

The scenarios below have been produced in connection with the scenario workshop on climate adaptation conducted by The Danish Board of Technology and Kalundborg Municipality in the fall 2009. The scenarios were sent out as a discussion paper to the participants of the scenario workshop before the meeting, and thus formed the point of departure for the participants' debate and development of their own visions and action plans. The scenarios are based on computations done by GEUS and describe what is expected to happen in the area as the climate changes in the next coming century.

Introduction to the scenarios

For most of us, global climate changes and their consequences are still a somewhat abstract concept. However, this is not likely to continue. Over the next few decades, climate changes will become noticeable in our daily lives. The temperature will increase. Sea levels will begin to rise, slowly at first and then more rapidly. Precipitation patterns will change; we will see more precipitation in the winter months and less in the summer. This will have consequences that can be difficult to foresee today. The sea will erode the coastline at an increasing speed, rivers will break their banks and flood low-lying areas; more cases of extreme precipitation will also result in floods and put a strain on urban sewerage networks; warm, dry summers replaced by violent precipitation will pose a great challenge for agriculture and the climate changes will put pressure on our environment and nature. The extent of the climate changes, and the speed at which they will have an impact, depend, among other things, on the rate at which we can reduce global emissions of greenhouse gases.

Development of the climate

Forecasts for the development of the climate in Denmark, and, thus, in the pilot region of the district of Kalundborg, are based on projections made by the UN's panel on climate change (IPCC). These are based on a number of different global development scenarios, each with different assumptions on economic growth, population increase and technological development. The IPCC has estimated the extent of greenhouse gas emissions resulting from each of the development scenarios in this century.

The selected development scenario, A2, results in a relatively large increase in global emissions of greenhouse gases. The development scenario describes a development in the climate that is not a worst-case scenario. However, it is certainly one of the more unpleasant scenarios described by the IPCC. At present, the current trend in global emissions of greenhouse gases slightly exceeds the IPCC's worst-case development scenario and, thus, exceeds the A2 development scenario. This could become reality if the global increase in energy consumption continues at the current pace and, at the same time, the industrialised countries, in particular, only manage a very slow reduction of their greenhouse gases emissions. The A2 development scenario is the worst, i.e. of

the two development scenarios recommended by the Danish government for planning purposes, this scenario has the largest emission of greenhouse gases.

The temperature

The A2 development scenario will result in a considerable increase in the concentration of greenhouse gases in the atmosphere, from 280 ppm (parts per million) before humans began emitting greenhouse gases to more than 800 ppm in 2100. This means that the average global temperature will increase by approx. 4 degrees in 2100 compared to the average temperature before industrialisation (3.4 degrees compared to the average for the period between 1980 and 1999). The increase in temperature will not stop at the 4 degrees but will continue into the next century.

A temperature increase of 4 degrees is twice as much as the 2-degree level considered by the majority of climate scientists to be critical. The final report from the international meeting of climate scientists in Copenhagen in March 2009 is quite clear: "A temperature increase of over 2 degrees will be very difficult for today's society to cope with and it will probably cause great social and environmental destruction, both in this century and in the longer term."

Sea levels

A global increase in temperature will result in a rise in the sea level, partly due to water's thermal expansion and partly due to the contribution of water from melting mountain glaciers, from Greenland's inland ice cap and West Antarctica. The most recent research has led to a drastic revision of projections for the rise in sea levels. The reason for this is that the rate at which the ice from both Greenland's inland ice cap and West Antarctica is melting has exceeded even the most pessimistic prognoses. The most recent report from the Danish Meteorological Institute (DMI) on future changes to sea levels does not give a clear indication of the extent to which sea levels will rise. However, it refers to recent research that estimates between 90 cm and, in the worst case, up to 2 m for the A2 development scenario. These estimates are still subject to a great deal of uncertainty. Therefore, we have chosen a conservative estimate of 90 cm for 2100 and 80 cm in 2090.

Local climate changes in the pilot region

Differences in average global climate changes and actual local climate changes can actually be quite large. Based on model predictions and estimates of local climate changes in the pilot region (see the attached map), a range of selections of prerequisites for the described scenarios have been made. The selections are relatively conservative and are in no way an indication of the "worst possible" situation.

1. The temperature

- a. Average temperatures for both summer and winter will increase by 3.2 degrees (on average for the period between 2071 and 2100 compared to the period between 1961 and 1999). This means that the region will probably have a climate similar to that of the north of France today; mild and usually frost-free winters and warm summers, probably with an increasing tendency to drought.

2. Rising sea levels

- a. It is assumed that the normal water level will rise by approx. 80 cm in 2090.
- b. Extreme water levels that, statistically, can be expected once every 50 years, are currently 150 cm above the daily water level. This is expected to increase by 10 - 20 cm due to an increase in pressure imposed by storms. This means that, in 2090, the extreme water level will be 230 - 240 cm above the current daily water level.

3. Coastal erosion

The Danish Coastal Authority expects that moderately exposed coasts in the Danish waters will experience coastal retrogradation of 8.8 m if sea levels rise by 42 cm. No estimates have been made for larger rises. However, if sea levels rise by 80 cm, coastal retrogradation will certainly be more than 8.8 m. Somewhere between 10 and 15 metres is a conservative estimate.

4. Precipitation conditions

Precipitation will increase by 26 to 30 percent during the winter season; however, the amount of precipitation will fall during the summer. On the whole, we can expect more precipitation than today. We can also expect more cases of very heavy precipitation, during the summer period too. The intensity of these so-called extreme precipitation events is expected to increase by approx. 20 percent compared to today.

5. Water table

On average, there will only be small changes in groundwater level. In some areas, the groundwater level will be slightly lower than it is today and in others it will be about the same. However, the maximum groundwater level will be slightly higher than it is today.

The three future scenarios

The question is what is the best way of alleviating the impact of the impending changes?

The future scenarios described here indicate the situation for a small region of Denmark, i.e. the area between Tissø in the east and Jammerland Bugt in the west, at the end of this century. The scenarios attempt to illustrate the consequences of reacting to the future climate changes in different ways. It is hoped that the scenarios will provide inspiration for a debate on the advantages and disadvantages of the various different options available.

The three future scenarios are based on three basically different ways of approaching future climate changes. The three future scenarios are:

1. A basic scenario or “laissez-faire” scenario based on the assumption that it is not possible to do anything special in advance to alleviate the impact of the future climate changes beyond what is economically achievable. Initiatives will be taken ad hoc.
2. A so-called “protection scenario” based on an attempt to protect all of the region's interests as much as possible, including residential areas, infrastructure, commerce and agriculture against the consequences of future climate changes. Initiatives will be launched in order to protect existing interests even if this has negative consequences for the environment and nature.
3. A so-called “adaptation scenario” based on the need to attempt to adapt to future climate changes rather than fight against them. Current use of land will be re-evaluated and more space allocated to wetlands. The scenario also assumes that we will give considerable consideration to our environment and nature.

The three future scenarios attempt to show what will happen when the region is exposed to an extreme, but not improbable, weather situation in addition to general climate change. The scenarios are fictional stories of the future, written by a fictional journalist at the local, fictional online newspaper. The stories take a journalist's critically neutral stance. However, unavoidably, they are slightly subjective as the description is not scientific but a report of the situation seen through the eyes of an ordinary person.

The scenarios describe the situation in 2091. Of course, this does not mean that climate change stops there. Temperatures will continue to increase, even after the turn of the next century, and extreme weather situations with heavy rain, floods and droughts, will become more and more frequent. Sea levels will continue to rise for many hundreds of years after 2100, even though greenhouse gas emissions will be significantly curtailed in the 21st century.

None of the future scenarios attempt to estimate the extent of the cost of the various different protection and adaptation initiatives.

In conclusion, it is important to stress that a description of something that may happen 80 to 90 years in the future is subject to a great deal of uncertainty. The situation may be better than described here, but it could also be worse. It is also important to emphasize that the selected development scenario is not a foregone conclusion. The development of the situation may be less drastic if great efforts are made soon to reduce greenhouse gas emissions in Denmark and globally.

Moreover, the scenarios do not consider ways in which our surroundings will be affected by climate changes and the impact that this will have on Denmark in the form of food crises, economic crises, oil supply crises, climate refugees etc.

Scenario 1

We let things slide

Brief description of the scenario:

The “laissez-faire” scenario is based on the assumption that we will not do anything special to alleviate the impact of the future climate changes beyond what is economically achievable. In other words, investments in adaptation to climate change are only made when it is assessed that it is worth taking action. This means that most adaptation initiatives are taken by private individuals and changes are not made until large interest groups risk financial or other forms of loss. Public authorities, the state and local authorities do not launch large, coherent initiatives in an attempt to adapt the development of the local community to climate change. More specifically:

- No coastal protection beyond initiatives that have already been implemented or adopted. As is the case today, coastal protection is left to the individual landowners and urban land associations.
- No changes to land use. I.e. basically no changes to urban areas, holiday home areas and agricultural areas unless required.
- No initiatives in response to the consequences of changes in precipitation conditions before absolutely required.

The future scenario:

Kalundborg, April 2091

The violent events of recent years have made it urgent to follow up on the consequences of global warming for our local area. It is mostly the large global problems associated with floods, famine and climate refugees that we hear about. We rarely attempt to gain some perspective on our own problems, both large and small. This is what I will try to do here.

This winter's floods badly affected both the coastline and a large area around the lower part of Halleby River. This is not to say that the situation was particularly good to begin with. Luckily, I suppose, a large section of the old holiday home area in the southern part of the Jammerland Bay had already been abandoned. The large number of large and small floods during the course of this century have made life difficult for holiday

home owners in Ornum Strand and Bjerger Sydstrand's holiday home area, and most of the exposed rows of cottages were already abandoned over 40 years ago, in 2050, after

Halleby River flooded almost all of the cottages closest to the river during the winter of 2049/50. Since then, people have gradually left the area, and the holiday cottages, even the ones in the more elevated parts of the district, are now unsellable.

Until the flood back in 2049, the small dyke along Halleby River, constructed by the house owners' association on its own initiative, had managed to keep the annual floods in check. However, the rise in groundwater levels posed a problem that could no longer be ignored and it was becoming more and more difficult to drain our way out of our problems. It should be added that the campsite at Bjerge Sydstrand, if anyone can remember that there used to be such a thing, had already been abandoned many years ago.

But this time it was much worse than ever before. At the end of February, the unthinkable happened. An area of low pressure came to a standstill over central and western Zealand and discharged over 80 mm of rain over Åmosen, Tissø Lake and the area between Tissø and the Great Belt within 48 hours. The water streamed down through Åmosen to Tissø Lake, which was already pretty full after the wet winter, and then down through Halleby River. Two days later, the strong westerly wind, which had forced the water up into the Baltic Sea and the Gulf of Bothnia, turned. As a result, the water streamed south again and through the belts. Water levels rose dramatically and peaked over one and a half metres above the daily water level. The water level had already risen almost 80 cm since the turn of the millennium and this meant that the old holiday home area at Bjerge Sydstrand and Ornum Strand was almost completely flooded when the water streamed from Halleby River and Great Belt all at once and, in several places, broke through what was left of the old range of dunes. I suppose it is now up to the local authority to decide what happens to the area. Of course, one of the great problems is that a large part of the area is still in private hands, even though it is actually abandoned.

There are other, smaller holiday home areas on the coast that were also affected by the flood. Dalby Strand and Kirke Helsing Strand were particularly badly affected. The most elevated part of Bjerge Nordstrand, out towards the beach, was mercifully spared but large parts of the lower lying area were flooded.

However, the summer cottage areas were certainly not the only areas to be affected. Many fields disappeared under a large, unbroken mass of water that stretched as far as the eye could see. Due to the extremely high groundwater level after the wet winter, the earth had difficulty in absorbing the large volume of rain, let alone the water that poured from Halleby River over the lowest lying areas. The water has now - almost 2 months later - almost disappeared. However, many farmers doubt whether it will be possible to work the land this spring. Right now, the smell of sludge and rotting plant matter lies heavily over the fields around the river. Luckily, a very large part of the lowest lying areas are planted with willow for use as energy crops. There is a fair chance that the willow has survived even though a large section of the lowest lying areas are still under water and probably will be well into the spring. On the other hand, it does look as though large areas of winter wheat and field beans have been lost.

Even now, two months on, no-one has a full overview of the damage. Many areas and people were affected. We have no figures indicating the number of houses and cellars flooded. Many farms in the low lying area have been badly damaged and the flood also affected the lowest lying areas of Gørlev.

Reersø was badly hit. A large stretch of the dyke from the mainland to Reersø, which was already in need of serious maintenance, was almost washed away and Reersø will only be able to be reached by boat for some time to come. The port, whose quay had been raised almost 40 years ago, was completely flooded, as were many houses, particularly the summer cottages remaining in the lower lying areas.

This may sound as if we have not been affected by climate changes before now. Of course, this is far from the case. The flooding around Halleby River and Bøstrup River in the winter months has been a recurring event for as long as most of us can remember and it is getting worse and worse as the years go by. As it is now, the meadows around Bøstrup River and Helsing River by Gørlev lie under water for most of the winter months.

There are no longer many of us who can remember that Halleby River actually ran into something called “The Bottle” close to Reersø. A rise in sea levels of around 80 cm this century has changed the area radically. The river mouth has moved north and the coastline has gradually moved inland due to the rise in the sea level. The sea now covers what used to be low meadows and a narrow fiord forms up the course of the old stream even when water levels are normal. As a result, the number of breeding waders that were dependent on the low salt meadows has been drastically reduced.

The risk of the penetration of salt into Tissø Lake has also increased as the sea levels have increased. Due to the low water level in Tissø Lake in the summer months, the sluice at the outlet from Tissø already had to be built up 20 years ago. This was to prevent the water from flowing from the sea to Tissø if sea levels were higher in the summer months. Higher water levels all year round mean that the majority of the meadows around Tissø Lake have now disappeared completely. This also means that only very small quantities of fresh water are discharged into the stream from Tissø in the driest summer months. Consequentially, sea water works its way well up into the river. If the sea level rises just slightly above normal, the sea water will reach the sluice. Fresh water in the winter and sea water in the summer are not a good mix for the river's ecosystem. Most of the plant and animal life has also gradually disappeared and only sticklebacks and flounders can cope with the changing conditions.

Apart from the owners of the holiday homes, the farmers are probably the people who have suffered most from the climate changes and the recurring floods around the river. A number of areas, particularly around Bøstrup River and Helsing River, have had to be completely abandoned and other areas, where grain and corn were previously cultivated, have now been designated as pasture and for the cultivation of willow. In spite of this, there are many locations in which there has been significant damage to winter crops after the very wet winters with high groundwater levels. In other years, lengthy droughts in the summer months have made life difficult for farmers. As if that were not

enough, several diseases and an increase in weeds, all caused by the warmer climate, have made life even more problematic for agriculture.

The wet winters with heavier precipitation have created other problems. The sewerage system in the urban areas has had difficulty in coping with the extra precipitation and, after several unpleasant floods, it was necessary to renew the drains and separate rain-water from sewage in the most afflicted areas, in spite of the large cost to the local community.

Damage to the roads in the lowest lying areas due to floods has also become an increasing problem and, in some areas, it has been necessary to raise the roads. Other, smaller roads have simply been abandoned because the cost of repairs broke the local authority's budget or purely because they were flooded.

The climate changes have also caused problems for both nature and the environment in the area. The most obvious problem, perhaps, is the frequent growth of algae. The increase in precipitation in the winter months has led to greater leaching of nutrients from agriculture. This, combined with higher water temperatures, has resulted in problems with algae both in Tissø Lake and in the Great Belt and a combination of very wet winters and dry, warm summers has added to the problem. This is something that we are seeing more and more.

The water supply in the district may be one of the smallest problem areas. A few drinking water wells close to the coast have had to be abandoned due to penetration of salt water. However, they were easily replaced by others further inland.

What about the future? It is difficult to imagine that we will see fewer problems. There are still both public drains and private waste water systems that need to be replaced or perhaps even abolished. What should we do with the remaining holiday cottage areas that are becoming increasingly endangered? The sea will continue to eat its way inland, both here and along other parts of the coast. Moreover, there is no doubt that there are still many agricultural areas that will have to be abandoned.

Several organisations and associations are demanding that we take serious steps to discuss ways in which to manage these recurring, destructive floods and ways in which to help landowners and the environment in the future.

Scenario 2

We protect ourselves

Brief description of the scenario:

The protection scenario presupposes that we make the greatest possible effort to protect all of the interests of the region against the consequences of future climate changes. This includes residential areas, commerce (including, in particular, agriculture) and the holiday home areas close to the coast. The scenario focuses on the potential for protecting current land use as opposed to adapting by, e.g., changing the way in which we use the land. The scenario prioritises the protection of infrastructure highly. The interests of the environment and nature are mainly protected when they do not come into conflict with other interests. This involves, e.g.:

- the protection of coastal stretches where rising sea levels may endanger residential areas, including holiday home areas, campsites and roads
- attempted retention of agriculture's current land use by means of dykes, drainage and pumping systems
- protection of urban communities against floods resulting from extreme precipitation
- attempted retention and protection of society's infrastructure against the consequences of climate change.

The future scenario:

Kalundborg, April 2091

I have just returned from a trip along the dyke and will make an attempt to describe my impressions of the situation after the dramatic weather conditions at the end of February this year. I have chosen to publish my impressions now, primarily because we are standing at a crossroad. Depending on the decisions we make, actions could be both expensive and problematic.

The severe situation was the result of a combination of heavy precipitation – in excess of 80 mm over a period of 48 hours over parts of central and western Zealand - and,

two days later, drastically increased water levels in the Great Belt. Water levels peaked at one and a half metres over the daily water level for over an hour. The combination of

the pressure of the water from the sea and the extremely heavy rain that caused the water levels in Tissø Lake to rise to record levels put enormous pressure on the dykes along the river and around the holiday home area. At Tissø the pressure of the water was so great that the water poured over the dykes and flooded small areas behind them.

The dykes held but they were drastically undermined in many places and it will probably be very costly to repair the damage. The question is whether this will be enough in the long term and whether an investment in reinforcement and extension of the dykes is a sustainable solution, although it will be necessary if we are to protect the agricultural areas, and the holiday home area in particular, in the future. The local authority financed the construction of the dykes and has contributed heavily to their maintenance ever since. Now, there are rumours that the local authority can no longer afford the maintenance, let alone the reinforcement of the dykes. The question is what is to happen?

It is perhaps a good idea to give a brief summary of events here. The discussion about the impact of climate change on our area began at the beginning of this century. It became clear relatively quickly that the public was strongly in favour of taking action to protect both the holiday home area next to Halleby River and the agricultural areas around the river against future floods. As drainage was quite clearly inadequate, thoughts turned to building dykes around the river. Construction of a dyke, initially around the holiday home area on the bank of the river facing the coast and then all the way along Halleby River and Bøstrup River, was begun at the beginning of the twenties. In most places, construction of the dyke adhered to the outer limit of the EU habitat boundary. Later, a drainage channel was dug on the outer side of the dyke and pumping stations were erected, enabling a reduction of groundwater levels in the areas up to the river. This initiative has proven its value as periods of heavier winter precipitation have caused the groundwater level to rise significantly.

Later, it was also necessary to begin pumping sand onto the beach along the holiday home areas, at Bjerger Sydstrand, at Bjerger Nordstrand and in the smaller holiday home areas south of Reersø. Until now, due to the pumping of sand onto beaches, the sea shores have remained fairly intact. As a result, the rise in sea levels and the increasing number of storms have only begun to erode Bjerger Sydstrand and Bjerger Nordstrand to a limited extent. However, the violent westerly gale followed by a rise in sea level last February hit the low dune belt hard and, in some places, it was close to being broken. This alone shows that, in the long term, it will not be sufficient to keep pumping sand onto the beaches. So much sand is now being pumped, and it is so expensive for the local authority, that it will not be a sustainable solution for much longer.

It is also becoming increasingly difficult to drain the holiday home areas, particularly the lowest lying areas of Bjerger Sydstrand and Ornum Strand, and this has caused problems with the sewerage system that was established almost 70 years ago. This raises a very unpleasant question: How much longer we will be able to protect the area against the sea and rising groundwater? Should we build dykes out towards the sea when the pumping of sand is no longer sufficient? If so, who should pay? And is a holiday home area that is barricaded in between dykes on all sides at all attractive and worth preserving? The preservation of the holiday home area has been extremely expensive through-

out this century. However, the many holiday home owners and other people who use the area, not least the campers, will probably be of the opinion that it is worth it. Whether it is possible to preserve the area in the future is another matter. It is difficult for the local authority to continue to ignore the increasing number of protests from the large numbers of the local authority's taxpayers who are not holiday home owners but who help pay the increasing costs.

The same problems apply to Reersø where the dykes were badly damaged after the most recent floods. The debate about whether it is worth improving and reinforcing the dykes yet again will most probably be heated. On the other hand, it proved to be the right decision to construct a low bridge across the shallow stretch between Reersø and the mainland instead of a dam, which would have been the cheapest solution. The high water level also affected the harbour, but only to a limited extent. The whole of the harbour was raised by approx. 70 cm 40 years ago so it ought to be able to cope in the decades to come. However, the increasing sea levels will also cause a problem here again at some time.

Dykes, drainage and pumping stations have been of benefit to the farmers but, on the other hand, have created problems for the environment and for nature. The sea already reaches well up between the dykes around the lower part of the dead branch of the Halleby River so that the Bjerge Sydstrand holiday home area is now a peninsular. Essentially, there is nothing left of the old salt meadows and, with the salt meadows, some of the bird life has also disappeared from the area. Waders have gone, although the area is home to a number of ducks in the winter season.

In the summer months, the sluices to Tissø Lake are closed most of the time in order to keep water levels up. The sluices also prevent the penetration of salt water into Tissø Lake, which endangers the abstraction of fresh water from the lake. On the other hand, during the winter months, the runoff from the lake to the river is severe. This means that the water in the summer months is often salty and stagnant whereas, in the winter months, the water is fresh and flow in the upper part of the river is powerful. Basically, the result of this is a dead ecosystem along most of the river.

Another problem, which has been on the increase throughout the century, is the growth of algae both in Tissø Lake and in the Great Belt. This is caused by a combination of an increase in leaching of nutrients from agricultural lands and higher water temperatures. This has affected the bathing water quality to such an extent that, for many summers, swimming off the coast has already posed a health risk from the middle of June. However, the situation could have been much worse. The oil crisis during the first half of the century meant that the import of animal feedstuffs fell drastically due to dramatically increased prices and domestic fodder production increased. However, a cutback in animal production was unavoidable; there was simply not enough room to cultivate all of the feedstuffs that had previously been imported. This was bad for the farmers but good for the environment due to the reduction in emission of nutrients.

Now that we are discussing the many problems, we ought also to mention that a good deal of the other initiatives that have been launched in order to counteract climate change have spared us numerous problems. The sewerage systems in the towns have

been reinforced and, in several locations, replaced by separate rainwater drainage and collection systems. These initiatives were implemented in good time, before the periodically violent winter precipitation caused problems. Another positive initiative that was taken in good time was the investigation of all buildings to ensure that they could withstand strong winds. Several intense storms and a few hurricanes in recent decades only resulted in limited damage.

There is hardly any doubt that current policy has had both positive and negative consequences. However, nor is there any doubt that we will need to take some unpleasant decisions about our future course.

Scenario 3

We adapt

Brief description of the scenario:

The “adaptation scenario” is based on a need to make the greatest possible effort to adapt to future climate changes rather than fight against them. In addition, the scenario presupposes that we will attempt to alleviate the negative impact of climate change on the environment and nature. According to this scenario, general action plans will be prepared during the coming decades. These will attempt to consider the probable consequences of future climate change. Among other things, this means that:

- current land use (residential areas, industrial areas, nature reserves, ...) will be assessed with the aim of re-evaluating the use of areas that are expected to be affected by frequent floods;
- agriculture’s methods of operation will be changed in order to take the warmer climate and more extreme weather conditions into account. Environmental factors such as the leaching of nutrients and emission of greenhouse gases will also be taken into account.
- importance will be attached to the restoration of the natural environment, partly to reduce the negative impact of climate change on nature and the environment and partly to offset the negative consequences of the change in precipitation conditions by means of natural buffer zones
- urban communities and all-year housing will be adapted to changes in climatic conditions.

Kalundborg, April 2091

It is over 80 years since discussions on ways in which to handle future climate change began. Not even my grandparents can remember this. Therefore, I have been digging around the archives. I discovered that there had been a heated debate at the time between those who wished to use protection as a means of solving the problems and those who wished to adapt. The latter group focused intensely on restoration of the natural environment.

How did it go?

The archives indicate that, after a long period of debate, the adaptation strategy received broad support. A significant argument for the strategy was that it was in line

with the nature restoration projects that were already on the drawing board. This meant that it would be possible to improve the recreational value of the area and, thus, attract more tourists.

Among other things, the adaptation strategy meant that a good deal of the agricultural land was abandoned and designated as potential wetlands and nature reserves. It also meant that no special initiatives were launched to protect low lying holiday home areas, particularly those already at risk of flooding. One of the most significant arguments of the debate was that protection of the areas that were under threat from rising sea levels and heavier precipitation would be financially unpredictable and, in the longer term, would not be worth it.

The changes to the climate and, in particular, the change in precipitation conditions throughout this century have resulted in the abandonment of even more cultivated agricultural land over time. Agricultural acreage is considerably reduced. However, as a result of the many decades of adaptation strategy, a great deal of effort has been put into replacing agriculture with crops that are financially more viable. Thus, it has been possible to make more intensive use of the remaining agricultural land. 80 years ago, it was probably difficult to imagine vineyards, fruit plantations and large areas with unheated greenhouses containing fruit and vegetables that, previously, could only be cultivated in expensive, heated greenhouses at these latitudes.

Naturally, climate changes still pose many problems, but much has been done to solve them. The high groundwater level means that there is still a risk of flooding in the lower lying areas. However, the large nature restoration projects in Åmosen and along the Halleby River have reduced flooding, primarily because the lower lying agricultural lands have been abandoned so that the water is free to spread without causing great damage to fields and crops. Extreme weather conditions are still a challenge. We are increasingly seeing long periods of drought, interspersed with severe precipitation, at times with hail. However, a good deal of damage has been prevented by constructing windbreaks, erecting hail nets and switching to crops that can withstand longer periods of drought. There is no doubt that the large numbers of small woods and shelter belts that have appeared during the century have helped reduce the negative consequences of the often long periods of drought that we have experienced, particularly in the most recent decades, and the often heavy downpours.

On the other hand, we no longer see the large fields of forage crops that were characteristic of the landscape at the turn of the century and a few decades beyond. Livestock farming in the area has been cut back drastically and most of the livestock are now free range. Due to the fact that there are fewer livestock, leaching of nutrients from the earth has almost stopped. This has been positive for both Tissø and Great Belt in which there was a substantial growth of algae from time to time during the first part of the century.

The adaptation project has focused intensely on nature. More, interconnected nature reserves with organic corridors have been created by the many living hedges. This has created excellent conditions for game and bird life, to the delight of the hunters. The wet meadows have been allowed to spread into new areas as the sea level has risen. Therefore, the conditions for waders are still good. An extensive system of paths has

created great opportunities to discover the area, both on foot and by bike. The path system is part of the local authority's larger strategy to promote nature tourism. Another aspect of this strategy is the creation of a number of camping areas with cottages, both at the coast and at Tissø Lake in connection with the path system. The cottage areas by the coast have been constructed to withstand small floods and they can be moved as sea levels rise.

In other areas, too, development has increasingly focused on adapting to climate change as opposed to fighting against it. As a result, the holiday home area, which, at the turn of the century, was located in the southern part of the bay with the beach on one side and Halleby River on the other, has been gradually abandoned, the areas most at risk of flooding disappearing first. It goes without saying that this was a bitter pill to swallow for the many holiday home owners who had hoped that the local authority would invest heavily in the protection of the holiday home area. The archives indicate savage denunciation of the local authority and a long-lasting and heated debate. The local authority's argument was that they simply could not afford the large investments required to protect the area against flooding and rising groundwater levels in the long term.

Today, the area is a nature reserve with a mixture of salt meadows and old woods in the most elevated areas. Parts of the other holiday home areas close to the coast and a large part of the holiday home area on Reersø have had to be abandoned due to the rising sea level.

As part of the large nature restoration project in the twenties and thirties, it was decided to allow Halleby River to develop into a naturally winding river, both in Åmosen and below Tissø Lake. As a result, the river valley has broadened over time. This has made room for larger volumes of water flow and has helped limit the impact of the winter floods that are now frequent occurrences. Fish stocks in the river have also increased.

The lower section of Halleby River, which, at the start of the century, ran into the sea just north of Reersø, is currently developing into a small fiord that stretches right up to Tissø Lake. There used to be a sluice here to keep the water in Tissø Lake at a constant level. In the middle of the fifties, it was decided to remove the sluice to enable dynamic development in the area in line with climate changes. This was in spite of the fact that it would cause problems, such as the penetration of salt water and, thus, reduce the potential for the abstraction of fresh water from the lake. The reasoning was that the rise in the sea level would make it impossible to keep the salt water out of the lake in the long term anyway and, therefore, it would be just as easy to allow the area to develop naturally in line with climate changes.

Both environmental scientists and biologists now follow the area with great interest. We can already see that Tissø is in the process of changing from a fresh water lake into a brackish water lagoon, with all that this implies. The continued rise in the sea level means that, during the next century, Tissø will increasingly come to resemble an inner fiord as the dead branch below the lake unavoidably becomes a salt fiord as it was in Viking times. Apparently, at that time, it was possible to sail from the Great Belt into Tissø Lake.

The whole of the lengthy adaptation project was severely tested during the extreme weather conditions at the end of February, with tremendous downpours followed by afflux in the Great Belt. The winter had been very wet and large areas of Åmosen were already flooded and could not absorb the extra volumes of water that came down during the two days of heavy rain. Even so, it was not as bad as we could have feared. The reason for this was, of course, that most of the areas that were flooded had already been designated as wetlands and the broad branch of the river below Tissø coped with the pressure from the sea on the one side and the runoff from Tissø on the other. The lowest lying areas of Gørlev and Kirke Helsingør were hardest hit. In spite of the fact that replacement of the sewerage system by a separate system with isolated rainwater collection is almost complete, the sewerage system had difficulty in coping with the tremendous quantities of rain. Many low lying areas and houses were flooded, primarily due to the fact that the groundwater level was already high after the wet winter but also due to flooding from the river.

The substantial rise in the water level also affected Reersø badly but both the floating bridge from the mainland and the floating harbour pulled through. It is a well-known fact that the floating bridge was built as a durable alternative to a dam and it looks as though it was the right decision. The same applies to the floating harbour that was built in the sixties at Reersø harbour as a new and exciting, yet expensive, alternative to a permanent harbour. However, it is doubtful that this will solve the problems for Reersø in the longer term. This time, the flooding affected a large part of the island and, when the water was at its highest, Reersø was divided into several small islands. Again the local authority was severely criticised for declining to contribute to investment in a dyke system to protect the small island community. The future will undoubtedly bring both problems and unpleasant decisions for the small island community.

Can the adaptation strategy handle the climate changes of the future? The question is whether anyone can answer this. One thing is certain: the climate will continue to change. Moreover, in the future, as now, there will be many problems to take into consideration.