

# DENMARK

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## 1 OVERVIEW OF THE REGION

### Characteristics of the Region

In the Danish context, it is a challenge that the Copenhagen Region does not exist as an administrative entity. The municipal reform in 2007 moved most of the tasks the regions previously had to either the national level or the municipal level. The new regions were shaped in order to fit their main task: to manage hospitals. The former Greater Copenhagen Region is today covered by the most of the Capital Region and part of Region Zealand.

The region named the Capital Region includes the remote island of Bornholm. The Greater Copenhagen Region only still exists in relation to spatial planning. Municipal spatial planning has to comply with the frames set by the national planning authorities.

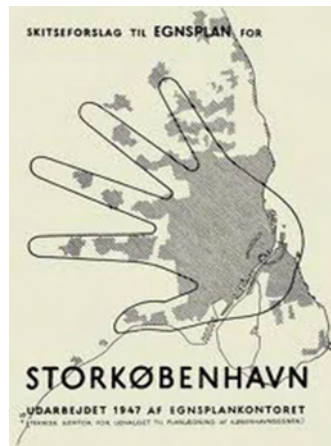


Figure 1 – The ‘Fingerplan’ for the development of the Copenhagen region, 1947

The most famous attempt to develop a regional plan for Greater Copenhagen was the so-called ‘Fingerplan’ from 1947. This plan covered the municipalities in the centre of the City: Copenhagen and Frederiksberg, and some of the surrounding suburban municipalities. Using this understanding of the Copenhagen Region, the region consists of an urban fabric with approximately 1.2 million inhabitants.



Figure 2 – Greater Copenhagen Region

The later version (2013) of the plan for the Greater Copenhagen Region includes more rural areas and a number of semi-independent towns like Køge, Roskilde, Hillerød and Helsingør. In this understanding of the region it has approximately 1.9 million inhabitants. It could be argued that an even larger region exists, when considering different resource use/ allocation, for instance taking the extraction of drinking water or typical daily commuting into consideration. In that way all of Zealand can be considered as representing the Greater Copenhagen Region, with a population of approximately 2.4 million.



Figure 3 – Öresundsregion

An even larger version of the region is 'Öresundsregionen' which in some definitions includes the entire Region Skåne located in southern part of Sweden, as well as the island Sjælland and the capital Copenhagen in Denmark. The Öresundsregionen has a population of approximately 3.7 million inhabitants. A smaller version only includes the old Greater Copenhagen region and only parts of Skåne. The Öresund Bridge has almost made the City of Malmö – with approximately 310,000 inhabitants – a part of Copenhagen.

Probably the most adequate way of dealing with the Copenhagen region in relation to Smart Energy Regions is to use the Municipality of Copenhagen because the municipality exists as an administrative and policy making unit, thus, being able to offer relevant data as a smart energy region.

### Characteristics of the Region

The municipality of Copenhagen has an area of 89.79 km<sup>2</sup> and a population of 559,440 inhabitants (www.statistikbanken.dk, 2013). In the municipality of Copenhagen the local government of Copenhagen consists of a governing body, called the City Council, and an administrative branch. The City Council is made up of seven committees: the Finance Committee and six standing committees, each of which has its own specialised field of responsibility. Energy policies are primarily dealt with in the Committee for Technology and Environment and in the Finance Committee. The Finance Committee is the overarching committee, which coordinates and plans the total management of the City of Copenhagen. It comprises the chairmen of each of the standing committees plus six other members of the Council. The Finance Committee is chaired by the Lord Mayor. Each committee is linked to a particular section of the administrative branch of Copenhagen's local government.

The City of Copenhagen has seven administrations. Each administration deals with the tasks related to its standing committee. Questions related to environment, energy, transport and urban planning are dealt with in two of these administrations: The Finance Administration and the Technical and Environmental Administration.

The economy for Danish citizens expressed in GDP per capita is €27,100 (DK, 2010). The employment rate in Copenhagen Municipality is 91.7% (CPH, 2012). In Copenhagen you find some of the leading industry clusters in Europe:

- medicon Valley offers an abundance of exciting opportunities for pharma, life science and biotech companies;
- Copenhagen Cleantech Cluster is one of the world's strongest clusters, focusing on aiding Cleantech research, development and implementation – (Copenhagen Capacity 2014).

### Energy demand and supply of the Region

- total energy consumption: domestic, commercial, industry, total energy consumption: domestic, commercial, industry: 7,900 GWh (2011). Transport is 2,900 GWh, including air transport (Planenergi 2013);

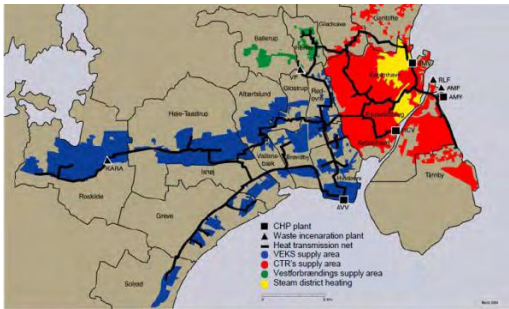


Figure 4 – Map of different supply areas of Copenhagen district heating system and CHP plant locations. Red colour indicates the supply area for Copenhagen central municipalities (CTR) and blue colour shows the supply area of the western municipalities (VEKS)

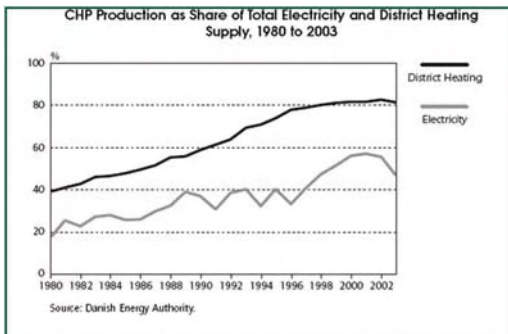


Figure 5 – Cogeneration Heat and electricity production development (Danish Energy Authority)

- 35% is used for electricity production (2,463 GWh, 2011);
- the average GHG emission factor for electricity is relatively low (0.100 kgCO<sub>2</sub>/kWh) due to the Nordic countries use of wind, water and nuclear power for Electricity production. (European average 0.500 kgCO<sub>2</sub>/kWh);
- the share of renewables in electricity generation in 2011 was 29%;
- cogeneration was identified as a cornerstone of the Danish energy conservation strategy in 1975. Three decades of responsible and dedicated policy-making have paid off: between 1980 and 2005, the share of CHP in the total electricity produced in Denmark doubled from less than 20% in 1980 to 42.6% in 2006, and the share of CHP in heat provision increased to 75%; this has resulted

in a 15% decrease in CO<sub>2</sub> emissions a year.

- the share of carbon neutral fuel in heating in 2011 was 42%;
- the total CO<sub>2</sub> emissions in 2011 was 1,857,000 tonnes for the region.

## 2. CURRENT SITUATION: TARGETS RELATED TO ENERGY POLICY

The following chapter is to great extent extracted from 'CPH 2025 Climate Plan', a document produced by the City of Copenhagen, Technical and Environmental Administration in 2012.

### Overall goals and objectives

Copenhagen wants to be the world's first carbon neutral capital by 2025. This is an ambitious plan requiring long-term action, but it is realistic. The city is already well underway. In 2011, Copenhagen had reduced CO<sub>2</sub> emissions by 21% compared to 2005.

In 2009, the City Council unanimously adopted the Climate Plan for Copenhagen, setting down goals for achieving a 20% reduction in CO<sub>2</sub> emissions by 2015. In addition, a vision for a carbon neutral Copenhagen in 2025 was formulated.

### Energy and Transport in Focus

To achieve carbon neutrality by 2025, Copenhagen must use less energy than it does today and also switch to green energy production.

To counteract continued increased emissions e.g. transport, Copenhagen must produce a surplus of green energy corresponding to these emissions. The initiatives are categorised into four themes: energy consumption, energy production, green mobility and city administration initiatives.

Energy savings account for nearly 7% of CO<sub>2</sub> reductions. Additionally, energy savings play an important role in relation to reducing the economic costs of the Climate Plan.

The reason is that every time Copenhageners save energy, Copenhagen avoids having to invest in production capacity in new power plants. Initiatives include energy retrofitting of existing buildings, implementing low-energy new build, promotion of solar cells

together with an improved framework for the construction sector.

Energy production initiatives account for 74% of the total CO<sub>2</sub> reduction in Copenhagen. These include installing onshore and offshore wind turbines, establishing a new biomass-fired combined heat and power plants, establishing a geo-thermal plants and the phasing out of fossil fuels for peak load production. Furthermore, Copenhagen is able to reduce CO<sub>2</sub> emissions from district heating production by separating and re-using plastic from the waste stream.

A broad range of initiatives in the transport area account for just over 11% of CO<sub>2</sub> reductions. The main transport initiatives include activities to promote cycling, biogas and hybrid buses and the introduction of electrical and hydrogen powered cars. In addition to this, new fuels for the heavy traffic in Copenhagen as well as initiatives focusing on efficiency and climate behaviour all play an important role. The City of Copenhagen wants to lead the way and reduce its CO<sub>2</sub> emissions considerably. To implement this, the City Administration will set activities in motion focusing on energy consumption, mobility, operations and management together with climate-friendly conduct among its employees.

### Cycling strategy

The cycling strategy for Copenhagen takes its point of departure in the following circumstances:

- the bicycle is low, practical – and common sense technology that anyone can use and afford;
- cycling is based on non-fossil ‘fuel’;
- cycling has additional health benefits;
- cycling can support public space to be perceived as public domains, and thus supporting the development of social sustainability and people’s perception of an improved quality of life;
- cycling in combination with other means of public transportation and supported by carefully street design encourage people to everyday cycling instead of using cars on both a local and on a regional level.

Since 1995, the City of Copenhagen has done cycle accounts that record the mileage for

bikes including the distance travelled, etc. For 2012 the figures tell that 36% of everyone working or studying in Copenhagen used a bicycle. In 1996 the figure was 30% and in 2002 32%. 1.27 million kilometres were travelled by bike every working day. In 1996 0.93 million kilometres were travelled by bike every working day, and in 2002 the number had increased to 1.11 million kilometres. There are 650,000 bicycles in Copenhagen (Centre) and 125,000 cars so that 5.2 times more bicycles than cars are in the city. Moreover, 28% of families with two children have a cargo bike and in 17% of households a cargo bike replaces a car. Furthermore, there is no significant correlation between income and the use of bicycles. Both rich and relatively poor inhabitants use bicycles. (Halldórsdóttir 2011).

The ambition to further stimulate people cycling on a regional level is supported by:

- facilitating connections between public transportation and cycling;
- construction of new cycling tracks and lanes;
- improving existing cycling tracks and lanes – by widening the lanes on behalf of the car area;
- positioning of ‘air stations’ (facilities with bicycle pumps) along the cycle super highways;
- green traffic light waves.

Plans for how many new bike paths and bike lanes to be made in Copenhagen next year have been developed. The so-called Cycle Track Plan covers the period 2006 – 2016 and indicates the order of almost 70 kilometres of new bike paths and bike lanes. The cost of completing the plan is estimated to approximately €50 million.

In 2012 there were:

- 359 km of cycle track;
- 24 km of cycle lanes;
- 43 km of green cycle routes;
- 32.5 of cycle super highways (June 2013).

Copenhageners are also stimulated to cycle by making the conditions for car driving difficult through one-way roads, fewer and more expensive parking areas.

The bicycle is a typical means of transportation



in Denmark. Both adults and children cycle on an everyday basis and throughout the year. Danish children are trained in cycling and traffic rules in school in collaboration between the school and the police.

Immigrants to DK (adults and children) are also offered to learn to ride a bike as part of the official integration process.

### Overall targets

Targets set for the region to be reached 2025:

- 20% reduction in heating compared to 2010;
- 20% reduction in electricity consumption in commercial and service sector compared to 2010;
- 10% Reduction in electricity consumption in households compared to 2010.

### Reduction of CO<sub>2</sub> emissions

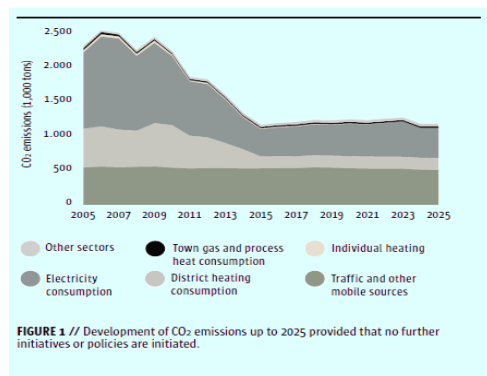


Figure 6 – Development of CO<sub>2</sub> emissions up to 2025 mainly due to introduction of wind turbines and new renewable energy-based cogeneration using biomass

When the objectives for existing buildings have been reached, heat consumption is reduced by almost 1,000 GWh and electricity by 250 GWh compared to 2010 levels. Energy savings and installation of solar cells, which provide currently 1% of the electricity, will reduce CO<sub>2</sub> emissions by a total of 80,000 tonnes.

These objectives will be achieved by:

- improving the building framework and conditions;
- develop a strategy for energy in construction;
- develop and test funding for the realisation of energy savings;

- working to change legislation to increase energy efficiency.

Towards 2025, Copenhagen will initiate and implement a variety of activities to reduce energy consumption of buildings. The following describes the main initiatives together with the initiatives, which will be implemented shortly to ensure frameworks and solutions to achieve energy savings up to 2025.

### Economy

Copenhagen's total cost to implement the initiatives which will help to reduce energy consumption in the buildings in Copenhagen, is expected to be less than €23 million to 2025. This includes concept and model development, and funding for demonstration projects in new and existing buildings. By reducing heat consumption by 2025 by 20% and electricity consumption by 20% in sales and service companies and 10% in households respectively, the total economic savings amount to approximately €215 million.

A couple living in an apartment will save approximately €535 in 2025 per year on their energy consumption if the objectives are met.

The total investment in new construction and renovation of existing construction will require investments of up to €24 billion until 2025. The total investment in PVs in the private sector is estimated to be €60 million up to 2025.

### Other Regional targets, barriers and drivers

Turning Copenhagen into a smart city means user-friendly development while also reducing consumption of resources. The starting point for the smart city is the unified whole. That is to say, limitations in capacity, renewable energy production, consumer patterns and consumer needs will be integrated into the solutions which are finally implemented.

With the smart city initiative, the City of Copenhagen wants to select the most energy-efficient solutions such as giving high priority to electricity largely produced by renewables and to ensure that the potential for flexible energy consumption is utilised. The City Administration will use its own vehicles and buildings to test and implement new technology.

*Digital infrastructure*

Smart city Copenhagen will monitor energy consumption – amongst other things by controlling the energy consumption in buildings – and learn from it. Access to public energy consumption data creates a scope for new services and new information for the benefit of both Copenhageners and businesses. The City of Copenhagen will be collaborating with relevant partners to ensure an open digital infrastructure so that Copenhagen will have an open platform for new and innovative solutions.

*Flexible consumption and Smart Grid*

In the future, the Danish energy supply will consist of increased amounts of renewable energy. This requires an increasingly flexible consumption and, together with a Smart Grid can accommodate more renewable energy being fed into the system. A Smart Grid must be the link between energy production and user.

The City of Copenhagen will, together with external players, strive to examine the possibilities of implementing a scheme whereby Copenhagen residents, businesses and authorities will have more opportunities to select and use electricity when the share of renewable energy in the over-all energy production is high.

The City of Copenhagen will also launch several initiatives to ensure intelligent recharging of the City Administration's own electric cars. To minimize the production of district heating in plants producing heat only – which happens during very cold periods – the City Administration will, in collaboration with Copenhagen Energy, examine whether the heating system could be made more flexible.

### 3. CASE STUDY: CARLSBERG DEVELOPMENT PLAN

Carlsberg has, for more than 160 years, brewed beer in Valby – a city district in the western part of central Copenhagen. The area has been a closed industrial area of 33 hectares with production buildings, basements and brewer family Jacobsen's private homes and gardens in the centre of Copenhagen.

In 2006, Carlsberg decided to move beer production to Fredericia and release the large areas in Valby to urban development. The vision is to make the area into an attractive and open urban area, being an integral part of Copenhagen – the Carlsberg City District is called "Our Town".



*Figure 7 – The entrance to the Carlsberg Brewery area between the foundations of the "Elephant tower", built by architect Vilhelm Dahlerup, 1901*

The idea is to conserve and recycle industrial buildings in conjunction with new construction of high architectural quality with a strong focus on sustainability in both the choice of materials and agglomeration operation with regard to water, heat, etc.

Although the production of beer has moved and new features were introduced into the area, the company Carlsberg A/S will continue to be present in the area with its international headquarters, Carlsberg Denmark, Jacobsen Brew house, Research Centre, the visitor centre and perhaps new activities in the future. Carlsberg A/S launched in the autumn of 2006 an open international architectural competition "Our Town" was run to get ideas on how the 33-acre brewery site could be developed. The vision was to create a new, vibrant neighbourhood with an intense urban life as a result of a dense urban structure with a mix of residential, commercial, trade, culture and leisure with an estimated population of 4 – 6000 (3000 dwellings). Sustainability played a major role in the competition and in the description of the winning project.

Carlsberg A/S and the Danish architect firm

“Entasis”, who won the competition, along with other consultants prepared the basis for a local plan in collaboration with the municipality of Copenhagen.



Figure 8 – The Carlsberg area | Copenhagen.  
Illustration from the winning proposal  
“Carlsberg – vores by” by ENTASIS

### Objectives and methods

The vision for the area is that citizens and visitors will experience the area, with its spaces and citizens linked together by one identity: inclusiveness and space. Inclusiveness can be seen and experienced in many ways:

*Cultural inclusiveness:* The district should reflect the inspiration the modern human being – the cosmopolitan – finds in globalisation. The inspiration found in architecture, function, light, smells, etc.;

*Social inclusiveness:* Carlsberg will embrace all social classes, generations and many ethnic groups. Modern people have broken out of dogmatic circles to follow their inspiration and desire. The city lives through its diversity;

*Architectural inclusiveness:* The district must be perceived as a laboratory where the typologies public space, the old buildings, the tower house and city houses are experienced cognitive and developmental;

*Environmental inclusiveness:* Carlsberg will be the first town in fully developed form manages to produce a surplus of energy;

*Experiencing Diversity:* The city should offer great diversity in experiences and functions.

Common to these experiences, the city’s ambition of “the good life” breaks through.

### District heating and renewable energy systems (RES)

Copenhagen Municipality as a whole is covered by a district heating plan, which makes it mandatory for larger buildings with a heating capacity above 0.25 MW to use district heating only. Alternative heating and energy sources such as solar collectors and PVs presume dispensation from the heating supply legislation. The use of district heating and renewable energy systems in the Carlsberg area thus complies with the overall energy and CO<sub>2</sub> targets for Copenhagen Municipality.

### Green mobility in Carlsberg

Developing the Carlsberg area as a sustainable urban neighbourhood does imply a number of considerations concerning transport. The area is designed for a limited car-based transport, the streets are predominantly meant for urban life, not for cars. The idea of establishing a metro-station in the area dominated the early phases of the project. The metro-station should be served by the circle-line ‘Metro-city-ringen’. However, the private part: Carlsberg and the public part could not reach an agreement concerning the financing of the station. Hence, the idea of a metro-station in the area was replaced with the idea of moving the existing nearby urban rail station ‘Enghave Station’ a few hundred metres closer to centre of the Carlsberg area, making it more convenient for the future residents to use urban rail. This project has now been confirmed.

Another central discussion in relation to the development of Carlsberg is car parking. 95% of all cars will be parked in underground facilities. The questions are: How many cars should these facilities provide space for and who should invest in the facilities? In the original negotiations, the Municipality argued for 1 parking lot per 200m<sup>2</sup> of floor space.

Carlsberg argued for 1 parking lot per 100 m<sup>2</sup> of floor space, because the area should be considered a mix of business development and residential development. The negotiations ended in a compromise: 1 parking lot per 133 m<sup>2</sup> of floor space. It is estimated that each

lot will cost approximately €65,000. For a part of the potential future residents, belonging to the creative segment in Copenhagen, it is not seen as positive to have access to parking. Other potential future residents would, however, consider access to parking as a must. Nobody is eager to finance the construction of the parking facilities, not even those actors who consider access to parking as a must.

### Re-Cycling Carlsberg

The reduction of CO<sub>2</sub> emissions from transport and transportation is part of the ambition to create and support people's perception of an improved quality of life in the area. The notion of the good life and reduction of CO<sub>2</sub> emissions are thus seen as essential and interrelated concepts and ambitions in developing the area successfully. The Masterplan, Vores By, describes the components (streets, squares etc.) of the area's infrastructural organisation and its relationship to adjacent urban road systems and public transport.

Streets, alleys and squares are functionally classified, as well as the definitions of different types of streetscapes, characters and traffic types. Some streets and squares are designated as shared spaces, in some only limited driving will be permitted, and in others driving will not be allowed. The dominant modes of transport are walking and cycling.

At a local level the plans for Carlsberg district follows the strategies and ambitions to stimulate bicycle and pedestrian traffic, and public transport as formulated at regional level for Greater Copenhagen. The ambition to develop Copenhagen to an *Environmental Metropolis* and a *Metropolis for People in 2015*, is supported in the plans for the Carlsberg area, and carried out through the spatial organisation, its relations to adjacent urban areas, the design of the streetscapes and the imbedded stimulation of walking and cycling.

Stimulation of bicycle, pedestrian and public transportation is regarded as essential tools supporting this ambition. As shown above behavioural and attitudinal measures are emphasised and supported. The cycling training programs target both school children and adults through organised and systematic

courses offered and organised by public authorities, the school system, and through volunteers (NGO) initiatives. People's behaviour and attitude towards cycling are sought supported through the spatial organisation and urban design.

The ambition is to create a common understanding among the Copenhagen residents of the beneficial good of bicycling on both society level and on an individual level, and thus to support people's perception of an improved quality of everyday life both on a local and on a regional level, and at the same time to reduce CO<sub>2</sub> emission.

### Long term focus

Copenhagen will in the coming years foresee an extraordinary population growth. At the same time the city has the ambition of becoming the world's first carbon-neutral Capital by 2025. This provides an excellent opportunity for creating a sustainable city in terms of both environmental and economic growth.

Copenhagen has the declared dedication to collaborate with cities, knowledge institutions and enterprises on an international scale in the development of new, innovative, sustainable solutions.

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The COST Action TU1104 Smart Energy Regions brings together over 70 researchers from European institutions to investigate the drivers and barriers that may impact on the large scale implementation of low carbon technologies in the built environment. The book “Smart Energy Regions” is the outcome of the Working Group 1 of the Action and collects analysis and case studies from 26 European countries. For more information about the Action and COST please visit [www.smart-er.eu](http://www.smart-er.eu) and [www.cost.eu](http://www.cost.eu).



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# COST DESCRIPTION

## THE ORGANISATION OF COST

COST - European Cooperation in Science and Technology is an intergovernmental framework aimed at facilitating the collaboration and networking of scientists and researchers at European level. It was established in 1971 by 19 member countries and currently includes 35 member countries across Europe, and Israel as a cooperating state.

COST funds pan-European, bottom-up networks of scientists and researchers across all science and technology fields. These networks, called 'COST Actions', promote international coordination of nationally-funded research.

By fostering the networking of researchers at an international level, COST enables breakthrough scientific developments leading to new concepts and products, thereby contributing to strengthening Europe's research and innovation capacities.

COST's mission focuses in particular on:

- building capacity by connecting high quality scientific communities throughout Europe and worldwide;
- providing networking opportunities for early career investigators;
- increasing the impact of research on policy makers, regulatory bodies and national decision makers as well as the private sector.

Through its inclusiveness, COST supports the integration of research communities, leverages national research investments and addresses issues of global relevance.

Every year thousands of European scientists benefit from being involved in COST Actions, allowing the pooling of national research funding to achieve common goals.

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communities of emerging countries. In particular, COST Actions are also open to participation by non-European scientists coming from neighbour countries (for example Albania, Algeria, Armenia, Azerbaijan, Belarus, Egypt, Georgia, Jordan, Lebanon, Libya, Moldova, Montenegro, Morocco, the Palestinian Authority, Russia, Syria, Tunisia and Ukraine) and from a number of international partner countries.

COST's budget for networking activities has traditionally been provided by successive EU RTD Framework Programmes. COST is currently executed by the European Science Foundation (ESF) through the COST Office on a mandate by the European Commission, and the framework is governed by a Committee of Senior Officials (CSO) representing all its 35 member countries.

More information about COST is available at [www.cost.eu](http://www.cost.eu).



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