Project Number: 793021

Project Acronym: CircuBED

Project title: Applying the Circular
Economy to the Design of Social
Housing

Periodic Technical

Report Part A

Period covered by the report: from 01/06/2018 to 28/02/2021

Periodic report: *[*1ˢᵗ*]*

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1.   Summary for publication

Summary of the context and overall objectives of the project (For the final period, include the conclusions of the action)

The project explored how urban communities in social housing can contribute to the implementation of a circular economy (CE) in cities, and how they can be engaged in envisioning the transition to a CE. Cities heavily contribute to the current climate crisis due to the growing urbanisation combined with our current linear production-consumption system. Cities emit around 70% of carbon emissions, consume over 78% of the world's energy and 75% of natural resources, and produce over 50% of global waste. Resource efficiency in cities depends on consumption and production patterns that are strongly linked to citizens' lifestyles and behaviors. Almost one-fourth of the ecological footprint of cities in the UK consists of citizens' food and drink consumption and that together with three other components - travel, energy, and consumables - constitutes 70% of the total footprint.

The CE offers an approach to rethink and reshape current production and consumption practices to reduce resource use, minimize waste and enable society, the economy and the environment to prosper sustainably. Until now, the CE has mainly focused on technical innovations in materials, products, business models and industrial systems with reduced attention to social practices and behavioral change. On the other side, the literature on behavioural change highlights the crucial role played by social innovation (SI) in promoting sustainable living and resource efficiency. SIs are initiatives that encourage alternative social practices through citizens' engagement, the creation of new roles and relationships, the development of new assets and capabilities and improved access to power and use of resources. Even if it is acknowledged that these interventions complement top-down initiatives in the implementation of a CE in cities, SIs are not well-known or well-established.

Therefore, the project pointed at exploring the phenomenon of SI for a CE in urban communities and groups of interest through the analysis of collective interventions aimed at promoting circular production and consumption practices among citizens to define the potential contribution of social housing communities to a CE. This study provided the identification of seven types of SI for a CE that can engage social housing communities in a transition to a CE. Based on this typology, the study defined potential opportunities, benefits and challenges for social housing. Moreover, it showed that SI can hold a complementary role with the industry, government and institution in the implementation of a CE in cities. Therefore, the project suggested the introduction of emerging SI concepts in the CE approach to overcome current limitations in the CE approach and support the transition to a CE in cities.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far (For the final period please include an overview of the results and their exploitation and dissemination)

Work performed:

1) exploration of the current implementation of a CE in cities and then in social housing by literature review, interviews and data analysis.
2) review of current knowledge on behavioral change through SI and recent understanding of SI for sustainability.
3) analysis of current issues in terms of housing maintenance and building lifecycle as well as social housing residents' needs and aspirations through secondary data analysis and interviews.
4) investigation of the phenomenon of SI implemented by urban communities and groups of interest in collaboration with social enterprises and businesses and focused on promoting circular production and consumption practices through empirical research.
5) categorization of case studies into three main categories and seven main modes of circular production and consumption practices through empirical observation, comparison and grouping.
6) identification of a typology of SI for a CE in urban communities and groups of interest and a systematic description of types.
7) definition of the potential contribution of social housing communities to the transition to a CE through SI by specifying SI opportunities, benefits and obstacles.
8) definition of SI opportunities for cities in the transition to a CE as well as challenges.
9) advancement on knowledge in the current CE approach by the definition of the circular community concept overcoming current CE limitations and by the introduction of emerging SI concepts into a

CE framework to support SI opportunities for a CE.

Project results:
- Knowledge advancement:
  1) a typology of SI for a CE composed of three main categories and seven types of innovation with a systematic description of features.
  2) a framework of opportunities, benefits and challenges for social housing to implement SI for a CE in their communities.
  3) a framework of opportunities and challenges for cities to implement SI for a CE.
  4) the formulation of the concept of circular community to overcome current limitations in the CE approach.
  5) the expansion of the ReSOLVE framework in the CE approach by the introduction of a SI strategy to be combined with CE actions for supporting the development of SI opportunities for a CE.

Exploitation and dissemination:
- Further research – new research fund applications to implement further research for providing additional evidence on potentials of the circular community concept and benefits of adopting gamification as a citizens' engagement approach for resource circularity.
- Training - educational programs for Bachelor and Master students in Architecture to support the implementation of CE concepts and strategies in the built environment by design.
- Societal knowledge and actions – promotion of bottom-up knowledge on the CE concepts and societal actions for the CE implementation by SI through gamification.
- Policy change – formulation of preliminary recommendations regarding support strategies and measures for policymaking to support SI for a CE based on evidence provided by further research.

Progress beyond the state of the art, expected results until the end of the project and potential impacts (including the socio-economic impact and the wider societal implications of the project so far)

Progress beyond the state of the art:
- introduction of SI concepts and strategies in the CE approach because of the role that SI can have in the transition to a CE in cities through behavioural change by engaging citizens in interventions that promote circular production and consumption practices.
- formulation of the concept of a circular community implemented by groups of citizens organized into communities, groups of interest, businesses and social enterprises that promote regenerative production and consumption initiatives to ensure well-being for all within planetary boundaries and overcome current limitations in the CE approach by prioritizing circular practices intertwined with degrowth principles.
- introduction of gamification as a citizens' engagement approach on resource circularity to facilitate decoding of CE concepts and strategies and support collaborative envisioning of SI scenarios for the transition to a CE.

Expected further results until the end of the project:
- Product prototype - a card game prototype on SI for a CE to engage social housing and urban communities in decoding CE concepts and strategies and envisioning possible SI scenarios for a CE into their communities.

Impacts:
- Researcher – restart of the academic career
- Climate change-related issue - contribution to the challenge of resource efficiency in cities to mitigate their impact on climate change.
- Behavioural change – public knowledge on the CE concepts and practices and SI interventions for a CE.
- Policymaking – potential implications on policymaking with impact on the European and Wales CE and SI policies.
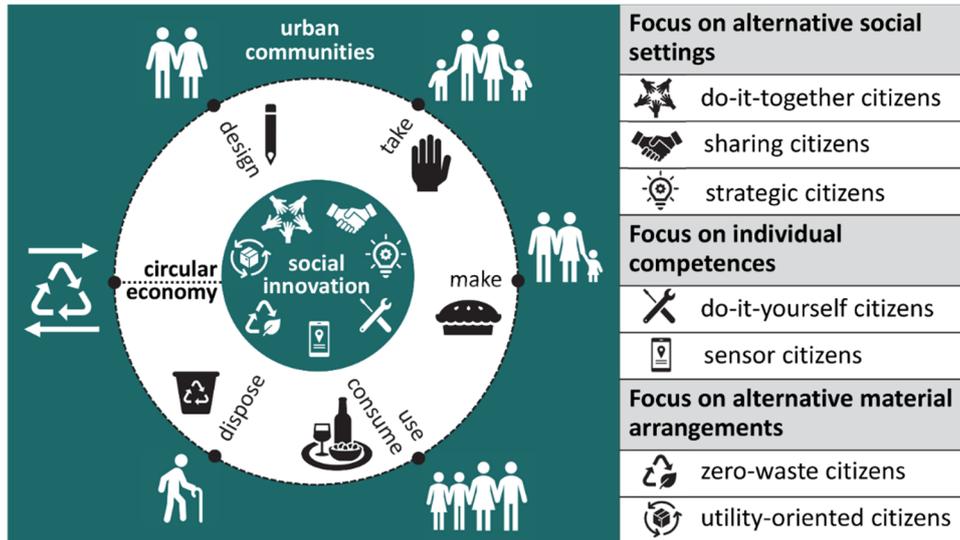
address (URL) of the project's public website
the website homepage should contain the EU flag (download an electronic version) and the name 'Horizon 2020'.
https://www.cardiff.ac.uk/research/explore/find-a-project/view/2412458-circubed-applying-the-circular-economy-to-the-design-of-social-housing

at least one image/diagram/photo illustrating and promoting your project work
you must have cleared any rights of third parties in advance.

Social innovation for a CE in social housing

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[3] Any rights of third parties must be cleared in advance in accordance with the GA.

Project Number: 793021

Project Acronym: CircuBED

Project title: Applying the Circular Economy to the Design of Social Housing

Periodic Technical

Report Part B

Period covered by the report: from 01/06/2018 to 28/02/2021

Periodic report: *[*1ˢᵗ*]*

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1. Explanation of the work carried out by the beneficiaries and overview of the progress

1. *overview of the project results towards the objectives of the project in line with the DoA*
- **Knowledge advancement:** 1) a typology of social innovation (SI) for a circular economy (CE) with a systematic description of types and their characteristics; 2) a framework of opportunities, benefits and challenges for social housing communities to implement SI for a CE in their communities; 3) a framework of opportunities and challenges for cities to implement SI for a CE; 4) definition of the concept of circular community to overcome current limitations in the CE approach and 5) expansion of the ReSOLVE framework in the CE approach by the introduction of a SI strategy to be combined with CE actions for supporting the development of SI opportunities for a CE.
- **Product prototype:** a serious card game prototype on SI for a CE to engage social housing and urban communities in envisioning SI scenarios for a CE to promote circular production and consumption practices in their communities *(under completion)*.

2. *summary of deliverables (i.e. Ethics requirements and/or Data Management Plan) and milestone*
   Ethics requirements: 1) *Deliverable D1-1*: Details on the procedures and criteria that were used to identify/recruit research participants; Detailed information on the informed consent procedures that were implemented for the participation of research participants; Templates of the informed consent forms and information sheet are available upon request; 2) *Deliverable D1-2*: Risk assessment and details on measures to prevent misuse of research findings.

3. *a summary of exploitable results*
- **Knowledge** - the concept of circular community and the approach to citizen engagement on resource circularity through gamification will be further explored through additional research for exploitation in policymaking.
- **Product prototype** – a card game prototype on SI for a CE will promote societal knowledge and actions for behavioural change *(under completion)*.

4. *an explanation about how they can/will be exploited*
- **Further research** – The concept of circular community and citizens' engagement on resource circularity through gamification will be further explored through small research fund applications - L' Oreal Award Rising Talent Award and the Research Wales Innovation Fund - Innovation for All - to provide additional evidence of potential and benefits. Based on emerging evidence, I will proceed with impact implications on policymaking. Moreover, emerging evidence will allow applying for a large fund grant (ERC Starting Grant) aimed at helping society to become circular overcoming current limits in the CE approach. The project will investigate economic, technical, social and regulatory frameworks to be adopted to support the transition to a circular society.
- **Training** – educational design programs for Bachelor and Master students in Architecture are already implemented in the Welsh School of Architecture (WSA) in Cardiff University (CU) to promote the implementation of CE concepts and strategies in the built environment through design thereby contributing to the 'regeneration of the gene pool' in the building industry.
- **Societal use for behavioural change** - public knowledge on the CE concepts and strategies and societal actions for the CE implementation through SI will be promoted through gamification. The game will be developed and will be freely available on the project webpage of the CU website. People will be able to download it from the webpage as a PDF A4 brochure, print the document and cut the cards for playing. Instructions for preparing and playing will be included in the brochure. If and when Covid-19 restrictions allow, play sessions will be arranged with social housing and urban communities in London and Cardiff Capital Region to collect feedback.
- **Policy change -** preliminary recommendations regarding possible support strategies and measures for policymaking to support SI for a CE will be formulated based on evidence provided through further research on circular communities and the use of gamification as public engagement for resource circularity, as well as the analysis of existing policy or other support measures and consultations with experts and policymakers. Findings will be embedded in a policy brief for the Welsh Government.

1.1 Objectives

Overall assessment:
The project has fully achieved its objectives and milestones for the period, with relatively minor deviations.

List of the specific scientific and training objectives for the project as described in the DoA and description of the work carried out during the fellowship towards the achievement of each listed objective:

Main Aim: to define the potential contribution of social housing to the transition to a CE in cities			
WP1 – Analysis (T = Task; D = Deliverables; M = Milestones)			
Aim 1: to understand the current state-of-the-art of the CE implementation in cities and in social housing as well as the desire situation in social housing in relation to the CE by literature review, interviews and secondary data analysis			
T1.1	to analyse the current implementation of a CE in cities and social housing to identify research gaps	**D1.1**	- current implementation of the CE in cities. - current implementation of the CE in social housing. - current knowledge on behavioural change through SI, and SI for sustainability.
T1.2	to analyse current issues in terms of housing maintenance and building lifecycle as well as social housing residents' needs and aspirations through secondary data analysis and interviews	**D1.2**	- a database about social housing management issues reported by Clarion Housing Group in their housing stocks. - collection of information from social housing residents on their needs and aspirations about current living practices as well as perceptions with regards to collective initiatives and services already existing in the field.
T1.3	to specify project objectives, relevant areas, activities and expected contribution	**D1.3**	List of project objectives, relevant areas, main activities and expected contribution.
M1.1	discussion on the expectations, needs and requirements in social housing in terms of resource circularity		
WP2 – Development			
Aim 2: to develop a comprehensive investigation of the phenomenon of SI for a CE in urban communities and groups of interest through design experiments, empirical research and reasoning			
T2.1	to develop a socio-technical design concept to support the implementation of a CE in a social housing community	**D2.1**	a design concept of a domestic kitchen as a hybrid socio-technical system composed of products and services offered through a social enterprise implemented in a social housing community in London.
T2.2	to develop an empirical research investigation on SI for a CE through the analysis of SI initiatives that promote circular production-consumption practices in urban communities and groups of interest	**D2.2**	- list of SI initiatives that promote sustainable production-consumption practices in residential communities and groups of interest. - theory-based template for data collection. - collection of data for each case study. - comparative matrix.
T2.3	to develop a typology of SI for a CE and main characteristics through data comparison and reasoning	**D2.3**	- definition of three categories and seven main modes of circular production and consumption practices. - definition of seven types of SI for a CE. - systematic description of each type and main characteristics.
M2.1	setting-up of a cross matrix for case study comparison and pattern identification		
WP3 – Evaluation			
Aim 3: to assess findings to define how they could be used to implement a CE in social housing and cities			
T3.1	to assess findings in terms of opportunities, challenges and benefits for social housing	**D3.1**	list of opportunities, challenges and benefits for the implementation of SI for a CE in social housing.
T3.2	to assess findings in terms of opportunities and challenges for cities	**D3.2**	list of opportunities, and challenges for the implementation of SI for a CE in cities into the urban product, food, mobility and building systems.
T3.3	to assess findings in terms of concepts and strategies to expand knowledge in the current CE approach	**D3.3**	- expanded ReSOLVE framework to support the implementation of SI opportunities for a CE.

			- formulation of the concept of circular community overcoming current CE limitations
M3.1	identification of SI opportunities, benefits and challenges for a CE in social housing based on the developed typology		

WP4 - Management			
Aim 4: to manage project progress, risks, exploitation and dissemination with the support of Prof. C. Tweed			
T4.1	to manage the project progress and outputs with the supervision of Prof. C. Tweed	**D4.1**	project progress report (once every month).
T4.2	to manage quality & risks with the supervision of C. Prof. Tweed	**D4.2**	quality and risks management review (once every month).
T4.3	to manage dissemination and exploitation with the support of Prof. C. Tweed	**D4.3**	exploitation & dissemination plan review (once every month).
M4.1	meeting with Prof. C. Tweed (once every Month) to monitor project progress, risks management and exploitation & dissemination		

WP5 - Training			
Aim 5: to increase competence in terms of skills by advance training and inter-sectorial mobility			
T5.1	to plan for training	**D5.1**	career development plan and update with the support of Prof. C. Tweed (once every month)
T5.2	to increase the set of research-related and transferable skills	**D5.2**	attendance of 18 workshops & training sessions organized according to three main areas (research management skills; specialist skills; career development skills): - *Research management skills:* 1) Managing research data (13 June 2018); 2) Managing research project (26 June 2018); 3) Open access: REF and funder requirements (8 October 2018); 4) Communication your research to non-specialists (17 January 2019); 5) Understanding intellectual propriety rights (11 February 2019). - *Specialist skills:* 6) Participatory design (04/05/2019 - 08/06/2019); 7) User Experience (UX) Design (08/05/2019 - 12/06/2019); 8) Service design (02/11/2019 - 14/12/2019). - *Career development skills:* 9) Career planning for researchers (25 September 2018); 10) CVs and job applications for researchers (30 October 2018); 11) Collaboration: the hidden research skill (5 December 2018); 12) Getting research funding: where to get info, points to cons (21 March 2019); 13) Storytelling for researchers (13 April 2019); 14) How to write a good research bid (9 May 2019); 15) Introduction to planning an academic career (14 June 2019); 16) Moving into research leadership (24 June 2019); 17) Getting started in teaching (4-6 May 2020); 18) Academic Support and Student Engagement (5-12 February 2021).
T5.3	to acquire inter-sectorial experience	**D5.3**	an inter-sectoral secondment at Arup Foresight in London (duration: 4 months - from 1 June 2019 to 31 October 2019) with the supervision of Dr D. Gerber.
M5.1	meeting with Prof. C. Tweed (once every month) to monitor career development progress and review the career development plan		

WP6 – Dissemination, Communication and Exploitation			
Aim 6: to disseminate and communicate the project and results to different target audiences as well as exploit research results			
T6.1	to disseminate project results in academia	**D6.1**	- 3 publications: 1 journal article in an open-access high-impact peer-reviewed journal (*Journal of Sustainable Cities and Society*); 1 peer-reviewed conference paper in the BEYOND 2020 conference proceedings; 1 peer-reviewed extended abstract in the ERSCP 2019 conference proceedings. - 2 participations at international conferences: The European Roundtable for Sustainable Consumption and Production

				(ERSCP) 2019 on 15-18 October 2019 in Barcelona (Spain) and BEYOND 2020 on 2-4 November 2020 held online.
				- 5 academic seminars/lectures: one in WSA on 17 October 2018, two in the Earth and Society Master programme of the WSA on 9 and 16 October 2018, one in the WSA on 20 March 2019 and one within intersectoral groups at CU on 28 January 2020.
				- 2 participations at events other than conferences or workshops: MSCA Satellite Event ESOF 2018 on 07-09 July 2018 and MCAA Conference in Vienna on 24-25 February 2019.
				Activities planned in the next months:
				- Workshop on Climate Change and Circular Economy (online) on 27 April 2021 to which I have been invited as a keynote.
				- Welsh Tech Week (online) on 21-25 June 2021 to which I have been invited as a keynote.
				- Sustainable Earth 2021, an online sustainability research conference, promoted by the University of Plymouth on 24-25 June 2020.
				- 2nd International Conference 2021 on Circularity in the Built Environment (CiBEn) on 24-26 November 2021 at TU Delft (Netherland) *(online or in-person)*.
T6.2	to disseminate project results to housing associations, policymakers, and experts on the CE and SI	**D6.2**		- Promotion of the project for establishing external collaborations on the project implementation by presentations to housing associations (Coastal Housing Group on 13 August 2018, Pobl Group on 9 October 2018, Wales & West Housing on 17 October 2018; and Clarion Housing Group on 19 November 2018), the industry (Tata Steel on 19 September 2018, BAM on 15 October 2018, HTA Design on 25 October 2018, and Symphony Group on 24 April 2019); and a service consultancy (Experientia on 16 July 2018).
				- Consultations with key stakeholders: 3 meetings with Clarion Housing Group (ref. Paul Quinn - on 25 January 2019, 8 April 2019; and on 26 November 2019); 2 meetings with experts on the CE in Arup London (ref. David Gerber, Carol Lemmens, Lucie Barouillet, Camilla Andersen, Becci Taylor and Davni Acharya - on 20 March 2019 and 02 October 2019); 1 meeting with Centre for CE, Exeter University (ref. Prof. Peter Hopkinson - on 8 July 2019); 2 meetings with CU Business School (ref. Prof. Peter Wells on 16 November 2018 and 13 June 2019), 1 meeting with CU School of Geography and Planning (ref. Dr Kersty Hobson - on 16 December 2019); 1 meeting with CU Sustainable Places Research Institute (ref. Dr Abid Mehmood, an expert on SI - on 29 January 2020); 2 meetings with Welsh Government (ref. Andy Rees - on 20 November 2018, and 9 October 2019); 1 meeting with Cardiff City Council (ref. David Jaques - on 16 November 2020).
				Activities planned in the next months:
				- Consultations with a housing association (Clarion Housing Group), policymakers (Welsh Government) and experts on CE (CERIG, SpaceMaker Center at CU Business School) and SI (Y Lab-Nesta, Dr Abid Mehmood).
T6.3	to disseminate the project results to social housing and urban communities	**D6.3**		*Activities planned in the next months:*
				- card game prototype development on SI for a CE to engage social housing and urban communities in envisioning SI scenarios for a CE into their communities.
				- if and when Covid-19 restrictions allow, gaming sessions with social housing and urban communities.
				- submission of the envisioned game for participation at "Science is wonderful! 2021".
T6.4	to communicate the projects by the media and to the public	**D6.4**		- Project webpage in the CU website.

			- Contribution to the following public engagement events:
			European Researchers Night in Bristol on 28 September 2018 (through a Video on Twitter and a storytelling session);
			European Researcher Nights in Bath on 27 September 2019 (through a Bitesize Research presentation);
			European Researchers Night in Cardiff on 27 November 2020 (through a Great Research Bake-Off entry).
T6.5	to exploit results	D6.5	- *Societal knowledge and action* – public knowledge on CE concepts and societal actions for the CE implementation through SI by gamification.
			- *Training* - design programs for Bachelor and Master students to promote the application of CE concepts and strategies at the urban and building levels of the built environment by design.
			- *Further research* - further research development supported by new fund applications.
			- *Policy action* - preliminary recommendations regarding possible strategies and measures for supporting SI initiatives for a CE based on evidence provided by further research.
M6.1	meetings with housing associations and other key stakeholders to inform them about the project at the beginning, during the project implementation and at the end of the project		

1.2 Explanation of the work carried per WP

WP1: Analysis

1) *Exploration on the current implementation of a CE in cities and social housing by a literature review to identify potential research gaps and issues*

A general overview of the CE implementation in cities was performed initially. This analysis highlighted that a CE has mainly been implemented at several levels of technological innovations from materials and products to business models and industrial systems with limited emphasis on changes in user behaviour and social practices. On the other side, resource efficiency showed to be affected by consumption and production patterns strongly linked to people behaviours. |Therfeore, the full implementation of a CE in cities needs to consider not only innovations in technologies and resource management infrastructures but also changes in people's production and consumption practices.

A literature review of behavioural change highlighted the crucial role played by collective interventions in promoting sustainable living as well as resource efficiency in cities. It was found that people are more willing to change and stabilize changed practices when they are engaged in initiatives with peers like their neighbours. These are local wider interventions that engage people and promote changes in social practices through the creation of new roles and relationships, development of new assets and capabilities and improved access to power and use of resources. These interventions are called SIs.

Moreover, the analysis explored the current implementation of a CE in social housing. Experiences in Denmark and the UK showed a focus on the development of flexible and adaptable housing technological assets with limited attention to the contribution of social housing communities to a CE despite an emerging interest among Housing Associations. Therefore, through this analysis, the project identifies research gaps and issues.

2) *Exploration on current issues in terms of housing maintenance and building lifecycle as well as social housing residents' needs and aspirations through secondary data analysis and interviews*

The project was presented to several potential housing association partners (Coastal Housing Group on 15 August 2018, Pobl Group on 9 October 2018, and Wales & West Housing on 17 October 2018, and Clarion Housing Group on 26 November 2018) to explore potentials for collaboration. Clarion Housing Group (ref. Paul Quinn) was finally engaged in the project. They were developing a large social housing project in Southwest London, called Merton Regeneration, in which they aimed at applying a CE approach by combining technological innovations with SIs. They meant to reduce waste generation and materials consumption at all stages of the building lifecycle and into their community as well as maximise social value creation and economic return within the community. Implementing residents-led

initiatives for a CE, they intended to strengthen social network and cohesion, creating a sense of ownership for residents and encouraging a sharing economy.

Clarion Housing Group provided information about housing management issues. Issues were mainly located in bathrooms, kitchens, windows and doors, roofing and services (control of fluids and electrical services). Kitchens, bathrooms, finishes and fixings were identified as the main technological opportunities for implementing a CE. Residents were recognized as crucial stakeholders to reduce the likelihood of early refurbishment, waste generation and vandalism actions. Initially, the study identified the domestic kitchen as a significant opportunity for the research project implementation because of its relevance economically (in terms of maintenance impact in social housing) and environmentally (in terms of waste reduction).

Through a preliminary analysis, based on desk-based research, consultations with Clarion Housing Group and experts in service design (Experientia), I identified representative social housing residents target segments: singles with children, singles without children, couples with children, couples without children, and elderlies. This segmentation informed the protocol for the selection of social housing occupants to involve in focus groups. A mix of people of different ages and family sizes among social housing occupants was recruited to be involved in a focus group. The focus group aimed at gathering information on their needs and aspirations on current living practices and housing issues as well as perceptions with regards to community initiatives and services. Even though the number of interviewees was small, they provided an initial understanding of the uses, likes and dislikes of people's living environment as well as potential barriers, and factors of success for the implementation of community initiatives and services for resource circularity. Interviewees' needs were mainly concerned with the maintenance of home services systems (like the central heating boiler), furniture abounded in common spaces, the shortage of community spaces and the lack of social cohesion in the community.

3) Specification of project objectives, relevant areas, activities and expected contribution

Through the early exploration, I concluded that the implementation of a CE in social housing implicates not only the development of technological housing solutions for resource efficiency and waste reduction but also the development of initiatives to promote circular production-consumption practices among residents. Based on these inputs, the project refined objectives, relevant areas, main activities and expected contribution pointing at SI for circular production and consumption practices to promote behavioural changes in social housing communities for a transition to a CE.

WP2: Development

1) Development of a socio-technical design concept for a housing component to support the implementation of a CE in a social housing community

The activity initially explored the idea of designing a housing component as a socio-technical innovation that implements a CE in social housing and supports its embedding in the community. The study considered redesigning a domestic kitchen as a hybrid system of products and services offered through a social enterprise. The system was envisioned to be integrated within a circular business model that supports collective value creation and retention between the parties involved, and a strategy to embed the system socially. The envisioned system aimed to keep resources in use as long as possible through reuse, refurbishment and re-manufacturing as well as recycling at the service-life end minimizing waste generation and materials consumption. A digital system platform supported product-information tracking and services supplies underpinning a social enterprise within the community. The enterprise provided access locally to products and services as well as fabrication space, tools and training, thereby promoting socio-economic benefits in the community. This activity was implemented during my secondment in the project partner Arup Foresight in London. The project was presented to a kitchen supplier (Symphony Group) involved in Clarion's Merton Regeneration project to explore the potential for further collaboration.

2) Development of empirical research study on the phenomenon of SI for a CE through the analysis of existing SI initiatives that promote sustainable production-consumption practices in urban communities and groups of interest

Through interviews, social housing tenants displayed a strong interest in having available SI services and facilities in the community to support them in pursuing circular production and consumption practices like reusing, repairing or borrowing. Instead, the opportunity to upgrade housing technical

components like kitchen or bathroom captured minor consent. Clarion Housing Group shared the interest in SI initiatives for a CE to promote change in residents' behaviour. Based on these inputs and considering the crucial role of citizens' production and consumption practices on resource efficiency, and the limited attention of the CE on behavioural change and SI, the study decided to focus on SI for a CE. Initially, it considered designing a SI initiative for a CE with a social housing community in the Clarion Housing Group. Because of the COVID-19 pandemic and consequent difficulties for the housing association to collaborate and engage tenants, a contingency plan was implemented. The study focused on the analysis of existing SI interventions aimed at promoting circular production and consumption practices in urban communities and groups of interest. Based on established criteria, I detected 56 existing SI initiatives for a CE. Then, I analyzed them by collecting secondary data based on a theory-based template developed according to knowledge gathered in the preliminary literature review. The template included general information for each case, an analysis of the innovation process implemented, and the impact assessment founded on potentials and empirical evidence. Data were gathered for each case study, and information was summarized in a cross-case matrix form to support comparison. This analysis provided an overview of contemporary SI initiatives implemented by urban communities and groups of interest or social enterprises and businesses which involve urban communities for the promotion of alternative practices in cities.

3) *Development of data comparison and grouping to define a typology of SI for a CE and main characteristics*

A process of comparison and grouping followed the analysis and allowed identified three categories of SI for a CE and seven modes of circular production and consumption practices for a CE across the case studies. Based on this, I identified seven types of SI for a CE and provided a systematic description of these types and their characteristics. Then, I focused on defining how these findings can be used to implement a CE in social housing and cities.

WP3: Assessment

1) *Assessment of findings in terms of SI opportunities for a CE, challenges and benefits for social housing*

Based on the developed typology, I defined how social housing can contribute to a transition to a CE through SI by specifying SI opportunities to develop for a CE in their communities as well as benefits and obstacles.

2) *Assessment of findings in terms of opportunities offered by SI for a CE to cities and challenges*

The developed database offered a framework to identify opportunities and challenges for cities to implement SI for a CE.

3) *Assessment of findings in terms of knowledge advancement in the current CE approach*

The study provided insights for knowledge contribution in the current CE approach. It suggested the introduction of the SI strategy "engage and empower" into the ReSOLVE framework, a well-established CE framework, to be combined with CE actions for the development of SI opportunities for a CE. Moreover, the study outlines the concept of circular communities overcoming current limits in the CE approach and practices. It displayed groups of citizens organized into communities, groups of interest, businesses and social enterprises that promote regenerative production and consumption practices in urban systems by prioritizing circular strategies intertwined with degrowth principles and by putting them into practice to ensure wellbeing for all within the planetary boundaries. Examples are cooperative housing or repair café.

WP4: Management

1-3) Management of project progress, risks, and plan for exploitation and dissemination

During the project implementation, the project progress has been reviewed once a month with the supervision of Prof. C. Tweed. A project report organized according to work carried per work package was developed in preparation for the meeting and reviewed during the meeting. It included project tasks, progress and outputs, quality & risks management as well as exploitation & dissemination management. This monthly review practice will continue until the completion of planned activities.

WP5: Training

1) Training on research-related and transferable skills
The fellowship offered the opportunity to increase competencies in terms of skills and experiences by advance training placing the ground to proceed with an academic career as a Lecturer (Research and Teaching path) in the WSAat CU. I increased the set of research-related and transferable skills by the attendance of 18 workshops & training sessions in three main areas:
- *Research management skills:* 1) Managing research data (13 June 2018); 2) Managing research project (26 June 2018); 3) Open access: REF and funder requirements (8 October 2018); 4) Communication your research to non-specialists (17 January 2019); 5) Understanding intellectual propriety rights (11 February 2019).
- *Specialist skills:* 6) Participatory design (04/05/2019 - 08/06/2019); 7) User Experience (UX) Design (08/05/2019 - 12/06/2019); 8) Service design (02/11/2019 - 14/12/2019).
- *Career development skills:* 9) Career planning for researchers (25 September 2018); 10) CVs and job applications for researchers (30 October 2018); 11) Collaboration: the hidden research skill (5 December 2018); 12) Getting research funding: where to get info, points to cons (21 March 2019); 13) Storytelling for researchers (13 April 2019); 14) How to write a good research bid (9 May 2019); 15) Introduction to planning an academic career (14 June 2019); 16) Moving into research leadership (24 June 2019); 17) Getting started in teaching (4-6 May 2020); 18) Academic Support and Student Engagement (5-12 February 2021).

2) Inter-sectorial experience
I acquired inter-sectorial experience through a four-month secondment (from 1 June 2019 to 31 October 2019) at Arup Foresight in London under the supervision of Dr D. Gerber. In this experience, I worked on the development of a socio-technical design concept to implement a CE and support its embedding in a social housing community in London. This opportunity offered me the chance to discuss the idea with staff members in Arup into the area of product design (Lucie Barouillet), service design (Camilla Andersen), building maintenance (Becci Taylor), CE (Carol Lemmens and Davni Acharya) and collect feedback for improvement and further development.

3) Career development and training plan/monitoring
During the project progress meetings, the career development and training plan were periodically monitored and reviewed with the support of Prof. C. Tweed.

WP6: Dissemination, Communication and Exploitation

1) Dissemination of project results in academia
During the project implementation, results have been disseminated to peers in the research field through academic publications and participation at international conferences. Early results have been included in a peer-reviewed paper published in the BEYOND 2020 conference proceedings. Then I published the final project results in an open-access high-impact peer-reviewed journal article in the Journal of Sustainable Cities and Society. Additional publications may result from citizens engagement through gamification.
I participated in 2 international conferences, The European Roundtable for Sustainable Consumption and Production (ERSCP) 2019 on 15-18 October 2019 in Barcelona (Spain), and the BEYOND 2020 conference on 2-4 November 2020 held online.
I presented the project in 5 academic seminars/lectures in CU: one in the WSA on 17 October 2018, two in the Earth and Society Master programme of the WSA on 9 and 16 October 2018, one in the WSA on 20 March 2019 and one within intersectoral groups at CU on 28 January 2020.
Final results will be presented at a Workshop on Climate Change and Circular Economy on 27 April 2021 to which I have been invited as a keynote. It is an event promoted by the UK Government Science and Innovation Network in Berlin with Smart Sustainable Cities partner and the participation of the University of Leeds, Zero Waste Scotland, University of Birmingham, UCL and the Umweltdachverband Austria. I will also present final results at the Sustainable Earth 2021, a University of Plymouth's annual sustainability research conference aimed to spark ideas and encourage collaborations to tackle global and local challenges around the climate emergency, on 24-25 June 2020. Additionally, I will participate at the 2nd International Conference 2021 on Circularity in the Built

Environment (CiBEn) on 24-26 November 2021 at TU Delft (Netherland).

2) Dissemination of the project results to housing associations, policymakers, experts on the CE and SI
The project was promoted initially and during its implementation for external collaborations by meetings with:
- *housing associations* (Coastal Housing Group on 15 August 2018, Pobl Group - Darren Bolton on 9 October 2018, and Wales & West Housing on 17 October 2018, Clarion Housing Group starting from 26 November 2018);
- *building industry* (Tata Steel on 19 September 2018, BAM on 15 October 2018, HTA Design on 26 October 2018, Symphony Group on 24 April 2019);
- *service consultancy* (Experientia on 16 July 2018).

Early results have been discussed during the project implementation in meetings with key stakeholders:
- *housing associations*: Clarion Housing Group (ref. Paul Quinn - on 25 January 2019, 8 April 2019; and on 26 November 2019);
- *policymakers:* Welsh Government (ref. Andy Rees on 20 November 2018, and 9 October 2019) and Cardiff City Council (ref. David Jaques on 16 November 2020);
- *experts on CE and SI:* Arup London (ref. David Gerber, Carol Lemmens, Lucie Barouillet, Camilla Andersen, Becci Taylor and Davni Acharya on 20 March 2019 and 02 October 2019), Centre for CE (Prof. Peter Hopkinson, Exeter University on 8 July 2019), and CU Business School (Prof. Peter Wells on 16 November 2018 and 13 June 2019), CU Sustainable Places Research Institute (ref. Dr Abid Mehmood on 29 January 2020), and CU School of Geography and Planning (ref. Dr Kersty Hobson on 16 December 2019).

Final results will be shown to policymakers and experts on the CE (through CERIG - Circular Economy Research and Innovation Group Wales) through participation at the Welsh Tech Week (online) as a keynote on 21-25 June 2021. Moreover, they will be disseminated through consultations with housing associations (Clarion Housing Group), and experts on CE (SpaceMaker Center at CU Business School) and SI (Y Lab-Nesta) for promoting exploitation.

3) Dissemination of the project results to social housing and urban communities
The final results will be disseminated to social housing and urban communities by gamification. Based on findings, the project is developing a card game to engage citizens on resource circularity, facilitate decoding of CE concepts and strategies and support collaborative envisioning of SI scenarios for the transition to a CE. The game will be freely available on the project webpage of the CU website. People will be able to download it from the webpage as a Pdf A4 brochure, print the document and cut the cards for playing. Instructions for preparing and playing will be included in the brochure.
If and when Covid-19 restrictions allow, gaming sessions will be arranged with a social housing community in London and urban communities in Cardiff Capital Region. Feedback from participants will be collected to assess the ability of a gaming practice to engage citizens, promote bottom-up knowledge on CE concepts and strategies and support collaborative discovery on how to contribute to a CE through SI.
The game proposal will be also submitted to Science is Wonderful! 2021 (SiW) for participation. The event engages young audiences by showcasing the impact of EU-funded research and innovation projects. This year, the 2021 edition of SiW will be a fully online event taking place on 22-26 November 2021.

4) Communication of the project by the media and to the public
The project was communicated by the media and to the public. A project website was developed, and it has been updated. It will also include the downloadable version of the card game when it is available.
Also, I communicated the project in 3 public events: the European Researchers Night in Bristol on 28 September 2018 (through a Video on Twitter and a storytelling session), the European Researcher Nights in Bath on 27 September 2019 (through a Bitesize Research presentation), and the European Researchers Night in Cardiff on 27 November 2020 (through a Great Research Bake-Off entry).

5) Exploitation of project results
Findings will be exploited for training, further research, policy change, and public knowledge & societal action.
Findings have been already exploited through training. They have been embedded in design units that I

have led in Bachelor and Master programmes starting from October 2019. In these programs, I engaged students through a set of presentations, and design workshops/tutorials in rethinking and designing a neighbourhood in an ex-industrial area as a mixed-use development with services and facilities to improve resource efficiency, reduce waste, keep the resources in use locally, create job opportunities and promote social value for the local community. CE concepts and strategies have been applied at the urban, building and component levels by design.

The concept of circular community and the approach of citizens engagement through gamification will be further explored through research to provide additional evidence. I will apply for small research funds (the Oreal Award Rising Talent Award, and the Research Wales Innovation Fund - Innovation for All) and a large fund grant application (ERC Starting Grant).

Based on emerging evidence, I will proceed with impact implications on policymaking by formulating recommendations regarding possible support strategies and measures to be embedded in a policy brief for the Welsh Government. The main background for developing our recommendations will be formed through examination of challenges, obstacles and success factors via case analyses, consultations with experts and the complementary study of policy and other support measures.

Finally, the card game prototype under development will be employed for promoting public knowledge on the CE concepts and strategies as well as societal actions for the CE implementation by SI.

Results:

a) main scientific and/or technological achievements:

Knowledge advancement:
- a typology of SI for a CE with a systematic description of types and their characteristics.
- a framework of opportunities, benefits and challenges for social housing communities to implement SI for a CE in their communities.
- a framework of opportunities and challenges for cities to implement SI for a CE.
- definition of the concept of circular community to overcome current limitations in the CE approach
- expansion of the ReSOLVE framework in the CE approach by the introduction of a SI strategy to be combined with CE actions for supporting the development of SI opportunities for a CE.

b) main innovation outputs (if applicable):

Product prototype: development of a card game prototype on SI for a CE to engage social housing and urban communities in envisioning SI scenarios for a CE into their communities.

c) contribution to the state of the art:

The project explored the contribution of urban communities in social housing to the transition to a CE through SI. Until now the implementation of a CE has mainly been pursued at the technological level through innovations in materials, products, business models and industrial systems with reduced attention to user practices and behaviours. Recent experiences on the implementation of a CE in social housing show the development of flexible and adaptable housing technological assets, while the contribution of social housing communities to the transition to a CE has not been yet considered. On the other side, resource efficiency in cities depends on consumption and production patterns that are strongly linked to people behaviour. The literature on behavioural change highlights the crucial role played by SI on sustainable living as well as resource efficiency by promoting changes in social practices. Even if it is acknowledged the complementary role of these bottom-up initiatives in combination with top-down initiatives in the implementation of a CE in cities, SI interventions for a CE have been not yet explored. Therefore, the project filled this gap.

Moreover, through this study, the project outlined the concept of circular communities. It showed seven types of citizens organized into communities, groups of interest, businesses and social enterprises that promote fair, caring and regenerative production and consumption practices in urban systems by prioritizing strategies and by putting them into practice through circular solutions intertwined with degrowth principles to ensure wellbeing for all within the planetary boundaries. Examples of circular communities are cooperative housing, transition communities, social enterprises and no-profit/public partnerships with local communities. These initiatives place restorative and regenerative interactions of humans with the environment at the centre of the economy for the benefit of all within environmental limits overcoming limits in the current CE approach and practices.

<u>*d) scientific and/or technological quality of the results:*</u>
Early results were included in a peer-reviewed paper published in the conference BEYOND 2020 proceedings. The final results were published in a peer-reviewed open-access article in the international high-impact Journal of Sustainable Cities and Society. Additionally, findings emerging from the game prototype development and play sessions will be reported in a peer-reviewed open-access high-impact journal article to guarantee the quality of results.

<u>*e) comment on secondment(s), if applicable:*</u>
During my four-month secondment from 01/07/2019 to 31/10/2019 at Arup Foresight in London, I focused on the conceptual development of a socio-technical solution to implement a CE and support its embedding in a social-housing community in London. This experience offered me the chance to discuss technical and SI aspects, collect feedback and develop the concept further with Arup staff members into the area of product design (Lucie Barouillet), service design (Camilla Andersen), building maintenance (Becci Taylor), and CE in the built environment (Carol Lemmens and Davni Acharya). In that period, I analysed several technical and SI case studies that implement CE concepts and strategies in the built environment. These data have been embedded in the case studies analysis on SI for a CE implemented later. The secondment also contributed to the discovery of the use of gaming to promote knowledge awareness on the CE in cities since Arup Foresight has already developed games for engaging children and youths on CE concepts and strategies.

Progress of the Activities:
<u>*a) main research / innovation*</u>
The project will be completed in the next months by disseminating findings to academia, key stakeholders (housing associations, policymakers, experts on the CE and SI) and end-users (social housing and urban communities) and by exploiting results for training, further research, policy change, public knowledge and societal action.
Final results will be presented at a Workshop on Climate Change and Circular Economy on 27 April 2021, at the Sustainable Earth 2021 conference on 24-25 June 2020 and at the 2nd International Conference 2021 on Circularity in the Built Environment (CiBEn) on 24-26 November 2021 at TU Delft (Netherland).
Final results will be presented to Wales policymakers and experts on the CE through participation at the Welsh Tech Week (online) on 21-25 June 2021. Moreover, they will be shown through consultations with housing associations (Clarion Housing Group), and experts on CE (SpaceMaker Center at CU Business School) and SI (Y Lab-Nesta) for promoting exploitation.
Based on findings, the project is developing a card game to engage end-users (social housing and urban communities) on resource circularity, facilitate decoding of CE concepts and strategies and support collaborative envisioning of SI scenarios for the transition to a CE. The game will be freely available on the project webpage of the CU website. Moreover, if and when Covid-19 restrictions allow, gaming sessions will be arranged and feedback from participants will be collected.
The game proposal will be submitted to Science is Wonderful! 2021 (SiW) for participation. It is an EC online event for young audiences taking place on 22-26 November 2021 to showcase the impact of EU-funded research and innovation projects.
Findings have been already exploited through training. The concept of circular community and the approach of citizens engagement through gamification will be further explored through research to provide additional evidence. Based on emerging evidence, I will proceed with impact implications on policymaking. Finally, the card game prototype under development will be employed for promoting public knowledge on the CE concepts and strategies as well as societal actions for the CE implementation by SI.

<u>*b) researcher's training*</u>
Training will be further implemented in the next months in the research and teaching areas. In the research area, the training will focus on *Delivering Research Excellence with Impact* (on 8 March 2021). In the teaching area, the training will focus on *Negotiation Skills* (7 June 2020); *Education Fellowship Programme* (*Introduction*, on 14 April 2021; *Applied Pedagogy*, on 12 May 2021; *Teaching Design for Learning*, on 16 June 2021; *Teaching Practice for Effective Learning*, on 7 July 2021; *Assessment for*

Learning, 8 September 2021; *Student Support and Learning Community*, on 6 October 2021; *Quality, Evaluation and Dissemination*, on 10 November 2021).

c) transfer of knowledge
Transfer of knowledge will be further implemented in the months through:
- dissemination: knowledge dissemination 1) in academia through an additional scientific peer-reviewed publication in a journal or book, and participation at two additional international conferences, and 2) in the no-academic community to social housing residents through gamification (game development and play sessions), and to housing associations, policymakers and experts through consultations, networking and participation at a workshop and a tech week.
- education: academic design programs for Bachelor and Master students in the WSA that promote the implementation of CE concepts and strategies in the built environment through design thereby contributing to the 'regeneration of the gene pool' in the building industry.

d) difficulties or problems encountered; how they were solved (included any deviations from the DoA in section 5)
During the project implementation, I encountered difficulties in the involvement of key stakeholders (housing associations, and the building industry) in research activities for different reasons.
Firstly, I arranged several meetings for presenting the project to potential partners (housing associations and the building industry) until I found partners interested in collaborations. After the attempts to involve housing associations from Wales without success, I was put in touch with Clarion Housing Group, a housing association in England interested in implementing a CE in social housing.
The project was also presented to the building industry, Tata Steel, BAM, and HTA Design, and also to a kitchen supplier (Symphony Group) involved in Clarion's Merton Regeneration project to explore the potential for collaborations, but finally, collaborations did not proceed because of end-users and research reconsideration. Clarion Housing Group and social housing residents showed interest in SI services and facilities to support them in pursuing circular production-consumption practices. Research displayed gaps in the area of SI for a CE. Therefore, I considered focusing on SI for a CE in social housing communities, and I planned to develop a SI initiative for a CE with a social housing community.
Moreover, because of the COVID-19 pandemic and consequent difficulties for the housing association to collaborate and engage tenants, it was not possible to involve residents in the development of a SI initiative for a CE in their community. Therefore, a contingency plan was implemented by focusing on the analysis of existing SI interventions aimed at promoting circular production and consumption practices in urban communities. These changes entailed a delay in the project implementation. Therefore, the last "dissemination, and exploitation" tasks will be completed after the project end date (28 February 2021).

Details on the (non-scientific) management activities of the project:
a) was the researcher involved in all management aspects of the fellowship?
I was involved in all management aspects of the fellowship. I managed the project progress and outputs as well as reviewed the project quality combined with risks and exploitation and dissemination activities with the supervision of Prof. C. Tweed once a month.

b) did the researcher manage the financial part of the project?
I managed the research budget by regularly updating and monitoring a budget expenditure plan once a month.

c) did the researcher receive support from the administrative staff at the host institution?
I received adequate support from the administrative staff of CU.

d) how was the integration of the researcher within the host/department?
I was gradually integrated within the department by initially sharing an office with colleagues and presenting my project to the School. When I started to be involved in teaching as a part-time Lecturer, my process of integration speeded up later.

e) did the researcher supervise Master/PhD students?
I have been supervising students enrolled on the MA in Architectural Design (MAAD) since October 2019 by leading a design unit that promoted the application of CE principles in urban and architectural

design. Moreover, I have been supervising Master students in Architectural Science on the development of their dissertation theses.

f) were there weekly meetings with the supervisor?
There was a meeting with Prof. C. Tweed once a month. Additional meetings were arranged when needed.

g) was the researcher involved in setting up external collaboration (if any), and in the publication of the results?
I promoted the launch of external collaborations for the project implementation by presentations and discussions with the following:
- *housing associations* - Coastal Housing Group on 15 August 2018, Pobl Group on 9 October 2018, and Wales & West Housing on 17 October 2018, Clarion Housing Group starting from 26 November 2018.
- *building industry* - Tata Steel on 19 September 2018, BAM on 15 October 2018, HTA Design on 26 October 2018, Symphony Group on 24 April 2019.
- *service consultancy* - Experientia on 16 July 2018.
- *governments* - Welsh Government on 20 November 2018 and 9 October 2019; Cardiff City Council on 16 November 2020.

I was the main responsible for the publication of results. I set up all the publications of the project and developed them as the first author.

1.3 Impact

a) Impact on the researcher's career:
The project implementation helped me to overcome the barrier caused by a two-year career break after my PhD completion and restart an academic career. Starting from September 2019, I was appointed as a Lecturer in Architectural Design in the WSA. Moreover, the project implementation offered the opportunity to focus on the CE as a promising approach for the sustainable development of the built environment, embed new concepts in teaching and implement research. As a Lecturer, I have been leading design units in Bachelor and Masters' programmes focused on designing neighbourhoods, buildings and components that foster the implementation of a CE by design.

Moreover, the project outcomes offer the opportunity to apply for further research development. Based on current research results, I am applying for small research funds (L' Oreal Award Rising Talent Award and Research Wales Innovation Fund - Innovation for All) as a Principal Investigator for implementing pilots at the regional level to provide evidence about the circular community concept and citizens' engagement through gamification. Then, the experiment will be extended to reach communities at the international level in the global north and south as well as to develop recommendations regarding strategies and measures for policymaking to support SI for a CE. Moreover, emerging evidence will allow applying for a large fund grant (ERC Starting Grant) aimed at helping society to become circular, overcoming current limits in the CE approach

b) Does the work carried out enhance innovation capacity, create new market opportunities, strengthen competitiveness and growth of companies, address issues related to climate change or the environment, address industrial and/or societal needs at the regional level or bring other important benefits for society?
The work carried out addressed the challenge of resource efficiency in cities by implementing a CE to reduce the impact of cities on the environment and its effect on climate change. Resource efficiency in cities depends on consumption and production patterns that are strongly linked to people behaviour, but until now the CE has mainly focused on technological innovations with limited attention to behavioural change. Therefore, this project pointed at exploring changes in production and consumption practices to promote behavioural change for the transition to a CE. Behavioural change can be effectively encouraged through initiatives of SI that involve people in alternative social practices. Through SI, citizens can develop innovative opportunities to satisfy their needs and access resources (food, energy, water, and fabricated products) efficiently, achieve social and environmental goals and benefit from new capabilities, improved autonomy and self-reliance. Therefore, SI can have a crucial role in the implementation of a CE in cities and thereby on climate change mitigation since it can align individual

interests with social and environmental benefits and promote mutually beneficial solutions towards sustainability.

c) Relevant innovation activities carried out (prototypes, testing activities, standards, clinical trials) and/or new products, services, reference materials, processes or methods (to be) launched to the market if any.

Based on results already implemented, I am developing a card game prototype to engage an urban community in social housing in envisioning SI scenarios for promoting circular production and consumption practices into the community. If and when Covid-19 restrictions allow, play sessions will be performed with a social housing community in London and urban communities in Cardiff Capital Region to collect feedback. This outcome will be the premise for the development of a "playful" platform to explore further the ability of games to engage urban communities on resource circularity, foster bottom-up knowledge and facilitate collaborative decision-making for the transition to circular communities.

d) Does the carried-out work contribute towards European policy objectives and strategies and/or have an impact on policymaking?

The carried-out work contributes towards European policy objectives and strategies on CE as well as on SI. The European Commission adopted in 2020 a new CE Action Plan, one of the main blocks of Europe's new agenda for sustainable growth (European Union, 2020). The CE Action Plan acknowledges the mutual benefits derived by linking SI and the social economy with the CE by skills and jobs creation, green transition and strengthening of social inclusion. Moreover, in the fourth quarter of 2021, the European Commission foresaw the adoption of an Action Plan for Social Economy (European Union, 2021). The social economy is recognized as a driver of collective interests as well as social and environmental objectives toward fair and sustainable growth.

Since the crucial importance of both topics in the European policy, the project results can have a potential impact on policymaking. Further research will be implemented to provide additional evidence and formulate recommendations regarding possible support strategies and measures in policymaking to support the transition to a CE through SI.

e) Please identify potential users of the project results. Has there been suitable communication with interested parties?

Potential users of the project results are 1) social housing communities, urban communities and groups of interest; 2) housing associations, policymakers, CE and SI experts; and 3) Bachelor and Master students in Schools of Architecture.

1) The project is developing a card game prototype for engaging urban communities on resource circularity through SI and foster bottom-up knowledge on CE concepts and strategies. The game will be freely available on the project webpage of the CU website. Moreover, if and when Covid-19 restrictions allow, game sessions will be played with a Clarion housing community in London and two urban communities in Cardiff Capital Region to disseminate results. Finally, the game proposal will be submitted to Science is Wonderful! 2021 (SiW), an EC online event taking place on 22-26 November 2021 to engage young audiences by showcasing the impact of EU-funded research and innovation projects.

2) Final results will be presented to policymakers and experts on the CE (through CERIG - Circular Economy Research and Innovation Group Wales) through participation at the Welsh Tech Week (online) on 21-25 June 2021. Moreover, they will be disseminated through consultations with housing associations (Clarion Housing Group), and experts on CE (SpaceMaker Center at CU Business School) and SI (Y Lab-Nesta) for promoting exploitation.

3) Regarding Bachelor and Master students, I have already implemented design units focused on involving students to trace new paths towards sustainable futures in cities through the implementation of a CE by urban and architectural design. Students have rethought how neighbourhoods, buildings and components are designed, made, used and recovered to explore new sustainable ways of producing, consuming and living. Students have been engaged in discussion with the Cardiff City Council on the redevelopment of a neighbourhood in an ex-industrial area based on CE concepts and strategies. Developed proposals will be shared with the Cardiff City Council. Moreover, the design unit is contributing to addressing a growing demand for expertise in the topic. Architecture design

firms are starting to search for collaborators with knowledge on the implementation of CE in cities by design. In London, the city building regulation has embed CE principles among the requirements for new constructions and retrofits, while the Royal Institute of British Architects (RIBA) has introduced CE requirements in the high-education accreditation procedures.

2. Update of the plan for exploitation and dissemination of results (if applicable)

a) Plan for exploitation and dissemination of results:

Tab.1. Exploitation & Dissemination Plan (in compliance with *H2020 Online Manual-Dissemination & Exploitation*)

WP	WP2	WP3
Exploitable outcomes	SI typology for a CE, and systematic description of different types of SI and their characteristics	- overview on opportunities, challenges, and benefits from the implementation of SI for a CE in social housing communities and cities - expanded ReSOLVE framework - the concept of circular communities
Main User	- housing associations, policymakers, CE and SI experts	- social housing and urban communities - policymakers, housing associations, CE and SI experts - students in Schools of Architecture
Importance for the main user	overview on SI initiatives for the promotion of circular production and consumption practices in urban communities	support for the development of SI initiatives for a CE
Barriers to the application of results	- regulation, political and infrastructural obstacles - inadequate skills - need for facilitation - traditional chains less keen to innovate	
Exploitation & Dissemination	- publication of an article in a high-impact open-access peer-reviewed journal - participation at 2 international conferences, and two international events - presentation at five seminar lectures within intersectoral groups at CU - design units in the WSA Bachelor and Master programmes to involve students in the implementation of CE concepts and strategies in the built environment by design - consultations with housing associations, CE experts and policymakers	
Communication	- contributions to the European Researchers Nights in 2018, 2019, and 2021 - development of a project webpage	
Further steps after the project end	- card game prototype development on SI for a CE and, if and when if and when Covid-19 restrictions allow, play sessions with social housing and urban communities - submission of the game proposal to Science is Wonderful! 2021 (SiW) for participation - publication of an article in a high-impact open-access peer-reviewed journal or a book chapter - participation at two international conferences, one workshop and one tech week - consultations with housing associations, CE experts and policymakers - research fund applications for further research to provide additional evidence and formulate recommendations for policy change	

b) List the conferences attended, and other activities undertaken to disseminate the results of the project.

Conferences attended:
- The European Roundtable for Sustainable Consumption and Production (ERSCP) 2019 in 15-18 September 2019, oral presentation.
- BEYOND 2020 conference in 2-4 November 2020, oral virtual presentation.

Other activities implemented:
- 5 academic seminars/lectures: one in the WSA on 17 October 2018, two for Master students in the Earth and Society programme of the WSA on 9 and 16 October 2018, one in the WSA on 20 March 2019 and one within intersectoral groups at CU on 28 January 2020.
- 3 presentations at policymakers: the Welsh Government (ref. Andy Rees, Head of Waste Strategy) on 20 November 2018, and 9 October 2019 and Cardiff City Council (ref. David Jaques, Operational Manager, Development & Regeneration) on 16 November 2020.

- presentations at experts on the CE, the built environment and SI: Arup Foresight London on 20 March 2019 and 9 October 2019, Prof. Peter Hopkinson (Centre for CE, Exeter University) on 8 July 2019, Prof. Peter Wells (Business School in CU) on 16 November 2018 and 13 June 2019, Dr Abid Mehmood (Sustainable Places Research Institute in CU) on 29 January 2020, and Dr Kersty Hobson (School of Geography and Planning in CU) on 16 December 2019.
- implementation of academic design units that promote the application of CE principles at the urban, building and component levels in Bachelor and Master programmes in the WSA starting from October 2019.

Activities planned in the next months:
- project results presentation at Workshop on Climate Change and CE on 27 April 2021 to which I have been invited as a keynote. It is an event promoted by the UK Government Science and Innovation Network in Berlin with Smart Sustainable Cities partner and the participation of the University of Leeds, Zero Waste Scotland, University of Birmingham, UCL and the Umweltdachverband Austria.
- project results presentation at Wales Tech Week - What is a CE and how Wales is leading the way - on 23 June 2021 – invitation as a speaker.
- project results presentation at Sustainable Earth 2021, a sustainability research conference, promoted by the University of Plymouth on 24-25 June 2020.
- project results presentation at 2nd International Conference 2021 on Circularity in the Built Environment (CiBEn) on 24-26 November 2021 at TU Delft (Netherland).
- consultations with housing associations (Clarion Housing Group), policymakers (Wales Government) and experts on CE (Circular Economy Research and Innovation Group Wales) and SI (Y Lab – Nesta).
- game development and, if and when if and when if Covid-19 restrictions allow, play sessions with social housing and urban communities to engage them in envisioning SI opportunities for a CE into their community.
- submission to Science is Wonderful! 2021 (SiW), an EC online event taking place on 22-26 November 2021 to engage young audiences by showcasing the impact of EU-funded research and innovation projects.

c) Provide details on the protection of the acquired intellectual property (patents applications, etc.), if applicable.
Not applicable.

d) Did you disseminate project results in scientific publications as planned in – or in addition to – the DoA (including the deposition of publications in open access repositories)? Do they include a reference to EU funding?
During the project implementation, early and final results have been disseminated to peers in the research field through academic publications. Early results have been published in a peer-reviewed paper published in the BEYOND 2020 conference proceedings. An article has been published in the open-access high-impact peer-reviewed *Journal of Sustainable Cities and Society*. They all included a reference to EU funding. An additional publication in a journal or book chapter may result in the next months from the game prototype development.

e) List all the outreach activities undertook (visit to schools, Researchers' Night, etc.).
- European Researchers Night in Bristol on 28 September 2018 - Video on Twitter and storytelling session.
- European Researcher Nights in Bath on 27 September 2019 - Bitesize Research presentation.
- European Researchers Night in Cardiff on 27 November 2020 - entry at The Great Research Bakeoff.

f) Did you disseminate and communicate project activities and results by other means than scientific publications (social media, press release, the project website video/film, etc.) as planned in – or in addition to – the DoA? Do they include a reference to EU funding?]
The project has been communicated by the media through a project webpage on the CU website. It included the reference to EU funding. The project webpage will be updated to include the card game prototype after its development and any further publications emerging from the last activities.

3. Update of the data management plan (if applicable)
Not applicable

4. Follow-up of recommendations and comments from previous review(s)
Not applicable for European Fellowships and the first phase of Global Fellowships.

5. Deviations from Annex 1 and Annex 2 (if applicable)
Explanation for deviations from the DoA, consequences and proposed corrective actions:
During the project implementation, there were the following deviations from the DoA:

- **WP2 - Change from the development of a technological component for a CE to the development of a SI typology for a CE.** The project moved from technological innovation to SI for a CE because of gaps that emerged from the literature review, and the interest from partners. Moreover, because of restrictions due to the Covid pandemic, I moved from the development of a SI initiative for a CE with a Clarion housing community to the development of a typology of SI and main characteristics by the exploration of existing SI initiatives that implement circular production and consumption practices.

- **WP3 - Change from the evaluation of a technical component for a CE to the evaluation of SI opportunities, benefits and challenges for social housing and cities.** Instead of evaluating a technical component for a CE, through the defined SI typology, I evaluated opportunities, benefits and challenges for social housing communities and cities in implementing SI for a CE and I provided insights for knowledge advancement in the current CE approach by the definition of the concept of circular community to overcome current limitations in the CE approach and by the introduction of emerging concepts of SI into a CE framework (the ReSOLVE framework) to support the development of SI opportunities for a CE.

- **WP4 - Delay on the completion of the project implementation.** Due to Covid-related restrictions, planned activities have been changed causing a delay in the project implementation; so, the last dissemination and communication tasks are going to be implemented in the following months after the end of the project.

- **WP5 - The duration of the secondment at the project partner Arup Foresight in London.** The secondment lasted 4 months instead of the planned 6 months because of a reduction of the permanence of the supervisor Dr David Gerber in Arup London due to his academic commitments in the US. This change did not affect the implementation of the project and allocated budget since activities planned in the remaining 2 months have been performed at the WSA with the supervision of Prof. C. Tweed.

- **WP6 – Change in the dissemination of project results from a guide for housing associations to a card game for social housing and urban communities.**
  Instead of developing a guide for housing associations, I focused on developing a card game to engage social housing communities through gamification and deliver project results directly to the groups that may use them in the real-life.

5.1 Tasks
Explanations for tasks not fully implemented, critical objectives not fully achieved and/or not being on schedule, and impact of other tasks on the available resources and the planning.
None.