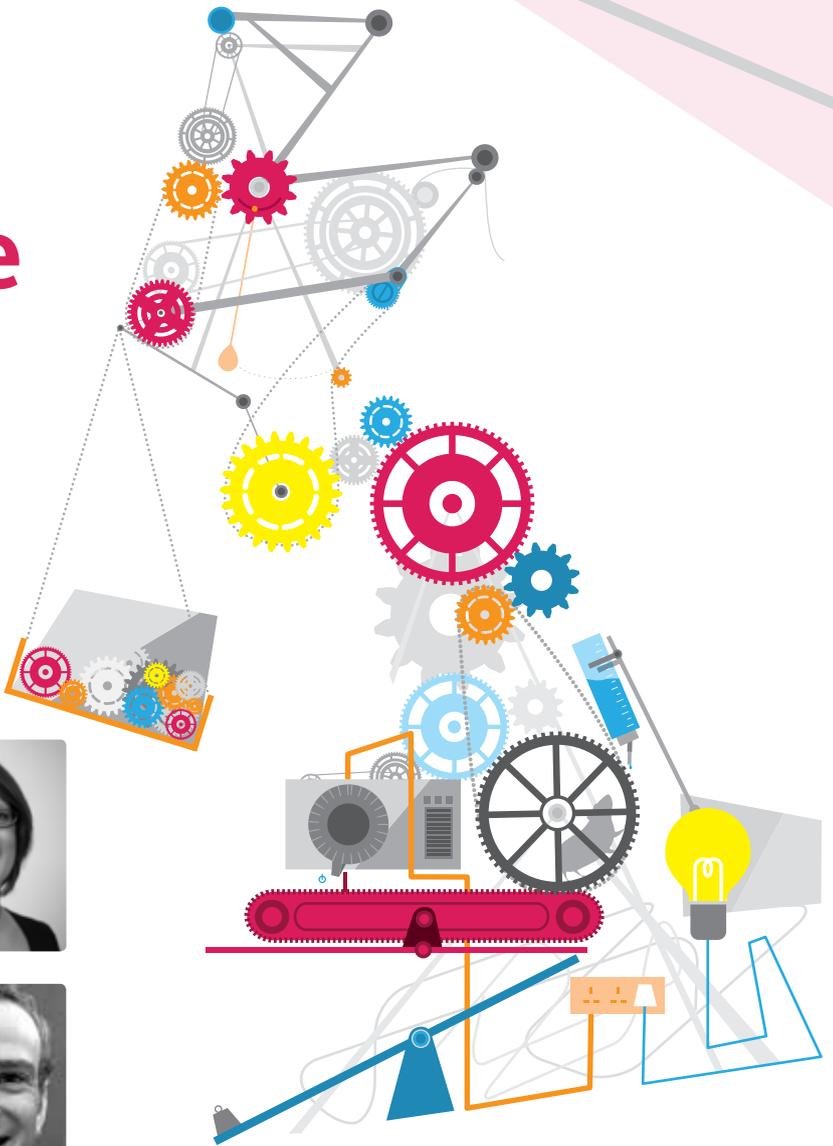


Shaking up infrastructure

Dr Julia Steinberger, Katy Roelich and Christof Knoeri of Leeds University's School of Earth and Environment share some of the exciting details of their research into a new model for sustainable infrastructure, which focuses particularly on delivering infrastructure services rather than merely gas, water or electricity



Can you explain what you see as the current problems with the configuration of infrastructure?

JS: Currently, infrastructure suffers from both physical design and operational problems. The design flaws are well known, and arise from a combination of ageing and disparate components, unplanned interdependencies and the challenges of meeting ever-growing demand. In this project, we focus on the operational aspects, which are less studied, but no less important. We have identified three central challenges to infrastructure operation. The first is that planning for unmanaged and growing demand levels is inherently unsustainable – demand should be actively reduced. The second is that infrastructure streams are regulated and operated as separate networks, prohibiting joint solutions. Finally, the end user is not integrated into infrastructure operation, despite playing a key role as a selector and user of key appliances and technologies.

Why is it important that there is a shift in infrastructure operation, particularly with regards to long-term sustainability and technical innovation?

JS & CK: A shift is required because infrastructure operations are fundamentally unsuited to future challenges, in particular in terms of climate change, societal resilience and security of supply, but also because of increasing uncertainties and complexity in the integration of new technologies. In the past, we have viewed infrastructure as the basic networks that enabled us to do more: travel more, use more and different types of energy and water. In the future, we need infrastructure operation to change completely. It needs to become a way for us to do more with much less, and for this, it needs to be completely rethought and reorganised. Our project attempts to chart some first steps in this direction. Rather than following technical innovations, infrastructure needs to be driving them, becoming a focal point for innovation with a purpose.

Taking all of this into consideration, what characterises a Multi-Utility Service Company (MUSCo)?

CK: The honest answer is that we don't yet know. We are talking with many stakeholders, from utility companies to local authorities, and identifying alternative directions for radical innovation in infrastructure operation. We are looking for three particular aspects in such innovation – firstly, interconnected operation – or at least consideration of several infrastructure systems; secondly, goals of delivering services at lower levels of natural resource use compared to business-as-usual; and finally, integration of end-user communities, be they local authorities themselves, industrial partners or commercial/residential groups, who then have an active stake in the new project. Generally we don't find all three aspects together, so in that sense we have yet to find a real MUSCo, but we are encouraged by our findings concerning 'partial MUSCos'.

Land of the MUSCOs

A team of scientists from all over the UK has been conducting research into possible routes to sustainable infrastructure; the concept they have arrived at centres on the new idea of **MUSCOs** – Multi-Utility Service Companies

You emphasise the importance of a highly interdisciplinary and integrative approach, not only between larger areas such as industry, government and science, but also within those areas (eg. between different scientific disciplines). How can outcomes be reached that satisfy such disparate fields?

KR: There is increasing recognition that the complex and interdisciplinary nature of contemporary challenges cannot be addressed without an integrative approach. We need to work together on common challenges, and use methods and insights from each other to make progress. Infrastructure, and its unique characteristics of underpinning all economic and domestic activities of industrialised societies, is a great topic to focus upon in an interdisciplinary context. The UK Research Councils have demonstrated a strong commitment in this area, building up a portfolio of small and larger research projects in this domain. Most recently, the Economics and Social Research Council teamed up with the Engineering and Physical Sciences Research Council to support two large centres on innovative infrastructure business models. Our team is involved in one of these, iBUILD (Infrastructure BUbusiness models, valuation and Innovation for Local Delivery), so this area is definitely growing.

How do you see the future unfolding for MUSCOs?

JS: We can't predict the future. However, we are encouraged by the strong and clear will of many actors and stakeholders within the energy, water and transportation arenas, as well as local authorities, for taking on the big challenges of the 21st Century: climate change mitigation, decentralised generation and local resilience, and generally moving as citizens and businesses to a more sustainable way of life. We see MUSCOs as a promising idea to move in this direction, as a vision to focus the mind of many partners to transition to a more sustainable mode of infrastructure operation and delivery.

INFRASTRUCTURE IS A key attribute upon which the comparative development of a country is commonly judged on, alongside other factors such as political stability and education. It is a simple word, but its scope of reference is vast – all of the structures that support everyday life are grouped under this title. In the UK, infrastructural components have been developed and used for hundreds of years – meaning that citizens enjoy the benefit of an infrastructure that has stood the test of time, and is one of the most comprehensive in the world.

But this is not to say that the infrastructure of the UK is a perfect system – far from it. To face key challenges of environmental sustainability and resilience, the infrastructure must change as well, and in the UK this is not happening on the timescale that is required. On average, the UK replaces 1-2 per cent of its infrastructure every year, meaning that any changes made to the system today are likely to remain active for between 50 and 100 years. The rate of technological change required by a low-carbon transition, on the other hand, is much faster. There is therefore an urgent need for innovative solutions which can direct existing and new infrastructure to a sustainable state.

AN IMPOSSIBLE CHOICE

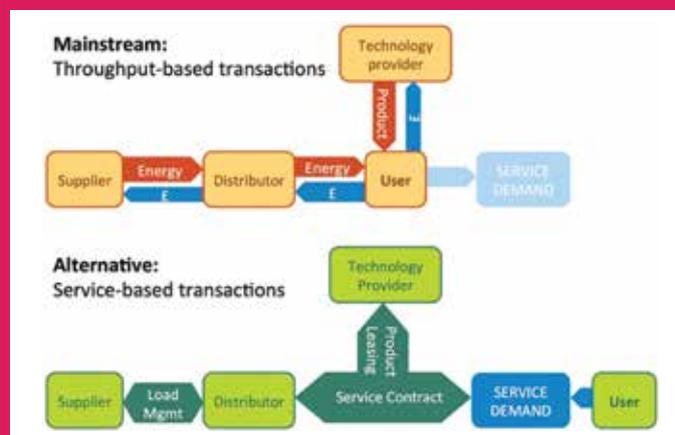
Apart from the problem of managing ageing assets, there is the question of sustainability to contend with. How can a system like the UK's infrastructure continue to function in the face of ever-increasing demand, without putting even more pressure on resources like water and energy? Simply put, in its current form, it cannot. Exceeding environmental limits with greater emissions and resource consumption has long-term negative impacts – but failing to meet increasing demand from end users is not an option either. It seems the UK is caught between a rock and a hard place, and if something does not change, either society or the environment will have to suffer the consequences.

Fortunately, a research team of scientists from institutions around the UK believes it has found a sustainable alternative. What is required is nothing short of an overhaul of the entire system, with changes not only to the way that infrastructure is provided, but also changes to the governance used to regulate it and the overarching focus of infrastructure provision. At present, the researchers explain, infrastructure is trying to blindly supply ever-growing demand, which is risky and unsustainable – but with the right changes, infrastructure service provision could be decoupled from increasing consumption of resources.

A DIFFERENT PERSPECTIVE

The team has suggested that infrastructure operation should be fundamentally changed. The end goal is an approach that incorporates and is centred on the needs and wants of the end user. Instead of being provided with vectors such as gas and electricity, the system will focus on providing the user with the services that they actually need such as thermal comfort and adequate illumination. This means that the focus of infrastructure will shift from providing increasing demand to meeting end user needs in the most resource-efficient way possible. Profits will be made through efficiency improvements, not increasing energy sales, which will incentivise the dramatic change needed to respond to pressing environmental and social challenges. Such a system will need to be governed in a way that is sensitive to the true complexity of infrastructure.

A model for the approach that the group is suggesting is Energy Performance Contracting in the industrial and commercial sectors. An external organisation, for example a utility, assesses the best way to provide energy services to a company and takes over the implementation and management of energy efficient technology, charging a fixed cost for this function. It is a fundamentally interactive process that is cost-effective, oriented by the



Flow chart comparing a mainstream (ie. current) and an alternative (ie. service) economy.

INTELLIGENCE

MUSCOs

OBJECTIVES

To investigate and understand how Multi-Utility Service Companies (MUSCOs) can be implemented and integrated into existing infrastructures to ensure long-term sustainability and efficiency.

KEY COLLABORATORS

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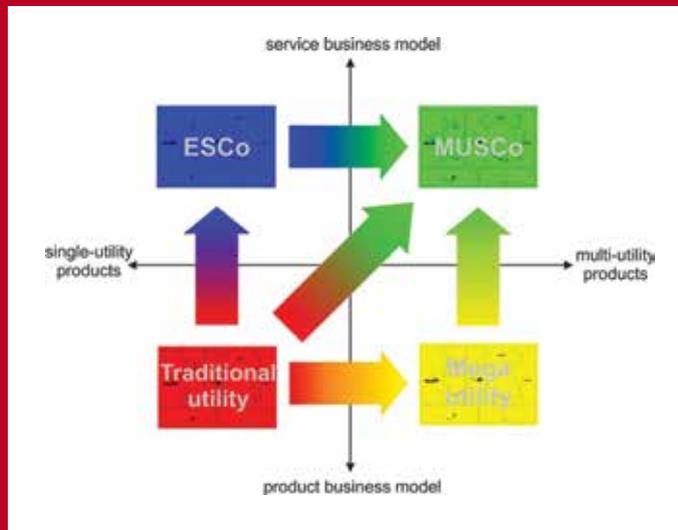
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BUSINESS MODEL
ROADMAP FOR
MUSCOs

needs of the customer, and incentivises resource efficiency. This model has yet to be applied to the domestic sector or to multiple utilities.

MUSCOs

This is where the idea of a Multi-Utility Service Company (MUSCO) arises. MUSCOs are a new paradigm in the provision of infrastructure, and would differ from other utility companies in their focus on the end user and drive to improve resource efficiency. They would also, as their name implies, provide a bundle of services, and exploit the cost and resource efficiencies presented by more integrated infrastructure operation, rather than focusing on one. MUSCOs could be an important part of the transition to a more resource-efficient and resilient infrastructure system in the UK – but the transition will not be an easy one, as there are many obstacles which limit the prevalence of such companies. The first of these is a widespread and deeply ingrained reliance on mainstream technologies and modes of operation, but the high costs associated with creating and monitoring service performance contracts are also an important factor.

Even greater an obstacle, however, is our existing regulatory framework. The whole emphasis of UK regulation is wrong for the development of MUSCOs: it enshrines the freedom to change providers and the requirement for short term contracts; it forbids the sharing of information between utilities – preventing joint utility solutions; and it excludes local groups of providers and users from being more actively involved in infrastructure operation. The team has called for future R&D to focus on overcoming these barriers and clearing the path for MUSCOs.

THE UTILITIES OF THE FUTURE

Perhaps the most attractive facet of living in the 'land of the MUSCOs' is the promise of data feedback on the most basic aspects of everyday life. Although we live in an increasingly data-filled and data-driven world, the majority of our basic, everyday activities are conducted without any data feedback at all. Whether commuting, making food

or heating our homes, we are operating – when compared with some other aspects of our lives – in the dark, we just have no idea of the demands we are making on these utilities. Comparatively simple feedback technologies could give us a valuable insight into the impacts of our own habits.

The MUSCO infrastructure would entail implementing technologies such as a home data system to track gas, electricity and water usage in a highly visible way. At the level of a single home, this data could be immediately used to inform us where we could both save money and be more sustainable, in terms of behaviours and alternative technologies. Envisioned over a public system like the transport system – a network of interconnected services – the potential benefits to fuel efficiency and travel time are huge.

THE FUTURE OF UTILITIES

The bottom line is that the way that infrastructure is operated in the UK has become unworkable. It disincentivises the adoption of efficient and low-carbon technologies and places intolerable pressure on the environment and society. Our physical infrastructure cannot adapt fast enough to the challenges of demographic and climate change that the country is set to face, so there is an urgent need to change the way we operate it to reduce resource consumption and encourage adoption of sustainable technologies. To do this we need to change the focus of infrastructure provision to deliver services, not products, and exploit the integration of infrastructure systems.

Infrastructure is known to be an area which is slow to change, but the research team says that the UK is ripe for a rapid transformation. The Localism Act of 2011 in particular, and the increasing attention to sustainability and resilience in infrastructure policy are factors that could presage – or enable – such a transition. Big changes are in the pipeline, whether the country can adapt or not, and there are already a number of other European countries that can and are doing so. The UK's chances of future success, it seems, may lie in the hands of the MUSCOs.