprises and local residents



The program also provided an increase of revenue from water consumers to fully cover the cost of water supply and waste water treatment

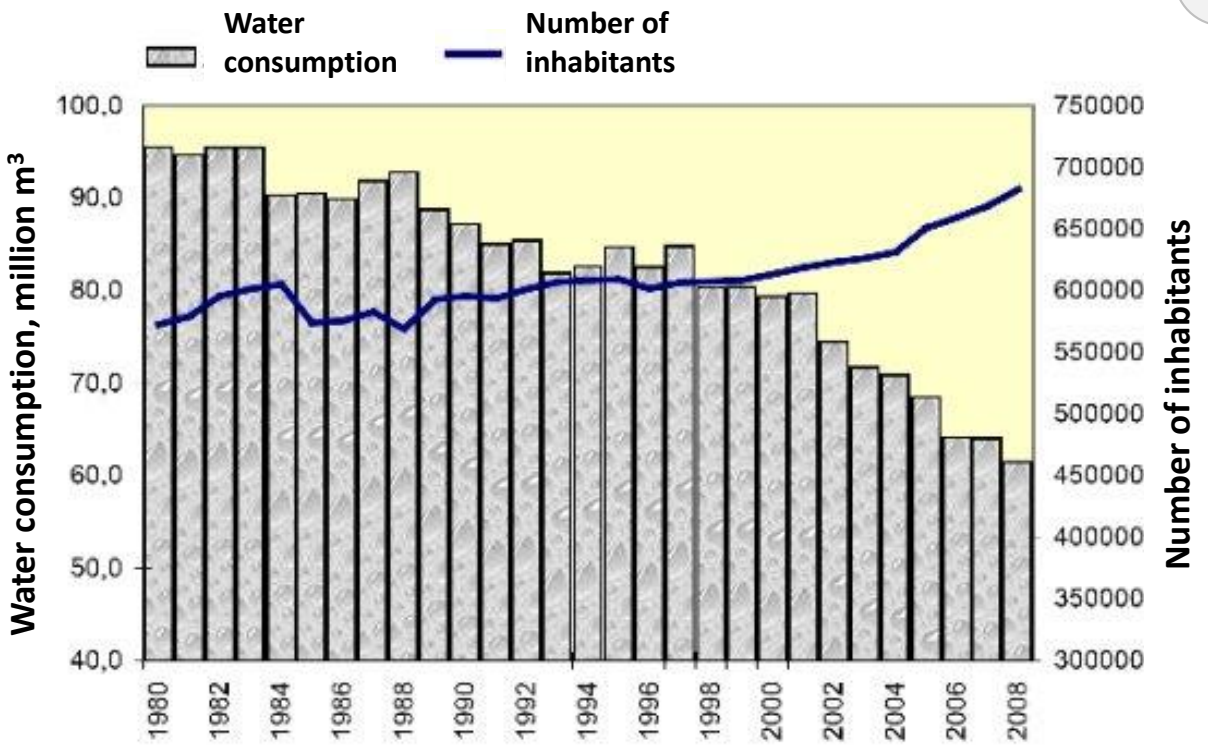
Increase of revenue would help to cover the costs to improve old water management infrastructure of the city

To reduce water consumption three different approaches were used:

1) **On the basis of social and cultural initiatives, the «water-saving culture» was promoted, which became a part of the city and the identity of inhabitants**
2) **Using economic tools, water consumers became more sensitive to water shortages, environmental pollution and excessive use of water**
3) **Actions taken involved restoration and improvement of the water supply infrastructure, using a variety of modern technologies and appropriate materials**

To promote the «water-saving culture» specific advertisements were put in public areas such as parks and gardens to convince people about the focusing on good practice of water use

Changes were also made in relation to water tariffs which were increased in order to reduce water consumption further



Changes in water consumption and population of Zaragoza during 1980-2009

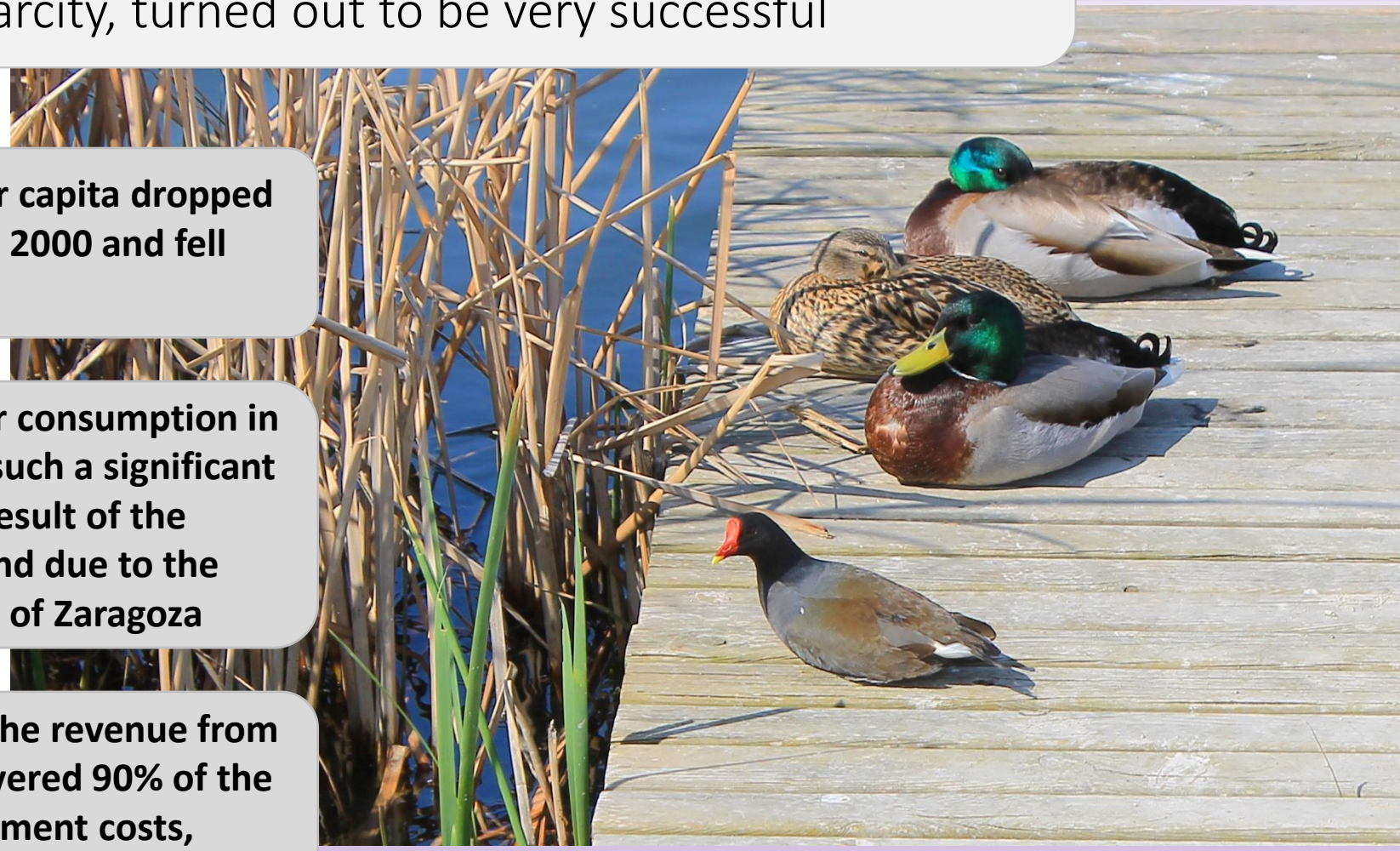
The municipality of the city introduced a discount for the consumed water in those households that had reduced its annual water consumption by 10% or more

By contrast, excessive water use was penalized by an elevated cost

Using the additional income from the change in water tariffs and including the municipal contribution the water pipe repair and elimination of water leaks were carried out in the city

Additionally, water pressure control was started and appropriate equipment was installed in order to reduce the loss of water, but damaged water storage reservoirs were repaired or replaced by new ones

Such a multi-disciplinary approach, bringing together the social, financial and technical measures to increase the city's resistance to water scarcity, turned out to be very successful

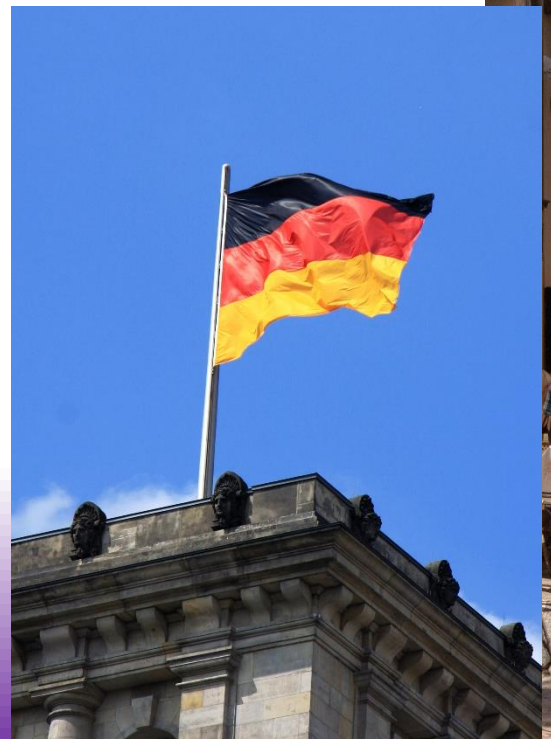


Daily water consumption in Zaragoza per capita dropped from 180 liters in 1980 to 136 liters in 2000 and fell below 100 liters in 2010

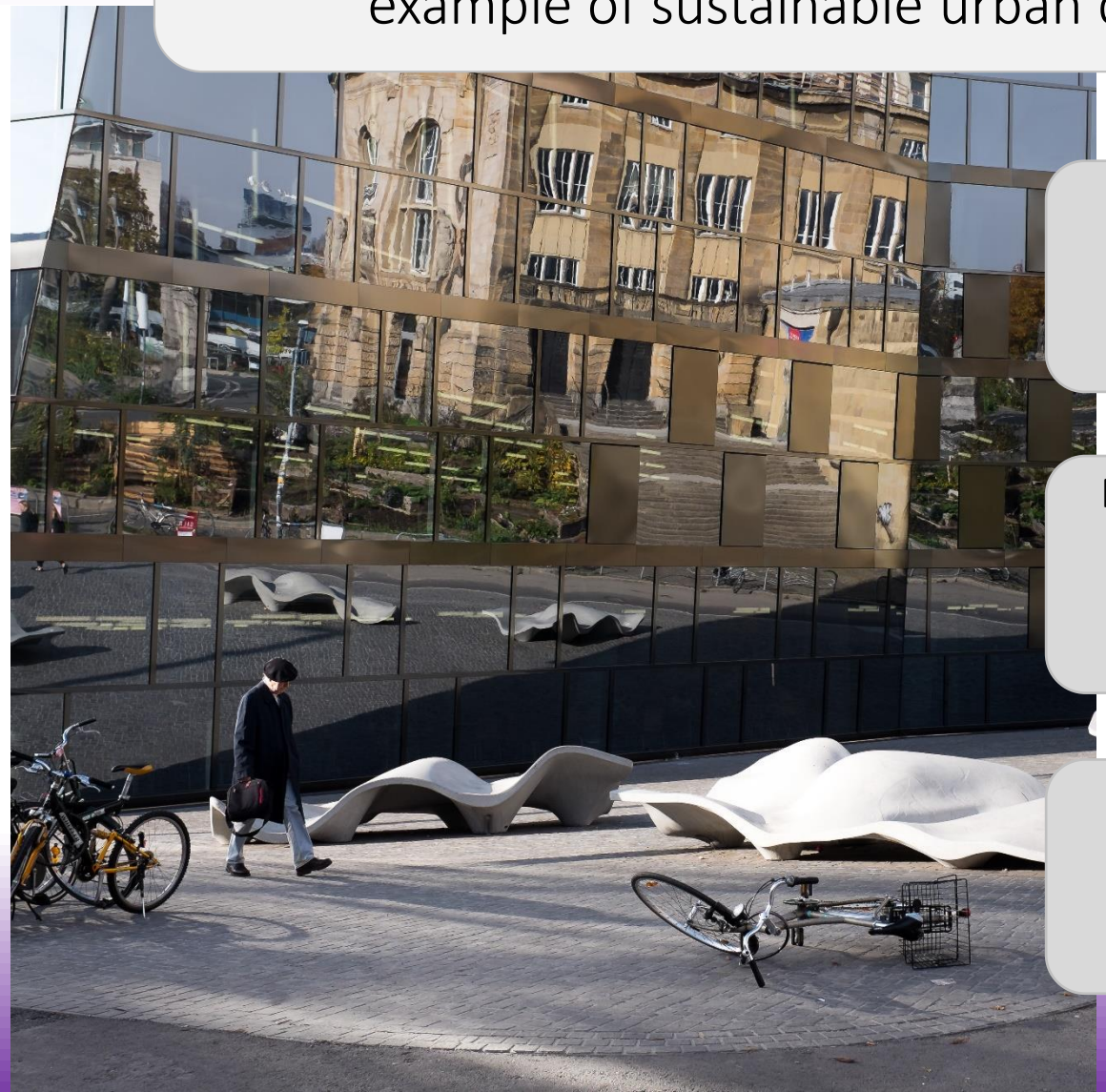
In spite of the growing population, water consumption in the city decreased by 27% in 15 years – such a significant decrease in consumption was the result of the implemented solutions at all levels and due to the participation of all water consumers of Zaragoza

Restructuring of water tariffs increased the revenue from water consumers – in 2006 revenues covered 90% of the water supply and waste water treatment costs, compared with 70% in 1997

Freiburg – the capital of solar energy of Germany



The city of Freiburg is the fourth largest city (220,000 inhabitants) in Germany, located in Baden-Württemberg (south west of Germany) and it is a good example of sustainable urban development, which began in 1970



In cooperation with various social groups the city has successfully managed to expand «green» economy, implementing a number of initiatives, including limited use of cars and improved system of public transport

Freiburg is the city of high standards regarding housing, which has been implemented by improving the quality of environment, use of energy and water, as well as caring for nature conservation

Freiburg is somewhat unique because it successfully exploits local factors and resources – municipal policy, civil commitment and involvement, surrounding environment and climate, as well as knowledge and innovation

In 1996, the municipality of Freiburg set the target to reduce CO_2 emissions by 25% till 2010 – emissions were significantly reduced, especially in sectors of transport and energy by implementing a series of measures

The system of public transport was improved by enhancing facilities for bicycles, energy efficiency in buildings was increased using sustainable building materials and solar panels

The transition to use of renewable energy was implemented in the city entirely

In the city, share of nuclear power was reduced from 60% to 30% and now the combined heating and power (co-generation) plants are producing nearly half of electric power necessary for the city

Since 1986, in Freiburg the use of solar energy is supported by projects, funding programs and land for solar panel installation

Solar panels now are installed in many places on private and public buildings and they can used more than 1800 hours of sunny weather a year, because Freiburg is one of the sunniest cities in Germany

The amount of waste per capita in Freiburg is lower than on average in Germany - in 2003, urban waste recycling rate was 62%, compared with 42% in the whole country, but in 2011, in Freiburg overall waste recycling rate rose to 69%

In 1991, a waste management concept was introduced creating a system in which appropriate waste management was rewarded by incentives

Discounts were applied for example when people were using non-disposable baby diapers, as well as for the collective waste disposal and discounts for people who were composting «green» (food and garden) waste

In Freiburg non-recyclable waste is incinerated by a company located about 20 km to south from the city - operation of incineration plant maintains high environmental standards and the company supplies electricity to 25,000 households

Despite the economic growth, the amount of CO_2 emissions from transport in Freiburg per capita have decreased since 1990

Use of bicycles has tripled, use of public transport has doubled, while the share of cars used has dropped from 38% to 32%

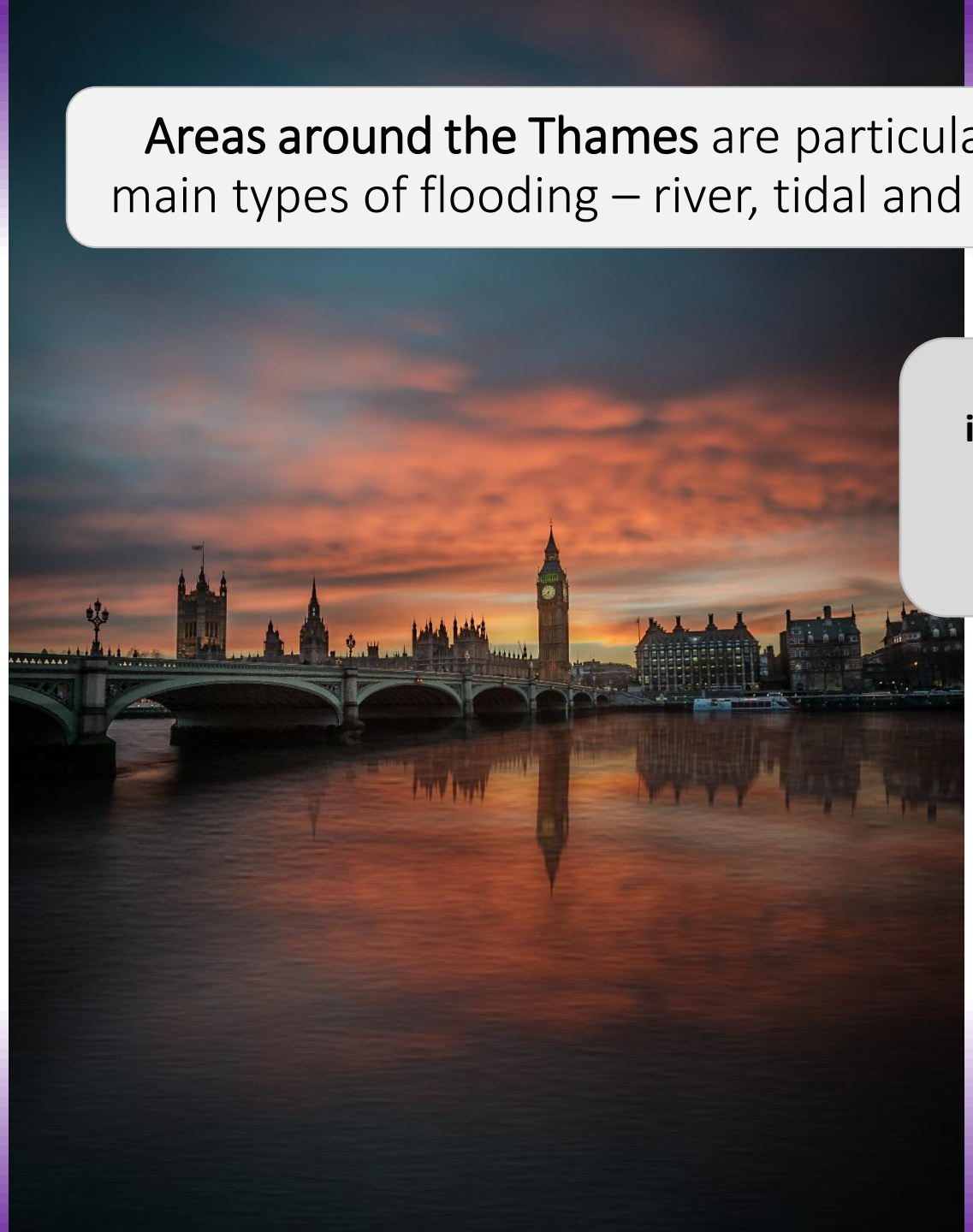
In order to promote bicycling, there are 500 km of bicycle lanes and 9,000 bicycle parking places made

With the help of designing and planning the city was transferred to more compact - it can be passed quickly, and need for transport was drastically reduced due to the establishment of strong service centers in the suburbs

Now the density of cars in Freiburg is very low – 428 cars per 1,000 inhabitants, and there are new tram lines made

Adaptation to increased risks of flooding at the Thames

Areas around the Thames are particularly sensitive to flooding, although the three main types of flooding – river, tidal and surface - can affect the whole area of London



London is exposed to flooding from five different sources - including river and tidal flooding, excess of tidal levels; the city must also deal with surface flooding caused by torrential rain, sewage flooding, if drains are clogged, and groundwater flooding, if groundwater level rise

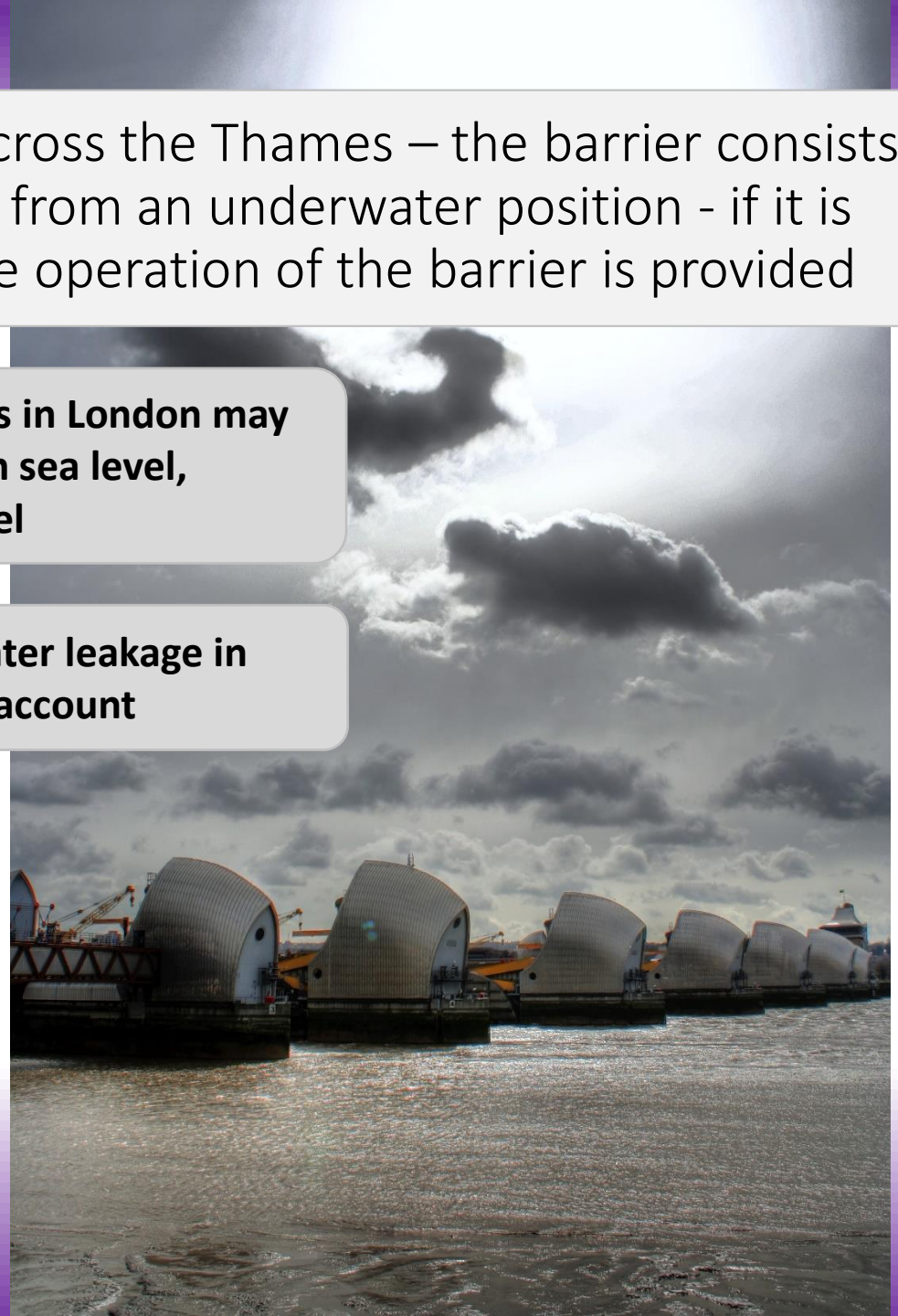
Possibility of tidal flooding from the North Sea is of a low risk, floods of the Thames and its tributaries are of a medium risk, but high risk of flooding remains if floods are formed from run-off of surface water

London is currently protected by flood protection system which includes protection walls, ramparts of embankments, networks of water gates and the Thames barrier, as well as sewer system

The Thames barrier is a water barrier that was built across the Thames – the barrier consists of arched flood gates that can rotate by 90 degrees from an underwater position - if it is expected that there will be extremely high tides, the operation of the barrier is provided

However, a risk factor for all possible types of floods in London may increase in long-term with the expected rise in sea level, consequently increasing the tidal level

Limited drainage capacity and increased rapid water leakage in low-pressure systems has to be taken into account



Tasks of local municipality include reduction of GHG emissions in London by 60% to 2025 and to prepare the city for upcoming climate change and extreme weather conditions, as well as to improve the quality of citizens' life and to provide affordable, qualitative housing

To implement these goals, the local municipality has to develop adaptation strategies, because climate change is already being felt, and probably it will become even more impending, thus, the need for an action is urgent

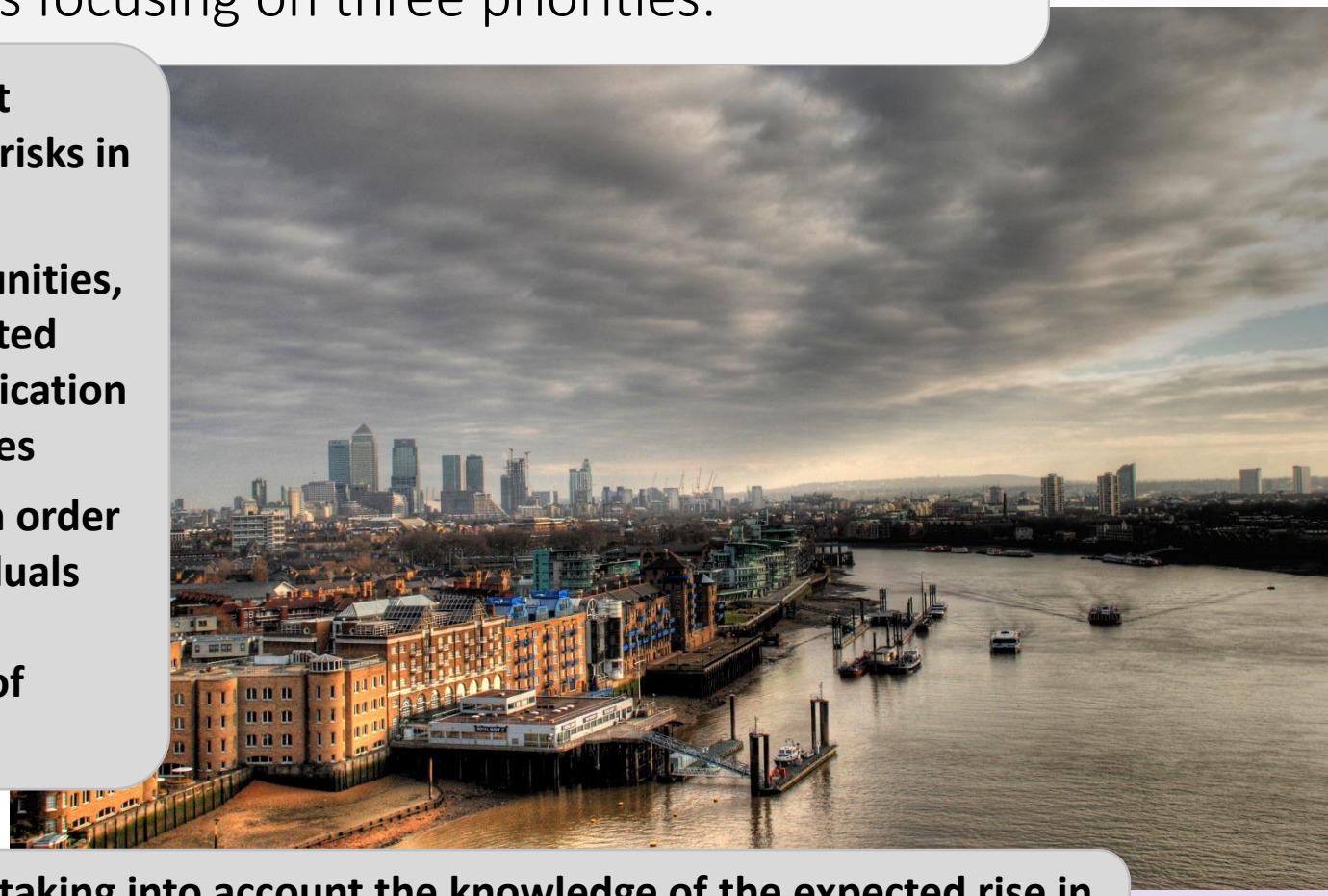
Climate change means increased risks of impact on the city of London, including, but not limited to drought, more frequent heat waves and floods

The flood protection system in the Thames estuary is built for hundreds of years and has successfully overcome the danger of flooding that has occurred over the years, after boosting the flood protection wall and embankment height

Modernization of the system was performed in1970-1980 in response to the severe flooding that took place in 1953

The Thames induces a large risk of flooding and to reduce its impact and to mitigate possible damage **the London's Climate Change Adaptation Strategy** is focusing on three priorities:

1. **Development of more effective flood management techniques, improving the understanding of flood risks in London**
2. **Identification and protection of vulnerable communities, because of their lack of knowledge due to the limited governmental support and prevention of communication failures among agencies responsible for these issues**
3. **Increase of public awareness and understanding in order to improve the resistance and flexibility for individuals and communities, that can be done only by understanding public perceptions and evaluation of possible flood risks and threats**



The system against floods has been developed taking into account the knowledge of the expected rise in sea level, and it is estimated that it will remain effective until 2030, however, afterwards level of defense will decrease, unless other measures will not be taken

Environment Agency of London has developed **the improvement project of the Thames estuary until 2100**, providing flood management, which is required in case of increased flood impact in the near future

The project action plan is divided into different business areas and it has identified **four possible options:**

1st option – to improve the existing options of defense

2nd option – to reduce the risk of tidal flooding

3rd option – to build a new barrier

4th option – to build barriers with flaps

Adapting to climate change in agricultural sector in the Netherlands

The Netherlands are located in the Atlantic eco-region and its largest part is converted to agricultural land which is well-known with nutrient-rich soil and a favorable climate

Although the soil is of good quality, climate change is a matter of concern for agricultural sector in future

Due to wetter winters, the soil in southern part of the country will become too wet in springs and autumns, limiting its good agricultural management (fertilization, sowing, planting, breeding) because it will be impossible to use existing equipment and techniques

By contrast, during drier summers on increased surface parts crop yields may be reduced due to the decrease in rainfall and frequent high-intensity rain

Similarly, during driest summer months, in swampy meadows, located in western part of the country, could be exposed to a number of interrelated problems such as land subsidence, water shortage during dry summer periods, excess of water during wet periods, as well as salt water intrusion in relation to sea level rise

Since in agricultural lands of the Netherlands agricultural a low level of groundwater is maintained, it causes accelerated oxidation of peat and soil settlement – it reinforces changes of scattered groundwater level between farmlands and natural areas

Currently average annual temperature in the Netherlands is about 1ºC higher than in the beginning of the 20th century - as a result, the vegetation season of plants has increased by an average of more than 3 weeks

Increase of CO_2 concentration may lead to a yield increase by 15-20% in the Netherlands

Higher levels of CO_2 will also reinforce the use of water, but increased evaporation due to higher temperatures will neutralize this effect

Climate change may have a positive and also a negative impact on agricultural production and economic situation of agriculture in the Netherlands

Risk of pests and diseases in the future will be higher, and the Netherlands are particularly vulnerable to these risks due to the high density of animals and great interaction with foreign countries

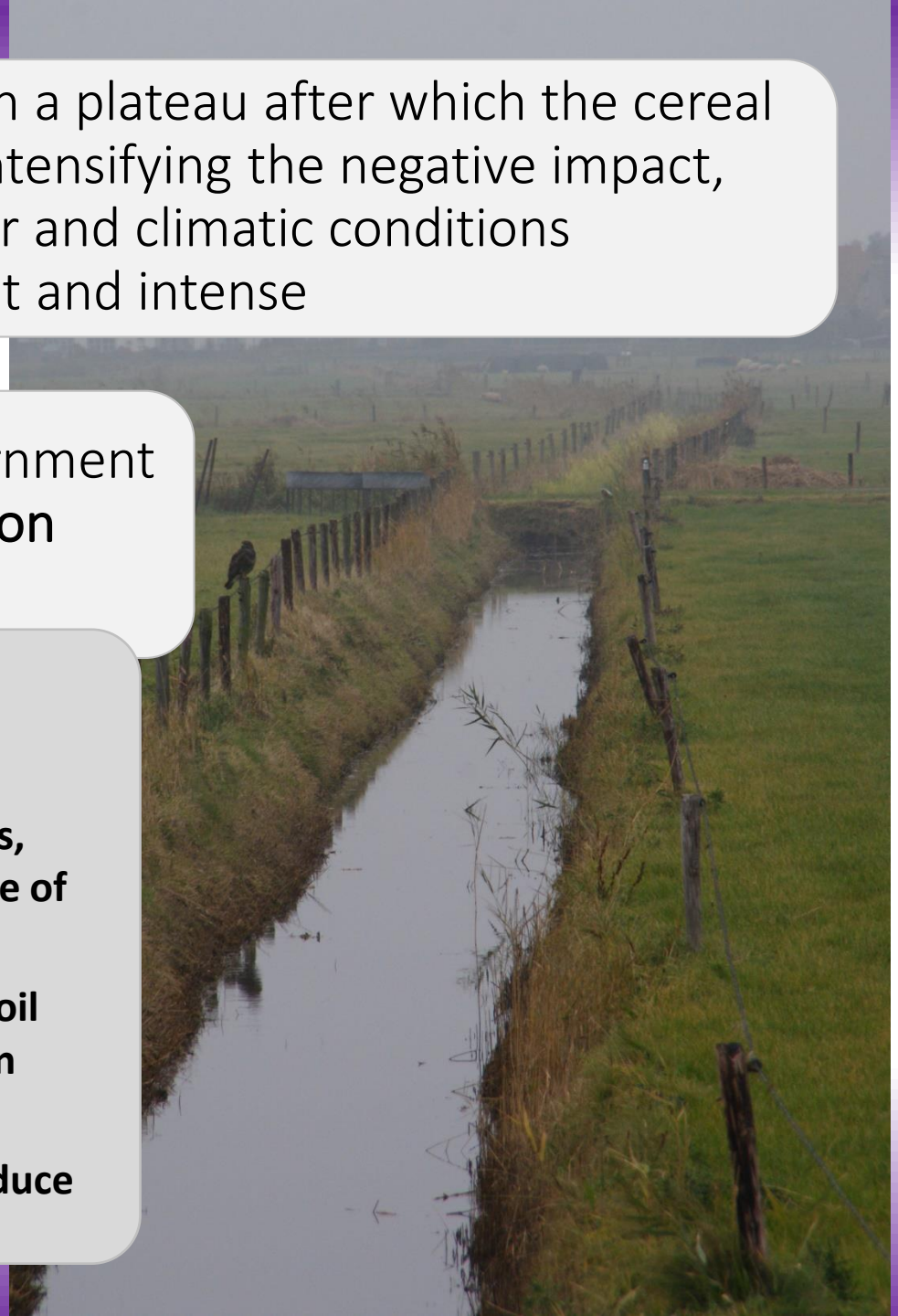
Rising sea level will lead to risk of salinization of surface water that may be harmful for salt-sensitive crops in agriculture

Deterioration of agricultural sector in southern Europe may lead to advantages of Dutch farmers in the European and world markets of agricultural production

However, the positive impact at some point can reach a plateau after which the cereal harvest will start to decrease significantly – thus, intensifying the negative impact, because there will be more extreme weather and climatic conditions which will become more frequent and intense

To prepare for the upcoming changes, in 2007, the government of the Netherlands developed **the National Program on Adaptation to Climate Change** which recommends:

- **Due to the changes in temperature, vegetation period increases, therefore farmers have to adapt to a rotation schemes of sowing or planting and harvest time**
- **To solve the problems of water salinization, moisture, drought, pests, diseases, frost and changes in vegetation periods, appropriate choice of crop varieties and genotypes have to be assessed**
- **To reduce the impact of dry summer period, the most appropriate soil moisture retention practices should be applied, such as conservation tillage**
- **To regulate cumulative irrigation throughout the year in order to reduce the impact of dry summers and optimize the use of water**



Planning of coastal area in Croatia

Length of coastal area of Croatia along the Adriatic Sea is about 5800 km, and it includes more than a thousand of islands and islets, 47 of which are inhabited - the coastal area provides a dynamic space in which the development of various sectors of the economy, e.g., agriculture, tourism, fisheries can be implemented

Global warming and rising sea level pose a direct threat to the Croatian coast and the national economics

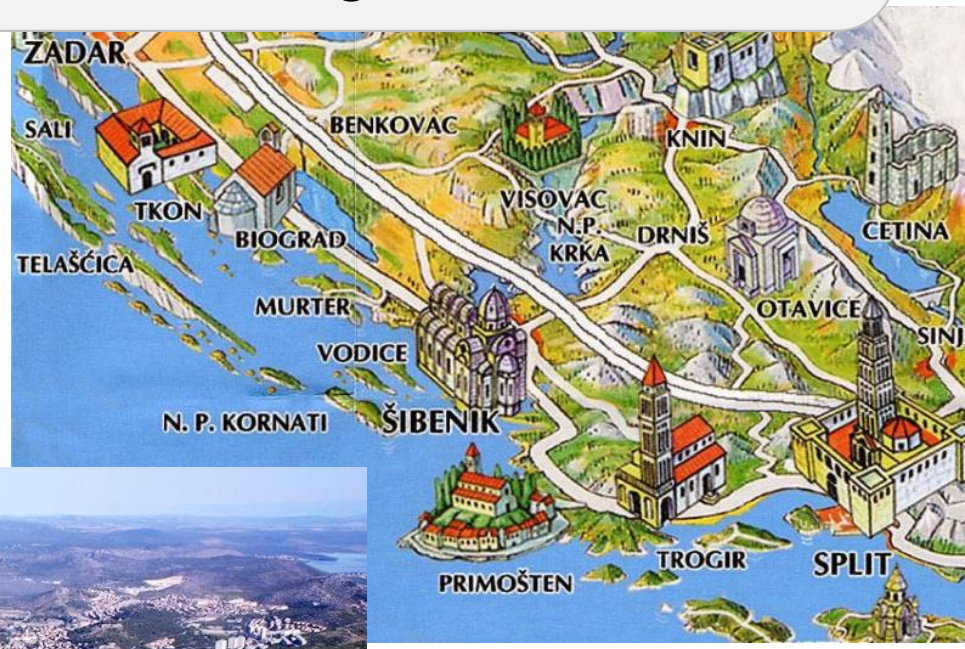
Rising sea level could lead to lower safety of ports, especially, during storms, may contaminate freshwater with saltwater on the coast, can harm ecosystems –

For example, in wetlands and swamps can be threatened local biodiversity, as well as damage can be caused to historic places and touristic resorts, which are of important cultural and economic value

Sibenik-Knin County, located between the Adriatic Sea and Bosnia-Herzegovina, in collaboration with the Global Environment Facility, the United Nations Environment Program (UNEP) and the Croatian coastal zone management program has developed its own **«Coastal Plan»** to study and mitigate the effects of climate change in coastal area

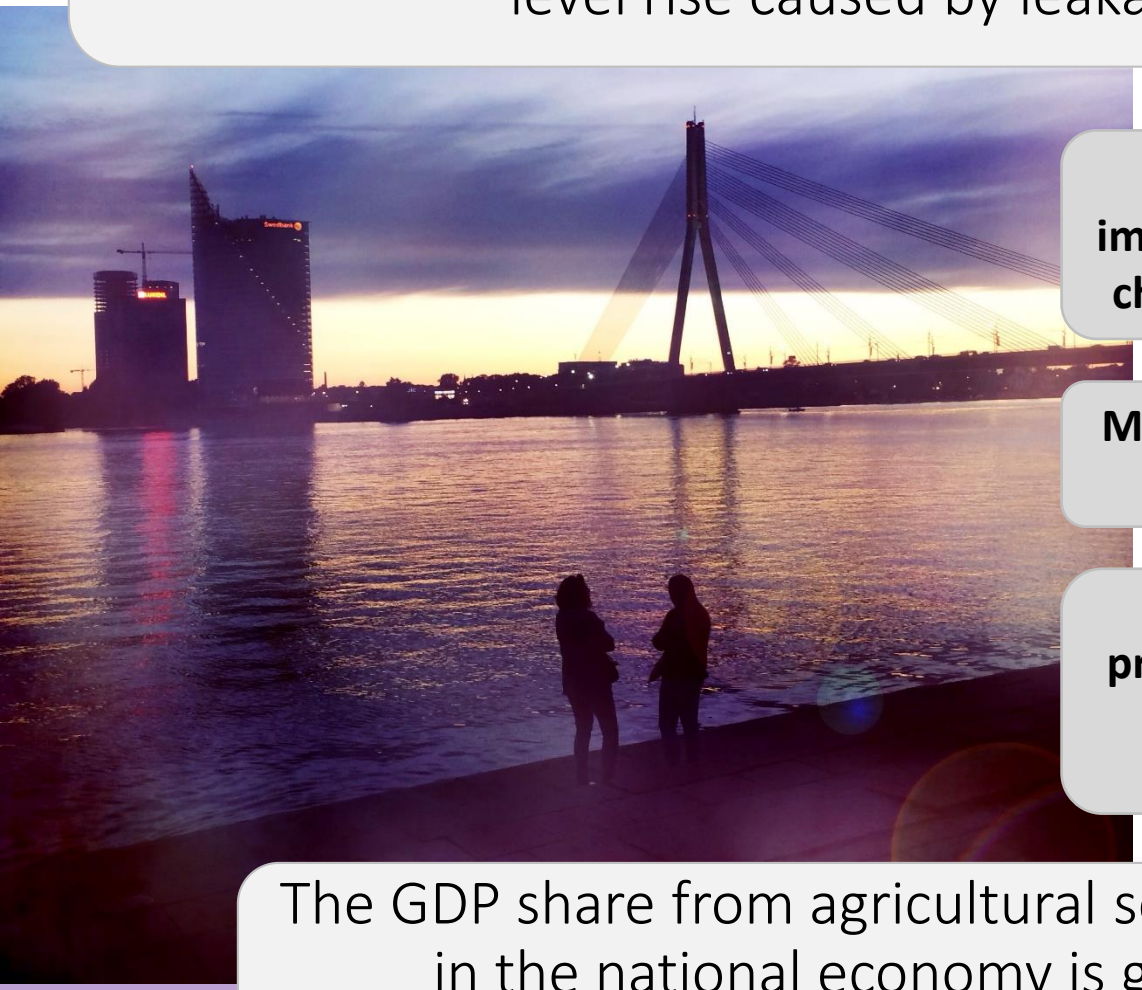
«Coastal Plan» aims to achieve sustainable development of the Sibenik-Knin region in seven broad areas: population, territory, coast, sea, water, nature and the economics

The plan provides development of guidelines and recommendations for policy makers, as well as expands the participation and the level of education of inhabitants, especially, regarding the local coastal community



RECOMMENDATIONS FOR RIGA, LATVIA

Riga, the capital of Latvia is located on the banks of the Daugava near the Gulf of Riga - the main risks of flooding in the city include winter storms, ice melting during spring and water level rise caused by leakage of water along the river Daugava



In 2010, the City Development Department of Riga began to implement the «Integrated strategy for Riga to be able to adapt to changes in the hydrological processes related to climate change»

Most significant economic damage, which is caused by the floods, is likely to increase due to climate change

Detailed studies on the impact of climate change on flood processes and development have to be carried out, as well as the experience of other countries in order to develop appropriate adaptation strategies have to be taken into account

The GDP share from agricultural sector in Latvia is not high, but its importance in the national economy is great, and it is important industry to be considered into adaptation to climate change

Thank you for the attention!