Prifysgol Wrecsam
Wrexham University

Mini-Knowledge Transfer Partnership in Energy Efficiency Improvement with Llangollen Railway

White Paper

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Abstract

Llangollen Railway, a heritage railway in North Wales, partnered with Wrexham University through a mini-Knowledge Transfer Partnership (mini-KTP) to improve the company's energy efficiency while preserving its historical integrity. The project addressed challenges related to high energy consumption, outdated infrastructure, and the need to comply with strict heritage preservation guidelines. A comprehensive energy consumption study identified opportunities for improvement, including the potential use of renewable energy from a community hydro scheme and solar power. The introduction of smart sensors for real-time energy monitoring and staff training helped to ensure long-term sustainability. This collaboration provided Llangollen Railway with practical solutions to reduce its carbon footprint, optimise operational costs, and balance modern energy-saving measures with heritage preservation.

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Problem Statement

Llangollen Railway is a heritage railway that faced the challenge of modernising its infrastructure while preserving its historical identity. The railway wanted to address their sustainability concerns and improve energy efficiency without compromising on its traditional characteristics. As highlighted by Robin Coombes (2021), the success of a heritage railway operation is governed by its sustainability, which is expressed through consideration of its life cycle trajectory around the three pillars of sustainability – environmental, economic, and social.

The team at Llangollen Railway aimed to enhance the heritage site's sustainability and address the high energy consumption caused by inefficiencies. A goal further projected by the railway's Environmental and Sustainability Officer, who wished to find a balance between modern energy-saving solutions and retaining the historical integrity of the site's Grade II listed buildings. To achieve this, the main objective aimed to address the railway's operations, as it relied on outdated infrastructure, contributing to high energy use and causing environmental impacts.

Additionally, the railway faced some principal challenges while trying to find a solution to their aim. For instance, the reduction in the railway's carbon and environmental footprint required a strategic approach to modernisation while adhering to the precise heritage preservation guidelines, as outlined in the National Planning Policy Framework (UK Government, 2019). The railway also lacked in-house expertise in sustainable solutions and modern energy systems.

To address these challenges, Llangollen Railway partnered with Wrexham University through a mini–Knowledge Transfer Partnership (mini-KTP). The mini-KTP provided an opportunity for the railway to receive consultation from academics specialising in low carbon engineering, and to develop practical, sustainable solutions tailored to the railway's Grade II listed specifications. The academic support was provided by David Sprake, Senior Lecturer in Mechanical Engineering, and Dr. Shafiul Monir, Associate Dean. Importantly, this project aligned with the objectives of Wrexham University's Enterprise Engineering and Optics Centre (EEOC) Project by delivering practical and innovative outcomes that supports local industries in integrating sustainable practices and carbon reduction.

Company Background

Primarily operated by volunteers, Llangollen Railway is the only standard-gauge heritage railway located in North Wales and serves as a key cultural and economic asset for the Denbighshire region. Established in 1975, the railway enables visitors to embark on a 10-mile journey through the Dee Valley to Corwen. During their journey, visitors follow a section of the River Dee, which is a designated Site of Special Scientific Interest (SSSI) and pass through a UNESCO World Heritage site located around the Llangollen and Berwyn stations.

Originally part of the Ruabon-to-Barmouth line, Llangollen Railway once played an integral part in transporting passengers to seaside destinations and carrying goods such as slate and chemicals. Today, it preserves this rich heritage by offering visitors a railway journey experience from a historic period. The station also retains its original Victorian buildings and provides a range of visitor facilities, including a shop, café, and accessible services.

Methodology

A mini-KTP was chosen to address Llangollen Railway's sustainability objectives as this was a shorter-term project that required quick and impactful solutions. Furthermore, should the railway require additional support from Wrexham University, a mini-KTP would lay down the groundwork for future partnerships and developments. Throughout the project, Wrexham University provided the railway with an academic consultant and a postgraduate associate to provide their research and expertise. Their skills were used to improve the railway's energy efficiency, reduce its carbon emissions, and equip the railways team with sustainable practices.

During the initial phase of the project, the local region was moving towards becoming the newest UK National Park. As a result, the project's primary objective became conducting a study focused on reducing the greenhouse gas emissions from the railway's energy consumption. The associate produced a detailed report illustrating how energy saving methodology could reduce energy consumption, including a carbon emissions analysis to develop actionable environmental strategies. The comprehensive assessment of energy consumption identified areas for cost and efficiency improvements. Alongside the report, staff training was also a crucial component, ensuring employees had the knowledge and skills necessary to implement and maintain sustainability measures effectively.

Results

The mini-KTP provided Llangollen Railway with access to the academic resources and industry expertise needed for this project, resulting in several impactful outcomes. As part of the study, an environmental analysis assessed the railway's emissions and energy usage, identifying areas for improvement. One key finding highlighted the community hydro scheme at Corwen Electricity Co-operative as a potential source of renewable energy for the railway's operations. The analysis also led to the development of a practical sustainability plan, focusing on optimising energy use and incorporating renewable energy sources such as solar and hydroelectric power. Furthermore, the introduction of smart sensors for real-time energy monitoring represents a major advancement in energy management, enabling data-driven decision-making to optimise operational costs and improve efficiency.

Figure 1: Community Hydro Scheme – Corwen Electricity Co-operative

Staff training also played a crucial role in the project's success, equipping employees and volunteers with the knowledge and resources needed to improve and sustain their environmental practices. This focus on staff training ensures long-term benefits for the railway by embedding sustainability into daily operations. The project also enhanced stakeholder engagement, encouraging further collaboration with funders and external energy providers. This engagement supported the development of a comprehensive renewable energy strategy, including a tailored proposal from Wattstor for a solar and battery storage system. Once implemented, this system is expected to significantly reduce both energy costs and emissions. Overall, this engagement is anticipated to drive future sustainability initiatives while ensuring that heritage conservation remains a priority.

This mini-KTP highlighted the complexities of integrating sustainability within a heritage environment, demonstrating how regulatory constraints can be balanced with modern energy efficiency measures.

Economic, societal and cultural impact

The guidance and resources provided by the mini-KTP not only increased the heritage railway's sustainability, but also reinforced the economic, societal, and cultural impact of the charity. Since the tracks were first connected to the mainline in 1861, Llangollen Railway has played a vital role in regional connectivity and economic development, in addition to reflecting the broader historical significance of railways as a transformative infrastructure (Schivelbusch, 2014). While the rise of modern transportation led to the decline and closure of many railway lines, heritage railways have emerged as both technical and cultural assets in the 21st century, warranting preservation (Horváth and Veöreös, 2023). As a multifaceted organisation established primarily by volunteers, Llangollen Railway continues to serve the public by showcasing historic railway technology, buildings, and routes (Coombes, 2021), contributing to local tourism and economic sustainability.

By successfully aligning with the carbon reduction and sustainability objective of Wrexham University's EEOC Project, this mini-KTP collaboration between Llangollen Railway and the University has improved the railway's approach to energy efficiency, provided solutions that will improve the approach to energy efficiency, and equipped staff with sustainable practices.

By integrating modern sustainability practices without compromising cultural heritage, the project safeguarded the railway's long-term environmental reasonability, reinforcing its role as a living museum and a key driver of local economic and social engagement. This partnership is a notable example of the EEOC Project's mission to support local industries through innovation, demonstrating how heritage organisations can modernise while maintaining their historical identity.

Testimonial

"The partnership between ourselves and the team at Wrexham University was strong and supportive. Nicholas [Zamblera,Graduate Associate] and the team ensured that everything was properly aligned within the project guidelines and framework. Their involvement helped streamline processes and provided additional resources to enhance the project's success."

- *Robert Gwynne, Environmental and Sustainability Officer Head of Technical, Innovation and* Climate at Llangollen Heritage Railway.

Interested In a mini-KTP?

For more information about Knowledge Transfer Partnership initiatives with Wrexham University, contact the Enterprise team by email, or visit our website:

E-mail: enterprise@wrexham.ac.uk

Website: wrexham.ac.uk/cy/business

References

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