2050

Something's Green in the State of Denmark

Scenarios for
a sustainable economy

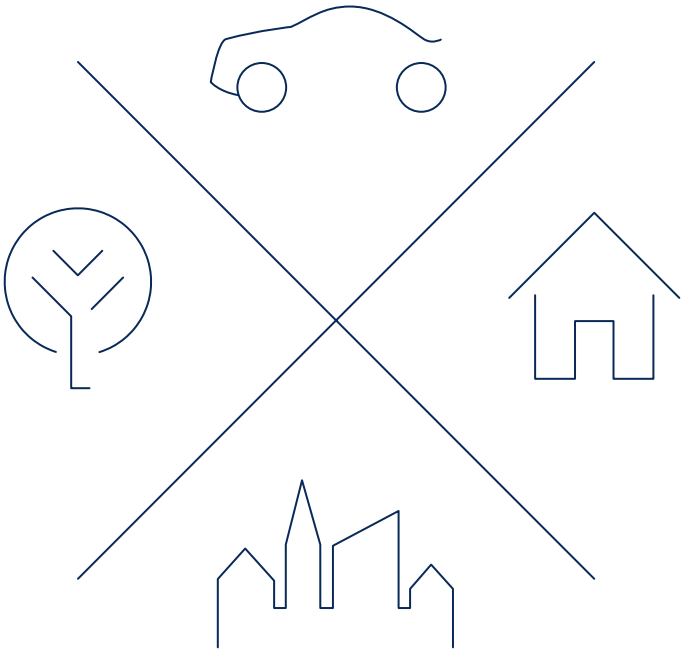
WELCOME TO DENMARK IN 2050

WELCOME TO A GREEN, EFFICIENT,
INNOVATIVE AND PROSPEROUS SOCIETY

WELCOME TO AN ECONOMY,
THAT IS FIGHTING FOR ITS PLACE IN THE WORLD

WELCOME TO A DENMARK
WHERE MUCH HAS CHANGED,
BUT MOST IS STILL THE SAME

WELCOME TO THE FUTURE



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FREJA, FYNSBROEN AND A LITTLE IMAGINATION

As the following pages will reveal, cities, bridges and buildings feature in a future Denmark that few people will have heard of. In some places we have added a little imagination and inspiration to the scenario, and also invented the Jutland urban region of Freja (the belt from Randers in the north down to Kolding in the south), the West Zealand market town Symbiosis (currently known as Kalundborg), the combined pig farm and industrial nursery Pig City in Galten near Aarhus and a bridge connection between Bogense and Juelsminde, which we call Fynsbroen. All these are predictions that should not, of course, be taken literally, but which are not entirely unrealistic in a future green Denmark – and which will help us tell our story.

FOREWORD
DIFFICULT TO PREDICT THE FUTURE BUT USEFUL

By Flemming Borreskov, CEO, Realdania

Is it possible to make predictions about Danish society four decades from now? The answer is simple: no, it is not. Nevertheless, you can learn a lot by trying.

Outlining the future is an effective and useful way of analysing the present. It gives an understanding of how our society will develop and how it is possible to achieve social goals. This may also contribute to qualifying the choices we make each day - to shape development and ultimately the world we want to live in.

Mark Twain said: Plan for the future because that's where you are going to spend the rest of your life. Denmark has made a specific choice for the future; to become a green society - a country and an economy creating prosperity and growth through sustainable solutions. The Danish Parliament (Folketinget) has decided that Denmark must be independent of fossil fuels by 2050. This vision is supported by municipalities, enterprises and organisations. This is a very ambitious goal. It means having to convert our entire energy system, minimising the environmental impacts on water, air, soil and biodiversity, whilst also creating the economic growth that will preserve and develop our welfare.

One thing is certain; such revolution is not possible without a shared idea about the future we want; a specific, realistic and shared vision of our cities, countryside, transport system and buildings; a benchmark that all of society's players are able to steer towards. This is the background for the publication that you are about to read.

"Something's Green in the State of Denmark" is no Utopia. It is a scenario for the green Denmark of the future based on the latest information on how the world is evolving. Over a period of one year, in collaboration with the think tank Monday Morning, Realdania has been analysing the trends shaping our future, and not least what is required to achieve green growth.

Six workshops have been carried out with hundreds of Realdania's members, the most important written sources have been reviewed, and more than 50 of Denmark's leading experts within a number of selected sectors and topics have been interviewed. We have chosen to create one scenario, namely Green Denmark. This may very well be the future of Denmark, and all important planning in Denmark is based on this benchmark. This publication examines the consequences of such development, and tries to illustrate - for the first time ever - what this will mean for us and our everyday lives.

We are not professing that this is what our future will be like. Even so, we have suggested a likely development on the basis of the most recent information and thus contributed to perhaps the most important debate in present day Denmark.

For the same reason, we have rejected a number of other likely scenarios, including a scenario for "business as usual", i.e. what the future will hold if decision-makers do not act on their word.

We have focused on physical Denmark; the structure of our cities, rural areas, houses, enterprises and infrastructure. Technology, politics, economy and social affairs are only included where relevant. Nor do we describe the future energy system in any detail, as this has already been outlined in the report of the Danish Commission on Climate Change Policy "Green Energy". Much can change in four decades but that does not make this exercise less relevant. Realdania aims at creating quality of life through the built environment and "Something's Green in the State of Denmark" is an important contribution to this mission.

We would like to give our heartfelt thanks to the hundreds of members of Realdania and more than 50 experts who participated along the way. Every single contribution has helped qualify this work, and we hope that this will help create an innovative, prosperous and sustainable Denmark in future.

Flemming Borreskov
CEO
Realdania

Methodology

WHAT WE DID

The green Denmark scenario was developed in cooperation with the members of Realdania and more than 50 leading experts. "Something's Green in the State of Denmark" is the result of one year's scenario work carried out between the think tank Monday Morning and Realdania.

The aim was to develop a scenario that describes the possible perspectives for Danish society, if decision-makers achieve the ambitions established in the "Green energy" (2010) report by the Danish Commission on Climate Change Policy. Based on "Green energy", a broad majority of the Danish parliament supports the vision that Denmark is to be independent of fossil fuels by 2050. Political visions have since been widely backed by the Danish business community, municipalities, regions, knowledge institutions and civil society.

The report by the Danish Commission on Climate Change Policy may be construed as an energy scenario for 2050, and this publication represents a parallel yet broader social scenario based on the classic definition of scenarios that were developed by the American think tank RAND Corporation in the 1950s: A rich and detailed portrait of a probable, future world.

We have used backcasting as our methodology. This means that we concentrated first on future goals; a scenario that we want to accomplish (in this case: Denmark free from fossil fuels) and then worked our way backwards. Accordingly, we examined which initiatives, processes and changes are the most likely requirements for the scenario to become reality.

We selected four focus areas which are among the most significant in the transition to a green society. Cities, buildings, the country and transport.

THE SOURCE MATERIAL IS PRIMARILY QUALITATIVE AND INCLUDES:

- A study of relevant literature.
- Qualitative interviews with 50 of Denmark's leading experts.
- Six workshops attended by about 300 members of the six debate fora of Realdania.

The scenario is limited to Denmark but is naturally influenced by the world around Denmark. We have assumed that the EU will continue implementing the "Roadmap for moving to a low carbon economy in 2050" (2011) as well as the targets of the EU Treaty aiming at turning the European region into a "green economy".

In a global perspective, the scenario is based on the International Energy Agency (IEA) and their "New Policies Scenario" (2011), as well as the international climate commitments undertaken by the countries of the world under the UN system (COP17, 2011). In brief, these two scenarios together pave the way for a moderately ambitious international effort to limit global warming. The most recent projections indicate that the average, global temperature rise will peak at 3.5 degrees above the pre-industrial level during the 21st century.

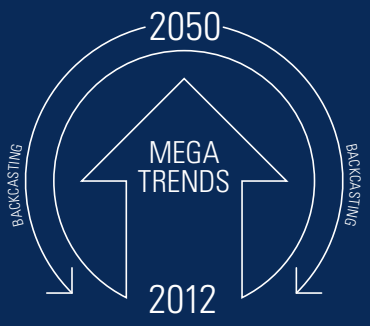
WE HAVE ALSO BASED OUR WORK ON A SERIES OF RECOGNISED, INTERNATIONAL WORKS ON SCENARIOS, PRIMARILY:

- UN's Climate panel: "IPCC Special Report on Emissions Scenarios" (2000)
- National Intelligence Center (USA): "Global Trends 2025: A transformed world" (2008)
- Shell: "Shell Energy Scenarios to 2050" (2008) and "Signals & Sign posts" (2011)
- HSBC: "The world in 2050; Quantifying the shift in the global economy" (2011)

BASED ON THE ABOVE, WE USED THE FOLLOWING FOUR GLOBAL MEGATRENDS AS OUR BASIS:

- Urbanisation
- Population developments
- Economic growth
- Environmental challenges

Members of Realdania were used as a reference group, mainly in relation to backcasting. Monday Morning is the largest independent think tank in Scandinavia, and has used scenarios as a method of analysis for many years. In 2011, together with a number of the world's leading experts and companies within the environment, climate and sustainability, Monday Morning developed a global 2020 scenario for sustainability entitled "Sustainia". This scenario report has largely benefited from this parallel work.



DENMARK
THE WORLD'S GREENEST ECONOMY

In 2050 Denmark is struggling to maintain welfare and to navigate its way through a tough, global reality. We have found our niche; supplying solutions to the world's challenges.

The world in 2050 is turbulent, changeable and challenged. Denmark must struggle to survive. We are trying to protect and develop our welfare while the population is becoming older and more expensive to support, and no less demanding. We are trying to create a sustainable economy – while the competition is becoming ever tougher. Internationally, the major global crises continue – with 9 billion people on the planet lacking food, water and resources.

In addition to this, the global power-balance, both financial and political, has moved eastwards. Asia, with China and India at the forefront, comprises half the world's population and dominates geopolitics. Competition on the global market has increased because many of the major developing economies have become wealthier, better educated and innovative. This is positive for them, but places major demands on Denmark and the rest of the "old world".

Fortunately for us, at the start of the 2000s we opted for a survival strategy that enables us to deliver solutions to global challenges, such as healthy food, as well as welfare, climate and environment technology. We are working purposefully on turning global risks into opportunities. On the back of historical Danish strongholds, we have fought to retain our place in the world as one of the wealthiest and best countries to live in.

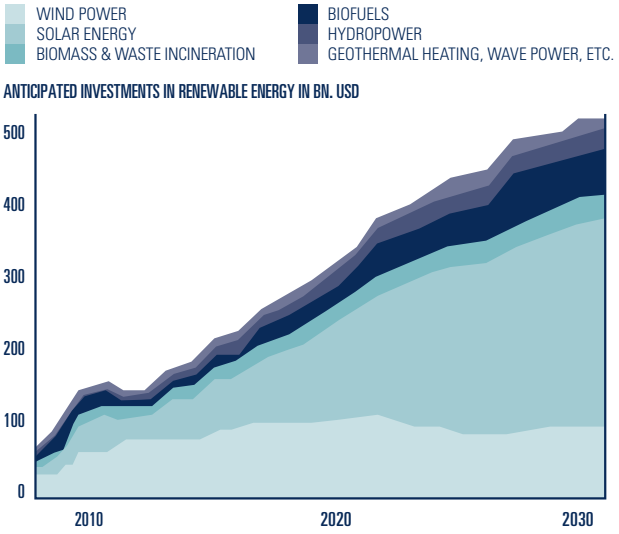
We are finding it hard to retain our place in various rankings of the world's strongest economies, but have conquered the position as the "World's Greenest Economy". This position was established in the 2010s, when decision-makers at all levels – municipalities, companies, organisations, politicians, knowledge institutions and civil society – chose to support a long-term, ambitious and shared green objective. Yet another chapter was written into the 80 year old Danish green story.

In 1971, Denmark set up the world's first Ministry of the Environment, and issued some of the world's first stringent environment regulation. In the forty years following, one of the world's most energy-efficient and affluent economies was founded, which succeeded in decoupling economic growth from energy consumption. And moving towards 2050 we developed the world's first economy 100% independent of coal, oil and gas.

"State of Green" is a strong, global brand, in line with the "Scandinavian Design" and "New Nordic Kitchen" of previous decades. We have gained recognition and revenues from new ventures, like the well-known wind turbines. We have been among the first to roll out electric cars on a large scale, make the national electricity grid intelligent and produce new, valuable biomaterials. Copenhagen and a number of other Danish cities are known for their liveability, organic food, green architecture, and mobility in Danish society which, with its advanced public transport system, is better than almost all other countries. This means that in spite of everything the Danish economy is well prepared for changeable times.

Our society is resource-efficient and this is one of the era's most important competition parameters. Exports of sustainable knowledge and technology creates much needed revenue for the Danish welfare model. The market is extremely competitive, as countries such as Germany, Korea, China and Sweden are also concentrating on green technology – but the market is constantly growing as a result of rising focus on solving the world's environmental challenges.

SOLAR ENERGY BECOMES A MULTI BILLION MARKET



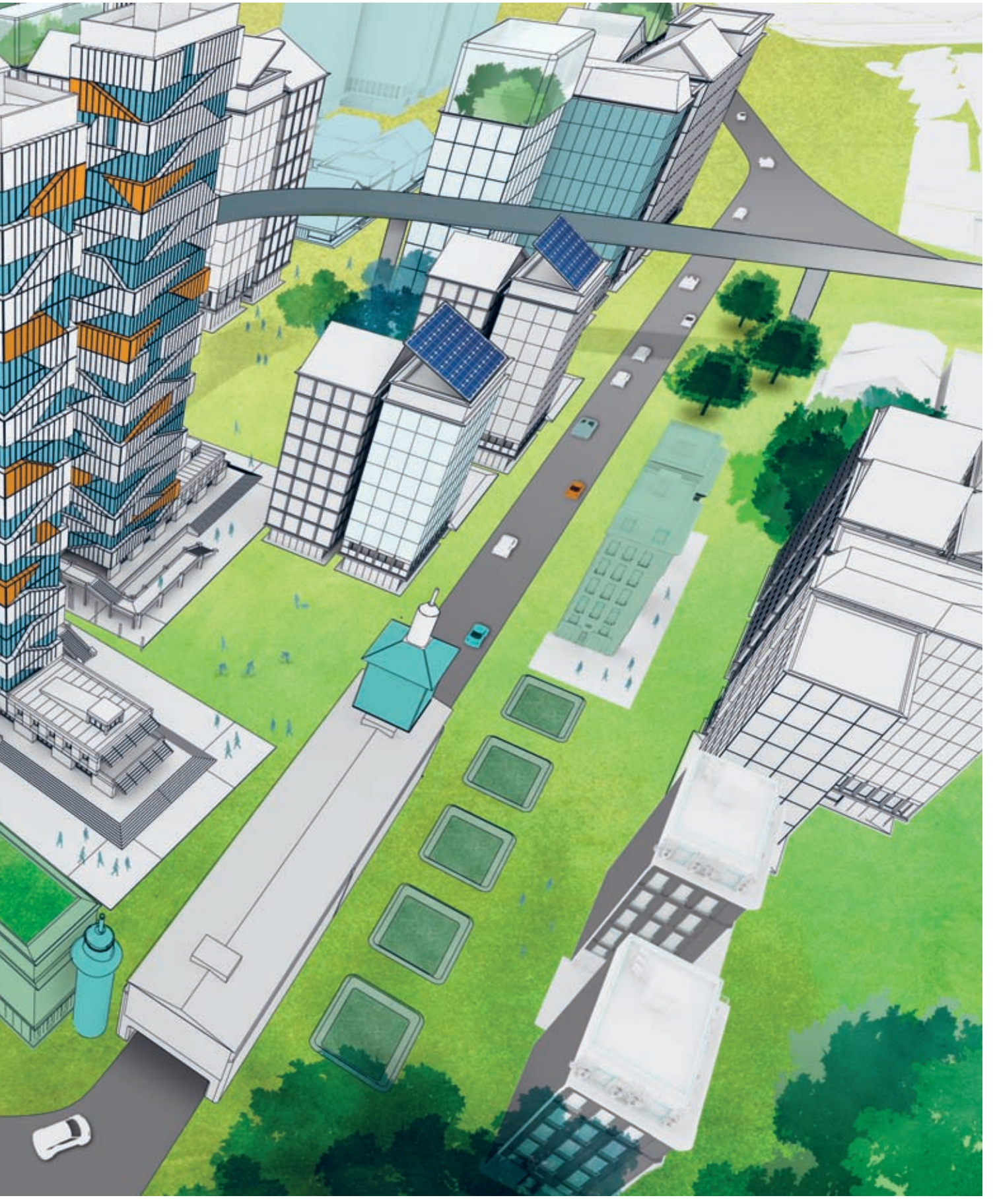
THE FUTURE IS GREEN PROFIT

In the next decades Denmark will base its economy on providing solutions to global challenges. A good example is green energy. In the forthcoming decades the market will grow drastically, and in 2010, Denmark already has a strong hold. More than 10% of our exports are environmental and energy solutions.

Source: Bloomberg New Energy Finance, Fact Book 2010

DENMARK IN 2050 — ACTUALLY QUITE LOGICAL


THE CITY
2050



THE ERA OF THE CITY

The 21st century will be the era of urbanisation. Denmark is dominated by two large urban regions and fewer yet larger provincial towns.

Danish cities and urban environments have undergone a fundamental change by 2050, from small towns and suburbs to market towns and big cities, which act as the country's central growth engines. Urbanisation, population developments, new financial conditions and the switch to a highly efficient society, running on renewable energy, have gradually transformed the built environment, the town structure and, not least, life in cities and urban areas.

Cities will adopt a crucial role for the economy, not only in Denmark, but globally. Growth and productivity is highest in dense urban areas. The short physical distances in urban areas between the business community, authorities, employees and educational institutions make up an important dynamic for creating innovation, as does the presence of key institutions such as universities and research environments, which comprise the lifeblood in a growing innovation economy. Instead of building shiny new research parks outside cities, the new innovation environments have moved into the city centre, often into old, surplus industrial buildings and factories, where they create new life in close interplay with culture, leisure and educational institutions.

In Denmark this development is particularly evident in the country's 10 largest cities, which all have more than 100,000 citizens. The large populations are a natural market for many service companies within the environment and energy sector, which want to be close to their markets and customer segments. The cities' surrounding areas are not just full of suburban villas, but have turned into smart peripheries. These are home to the heavier high tech business clusters within agroindustries for example, which benefit greatly from drawing on the cities' knowledge-intensive environments and the highly educated population.

This development is intensifying the fight for well-educated employees. Citizens, not least the well-educated high earners, take it for granted that their municipality, regardless of whether it is a small provincial town or a major city, lives up to the most stringent of environmental requirements and plays an active role in the green development. Marketing of "green cities" and a "green lifestyle" is hopelessly outdated. A town that offers quality of life and development is by nature environmentally friendly, and what attracts citizens and companies is a sharp profile that makes that city stand out from all others while supporting citizens' and companies' perception of themselves as value-oriented and socially responsible.

In larger cities, the creative entrepreneurial environments, which combine design, communication and art with new growth industries in IT, finance, biotechnology and life sciences, appeal in particular. The smaller towns have other competitive advantages: safe surroundings, a slower pace of life, affordable house prices and growth businesses based on agriculture, food and bioproducts. The small towns also compete with their proximity to nature. As awareness of nature and the environment increases, so does the demand for "outdoor experiences". The same applies to the extent of "wild" nature that has grown via nature restoration projects and afforestation.

"We have the right DNA to pursue green growth, and we are among the best in the world at city planning. A condition for this to succeed is more entrepreneurship and new growth companies."

Kent Martinussen, CEO, Danish Architecture Centre

TOWARDS 2050

Realdania has conducted a number of workshops for members with a view to qualifying the work on scenarios and to define what is needed if Denmark is to achieve a green growth economy. At the city management workshop, the members, who include many of Denmark's mayors, identified the following actions as important:

1

TOWN MANAGEMENT

Denmark's towns need a more strategically oriented organisation and management with greater focus on vision, service and development than on administration.

2

PARTNERSHIPS

Green growth is only achievable if the business community, knowledge institutions and politicians work closer together towards a common goal, and exploit complementary strengths, skills and spheres of influence.

3

FREEDOM WITH RESPONSIBILITY

The transformation requires Danish Parliament to provide long-term overall goals, but assign the realisation of these to the municipalities, which in return have to show a willingness to take risks.

4

VOLUNTARINESS

In order to strengthen cohesion, innovation and resources in local communities, citizens' strength and skill sets must be released. Many citizens want to contribute voluntarily to society, and municipalities must welcome and facilitate this.

ORESUND AND FREJA - GROWTH METROPOLISES

Instead of cities with one centre, Denmark is dominated by two large growth regions, where the classic town centre has been replaced by several town centres. Former city identities that were determined by city limits have gradually been erased.

Oresund, which covers the Capital Region and most of North Zealand, and on the Swedish side, Malmö, Lund, Helsingborg and Karlskrona, is by far the biggest growth metropolis with its 4.5 million inhabitants. The region is connected by the Loop; the light railway that runs in a circle round Oresund, trains and not least the metro, whereby the latest line travels under Oresund to Malmö. The region which is Denmark's biggest economic powerhouse, has developed into a global hub for research, education and business community, which is internationally recognised within climate, health and welfare.

In the west, Freja is a growth region more than 200 kilometres long, running like a belt along the Jutlandic east coast, from Randers in the North across Aarhus to Kolding in the south. It comprises the economic spine of Jutland, has 1.5 million inhabitants, and is named after "Frejas Sal", which refers to the stunning Danish scenery in the Danish national anthem. Freja is particularly well-known internationally as a strong wind and biocluster.

However, the development has also polarised Denmark. In the areas not connected to the two large Danish urban regions, competition has been tough for many smaller villages. While the larger cities grow and thrive, many of the small local communities on the outskirts are being drained of resources, activity and young people. The share of elderly people in outlying areas has increased significantly, and more and more residents in rural municipalities are over 65 years of age. Several villages have disappeared completely because influential mayors and municipal politicians lost the race to attract new taxpayers.

However, the challenge of managing a diverse population is also found in big cities, where marginalised groups unable to keep up with the demands of the ever increasing and specialised job market, dominate certain urban areas and struggle with a poor social profile. The social housing sector has played a key role in several areas by giving problem environments a new green profile, which attracts more stronger residents. Young well-educated couples and families are attracted by access to shared services, such as energy-saving communal laundries, photovoltaic solar modules and green roofs.

The quality of life in the urban age tends to be higher than ever, and citylife offers numerous possibilities. As part of the historical effort to restore nature in Denmark, forests and wild nature have also been set up in urban areas, to give city residents who live with ever denser proximity to one another quick access to nature. This also applies to city centres, where e.g. waterfronts close to urban areas have been furnished with sea swimming pools, artificial beaches and maritime theme parks.

THE SUSTAINABLE URBAN DWELLER

The contents of cities are not the only features to have changed. Cities also look different. New architecture and experimental buildings blend with well-known, renovated low-rise buildings and smaller historical town houses. They are located in city centres, where small, narrow

"In order for the compact and dense cities to become attractive, it is essential to remain focused on 'liveability'."

Prof. Gertrud Jørgensen, Forest & Landscape Denmark, University of Copenhagen

FACT 2050

9 OUT OF 10 DANES LIVE IN CITIES.

SOURCE: STATISTICS DENMARK

streets wind through residences, businesses and institutions. The wide roads, car parks, traffic lights and boulevards have disappeared from town centres to be replaced by denser housing and new urban space in the form of parks, city and courtyard gardens, large squares and small market squares.

Development has also gone underground. Frequent extreme weather conditions, such as heavy downpours and hurricane-like storms have made it necessary to invest heavily in new water and sewerage systems, and buildings, roads and railways are climate protected to withstand tempestuous storms.

The rest of the cities' infrastructure has also been renovated as part of a national effort to integrate and make the Danish national electricity grid smarter, and to build a supply system that can handle advanced waste separation. This development has also created new opportunities for residents, for whom the level of sustainable and green construction has reached new heights with e.g. recyclable housing concepts. Denmark's cities have not only gone green and entered the green economy, they have also become one of the most significant driving forces in a new era; they are gradually gaining power over a larger part of planning, development, regulation and financing.

More than 9 out of 10 Danes live in the city, and have therefore had a strong impact on the forty years of work gone into creating a society that balances resource and energy consumption with a continued rise in prosperity. The difference in carbon emissions per Dane largely depends on where they live. An urban dweller emits just 6 tonnes of carbon a year, whereas a rural dweller emits 9 tonnes. Previously, households and transport were the two biggest sources of carbon emissions in Denmark. In 2050, household energy consumption has halved, and the transport sector's share has reduced significantly when compared to the continued rise in transport.

This is mainly due to technological progress within e.g. energy production, materials and batteries, but the cities themselves have also been a factor. Nearly 100% of all buildings are connected to district heating and district cooling systems, which use mainly biomass, solar energy and geothermal heating. The rest of the city's energy is electric and is produced from the many large and small installations that only use renewable energy sources such as wind, sun and waves. All producers and end users are connected by an intelligent, flexible energy grid. Our houses have become intelligent units, which "speak the same language" as our car, the fridge, the deep freezer, the building's other infrastructure and the home's many electronic gadgets. This ensures the maximum exploitations of electricity, water and heat day and night.

Urban dwellers' sustainable mindset is however not only limited to the environment and being green. In 2050, we have come so far in transition to the green economy that new challenges have taken over the agenda. The biggest is health and the hunt for solutions that can eliminate chronic lifestyle diseases. The opportunities for physical exercise in the urban space are of major importance and many areas are now designed with focus on recreational and physical activities. Play areas for adults exist in many areas, as do parks and green oases. They create space for reflection and peace in an otherwise hectic world.

ORESUND AND FREJA - GROWTH METROPOLISES

Instead of cities with one centre, Denmark is dominated by two large growth regions, where the classic town centre has been replaced by several town centres. Former city identities that were determined by city limits have gradually been erased.

"90% of the city structure we see today will still be there in 2050. But the way we use the city has changed in line with the new rhythm of our daily lives."

Prof. Jens Kvorning, Royal Danish Academy of Fine Arts, School of Architecture

NEW CITIES IN THE CITY

In 2050 many Danes still dream of living in a detached house, which for many equals the ultimate home comfort. With citylife's combination of good jobs, attractive housing, education, short distances, accessibility and the great selection of creative environments and culture, the city represents an attractive alternative that continues to attract students, singles, families with children and career people to Denmark's two growth centres, which also continue to accommodate many of the elderly.

In the cities we will live more densely, and on top of one another, in more energy-efficient homes and residential areas. Buildings and homes from the massive construction boom, which began 100 years earlier during the welfare boom from the 1950s to the 1970s, have undergone comprehensive energy renovation. Climate and energy-certified builders have helped secure billions of savings, both in the private and public housing stock.

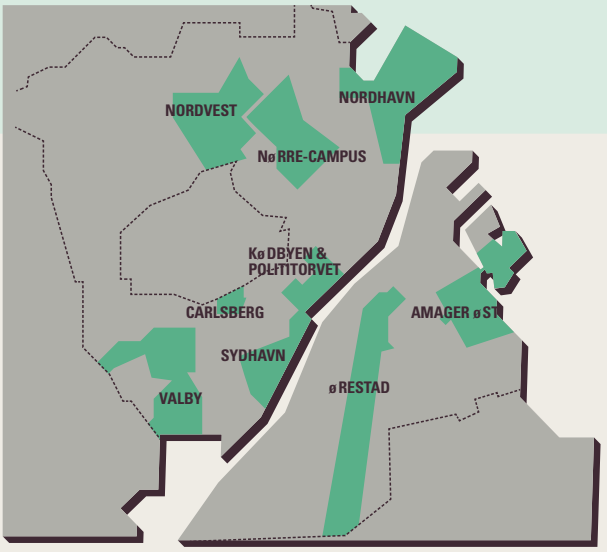
The most significant change is, however, in the new neighbourhoods which form the framework for most of the experimental new building. In Copenhagen an example is the carbon-neutral district Nordhavnen, which with its mix of old and new buildings, provides homes for 40,000 inhabitants.

Nordhavnen was from the very beginning designed to be state-of-the-art sustainable. This means for instance that car traffic is limited, and that the waste disposal companies have implemented advanced urban mining, i.e. that they systematically collect, sort, separate and recycle all materials that would otherwise end up as waste. In Nordhavnen self-sufficiency has also been systematised. Accommodation typically has access to a small balcony – or roof garden, where you can grow your own vegetables; urban farming. The concept of sharing continues, even if cooperative dwelling has died and been replaced by owned or rented accommodation.

Also Sydhavnen and Valby are home to new attractive districts such as Carlsberg Byen and Christiansberg, which is flourishing on the old market square in Valby. Also in Nordhavnen, the sustainability profile is built on cohesive concepts, which strive to attract resourceful inhabitants. For instance, Carlsberg, a new international district, is full of foreign students and employees, while Christiansberg has focused on creating the right environment for children and family life.

Even though the districts ooze new groundbreaking architecture, many areas have also tried to retain and build on the heritage from the industrial architecture with renovation of silos, factories, cranes, etc. which have now become homes, culture houses, office buildings, daycare facilities and schools.

The new districts have also had the best prerequisites for putting an end to the car being the dominating element, and have instead become "smart cities", with a much more flexible urban space. Here cars, cyclists and pedestrians share the same transport routes, with pedestrians and cyclists taking precedence over the car, which has been relegated to the bottom of the traffic food chain. The urban space is thus much better exploited for free play and movement.



THE NEW CAPITAL

Copenhagen has 170,000 more inhabitants than in 2010, and a number of new districts have appeared.

Source: City of Copenhagen

New building does not take up much space in terms of square metres compared to renovated areas, but individual beacon projects have supported Denmark's brand as "State of Green" and the world's greenest economy. In Symbiosis on West Zealand, the old Kalundborg, an entire market town has been integrated into the all-encompassing resource cycle, which means that homes, the business community and local transport are based on 100% recycling of water, energy and biomass.

In Galten outside Aarhus, Pig City the world's first combined pig farm and industrial nursery on three storeys, continues to attract plenty of attention from investors and experts from all over the world. 16,000 square metres of pig farming on the ground floor, an industrial nursery on the first floor and biogas plant in the "cellar". The production of pigs, roses and tomatoes are part of a resource cycle that also involves energy self-sufficiency. The idea has been exported to the rest of the world, and Pig City has brought Denmark on to the front pages as an example of radical, green innovation.

2012
THE FUTURE IS ALREADY HERE

MIDDELFART

The Municipality of Middelfart is already ahead of the game when it comes to energy efficiency, partnerships and new business models. In the forthcoming decades we will see a large number of municipalities follow this example.

In 2008, the municipality started Denmark's first and until now largest energy renovation project based on the ESCO model. ESCO stands for Energy Service Company, and means that a private company can offer to energy renovate buildings in return for a share of the savings. ESCO guarantees energy savings over a number of years, and in many cases also offers financing. The customer is therefore guaranteed savings, and can be sure that state-of-the-art technology is used for the renovation.

In Middelfart, renovation of more than 100 municipal buildings has already begun. The guaranteed savings on energy bills are 21% and the payback period is 12-14 years. The money saved is given to the municipality's institutions.

The Municipality of Middelfart has already begun expanding ESCO to the private housing stock, where home owners club together to renovate their homes. Local builders are also being re-trained to enter into partnerships with municipalities, banks and energy companies.

THE METRO IS COPENHAGEN'S LIFEBLOOD

Residents of Denmark's major cities are proud to live in carbon-neutral cities. The air is cleaner, and it has become healthier to be a city dweller. Quality of life has improved. A visitor from the past might notice the peace and quiet since the combustion engine left cities during the 2030s'.

But the conversion to renewable energy has not been able to solve the biggest problem facing Denmark's capital city and other large metropolises: Traffic jams. Well developed information technology makes it easier to work and hold meetings from home, but most people still prefer to be physically present to benefit from social contact and networks. Knowledge and consultancy is our biggest export, and this requires us to be able to move around quickly, locally, regionally and globally. For the same reason, the need to commute has grown significantly compared to the level 50 years earlier.

This is evident in Copenhagen, where the number of residents has drastically increased by around 170,000 people in just forty years, while over half a million move in and out of the municipality's borders daily to work or study. Despite the electrically powered means of transport being much more environmentally friendly, the heavy pressure on the infrastructure is bad for growth. This has forced Copenhagen and surrounding municipalities to invest hugely in public transport routes.

The biggest investment can be found underground. What initially began as a single metro line connecting Vanløse and Amager has grown into a network of several lines that meander around the Copenhagen underground and makes Copenhagen one of the world's most effective cities in respect of public transport. The expansion means that nine out of ten residents in the city's centre and adjoining districts only have to move 600 metres to the nearest metro or S-train station. Busy passengers on the most popular metro connection, Cityringen often need to stand up despite trains leaving every 2 minutes and old three-carriage trains have been expanded to four carriages. Another popular connection links the city's newest districts and runs between Nordhavnen and Sydhavnen whilst two other lines make up a vital transport artery for thousands of employees and patients who travel to the region's large hospitals in Hvidovre, Bispebjerg and Rigshospitalet on a daily basis.

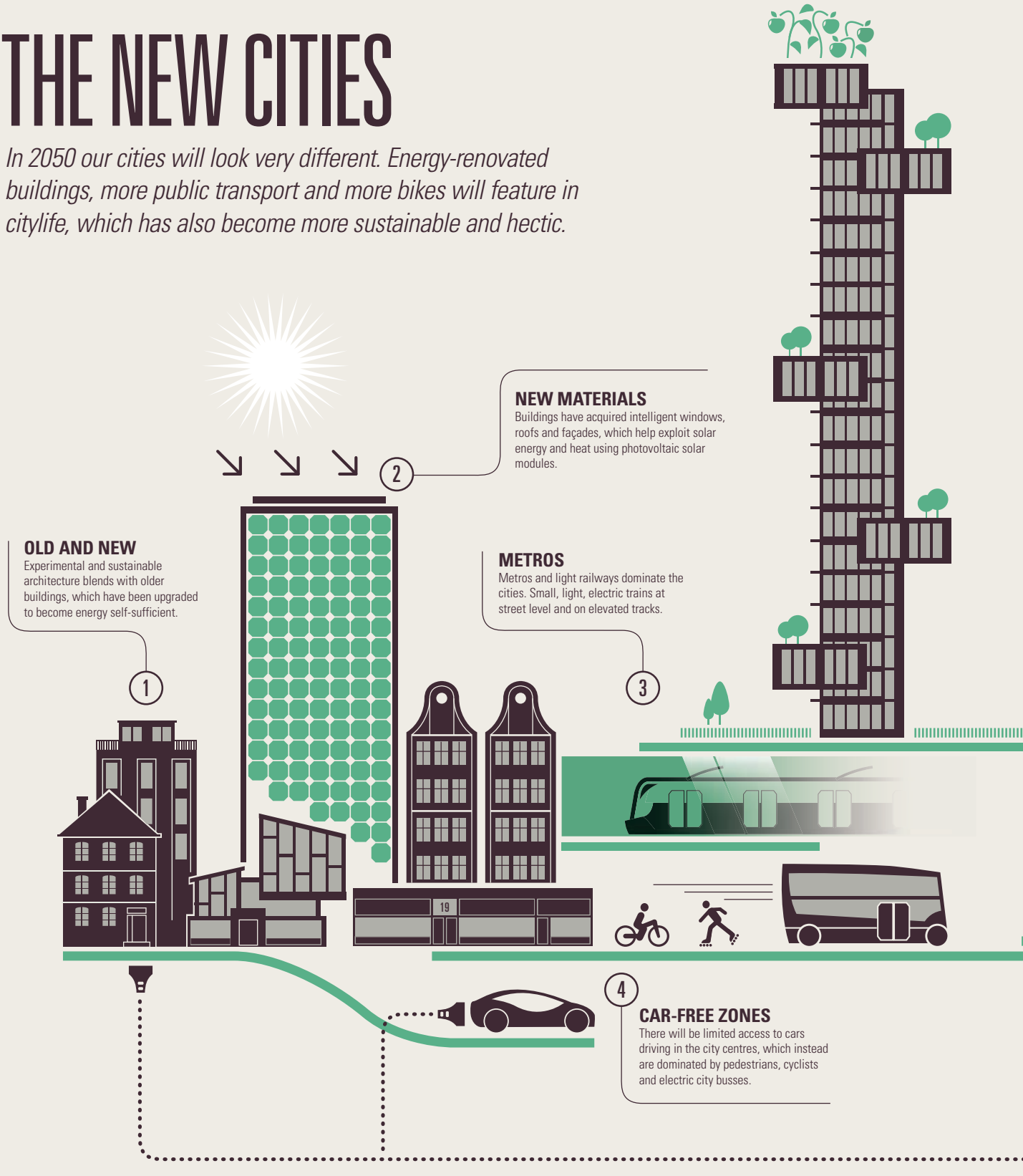
Particularly the elderly and patients, benefit from being within quick and easy reach of treatment and rehabilitation at the large hospitals, thanks to the metro. Many also choose to use the electric city busses, which pass by the long queues of electric cars in special bus lanes reserved for public transport. The busses do not follow a specific timetable, but act as shuttles between the traffic hubs, and routes are adjusted by intelligent traffic management to accommodate large passenger flows.

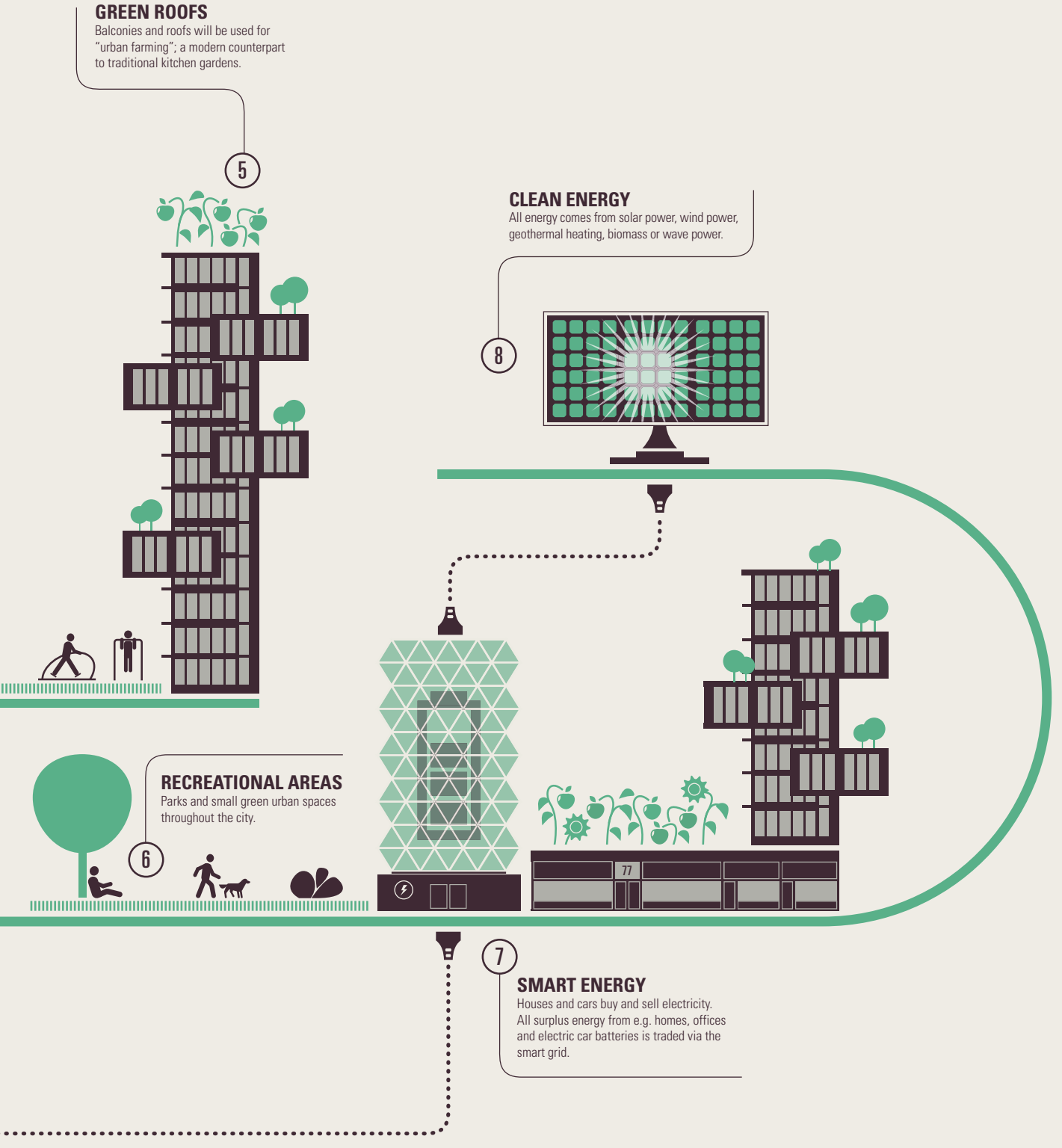
Another alternative is provided by the S-train network, which has been expanded and automated to provide a shuttle service similar to that of the metro.

Much of the energy required to run the capital's metro; electric busses and S-trains is supplied by large offshore wind farms in Oresund just outside Copenhagen. Beneath the seabed, construction of the latest metro line is in progress. When this is completed, travel from Copenhagen to Malmö will take just 10 minutes, and the project completes years of work to make the Oresund Region an interconnected city area.

THE NEW CITIES

In 2050 our cities will look very different. Energy-renovated buildings, more public transport and more bikes will feature in citylife, which has also become more sustainable and hectic.




GREEN ROOFS
Balconies and roofs will be used for "urban farming"; a modern counterpart to traditional kitchen gardens.
5
CLEAN ENERGY
All energy comes from solar power, wind power, geothermal heating, biomass or wave power.
8
RECREATIONAL AREAS
Parks and small green urban spaces throughout the city.
6
77
7
SMART ENERGY
Houses and cars buy and sell electricity. All surplus energy from e.g. homes, offices and electric car batteries is traded via the smart grid.

2012
THE FUTURE IS ALREADY HERE

THE CARBON-NEUTRAL CITY

In the previous industrial harbour of Nordhavnen, the first steps have been taken in what will be the largest district built in Copenhagen in recent times. The artificial peninsula will be home to no less than 40,000 people and 40,000 workplaces, once the full 3.5 million square metres of floorspace has been completed in around 2050.
The area will act as a carbon-neutral district, which gets its heat and electricity from the subsurface, the wind and the sun via geothermal installations, local wind turbines and solar panels on buildings. The idea is also to exploit the proximity to the sea and establish as many green roofs and areas as possible in order to enhance the quality of life in the area, that will be connected to the rest of the city via the Copenhagen metro. The buildings in the area will be a combination of the new and the old, and the tallest buildings will be no more than six storeys high to respect the rest of the Copenhagen skyline. However, there will be distinctive buildings, with characteristics reflecting the existing structures in the area such as silos, CHP plants etc. The project has been divided into several phases, with the first commencing in the part of Nordhavnen closest to the rest of Copenhagen.

TWO WHEELS INSTEAD OF FOUR

The Capital Region of Denmark has joined forces with 16 municipalities to set up a network of super cycle highways, which will connect the municipalities surrounding the capital with the city centre and large workplaces. So far, only one route has been designated: Albertslundruten. However, according to the outline of the complete route network, there will be a total of 26 routes, of which the longest will reach up to 30 or 40 kilometres, from Dragør in the south to Birkerød and Farum in the north.
The idea behind the super cycle highways is to make it quick, comfortable and safe to cycle to work. For the same reason, all routes will have to meet a number of criteria to be rubber-stamped as super cycle highways. Furthermore resources will have to be earmarked to keep the cycle highways well maintained, in the same way as maintenance is a top priority for major roads. Projections show that the network will increase the number of commuter cyclists in the region by 30% corresponding to 15,160 cyclists. This corresponds to a saving of 6,974 tonnes of CO2 a year and DKK 307 million, as the wear and tear of roads caused by cyclists is significantly less than that of motorists.

FACT 2050

9 OUT OF 10 COPENHAGENERS LIVE A MAXIMUM OF 600 METRES FROM A METRO STATION.

SOURCE: THE CITY OF COPENHAGEN

"As numbers of pedestrians and cyclists increase, we will break away from the classic division of traffic in many densely populated urban areas, and combine different traffic flows in new ways."

Brian Hansen, Head of Transport Planning, Technical and Environmental Administration, City of Copenhagen

MOSTLY FOR PEOPLE

While the metro is busy underground, the Copenhagen cityscape will be dominated by pedestrians, electric busses and, not least, tens of thousands of cycles. Copenhagen is one of the few major cities in the world in which more than half of journeys are by bike, and many of these by carrier bike to transport shopping and children.

Cyclists commuting from the city's surrounding municipalities will be brought in and out of the city's centre via super cycle highways, which are linked to important traffic hubs and large workplaces. These super cycle highways will accommodate the many electric cycles that are particularly popular with commuters travelling more than 5 km.

Traffic between the city and surrounding municipalities is separated in many places to ensure that the cyclists, cars and public transport can reach their destinations as quickly as possible. This has a positive impact on road-accident statistics.

Just as other Danish cities, the City of Copenhagen invests a great many resources on maintaining cycle paths, and services such as the provision of cycle pumps and drinking fountains along routes, making life much more comfortable for commuter cyclists. And while most streets in the city centre are one-way for cars and busses, the same rules do not apply to cyclists, who are free to move in any direction.

If you decide to take your car into the city centre, the majority of parking will be underground. Most of the current parking spaces above ground will have been removed to make way for cycle paths, wider pavements and recreational areas. In many of the residential areas in the city, kerbstone parking is only permitted for 15 minutes and for delivery vans with packages and goods bought on the Internet.

Cyclists also have to find their way into underground parking installations, where their bikes will be sheltered from the rain, snow and wind, as most above ground cycle parking is reserved for the municipal bike-hire service, in which a simple text message will allow you to use one of the many thousand municipal bikes.

It is also tempting to take shorter journeys on foot. Cities will be built to encourage people to use their own bodies as a mode of transport. For the same reason pedestrians have been especially cared for in larger cities, and pedestrian streets and wider pavements protect them from the rest of traffic. Such measures have led to major reductions in the number of fatal road accidents.

The square surrounding the central traffic hubs has been freed of cars. For example users of Denmark's busiest station, Nørreport, are no longer ejected directly into the road as soon as they leave the depths of the underground, but instead they can move without interruption via a large open square to the numerous narrow streets and alleys in the city centre. In many areas pedestrians no longer bow to the needs of motorists by being forced onto pavements along busy roads, but instead there are corridors with shortcuts through housing blocks and courtyard systems.

LIFESTYLE:
NEW TIMES – ALSO BETWEEN THE EARS

New regulations, legislation and prices have forced us to live more sustainably.

Changes in the world around us have also spread to our way of living and thinking. Population growth, the resource shock, food shortages in many places in the world and frequent natural disasters have all given us something to think about. We are also subject to new regulations and legislation designed to change our way of life. Similarly, the price of everything from water to cars has provided us with a strong incentive to live more sustainably, and for decades we have been inundated with information campaigns. The result has been a slow but sure shift in our lifestyles and habits. Even though we are still resisting.

Most Danes remember the day in October 2046, when the population of the earth reached 9 billion. Among the consequences has been that prices of scarce resources - from cotton and paper to water and energy - are now higher than ever. The new substitute materials are better than before, but not yet cheaper.

Meanwhile, changing governments have reformed our tax system, so that we now pay much more tax on consumption rather than on income. Hitting us in the wallet is still the most effective way of forcing us to change our behaviour.

All forms of energy are expensive - very expensive - in order to ensure that we maintain and optimise our houses, cities, production and transport systems. Enjoying cheap products from Asia is a thing of the past. Throughout the EU taxes are imposed if manufacturers and producers cannot document that products have been produced resource-efficiently and with respect for the environment. Many companies in Denmark are subject to quotas for their energy and resource consumption.

Seasonal locally-produced foods have lower VAT than imported goods. Manufacturers of nearly all consumer products are forced either to collect their products and packaging after use, or to pay others to do so. There are deposits on milk cartons, light bulbs and paper.
Some things have been completely banned. For example oil and gas-fired boilers, aluminium cans and wood from rainforests.

Danes continue to moan about taxes and duties, but most know why things cost what they do. As a result of many years of international political disagreement and hesitation on climate change, the consequences that no one really believed would ever happen have become a reality. Firstly, the weather has become more unsettled. Denmark experiences heat waves, violent storms and flooding, even though we are still in something of a safe haven. In other parts of the world, natural disasters are relentless, not least in areas least capable of coping. In many ways we have become accustomed to climate change in our everyday lives, but it still affects us mentally in the same way as other major upheavals throughout history.
For decades we have been bombarded by information campaigns and suggestions of how we can change our consumption patterns. At schools our children learn about animal species, such as rhinos, gorillas and tigers, that no longer exist outside zoos. They look at pictures of colourful coral reefs from a time when they were commonplace. They read about forests that no longer exist, and islands that have been abandoned.
It is mainly our consumption that has changed. We are neither holier nor wiser than before, but circumstances have pushed us in new directions. In reality, it is a case of old virtues returning: To use up what you have before buying something new. To inherit, maintain and pass on. We do not do this necessarily out of respect for the environment. We often do it because it is common sense.

We are not the only ones trying to change the world. The trend towards a more sustainable behaviour pattern and culture is being closely monitored by researchers on a global scale. Numerous studies indicate that the middle of the 21st century marks the start of a significant change. In line with us becoming more affluent and better educated, our consciousness is changing from focusing on material values to gradually focusing on the quality of life.

"We are the first generation that actually knows what we are doing to the climate system, and that makes us the first generation capable of doing anything about it."

Prof. Katherine Richardson, Vice-Dean, University of Copenhagen.

THE INFINITE SHAVER

A SHAVER, MADE ACCORDING TO CRADLE-TO-CRADLE PRINCIPLES, IS MANUFACTURED FROM 100% RECYCLABLE MATERIALS. IT IS DESIGNED TO BE TAKEN APART, SO THAT ALL MATERIALS CAN BE REUSED.

Materials
Renewable or recycled

Production
Designed to be taken apart and recycled

Use
Energy and resource efficient

Transport
As light, compact and small as possible

Disposal
Disassembly and recovery of all materials

JARGON 2050

BIO EFFECTIVE

Societies that strive to use and recycle their organic resources as intelligently as possible, for example with systems that enable effective exploitation and recycling of all waste and surplus products.

URBAN REGION

Densely populated areas of the country, where larger towns merge together to form cohesive regions.

THE SMART PERIPHERY

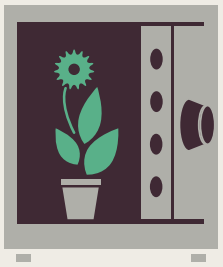
A term for parts of outlying areas of Denmark, which have regained growth by functioning as a test platform for green technology and innovation in new energy, agriculture and transport solutions. 'Smart' means 'intelligent' in this context.

DOCKING HOMES

Special housing concepts that give residents access to the most important services in a relatively small space. Originally developed for busy career singles, who were constantly on the go and did not need much living space. Rent often includes services such as laundry and cleaning. Located centrally in large towns, close to culture, shops, airport and international train routes.

ENERGY LANDSCAPES

Large rural areas in which energy-intensive crops such as soya, maize and willow are cultivated next to large wind farms and solar panels.



GENE POOLS

Laboratories that preserve animal and plant genes under special conditions to avoid contamination. A major business area for Danish research institutions and companies that have researched into and developed drought-resistant crops, for example, and laid the foundations for the world's biggest gene pool for clean animal and plant genes.

MAN-MADE POOL

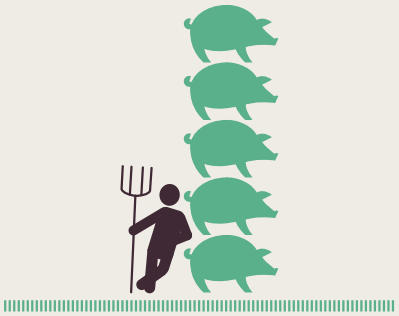
The global sum of materials that the human race has already extracted and which, in principle, can be recycled to infinity. The more we can use the materials we have already extracted, the less we need to remove from what remains of nature's store.

MOBILIQUALITY

A concept that describes the quality of being mobile, often in public transport. High 'mobiliquality' means it is easy and convenient to move from one place to another, while at the same time having access to a number of services that facilitate work or meetings for example, or which provide entertainment en route.

NEXT-USE

Instead of using something and throwing it away, you swap, share, borrow or rent, so that material efficiency is multiplied. Why throw something away that others can use? Why not share something that you do not need yourself all the time?



URBAN FARMING

Production of crops and other agricultural produce in urban areas, from small local roof nurseries to larger agroindustrial farming in old industrial districts, where, for example, pigs are bred in towers; also known as vertical farming.

RESOURCE SHOCK

The crisis that broke out in the 2020s as a result of over exploitation of lithium, copper, steel, phosphorus and other scarce raw materials, and the subsequent record-breaking price hikes.

RESOURCE ETHICS

Concept associated with the global resource crisis. As the battle for vital resources such as clean drinking water, energy and food comes to a head, we are debating how much-sought-after resources can be used and who has priority to them.

SMART GRID

The intelligent electricity grid that links us all, and which enables electricity and information to be exchanged between consumers and electricity producers.

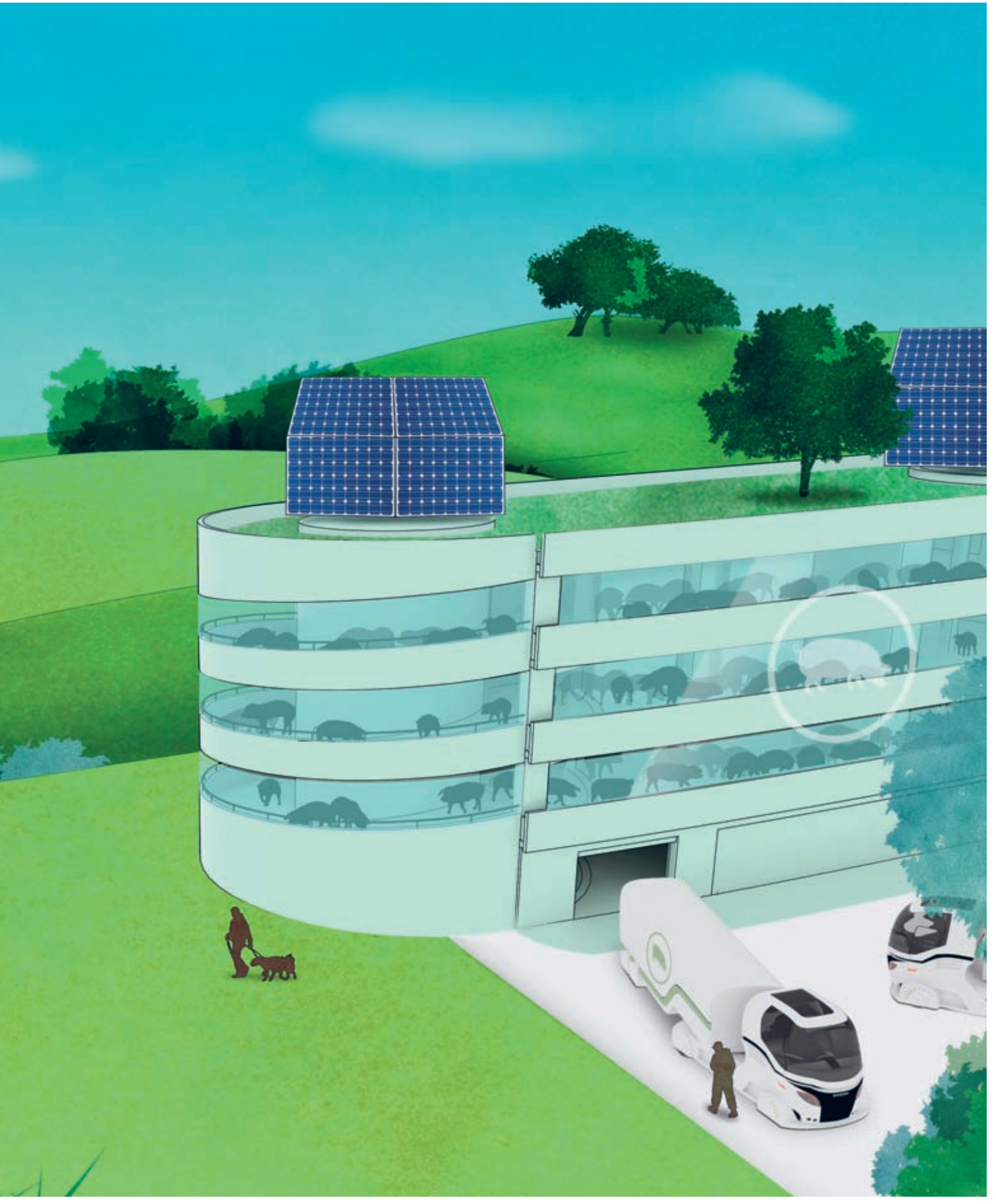
UPCYCLING

Intelligent recycling of materials, such as construction materials, so that the value of the material is recovered or even increased. Represents an enormous savings potential and is therefore high on the business community's agenda.

URBAN MINING

Collection and recycling of old electronics and other items, which contain valuable metals such as gold, silver, platinum, iridium and other rare metals. Has become an entire movement with a strong presence in larger towns and cities. It has become a profitable business.


THE COUNTRY
2050



FROM FRINGE TO FRONT EDGE

In 2050 Danish rural districts will be dominated by advanced production of quality food and biomaterials, research, adventure tourism, and wild nature. There is growth out in the countryside, but many smaller communities have also become marginalised or have completely disappeared.

The 2000s favoured the towns, and urbanisation has been tough on many rural areas. Small rural communities have dissolved as young people move to the cities and the remaining population grows older. Thousands of farms have been closed. The old building stock has been demolished where energy renovation was inappropriate. Thousands of abandoned properties, stables, barns, silos and slurry systems have been torn down.

But the story of the Danish rural areas and countryside is far from a story of complete demolition. In 2050, rural districts and agriculture have gained a new and significant role in Danish society – as growth creators, as recreational resources and as innovators.

The lack of vital resources remains a major challenge to the world economy, especially as the planet is now home to 9 billion people. This applies to everything, from food, drinking water and energy to rare metals, commodities and mineral resources, and Danish agriculture has turned this challenge into a highly lucrative opportunity.

Resource efficiency is crucial in a scarcity society. The most efficient economy is the most competitive, and the countries that can provide knowledge about ingredients, materials and raw materials, or can manufacture their own, earn great benefits in terms of jobs and exports.

Traditional livestock and plant production has dropped off, but new agriculture is doing well and has gained a larger share of the growth which had otherwise been concentrated in cities.

Rural districts produce most of the vital resources on which Denmark's six million inhabitants depend. Danish agriculture is not just a pantry of meat, milk and corn, but has developed into a highly specialised industry, which thanks to efficient resource exploitation has become a major supplier to other sectors such as energy, ingredients, plastics and the pharmaceutical industry. It has also become attractive to settle in the countryside, which can now offer many good alternatives to the more stressful, chaotic lifestyle of the city.

Rural districts have become major suppliers of holidays and recreational activities. In an ever more hectic urban society, outdoor activities, physical exercise and mental breaks in nature are in high demand. 'Fringe Denmark' has in many ways become 'Front Edge Denmark'.

THE SMART PERIPHERY

Developments have brought new life to several rural areas close to towns and cities, which are now referred to as 'The Smart Periphery'. Out where the wind is fresh and the nearest lamppost is a long way off, the majority of the thousands of smaller farms, which had to close as they became unprofitable, have now been replaced by around 1000 large farms, of which the biggest cover several thousand hectares.

The idyllic pastoral farming culture of the past has disappeared and in terms of scale and staffing, the new farms are more like factories. They are all highly specialised and focused on exploiting resources as efficiently as possible. This is the heart of good business. It is often necessary to deal with different sales channels. For example, the smart corn grower no longer only sells his crop as pig fodder, but splits it into sub-segments, with some going to food manufacturers, some to a bioethanol factory and the rest to pig and cattle farmers, who use it as fodder. Other examples of customers for agricultural products are manufacturers of dyes, pharmaceuticals and building materials.

This specialisation also applies within individual product categories, where parts of agriculture have regained their competitiveness. Organic production is widespread, but other niche markets have also appeared. For example, a dairy farmer in 2050 not only produces milk, but milk with special health-promoting properties, thanks to the special feed given to the cows. In supermarkets there are a number of different types of speciality milk, for example for the elderly, children and pregnant women.

Completely new specialist markets have emerged as a result of climate change, which makes it possible to produce wine, for example, and different medicinal plants and herbs that can replace chemically produced substances in pharmaceuticals.

"The fringe will be the frontier for new and greener resources and solutions."

Prof. Lene Lange, Aalborg University

TOWARDS 2050

Realdania has conducted a number of workshops for members with a view to qualifying the work on scenarios and to define what is needed if Denmark is to achieve a green growth economy. For agriculture, members identified the following as some of the most important aspects:

1

COOPERATION

Green growth is only achievable if Danish agriculture, the business community, knowledge institutions and politicians work much closer together towards a common goal and exploit complementary strengths, skills and decision-making powers. The co-operative movement is one example of how Denmark has done this before. This experience should be reused to build new partnerships and consortia.

2

KNOWLEDGE ECONOMY

There is a lot of valuable knowledge in Danish agriculture that is much sought after by the rest of the world. Therefore there is a good foundation for a new global business potential, in which the sale of knowledge and innovative solutions are active growth initiators in agriculture.

3

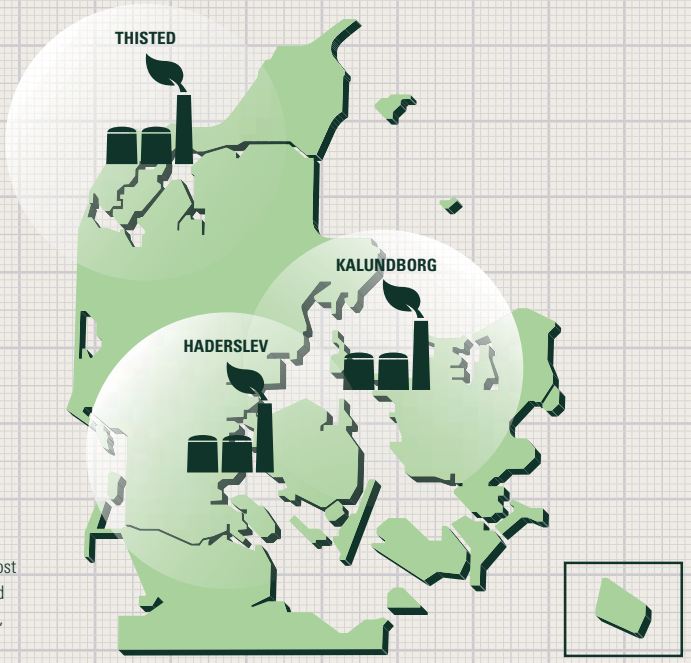
ENERGY PRODUCTION

The world is facing significant energy challenges. Biomass will play an important role in the transition to a fossil fuel free society. As a producer of renewable energy, Danish agriculture will play a key role in this green transition.

4

FINANCING

The transition to a green growth business requires that agriculture receives sufficient financial support. This is not just about subsidy schemes, but about developing new financing models that encourage external investors to invest in farming.



REFINED PRODUCTS
In 2050, Denmark will have three of the world's most advanced biorefineries, which convert biomass and waste into high-value products, such as chemicals, plastics and pharmaceuticals.

PHDS MOVE OUT

Development requires a high level of knowledge. The agricultural workforce has spent more hours in a laboratory and lecture hall than on the barn floor. Moreover, developments have made many Danish universities and research institutions look to the countryside, where they are now very much in evidence, with departments at the larger farms. All branches of research are highly focused on the resource issue. This is where the most promising patents are waiting to be discovered. There is good opportunity to test new solutions in practice before they go to market.

Many smaller farms act as study cases, at which students and researchers can build on their learning and help innovate production.

The prospect of knowledge-intensive environments and jobs has made several areas, which had previously been drained of highly-educated residents, more attractive again, and there has been extensive construction of new housing in many rural areas, where an increasing number of well-educated families are settling. Some are employed in animal and plant breeding, where many years of focused effort has turned into strong businesses.

Denmark boasts the world's largest gene pool of clean animal and plant genes, and orders from large-scale agriculture in China and India, for example, are flooding in as massive herds of livestock are hit by epidemics. Global climate change has also increased the demand for drought-resistant crops and crops rich in proteins and energy. Also here Danish farming has proved it can deliver, by developing and distributing different seed and corn types that can withstand changes in climate.

"We are going to see an entirely new organisation of farming, where the family farm is replaced by a company, the farmer by a director and fragile self-financing by much more sustainable share capital."

Henning Otte Hansen, Senior Adviser, Institute of Food and Resource Economics, University of Copenhagen

FACT 2050

A QUARTER OF DENMARK'S ENERGY COMES FROM STRAW, SLURRY, WASTE AND OTHER FORMS OF BIOMASS.

SOURCE: DANISH COMMISSION ON CLIMATE CHANGE POLICY

WELCOME TO THE BIO ECONOMY

In the 2010s, the foundation for Danish farming's biggest ever financial success was laid: bio-based products. At the same time as the scarcity of fossil fuels was forcing up prices, industry, agriculture, the government and municipalities developed a long-term strategic collaboration to build three of the world's most advanced biorefineries. In principle, a biorefinery is the same as a traditional oil refinery, but biomass is used instead of oil to extract fuel, chemicals and materials.

Thanks to a massive investment, the refineries in Symbiosis (previously the town of Kalundborg), Haderslev and Thisted succeeded in bringing Denmark into pole-position by developing a non-polluting alternative to replace the many thousands of oil-based substances and materials contained in chemicals, plastics, pharmaceuticals and electronics.

In a period up to 2020, residual products from farming, such as hay, straw, crop residues and slurry, were primarily converted to energy for heating, but by 2050 most is sent to refineries. In a world where resources are under pressure, it is clear that burning these residues is a waste of valuable biomass, and destroys the cells which could otherwise be exploited for their unique properties. We have long since stopped producing biofuels from food crops. Second generation biofuels consisted of crop residues, and with the 3rd generation it has become possible to use nature's own process, photosynthesis, to extract energy from algae and bacteria, for example.

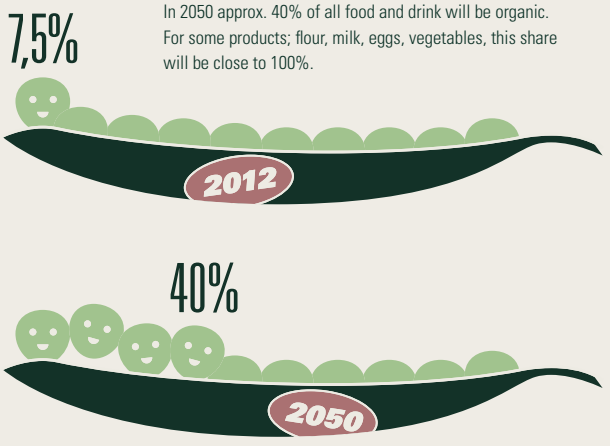
The bio-industry builds on the centuries-old tradition of strong farming skills. This applies to the entire value chain from the individual farm to dairies, abattoirs, the refining industry, biotechnology and research. Bio-based products are a great help to maintaining Danish agriculture as a major source of Danish exports. However, instead of ham and bacon, revenues in 2050 come mainly from enzymes in different contexts, ingredients, organic foods and research-based consultancy.

"The big challenge for the future is the ability to produce sustainably, efficiently and safely. This is where Danish farming is strong, with a great opportunity to contribute with knowledge and solutions."

Søren Gade, CEO, Danish Agriculture & Food Council

ORGANIC PRODUCTS WIN MARKET SHARE

In 2050 approx. 40% of all food and drink will be organic. For some products; flour, milk, eggs, vegetables, this share will be close to 100%.



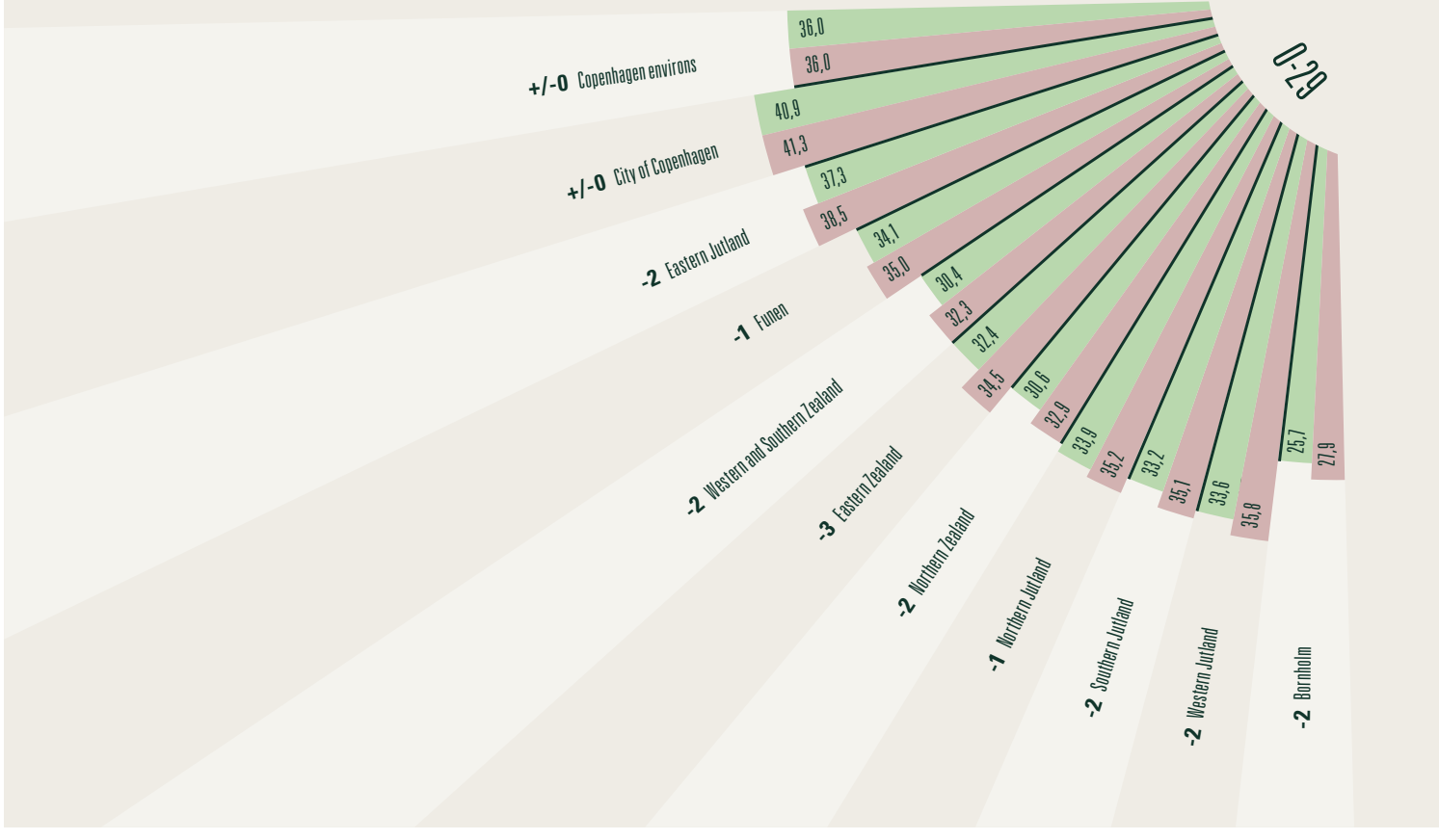
POPULATION PROJECTIONS

THE ERA OF THE ELDERLY

The numbers of elderly have grown significantly by 2050. This development is most notable on the Danish island of Bornholm, where almost one in two inhabitants are over 65 years in 2050. But all over Denmark, towns and rural areas have to prepare for a change in demographics, which will demand efficiency improvements and new services.

DIVIDED BY AGE, GEOGRAPHY AND TIME

*Source: Statistics Denmark only issues detailed projections up to and including 2040.



60+
30-59
Bornholm +12
Western Jutland +8
Southern Jutland +8
Northern Jutland +7
Northern Zealand +10
Eastern Zealand +9
Western and Southern Zealand +9
Funen +7
Eastern Jutland +6
City of Copenhagen +3
Copenhagen environs +4
43,7
24,2
32,2
24,7
32,5
25,4
31,9
26,4
35,9
24,4
33,2
27,2
36,1
25,3
32,3
21,8
27,5
16,4
18,9
23,5
28,0
32,2
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Bornholm -9
Western Jutland -6
Southern Jutland -6
Northern Jutland -5
Northern Zealand -8
Eastern Zealand -7
Western and Southern Zealand -7
Funen -6
Eastern Jutland -5
City of Copenhagen -2
Copenhagen environs -5

ARRIVAL OF SUPER CLUSTERS

The need to take advantage of economies of scale and share the costs of expensive plants has forced several large farms to join forces in approx. 20 agroindustrial super clusters.

Because special fermentation processes have now made it possible to produce animal feed from crop residues, many farms no longer need access to large areas of land. On the other hand, it can be an advantage to be close to major sales channels in towns and cities, and individual clusters have therefore located themselves in industrial areas around larger cities, such as Copenhagen's Kalkbrænderihavn, a part of Nordhavnen. From here, a cluster supplies the capital's citizens with fresh meat, tomatoes and other vegetables by coupling pig farming with greenhouse operations.

Most of the clusters continue to be based in rural areas, but they have easy access to the bigger cities, main roads and railways to enable rapid transportation of their produce. The oldest clusters are based near Nakskov on Lolland, and have been built around one of Denmark's largest pig farms. The production is so great that an abattoir has been built next door, and with almost 5,000 jobs this cluster represents an important growth centre for the area. Slurry from the many thousands of pigs is recycled in large plants with help from algae, which extract valuable nutrients from the waste.

In 2050, Denmark is among the leading countries in the world at using photosynthesis and algae to convert waste products into new ingredients and energy in the form of biogas, also known as 3rd generation biofuel technology. Several large agricultural producers have an indoor or outdoor algae operation. This also applies to the large nurseries, which have become good at exploiting the expensive surplus heat and light from other production to grow the much sought-after plants. In addition to helping produce energy, certain types of algae are being demanded by several manufacturers to replace substances that otherwise require energy-intensive chemical processes.

As in Nakskov, the other agroindustrial clusters act as smart self-sufficient networks, with their own CHP plants and biogas plants, which also serve the rest of the region. In several places sludge is also taken from the treatment plants which process waste from the towns' many households and companies and treat it for reuse as fertiliser. It has therefore been possible to find a replacement for naturally occurring phosphorous, the use of which stopped a number of years ago.

"It is obvious that the well developed Danish nurseries sector should become a major supplier of algae and thereby play a key role in reducing the energy production, which is currently challenging our environment."

René Logie Damkjer, CEO, AgroTech

"In 2050, the Danish farming sector will have moved up in the value chain and developed into an industry that creates the most highly refined and research-based products."

Prof. Claus Felby, University of Copenhagen

FROM WASTE TO VALUE

In other parts of Front Edge Denmark, it has been possible to create growth in ways that stretch beyond agriculture. This applies to the Danish island of Bornholm, for example, which in 2050 has been transformed into a test platform for large global companies, which pay to use the island to test new technology in full scale.

As an island community, Bornholm is the obvious choice for such a task, because it is possible to isolate and test new solutions without them being affected by external factors. For example, the island provided residents, towns, homes and land to test the smart grid system which was later rolled out throughout Denmark. Bornholm was also where the first international electric car manufacturers tested their concepts and infrastructure, before launching the products on the international market. As well as attracting new knowledge-jobs to the region, the initiative also helped brand Denmark as one of the most innovative countries in the world.

Other areas are focusing on energy production, and large agricultural areas have been designated as special energy zones, which combine large technical installations such as onshore wind farms and solar panels with energy-intensive crop cultivation such as corn, soya beans and sugarbeet. This is a clear break with the monotonous rows of yellow rapeseed, once a common feature of the Danish landscape.

Global climate change has made Danish summers drier, and winters wetter, and the climate suits the less drought-sensitive energy crops. Approx. 15% of the Danish agricultural area has been converted to clean-energy crops, while the rest is used to grow feed and food crops, with waste products being recycled for energy or as bio-based products.

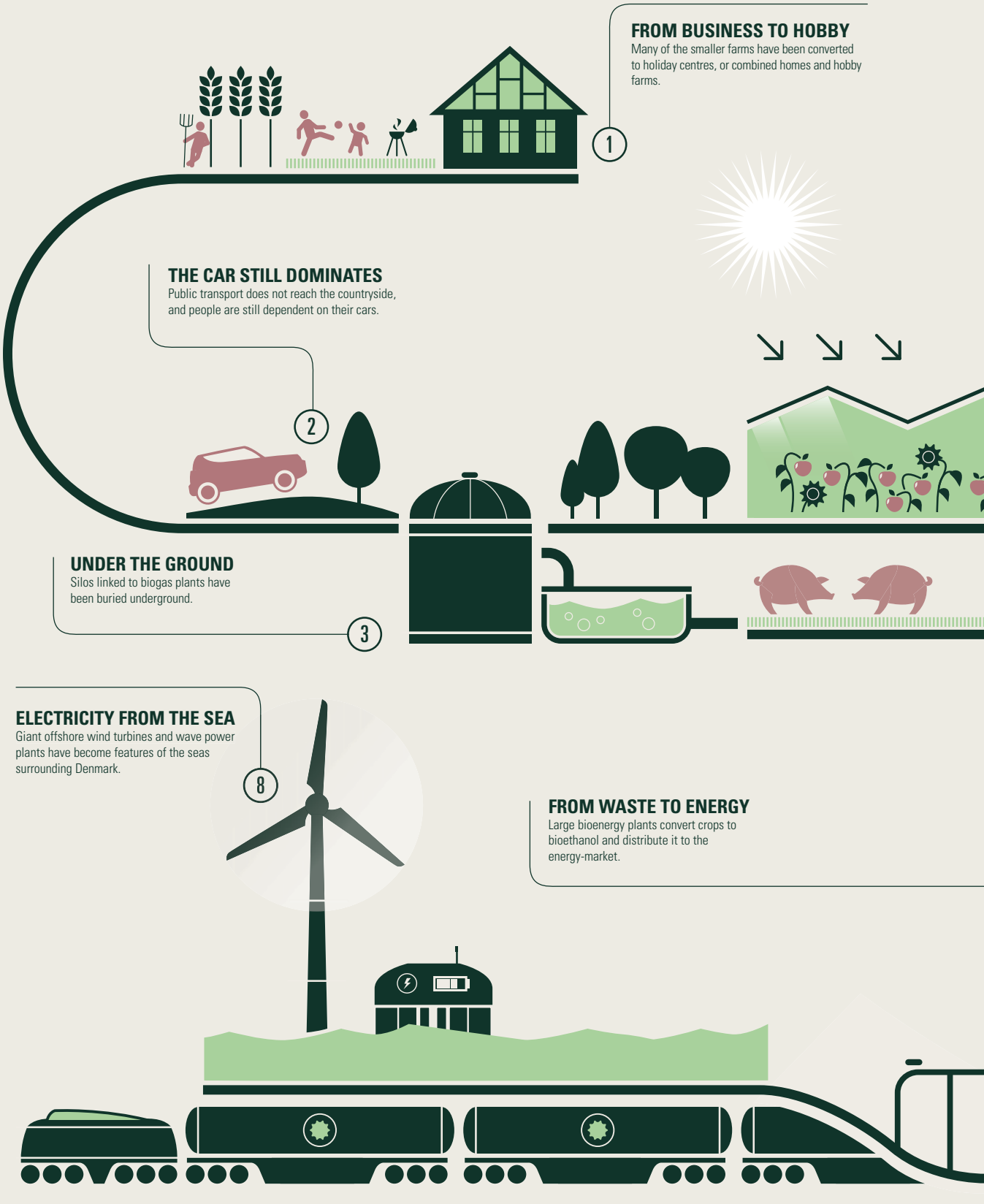
Crops such as poplar, elephant grass and willow have also become popular energy crops for many farmers, who have made a thriving business out of ethanol production. However, the more widespread growing of the energy willow, with a height of up to six or eight metres has significantly changed the landscape in several places, and has met with enormous resistance. Now it can only be grown with special permission in specially designated energy farming zones. An exception is the many willow fences that have been re-established as part of measures to reduce the use of pesticides.

A number of new market models have been developed and several farms have earned good money by making land available for wind turbines, photovoltaic solar modules and other types of energy production installation.

FACT 2050

DENMARK HAS A TOTAL OF 1,000 LARGE FARMING ENTERPRISES. IN 2011 THERE WERE 25,000 SMALL AND LARGE FARMS.

SOURCE: DANISH AGRICULTURE & FOOD COUNCIL

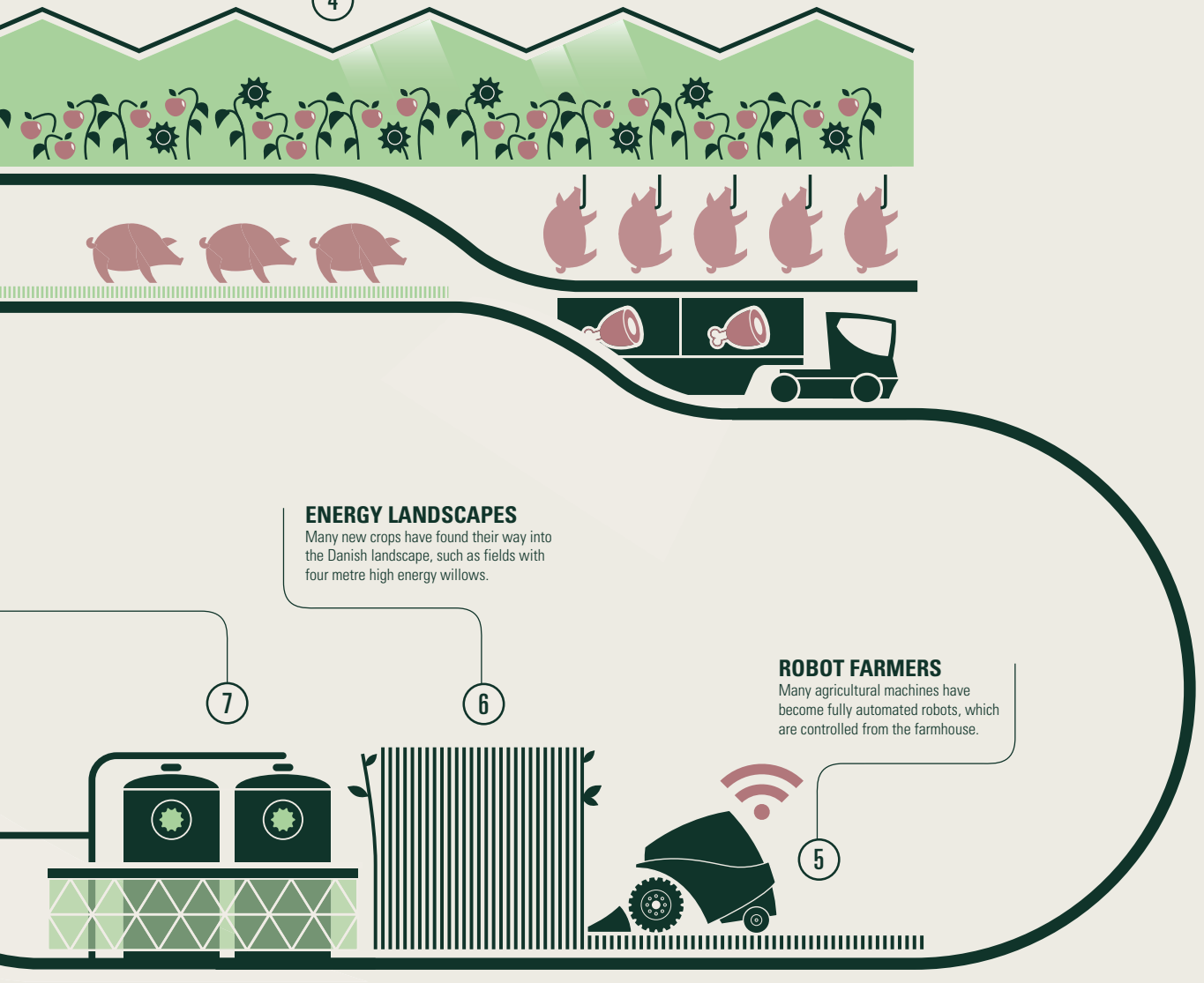

FROM BUSINESS TO HOBBY
Many of the smaller farms have been converted to holiday centres, or combined homes and hobby farms.
1
THE CAR STILL DOMINATES
Public transport does not reach the countryside, and people are still dependent on their cars.
2
UNDER THE GROUND
Silos linked to biogas plants have been buried underground.
3
ELECTRICITY FROM THE SEA
Giant offshore wind turbines and wave power plants have become features of the seas surrounding Denmark.
8
FROM WASTE TO ENERGY
Large bioenergy plants convert crops to bioethanol and distribute it to the energy-market.

DENMARK'S RESOURCE STORE

In 2050 many of Denmark's rural areas have enjoyed a renaissance as producers of not just food, but also of the enormous amounts of energy consumed by urban areas. In 2050, the farmer is a well-educated knowledge worker, who manages large high-tech production processes and strives to exploit all parts of production as well as possible.

A MEANINGFUL COMBINATION
The modern farm is a self-sufficient combination of, for example, pig farm, nursery, bioenergy plant and abattoir.

4



ENERGY LANDSCAPES
Many new crops have found their way into the Danish landscape, such as fields with four metre high energy willows.

7

6

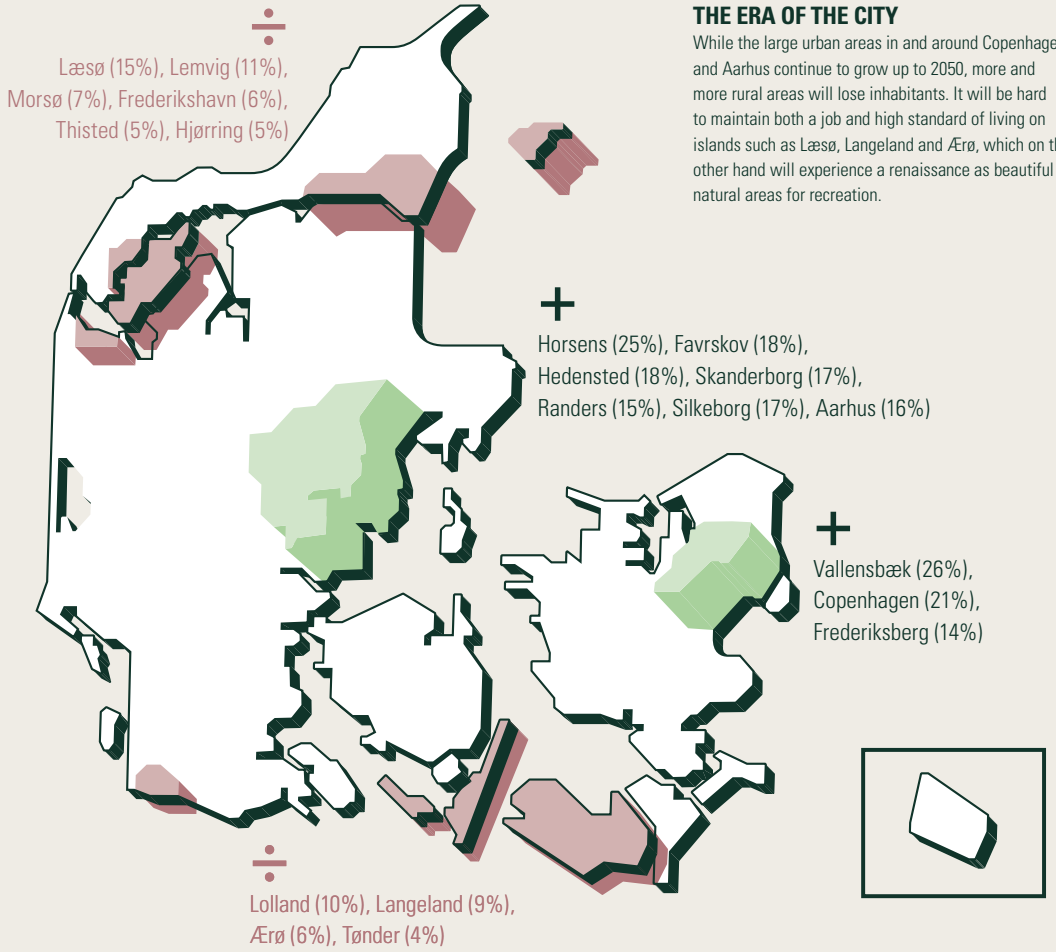
ROBOT FARMERS
Many agricultural machines have become fully automated robots, which are controlled from the farmhouse.

5

2012
THE FUTURE IS ALREADY HERE

FROM PIG FARM TO HOLIDAY DESTINATION

In 2009, farming couple Ruth and Christian Lorenzen made a drastic decision. After several years of hard struggle to make their pig farm profitable, they decided to try something completely new; the experience industry. The couple's bread and butter, in the form of 8000 pigs, were sold and approx. 2000 square metres of barns and stables were demolished. Then, their four winged farmhouse, which looks out to Wadden Sea National Park, was restored and redecorated as an information-centre with bed and breakfast. School camps are now held on the farm several times a year and there are cookery courses, where you can get to know the cuisine of the local marshes. The couple's own local knowledge and stories about the farm, which has been in the family for six generations, provide guests with a unique atmosphere and experience:
"Instead of seeing the preservation of the Wadden Sea as a big threat, which would limit our pig production, we decided to see it as an obvious opportunity to set up a new business by replacing the pigs with happy guests who can enjoy no end of activities," says Christian Lorenzen.
The initiative, which has been supported by the Realdania project 'Recycle the farm', was a success right from the start and the couple have had to keep extending to provide more rooms. To supplement these activities, they still grow wheat and barley on the farm's 200 hectares. As well as creating a new profitable business, the initiative has also had a knock-on effect on the rest of the area, which now provides experiences, services and products for the farm's guests and course participants. The new business is also helping brand the region and it is a good positive story about a more remote area of Denmark.



THE ERA OF THE CITY

While the large urban areas in and around Copenhagen and Aarhus continue to grow up to 2050, more and more rural areas will lose inhabitants. It will be hard to maintain both a job and high standard of living on islands such as Læsø, Langeland and Ærø, which on the other hand will experience a renaissance as beautiful natural areas for recreation.

"In 40 years, Danes will still want to live in the countryside. We are already seeing new types of entrepreneurs who settle in the country because they seek values that cannot be found in the city."

Hanne Tanvig, Senior Consultant, Forest & Landscape Denmark, University of Copenhagen

WINNERS AND LOSERS

Even though many parts of the countryside are experiencing a renaissance, there are also areas that have become almost entirely depopulated. The many jobs that follow the clusters often lie close to the larger provincial towns, where many employees have to settle in order to have access to schools, hospitals and other important infrastructure.

The urbanisation in rural areas has had both winners and losers. The winners are the larger provincial towns and market towns, and the losers are the small communities in the more remote outlying areas. Here it has been financially impossible to maintain access to public transport and services, and this has isolated several villages and communities from the rest of Denmark.

This has especially affected the elderly and the less affluent, who cannot afford a car, for example. The widespread use of online shopping and e-learning has not counterbalanced the lack of social contact, which has been detrimental to so many small communities.

Some communities have disappeared completely. Others have survived because of their surrounding nature and recreational value, such as those close to national parks or other forms of wild nature.

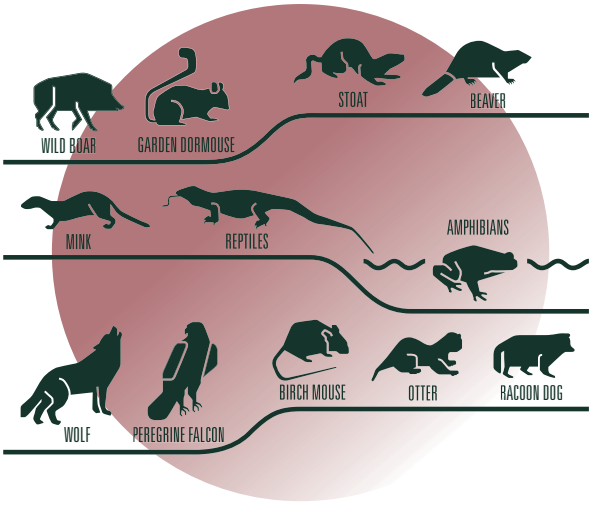
FACT 2050

ONE IN THREE RESIDENTS IN WESTERN JUTLAND ARE OLDER THAN 60 YEARS.

SOURCE: STATISTICS DENMARK

DANISH ANIMAL LIFE IN THE FUTURE

More forests, restored lakes and streams as well as wild and coherent natural areas have attracted some new residents to Danish nature.



BACK TO NATURE

Parts of Denmark have even "gone back to nature". The most intensive nature restoration efforts in Danish history mean that more than a fifth of the area that once was farmland has now been converted into forests and other types of nature. Dilapidated barns have been removed to unblock the view of beautiful river valleys. And water holes, which once drowned corn in the middle of fields, have now been dug out to allow the water to flow away freely.

These efforts, which are partly due to stringent EU requirements to protect certain natural areas and ecosystems, have enhanced Danish biodiversity. More natural corridors have made it easier for animals to move around, while more bogs and water holes have improved habitats for many species. This also applies to species which were previously close to becoming extinct such as the original strain of black squirrel, as well as crabs and oysters, which are farmed in marine aquaculture in several places in Denmark.

More and better nature, together with higher temperatures, has meant that Denmark has gained a number of new animal species. These include the snake eagle and the Eurasian spoonbill, which now breed in Denmark. In connection with national parks and as part of landscape management, the authorities have also introduced wild boar, wild horses, beavers and even bison.

Even the parts of the countryside that still provide farmland have changed and have become more natural in appearance. Where previously it was necessary to divide land with clear boundaries to allow plenty of space for farm machinery to access fields etc., the majority of farm machinery in 2050 is controlled by intelligent robots, which are programmed to follow automatically the natural contours of the landscape.

The rural areas, which have benefited from the transformation, have been able to attract residents who want to live near nature and open fields, rather than in the fast paced, busy cities such as Copenhagen and Aarhus. Danes spend more holidays in Denmark than abroad, partly because it has become more expensive to fly, and partly because efforts to restore nature and developments in agriculture have together made holidaying in Denmark more attractive.

In some places more summerhouses have been permitted, although under strict control, particularly along the coastlines in order to bring new life to remote areas and to enhance the number of important jobs in the tourist sector. Formal contracts have been signed with landowners, which allow the public greater access to local nature. Forests have been opened and old path systems revived.

"We are going to see that the Danish landscape, and our experience of being out in the countryside, changes significantly as we see less farming and more forests and nature."

Ella Maria Bisschop-Larsen, President, Danish Society for Conservation of Nature

Nature hikes have become very popular, as they are in Sweden and Norway. Some of the most popular holiday destinations include the adventure centres which once housed pig farming or corn production, but which are now living cultural-historical examples of how life in the country once was, before the green revolution took hold and significantly changed the Danish landscape and agriculture.

In several rural areas, social polarisation has become very clear. Unemployment is high in many places where it has been hard to create new jobs after the factories closed down and manufacturing jobs moved to low-income countries. Meanwhile, several welfare services, city halls and hospitals have been located closer to larger provincial towns, and this has undermined close contact to the public in many areas. For the same reason, many areas are struggling to help and advise socially vulnerable families and people, who have been pushed out of the labour market.

However, several of the same areas have become popular among entrepreneurs and other self-employed people who work within e-commerce or other areas that do not require daily commutes to a large city. Even though there is a need for investment in energy renovation, many new entrepreneurs have found settling into old village houses or country properties attractive as it is a cheap alternative to the high house prices in the towns and cities. Unlike previously, properties do not look out onto roads, which have lost their significance as important trade routes, but now properties face nature, with uninterrupted views of a changed and more picturesque landscape.

DANISH FOOD – BON APPETITE

Even though many have grown up in cities, many newcomers have chosen to throw themselves into hobby farming. While the global food shortage continues to increase the price of food, it has become both trendy and common sense to grow your own vegetables for your own consumption, and sometimes the neighbours' too. Healthy, environmentally friendly quality food has become highly popular.

In several areas, production has grown into smallholdings, specialising in specific types of food or methods of cultivation. Some of these are closely connected to the agribusiness, which uses the smallholdings as sources of inspiration to innovate their own range and value chain. Another source of inspiration in this context, is the Danish gourmets and restaurants, which work together closely with e.g. large pig farmers to process and develop new products for the global market.

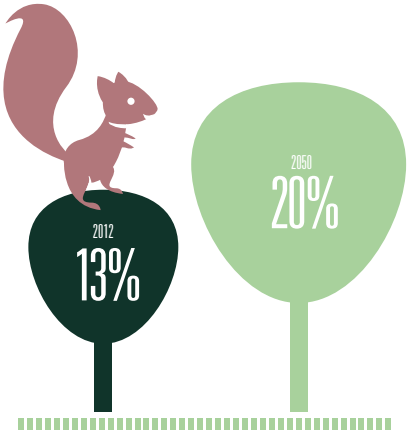
The development towards refining Danish food into high quality food products has helped several rural areas brand themselves as attractive tourist destinations.

Internationally Denmark has become well-known for our cuisine. Danish Food is the brand for the traditional Danish kitchen based on seasonal products, and on recipes dating back hundreds of years. The raw ingredients, from rape oil and root vegetables to plaice and redcurrants, are healthy and organic. Danish chefs and restaurants are well-known abroad for their - believe it or not - porridge and stews, and venison, and the food industry has benefited from this positive image, which is reflected in a wealth of specialities now in display in fridge and freezer cabinets both abroad and at home.

MORE FORESTS

Nature has returned to Denmark as a result of nature restoration and the requirements to protect certain animal and plant species. The total forest area has grown from 13% to 20%.

Source: Danish Nature Agency



"In 2050, we have a new landscape - the Energy Landscape - where technology such as wind turbines and solar panels stand alongside energy crops and new energy power plants."

Nee Rentz-Petersen, Architect and PhD, the Royal Danish Academy of Fine Arts

2012
THE FUTURE IS ALREADY HERE

DENMARK'S FIRST AGROINDUSTRY

If the Municipality of Lolland Falster has its way, the area will within a few years accommodate Denmark's first agroindustrial cluster. The municipality has been at the leading edge of the forthcoming energy act and decided to assign an area of 1 million square metres to combine industry and farming. According to current legislation, it is not possible to set up industry in rural zones, and thereby not possible to exploit the synergy that exists between agricultural and industrial production, for example to convert slurry to high value products and energy:
"Instead of today, where slurry is transported and waste from agricultural production is burnt as biomass, we want to create a connected ecosystem, where all parts of agricultural production are exploited as much as possible on site. This saves on transport and gives agriculture major added value," says Leo Kristensen, project manager for the municipal unit for business development, LF Business.
It is yet undecided as to which type of production the cluster could include, but it could be both major production or a co-operative of smaller production units that work closely together. Their new neighbour will be a newly established industrial area, which will function as a commercial test platform for green technology. Here both Danish and international companies will be able to test new technology at full scale. In addition, the area is being developed to accommodate one of Denmark's large biorefineries.

LIFESTYLE:
FROM OWNERSHIP TO CO-OWNERSHIP

Second-hand dealers, second-hand shops and rental agencies are in business. Vintage is hot. The throw-away culture has become vulgar, like smoking used to be. And it's expensive.

New consumer goods are expensive, and it is costly and difficult to get rid of your rubbish. There is money to be saved by reducing your consumption and recycling.

Quality has become the most important competitive parameter. Nearly all products in shops are labelled according to how responsible they are so that consumers can make informed choices at supermarket fridge cabinets. The digital revolution has to a high extent been used to dematerialise our daily lives. The Internet has eliminated much goods and freight transport. More and more meetings are held via the PC and phone.

Books, newspapers, journals and documents are digitalised. Cars and housing, including domestic appliances, are supplied and controlled through the electricity grid. The products we use at home, no matter whether it is the fridge, washing machine, lawn mower or sander, are also different. We do not own as much as we used to. We lease, rent, subscribe and share. As washing machines, windows and energy management systems become increasingly advanced, expensive to run and hard to service, we lease them from companies which ensure maintenance and ongoing optimisation.

Instead of owning a square metal box that can wash clothes, we have a laundry subscription. The company ensures that we have the necessary equipment installed in our house to wash clothes, and we pay on a monthly or annual basis, including maintenance. This benefits the consumer, creates a new industry for service companies, and is good for the environment, because the company has an incentive to use the best technology when not just selling you a product but also a service.

We share more. We have discovered the sheer stupidity of all of us owning expensive power tools. Studies have shown that we use them on average twice a year. The rest of the time they are out in the shed gathering dust by the dozen. In residential areas and areas with blocks of flats we therefore have a central store for equipment and tools, which we fetch as and when we need them. It costs a small amount of money per person on an annual basis, but in return the entire neighbourhood has a pool of equipment, and can afford the coolest power tools.

THE BURNING PLATFORM

The world map has changed over four decades. Urbanisation, population growth, climate change and economic growth have transformed our world.

9 billion – and still counting
The world population exceeded 9 billion in 2046 and continues to grow – but the curve is likely to level out towards the end of the century as more and more people achieve a higher standard of living, which means they have fewer children.[1]

As the wind blows
Wind turbines are the future power plants, both in remote rural areas and at sea where we will see turbines with a wingspan of up to **250 metres**. In comparison, the world's largest passenger plane, the Airbus A380, has a wingspan of 79.8 metres.[2]

Mega regions
Due to urbanisation, in many places in the world many people live in mega regions of over **100 million** inhabitants. The first mega region is the Hong Kong-Shenhzen-Guangzhou region in China. Tokyo is no longer the world's biggest city or urban region due to the decline in the Japanese population.

Full of energy
Solar energy is a relatively new technology, but in **2050** it will have significantly matured. Enormous solar energy systems will supply us with energy, and a cooperation between Africa and Europe will mean that Desertec, a co-owned plant in the Sahara, supplies Europe with **15%** of all electricity consumption as well as electricity to North Africa. The Desertec plant will be the size of the Danish island of Zealand. Every year, the sun sends energy to earth corresponding to **1,500** times our total, global consumption.[3]

Food
In the period **2010-2050**, the world will have produced more food than total production during the entire history of mankind.[4]

Chindia
The world's power balance will tip eastwards, as China and India, often called Chindia, become the dominant economies. This is the result of the world's two largest populations, which combined represent over 3 billion people. China and India will be the world's biggest and third largest economies.[5]

*[1]Source: UN, [2]Source: Forbes, [3]Source: Atmosphere Science Research Centre and Desertec, [4]Source: Australia National Science Agency, [5]Source: HSBC, [6]Source The scenario is based on recent analyses of "emission pathways", from the OECD, IEA and UNEP. 3.5 degrees is the estimation in IEA's New Policies Scenario. [7]Source: IEA, Stern Review, National Oceanic and Atmospheric Administration. [8]Source: HSBC, [9]Source: UN, [10]Source: IPCC, IEA** A conservative projection by IEA's New Policies Scenario, which in 2035 anticipates 20% renewable energy. [11]Source: World population prospects*

A changed climate
The global effort against climate change has not followed scientific recommendations, and the global average temperature has therefore risen significantly (3.5 degrees above pre-industrial level[6]).
This means that:

1.000.000.000
people do not have access to clean drinking water

Food production in Africa is stagnating

Due to rising sea water levels, cities such as London, Shanghai, New York, Hong Kong and Tokyo have to build dykes and other forms of protection

25-80%
more people are hit by starvation

20-50%
of all animal species are endangered

Since 2035
the Arctic circumpolar ocean has been almost ice free in certain periods[7]

Power shift

19/30
of the world's biggest economies will be non-western economies.[8]

The Urban Age

75%
of the world's population will live in cities.[9]

Ever-lasting energy
In 2050

30%
of the world's energy consumption will come from renewable energy in the form of wind, solar, geothermal heat, hydropower and biomass. Today,

87%
of the world's energy consumption comes from coal, oil, gas and nuclear power.[10]

More and fewer hands
In Japan the population capable of work has fallen by

37%
compared to 2010.
In Egypt the population capable of work has risen by

62%
compared to 2010.

Mega cities

70%
of people live in megacities of over 10 million inhabitants.

Dominance of the East
In 2050 Asia will comprise

57%
of the world's population. By comparison, Europe's population will comprise[11]

8%


HOUSING
2050


08
RENT-O-BIL

HOME SWEET HOME

Our homes are producing energy, are recyclable and can think for themselves. In 2050 we live in very much the same houses and flats – but they are top-tuned.

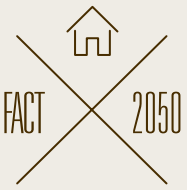
We love our detached homes. And will continue to do so in 40 years time. Having our own house with a garden, driveway and garden fence is still the Danes' preferred type of home. Our surroundings will change significantly, but to a high degree we will be living in the same homes, regardless of whether these are flats, terraced houses or villas. Our home is the basis of our existence and the place we seek when we need to be by ourselves or with our family.

Experimental and innovative architecture has made its mark on new parts of housing stock in 2050, just as it has become popular to build something new from old materials. However, the construction rate has been low in recent years, and seven out of ten buildings are more than 40 years old. New buildings will only represent a very limited part of housing stock. The buildings do however look remarkably different from the first time they were built, and once you enter them you start to notice clear differences. Firstly, our homes have been energy-renovated to a high standard. They have also become intelligent.

The buildings' carbon emissions, which were once 40% of total Danish emissions, have more than halved. We have changed our windows, façades and roofs and converted to renewable energy, providing the majority of our homes with heat supplied by heat pumps or district heating from renewable energy sources such as the wind or the sun.

Denmark has been linked up by an intelligent electricity grid, also called a smart grid, a type of Internet for electricity and energy, which enables your home, your fridge, your car and your smartphone to communicate directly with the power supplier 24 hours a day.

While houses used to be connected to the outside world via physical infrastructure such as roads, supply channels and maybe a post box, our new home has become a living and intelligent unit connected to a digital infrastructure that plays an increasingly important role in our day-to-day lives.



NEW MATERIALS – FOR EXAMPLE CONCRETE, WHICH REGULATES TEMPERATURE, SAVE 25% OF ENERGY IN NEW BUILDINGS.

SOURCE: 3XN ARCHITECTS

"In 2050, we are very conscious about living in a way that contributes positively to society's overall energy use. This will radically change the look and functionality of our homes."

Michael Arentsen, Head Consultant, Danish Energy Association

TOWARDS 2050

Realdania has conducted a number of workshops for members with a view to qualifying the work on scenarios and to define what is needed if Denmark is to achieve a green growth economy. When it comes to starting energy renovation of both publicly and privately owned homes, members identified the following actions as some of the most important:

1

NEW FINANCING MODELS

Improved cohesion between investments and savings is essential. Banks, credit associations, estate agents and the state must develop loan products and financing models so that the individual owner does not have to pay the whole investment up front and wait years before seeing the first savings. One such example is ESCO and the ESCO Light model, whereby private companies or consortia offer to energy-renovate public buildings in return for a share of the savings from the reduced energy consumption.

2

FINANCIAL INCENTIVES

We must be better at rewarding those who insulate their home, save energy and install e.g. solar panels. These consumers are contributing to society's energy balance, taking on part of the risk, and should therefore also be offered attractive grants, loans and tax allowances.

3

NEW STANDARDS

Energy requirements for both new and existing buildings should be tightened on an ongoing basis to create innovation and incentives for owners. Building regulations, standards and legislation must make it attractive to continuously maintain your home or flat with a view to improving the re-sale value.

4

CONTINUING TRAINING

Builders, consultants and developers must be trained to a level that allows them to make decisions about renovation. The number of energy-certified builders and consultants must increase, so that the market potential for energy renovation can be fully exploited and benefit the industry.

"Towards 2050, we will see a growing selection of more experimental residential architecture, which abandons the traditional classification of buildings into e.g. flats and terraced houses."

Prof. Claus Bech-Danielsen, Danish Building Research Institute

HOMELINESS

The concept of "home" seems to have retained the same importance to Danes in 2050. Despite major changes to our surroundings, new technology, increased mobility and even greater choices for citizens, our home continues to be our castle. This is where we hit the couch. This is our family's comfort zone.

Architects, sociologists and psychologists have gained an even greater understanding of the importance of having a home in a world that is changing more and more rapidly. They talk of "homeliness"; a mental state of peace, security and stability in one's life, a feeling closely connected to the place you live, surrounded by all your things. The property market, house prices and property taxes are among the most important political agendas, and all media platforms are bursting with decorating tips, furniture ads, gadgets for the home and offers of home-related services.

OLD HOUSES IN NEW CLOTHES

At the start of the century, Denmark launched the biggest overall energy project since the 1970s oil crisis. As energy prices rose significantly in the 2010s, Danish home owners and tenants realized how their homes had become energy hungry and a burden on the economy. Politicians from city councils, regions and parliament, all agreed to focus on the two only paths towards a greener Denmark: Replacing "traditional" energy with modern energy from renewable sources, and reducing energy consumption.

Energy savings in buildings were first in line, as this is where the most accessible benefits could be reaped. Technology such as insulation, new windows, new materials and new light and electrical systems already existed. It was only about rolling it out - everywhere and as fast as possible.

Public subsidy schemes, new loan products and partnership models between house owners, authorities, investors and entrepreneurs have meant that the majority of the country's 2.5 million homes have been energy-renovated, whether these are housing association flats or owned homes.

New forms of financing play an important role. Where the individual house owner or tenant previously had to front all the investment from the start, banks now assume most of the "pain" in return for profits earned from the savings made over time. This means, for instance, that energy loans follow the house, not the owner.

Another important element is new legislation in the form of stringent energy standards and new regulations, enabling the owner of a property to regulate rent levels in accordance with the investment, often also with help from the bank.

When the municipalities build schools, a team of entrepreneurs, investors and property companies not only supply a building, but are also responsible for running it throughout its lifetime. This means that it is in everyone's interest to use the best solutions and materials, and not just build as cheaply as possible without any concern for how the building works.

FAREWELL TO GAS CONCRETE

The renovation wave also spilled into the commercial property market, where focus is on increased productivity, created by modern offices and factories through improved indoor climates. The extent of allergy-related illnesses has fallen, and employees generally tend to be less sick when they have plenty of access to daylight and fresh air.

Energy renovation is an obvious part of all building maintenance, and development within materials and technology is so fast that it pays to renovate regularly. If an office building or owner-occupied flat is not as energy efficient as possible, it becomes as hard to sell as if the roof was leaking.

A number of abandoned farm properties and houses made of gas concrete or other light materials have been demolished as they were not suitable for renovation. However in many cases it has been worth leaving the building's foundations and brickwork intact while only replacing windows, doors, roofs and façades.

Energy renovation has taken place in two waves. In the first wave, driven by a savings rationale, focus was on limiting energy loss in homes by insulating them and replacing old windows with energy-efficient ones. In the second wave, driven by technology development, houses became intelligent and in many cases self-sufficient with heat and energy being supplied from small-scale plants.

"Everything points to the fact that the next decades will be dominated by energy renovation. We will experience most residential buildings in Denmark either being renovated so that they use much less energy, or demolished to make way for new contemporary buildings."

John Sommer, Sales Director, MT Højgaard

MY HOME IS MY GREEN CASTLE

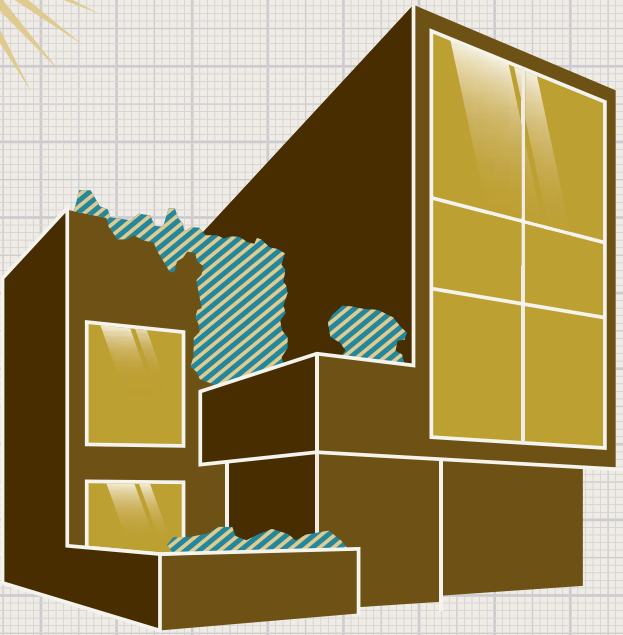
THE HOUSE OF THE FUTURE IS SMART

Sun on the roof
Solar collectors on the roof provide most of the electricity you need for your home. Because our energy source no longer needs to be transported from afar, but is provided directly from above, solar energy helps save Danish home owners enormous transmission costs.

Green roofs
They collect rainwater, absorb harmful airborne particles and provide better insulation. Green roofs are a great idea.

LED lights
Since 2010, when LED lighting slowly started to find its way into Danish homes, major changes have taken place. LED lighting has become cheaper, and major improvements have been made on design.

Self-cleaning and environmentally friendly paint
Air pollution both in and outdoors will be drastically reduced as more and more people choose photocatalytic paint for their home. This type of high-tech paint is both antibacterial, odour-free and self-cleaning. The paint is also environmentally friendly and far less harmful to our health than the paint we used to decorate our walls with forty years ago.



Insulation
Our houses are insulated with a special type of aerogel or "dry ice" as this new type of superinsulation is also known. This is a nanotechnological wonder and helps make future green homes much more economical and energy-efficient than today. Improved insulation has also played an important role in Denmark's carbon reduction, because insulation is one of the most cost-effective ways to reduce energy consumption.

Windows
The maximum daylight and ventilation from our windows ensures an improved indoor climate in our homes. Good daylight is extremely important for our health and well-being and also ensures electricity savings.

Smart Grid
Your home is connected to an intelligent electricity grid, also known as a smart grid, a sort of Internet for electricity and energy. The system makes it possible for your home, your fridge, your car and your smartphone to communicate directly with the electricity company 24 hours a day.

Eco-labels
Via easy-to-read eco-labels, it will be easier for you to make informed and sustainable choices when buying building materials for your home.

Source: Sustainia, Monday Morning

"There is nothing to suggest that our homes will stop growing in size. But if they become self-sufficient with renewable energy, this development is not as problematic as many believe."

Hans Kristensen, Researcher, Danish Centre for Housing Research

SUN ON THE ROOF

The most visible change is found on Danish rooftops. Buildings worthy of preservation have been allowed to keep their tiled roofs, but otherwise the old roof materials have been replaced by intelligent roofs containing inbuilt solar panels. In apartment complexes and detached houses shiny sun roofs work hard to capture the sun's rays.

The same technology is used in the many façade screens that cover the many blocks of flats in urban areas. In several places owners have chosen to use materials that enable the display of film or art. Often, the screens change the buildings' appearance and aesthetics significantly. Usually for the better.

In cities such as Copenhagen and Aarhus several buildings have become taller, as instead of insulating the old roofs, people have decided to build completely new well-insulated floors on top. Other areas have chosen to finance energy renovation through loft conversions, thereby reducing the heat loss that used to come from the empty space.

But forget all about a future full of skyscrapers. Buildings of more than six storeys are still extremely rare in Denmark because from a planning and architectural perspective, they do not fit in with the Copenhagen skyline of copper roofs and small towers.

A significant reason why detached houses with so much space have survived the development is that they have been "tuned"; partly through radical energy-efficiency measures, partly through a completely new type of energy supply.

According to the BR2050 building regulations, homes outside cities must be as self-sufficient as possible with renewable energy. The oil tank has long been discarded and replaced with renewable energy sources such as heat pumps, solar thermal energy and geothermal systems. In cities all buildings are connected to the district heating grid.

FROM CONSUMER TO PRODUCER

In many areas, energy efficiency improvements have been so effective that residential buildings now produce more energy than is consumed. This also applies to blocks of flats, where some owners have chosen to install small local combined heat and power plants, which supply energy for the whole property or site. As a home owner, you can earn money by having the property function like an energy storage, which sells surplus power when market prices are favourable. Everything is controlled automatically via the grid. If there is a surplus of electricity production, the electricity meter simply goes backwards.

The so-called plus-energy residences get electricity from solar photovoltaics and heat from photovoltaic solar modules, which together with the heat pump heat the water tank. The heat energy derived from the many electrical and electronic appliances, the residents' own body heat and daylight is used and distributed through the house using intelligent ventilation systems.

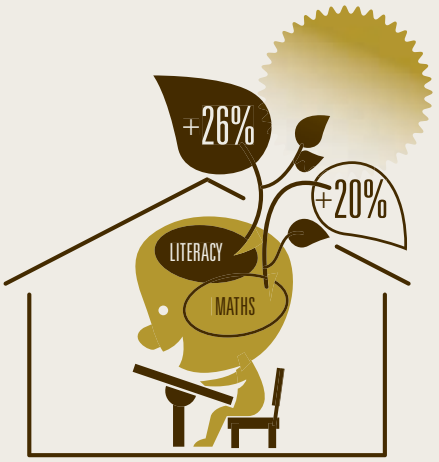
There is a signal value associated with having the household contribute positively to society's total energy bill. However it requires money to join the trend. Even though a broad range of mortgage-credit firms and capital funds have invested in the enormous energy market, it has not become cheaper to live in Denmark, whether as a tenant or home owner.

The finance sector offers everything from traditional loan products to special schemes where you 'rent' your roof or façade out to an investor, who is allowed to cover it with photovoltaics in return for you to have cheaper energy supply.

ANOTHER LESSON LEARNED

According to an American study, sustainable construction has other benefits than purely environmental. The study discovered that pupils who were taught in premises with an optimal indoor climate achieved remarkably better results than pupils who were taught in an average indoor climate. Results improved by 20% at maths and 26% at literacy.

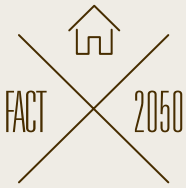
Source: California Board for Energy Efficiency and Monday Morning



2012
THE FUTURE IS ALREADY HERE

WITH KNOWLEDGE COMES AWARENESS

The conversion to renewable energy requires a large share of wind power to enter the Danish energy system. As wind cannot be controlled and the quantities of energy produced vary constantly, consumers need to become more aware of when and how they use energy. As the first power supplier in Denmark, SE (previously Syd Energi), has taken major steps in this direction in Southern Jutland. SE was the first power supplier in Denmark to set up intelligent electricity meters for all their customers. All 256,000 households can now monitor their own electricity consumption hour by hour over 24 hours. Customers can also pay according to actual consumption, which increases their motivation to control and reduce consumption. 2012 will see the next step with a trial involving 400 households being able to pay flexible prices depending on when there is most power available in the system. Consumers who take an extra minute to think about whether to switch the oven or washing machine on at 6 p.m. - a peak time for the grid - will see a direct financial effect.



THE BUILDING STOCK IS RENEWED ON AVERAGE BY 1% A YEAR. MOST OF THE BUILDINGS IN 2050 HAVE ALREADY BEEN BUILT TODAY.

SOURCE: DANISH BUILDING RESEARCH INSTITUTE

"As our homes fill with intelligent new technology, which we can't update or repair ourselves, a new service industry will emerge."

Helge Pedersen, Chief Economist, Nordea Bank

MY HOUSE IS SMARTER THAN YOURS

The roll out of the smart electricity grid means that home and building owners can control and regulate their resource consumption far better and more intelligently. We can exploit water, heat and electricity far more efficiently and also ensure we have the daylight and air to create a good, healthy indoor climate.

The building's or property's overall consumption and development can be read on the interactive screen, which has replaced the electricity meter in most homes. The screen acts as the sort of 'heart' of the intelligent house, which gathers and connects the entire property's resource consumption of electricity, water and any biogas onto one platform and constantly measures the consumption with the aim of intervening quickly if the green account balance tips the wrong way. If the building is equipped with intelligent surfaces, such as materials that can clean the air or resist dirt, it is also possible to measure how effectively these are working.

Of course the system can also speak with other platforms, such as your car, your computer or your phone. The house adjusts to the family's profile; who is at home and when, what temperature is required in the lounge or bathroom, what appliances are to be online or on standby, when the house needs airing and when you want the outside light on in the garden. Should the house's heat pump break down while you are on holiday, the system will automatically notify you by text message. The same applies when a water pipe bursts or other types of leakage occur in the building's supply system.

The price of electricity and water varies during the day, depending on production and consumption, and of course the user's wishes. If you want, the washing machine and dishwasher can start automatically when the price is lowest, because there is a surplus amount of power available in the local system. This also applies to other appliances, such as the electric car. On average an electric car is stationary for 23 out of 24 hours a day, and it charges or sells power depending on how burdened the system is and on the owner's driving patterns. The dynamic prices and automated systems ensure that all Danes do not charge their car, cook and switch on the TV and computers at 6 p.m. (which we would otherwise still do). Typically, cars will be charged overnight while we sleep, and the wind turbines are spinning out at sea.

MOTORWAYS FOR ELECTRICITY

The Danish electricity grid is part of the transeuropean grid that distributes megawatts from Scotland to Hungary and Norway to Portugal along "motorways" in the form of gigantic underground and undersea cables. In the Nordic countries we can therefore get power from the Mediterranean, when the wind is not blowing and vice versa. European nature is actually so ingeniously designed that production of sun and wind power in Northern and Southern Europe mostly balance each other out.

The electricity grid has created a foundation for a new service sector – energy services. Few home owners and property companies have the time or the skills to exploit the new opportunities to regulate a building's resource consumption and production. We therefore subscribe to specialist service providers who do it for us, and are paid from the savings gained from optimisation.

As the walls, floors and appliances are supported by digital systems, life becomes harder and harder for the DIY man. However, a number of sustainable building industries will flourish, bringing with them new jobs.

"As the principle of sustainability takes over our homes in earnest, we will look for simpler building materials. Increased focus on healthy houses will make us choose materials that do not affect the indoor climate negatively. That is why we will e.g. see more wood and porcelain."

Signe Kongebro, Head of Sustainability, Henning Larsen Architects

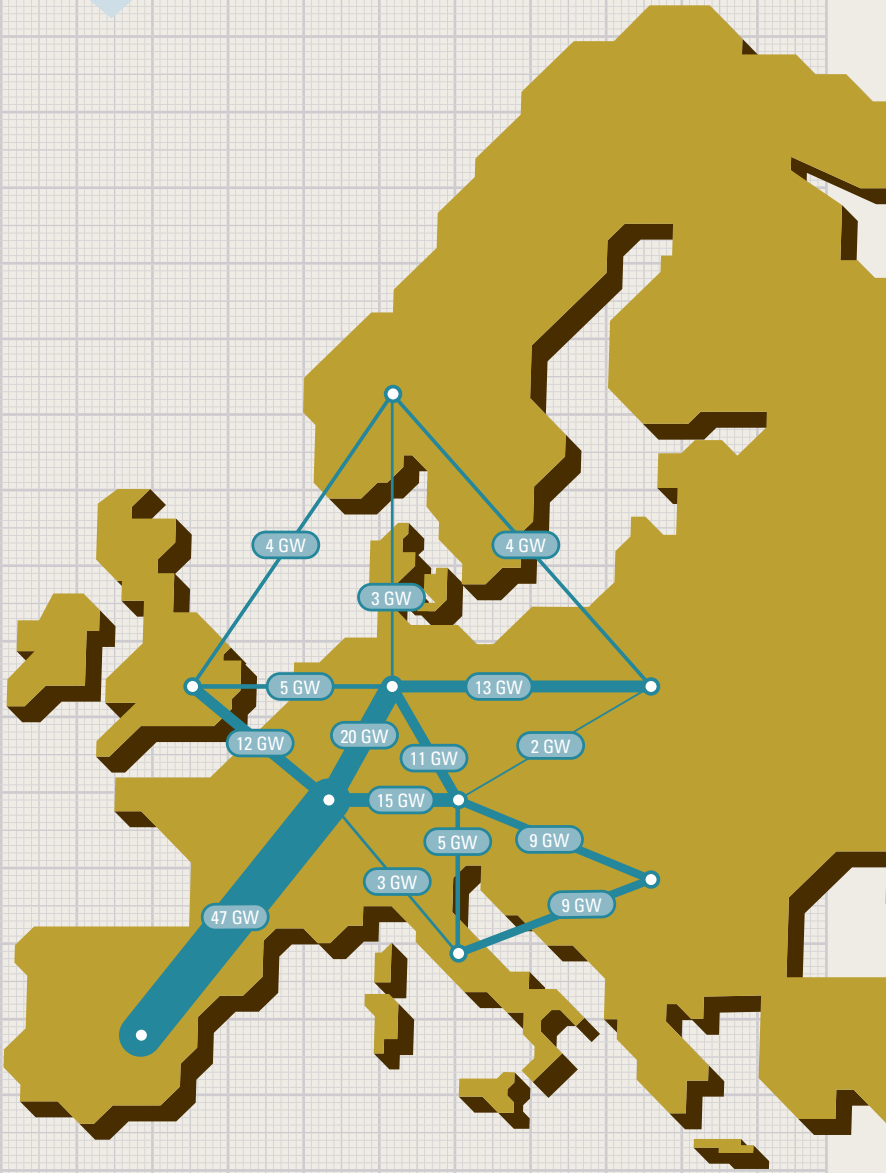
"With the smart electricity grid we get a chance to control the building's consumption and production of energy in a way that completely turns the relationship between consumers and providers upside down."

Steen Kramer Jensen, Senior Consultant, Energinet.dk

FACT 2050

THE PRICE PER KILOWATT HOUR IS FOUR TIMES AS HIGH AT 6 P.M. AS AT 1 A.M.

SOURCE: MONDAY MORNING



THE BIG GRID

In 2050, Europe will be criss-crossed by a smart electricity grid, which distributes energy from north to south and east to west along gigantic "motorways" underground and under the sea.

LESS SICKNESS, MORE PRODUCTIVITY

Better indoor climates and well-being at workplaces as a result of sustainable solutions will significantly increase productivity. A study from Australia shows it is possible to reduce sickness absence by up to 39%.

Source: Monday Morning and Business Outlook

"In 2050 the issue of energy optimisation has been solved. Instead the main issue on the agenda will be how a building affects our health and quality of life."

Lone Feifer, Project Director, VELUX

FROM CRADLE-TO-CRADLE

Denmark also has new, sustainable buildings, mainly around the major cities and in town centres, where industry has vacated large areas. Urbanisation and population growth have created the need for new housing.

Entire residential areas are certified according to the European Flower eco-label, which guarantees that the houses have been built with the most eco-friendly technology and materials. Some have in fact been built according to principles such as cradle-to-cradle and upcycling, which means that all materials are recycled and once they are ready to be torn down, houses can be used as new buildings elsewhere.

When a building is demolished or renovated, the different elements are typically dismantled or returned to production, which is then responsible for either - if they are not obsolete - recycling them into another production, degrading them or breaking them down in an environmentally responsible way together with waste disposal experts. It is also possible to recycle materials from other industries, which means it is not unusual to live in houses made of discarded container elements. Natural materials such as wood have again become popular building materials, also for larger buildings with multiple floors. In some residential areas, all structures are made of wood, including tall buildings, supermarkets, schools and nursing homes.

Recycling also means that more of us live in buildings that are composed of independent modules. It is cheaper, easier and safer to produce, and the demand for flexible homes has also risen as family patterns become less homogenous. There are more elderly and more singles, who want less space. When new owners take over, it is easy to extend with a new bathroom or bedroom module. The flexibility is reflected in how flexible walls and elements have replaced fixed walls in newer constructions thus making it easy to design a home according to different requirements.

Many experiments are being conducted in residential property construction and the classical distinction between housing types as we once knew them, has almost disappeared. We mix terraced houses, flats, retirement homes and residence flats into common residential complexes to increase diversity and liveability.

New housing types have emerged. Retirement communities have enjoyed a renaissance and many of them are theme-based, so that residents gather around shared interests such as food, films or music. Busy singles who travel a lot, live in docking homes, small flats and houses that act as a type of practical and mental recharge station.

HEALTH ABOVE ALL

A new parameter has gained a foothold in the property market - health. Welfare in our home has come into focus and factors such as daylight and fresh air are often an integral part of energy renovation. The individual home is certified according to its indoor climate. The number of polluting particles drifting around indoors is measured, as is the amount of natural light.

The development has paved the way for new types of surface treatments and active materials. This includes surfaces that automatically clean the indoor air, or which are easy to clean or update without the need for cleaning products or toxic-smelling paint. It is also possible to incorporate microscopic sensors in the surface, which constantly measure and report on the quality of the indoor climate.

FACT 2050

ENERGY CONSUMPTION IN BUILDINGS HAS HALVED.

SOURCE: TECHNICAL UNIVERSITY OF DENMARK (DTU)

2012
THE FUTURE IS ALREADY HERE

GREEN ARCHITECTURE ON THE GLOBAL MAP

When 3XN Architects in a few years cut the ribbon to open Green Solution House, Denmark will set new standards in the area of green and sustainable architecture.

The 4,500 m2 large knowledge and conference centre, which will be located on Bornholm, will include some of the first buildings in the world using the cradle-to-cradle principle by which all waste and impacts on nature are banished.

Most building materials can either be re-used or organically broken down, just as special waste systems ensure that daily consumption is either re-used or composted. Photovoltaic solar modules contribute to the energy supply, and organic fruit and vegetables are produced for guests in rows of integrated greenhouses that collect rainwater and where the building's tap water is recycled. The project is part of Bornholm's "Bright Green Island" strategy, and aims to attract significantly more foreign tourists to the island. It means not just more exposure for Danish green architecture, but also a higher turnover for the business community as well as new jobs.


TRANSPORT
2050

THE TAILOR-MADE JOURNEY

We are still driving cars, but public transport is enjoying a renaissance in the 21st century. We combine modes of transport according to requirements, lease our cars and are smarter at getting from A to B. However, congestion continues to be a huge problem.

In 2012 it was hard to imagine a town without traffic noise. Since the mid-1900s cars, horns and engine noise have been a permanent feature of the cityscape alongside buildings, shops and people.

In 2050, this image has disappeared into the history books once and for all. In a few decades Denmark's transport system has been revolutionised as a result of the transition to a greener renewable energy-based society. City traffic noise has become something of the past, and noise levels have in many ways returned to what they were at the start of the 1900s; the time of carts and horses.

A combination of rising oil prices, increased regulations, technical breakthroughs and pressure from consumers has sent petrol and diesel-run transport to the scrapyard and removed the majority of the harmful particulate pollution and traffic noise that was slowly choking the cities.

In 2008, we used 32% of our energy in the transport sector, and continued rises seemed unavoidable in the hunt for more economic growth.

However, by 2050 total energy consumption has fallen by a fifth, even though economic growth has continued and transport now only represents 27% of energy consumption.

Over 80% of Danish passenger and goods transport runs on electricity in 2050. Thanks to major investments in public transport and new technology, Denmark has been linked together through an effective and flexible infrastructure, which makes it quick and easy to get around, regardless of whether your journey is within city limits or across the nation. Different modes of transport are gathered into new integrated solutions, which are put together according to individual users' needs, and purchased as one single service. The green transition has significantly changed our use and perception of transport.

One social problem that still persists is congestion. Cars still queue up on the roads in and out of cities during rush hour, and trains, busses, light railways and the metro are overcrowded.

"While most people's experience of public transport today is based on a forced necessity, it will become an attractive service in the future that takes into account individual needs to get somewhere fast in a specific way."

Jacob Christensen, Chief Project Manager, COWI

TOWARDS 2050

Achievement of a sustainable and future-proof transport system will require a number of important decisions in the years to come. Based on interviews with many of Denmark's leading traffic experts, Monday Morning has identified the following three decisions as the most important:

1

ROLL-OUT OF INTELLIGENT ROAD TRAFFIC MANAGEMENT

Denmark does not exploit the enormous opportunities that exist within intelligent traffic management. If the benefits of an integrated transport system are to be fully exploited, the system's different parts must be able to communicate with one another.

2

NATIONAL ELECTRIC CAR STRATEGY

Many tests are required to mature new electric car solutions for the market. Denmark is especially suitable to function as a global test platform, and areas such as Bornholm have already begun. However, this requires national support and political willingness to take risks.

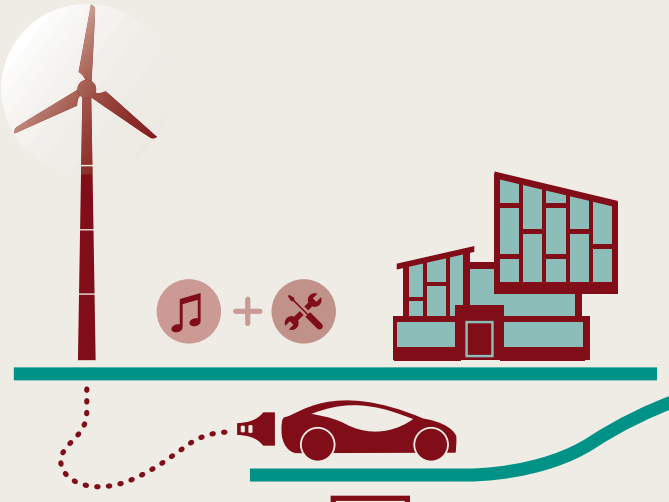
3

NEW LEGISLATION

Proximity is crucial if more Danes are to be tempted out of their cars and onto public transport. A change in planning legislation will ensure that new residential areas and companies are located close to public transport.

FROM A TO B

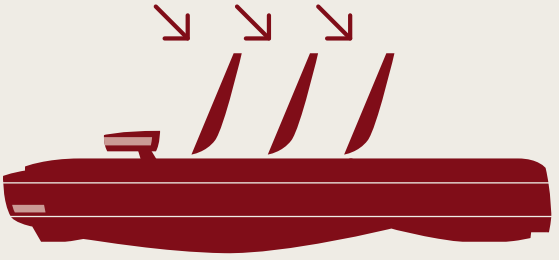
In 2050, we tailor our own journeys instead of them being determined by a specific mode of transport. We go online, design the fastest, cheapest journey and then buy a single ticket that covers the metro, train, car, ferry, flight and bike.



1

WHILE YOU'RE ASLEEP

The electric car is out in the garage and charges overnight. At the same time your software is updated, your favourite music is downloaded and your mechanic checks online that everything is OK.



5

DAILY PACKAGE TOUR

The ferry runs on solar energy. Your ticket includes ferry crossings, the light railway and a bike for the last part of the journey.

6

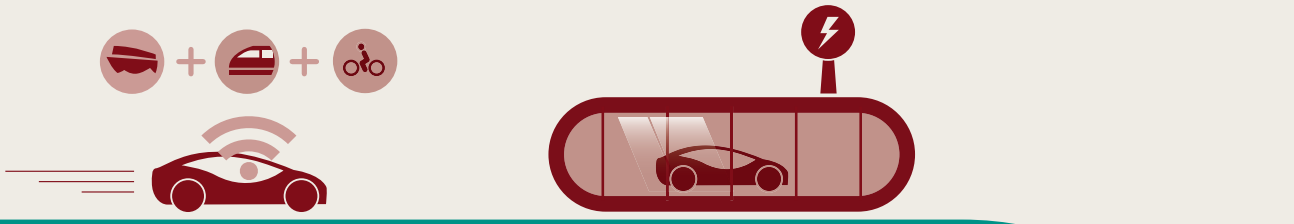
RECHARGE

You leave the car to charge in town, so it is charged up and ready for your home journey.

7

GET THERE QUICKLY

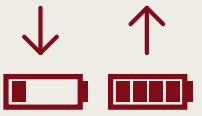
The light railway and metro get you to your destination quickly, through the worst of the rush hour.



2

AN EXTRA BRAIN

During the journey, the car's computer plans the quickest route, buys a ticket, books a hotel and checks whether any colleagues or friends are going the same way.



3

ON LOAN

You do not own your car, you lease it. Your subscription will also allow you to charge your car at a number of public car parks and charging stations around the country.

4

COMPANY EN route

On the way to the ferry you agree to drive with your colleagues.

8

ON TWO WHEELS

At the station, a hire bike is waiting for you so that you get some fresh air before you arrive at your meeting.

"There are many reasons why Denmark could become a pioneer country for electric cars. If we pursue this ambition, there'll be around 200,000 electric cars and hybrid cars on Danish roads and streets in 2020."

Lærke Flader, Managing Director, Danish EV Alliance

A COUNTRY USING PUBLIC TRANSPORT

The public transport system comprises everything from bikes and cars to trains and busses, and now more than half of the distance people travel in Denmark is by public transport.

Public transport is in its heyday – and its branding has changed fundamentally. Previously, many associated public transport with choosing not to take a car, and trains and busses suffered from an image of being worn out and difficult to use. In 2050, the picture is completely the opposite. Thanks to flexible infrastructure, intelligent IT and sleek new technology, trains, busses, light railways, shared bikes and shared cars have been customised and made more appealing, much like another mode of public transport - the aeroplane - always has been.

Public transport represents the future, and in many ways it is more user-friendly and cheaper than private modes of transport. The sharp divide between private and public transport has disappeared and in line with more and more people leasing cars, it has become commonplace to use shared cars and bikes. Fuel-price increases have encouraged more Danes to replace their cars with public trains, metros, light railways and busses. However, the greatest incentive has been the successful transformation of public transport to individualised services, which can compete with private motoring.

THE NEW SECTOR: MOBILITY

In line with fiercer global competition, mobility is becoming an ever more important focus area. In 2050, Denmark's major transport providers have undergone a major transformation and have merged with large parts of the IT sector. Mobility has become Denmark's biggest service business, with millions of customers every day.

Information and communication technologies have been integrated and developed in vehicles and the infrastructure. Services such as flexible route planners, integrated communication platforms and package solutions ensure journeys are as efficient as possible and customised to individual needs.

For example, at most larger stations it is possible to go directly from the train or bus to a hired electric car or bike. The ticket is the same, as the journey is paid as a single interconnected service through intelligent online travel agents, which with just a few simple clicks put together an individualised itinerary.

Establishment of strong traffic hubs has also helped boost enthusiasm for public transport. One example is the capital region, where the number of commuters heading to work in central Copenhagen every day will have grown by half a million by 2050. Many choose to leave their cars to charge up in the car parks that have been set up at major traffic hubs on the outskirts of the city. Selected suburban station areas such as Ellebjerg and Rødovre have been upgraded and now link different modes of transport such as the metro, suburban railway system and electric busses.

The modern light railways, which have become a feature around the biggest cities, have also persuaded more private motorists to become commuters. In Copenhagen and Aarhus, the light railways wind their way alongside the large ring roads and link the surrounding municipalities in new ways. They have also become a permanent feature of the cityscape in Odense and Aalborg, where they connect the large university campuses and hospitals with the city centres and major traffic hubs.

FACT 2050

OVER HALF OF ALL PASSENGER TRANSPORT IS BY PUBLIC TRANSPORT.

"Over time we won't be able to avoid having to pay to drive in cities, and by 2050, we will have an intelligent road pricing system that covers the whole of Denmark."

Per Homann Jespersen, Traffic Researcher, Roskilde University

TRANSPORT GOES PUBLIC

Our transport system will have become far more integrated and public in 40 years. Trains, light railways, metros and suburban trains have taken over much of the work of the car, but the overall volume of traffic continues to rise.

Source: Ministry of Transport (2008) and Monday Morning.

HOT


SUBURBAN TRAIN, LIGHT RAILWAY, METRO


TRAIN


BIKE, ELECTRIC BIKE, MOPED


MOTORBIKE

NOT


BUS


CAR


AIRPLANE


FERRY

DENMARK IS A PIONEER FOR ELECTRIC CARS

The growing enthusiasm to use public transport has left significant marks on Denmark's carbon footprint. Even though the number of people and goods being transported around the country is constantly on the rise, the sector's overall energy consumption has fallen, and its poor image of being harmful to the environment has been buried.

We still use cars – and we love them. The number of cars in Denmark is growing, but we drive less kilometres in our cars. And the petrol car, rolled out by Henry Ford in 1907, more or less disappeared 120 years later to be replaced by new and far more energy- and environmentally efficient technology. Electric cars, so called plug-ins, which are charged up via recharging stations, fill the garage space in Danish homes. For a brief transitional period, many chose hybrid cars, which switch between petrol/diesel and a battery, but battery capacity has gradually become so powerful that most people have now switched to 100% electric. The transition from petrol to electric took its time, partly because the electricity grid had to be adapted to cope with the large number of cars. Only when Denmark and the rest of Europe were properly linked by a smart electricity grid in 2030-40 was it possible to produce and distribute electricity for so many cars.

The number of kilometres driven has fallen, however. It is neither easier nor cheaper to be a motorist. In and around the larger cities, traffic congestion continues to grow and much patience is required to drive into the city centres of Copenhagen or Aarhus. Electricity prices have also risen as global energy demand booms, and new taxes have been introduced in an attempt to limit private motoring and avoid traffic congestion.

Yet the electric car still plays a key role in 2050 as a vehicle that has most radically changed people's perception of transport. Firstly, it has paved the way for new market models, which means that for many it is now more attractive to hire or lease an electric car rather than own one. This applies in particular to many city residents, who only need a car when they are going to their summerhouses or at the weekend. This development means they always drive in a car with the latest technology and that is free from expensive repairs; a frequent consequence of high-tech vehicles.

Secondly, the electric car not only functions as a mode of transport, but it is also a gadget, which communicates directly with all other communication platforms. For example, when you book an appointment in your digital diary, the car can automatically calculate route directions that take into account electricity consumption and other traffic. This allows you to manage your consumption and get there quickly.

The smart, new electric cars are brimming with services, entertainment and smart applications. There is much prestige in having the latest software. It is about what a car can do rather than what it is. This development has paved the way for more than 20,000 new knowledge-intensive jobs in Denmark.

"The older part of the population will rise drastically in the next thirty years, and we will experience a massive need to make public transport solutions available to them."

Jan Albrecht, Head of Division, Danish Transport Authority

2012
THE FUTURE IS ALREADY HERE

MUNICIPALITIES FOCUS ON LIGHT RAILWAYS

In the Copenhagen area, the eleven surrounding municipalities have joined together with the Ministry of Transport to set up 23 km of light railway, which will stretch from Lundtofte in the north to Ishøj in the south, with 28 stations along the way. The light railway, which is planned to begin operating in 2020, will follow the busy Ring 3, which is one of Denmark's most congested road arteries. The project is the start of what could develop into Loop City, a new sustainable urban belt that activates and connects new urban areas around the Capital Region, with the light railway as its spine. In contrast to the express busses, which have been put on motorways around the capital, the light railway is isolated from the rest of traffic and thereby not affected by general congestion. In addition, the light railway is expected to bring enormous value to the area by attracting new building projects and companies. The same conclusion has been reached in Jutland, where Aarhus municipality and the Central Jutland Region have signed an agreement with the Ministry of Transport to establish a light railway in eastern Jutland. The first phase of the railway, which is expected to open in 2015, will connect the two existing local lines together and relieve a large amount of commuter traffic currently travelling through the city centre. It is planned to develop the network over time to include the eight eastern Jutland municipalities.

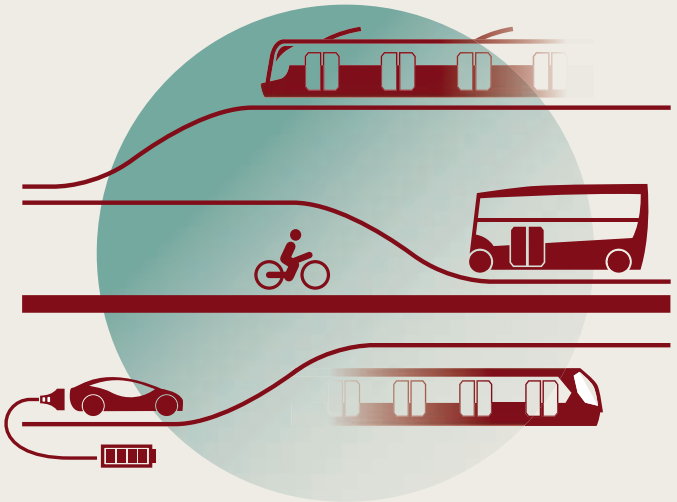
FACT 2050

MORE THAN 80% OF ALL TRANSPORT ON DANISH ROADS IS ELECTRIC.

CONNECT!

Integration between different modes of transport is essential to ensure flexible and efficient transport in 2050. Central, busy hubs will provide quick, easy changeovers between metro, train, car, bike and light railway.

Source: Monday Morning



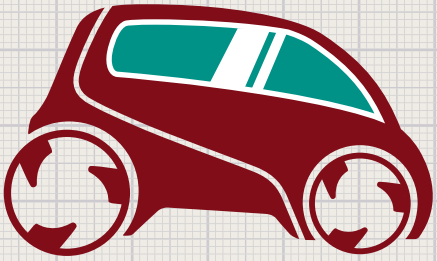
YOUR CAR IS A GADGET

THE CAR OF THE FUTURE IS A MOBILE DIGITAL PLATFORM

The dashboard is a digital user interface, like your smartphone. It contains everything from milometer to music and traffic information.

You choose the sound of the car in the same way as you choose a ring-tone for your mobile.

Road pricing ensures you automatically pay for the distance you drive. The better you become at avoiding congestion and filling the car up, the cheaper it is.



When you book a meeting in your diary, the car will know how to get there quickest.

The car tells you if there are friends or colleagues you could pick up on your way.

When you enter your destination, the car suggests the best route on the basis of your profile, including when you need to switch to a bike or train along the way.

Your car buys and sells electricity from the grid when you park, so that you always get the best deal.

You lease your car instead of owning it. The leasing company maintains it, and you pay according to how much you use it. Electricity is paid for through your subscription.

"MY" CAR

Finally new partnerships have paved the way for new market models, where the electric car is part of an overall transport product that also includes public transport. For example, while buying a train or bus ticket, you can also buy access to a hire car, which will be ready for you to use at the station. All of this is paid for with one ticket from one provider. It is not unusual for employers to provide hire cars for their employees, and many of the bigger housing companies provide the same service to their residents, who can quickly pick up a fully charged car at the local car park.

Denmark has come a long way with this type of model, and this is particularly because of the decision at an early stage to turn parts of the country, such as Bornholm, into test platforms. This gave Denmark insight and important knowledge, which was then sold as a service to the global market. There is not a large range of Danish-manufactured electric cars. However, many of the applications that connect cars with other communications platforms have been developed by Danes. And several Danish companies have enormous insight into knowledge about behaviour patterns which follow from using electric cars.

CONGESTION IS A STRAIN ON THE ECONOMY

As economic growth and jobs have been concentrated in Denmark's major cities, some Danes have had to get used to life as a commuter, and there is pressure on traffic between the large residential municipalities and city centres. In Copenhagen alone, the traffic to and from the nearest surrounding municipalities has grown by around 30% since the 2010s. It costs a lot of money for a productive workforce to sit in traffic jams, and this has forced huge investment in public transport systems between the largest cities and their catchment areas.

Nevertheless, congestion continues to be a major problem and a heavy drain on the economy. Throughout the world when urbanisation takes hold, traffic jams follow, and public transport suffers from an ever increasing number of passengers. Mobility has become a central competitive parameter internationally. When companies are looking to locate around the world, mobility plays just as big a role as salaries and educational levels.

Things are not always easier for commuters who choose their car rather than public transport. In Copenhagen, the harbour tunnel beneath Copenhagen's harbour has relieved much of the commuter traffic, which previously had to go through the city centre to travel between northern and southern districts. Large information screens and intelligent traffic management continuously regulate traffic speeds to avoid major traffic jams and to reduce the number of accidents. The better the infrastructure, the more cars on the road. It's a vicious circle.

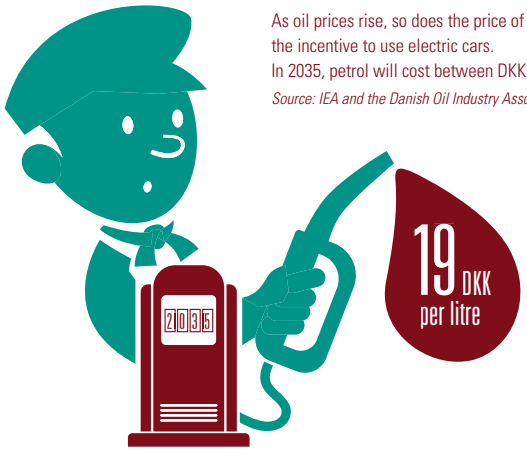
In central Jutland, light railways have emerged and connect the central growth centres in the Freja region. As many large housing estates and industrial parks cannot be reached by public transport, the electric car still remains the preferred mode of transport for the region's busy residents. Like Copenhagen there is massive pressure on traffic, and it has been necessary to extend a motorway network and widen the popular main E45 artery from six to eight lanes.

However, even if the ring-road systems surrounding big cities like Copenhagen and Aarhus have been extended, and intelligent traffic management systems help avoid the worst queues, a large part of transport time is still spent in traffic jams.

This can be expensive for the individual. The road pricing system has now been rolled out all over Denmark so all motorists pay according to where they drive to and when. Charges are highest for those going into the cities during rush hour. Patient motorists can usually console themselves with the fact that the technology in their electric cars makes it easy to work while waiting in their car, and intelligent real-time traffic management tells the driver the quickest and easiest way out of the jam and into a parking space. Several also spend their time socialising. Expensive car kilometres make filling the car with extra passengers more appealing, and a wide range of shared journey schemes have shot up at the initiative of both workplaces and individuals.

"We will see big established transport providers enter into new strategic partnerships with smaller private service providers and thereby break away from the practical and mental division between public and private transport."

Johnny Hansen, CEO, Better Place Danmark



As oil prices rise, so does the price of petrol – and in turn the incentive to use electric cars.
In 2035, petrol will cost between DKK 16 and 19 per litre.
Source: IEA and the Danish Oil Industry Association (EOF)

BUS ON DEMAND

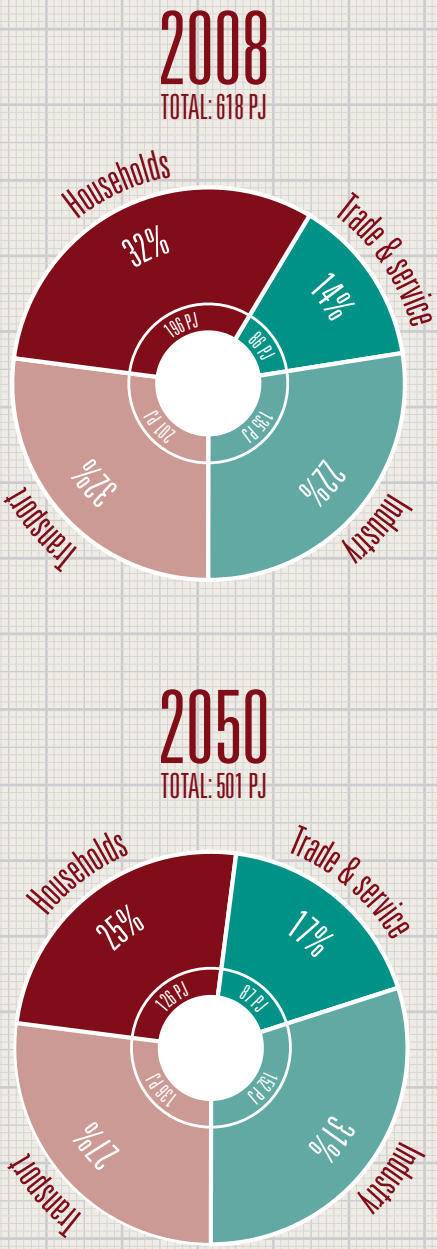
Cars are essential in rural districts, where there is poor or no access to public transport, and where the only alternative to the car is often an electric bike. In some of the more active rural areas, which e.g. house larger farming clusters, there is also access to special electric busses, which have neither fixed stops nor fixed routes, but which follow an intelligent on-demand system that can communicate directly with an application on the user's smartphone.

On the other hand, it is only rarely worth taking the car to travel between the large cities of Copenhagen, Odense, Aarhus and Aalborg. An improved railway network and the new bridge between Funen and Jutland - Fynsbroen from Bogense to Juelsminde - mean that travel between Denmark's four largest cities takes just three hours. As a result many domestic air routes have been dropped and domestic air transport is now primarily just between Copenhagen and Aalborg. Domestic air travel has lost ground in terms of price, time and comfort, to rapid train connections in which time spent travelling can also be spent working or holding meetings.

From their train window, passengers can look out across the large battery charging stations, which were set up before the breakthrough in development of long-lasting batteries for the large number of electric cars. Batteries can now run for a long time and are usually charged at home or at work, but people on longer journeys also need to be able to charge their cars, or in some cases change battery when on the motorway. Trials of automatic chargers, using cables buried under roads and larger car parks, are underway in several larger cities. If these are successful, it will be even easier to be electric car owner.

"The better educated we are, the further we'll want to transport ourselves. Digital developments can take some of the pressure off having to be physically present. Nevertheless it is still likely that transport will grow significantly."

Henrik Harder, Traffic Researcher, Aalborg University

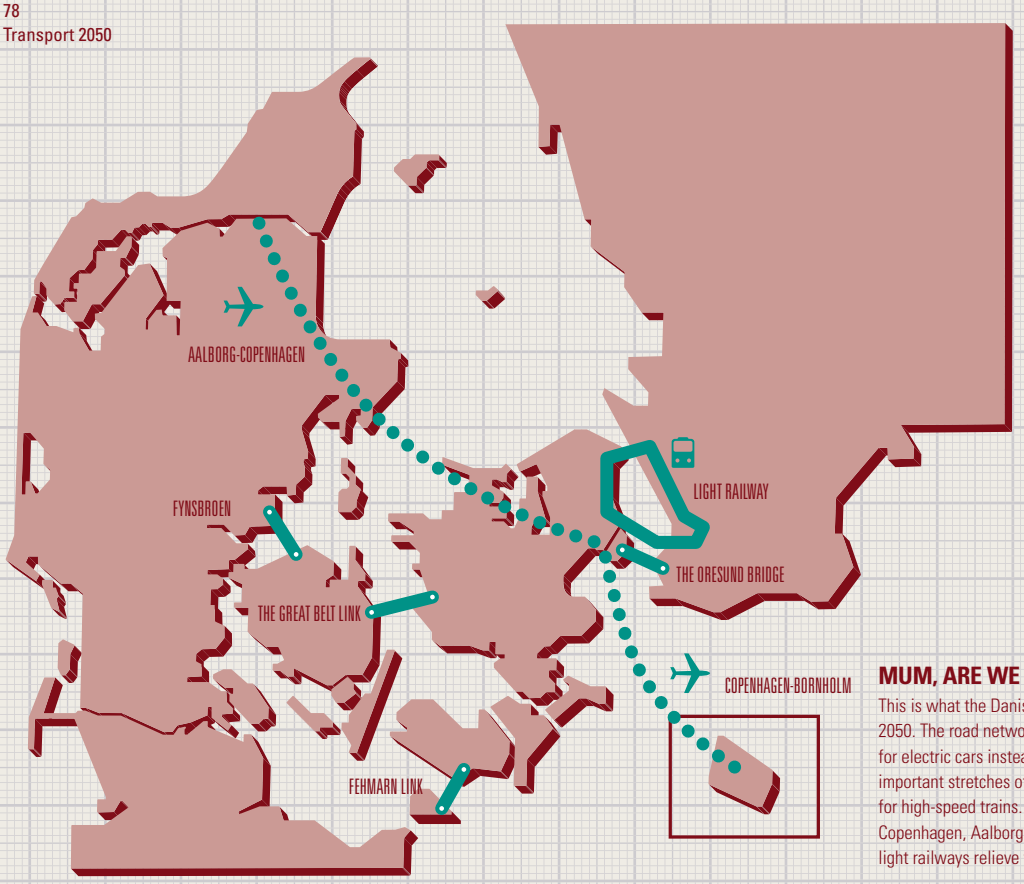


MORE GROWTH, LESS ENERGY

Denmark has streamlined its economy drastically in 2050. Economic growth continues but energy consumption has dropped by 20%. Consumption by end-users amounts to 501 PJ in 2050, compared to 618 PJ in 2008. (1 PJ ≈ 30,000,000 kWh).

Source: Danish Commission on Climate Change Policy

PETROL STATIONS HAVE BEEN REPLACED BY LARGE CENTRAL RECHARGING STATIONS AND BATTERY CHANGING STATIONS.



MUM, ARE WE THERE YET?

This is what the Danish transport system could look like in 2050. The road network is serviced by recharging stations for electric cars instead of our current petrol stations. Some important stretches of railway have been straightened for high-speed trains. Domestic flights only exist between Copenhagen, Aalborg and Bornholm. Around major cities, light railways relieve the pressure on the roads.

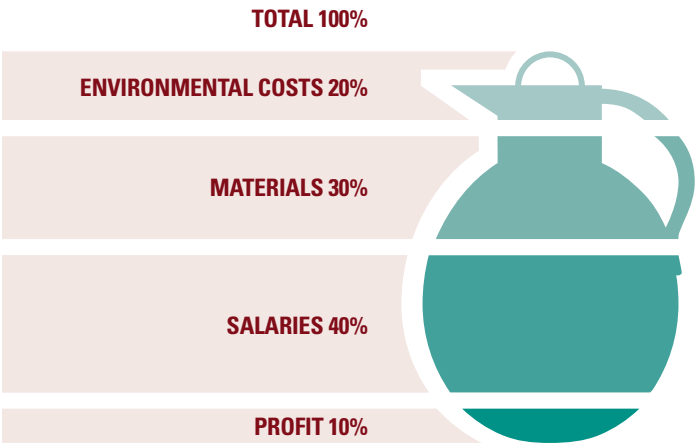
ON TRACK

The electric car is also used by Danes travelling beyond national borders to visit their European neighbours. However, most prefer the train. Connection to the European high-speed network and completion of the Fehmarn Belt link mean that major European cities such as Berlin and London are just a few hours away from Copenhagen.

The Danish rail network has undergone major modernisation and is now responsible for the majority of the freight transport between Denmark and Europe. As Danish industrial production has been outsourced to low-income countries, exports consist primarily of lighter traffic. Unlike in earlier years, goods from overseas markets do not arrive in Denmark by aircraft as often, but by huge container carriers to Danish industrial ports or ports in neighbouring countries, where they are unloaded onto freight trains. In cities, custom-built terminals ensure it is easy to unload goods from trains and onto lorries that transport the goods for the last stretch of their journey. Lorries will either run on bio-based fuel or special super-batteries, designed to haul heavy goods.

With regard to passenger transport, comfortable high-speed trains have out-competed the majority of shorter flight connections in Europe, and many airports are struggling to survive. This development means that intercontinental routes to large growth metropolises in Asia and South America only fly from a few designated airports in Europe. Danes therefore often have to take a train to another city, before taking their seat on one of the large superjets that serve the intercontinental routes. The latest aircraft types make the most of their capacity with passenger seats also being placed inside the wings.

However, very few Danes make this journey, and they have usually had to save up for a long time. It is many years since the typical middle class family could afford to travel to Thailand once a year. The price of flights has rocketed, firstly because of the increases in duties and oil prices, and also since the switch to alternative biofuels, which retain a high price on the global market.



WE VALUE THE ENVIRONMENT
In 2050 the price of a product will also include the environmental costs associated with production.
Source: Monday Morning

LIFESTYLE: THE PRICE OF POLLUTION

Our economic system has undergone enormous change. GDP belongs to the past – and we have put a value on our environment.

Many years of effort on designing our economic system to take account of the environmental impacts of our production and our consumption have gradually started to bear fruit.

Meanwhile global institutions such as the UN and the OECD have scrapped the old-fashioned GDP and introduced a more accurate way of measuring social value.

Around the world, taxes, allowances and insurances have been introduced, which are either paid by the consumer or the manufacturer. This means that the price we pay for a product not only covers the costs of wages and materials, but also any damage to nature that the product may cause.

The less polluting a product is, the lower the price, thus giving consumers an incentive to buy environmentally friendly products. Companies are encouraged to innovate and reduce pollution, or eliminate it entirely.

In the 20th century, the world's economies measured their muscle in terms of GDP – Gross Domestic Product. The problem was that GDP calculated all types of production as equally good. A traffic accident or chemical leak was positively reflected in GDP, because it created economic activity. Costs of pollution or loss of life were not taken into account and GDP therefore helped to derail the global political debate on sustainability and growth. It took many years to end GDP, but the new global economic key figure, GDP+, was finally accepted in the first half of the 21st century. GDP+ reflects all dimensions of the economy, including wear on natural capital and resources as well as human and environmental costs of growth.

The most important change of mentality is perhaps our realisation that environment and growth are not diametrically opposed. We know that we are better off than when our grandparents were growing up, and our society is also greener. Our quality of life has not fallen, on the contrary. This has made us ready to make our contribution. We can see there is a point to it all.

"It seems crazy doesn't it? First we spend a lot of money buying expensive items such as consumer goods, and then we start spending money on getting rid of them all again".

Prof. James Clark, Green Chemistry Centre, University of York

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