OXFORD ECONOMICS

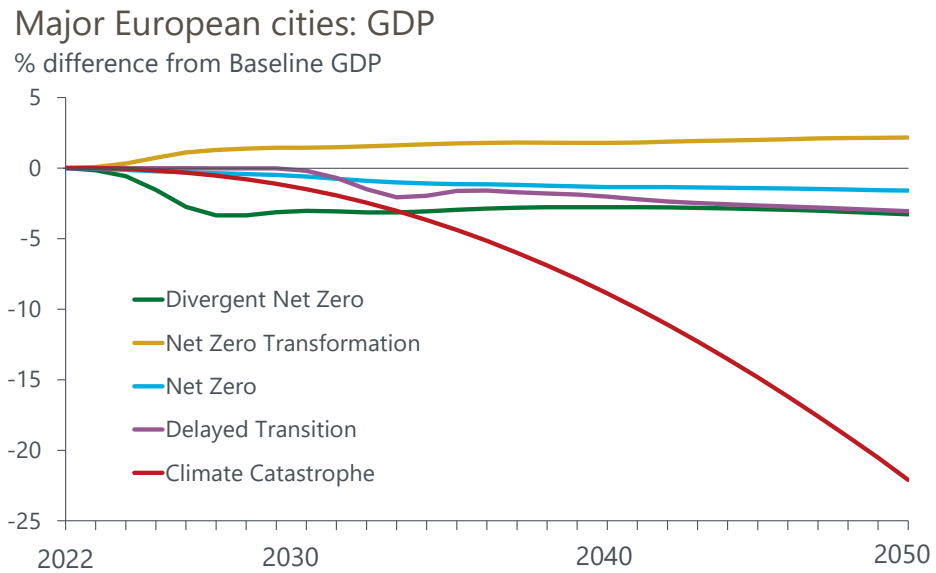
14 April 2023

Research Briefing | Europe

The impact of different climate scenarios on city economies

- **The impact of policies to address climate change cannot be discussed only in national terms. There will be variations by region. Cities overall are likely to retain or increase their growth premia over national economies, but some will suffer. And our modelling of very local geospatial variations in Europe also shows that, in a scenario where no actions are taken to avert climate catastrophe, some of Europe's cities are in danger of extreme economic damage.**
- **As climate moves to the forefront of government policy, we continue to build our research capabilities to help organisations understand how mitigation policies to meet net zero emissions and global warming will impact the economy. Our latest analysis adds a local dimension to our existing national-level climate scenarios which link the economy, the energy system, and the environment.**
- **Cities and regions more reliant on carbon-intensive industrial sectors will face the most significant challenges from climate adjustment measures. This means the burden of transition risks tends to fall more heavily on some of Europe's less affluent regions, particularly those in central and eastern Europe, which maintain a traditional industrial base.**
- **In contrast, most of Europe's major city economies are characterised by high-value ICT and financial and business services, and so are much less reliant on the carbon-intensive sectors. Nevertheless, disparities exist between cities, and each will face a different growth trajectory under each scenario reflecting their unique sectoral composition and inter-regional dependencies.**
- **Furthermore, city economies could be amongst the biggest losers if governments fail to meet pledges to reach net zero. The geographic location of many cities—often near rivers or the sea—leaves them vulnerable to more frequent and extreme climatic events, such as flooding, that may occur in the event of climate inaction. Our approach to measuring regional economic disruption from physical risk captures both natural vulnerability and hyperlocal economic activity from our novel geospatial modelling.**

Chart 1: Regional impacts and outlook under a range of climate scenarios



Source: Oxford Economics

Mark Britton - Director, City Forecasting - mbritton@oxfordeconomics.com

Europe's net zero ambition lacks policy detail, for now

The EU has stated its commitment to reaching net zero emissions by 2050, as has the UK, while Germany and Sweden are aiming for 2045. The EU objective is at the heart of the European Green Deal and in line with the EU's commitment to global climate action under the Paris Agreement.

At this stage, however, the ambitions are not sufficiently backed by policies, such as carbon pricing and investment. Therefore, within our baseline economic assumptions, European emissions decline over the forecast horizon, but fall well short of achieving net zero. That said, some adjustments are clearly taking place, many of which fall more heavily on some sectors than on others. That in turn means that they fall more heavily on some regions and cities than others. And if efforts to achieve net zero intensify, the regional and city-level differences in impact will increase. Until recently, research has tended to overlook that, and focus only on the possible pathway for national economies, ignoring the disparities that exist between regions owing to the diverse range of local specialisms in each regional economy.

To address that gap, and support organisations with their strategic planning, risk assessments, and location decisions, we have developed a set of alternate climate-focused scenarios which quantify the economic costs and opportunities associated with different global pathways towards reaching net zero for around 2,000 cities and regions across Europe.

Quantifying possible pathways towards net zero for European regions

Our research into the regional implications of different global pathways towards achieving net zero uses our Global Economic Model to generate national-level and hence industry-level scenarios, and then feeds these down to the regional and city level. This approach is underpinned by a range of assumptions on emissions pathways, within a set of alternative climate scenarios. This is therefore a hybrid structural model, which connects the economy, the energy system, and the environment.

Chart 2: Global assumptions under four different climate policy scenarios

Net Zero	Net zero carbon emissions are achieved in 2050 through early policy action, technological advances and global coordination. Global warming is limited to around 1.5ºC. The impact on the economy is modest with higher investment helping to offset carbon taxes.
Net Zero Transformation	The transition to net zero eliminates prevailing market failures and inefficiencies. As a result, the global economy moves up to a new equilibrium growth rate with a Keynesian shock that reverses much of the stagnation we have seen over recent years.
Delayed Transition	Climate policies to limit global warming are taken relatively late. Efforts to reach ambitious climate goals therefore require stronger policy action. Difficulties in shifting towards renewables and aggressive carbon taxes create substantial inflationary pressure and require greater energy efficiency.
Divergent Net Zero	Net zero carbon emissions are achieved in 2050. However, failure to coordinate mitigation policy across sectors results in a higher burden on consumers, while decarbonisation of energy supply and harder-to-abate industry is less stringent.

Source: Oxford Economics

Mark Britton - mbritton@oxfordeconomics.com

In order to reach national net zero targets by 2050, governments will need to implement stringent policies to move towards cleaner and more efficient energy consumption. We have modelled various pathways in which the EU moves towards this target—see **Chart 1** for a summary of our results under a range of climate scenarios, and **Chart 2** for a summary of the relationships we are modelling.

The overall impact of our Net Zero scenario is modestly weaker European GDP than expected in our baseline. But even within this scenario some cities and regions are expected to achieve faster growth than in the baseline, whilst others do much worse, highlighting that the transition to net zero has some winners as well as losers. Furthermore, our Net Zero Transformation scenario shows how there can be even more winners on the path to net zero, with long-run GDP boosted by increased productivity achieved through improved resource allocation, reduced environmental damages and greater innovation.

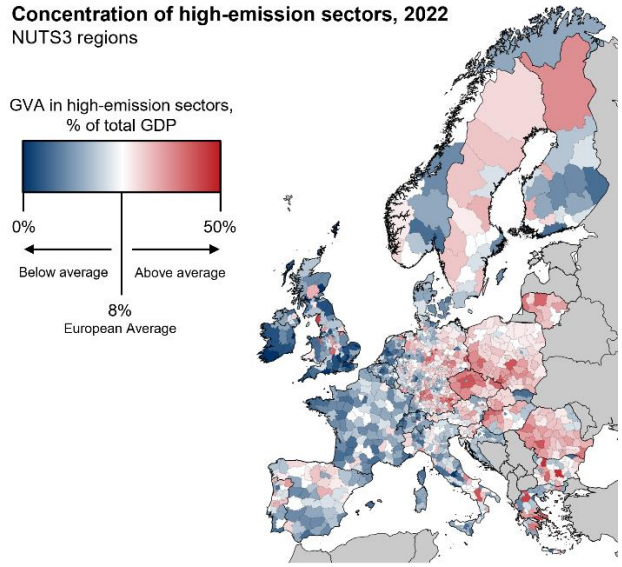
No matter which policy pathway countries follow, there will be vast differences in the impact between regions. This is underpinned by a common feature of our modelling in each scenario: the sectoral impacts primarily reflect the relative carbon intensity of industry-level output. Therefore, the burden falls more heavily on industrial sectors than parts of the service sector economy, and this is key to understanding the likely impacts across cities and regions.

Of course, the production side of the economy is just part of the transition towards net zero and the speed at which consumers adjust will also be also important, through for example switching from gas to electricity for home heating or from petrol and diesel to electric-powered vehicles. Further research will be required to understand any regional variation in the policies aimed at influencing the consumer transition. Nevertheless, we expect regional variations in the consumer transition to have a smaller impact on the relative performance of economies compared to the sectoral transition associated with climate policies.

The burden of transition risk falls heavily on industrial regions

Unsurprisingly, regions in Europe's industrial heartlands with large clusters of the highest-emitting and carbon-intensive sectors—including extraction (coal, oil, gas), utilities, manufacturing (particularly cement and steel) and transport—will face some of the largest challenges (**Chart 3**). For example, Stara Zagora in Bulgaria—an industrial city with a large coal industry—relies on those high-emission sectors for a third of economic activity. As a result, under our net zero scenario, the city's GDP will be 6.3% lower than baseline, whilst the rest of Bulgaria will fall by around 1% below baseline. Similar examples of high reliance on these sectors can be found in regions across most central and eastern Europe (CEE) economies, including the Central Bohemian Region in Czechia, Rybnik in Poland, and Gyor-Moson-Sopron in Hungary. But this is not just a CEE story: industrial powerhouses in western Europe such as the cluster of chemical manufacturing in the German Rhineland face significant challenges to move towards greener energy sources.

Chart 3: Europe's industrial heartlands will face some of the biggest challenges



Source: Oxford Economics

Mark Britton - mbritton@oxfordeconomics.com

Nevertheless, many CEE regions are still likely to lead growth

Despite the challenges posed by the transition towards cleaner and more efficient energy consumption to regions in CEE, we expect many of these regions to lead European GDP growth over the long term under net zero assumptions, just as they do within our baseline. The strong growth reflects a range of factors, such as low wages and highly skilled workers relative to their western European peers.

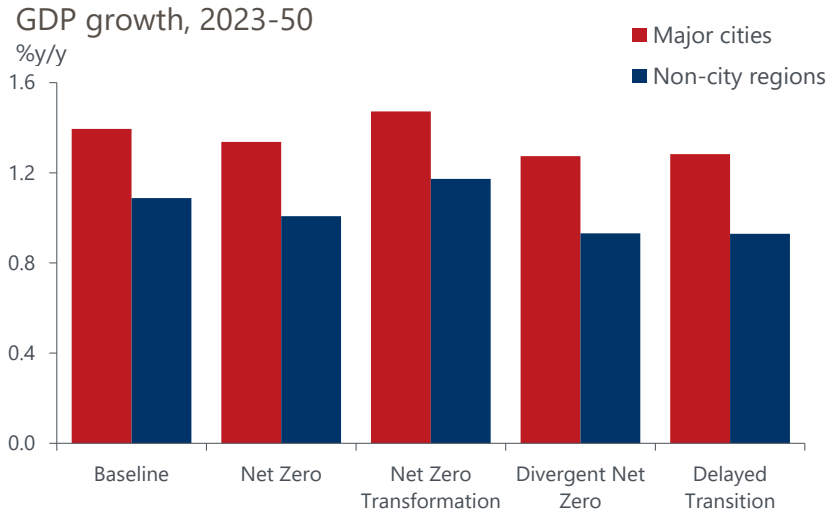
But perhaps more importantly, there are also disparities in growth within CEE countries, and above-average growth tends to be more localised to key cities or regions. In Poland for example, we expect the major cities—including Warsaw, Kraków, and Wrocław—to outperform the rest of the country.

And climate change adjustment will increase the tendency for cities to outperform

Another key feature of our projections is the outperformance of city economies across the whole of Europe, both in the baseline and under the transition towards net zero. This is underpinned by our expectation that European growth will be driven by the digital sector and business services. As cities tend to have higher concentrations of these faster-growing industries, they (on average) fare better in our forecasts. This is amplified in the Net Zero scenario as carbon-intensive sectors have a smaller presence in Europe's major cities than the rest of the economy—which suggests they will typically face a smaller challenge to decarbonise economic output.

The overall impact is that major cities will continue to hold an economic growth premium over non-city regions under each of the modelled pathways to net zero, assuming that there is no government intervention to compensate the most affected regions.

Chart 4: Major cities mostly maintain or increase their growth premia in net zero scenarios



Source: Oxford Economics

But there are exceptions, such as Barcelona, particularly under less favourable scenarios

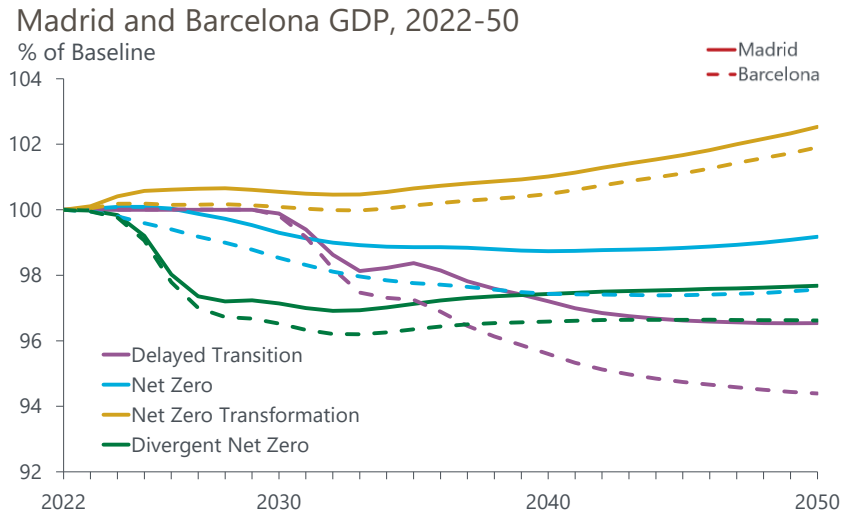
While it is true that major cities will outperform on average, there are of course exceptions, and no two cities are alike. The performance of Spain's two largest cities, Madrid and Barcelona, under alternate climate scenarios illustrate how local sectoral composition can impact growth.

Barcelona is one of the few major European cities for which manufacturing remains a substantial part of the economy, accounting for 18% of total economic activity (in Madrid it contributes just 6%). Barcelona's manufacturing sector includes a range of both low and high carbon-intensive subsectors, including food, textiles, chemicals and automotive. In contrast, Madrid's economic structure is more stereotypical of a

Mark Britton - mbritton@oxfordeconomics.com

European city—it is predominantly services-based, with a large presence of business services, consumer-focused activity and—as the capital of Spain—a sizeable public sector.

Chart 5: Barcelona's economy is more vulnerable than Madrid's to transition risks



Source: Oxford Economics

For any city, the profile clearly reflects the speed at which governments force industries to adjust. Under our Delayed Transition scenario, governments in Europe and elsewhere are slow to ramp up efforts to limit global warming. As a result, when policies are implemented in 2030, they must be more stringent, and therefore result in greater economic damage, particularly for carbon-intensive sectors. As a result, manufacturing is much harder hit than service sectors, and therefore Barcelona's economy is hit much harder than Madrid's—Barcelona's GDP is 5.6% below baseline by 2050, compared with Madrid at 3.5%. In contrast, under our Divergent Net Zero scenario, in which decarbonisation of energy and harder-to-abate industry is less stringent, the difference between Madrid and Barcelona is much less (**Chart 5**).

If net zero is not achieved, many cities look more vulnerable

To illustrate the costs of climate inaction, we have modelled an additional scenario in which governments fail to meet their policy pledges to transition to net zero. This high-emissions pathway causes higher temperatures but also greater temperature volatility, and as a result more frequent extreme heat events that cause physical damages that increase over time. We have sought to model some of the likely impacts of that damage.

Our approach to assessing regional economic disruption from physical risk within our Climate Catastrophe scenario follows a bottom-up process, combining geospatial analysis of the probability and severity of events occurring in a location with hyper-local estimates of economic activity. That enables us to identify very local areas most risk of economic disruption due to climatic events, such as flooding, droughts, storms, temperature anomalies (cold/heatwaves), and more.

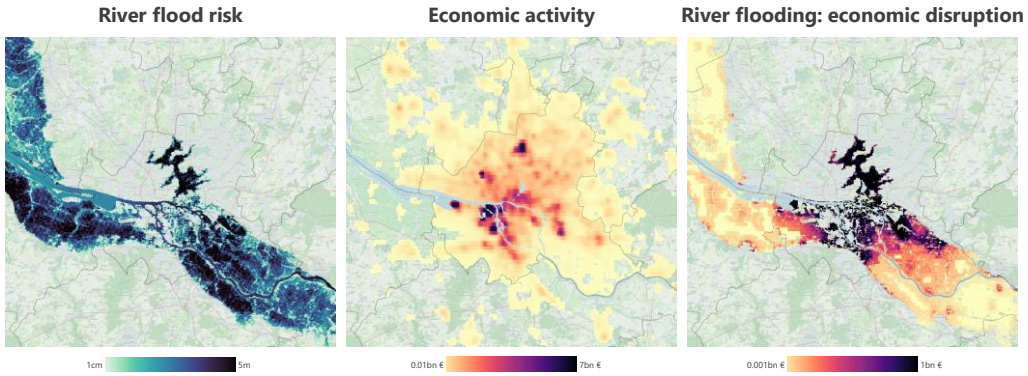
Since our Climate Catastrophe scenario is on the tail end of the distribution of scenarios, it is especially suitable for stress testing and risk assessment. In this scenario, European GDP is around 21% below baseline levels by 2050, and regional variations are very stark—some of the hardest hit regions see GDP fall to around half of baseline levels, due to a combination of sectoral transition risks and their exposure to economic disruption resulting from worsening physical risks.

Whereas in the more moderate adjustment scenarios cities tend to maintain or even improve their growth premia over national economies, in the Climate Catastrophe scenario that may not be the case. Instead, the geographic location of many cities, often near rivers or the sea, suggest that they may be amongst the biggest losers of climate inaction. Some of Europe's major city economies, such as Amsterdam, Rotterdam, and Hamburg are especially vulnerable in this regard, unless their sea defences are, or can be made, hyper-resilient. But in addition to that, our approach ensures that we also account not only for the natural

Mark Britton - mbritton@oxfordeconomics.com

vulnerability (such as proximity to rivers and coastlines), but also the amount of economic activity located in the streets and neighbourhoods most likely to flood. For instance, the low-lying areas north of the Elbe River in Hamburg where the Alster lakes are located are susceptible to riverine flooding, but also contain a significant degree of economic activity. In contrast, some of the exposed areas to the west of the city have lower economic activity. So, the potential economic risk is not as great in those local areas. This granular analysis, illustrated in **Chart 6**, is a key feature of our city and regional climate change analysis.

Chart 6: Calculating potential economic damage from riverine flooding in Hamburg



Source: European Commission/JRC, Oxford Economics

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