

# The Biochar Locomotive

## Product idea in Wales & Ireland

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## The Project in a nutshell

### The Challenge

- Due to the impending closure of the last UK coal mine, and the difficulties in importing good quality coal, operators of historic steam engines in the UK are facing a fuel crisis.
- The 156 operating heritage railways and museums in the UK are an important part of its tourist industry of which heritage tourism contribute >£20 billion pounds. They employ 4000 staff and provide thousands of training and volunteering placements.
- In the North Wales region alone, heritage railways attract more than 200,000 visitors a year, and research confirms that historic steam locomotives are a key factor in this attraction.
- There is a desperate need for an alternative, non-fossil coal substitute with similar energy characteristics to provide a Net Zero Carbon replacement.
- Providing a specialist product for this niche market would require 35,000T of biocoal per year – a very small amount. The product should NOT be used for other industrial applications such as power generation or steel making.

### The Solution:

- A detailed analysis was made of the best available fossil steam coal from South Wales. Note was also made of its draw-backs such as pollution, wastage and increasing price.
- A similar type of Bio-coal intended for domestic heating was compared to the fossil coal, and the specification proved very encouraging. It is made from 100% bio-waste from the food industry (olive stones)
- The manufacturer confirmed that a modified product with a higher energy density could be made if the first trials proved encouraging.
- THREE-C project partners will bring together experience of biomass pre-processing with a view to identifying local alternatives to olive stones so that biocoal can be produced within the regions it is needed.
- Trials are taking place with heritage steam locomotives in Ireland and Wales to assess the suitability of the fuel in use.
- Biocoal could be created as a by product of the production of biochar, so potentially a manufacturing plant could create products for agriculture, soil remediation, and filtration uses alongside biocoal. This would be energy efficient for both the process and for transport and would mean that part of the output would contribute to Carbon sequestration.

## Central ideas and properties

### 1. Where is your project located

The project is a bilateral development partnership between Severn Wye Energy Agency in Wales and The Irish Bioenergy Association. Initial trials will take place on a heritage railway in Ireland during late September 2020 followed by trials at a narrow gauge steam railway in North Wales and at the National Railway Museum's site at Shildon, England.

## 2. Why did you start this project?

- a. Originally the idea of combining the production of Biochar with a steam locomotive was suggested as a joke after dinner one evening. The following day, several colleagues started discussing the idea in more detail and suggested that we should explore the potential for the concept. Several telephone calls were made, emails were sent and an initial meeting was held with representatives from the UK's heritage railway movement who were instantly, and surprisingly extremely interested.
  
- b. What was the main challenge?**

It became clear that heritage steam railways and museums in the UK were facing a crisis. Supplies of suitable coal from within the UK are about to end and with the war in Ukraine, the cost and availability of imported coal is becoming problematic. The 156 working steam railways and museums in the UK form an important part of the country's tourism product and provide both jobs and recreation activities for thousands of people. An alternative source of fuel is urgently required.
  
- c. What is the community impact?**

Steam railways – especially those here in Wales – helped form and shape many of communities. Even though they performed an industrial function, they are often sited in attractive rural areas and were also used for transporting passengers and tourists almost from the start. They allow the landscape to be seen in a way that is often not possible by car. The additional spending by visitors helps to keep many small local businesses going that would otherwise not be viable.
  
- d. How does this project affect the environment**

Developed countries need to urgently move away from burning fossil fuels, especially coal. The mining, processing and burning of coal has caused enormous and far-reaching damage to our biosphere. With advances in renewable energy technologies, there is no longer any need to burn fossil fuels to generate electricity. However, there is a case to be made for producing small amounts of a coal substitute for specialist applications. If this can be done in a way which supports more sustainable landscape management in the production of biomass, then that is even better.
  
- e. How does this relate to History and its presentation.?**

Great Britain was in the forefront at the beginning of the Industrial Revolution with coal-fired steam powered technology. It changed our civilisation and the face of our planet. Much of the social structure and working practices of communities in Western countries and elsewhere were shaped by steam-powered railways and ships and the connectivity they provided. It is important for future generations to be able to experience the sights, sounds and smells of some of the surviving machines at work in order to understand the role that they played in the creation of modern

society. If they are not to be left cold and silent inside museums, then an alternative, and fully sustainable fuel is needed.

### **3. Who was involved**

THREE-C Project staff from SWEA and IrBEA were involved together with Dr Dafydd Gwyn from the Bala Lake Railway in North Wales, Bob Gwynne from the National Railway Museum UK, Dr Robert Johnson from Arigna Fuels, Luned Roberts from IBERS in Aberystwyth, and Prof Jenny Jones from the University of Leeds. Other specialists are joining the project.

### **4. How do you want to go on (perspective)**

The objective is to prove that a Coal substitute made from 100% sustainably produced biomass can be manufactured that is as good or better than the traditional fossil fuel alternative. There is an existing strong demand for a product like this and strong political support in the UK and Ireland. We want to make a dual-purpose plant that makes both Biocoal and Biochar using the excess energy from the process to achieve maximum energy efficiency. The biochar products will be applied to regenerative agriculture, horticulture, land and nutrient management and will also help permanent sequestration of Carbon out of the atmosphere.

By identifying stakeholders in different parts of the Carbon cycle but in the same region, we intend to demonstrate that an economically viable, local circular carbon business model can work, and be replicated where the need exists. We aim to raise financial support to build a new plant in Wales to supply Welsh heritage railways and work in close partnership with Arigna Fuels in Ireland who are themselves developing a full scale production plant.

One of the key objectives is to convince policy makers that this is an unique solution for a small scale specialist market. This is not about creating biocoal on an industrial scale to generate electricity, nor should it ever be. It is about making a product which links industrial and social history to regenerating soil and landscape for people, wildlife and climate at a local level.

## Testimonials

*“The United Kingdom has a rich and varied industrial history in the form of steam railways, industrial steam engines, steam ships and road tractors. It has historic houses and museums with simple open fires and grand and extensive heating systems. There is a real risk that without an alternative to coal, these assets will become cold and lifeless, denying future generations the chance to experience something of their history. To create a product that puts a tangible benefit back into the environment instead of detracting from it would be a huge win for both social history and environmental justice”.*

**Bob Gwynne. Assistant Curator National Railway Museum, York, England.**

*“This is a fantastic and exciting project and I look forward to September and seeing it take it's next steps, delighted to be a part of it. I have had a chat with the Supervisors at the railway and all are very appreciative at the opportunity to participate in such a groundbreaking trial. It represents a wonderful opportunity for the future of Steam in Ireland in general and I must commend Nicola and Nigel Glynn for their wonderful enthusiasm in leading the Irish Steam Preservation Society in these exciting times.”* **Sean Cain. Irish Steam Preservation Society**

*“Thanks all for a very interesting meeting last night – even though I have no experience of steam engines! I’ll need to discuss with some of my colleagues in relation to biomass compression and briquetting work that’s taken place previously which may have been part of other R a D collaboration and not resulted in a paper. We have colleagues within Aberystwyth Physics department who research into graphene and artificial diamond, there’s also a wide range of equipment within their workshop, I can fact find further if their equipment could be of potential benefit for future compression and densification studies to evaluate prospective lignocellulose-based material.”*

**Luned Roberts, Research Assistant in Molecular Biology and Chemistry of Energy crops at Aberystwyth University**

*“ The solution to the need to establish a long term, reliable supply of fuel for steam locomotives is not going to be found quickly, but these meetings are yet further evidence that progress is being made and I am encouraged by the response of both government ministers we met. It is clear that they understand the importance of heritage rail to the cultural and economic prosperity of the country – and how vital the supply of steam locomotive fuel is to that”*

**Lord Faulkener: President. UK Heritage Railway Association**

*“The future of heritage railways is vital, especially in constituencies like mine in Dwyfor Meirionydd, where the Great Little Trains of Wales are a mainstay of the local economy. We have worked hard to bring those involved together to look at alternative supplies and alternatives to coal to keep the trains running”* **Liz Saville Roberts MP, Co-Chairman of the Heritage Rail All Party Parliamentary Group.**