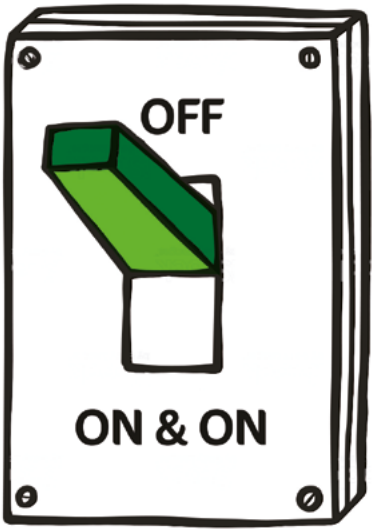
The government could place the UK's long-term economic prosperity at risk if it does not put action on climate change and sustainability at the heart of its growth strategy. That is the central message of a special report for the LSE Growth Commission, summarised by lead authors **James Rydge**, **Ralf Martin** and **Anna Valero**.



Sustainable growth in the UK

Promoting strong, sustainable and inclusive growth is a priority for all governments, reflecting the need to drive improvements in labour and resource productivity through more and better investments in innovation, infrastructure and skills. Our report shows why it is sensible for environmental sustainability to be at the heart of the UK's growth strategy and how this can be achieved.

The pursuit of sustainable growth and the 'low-carbon transition' provides opportunities for investment that are likely to improve productivity across communities and regions. At its essence, our report is about managing change and shifting resources from low-productivity, slow-growing sectors to high-productivity sectors with strong prospects for future growth. It is not about costs and burdens, but investments with attractive returns.

The transition to a low-carbon economy and sustainable growth is highly likely. Action is urgently needed to avoid 'lock-in' to high-carbon investments, institutions and behaviours: the longer we wait, the costlier the transition will be, due to both higher economic costs and climate change. The rapid pace of technological change and lessons from past technological transformations make it clear that achieving a 'net-zero-carbon' economy is entirely consistent with continued strong growth of GDP.

This does not mean that action on climate change will all be 'win-win'. Achieving net-zero-carbon and a full decoupling of scarce environmental resources from output will require some tough decisions and trade-offs involving material consumption. The extent and cost of these trade-offs will depend, in part, on how well the government manages the transition – and our report, detailed below, makes clear recommendations on this front.

But while discussion of these trade-offs continues, the UK should already enact the up-to-90% reductions in levels of greenhouse gases that recent work by New Climate Economy estimates can be achieved at net-zero-cost (or even positive gains) to GDP, relative to achieving a target of limiting global warming to 2°C. The case for early and strong growth-enhancing action is strong.

The UK government recognises the economic opportunities from 'clean growth' and a net-zero-carbon economy, as evidenced by its *Industrial Strategy* and its *Clean Growth Strategy*. But it is essential that these are integrated into one coherent strategy that considers sustainable growth everywhere.

Policies need to go beyond a static focus on a single, narrowly-defined low-carbon sector that contributes around 1% of GDP today, while the other 99% of the economy gets on with the real business of growth.

Future growth is about sustainable growth and a net-zero-carbon economy that is resilient to the changes that are likely to characterise the twenty-first century. It will involve all economic sectors and regions, and it has the potential to empower local communities, foster entrepreneurship and improve living standards across society.

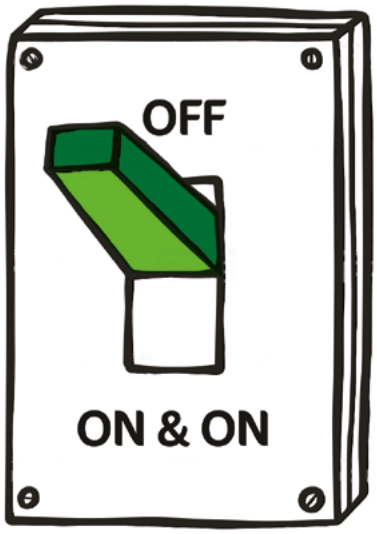
The challenge for policy-makers is to design effective institutional and policy frameworks, with coherent incentives that drive improvements in labour and resource productivity and sustainable growth across the economy, while also limiting the risks of disruption and dislocation from the low-carbon transition.

These institutions and policies should encourage investment across a diverse set of complementary assets; for example, investment in educational or research institutions located next to transport hubs (think of science hubs by Cambridge rail station or the Crick Institute near St Pancras International). They should also promote economic flexibility and the capacity to diffuse and absorb knowledge and innovation.

Four policy priority areas

Our report examines institutional and policy priorities in four key mutually supportive areas: innovation, infrastructure, skills and cities – all areas that are home to the UK's key assets, are recognised as crucial drivers of productivity growth, and are also likely to be determinants of the country's success at managing the low-carbon transition.

Moreover, these are areas where many of the UK's strengths apply and can be leveraged – including the development of cutting-edge technologies and financial services – but where the UK can also do better than it has in the past.



The UK government's Industrial Strategy and Clean Growth Strategy should be combined to create coherent policies on innovation, infrastructure, skills and cities

Innovation

Innovation is fundamental for productivity and growth, and for getting the most out of the resources we have. But innovation is generally underprovided by the private sector because of 'knowledge spillovers', which discourage firms from investing in research and development (R&D): innovations by one will potentially 'spill over' and provide valuable information that leads to new inventions in others.

This market failure justifies government intervention to increase the rate of innovation, via direct investment and incentives for private sector investment. What's more, government can influence the direction of new innovations, such that they are consistent with sustainable growth.

As a share of GDP, UK R&D spending – both public and private – is consistently lower than that of its peers. R&D on energy technologies is particularly low by historical standards, at under 0.02% of GDP today, compared with around 0.1% in the early 1990s.

Evidence suggests that spillovers generated by low-carbon innovation may be significantly higher than for high-carbon technologies, increasing the potential for low-carbon R&D to raise productivity and growth relative to a high-carbon scenario.

For example, there is evidence that spillovers from low-carbon innovation in the energy production and transport sectors are over 40% greater than from conventional technologies. Innovation spillovers are therefore a useful metric for assessing where government R&D support should be targeted, and could be more effective and forward-looking than metrics based on comparative advantage alone.

Our analysis of innovation, based on patent data, seeks to assess which sectors have a comparative advantage in the UK and which are prone to productivity-boosting domestic technology spillovers. It finds that some sectors – such as marine energy – fulfil both criteria and yet are subject to diminishing support by the UK government. Others, such as support for clean vehicles, must be carefully considered as they are unlikely to have as many benefits for UK productivity.

Beyond innovation, promoting the diffusion and uptake of low-carbon technologies requires carefully designed policies to tackle the market failures that hold them back, including unpriced greenhouse gases, finance constraints and incomplete information. A priority area for reform is carbon pricing. As the UK redefines its relationship with Europe and the rest of the world, it would be sensible to revisit carbon pricing and adopt a broader and more effective domestic policy.

Innovations are also increasing the potential for 'circular economy' business models that radically improve resource productivity. Extensive expansion of circular economy activities in the UK could create around half a million jobs, reduce unemployment by over 100,000 and potentially offset close to 20% of the expected loss in skilled employment over the next decade from globalisation and industrial change.

Policy recommendations

- Bring together existing growth and green innovation strategies – in particular the innovation priorities in the *Industrial Strategy* and the *Clean Growth Strategy* – to ensure low-carbon and resource-efficient innovation is embedded throughout the economy.
- Develop UK research priorities based on a range of metrics, including positive technology spillovers, rather than comparative advantage alone. This approach suggests high productivity benefits from R&D support for areas such as efficient aviation and marine technologies.
- Create a clear and credible carbon price across the economy, both to replace today's less efficient and long-established patchwork approach to reducing emissions, and to increase the coherence of incentives to help shift expectations towards low-carbon innovation.
- Work together with 'hard-to-decarbonise' sectors to create roadmaps for achieving a circular economy by 2050, which includes measures such as lower taxes on reused materials, and which are designed to deliver substantial increases in resource productivity.

Infrastructure

Infrastructure creates networks that spur creativity, innovation and productivity across key economic assets and systems, thereby linking cities and regions. It is an essential input for sustainable and inclusive growth. For example, evidence suggests that a 10% increase in the broadband penetration rate in OECD countries from 1996 to 2007 resulted in a 0.9-1.5% increase in annual per capita growth.

Infrastructure is long-lived and locks in emissions and resilience patterns for decades. Like innovation, infrastructure is likely to be underprovided by the private sector, making government support essential. Market failures around finance and coordination, in particular due to the long-term, large-scale and high-risk nature of infrastructure projects, make infrastructure projects less feasible for private industry to undertake.

The UK's infrastructure is not fit for the twenty-first century due to years of underinvestment. Public investment in infrastructure as a share of GDP is lower than in Canada, France, Switzerland and the United States, and has been since the late 1970s. What's more, the perceived quality of UK infrastructure assets is below that of other G7 countries. This is constraining aggregate growth and regional development.

Government action to strengthen the relevant institutions and policies would 'crowd in' investment in sustainable infrastructure. Investing in the right institutions is key; investing in the wrong institutions or underinvesting in the right ones can leave institutional assets stranded. Scaling private finance for sustainable infrastructure investments is also needed and is likely to require systemic transformation of the finance sector.

The work of bodies like the Green Finance Initiative is crucial here. Now is the time to invest. With positive social returns on these investments and historically low real interest rates, there is strong evidence that such investments will pay for themselves in the long run.

While sustainable infrastructure may require higher upfront capital – these investments will not be costless and not all will pay off quickly – in most cases the social payback period will be fast and the dynamic benefits to the economy significant. By contrast, the risks associated with delaying such investment, including lock-in to high-carbon assets and institutions, are high.

Policy recommendations

■ Bring together the *Industrial Strategy* and the *Clean Growth Strategy* to create one coherent strategy for sustainable infrastructure investment across the economy.

■ Develop and publish a pipeline of clean and sustainable infrastructure investments. This would contribute to meeting the UK's 2050 decarbonisation targets, avoid locking into capital assets that could render the UK uncompetitive or require scrapping/retrofitting, and be consistent with the recommendations of the National Infrastructure Commission and other relevant statutory bodies.

■ Establish a National Infrastructure Bank, with an explicit sustainability mandate, which can both signal the scale and type of sustainable finance needed from the private sector and use a range of financial instruments to 'crowd in' private finance.

■ Develop a governance structure for infrastructure that empowers local authorities, enabling coordination of infrastructure investments across regions and cities, in particular across housing and related infrastructure investments. Prioritise regions where productivity would be most responsive to higher capital intensity, and where network and agglomeration effects can be exploited to support low-carbon innovation hubs.

Skills

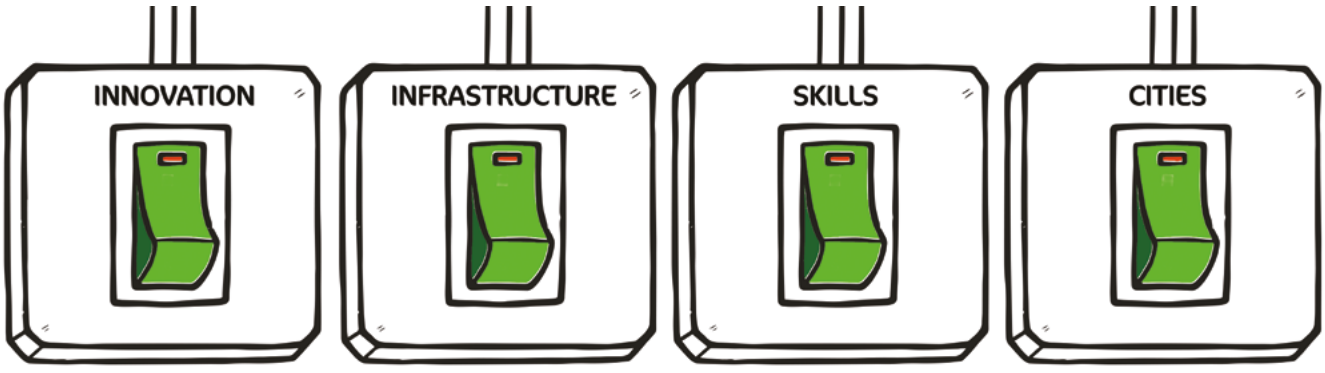
Workforce skills and 'human capital' more broadly are key drivers of labour productivity and crucial for improving economic opportunities and social mobility. As the low-carbon transition intertwines with emerging technologies such as artificial intelligence, the nature of work and skills needed could change radically and rapidly.

If the transition is managed badly, there is potential for disruption and hardship for workers, and constraints on growth. Poor policy decisions will mean locking individuals and communities into outdated skills and human capital, which can be left stranded or devalued as the world moves on.

A key role for government is to create a strong institutional framework and sound policies for flexible labour markets and a 'just transition' for workers. This will be necessary during a process of creative destruction in which the demand for some occupations or skills might disappear and demand for new low-carbon jobs will emerge.

Universities, colleges, schools and employers have key roles to play in equipping workers to deal with and embrace inevitable change throughout their lives. Equipping people with the right skills and resilience to changing labour markets can limit the harm to people's lives and

Developing smart cities across the UK is crucial for improving the performance of the regions



livelihoods from potential and actual job displacement.

Investors and financial markets, as stewards of assets and allocators of capital, can also make a valuable contribution to achieving a just transition. This can help to maximise productivity gains from the low-carbon transition.

Policy recommendations

■ Bring together the *Industrial Strategy* and the *Clean Growth Strategy* to create a single forward-looking and coherent plan for strengthening the UK's human capital for the low-carbon transition. This would coordinate investments across all levels of government and institutions, including across all stages of education, with the aim of maximising adaptability to technological change, fostering entrepreneurship and increasing the ability of workers to re-skill or up-skill through lifelong learning. There should be a particular focus on improving outcomes and opportunities for disadvantaged students.

■ Devise targeted employment transition policies in areas at high risk of disruption from the forces of change, such as Northeast England and South Wales, to improve the resilience of local communities.

■ Ensure education institutions are responsive and flexible as the low-carbon transition accelerates and the demand for skills shifts, by working closely with other economic, environmental, technological and social institutions. This will require better data for assessing employment changes and shifting demand for skills.

■ Help firms to overcome barriers to in-house training through tax credits and partnerships with education providers.

There is no trade-off between sustainability and growth at the urban level: polluted, congested, unattractive cities fail to attract labour and capital

Cities

Cities are central to the UK's economic and social success. Around 55% of UK residents, around 35 million people, live in cities and the four largest – London, Birmingham, Manchester and Glasgow – are home to almost a quarter of the total population.

Cities are areas where physical and human capital combine to spur creativity and innovation, which is particularly important in the UK's service-driven 'knowledge economy'. As hubs of productivity and economic growth, the government has rightly positioned them at the centre of UK growth strategy.

UK cities face considerable sustainability challenges, including congestion, air pollution, urban sprawl and the impact of climate change such as flooding. The nature of these challenges implies a crucial role for local and national government in tackling them. Well-planned and governed cities that are compact, efficient, interconnected and make appropriate use of technology – so-called 'smart cities' – can maximise agglomeration economies, benefitting the flow of people, ideas, creativity and low-carbon innovation.

Developing smart cities is crucial for improving the performance of the regions. Progress on development in the North, for example, can be accelerated through further devolution of political and fiscal powers. This would enable local residents to have a greater say in investment plans for the smart cities where they will live. There is no trade-off between sustainability and growth at the urban level: polluted, congested, unattractive cities create alienation and fail to attract skilled labour and capital.

Policy recommendations

■ Commit to investment in smart cities across all UK regions. This commitment could be supported by a national smart city strategy, which sits at the heart of government and is overseen by a high-level cross-ministerial committee. This should be coordinated and aligned with local industrial strategies, local city development and decarbonisation plans, and aligned with national emissions reduction commitments.

■ Foster deeper partnerships between universities, business and local policy-makers, to help build on local strengths or address local weaknesses.

■ Devolve greater policy and fiscal autonomy to cities and regions, while concurrently building their fiscal capabilities, building on the Cities and Local Government Devolution Act 2016 and other recent moves to empower cities. This will enable local communities to have a greater say in future investment plans for the smart cities where they will live.

■ Encourage creativity and experimentation around policies for productivity and sustainable growth and improve evidence, evaluation and data collection to gain a better understanding of what works.

There are no guarantees that investing in a coordinated set of policies to manage a low-carbon future will boost the UK's productivity performance. But the evidence suggests that a more sustainable and inclusive growth path will bring great opportunities.

What's more, the alternative of investing in high-carbon, resource-intensive infrastructure, behaviours and institutions will be an economically and socially risky proposition, potentially to the detriment of the economy and UK citizens. The risks of inaction go well beyond climate change, and could see the country left behind in a rapidly changing world.

We conclude that although there are uncertainties with every option, a rigorous risk management strategy should acknowledge the likelihood that the future will be resource-efficient and low-carbon. The UK should capitalise on its strengths in the development of cutting-edge technologies and financial services, and grasp the opportunities from sustainable growth.

This article summarises 'Sustainable Growth in the UK: Seizing Opportunities from Technological Change and the Transition to a Low-carbon Economy', a special report for the LSE Growth Commission published jointly by CEP, the ESRC Centre for Climate Change Economics and Policy and the Grantham Research Institute on Climate Change and the Environment at LSE (http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2018/12/Sustainable-Growth-in-the-UK_Full-Report_78pp.pdf).

The lead authors are **James Rydge**, who is at the Grantham Research Institute; **Ralf Martin** of Imperial College Business School, who is director of CEP's growth programme; and **Anna Valero**, ESRC Innovation Fellow at CEP.