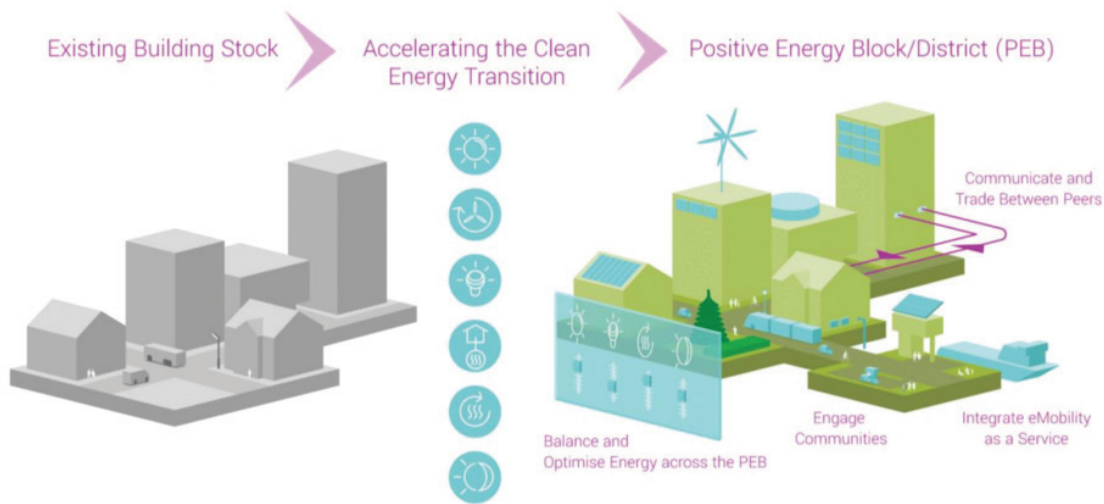


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+Limerick: Innovation and infrastructure in the positive energy city

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+Limerick

Innovation and infrastructure
in the positive energy city

by Helena Fitzgerald MRIAI

(this page) 1. City transitions towards clean energy and positive energy districts, including common energy markets. Source: +CityxChange

If you walk through Limerick’s Georgian streets and cast your eyes downward, you might notice a square object punctuating the surface of the path – a cast iron plate in a limestone frame, cut from a single block. When the plate is removed, the opening leads to a brick vault running beneath the street. These openings were used for the delivery of fuel, coal mainly, but also turf to the basements of Georgian buildings. From there, the fuel was distributed to fireplaces beautifully and elegantly articulated in the Georgian style. The coal holes, brick vaults, fireplaces, and chimneys all describe the energy infrastructure of the late eighteenth century when Limerick’s Georgian city, Newtown Pery, was built. Though coal has been replaced by electricity and gas, our present-day energy infrastructure is still reliant on carbon-based fuels and we now know that this must change.

What replaces carbon-based fuels is the question being explored in Limerick through the Positive City Exchange (+CityxChange) Smart Cities and Communities Lighthouse Project.¹ Funded by the European Commission through its Horizon 2020 research and innovation programme,² +CityxChange examines the co-creation of Distributed Positive Energy Blocks (DPEBs) in the Lighthouse Cities of Limerick – Ireland’s first Smart Cities

and Communities Lighthouse City – and Trondheim in Norway. Five ‘Follower Cities’ who are to follow the experience of the Lighthouse Cities and replicate results include Alba Iulia in Romania; Písek in the Czech Republic; Võru in Estonia; Smolyan in Bulgaria, and Sestao in Spain. +CityxChange is developing a structured approach to the creation of Positive Energy Blocks (PEBs) and to scaling these up to create Positive Energy Districts (PEDs) as part of the clean energy transition of the participating cities.³

So what are PEBs, DPEBs, and PEDs, and how do they work? A PEB is a group of buildings – at least three in number with a minimum floor area – which cooperate around energy and which together, on an annual basis, produce more primary energy than they consume. Buildings in a PEB must have different uses, e.g. residential and commercial, to take advantage of complementary patterns of energy consumption and to optimise local renewable energy production, consumption, and storage. A DPEB refers to where the buildings in a PEB are distributed and not directly attached to each other. A Positive Energy District, comprising a number of PEBs or DPEBs, refers to where a defined urban area produces more energy than it consumes. A series of PEDs created over time can create a positive energy city.

(this page) 2. Transformation from passive distribution system operation to active distribution system operation. Source: +CityxChange

(opposite page) 3. A structured approach to the co-creation of Positive Energy Blocks. Source: +CityxChange

In Limerick, +CityxChange is developing a pilot DPEB which initially includes five buildings whose energy use will be analysed throughout the course of the project using smart energy monitors. Interventions including energy saving and retrofit measures, the introduction of additional local renewables, and local energy storage will be designed and evaluated with the building owners to enable the group of buildings to become net energy producers. Communication in real-time using smart grid digital technologies will allow the system to actively manage supply and demand and to enable peer-to-peer energy trading. A tidal turbine developed by Limerick company GKinetic is proposed to boost the proportion of locally generated renewables in the historic built environment of the Georgian city. By the end of the project, the pilot DPEB is to extend to include twenty-five buildings.

Though the PEB concept might appear to be straightforward, realising the potential of local and small-scale renewable energy presents a considerable challenge which the +CityxChange consortium of thirty-two partners – including Limerick City and County Council, ESB Networks, and ESB Innovation – seeks to address. Electrical power systems have traditionally consisted of large fossil-fuel-based power stations connected to the transmission system. The transmission system in turn supplies power to the distribution system which distributes the power to individual customers. This paradigm is no longer valid as the distributed generation of renewable energy means that power is generated on the distribution network,

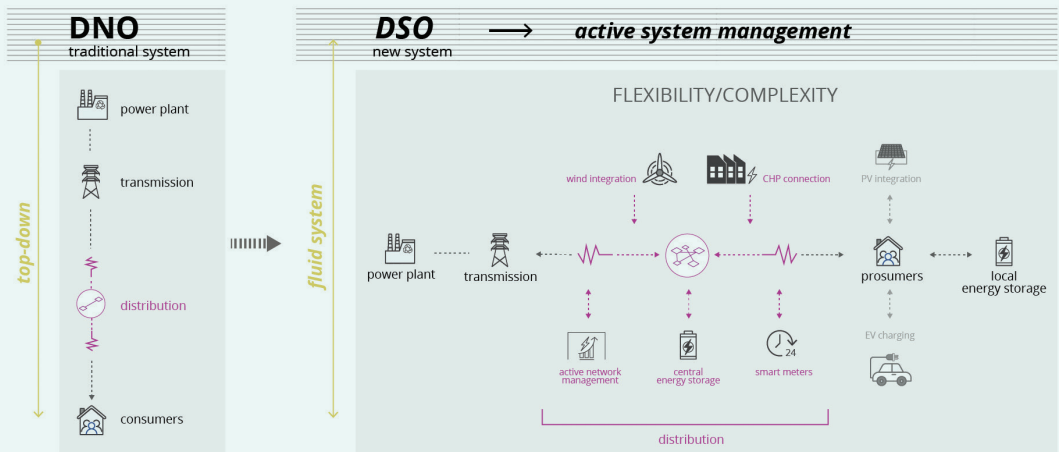
providing energy to customers and in some cases feeding power back to the transmission system. In Ireland, the Distribution System Operator (DSO) is ESB Networks and the Transmission System Operator (TSO) is Eirgrid, who also run the all-island energy market known as I-SEM.

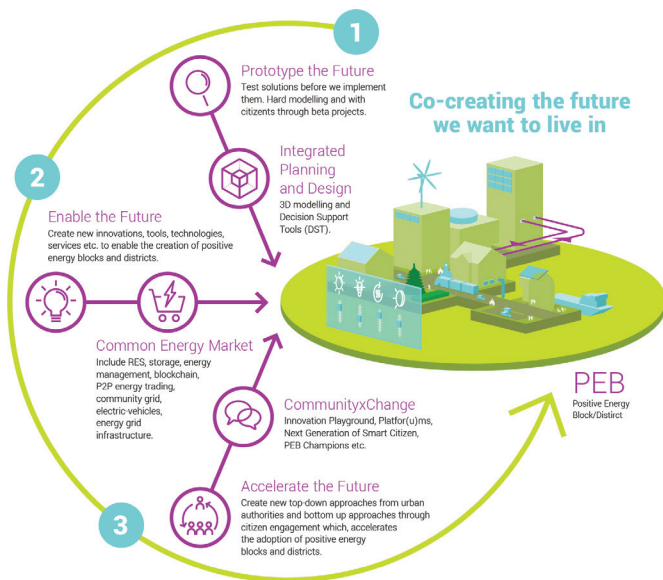
The electrical energy system concepts that are being trialled as part of +CityxChange reflect the requirements of a system that will facilitate the cost-effective integration of small-scale renewable energy with large-scale renewable energy using decentralised trading of electrical energy and flexibility, supported by the exploration of distributed ledger technologies. Integrating small-scale renewable energy, where central renewable energy production is added to by prosumers – consumers who both produce and consume energy – creates complexity.

To address this complexity, the +CityxChange project is structured around three distinct strands of investigation, each of which generate frameworks and systems for implementation. The first strand, titled ‘Integrated Planning and Design’, develops the open ICT architecture and the integrated and interconnected approaches needed in the service-based ecosystem supporting the PEBs and PEDs. It includes the development of an interactive Decision Support Tool – an ICT-enabled city energy model to design the PEBs and PEDs in both space and time – with interfaces to allow citizens to participate in the design process. The second strand, ‘The Common Energy Market’, focuses on developing tools to enable local energy markets and includes development of the regulatory mechanism needed to create a regulatory sandbox where the technical solutions

Transformation from traditional network operators (DNOs) to active system management (DSOs)

*DNO - Distribution Network Operator
*DSO - Distribution System Operator





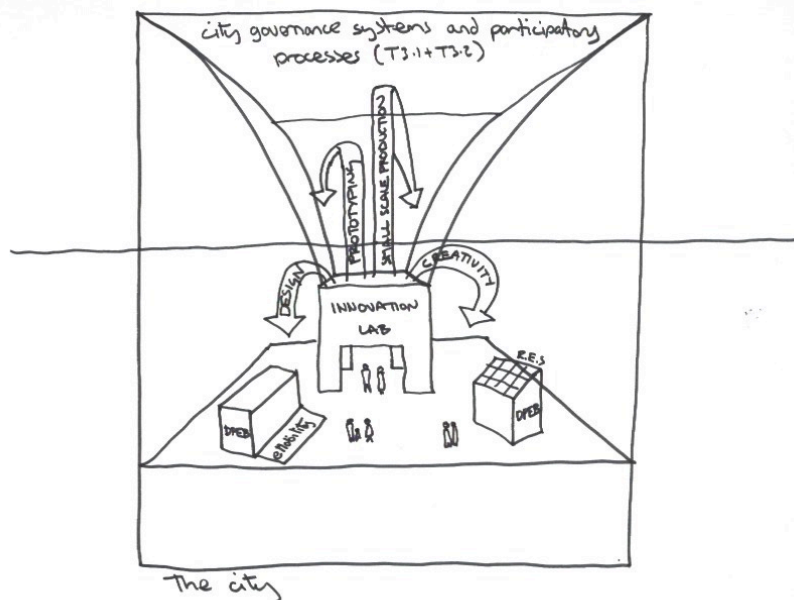
developed in +CityxChange, e.g. community grids, can be demonstrated in the cities. University of Limerick (UL) lead the third strand, called 'CommunityxChange', which includes six frameworks to enable citizen participation and co-creation in the clean energy transition through top-down and bottom-up processes of engagement. The focus on citizen engagement responds to the potential that exists for citizens to become prosumers and to collaborate to develop local energy projects as citizen energy communities⁴ or renewable energy communities,⁵ while also acknowledging that citizens' contributions can shape their future city and their future energy infrastructure in innovative ways. The first three frameworks – 'The Bold City Vision Framework', 'The Participation Playbook' and 'The Framework for Innovation Playgrounds' – are complete and can be viewed on the +CityxChange Knowledge Base.⁶ The remaining three frameworks – 'Framework for DPEB Learning and Education', 'Framework for a Positive Energy Champion Network', and 'Framework for DPEB Innovation Labs' – will be complete by November 2020.

The +CityxChange DPEB Innovation Lab, the concept for which can be viewed as an extension of the School of Architecture at University of Limerick's Fab Lab, creates a place where the CommunityxChange frameworks become manifest. A dedicated centre for digital innovation within a city,⁷ the DPEB Innovation Lab is both a physical space and a programme, focused on the creation of DPEBs. The Lab is to be directly integrated with city governance systems and closely linked to the +CityxChange Citizen Observatory system, where citizens use portable and mobile devices to actively participate in recording observations on their environment to build an evidence base to bring about change. A collaborative operating structure supports an Open Innovation 2.0 ecosystem where citizens, business, academia, and government can co-create and prototype solutions and approaches responding to issues faced in the clean energy transition.

"A collaborative operating structure supports an Open Innovation 2.0 ecosystem where citizens, business, academia, and government can co-create and prototype solutions and approaches responding to issues faced in the clean energy transition"

The Lab will host open challenges where stakeholders will have access to open city data and citizen-sourced data generated through implementation of the Participation Playbook. Access to the DPEB Decision Support Tool will allow the design and operation of the DPEBs to be visualised and analysed. The Lab activities will be supported by active learning processes to enable a permeable culture of co-creation in the city.

(this page) 4. An operational DPEB innovation lab. Source: Helena Fitzgerald



Notes

- 1 cityxchange.eu.
- 2 The +CityxChange project has received EU funding under Grant Agreement no. 824260.
- 3 D. Ahlers, P. Driscoll, H. Wibe, A. Wyckmans. 'Co-Creation of Positive Energy Blocks', *First Nordic Conference on Zero Emission and Plus Energy Buildings*. IOP Conference Series: Earth and Environmental Science. vol. 352, IOP Publishing, 2019.
- 4 Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU [2019] OJ L158/125, (Electricity Directive), Article 2(11).
- 5 Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources [2018] OJ L328/82, (Renewables Directive), Article 2(16).
- 6 cityxchange.eu/knowledge-base.
- 7 'Innovation is when new or improved ideas, products, services, technologies, or processes create new market demand or cutting-edge solutions to economic, social, and environmental challenges'. B. Katz and J. Wagner, 'The Rise of Urban Innovation Districts', Brookings Institution, May 2014, p. 2.
- 8 R. Murray, J. Caulier-Grice, and G. Mulgan, *The Open Book of Social Innovation*, youngfoundation.org, 2010, pp. 11-13.
- 9 'Italian Team Covers Glacier With Giant White Sheets to Slow Melting', *The Guardian*, 21 June 2020.
- 10 D. Harvey, 'The Right to the City', *The City Reader*, vol. 6, no. 1, 2008, p. 23.

At the University of Limerick (UL), +CityxChange is a collaboration between the School of Architecture (SAUL) and the Kemmy Business School. Professor Merritt Bucholz led UL's contribution to the successful H2020 project bid and Stephen Kinsella, Associate Professor of Economics, is the Principal Investigator in implementation. The UL team includes Gabriela Avram, Lecturer in Digital Media and Interaction Design at the Department of Computer Science and Information Systems, and Gerard Walsh, Lecturer at the School of Architecture University of Limerick (SAUL) and coordinator of its Fab Lab located in Limerick city centre. Helena Fitzgerald is UL's +CityxChange coordinator and Work Package Lead on the CommunityxChange suite of frameworks for citizen engagement and co-creation. Collaborators on the CommunityxChange frameworks include the Digital Strategy and Urban Innovation Departments of Limerick City and County Council, Trondheim Kommune, the +CityxChange Follower Cities, Colaborativa.eu, ISOCARP, NTNU – Norwegian University of Science and Technology as overall project coordinator, Officinae Verdi, and Space Engagers.

As a research and innovation project, the CommunityxChange frameworks have been developed and tested in Limerick over the last year. A CityEngage week was held in September 2019 focused on the laneways of the Georgian City which are seen as having more capacity to adapt to change. The CityEngage concept, developed by Rosie Webb (Senior Architect at Limerick City and County Council's Urban Innovation Department), builds on the +CityxChange Participation Playbook and includes participatory mapping using a digital mapping tool, intergenerational learning events, co-design workshops, hackathons, matchmaking, and gamification events all focused on a particular theme.

In January 2020, Limerick City and County Council (LCCC) launched the first +CityxChange Open Call using Limerick's digital public collaboration and consultation portal, mypoint.limerick.ie. Five citizen-led projects have progressed to develop rapid urban prototypes in response to the open call theme and will appear in Limerick over the coming months. The +CityxChange Open Call challenges can be viewed as an example of the implementation of a social innovation process which can contribute to the creation of an open innovation ecosystem in the city.⁸

Innovation in energy is not new to Limerick. The Ardnacrusha power plant, located just outside the city, was the largest hydroelectric power plant in the world for a time, until the Hoover Dam surpassed it in the 1930s. Generating electricity in the city centre has also been done before. Between 1902 and 1927, when the ESB was formed, the Corporation of Limerick supplied electricity to street lights, homes, and businesses from a generating station located on Frederick

Street, now known as O'Curry Street. In a way, the creation of DPEBs in Limerick with local renewable energy generation can be seen as going back to the future, a view held by Pat Stephens of the Limerick Clare Energy Agency.

While writing, I see an article about the Presena glacier in northern Italy which has lost one third of its volume since 1993.⁹ Each summer, it is wrapped in a protective layer of white fabric, 100,000m² in size, which reflects the sun and lowers the temperature of the glacier's surface, thus slowing the rate at which the ice melts. The work takes six weeks to complete, a considerable effort, only for the fabric to be removed again in the autumn. The response to global warming requires effort, from individuals, communities, business, academia, and government. We need to do things we have not done before, to innovate. +CityxChange offers a pathway for the people of Limerick to play a part in the clean energy transition of their city, to innovate in developing new clean energy infrastructure and to perhaps approach what David Harvey refers to as their 'right to the city'.¹⁰ In years to come, you may walk through Limerick and a feature may catch your eye, something unique to the place; perhaps a novel idea for integrating local energy storage into the Georgian grid, or a particular user interface to a smart meter, or a method of fixing photovoltaic panels to historic roofs which minimises disruption to the building fabric. But perhaps the most significant piece of infrastructure will be that which you cannot see, the collaborative structures and processes in Limerick supporting constitutive communication and local energy innovation. The +CityxChange project in Limerick is carefully and deliberately designing this infrastructure and working to embed it in the city.