Urban Transitions

Urban Transitions

Climate change and the demands of booming urban populations pose a major challenge for infrastructure, buildings, energy, water systems and drainage, sanitation, waste management, housing and mobility. Cities need to be able to deal with climate risk and impact: be sustainable, zero-carbon and resilient. The onus is on cities to improve air quality, reduce emissions, waste and resource use, and at the same time promote wellbeing, public health and social balance.

Meeting these ambitions will demand trillions of investment, and innovation in governance and financing. As much as it is a challenge, this is an opportunity for a new, sustainable market to emerge. Climate-KIC's Urban Transitions catalyses urban transformation through collaboration and systemic innovation across infrastructure, governance and investment.

Key Activities

- Integrated and Systemic Innovation
  Urban Transitions fosters innovation that synergises city systems and infrastructure on the following principles: district proximity, connectivity and efficiency; circular economy and waste as a resource; novel data architecture and management to support smart and responsive technologies.

- Smart and Sustainable Development
  Urban Transitions makes the case for smart, sustainable development through articulating new models of value, and visualising and making sense of complex data. Urban Transitions demonstrates how one 'engagement' can be more efficient and have multiple outcomes and benefits.

- Education, Facilitation and Capacity Building
  Urban Transitions facilitates, catalyses and enables collaboration, bringing diverse and competing stakeholders together. It is a beacon for best practice and knowledge in urban transformation.

Smart Sustainable Districts (SSD)

Summary

Smart Sustainable Districts is a group of pioneering city districts working together to deploy and accelerate the knowledge, expertise and best practice needed to transition to zero-carbon living and build resilience into Europe's cities. A smart sustainable district is characterised by low carbon mobility, smart grids, energy neutral buildings, efficient water management and accessible, public green space, all underpinned by responsive technologies that optimise resources. A smart sustainable district also promotes wellbeing and sustainable lifestyles, and facilitates new ways of working, commuting, consuming, interacting and enjoying the city. Smart Sustainable Districts is one of Climate-KIC's flagship programmes.

Key Points

- The onus is on cities to build resilience, mitigate environmental impact and reduce resource use in the face of climate change
- The district scale is the optimum size for testing and implementing innovation - large enough to gauge positive impact, yet small enough to achieve change
- A lack of joined-up policy and implementation frameworks are holding back the wider uptake of district developments
- The SSD network offers support and services to create the dialogue, test the beneficial impact and help realise sustainable, district-led development
- As of 2016, Climate-KIC's SSD programme comprises nine districts across Europe and is expanding globally

Background to Smart Sustainable Districts and Programme Drivers

Cities are where 75 percent of the global population will live by 2050. In the face of climate change, as major users of resources, and producers of municipal waste and greenhouse gases, the onus is on cities to mitigate their environmental impact and build resilience. Globally, cities have committed to ambitious climate and energy reduction goals, but most are struggling to bridge the gap between the rhetoric of aspiration and the practical steps that lead to measureable impact.

Districts are the most effective unit of scale at which to test integrated systems and infrastructure, and accelerate sustainability. Districts are compact enough to concentrate resources and improve efficiency, are autonomous, yet they are large enough to have noticeable impact.

Integrating projects and systems that conventionally operate separately such as building functions, energy or mobility can enhance environmental performance and help meet ambitious performance goals. Such technologies and systems – district heating, smart grids, demand management and resource sharing – already exist but a lack of joined-up policy and implementation frameworks at the municipal level can be a barrier to widespread adoption. At the district level, it's possible to test out the new models of financing and contracting, joint ventures, partnerships, community engagement or novel governance models that this integration demands.

To be able to build the joined-up policy and implementation frameworks, there must be effective coordination across stakeholders who often have disparate interests. There must be effective data to determine priorities, demonstrate the value and support decision-making, effective schemes and structures to raise the capital required and make propositions attractive to investors. All of this is crucial in helping districts go beyond being a pilot, to replicate and scale up their achievements.

Smart Sustainable Districts – What

Typical district projects and innovations include smart grids, district energy and heating, drainage and water management, rainwater harvesting, green streets, zero waste programs, district composting, waste-to-energy, car sharing, biking and bike lanes, urban agriculture, culture and events, local maps and data interactions. Smart Sustainable District developments are guided by the concept of 'factor four' – the idea of leveraging twice the value with half the resources. Goals can include local job creation, boosting local business, improving community participation or inspiring new patterns of citizen behaviour, as much as enhancing environmental performance.

Smart Sustainable Districts – How

While conventional green development strategies tend to be led by master developers or agencies, district developments often demand wider collaboration and input from a diverse range of stakeholders. The Smart Sustainable Districts programme acts to bring together consortiums of policymakers, local municipalities, utilities, private developers, innovation experts, sustainability specialists and citizen groups.

Districts undertake a multi-stage process, firstly, to determine their priorities, strategies and opportunities. From this starting point they work on identifying tangible 'factor four' outcomes from achieving cross-sector synergy, either through demonstrating previously unconsidered benefits and values, or through bringing in new data. Smart Sustainable Districts has helped articulate the return on investment for integrated outcomes through realising new models of value in social, economic and environmental terms. This often involves making a more compelling business case through visualisation, modelling complex environmental data interactions and envisaging scenarios. Such 'win-win' scenarios often lead to improved sustainable outcomes.

The last phase of the process is about managing, evaluating and refining the proposition. Districts can collect local data such as greenhouse gas emissions, microclimates, heat islands, wind tunnels, vehicle miles traveled, crowd behaviour, spatial navigation, drainage, storm water quality, energy and utility savings. By integrating and layering such data, by understanding the interactions, sharing best practice and applying new techniques, districts can enhance and refine the emerging developments.

The typical outcomes of Smart Sustainable Districts include frameworks and implementation strategies, implementation tools and processes, methods of assessment, ways to raise capital, and recommendations to help develop the incentives and policies needed to scale up district development. For example, SSD work in Berlin demonstrates how sharing data instruments can bring transparency in multi-level governance and involves citizens in decision-making. In Paris, SSD has facilitated the local community in co-designing their own tools to help monitor construction and development, while SSD in London has advanced the applications of data to the concept of smart park'.

Smart Sustainable Districts Network – Achievements

Smart Sustainable Districts was established in 2014 as a way of accelerating sustainable district development, and district-led technologies and innovations across Europe. The programme has achieved proof of concept in several districts including Queen Elizabeth Olympic Park, London; Moabit West, Berlin; Utrecht New Centre and Les Docks de Saint-Ouen, Paris. The challenges, methods, tools and implementation frameworks developed are are detailed in further case studies.

What's Next?

Smart Sustainable Districts currently has nine districts within its network – Rotterdam's Stadshaven Harbour, Utrecht The New Centre, London's Queen Elizabeth Park, Paris' Les Dock de Saint-Ouen, Gothenburg's Johanneberg, Malmö southeast, Berlin Moabit West, Helsinki's Kalasatama and Copenhagen Energy Block. Over the coming year, Smart Sustainable Districts is looking to expand globally.

Smart Sustainable Districts is currently funded and supported by Climate-KIC, but the long-term ambition is to develop and offer the scoping, assessment, feasibility and framework implementation services, reflecting the commercial value and market opportunities that integrated district developments bring.

Queen Elizabeth Olympic Park – SSD

Summary

Queen Elizabeth Olympic Park (QEOP) is a major urban district development in London regenerating the east end of the UK capital, positioning it as a new social and economic hub. Having hosted the 2012 London Olympic Games, the park is looking to build on its Olympic legacy. It is home to five world-class sporting venues, including the Zaha Hadid London Aquatics Centre and the Copper Box Arena. It is responsible for creating 10,000 new homes, a world-class cultural and education district, and a digital and media business hub. Smart Sustainable Districts (SSD) has helped advance QEOP's work on resource-efficient buildings, energy systems and developing a smart park.

Key Points

- The London Legacy Development Corporation is tasked with rebuilding a local east London economy harnessing the activity of QEOP
- Strategic strands of the development include energy systems, building resource efficiency 'real-time, local data', and innovation in data architecture and management
- Smart energy management systems support a proactive and evidence-based approach to energy conservation of the sporting venues
- Successful tools for citizen engagement emphasise learning, fun and interaction
- Data on crowd behaviour informs the development of interactive park features and displays
- Deployment of an integrated data architecture approach is advancing emerging international standards, setting a benchmark for London and Europe
- Each of these work streams draw on the expertise of Climate-KIC's SSD programme and its partners

Project Background and Drivers

The regeneration of east London has been on the agenda for successive London mayors and British governments. Throughout the 2000s, the Channel Tunnel Rail link, the Westfield Shopping Centre and the formation of Stratford City Olympics and the Paralympics London Legacy Development Corporation have all sought to revive an area suffering deprivation and unemployment as manufacturing, the area's historic economic base, moved offshore.

The London Legacy Development Corporation, formed in the wake of the 2012 London Olympics, has been tasked with enacting a global sporting legacy, and rebuilding a local economy through QEOP. Its aim is to create a thriving sport, tourist and visitor destination, attract high-profile institutions across culture and education, and entice international investment to help secure the future of the area.

At the centre of this development is QEOP. Spanning 45 hectares, it is home to five world-class sporting venues, and a blossoming digital and media business hub, with plans for 10,000 new homes, an international business quarter and a world-class cultural and education district. The major focus for the district is on creating high quality buildings based on inclusive design and high environmental performance, greening and rehabilitating the environment, and evolving with the local community.

The District Plan

As part of the SSD programme, QEOP focuses on strategic strands including energy systems, resource efficiency of the park's buildings and sporting venues, the collection and use of real-time, local data to enhance navigation across the park, as well as user experience and quality of life – all of which are underpinned by innovation in data architecture and management of urban spaces.

Resource efficiency in buildings is a priority across the district, with data modelling centred on the iconic London Aquatics Centre and Copper Box Arena. The aim has been to create tools and approaches to enable low cost, low environmental impact future-ready, non-domestic buildings.

Particularly from an engineering perspective, improvements are ongoing, but for the SSD QEOP team, integrating management and metering systems has been critical. A new energy management system, which tracks remediation, makes recommendations and supports a proactive approach to energy conservation, is being trialled with French energy provider, and Climate-KIC partner, Engie. The SSD QEOP team is also working with the ICRI Lab to pilot domestic smart energy meters in its residential blocks, to help make energy consumption tangible, and promote energy conservation.

SSD has supported the team in managing the district energy network through identifying energy consumption patterns, pinpointing peak heating loads or when capacity is constrained. This helps even out peaks and troughs, according to Jennifer Daothong, head of strategy and sustainability at the London Legacy Development Corporation.

Efficiency of the energy-intensive London Aquatics Centre, with its heated 50m pool, has been addressed by integrating pool pumps and backwash recovery. "Sweating your assets harder helps push back when you need to upgrade the infrastructure capacity," says Daothong. The positive impact and energy savings from buildings can be reintegrated into the network operation.

images provided by QEOP

Smart Park / Future Living

The QEOP team is also exploring how the combination of smart spaces and sustainability can enhance local user experience, boost quality of life, support better wayfinding in the area and facilitate community engagement, according to QEOP IT programme and change manager. "It's not just visitors to the park that we're looking at, we have local residents, workers and employees - we want to connect with all of our park users," says Edmonds.

The park offers free public wifi throughout, allowing visitors to engage in its events and schemes through a park smart phone app, and web and social media platforms. This enables the team to understand how people are using the space and buildings, how they respond to indoor temperatures, and to ascertain how indoor climate control can impact behaviour.

"Connecting with people through the wifi helps us to understand use of the sporting venues, crowd routes and park hotspots. We're also looking at how we might use this data to provide intelligent park lighting and dynamic wayfinding solutions, for example," explains Edmonds.

Feedback through Fun

Getting public feedback on the development is a crucial part of the evolution of the park. While demographics are vital to confirming the involvement and participation of the local community, qualitative data and how people feel about the space is equally as important. The team has developed a number of innovative engagement tools to gather feedback, with an emphasis on interaction and fun.

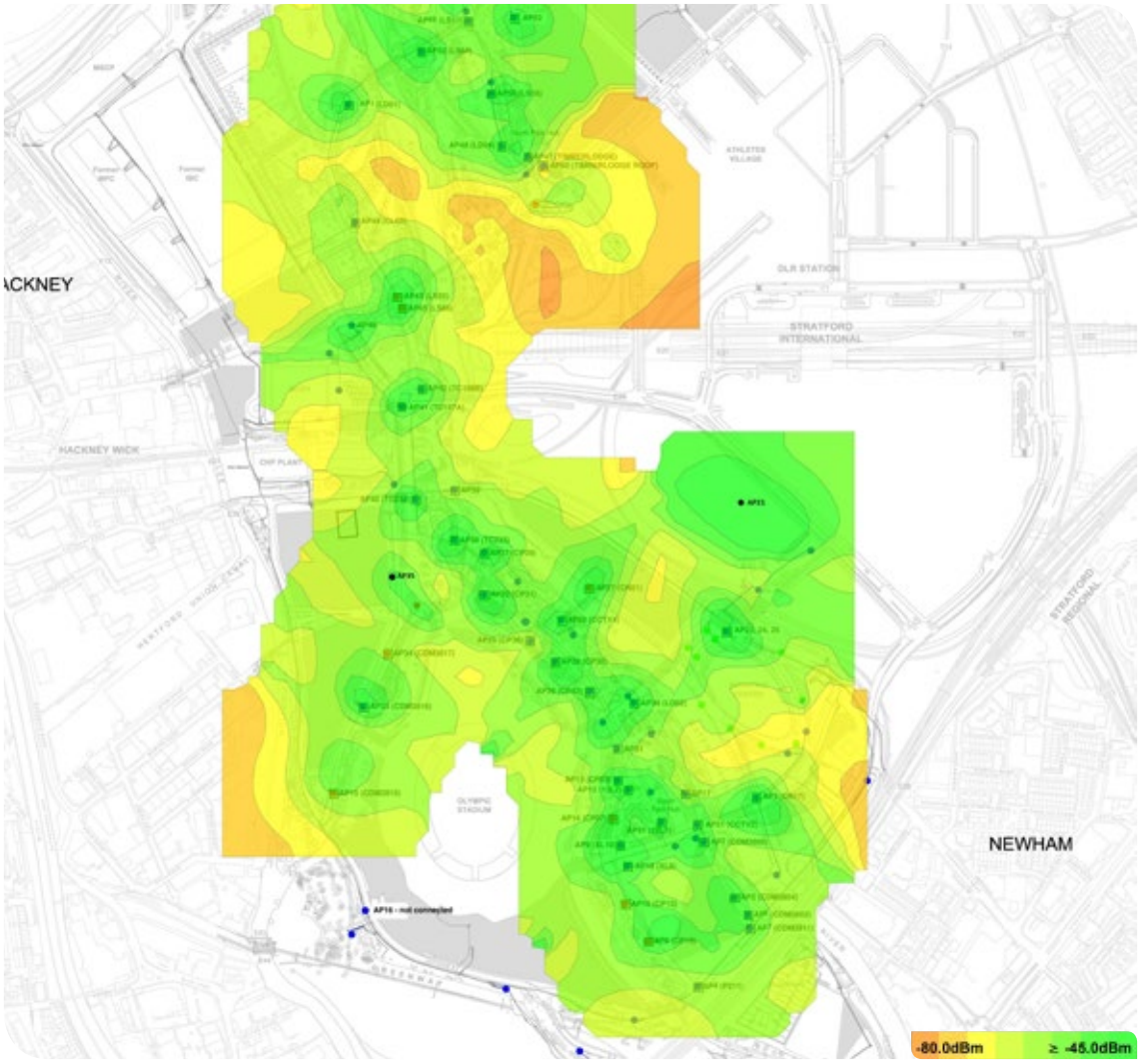
"With a change of governments over the last few years has been successive asking residents what they think of the development. We understand that at this stage, they're tired of being asked that question, so we have focused on making engagement innovative and fun. And, data and technology can support this," says Daothong.

The park is trialling smart features that respond to social interaction, such as 3D projections, or a fountain controlled by facial recognition and emotion. The team has successfully piloted a series of tools to engage citizens, including Hello Lamppost, an interactive concept whereby street furniture can engage in conversation; a mobile park robot, developed by University College London and VoxBox, a game questionnaire that can channel visitor responses into the park's data architecture system to allow comparison between qualitative and quantitative data sets.

Sensors throughout the park, provided by Intel as part of the Capstone project, collect data such as air quality and heat patterns, and provide an actual real-time micro-climatic picture, rather than an extrapolated one based on models from a general London monitoring system. These help pinpoint and track changes stemming from the development, further understanding its environmental impact, according to Edmonds.

Innovation in Data Management

An overarching approach to data architecture and management allows the information stemming from different systems within the development to be integrated. This is a major shift away from standalone, in-house databases, where you might be restricted on the array of data sets you can analyse, according to Edmonds. QEOP is working with leading global researchers and institutions on a cutting edge architectural and management data store project, experimenting with emerging international standards.



The team is exploring how the combination of smart spaces and sustainability can enhance local user experience, boost quality of life, support better wayfinding in the area and facilitate community engagement.

"It's all part of an integrated data store and web services based architecture, that would enable you to compare and correlate many different types of data sets. We're working with [SSD partner] Technical University (TU) Munich on this. They have built proof of concept data architecture, using CityGML" says Edmonds. "This work is a testbed for London too. The Mayor's office and the London Data Store are working with us on our findings."

The Role of Smart Sustainable Districts in QEOP

Each of the work streams in QEOP draws on the expertise of Climate-KIC's Smart Sustainable Districts programme and its partners. SSD has not just opened the doors to a wider network of potential partners, but has enabled QEOP to share innovation concepts with other European districts. Being part of a European-wide district programme has helped it gain wider recognition within London and the UK.

Daothong says: "So many of the themes that run through SSD fit with our ambitions. That's why we wanted to be part of it." Edmonds adds: "If we find that what we're doing here has real value, then we look to SSD to help articulate, qualify and share those successes," he says.

What's Next?

For the QEOP SSD team, 2015 has encompassed designs, concepts and building a framework for the work streams, while 2016 has been about proof of concept and testing. As the team moves into 2017/2018, attention will shift to consolidating this expertise, potentially offering it as a Smart Sustainable District on a commercial service basis. "It's about showing the real benefit for the QEOP and for the public," says Edmonds.

Moabit West, Berlin – SSD

Summary

Moabit West is an inner city district in Berlin, home to both domestic-residential and industrial activity. As part of Climate-KIC's Smart Sustainable Districts programme, the district project is working to take the first steps in implementing The Green Moabit 2013 urban development plan. The development is driven by ambitious sustainability goals for energy efficiency in manufacturing, electric commuter mobility and sustainable water management, with a District Data Atlas and citizen engagement strategy at its core.

Key Points

- There is significant pressure on the Berlin administration to upgrade central urban living spaces without gentrification, particularly in districts, like Moabit, that are located in the heart of the city
- District and city authorities have notable ambitions for sustainability to become climate-neutral by 2050
- SSD Moabit provides an implementation plan and tools to realise the Green Moabit urban development process, based on a related plan adopted in 2014
- Strong stakeholder networks (enterprise network, quarter management network) are core assets for replicating measures and solutions
- SSD Moabit focuses on sustainable water management, energy efficiency and low carbon mobility
- The development will only be a success if it addresses the needs of the people living in the district, and citizen engagement has been crucial
- The team has created a series of data management and visualisation tools to support transparency and citizen engagement including a District Data Atlas
- Multi-level governance, with the Smart Citizen Network Board, has motivated utilities and infrastructure companies to become implementation partners

Project Background and Drivers

Moabit West, part of Moabit island at the heart of Berlin, is a city district area that is both residential and industrial. More than half the area is home to manufacturing, service and logistics firms, while there is a strong migrant population. The project's borders are the contact point for new arrivals, and are a first stop for refugees coming to Berlin.

Like many European cities, there is significant pressure on the Berlin administration to create quality living spaces and affordable housing for a growing Metropolis, particularly in districts, like Moabit, located in the heart of the city. The borough of Mitte, which oversees the administration of Moabit, expects at least 24,000 inhabitants by 2030, and, in 2015, approved planning for almost 4,000 flats. The Senate of Berlin, too, has responded to the increasingly pressured housing market, pledging to create an additional 10,000 units per year.

Against this housing backdrop, the district and city authorities have notable ambitions for a sustainable, resilient and low-carbon future. The main challenge lies in the retrofitting of the building stock that cause high energy and heat demand. Extending low-carbon mobility through schemes such as e-charging stations and the city's first electric bus line are all efforts to become climate-neutral by 2050. The city is looking to reduce its GHG emissions 85 percent through energy supply, buildings, economy, transport, private households and consumption. The vision for Moabit West, nestled in one of the scheme's core development zones, City West, is to be a "core of inner-city growth" with high levels of innovation.

The Green Moabit process, an urban development plan adopted in 2014 by the district municipality, provided a starting point for Smart Sustainable Districts Moabit West. While the plan encompassed an integrated landscape of solutions spanning water, waste, energy, mobility, public space and social infrastructure, it lacked an implementation strategy, and had few resources from local authorities. It needed a neutral partner and a visionary leadership to help realise the plan. Green Moabit, a recognised brand throughout the city, serves as the main source for the opportunities and project formulation with the process driven by the Smart Sustainable Districts management team.

The District Plan

The Smart Sustainable District "Moabit West" has been managed by TU Berlin's CHORA City & Energy department since September 2014. The department acts as an unbiased and neutral party, liaising between stakeholders, managing and coordinating interests, and facilitating the integration of innovations and technologies. The main areas of focus for SSD Moabit are sustainable water management, energy efficiency and low carbon mobility. In the first phase of the project, the three focus areas were developed separately, before identifying interactions and potential for integration. The cross-cutting urban planning tools, like District Data Atlas and Citizen Engagement integrated all themes right from the beginning and tried to represent the challenges in a holistic way.

Sustainable water management solutions can be applied in many private and public water systems. The main challenge adopted in SSD in Moabit West is related to the industrial properties with sealed surfaces and large roof areas that cause the overflow and flooding of the sewage systems during storms. The rainwater sewage fee that needs to be paid by owners and tenants according to the size of the roof is relatively high in Berlin and puts pressure on fee payers to reconsider their drainage systems.

Smart tree planting concepts are being installed to help store storm water from roads. Collected rainwater will be used for cooling or irrigation.

Although Moabit's period building stock presents an opportunity to improve energy efficiency, the district's public lighting, industrial sites and industrial processes were deemed a greater priority in SSD because of their potential for an easier steering by municipalities and the enterprise network. This work focuses on understanding the factors that support or hinder efforts to improve energy efficiency through auditing of local businesses and scenario development (simulations) of public street conditions.

"This is an area that struggles with investment from the private sector, even though it's proven that changing to energy efficient technologies, processes or upgrading buildings can be financially worthwhile," says Nadine Kuhla von Bergmann, district key account manager for Moabit. "We're focusing on the decision taking processes. With SMEs, the owner isn't usually running production processes or sitting in the building. That's a huge discrepancy. We're doing three audits, looking for incentives, evaluations and looking to the district level to see where there might be cross benefits between stakeholders."

The SSD team is also examining the potential of e-mobility, low-emission transport and innovative transport technology for local private and commercial travel. The aim here is to use Moabit to test out options for commuters, local businesses and residents, and estimate the impact of different strategies on emissions. Most recently, with the support of the SSD network, Moabit has secured its first bike-sharing scheme partner, nextbike. This will enable the first bike stations of a non-motorised shared transport system to be piloted in Moabit West in 2017.

Engaging the Local Community

The SSD Moabit team works on the principle that the development will only be a success if it addresses the needs of the people living in the district. Engaging the local community has been crucial. It has created a series of tools that supports citizen network engagement, such as crowd-mapping of projects and transport demands.

The outcomes have influenced decisions taken on infrastructure measures, such as the bike station location. A seminar "Citizen City Science" developed instruments for smartphones and social media, and designed intervention for public spaces to encourage dialogue driven by cultural interest.

Scenario games are used to negotiate between different interests during development, and led to the definition of "low hanging fruits" for the implementation strategy of SSD. They were also used for creating a shared future vision among stakeholders with different backgrounds and to overcome sectorial thinking and mistrust.

The Smart Citizen Network Board (SCNB) consists of representatives of the district administration, the urban utilities, the enterprise network, the quarter management office and the opportunity project leads. These exchange regularly about ongoing processes in the city and in the district, acting as an innovative multi-level

planning instrument. During its steering meetings chaired by the district key account manager, the Smart Citizen Network Board discusses general needs across Berlin and the ways in which the pilot projects in Moabit are relevant for the city as a whole.

"One of our challenges with citizen engagement has been how to attract those who don't connect to the idea of 'smart' and 'city'," says Kuhla von Bergmann. "When we didn't get the numbers of people we had hoped for the citizen dialogue at the ZK/U, we evaluated, and got critical feedback that how you communicate the project has to have relevance for people's everyday lives. Knowing what the local community is struggling with is critical to getting people engaged into a dialogue about the future of their district."

The main focus for the next phase in terms of citizen dialogue will be on producing education material around "smart city" aspects to create a common language with the younger generation and to give the knowledge collected within SSD back to the community.

The District Data Atlas, a database containing all the data relevant to the SSD Moabit development, makes the process transparent and accessible to all stakeholders. This data management catalogue plays a key role in integrating solutions for various urban systems, and supports project management processes.

Stakeholders are desperate for knowledge and evidence. If a water expert from the Netherlands supports a particular perspective, for example, that can really influence and will impact the local readiness to put investment behind it.

Partners

The SSD Moabit team has brought on board several local partners from Mitte borough, the business network, the district administration, city utilities, civil society initiatives.

Engineering firm Prof. Sieker mbh and Berliner Wasserbetriebe (BWB), with TNO and Deltares from the Netherlands are tackling sustainable water management challenges, while RWTH Aachen, CHORA (TU Berlin), TU Munich, TNO and Ökotec are providing expertise on energy efficiency. Mobility scenarios and solutions are developed by ZTG (TU Berlin) and ICL form London. The District Data Atlas tool is being developed by TU Berlin (CHORA) with TU Munich and VirtualcitySYSTEMS.

The project partners in the Climate-KIC network represent a wide range of experts from the private and public sectors and the academic and research community, keen to apply their skills in transforming existing approaches in individual districts into integrated solutions.

The Role of Smart Sustainable Districts in Moabit West

The multi-layered governance structure of Berlin can render decision-making complex and challenging. Being a SSD project has allowed the team to take on the role of broker, facilitator and accelerator, catalysing the much-needed implementation of the Green Moabit plan, according to Kuhla von Bergmann.

The Smart Citizen Network Board, meanwhile, has helped institutionalise a multi-level forum with sustainability goals at the fore. As a result, Moabit has successfully established vital discussion about various topics around sustainable urban development and attracted players to commit to further investment into urban technologies and infrastructure. The project has also gained support from the head of the district built environment department.

"There's some magic about being part of a European-wide programme and sharing the experience with other districts," says Kuhla von Bergmann. "Stakeholders are desperate for knowledge and evidence. If a water expert from the Netherlands supports a particular perspective, that can really influence and will impact the local readiness to put investment behind it."

What's Next?

Having identified its priorities and work streams, and developed tools and instruments to realise its vision, the next step for Moabit will be to consolidate its outputs and learning, before handing over to local stakeholders. "There will be a position created at the district, funded by national government to continue our management work," says Kuhla von Bergmann. "There are so many spin-offs and research projects from the SSD work, and we're looking at grants and funding mechanisms for these."

Smart and Sustainable Offices – Building Technologies Accelerator (BTA)

Summary

Smart Sustainable Offices (SSO) is a multi-disciplinary project within the Urban Transitions Building Technologies Accelerator programme run by Climate-KIC partners Chalmers University of Technology in Gothenburg, Sweden, the Valencian Institute of Building and the University of Valencia in Spain.

The project has developed a comprehensive database with models and methodologies that demonstrate patterns and interactions between office design, building systems, indoor comfort, wellbeing and employee productivity. SSO takes a holistic view of the office to evaluate the relationship between energy building performance and the end user's wellbeing. This approach links improved work environment to enhanced productivity, demonstrating how it can boost an organisation's overall performance due to less sick leave, higher engagement, greater job satisfaction and lower staff turnover. The programme has developed Europe's first such knowledge of workspace buildings.

Key Points

- The building sector is one of the most resource-intensive in EU
- Making the case for sustainability through renovation requires integrating the user, and new approaches beyond energy cost savings
- SSO takes a holistic view to evaluate return on investments in energy performance and carbon savings for the office
- Improving work conditions can also improve productivity, boosting an organisation's overall performance
- The programme has developed Europe's first such knowledge with empirical data of workspace buildings in Spain and Sweden
- SSO is formalising this research, developing a suite of consultancy and building certification services for users including real estate owners, architectural practices, engineering companies and office furniture suppliers

Project Background and Drivers

The building sector is one of the most resource-intensive in EU – from extracted raw materials to energy use, water consumption and waste. As such, the European Commission is increasingly looking to drive improved environmental performance, energy and resource efficiency in the continent's building stock. The ability to make comparison between buildings through a common framework is fundamental to achieving these goals.

Offices play a major part in this – while they make up around eight percent of the overall building stock, we spend up to 90,000 hours of our working life in them. Sustainable building standards such as BREEAM and LEED provide guidance on the materials lifecycle for renovating existing or constructing new office buildings, but these are generally based on conventional cost-benefit approaches. There is little focus on the occupant, how the building is used, or how the renovation may impact wellbeing or comfort.

Basing renovation purely on cost savings from energy enhancements can fall short with real estate owners, increasingly asked to make such investments. "Trying to convince real estate owners to tackle the energy and carbon issues in the building stock can be difficult when energy prices are too low, labour costs too high or solutions are too technical. Portfolio owners would like to see a return on investment within ten years, but the solutions lifecycle ROI often goes beyond that," explains Holger Wallbaum, Professor, Sustainable building, Civil and Environmental Engineering at Chalmers University of Technology.

There is a need, then, for different approaches that leverage a co-benefits perspective. Increasing wellbeing and resilience, and providing adaptable solutions presents a way forward. Many studies indicate that smart and sustainable offices may positively affect health. Improving work conditions can also improve productivity, boosting an organisation's overall performance due to less sick leave, higher engagement, greater job satisfaction and lower staff turnover.

Project Detail

Smart Sustainable Offices (SSO), run by Climate-KIC partners Chalmers University of Technology in Gothenburg, Sweden, the Valencian Institute of Building and University of Valencia, Spain, is based on this thinking, taking a holistic view of the office.

The project has developed empirically robust, region-specific models and methodologies that demonstrate patterns and interactions between office design, building systems, indoor comfort, user behaviour and employee productivity. At its core is a comprehensive database – Europe's first – that offers insights from Spanish and Swedish workspace buildings, and crucially, how they are used. In-depth research was collected from employees through a multi-method research approach, before being aggregated for analysis and compilation.

"What we see is that if there is a poor [building] design, then people misuse buildings. They cover ventilations, put extra fans in or use personal heaters. All these observations suggest that the real energy consumption in the design can be very different to the real energy use," points out Professor Ulrike Rahe, Industrial Design at Chalmers University of Technology.

She adds: "Stating sustainability aims or standards can also impact people's behaviour. People then often overestimate the functionality of the building and assume that they do not have to adjust their behaviour, or that they can use energy freely. This is why we have psychologists from University of Valencia on our research team, as well as designers, engineers and architects. We can make recommendations with regard to this."

Developing SSO Tools and Services

Smart and Sustainable Office has begun to formalise this critical research, creating a suite of tools and services that can be harnessed by stakeholders across the industry, from real estate owners and architectural practices to engineering companies and office furniture suppliers.

Its office insights and diagnosis are intended to evaluate user demands, while an office improvement strategy and building certification provides a methodology and the parameters with which to design a more comfortable office. Consultation on how to execute this combines sustainable building systems technologies with improved indoor environmental quality and high quality interior design. The project is also developing an Office Planning Tool providing specific information on products, materials and constructive systems including prices, technical characteristics and visual information form the SSO online office planning tool.

The team is also developing critical guidelines for sustainable offices in different climate zones in Europe, based on the data collected. The SSO office building certification, currently in development, will encompass accessibility, indoor environmental comfort, design, space quality and environmental efficiency.

Carolina Mateo Cecilia, Head of International Affairs at the Valencian Institute of Building (IVE), who is working on the building certification, explains that the real added value for the project is having actual data of different climate zones, something very much appreciated by the Sustainable Buildings Alliance, the European association for which IVE represents the Spanish market.

"In the case of Spain, we have symphonised real data of energy consumption and building indoor environmental quality parameters, directly related to employees wellbeing, health and work performance during three different climatic periods in five real office buildings. In this work, the contribution of psychologists from University of Valencia has been crucial. All this data is really valuable to design a tailored building certification for offices in specific climatic zones" says Mateo.

The energy consumption of a building design can be very different to the real energy use

images provided by SSO team

Climate-KIC Support

Chalmers University of Technology in Gothenburg and the Valencian Institute of Building and University of Valencia have been leading the SSO project, bringing in other critical players including global real estate consultant Knight Frank and the Sustainable Buildings Alliance.

Climate-KIC, through funding and its network, has played a crucial part in helping consolidate the research, according to Wallbaum. "Being able to take on post-docs and PhD researchers was fundamental. As a result, we've developed a rigorous scientific model and methodology for advanced indoor environmental quality, with multi-disciplinary experts from all around the world. This has never been researched before. The unique proposition is our database and its insights," says Wallbaum.

Climate-KIC's support and network has also enabled the SSO team to explore strategic avenues for the certification system, introducing global real estate partners like Knight Frank, according to Mateo. "Climate-KIC support has been key. We were not certifying offices, just the residential market for direct demand of our regional government, so it helped us to open up to the kind of building we could [and wanted] to certify. certify. Additionally, we have changed the paradigm of the building certification. Instead of being focused on building performance itself, now we are more focused on the effects of a low carbon building in in health and wellbeing. Offices are cradles of innovation and we need to take care of the people inside."

What's Next?

With strong empirical foundations for its holistic office model and methodology in place, Smart and Sustainable Offices is now looking to commercialise this, exploring ways to work with clients across the construction industry on planning, design and procurement. It is currently in discussion with a Swedish municipality to develop its office for 400 employees, and with the Valencian Community, to establish pilot action in their public office buildings.

"We already have three strategic partners," says Wallbaum. "We can really add value for the architectural practice, engineering and ventilation and office furniture. We're looking to build long-term cooperation in the market and to have the flexibility to work with a range of competitors."

Façade Leasing

Summary

Façade Leasing is a pilot scheme that aims to explore how the construction industry can work together to lease façades as a service based on energy efficiency or ventilation control. There are two aims: first, to de-materialise this part of the construction industry, by shifting the current business model based on product volume to product-service-systems where materials can be recovered and repurposed, improving lifecycles and fostering circularity. Second, when façades are integrated into buildings with different technologies, they can vastly improve energy performance, making cost savings on energy consumption and reduce carbon emissions.

In a competitive construction industry, with a large number of intermediaries, the challenge is to foster collaboration and build direct channels between building owners and façade fabricators. Climate-KIC has provided initial funding for the project, helping give a sense of credibility and create conditions of trust. This has encouraged key industry players to get on board with the pilot to develop the new ways of working that leasing requires.

Key Points

- Improving the energy performance of buildings through façade renovation could reduce EU CO2 emissions by five percent
- Dematerialisation, shifting from product volume to services based on product functions, based on product functions can improve lifecycle
- Developing façade service packages to enhance building performance and indoor comfort represents a new strategic direction for a new strategic direction for the industry
- An organisational shift in the construction industry is needed to create the structures and incentives to deliver façades as services
- The Façade Leasing project has assembled interested industry partners to collaborate and explore potential risks, benefits and ways to work together

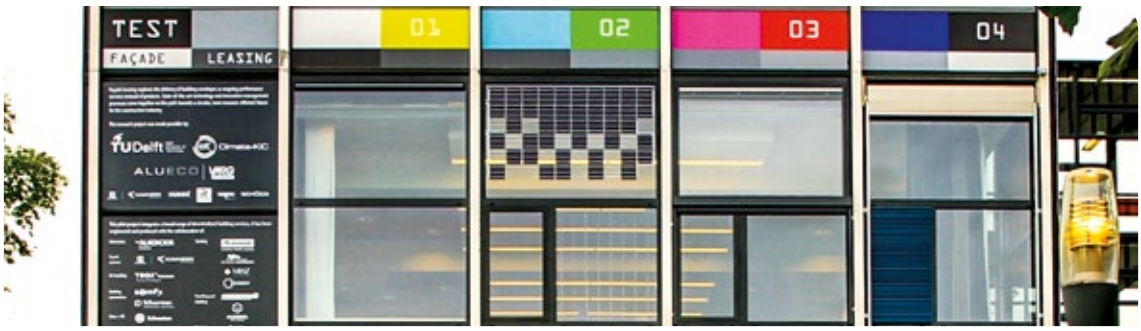
Project Background and Drivers

Buildings are responsible for 40 percent of energy consumption and 36 percent of CO2 emissions in the EU. Older buildings can be up to 20 times as inefficient in their energy consumption for heating as new ones. Around a third of Europe's building stock is more than 50 years old, but by improving energy performance and reducing energy demand, CO2 emissions could be reduced by around five per cent.

The legislation driving this includes the 2010 Energy Performance of Buildings Directive and the 2012 Energy Efficiency Directive. Countries, too, have national measures to reduce the energy consumption of buildings. These include schemes to provide financial support for insulation measures, air sealing, and improved ventilation systems.

Another key aspect of reducing environmental impact is to address the linear use of resources and materials through dematerialisation. Current systems of production and consumption are based on a 'take, make and dispose' model, using energy, and creating waste and pollution along the way. In a 'circular' approach, materials are regarded as valuable at all stages throughout a product lifecycle. In this way, products and materials have greater longevity – they can be retreated, restored, reprocessed or remanufactured into new products.

Conventional façades provide protection against climate, noise and pollutants, ventilation, humidity control and fire safety. However, they tend to be part of larger, centralised control systems, which are often inefficient. Integrated façades, by contrast, are de-centralised, flexible and responsive. As such they offer greater opportunity to control and enhance building performance and provide services – from thermal and indoor comfort to PV energy supply, passive air purification or even food production. Service contracts can be combined and tailored to the needs of the building.



A New Strategic Direction for the Façade Industry

The façade industry is currently considering a number of factors that may impact it in the long-term. These include a reliance on selling greater quantities of technological products dependent on vulnerable raw materials and reliance on a fluctuating construction industry for new business. Up to 88 per cent of façade installations are tied to the construction of new buildings. Because of this, it is difficult to begin discussions about façade renovation since general contractors are the main point of contact and hold sway over price structure, contract and operations.

The gap between client and supplier, occupied by general contractor intermediaries, prevents direct communication, long-term collaboration or material co-ownership between sub-contractors and clients. Façade manufacturers are the party with the widest technical expertise on the functioning of components, yet they are currently excluded from the life-cycle process of the building when construction is finished.

In the current business model, the building owner invests in a new façade, effectively becoming responsible for its maintenance – an activity outside of its core business. When the façade reaches the end of its life, the tendency is to initiate a new project, with new consultants and fabricators, who often lack in prior knowledge or material continuity. Work is duplicated and efficiency is lost.

Financial incentives are not shared between demand and supply side stakeholders. The short-term capital investment required by suppliers to maintain operations requires them to find new projects constantly. This is incompatible with the long-term investment required by real estate development or renovation projects.

The circular business model approach proposes an alternative way forward by offering different functionalities of façades service packages to enhance building performance. In this way of working, the façade fabricator acquires components from sub-suppliers and assembles them into a complete functional system. They deliver the service to the client through installation, maintenance, replacement and/or removal of components.

Financing for the façade renovation is based on Energy-Savings Performance Contracting, where the cost of an energy renovation is offset by the savings resulting from improved performance. The financial incentive for leasing façade services puts greater relevance on the energy saving potential of the system during operation, not just in its theoretical calculation at the time of construction.

"The idea of leasing a façade was not new – firms have been thinking about this direction for some time. When we heard that TU Delft was working on this

topic, we decided to team up on the concept. VMRG is the mediator, if you like, between the research activities and firms producing, engineering and installing the façades. It has worked out well so far. It's been hard getting construction companies so far that they go investing in innovation, but with this concept they will slowly move. It is one of the main tasks for our association," says Martijn Veerman, project coordinator for the VMRG, the Dutch metal façade industry association.

Project Detail

The Façade Leasing team has developed a base of calculations estimating the financial performance and cash flows from client and supplier perspectives for four different façade service packages. These are a low-cost option, an option maximising de-centralised services, and two high-end models with high-performance solar shading and in-built automated control. When connected to data from energy simulation models, this practical tool can quickly provide an estimate of the benefits and costs of specific components within an integrated façade unit. The calculations can be adapted for variations in technologies, maintenance schedules, macro-economic context and contracting period.

In September 2016 a consortium, including component suppliers and façade fabricators, installed a pilot project temporarily replacing a section of the façade on the low-rise building of the Faculty of Electrical Engineering, Mathematics and Computer Sciences at TU Delft, otherwise known as the EWI building.

This pilot façade will demonstrate the state-of-the-art in façade-integrated technologies and allow the team to run tests and simulations with client and suppliers. The façade section replaced on the EWI building will stay in place for one year. The Façade Leasing team has organised a series of workshops with both supply and demand industry partners over the next year to develop energy service contracts,

Issues such as design for disassembly, legal issues, organisation issues, electrical-technical issues – they all have to be sorted out before the first leased façade can be offered on the market.

financing structures and operational services. These workshops will help identify specific problems in the current process, and propose new products and ideas to solve these towards the practical implementation of façades through performance contracts.

"There is still some way to go on this. We need to do much more research to get the lease façade up and running in the market. Issues such as design for disassembly, legal issues, organisation issues, electrical-technical issues – they all have to be sorted out before the first leased façade can be offered on the market," says Veerman.

Climate-KIC Support

TU Delft applied to Climate-KIC's Pathfinder programme in 2015. Pathfinder projects are those that the connect suppliers and clients, demand and supply, getting industry players on board to explore the parameters of the innovation.

Getting a Climate-KIC Pathfinder grant was critical in getting the project off the ground, enabling the team to hire a dedicated researcher and spend time working with the supply chain, while getting industry parties interested in the proposals, according to Professor Tillmann Klein, Head of the Façade Research Group at TU Delft.

"Some of them are now sponsoring the project in kind. Being awarded a grant from Climate-KIC sends a signal to the market and helps kick-start the trust process. In innovation, if you can cover that most risky part, that's half the battle," says Klein.

Municipal E-Bus Planner (Munep2)

Summary

Municipal E-BUS Planner (Munep2) has developed a suite of planning software to aid the transition from diesel to electric bus services by reducing complexity and supporting decision-making. Potential end users include municipal offices, urban developers, transport providers and operators, traffic managers and vehicle manufacturers. The software simulates and models scenarios around the operational and logistical requirements of bus services – from mileage and technical specifications to timetabling and route planning.
The vehicle model outputs the power flow in electric buses to determine energy consumption and the necessary charging infrastructure on different routes.
The major innovation is bringing together operation planning with technical models and optimisation algorithms so that the impact of developing particular vehicles, infrastructure and operation schemes of the electric buses becomes transparent.

Key Points

- The European Commission's low energy mobility strategy aims to reduce greenhouse gas emissions from transport by 60 percent on 1990 levels by 2050
- In cities, many local authorities and bus operators are under pressure to switch from diesel to electric bus services
- The differences between electric and diesel bus operations is significant in terms of range, components and technical specifications
- Munep2 has developed a comprehensive software system that supports planning and decision-making for implementing large and complex electrification scenarios
- Climate-KIC has played a central part in getting Munep2 off the ground, funding early stage customer research and supporting crucial software development

Project Background and Drivers

The European Commission has recently adopted a low emission mobility strategy with aims to reduce greenhouse gas emissions from transport by 60 percent on 1990 levels by 2050. Low-emission transportation and electric mobility will be the cornerstone of this. In cities, bus providers, transport operators and local authorities are making the switch from diesel to electric bus services.

However, this process is far from straightforward. It requires dramatic changes in operations and planning because there are marked differences between diesel and electric buses. Most public transport operations have been developed around diesel buses, which can run for longer periods without having to recharge, and have ease of refuelling. Electric buses, however, have limited driving range and need to be charged in the garage ("back-to-home" concept) or at the terminal stops of the route ("opportunity charging" concept). This means that without proper planning and optimisation, such as rescheduling the timetabling, or re-planning the vehicle schedules, more buses are needed to service routes, or more charging points needed along the way. This creates additional effort: more deadhead, higher driver costs, and a less robust operation. This is compounded by the fact that there are different technologies on the market for electric buses, each bringing different constraints and requiring different operation schemes.

Project Detail

Munep2 has developed a suite of planning software to aid the transition from diesel to electric bus services by reducing complexity and supporting decision-making. Potential end users include municipal offices, urban developers, transport providers and operators, traffic managers and vehicle manufacturers. The software simulates and models scenarios around the operational and logistical requirements of bus services – from mileage and technical specifications to timetabling and operation planning.

The major innovation is bringing together operation planning with technical models and optimisation algorithms so that the impact of the choice of vehicles, infrastructure and operation schemes of the electric buses becomes transparent.

The software, through detailed simulation and scenario calculation, supports decisions relating to the type of energy source (opportunity charging, overnight charging, plug-in hybrids), battery type (choice of technology, sizing), recharging infrastructure, fleet size, load profiles for the components and the electricity network connections, operation strategies and operational planning.

Munep2's software aids the transition from diesel to electric bus services by reducing the complexity of technical and operational planning, supporting decision-making

The final output of the software is a scenario with an optimised set of all these parameters leading to the lowest total cost of ownership. But as the basis is a detailed simulation of the entire electric bus operation, it also yields concrete, directly implementable electrification concepts, and supports everyday operation planning. All of these factors are evaluated in terms of impact, cost and potential emissions reductions, enabling comparison with diesel buses.

"It essentially helps evaluate specific configurations of factors to see if they are technically feasible, and at what costs and emissions reductions. It also suggests using different components available on the market. For example, bus manufacturer X might have a spec that fits. We have all this in the database, so that we then can see how products perform," says Philipp Sinhuber, co-founder of Munep2.

Because of the diverse nature of public transport governance and operations, there is a range of possible end customers for Munep2, says Sinhuber. "It's different from country to country. In Germany, for example, the employer of electric buses, the bus operator, is owned by the city, the latter taking the initiative to electric buses. In London, Denmark and the Netherlands, there's a competitive structure. You have the transport authority granting concessions to privately owned bus operators by competitive tender procedures, so the operators need to be very cost efficient. In the rest of the UK, the bus operators operate on an almost purely commercial basis, with very little constraints and subsidies by the transport authority" says Sinhuber. "A lot of cities request feasibility studies for electric buses but with different end goals and needs."

This diversity of governance and operations makes developing a business model challenging.
As a result, Munep2 is looking at how it can offer services and coordinate with customers of different sizes, each with different numbers of bus routes, bus network size, and energy requirements.

Climate-KIC Support

The Munep approach has been through the Climate-KIC development process since 2010, firstly as a Pathfinder project. Munep 1, as it was called, began at the Institute of Power Electronics and Electrical Drives (ISEA) of RWTH Aachen University, with the aim of scoping out the parameters of a feasible innovation by assembling partners and investigating potential markets.

More recently, Munep2 has evolved into a Demonstration project. Climate-KIC has played a central part in getting the Munep story off the ground. It provided funding for the early stages of the project, which enabled the team to carry out much needed research, contacting potential customers, gathering information on real needs, and developing the software.

"We couldn't have established the software without Climate-KIC's help. It's a complex discipline. The funding was really important in helping us develop our tools, but Climate-KIC has also guided us in networking. Through the network, we came into contact with our first project partner, the Technical University of Delft, with the Birmingham City Council, and with many different supporting partners from the different potential customer groups," says Sinhuber.

What's Next?

While Munep2 has a strong foundation for its electric bus planning offer, the next step is to hone in on customer development, and establish a foothold in the market. "We have a series of planned improvements for the software and are looking at furthering our work with cities. We are making commitment on the business plan in terms of customers. We want our tool and our services to empower transport authorities and bus operators to overcome the hurdles of electric buses and roll out electric buses in every city," says Sinhuber.

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Climate-KIC Info

Climate-KIC
European Headquarters
21 Great Winchester Street
London EC2N 2JA
United Kingdom

Editor: Gina Lovett
Writers: Gina Lovett, Simon Brandon
Designer: Patrick Tartaglini

About Climate-KIC

Climate-KIC is the EU's largest public private partnership addressing climate change through innovation to build a zero carbon economy. We address climate change across four priority themes: urban areas, land use, production systems, climate metrics and finance. Education is at the heart of these themes to inspire and empower the next generation of climate leaders. We run programmes for students, start-ups and innovators across Europe via centres in major cities, convening a community of the best people and organisations. Our approach starts with improving the way people live in cities. Our focus on industry creates the products required for a better living environment, and we look to optimise land use to produce the food people need. Climate-KIC is supported by the European Institute of Innovation and Technology (EIT), a body of the European Union.

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Urban Transitions

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