Institution: University of Liverpool		
Unit of Assessment: UoA14 – Geography and Environmental Studies		
Title of case study: Achieving low-carbon growth across small businesses in Liverpool City Region		
Period when the underpinning research was undertaken: 2012 to present		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Prof. Andrew Plater;	Professor in Physical Geography,	1990-present
Dr Matt Fulton;	Project Director for CGE and LCEI;	2012-present
Dr Alex Nurse;	Business Development Manager for CGE and LCEI, now Lecturer in Planning;	2014-present
Prof. Pete North	Professor in Human Geography	1998-present
Period when the claimed impact occurred: 2013 to present		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact

Economic growth is important but is often coupled with increasing carbon emissions. The move to a cleaner, low-carbon economy is a central pillar of national and international economic and climate strategies. Small and Medium Enterprises (SMEs) play a key role in the UK economy and have great ambition to support clean economic growth but have limited capability, capacity and funds for research and development. The Centre for Global Eco-Innovation, subsequently the Low Carbon Eco-Innovatory, are award-winning centres for delivering low-carbon innovation across SMEs in Liverpool City Region and the North West. Our centres have provided small businesses with dedicated researchers and access to world-leading expertise and facilities, thus enabling the translation of ideas from the drawing board into new, marketable products and services. This body of industry-focussed research and development has achieved low-carbon growth by assisting over 300 businesses, delivering energy and resource savings, and generating a minimum of 51 new, eco-innovative products and services.

2. Underpinning research

World-wide, carbon emissions are contributing substantially to global warming and climate change, both of which impact on the health and longevity of populations and the planet. The move to low-carbon economic growth has been identified as “one of the greatest industrial opportunities of our time” (BEIS, 2019 – The Grand Challenges policy paper). The opportunity for this is greatest for Small and Medium Enterprises (SMEs) as they are agile and often find it easier to adopt new business practices that lead to efficiency and sustainability gains. However, SMEs have limited capacity for innovation research and development, and lack facilities and expertise. Our research responds to these dual challenges, establishing ways to achieve low-carbon growth amongst SMEs via the Centre for Global Eco-Innovation and Low Carbon Eco-Innovatory. Research led by staff in UoA14 at the University of Liverpool has provided important detail on the context and delivery mechanisms for achieving low-carbon economic growth, as well as metrics and tools for assessing their success (theme A). Further, within UoA14 at the University of Liverpool, the impact of the underpinning research to support SMEs in their low-carbon ambitions centres specifically on the development of products and services for coastal monitoring (theme B).

A: The Eco-Innovation Model. The Centre for Global Eco-Innovation (2012-2015) and the Low Carbon Eco-Innovatory (2015-present) established an effective and well-received mechanism (as viewed by both funders and recipients) for delivering low-carbon growth through European structural funding **[3.1];** a life-cycle assessment method for quantifying the resource savings and environmental benefits of products and services arising from European structural funding projects **[3.2];** and providing the wider academic community with critical insights into the motivation of ‘green entrepreneurs’ **[3.3]**. Equipping SMEs with an understanding of what is needed to achieve low-carbon growth through this research, while also developing research-led

tools to evaluate their success, are critical insights identified within research led by University of Liverpool (UoA14) staff.

B: Exemplifying SME-specific research led by the University of Liverpool. Research staff in UoA14 supported Marlan Maritime Technologies Ltd. and MM Sensors Ltd. in the development and implementation of two eco-innovative products and services that focus on coastal change monitoring. Research undertaken in the Centre for Global Eco-Innovation by Prof. Andy Plater in UoA14, Paul Bell at the National Oceanography Centre, and Dr Cai Bird from 10/2012 to 10/2015 enabled the development and validation of a novel approach to mapping the morphology of intertidal areas **[3.4]**. Traditionally a logistical challenge, time-consuming and expensive, our research addressed this using a time series of X-band radar images. The new monitoring tool also reveals long-term and event–based changes in coastal deposition and erosion that threaten safe port navigation, reduce the effectiveness of coastal defence schemes and increase physical and economic vulnerability to coastal flooding **[3.5]**. From 11/2015 to 11/2019, Low Carbon Eco-Innovatory support for MM Sensors led to the development of new low-cost tide gauges based on the use of global positioning systems data and the near real-time transmission of pressure gauge data using an Internet-of-Things methodology **[3.6]**. The impact of these new tide gauges is improved spatial accuracy from the radar monitoring surveys, with the capacity to support monitoring programs in Small Island Developing States that are current paused due to COVID-19.

3. References to the research

3.1 Nurse A. and Fulton M. (2017) Delivering strategic economic development in a time of urban austerity: European Union structural funds and the English city regions. LOCAL ECONOMY, 32(3), 164-182. https://doi.org/10.1177/0269094217704646

3.2 Fulton, M., **Nurse, A**., & **Plater, A**. (2019). A Simplified Environmental Assessment Methodology for Research Projects as an Alternative to Life Cycle Assessment. JOURNAL OF ENVIRONMENT AND DEVELOPMENT, 28(4), 339-365. https://doi.org/10.1177/1070496519867435

3.3 North, P. & **Nurse, A.** (2014). 'War Stories': Morality, curiosity, enthusiasm and commitment as facilitators of SME owners' engagement in low carbon transitions. GEOFORUM, 52, 32-41. https://doi.org/10.1016/j.geoforum.2013.12.007

3.4 Bell, P.S., Bird, C.O., & **Plater, A.J.** (2016). A temporal waterline approach to mapping intertidal areas using X-band marine radar. COASTAL ENGINEERING, 107, 84-101. https://doi.org/10.1016/j.coastaleng.2015.09.009

3.5 Bird, C. O., Bell, P. S., & **Plater, A. J.** (2017). Application of marine radar to monitoring seasonal and event-based changes in intertidal morphology. GEOMORPHOLOGY, 285, 1-15. https://doi.org/10.1016/j.geomorph.2017.02.002.

3.6 Knight, P.J., Bird, C.O., Sinclair, A., & **Plater, A.J.** (2020). A low-cost GNSS buoy platform for measuring coastal sea levels. OCEAN ENGINEERING, 203. https://dx.doi.org/10.1016/j.oceaneng.2020.107198

Both the CGE and LCEI grants were awarded to the University of Liverpool, with Prof. Andrew Plater as the Institutional PI. The respective grant titles and details are:

- Centre for Global Eco-Innovation, ERDF (01/04/2012-30/09/2015) – GBP1,680,000
- Low Carbon Eco-Innovatory, ERDF/ DCLG (01/10/2015-30/09/2019) – GBP1,230,000

4. Details of the impact

The impact of research is seen in two areas, 1. **delivering successful interventions and tools for low-carbon growth** that facilitate the development of a low-carbon economy in the Northwest and Liverpool City Region, and 2. **new, low-carbon products and services** that have led to increased market share, employment and environmental credentials for SMEs.

1. Interventions and Tools

Impact has been realized in the development, implementation and recognition of an award-winning business-support approach that utilizes structural funds to successfully support small businesses in achieving their low-carbon innovation ambitions **[3.1]**. In addition to the SMEs themselves, the beneficiaries of achieving this high-level impact have been the Liverpool City Region Combined Authority and Local Enterprise Partnership, the funders (Ministry of Housing,

Communities and Local Government), and the collaborating HEIs in terms of new business collaborations.

The achievements of the Centre for Global Eco-Innovation (CGE) for the Northwest region were externally audited by Amion in 2014 **[5.1]**. The findings of this independent audit illustrated the aggregate effects of the CGE, to which research cited above equipping SMEs with an understanding of what is needed to achieve low-carbon growth and how to evaluate their success, was instrumental. At the time of the audit, the CGE had assisted 147 businesses (p.40). The CGE had created 166 gross jobs - a net addition of 125 jobs (p.46). In relation to longer-term project targets, Amion identified 236 net additional jobs and £35.1 M net additional GVA by 2018 (p.ii). The success of the CGE model for delivering business support was underlined by its value for money, audited at £20,922 per additional job compared with a regional benchmark of £37,600 per additional job. This gave a return on investment ratio of 5.5:1 by the end of 2017 compared with a regional ratio of 1.8:1 and a national average of 2.8:1 (p.58). The audit identified the environmental benefits of the CGE, saving 27,000 tonnes of CO_2 by 2017 and exceeding its 2022 target savings in water and material use by 2016, with reductions of 78,000 and 60,000 tonnes, respectively.

The success of the Centre for Global Eco-Innovation as a HEI-Business collaboration model for knowledge exchange and commercialization has been recognized across the HEI sector through the 2015 PraxisUnico RCUK award for 'Outstanding KEC Initiative' **[5.3a]**, and for developing new eco-innovative products and services with ambitious small businesses through the 2015 Green Gown award for Research and Development **[5.3b]**. The CGE achievements are the foundation of a recently published BEIS Science and Innovation Audit on the capacity and capability of the North West Coastal Arc™ Partnership for Clean and Sustainable Growth **[5.4**, p.20-21**]**.

In recognition of our Centres' successes in delivering low-carbon growth in Liverpool City Region from European structural funding **[3.1]** both the Amion and Inner City Solutions evaluations conclude that the Centre for Global Eco-Innovation was successful "*increasing innovation activity and in strengthening the performance of beneficiary SMEs in the North West*" **[5.1**, p.62**]** and that the Low Carbon Eco-Innovatory "*provided valuable support to businesses in Liverpool City Region that are seeking to inject low carbon practices to their operations*" (**[5.2**, p.56**]**. The Head of Low Carbon at Liverpool City Region's Local Enterprise Partnership further affirms the role of the Low Carbon Eco-Innovatory in stimulating *clean growth* in the city region **[5.4**, p.10**]**, and the Principal Environment Officer, Liverpool City Region Combined Authority identifies that the "*Low Carbon Eco-Innovatory is fundamental to securing the creativity and innovation that we need to achieve our zero carbon goals*" and that "*the partnership work championed by the Low Carbon Eco-Innovatory represents the best of Liverpool City Region and shows that clean growth as a city region is well within our grasp*" **[5.5]**. The Low Carbon Eco-Innovatory has been further recognised in the maritime sector by 2020 Mersey Maritime Industry Award for Environmental Impact for supporting more than 160 businesses in Liverpool City Region in achieving their low-carbon ambitions **[5.3c]**.

The regional contact for the Ministry of Housing, Communities and Local Government has further advised other Local Enterprise Partnerships on the Centre for Global Eco-Innovation and Low Carbon Eco-innovatory methodology as being an effective means for delivering low-carbon growth, substantial business support, and for assessing the GHG reductions from the resulting products/services **[5.6]**. Research examining the resource life-cycle of the businesses supported by our Centres has underpinned a new environmental assessment methodology that captures the success of European projects in terms of their resource savings **[3.2]**.

Novel academic insight **[3.3**, evidenced through 31 citations and new research activity**]** and enthusiasm around motivations and perspectives on green businesses has also been instrumental in fostering wider engagement in the Centre for Global Eco-Innovation model across Local Enterprise Partnerships (LEPs) and HEIs in the NW and North Wales. This has led to a new pan-LEP project (EcoI-NW, 2020-2023).

2. New, Low-Carbon Products and Services

The impact of research undertaken in the NW and Liverpool City Region is evidenced by bringing new products and services to market, increasing market share, business revenue, employment, and reduced costs. The Inner City Solutions audit of the Low Carbon Eco-Innovatory **[5.2]** identified the main sectors supported as advanced manufacturing, visitor economy and the arts, maritime operations, digital and creative, and food production. In terms of satisfaction, "*Survey results reveal very high levels of satisfaction among LCEI's clients and the project team is well positioned to build on this momentum and play a key role in driving forward low carbon activity in the city-region.*" (**[5.2**, p.3**]**.

In evidencing the impact of the research delivered through the Centre for Global Eco-Innovation and Low Carbon Eco-Innovatory in combination, it is challenging to normalize the experience across the range of SMEs involved, particularly as the needs of each business were highly specific and the nature of support provided was bespoke to those needs. Several examples of this research and development are presented in the Amion audit of the CGE **[5.1]**, the Inner City Solutions audit of the LCEI **[5.2]** and the BEIS Science and Innovation Audit **[5.4]**. With regard to the specific impact of research undertaken by University of Liverpool colleagues in UoA14, this is exemplified through the products and services developed with Marlan Maritime Technologies Ltd. and MM Sensors Ltd. The new, radar-based coastal monitoring tool **[3.4, 3.5, 3.6]** has opened up new and diverse markets for Marlan, particularly as it is extremely cost effective when compared with previous survey solutions. The product is gaining traction in the areas of port navigation and coastal monitoring, particularly amongst the Environment Agency and Natural Resources Wales, local authorities with coastal defence responsibility, and coastal engineering companies. In support of Marlan's Highly Commended recognition for Coastal Management at the EA's Flood and Coast Excellence Awards in 2020, the Chair of the monitoring programme stated *"By continuously observing the immediate nearshore zone adjacent to the seawall over £2M efficiencies have been gained… This sustainable approach is readily transferable to other coastal authorities and provides visible evidence to the local community allowing them to understand and adapt to coastal change."* **[5.7]**

Marlan have benefitted in terms of increased contracts (including involvement in academic research projects in the UK and overseas), turnover, Gross Value Added and staffing, but also in terms of expanding and differentiating their commercial offer **[5.8]**. Marlan Maritime Technologies and the National Oceanography Centre also received KTP funding from InnovateUK to further develop the survey capacity of the '*RAPIDAR*', thus enabling the original Centre for Global Eco-Innovation graduate researcher to become Director of Research at Marlan (along with an additional job created). This KTP was awarded an 'Outstanding' grade in January 2019 **[5.9a]**.

MM Sensors now offer the Synoptic-4D data product package as defined for the Regional Coastal Monitoring Programme Framework issued by Sefton Metropolitan Borough Council in terms of providing data on intertidal topography subtidal bathymetry, surface current, wave spectra, tidal level and observed local meteorology. End-user beneficiaries of the radar monitoring application so far have been local authorities with a responsibility for coastal management and protection (Sefton and Wyre councils), Peel Ports, the Environment Agency and Pevensey Coastal Defence Ltd., as well as coastal research and consultancy organizations **[5.8]**. This offer is now being rolled out to Argyle International Airport in St. Vincent & the Grenadines and to the Port of Beira in Mozambique, although delivery has been paused due to COVID-19.

Marlan Maritime Technologies Ltd. have been recognized for their innovation and achievement within the NW region by receiving the Merseyside Innovation Award in 2017 **[5.9b]**, across the maritime sector through the Mersey Maritime Award in 2018 **[5.9c]**, and in receiving Highly Commended recognition in coastal management at the EA's Flood and Coast events in both 2019 and 2020 **[5.9d&e]**. Their Director of Research also received the Mersey Maritime Rising Star Award 2020 for his achievements in developing new coastal monitoring tools and methods **[5.9f]**.

5. Sources to corroborate the impact

5.1 Amion audit of the Centre for Global Eco-Innovation, 2014. Evidences achievements of the CGE in terms of businesses and sectors assisted (p.40); jobs created (p.46); increased Gross Value Added (p.ii); value for money (p.58); CO_2, energy and material savings; participant satisfaction (p.ii and p.21); and regional impact in the North West (p.62).

5.2 Inner City Solutions audit of the Low Carbon Eco-Innovatory businesses assisted and new products developed (p.36); value for money (p.48); environmental benefits (p.45); participant satisfaction (p.3); and regional impact in Liverpool City Region (p.56)

5.3 Awards won by Centre for Global Eco-Innovation and Low Carbon Eco-Innovatory: a) CGE won the 2015 PraxisUnico RCUK award for 'Outstanding KEC Initiative: https://www.praxisauril.org.uk/news-policy/news/winners-impact-awards-2015-announced [last accessed: 08/01/2021]; b) CGE won the 2015 Green Gown award for Research and Development: http://www.sustainabilityexchange.ac.uk/green_gown_awards_2015_research_and_development [last accessed 08/01/2021]; and c) LCEI won Merseyside Maritime 2020 Environmental Impact Award: https://merseymaritime.co.uk/news/mersey-maritime-industry-awards-2020-biggest-and-best-so-far/ [last accessed 08/01/2021] (PDFs of webpages provided in compiled evidence)

5.4 Centre for Global Eco-Innovation achievements included in BEIS Science and Innovation Audit as evidence of track record and experience in the NW region for delivering clean growth (p.20-21 – see p.11 of PDF provided). Also statement of Low Carbon Eco-Innovatory's contribution to clean growth in Liverpool City Region (p.10 – see p.6 of PDF provided) http://northwestcoastalarc.net/files/2019/03/LAN5068_NWCA_Brochure_Design_FULL_AW.pdf [last accessed 08/01/2021]

5.5 Testimonial from Principal Environment Officer, Liverpool City Region Combined Authority confirming the significance of the Low Carbon Eco-Innovatory model in enabling businesses and academia to work together in providing the technologies and methodologies that will deliver our sustainable future, and in being fundamental to securing the necessary creativity and innovation to achieve Liverpool City Region's zero carbon goals.

5.6 Testimonial from ERDF Sustainability Manager, MHCLG attesting to the rollout of the Low Carbon Eco-Innovatory methodology to other projects for capturing savings in 'greenhouse gas' (GHG) emissions.

5.7 Citation for Marlan's Highly Commended award at the EA's Flood and Coast 2020 regarding the cost savings and sustainable resource management achieved by continuous radar monitoring of the Rossall sea defence scheme provided by Carl Green, Chair of NW Regional Monitoring Programme: see 9.03-10.08 minutes, https://www.youtube.com/watch?v=fsQA8U7xfQE [last accessed 08/12/2021]

5.8 Testimonial from Managing Director, Marlan Maritime Technologies Ltd. and MM Sensors Ltd. confirming benefits to the company as a result of the research support of the Centre for Global Eco-Innovation and Low Carbon Eco-Innovatory.

5.9 Awards won by Marlan Maritime Technologies Ltd.: a) Marlan and NOC receive outstanding grade for Innovate UK KTP: https://marlan-tech.co.uk/post-2-10/ [last accessed 08/01/2021]; b) Marlan win Merseyside Innovation Award 2017: https://noc.ac.uk/news/award-noc-partner-company-marlan-maritime-technologies [last accessed 08/01/2021]; c) Marlan win the 2018 Mersey Maritime Innovation Award https://marlan-tech.co.uk/post-2-6/ [last accessed 08/01/2021]; d) Marlan celebrate successful Flood & Coast conference 2019 with Highly Commended award: https://marlan-tech.co.uk/post-2-15/ [last accessed 08/01/2021); e) Marlan receive Highly Commended award in Coastal Management at Flood & Coast Excellence Awards 2020 https://www.youtube.com/watch?v=fsQA8U7xfQE [last accessed 08/12/2021]; f) Marlan win Mersey Maritime Innovation Award 2018: https://marlan-tech.co.uk/post-2-6/ [last accessed 24/11/2020]; and g) Marlan's Director of Research wins Rising Star Award, Mersey Maritime 2020: https://marlan-tech.co.uk/rising_star_award_win/ [last accessed 08/01/2021]