



ETUC Project “Involving Trade Unions into adaptation policy”

Thematic workshop #2 –
Consequences of climate change and employment:
sectors and regions at risk and how to anticipate

DISCUSSION PAPER

This document is part of the ETUC European project on adaptation to climate change. The three main objectives of this project, which builds upon several projects dedicated to climate change policies that the ETUC has performed in the past, and which outcome will be based on the results of 2 questionnaires sent to national and sectoral European trade unions as well as on 5 thematic workshops¹, are: (1) to inform European trade unions about the consequences of climate change on the world of work; (2) to prepare trade unions to play an active role in the design and implementation of the national strategies for adaptation; (3) to develop a tool kit for trade unions to bring adaptation on the agenda of industrial relations.

At COP 21 in Paris, countries committed to keep global warming well below 2°C and to continue efforts to maintain it under 1.5°C compared to pre-industrial levels. Countries also committed to become carbon neutral by the end of this century². These collective commitments imply that the collective ambition of the world was to shift to a zero-emission economy in a few decades. Despite all the already visible effects of climate change and the human, social and economic costs coming along³, the actual collective mitigation efforts appear, however, to be insufficient to limit global warming to the abovementioned extents. The USA have withdrawn from the Treaty. The Amazon forest is burning. Even in Europe, several countries, including EU’s biggest emitters France and Germany, are about to fail to meet their 2020 targets.

Because of the delayed effect of past and present emissions, global warming is anyway expected to continue for at least the next 2 or 3 decades. As shown by the IPCC (International Panel on Climate Change), because of the inertia of climate systems, the mitigation measures that are today being taken will only start to produce visible effects in the second part of the century (beyond 2050)⁴.

In this context, the adoption of coherent adaptation policies is crucial. These policies and strategies will however have to be adapted to each particular situation. Vulnerability is region-specific and derived from particular physical, social and economic features. Each Member State will experience different effects and impacts of climate change (I). On the demand side, and despite some spill-over

¹ The 5 selected themes are: adaptation and the world of work, sectors and regions at risk, working conditions and health and safety, emergency services, role of public authorities.

² <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

³ According to the European Environmental Agency (EEA), the total reported economic losses caused by weather and other climate-related extremes in Europe amounted to over EUR 436 billion for the period 1980-2016. For more information see: EEA Report No 15/2017, “Climate change adaptation and disaster risk reduction in Europe” (2017), updated in 2018.

⁴ <https://www.ipcc.ch/sr15/>

effects expected for the whole EU economy, some economic sectors appear to be more exposed than others because of their dependence on regular climate conditions.

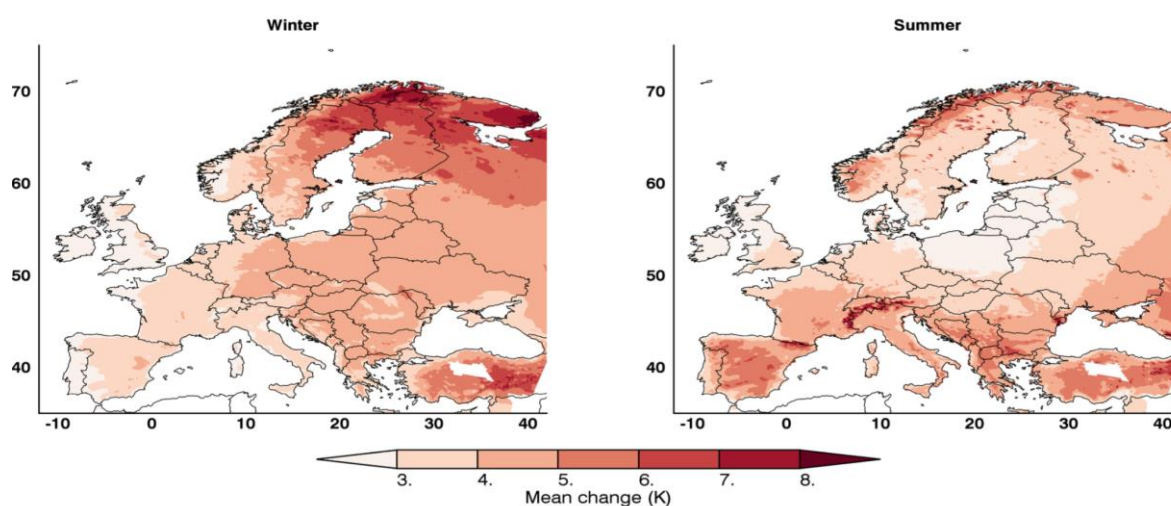
I. Climate change impacts in Europe: everything but not a uniform situation

Currently, the average temperature for the European land area for the last decade (2002- 2011) is already 1.3°C above the preindustrial average, which makes the increase over Europe faster than the global average. In the forthcoming years, climate change should lead to additional increases in average temperatures, changes in precipitations levels as well as to a high increase in the number of extreme weather events. Even no European country is protected against the consequences of climate changes, evidence from literature show a clear North-South divide. Coastal (coastal flooding, loss of habitat), mountain areas (forest fires, snow and glacier melting) and cities (flooding, heat stress) are also particularly at risk.

A. Increased temperatures

The latest climate projections for Europe have confirmed that Europe is warming faster than the global average. According to Eurocordex⁵, the continent is expected to experience more than 2°C of warming, even if the Paris agreement targets are met. In the case of high warming scenarios, this increase could reach 4°C. As show in the graph below, the patterns, however, largely differ across the different European countries, showing also important seasonal differences.

Projected change of seasonal mean daily temperature for winter and summer, at the end of the century (2071-2100) compared to the present climate (1981-2010) under a high warming scenario (Source: JRC)



According to these data, Northern and Central Europe should experience milder winters than in the past but limited average temperature rises in summer. On the contrary, warmer summers are expected for the Mediterranean area. These trends are exacerbated under higher warming scenarios. For instance, due to the moderating effects of marine climate on the one hand and polar amplification on the other hand, winter temperature is projected to increase, on average, between 2.7°C over the

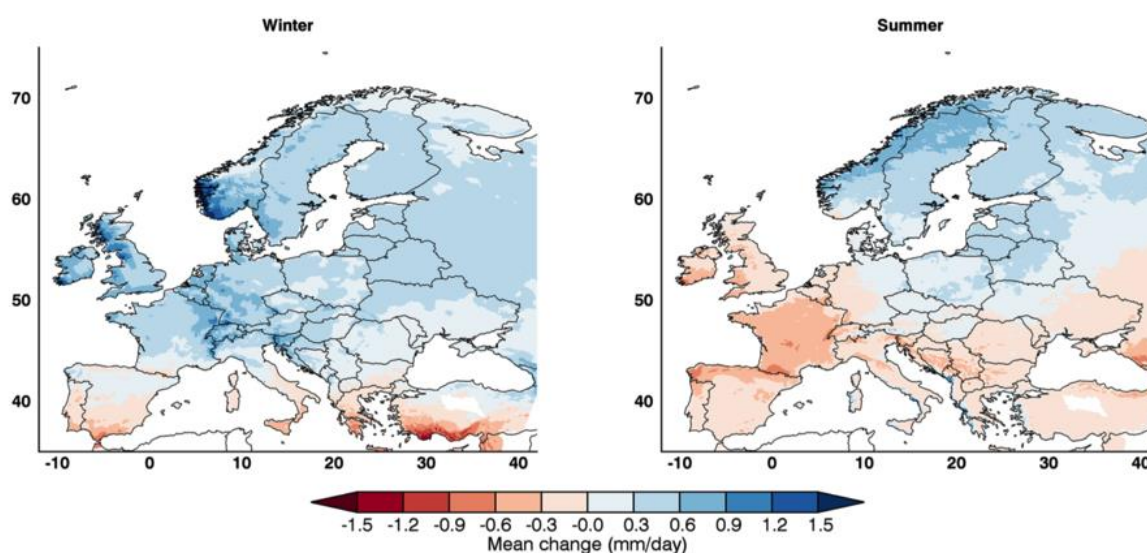
⁵ <https://euro-cordex.net/>

British Isles and 5.4°C over Scandinavia. In summer, the projected change ranges between 3.0°C over Britain and 4.7°C over the Alps and the Mediterranean regions.

B. Changes in precipitation levels

Projected changes of winter and summer daily precipitation, which are shown in Figure 2, present somehow a similar trend. Winter precipitation is projected to increase over most of Central and Northern Europe. In summer, a general reduction in precipitation is projected for all regions except Scandinavia and Eastern Europe. The southern regions of several Mediterranean countries see declines in precipitation in both seasons.

Projected change of seasonal daily precipitation for winter and summer, at the end of the century (2071-2100) compared to the present climate (1981-2010) under a high warming scenario (Source: JRC)



C. Extreme weather events

Another consequence of global warming is that extreme climatic events, such as heat and cold waves, river and coastal floods, droughts, wildfires and windstorms are likely to become much more frequent. A recently completed study⁶ show that the overall Expected Annual Damage (EAD) caused natural hazards is projected to rise progressively and amount to approximately €9.3 billion, €19.6 billion and €37.0 billion per year by the 2020s, 2050s, and 2080s, respectively, only as a result of the effects of climate change. For comparison, current damages are estimated at €3.4 billion per year for the EU.

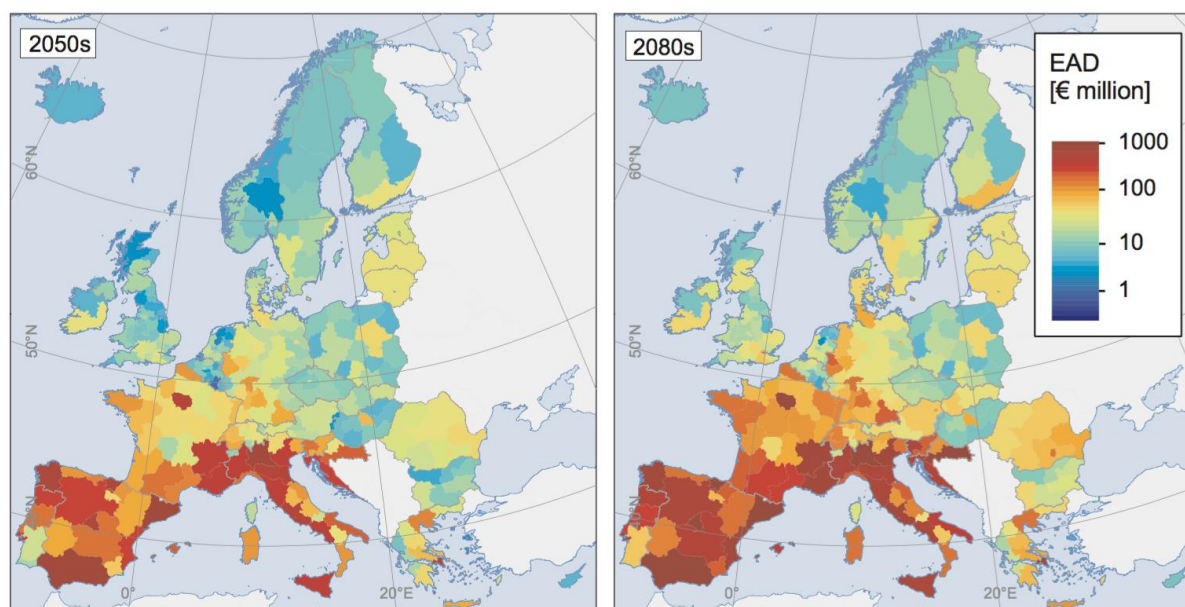
This increased frequency of natural hazards will affect all regions. This means, for example, that the number of heat waves will increase even in regions where summer temperatures are not forecasted to increase the most, such as Northern Europe or Scandinavia. Similarly, heavy rain episodes are also predicted to occur in regions where precipitation levels are expected to decrease (Southern Europe), increasing therefore the already felt negative effects of climate change. This situation does not change the fact that certain regions are going to stay more affected by certain concrete types of natural

⁶ Forzieri et coll. (2018), «Escalating impacts of climate extremes on critical infrastructures in Europe», *Global Environmental Change*, vol. 48, pp 97–107, available at: <https://www.sciencedirect.com/science/article/pii/S0959378017304077>

wizards than others. Drought will primarily occur in Southern countries. Similarly, River and coastal floods will remain the most critical hazard in many floodplains and coastal stretches of western, central, and eastern Europe, including the British Isles, Poland, the Czech Republic, Bulgaria, Romania, and northern coastlines of the Iberian Peninsula.

At present, the most damaging climate hazards in Europe are mostly river floods (44%) and windstorms (27%). The situation is however expected to change in the forthcoming years, with the proportions of drought and heatwaves rising strongly, to account for nearly 90% of climate hazard damage by the end of century. Based on this, we can assume that, once again, the southern regions of Europe will bear the most important costs of the consequences of climate change. The map below, which is part of the aforementioned report, shows the expected spatial distribution of costs related to climate damages to critical infrastructure in Europe.

Expected annual damages of overall natural hazards linked to climate change on critical infrastructure in Europe
(Source: Forzieri et al.)



II. Sectors at risk

Although the whole European economy is concerned, some economic sectors are considered to be particularly at risk. This is especially the case of sectors which are heavily dependent on natural resources (but not only). Difficulties (or positive development) in these sectors will have spill-over effects over the whole economy.

1. Agriculture

Agricultural land accounts for 40 % of total EU land. Agriculture and food-related industries and services provide over 44 million jobs in the EU, and 22 million people are directly employed in the sector itself. Because of a favorable climate, technical skills in the sector and the quality of its products, the EU is one of the world's leading producers and exporters of agricultural products.

The sector is highly sensitive to climate⁷, both in terms of longer-term trends in the average conditions of rainfall and temperature, which determine the productivity and spatial distribution of crops, but also in terms of year-to-year variability and the occurrence of droughts, floods, heat waves, frosts and other extreme events. Climate change is already having an impact on agriculture. It has been recognized as one of the factors contributing to recent stagnation in wheat yields in parts of Europe. The variability of crop yields has also greatly increased over the last decades mainly as a consequence of extreme climatic events, such as recent heat waves and drought. This trend should continue and increase in the future, leading to high prices volatility.

Regarding the spatial distribution of climate impacts, studies indicate strong regional divergences⁸. In northern areas climate change may produce positive effects on agriculture through the introduction of new crop varieties, higher yields and expansion of suitable areas for crop cultivation. Increased crop productivity, especially for cereals, is due to the expected increase in the duration of the thermal growing season, decreasing cold spells and extended periods without frost. Negative impacts are also projected in northern areas such as increased pests and diseases, nutrient leaching, and reduced soil organic matter. In southern areas the disadvantages are likely to be predominant. The overall expected reduction in precipitation might lead to water scarcity. Combined with extreme heat events, this may negatively affect crop productivity, lead to higher yield variability and, in the long term, drive a change in the range of current cropping possibilities.

Finally, Drier conditions and rising temperatures are expected to affect livestock activities in different ways, including implications for animal health and welfare and impacts on grassland productivity. The projected increase in rainfall in northern Europe may for instance pose challenges for grazing livestock and harvesting grass, owing to the accessibility of land and the declining soil fertility through soil compaction.

2. Forestry and fisheries

Forests and the way they are managed are particularly sensitive to climate change because the long lifespan of trees does not allow for a rapid adaptation to environmental changes. Forestry can be impacted in different ways.

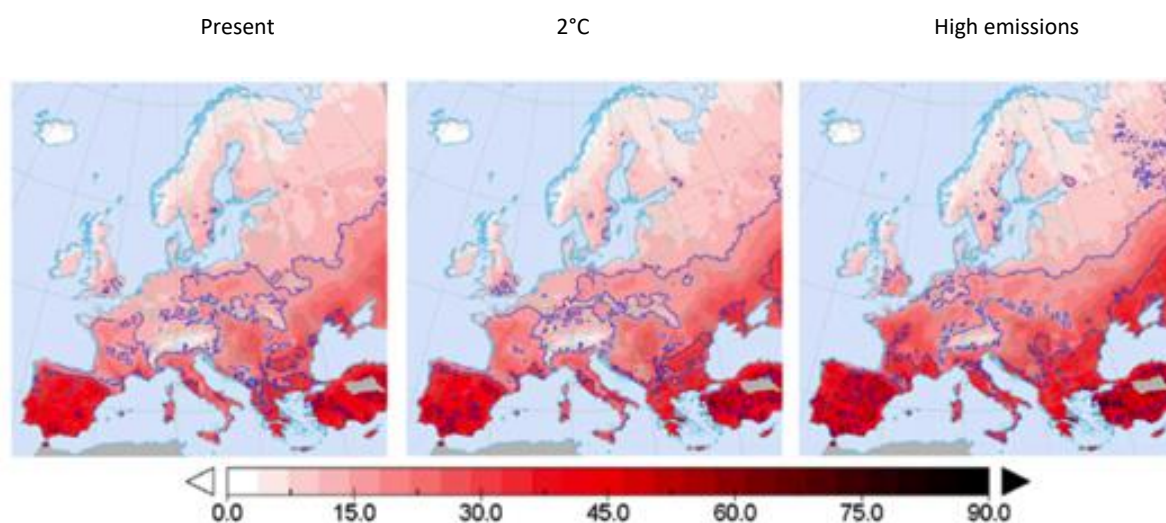
- The main impact of climate change over European forests is of course linked to forest fires. Studies on this issue project an increase in frequency and extent, especially in Southern Europe. Fires currently affect more than half a million hectares of forest each year, with estimated economic damages of €1.5 billion annually. According to the JRC PESETA III report⁹, areas burned in Europe could increase by 200% by the 2080s due to climate change. Spain, Portugal, Greece, Italy and Mediterranean France are particularly at risk.

⁷ EEA (2019), Climate change adaptation in the agriculture sector in Europe, available at: <https://www.eea.europa.eu/publications/cc-adaptation-agriculture>

⁸ European Commission Joint Research Center (2018), Climate impacts in Europe, Final report of the JRC PESETA III project, available at: <https://ec.europa.eu/jrc/en/news/climate-change-human-and-economic-outlook-europeans>

⁹ ibid

Forest fire danger estimated by the Fire Weather Index in the present, and under two climate change scenarios
(Source: JRC)



- Changes in the patterns of disturbance by forest pests (insects, pathogens and other pests) are expected under a changing climate as a result of warmer temperatures, changes in precipitation, increased drought frequency and higher carbon dioxide concentrations.
- Forest growth is projected to decrease in southern countries and to increase in northern Europe. Forests' biodiversity is also expected to change across Europe, with changing tree species and increasing threats for specialized plant communities. Biomass productivity is expected to increase in Central and Northern Europe.

In the fisheries sector, global warming can lead to a displacement of fish stocks, regional declines in some species or, on the contrary, to an increase of populations which can create environmental stress (reduced oxygen concentration and ocean acidification, etc.).

3. Tourism

Many tourism activities are directly related to the climate and will likely be impacted by climate disruption. Here are some examples:

- Due to higher temperatures, the suitability of southern Europe for tourism is projected to decline during the key summer months but improve in other seasons. Countries from this region will be more and more in competition with regions with a milder climate, such as Central Europe and Scandinavia. Heat waves and high temperatures can also have a negative impact on urban tourist centers, so as extreme weather events on sunny destinations.
- Sea level rise and erosion threaten tourism infrastructures, some resorts possibly having to be relocated. Furthermore, water scarcity could become an issue in some tourist destinations, so much so that their economic viability could be threatened. In general, climate change is very likely to exacerbate conflicts with other users over resources, principally water and land.
- Nautical tourism on the seaside, lakes and rivers could be impacted by surface water scarcity and health problems related to rising temperatures (such as the development of cyanobacteria making the waters unfit for swimming).

- The change in snow conditions will affect winter tourism. Not only will the snow cover be thinner in the future, but also the ski season will be shortened. There could be a redistribution effect from little resorts at medium altitude to higher resorts, like glacier resorts. The adverse effect on employment of such redistribution of the tourism demand could be worsened by the fact that ski resorts are principally located in rural areas where alternative employment is scarce, most especially in winter.
- On the contrary, public awareness about climate change may trigger a higher demand for eco-tourism, with its corresponding positive effect in terms of employment in the branch¹⁰.

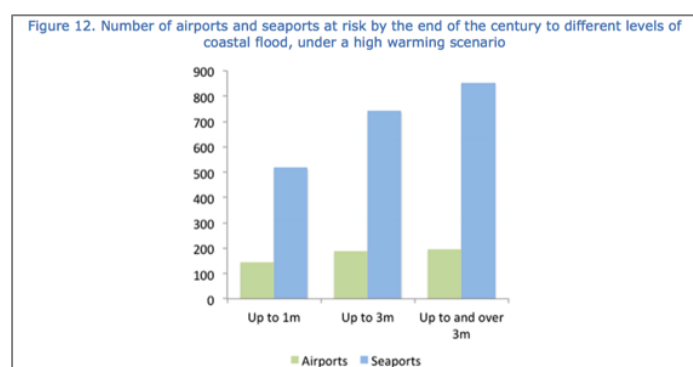
4. Transport

The risks of climate change for the transport sector primarily arise from extreme events, such as flooding, heat waves, droughts and storms, especially where these exceed the design range. Some beneficial effects can also occur, through for example reduced snow falls for most European regions improving traffic conditions.

Extreme weather events can cause accidents but also damages to infrastructure, especially in the case of road and freight transport, what in turn can beget important economic losses. Wider indirect impacts are also expected, through travel time extension or disruptions affecting the supply of goods and services, which can be significant for major events. In 2014, the PESETA II study considered impacts on the road and rail network in Europe, estimating the total damages to transport infrastructure due to extreme precipitation at €930 million/year by the end of century under a high warming scenario (around a 50% increase from the current baseline damage of €629 million/year) and €770 million/year under a 2°C scenario.

Droughts can severely disrupt inland navigation services by reducing water levels to the point where navigation is impossible, or to a point where water vessels have to carry a reduced load. The situation will however vary from region to region. Thanks to forecasted higher precipitation levels, fewer low flow events are for example expected on the Rhine and the Danube, allowing the inland waterways network to function with less disruptions.

Airports and seaports may also be vulnerable. The JRC PESETA III report has for instance estimated that, by the end of the century, under a high warming scenario, about 200 airports (especially in the North Sea region) and 850 seaports of different size across the EU could face the risk of inundation due to higher sea levels and extreme weather events¹¹.



¹⁰ Syndex (2007), Climate Change and employment - Impact on employment in the European Union-25 of climate change and CO2 emission reduction measures by 2030, available at : http://www.unizar.es/gobierno/consejo_social/documents/070201ClimateChange-Employment.pdf

¹¹ European Commission Joint Research Center (2018), loc. Cit.

5. Infrastructure and construction

The impacts of climate change are particularly pertinent to infrastructure and buildings given their long-life span and their high initial cost, as well as their essential role in the functioning of our societies and economies. Buildings and infrastructure can be vulnerable to climate change because of their design (low resistance to storms) or location (e.g. in flood-prone areas, landslides, avalanches). They can be damaged or rendered unfit for use by any changing climatic condition or extreme weather event: rising of sea level, extreme precipitation and floods, occurrences of extreme low or high temperatures, heavy snowfalls, strong winds.

Flooding is (after earthquakes) one of the costliest kinds of disasters and this is mainly due to floods in built-up areas. Many European cities have been built along a river; and these rivers will respond to extreme rainfall or snowmelt events with extreme discharges, threatening the cities with floods, what can have dramatic consequences for people but also from an economic point of view (impacts on the local economic tissue, industry, retail, SMEs, etc.). There is also a growing problem with overheating of the built environment being exposed to rising temperatures and extreme heat, which is not only an issue for the construction material but also affects the occupant's comfort and health. In coastal areas, coastal protection (e.g. sea walls, barriers) may require increasing maintenance costs and higher frequency of readjustments. Last but not least, cultural and nature-based heritage sites are increasingly threatened by climate change¹².

The construction sector is one the sectors that could benefit the most from the adoption of adaptation policies. Urban-planning, investment in resilient infrastructure and housing will play a crucial role regarding disaster prevention.

6. Public services

Public services will also be impacted. As underlined by a recent EPSU study¹³, central and local government, social services, education, healthcare, public transport, disaster management, and emergency services (e.g. firefighters) will be put under pressure¹⁴. The case of emergency services is of particular importance. Climate change is expected to have severe impacts over human health and mortality. As heat waves are projected to increase in terms of both frequency and duration, mortality due to heat stress will increase accordingly. Extreme weather-related events, such as floods and storms, are also expected to become more frequent, representing an additional threat to life and health. Beside the physical impacts, the psychological consequences of such devastating events are not to be underestimated. The situation is serious as, at the same time, emergency services (especially the medical sector but not only) are facing personnel shortages in most of EU countries following the recent crisis-related budget cuts.

¹² European Commission (2013), Commission staff working document - Impact Assessment - Part 2 -Accompanying the document « An EU Strategy on adaptation to climate change», SWD (2013) 132 final, 16 April 2013

¹³ <https://www.epsu.org/article/epsu-feature-adaptation-climate-change>

¹⁴ Galgoczi B. (2017), Public services and adaptation to climate change, EPSU, available at: <https://www.epsu.org/article/epsu-feature-adaptation-climate-change>

7. Utilities

Major utilities, such as energy (e.g. increased electricity demand for air-conditioning) and water providers (e.g. water scarcity), will also be affected.

Regarding energy, CC is expected to reduce demand for heating in northern and north-western Europe and to strongly increase energy demand for cooling in southern Europe, which may further exacerbate peaks in electricity supply in the summer.

- Further increases in temperature and droughts may limit the availability of cooling water for power generation in summer but also for other activities which are heavily water dependent (agriculture for example).
- Nuclear power plants for example need large quantities of water to cool and cooling them causes the rivers to warm up. They are therefore likely to exert additional pressure on rivers whose flow is decreasing.
- Hydroelectric production is also very sensitive to drought. French hydropower production may be one-third lower during a dry year than in a wet year.

Water scarcity is an issue not only for the energy sector. A fierce competition for scarce water resources is forecasted between households, industry, power producers, agriculture, and nature. Water management will play a key role. The recently completed ClimWatAdapt project¹⁵ investigated the future water situation and developments in the water sector in Europe until 2050. The project concludes that changes in future water scarcity are mainly driven by changes in water withdrawals and that the percentage of area under severe water stress is expected to increase in all regions until 2050, with major changes in particular in eastern, western, and southern Europe. Increasing water withdrawals are the main cause in eastern and western Europe. In southern Europe a decrease in water availability due to climate change exacerbate the situation.

8. Banking and insurance

The probability of most types of extreme event is expected to change significantly, what can in turn affect the banking and insurance sectors¹⁶. New financial products, such as green loans, should continue to develop. Insurers could benefit from opportunities due to climate change, by being able to offer new risk management products, and could actually experience an increase in the demand for insurance itself, with its potentially positive impact on employment in the sector. Insurance premium are expected to increase. Banks and insurance companies are however also vulnerable. Climate change is very likely to increase uncertainty in risk assessment and thus affect the functioning of the insurance market. Furthermore, since banks and insurance companies hold and manage important assets, climate change may highly influence their long-term investments¹⁷. As damage to property may increase, the insurance sector will be affected. In certain cases, some properties may simply become uninsurable against certain types of risks. In addition, new losses will emerge from life and health branches due to injuries and mortalities. Similarly, insurance services linked to transport activities could be affected. In the longer term, particularly in most vulnerable sectors or areas, climate change

¹⁵ <https://www.ecologic.eu/3586>

¹⁶ Institute for Climate Economics (I4CE), La finance n'a pas encore pris la mesure des impacts climatiques, Point climat n°60, available at: https://www.i4ce.org/wp-core/wp-content/uploads/2019/05/I4CE_2018_La-finance-et-les-impacts-climatiques.pdf

¹⁷ https://www.lemonde.fr/economie/article/2018/10/15/pour-les-banques-le-risque-climatique-devient-systemique-et-doit-donc-etre-traite-comme-tel_5369505_3234.html

could indirectly increase social disparities as insurance premiums become unaffordable for a fringe of the population. Finally, it is also possible that insurers may have to withdraw from some activities where the risk is evaluated as being too high with changed climatic conditions.

9. Spill-over effects over the whole EU economy

Last but not least, multiple indirect impacts are also expected. These can for example relate to the manufacturing sector and the industry, due for instance to a lower availability of raw-materials, water-scarcity, price hikes disruption in logistic supply chains or lower labor productivity (e.g. for outdoor workers). Overall, climate change is expected to have impacts over the whole EU economy (lower productivity, higher mortality, impacts on other sectors via downstream intersectoral linkages, etc.). The PESETA III report, commissioned by the Commission and published in 2018, evaluates the total EU overall welfare loss under a high warming scenario at around 1.9% of GDP (€240 bln) per year at the end of the century.

Conclusion

Climate change might have severe consequence and the adoption of efficient adaptation policies is crucial. In 2012, the European Commission (EC) has estimated that the economic, environmental and social costs of not adapting to climate change could range from EUR 100 billion a year in 2020 to EUR 250 billion a year in 2050 for the EU as a whole. Due to climate change alone, annual damage to Europe's critical infrastructure could for example increase ten-fold by the end of the century, under business-as-usual scenarios, from the current EUR 3.4 billion to EUR 34 billion. The average annual cost of flood damage alone across the European Union (EU) could rise from €4.5 billion to €23 billion by 2050¹⁸. From an employment perspective, risks and opportunities are also identified. In 2014, a Triple E report¹⁹ estimated at 240 thousand and 410 thousand job losses by 2020 and 2050 respectively, in case no adaptation measures are taken. The highest job losses should occur in in Bulgaria, Croatia, Cyprus, Estonia, Greece, Latvia, Lithuania and Romania²⁰. Regarding the sectoral dispatching of job losses due to climate change, the report concludes that the highest number of job losses will occur in manufacturing and public utilities, retail and leisure (around 100 000 job losses for both sectors by 2050) and business and public services (up to 90 000 jobs lost). Important impacts are also expected on working conditions, skills' needs as well and health and safety at work.

Adaptation have positive effects over the economy and employment. It contributes to preserving existing jobs through maintaining viability and resilience of existing businesses. Furthermore, many adaptation measures will require substantial investments which can stimulate demand for labor. These investments can also stimulate the demand for new types of goods and services and thus create new market opportunities and increase innovation. The Triple E study has assessed the impacts over

¹⁸ European Commission (2018), Report to the European Parliament and the Council on the implementation of the EU Strategy on adaptation to climate change, COM/2018/738 final, 12 November 2018

¹⁹ Triple E Consulting (2014), Assessing the implications of climate change adaptation on employment in the EU, available at: <https://climate-adapt.eea.europa.eu/metadata/publications/assessing-the-implications-of-climate-change-adaptation-on-employment-in-the-eu-1>

²⁰ This is explained by the fact that these countries have a large agricultural sector as well as, in a majority of them, a well-developed touristic sector. On the contrary, Belgium, Ireland, France and Luxemburg have much lower negative climate change effects and hence a lower number of lost jobs compared to the rest of Europe. Scandinavian countries and Great Britain have positive climate change effects on a number of their economic sectors including agriculture, forestry and tourism.

employment of the implementation of adaptation measures at EU and national level, in both a reference (average annual spending on adaptation measures for EU countries equivalent to 0,5% of GDP) and an ambitious scenario (1% of GDP). According to the study, such implementation could lead to the creation of 500 000 (reference scenario) to 1 mln direct and indirect jobs (ambitious scenario) by 2050. Adaptation measures could also help to preserve from 136 000 to 300 000 on the same period. In both scenarios, it is estimated that most jobs would be created in the business and public services sector and the construction sector.