Agri-Food Technology Challenge Report

Future-Proofing Growers and Communities through Sustainable Agri-Tech Innovation

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About the Challenge

The SBRI Agri-Food Technology Challenge sought innovations that led to increased efficiency, productivity and sustainability in Welsh agriculture and agri-food supply chains, delivering environmental benefits and accelerating the transition to Net Zero. The challenge has four priorities:

- Accelerate Home Grown Welsh Agri-Tech Capabilities.
- Drive on-farm adoption to achieve productivity and efficiencies (incl. Environmental) gains 'more for less'.
- Deliver environmental benefits and help transition to Net Zero.
- Support educational and skills development to equip future and existing agricultural professionals to exploit Agri-Tech to its fullest.

The challenge is funded by Welsh Government, and supported by the SBRI Centre of Excellence. CCR Energy was successful in securing funding through a contracts for innovation competitive process and undertook a three-month research, development and feasibility study assessing the site potential for sustainable transformation of Aberthaw into an Agri-Tech innovation hub.

About Aberthaw

Information:
- CCR Energy Limited has been established by Cardiff Capital Region to oversee the development and transformation of Aberthaw into a new low-carbon destination.
- The site is 500 Acres.
- Close proximity to Key Economic Growth Areas.

Site Purchase & Demolition:
- Site acquired March 2023.
- Demolition contract signed February 2024.
- Demolition started February 2024.

Assets & Infrastructure:
- Operational Railhead (Loop)
- 2 x Sub-Stations (275KV & 132 KV)
- Tidal Range (up to 10.5m, up to 1GW)
- Pulverised Fuel Ash (18m tonnes)
- Location (Anchor Wider Region)

Project Team

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Overview of Our Solution

Showcasing Sustainable Agri-Food Technology Innovation at Aberthaw

The Aberthaw initiative is a visionary low-carbon project focused on transforming the former Aberthaw coal-fired power station in South Wales into a dynamic hub of renewable energy, technological innovation, and sustainable development. The **Aberthaw Transformation Feasibility Study** aims to assess the potential for incorporating an Agri-Tech innovation hub within the wider masterplan to transform the historic coal-fired power station into a forward-looking low carbon destination. It explores the potential relationship between sustainable energy solutions, advanced Agri-Tech modular farming, novel food production and skills development, ensuring the site supports economic growth and Net Zero ambitions. By introducing Agri-Tech to Aberthaw, the feasibility study ensures the project aligns with the Welsh Government Action Plan for Wales and the goals for food security, clean energy, and economic resilience.

Challenge Objectives

- **Assess Site Potential for Sustainable Transformation:** Evaluate the former coal-fired power station's infrastructure, location, and environmental conditions to determine its suitability for redevelopment into a low-carbon destination for sustainable innovation. Identify structural, logistical, and regulatory considerations for integrating advanced Agri-Tech and renewable energy solutions.

- **Analyse Technological Integration:** Examine the feasibility of implementing key technologies, including AI-driven systems, Digital Twin Farming, 4D Bioprinting, and modular Controlled Environment Agriculture (CEA) units. Assess compatibility with renewable energy sources such as tidal, solar, or wind power to create an off-grid, autonomous operational model.

- **Examine Technological Viability:** Showcase modular farming technologies and water management systems that can operate autonomously in post-industrial and rural landscapes.

- **Engage Stakeholders and Partnerships:** Engage community stakeholders, local government, industry experts, and academic institutions to foster support and partnerships. Explore opportunities for public-private partnerships and blended financing models to support project implementation and scalability.

- **Develop a Scalable and Replicable Model:** Evaluate the commercial viability of the model and explore how it could be scaled globally as part of a network of sustainability innovation parks. Define success metrics and key performance indicators (KPIs) to measure the project's long-term impact on food security, environmental regeneration, and economic growth.

- **Create a Roadmap for Implementation:** Develop a detailed action plan, including timelines, milestones, and resource requirements, to guide the redevelopment process from concept to execution. Outline strategies for risk mitigation, regulatory compliance, and stakeholder alignment to ensure project success.
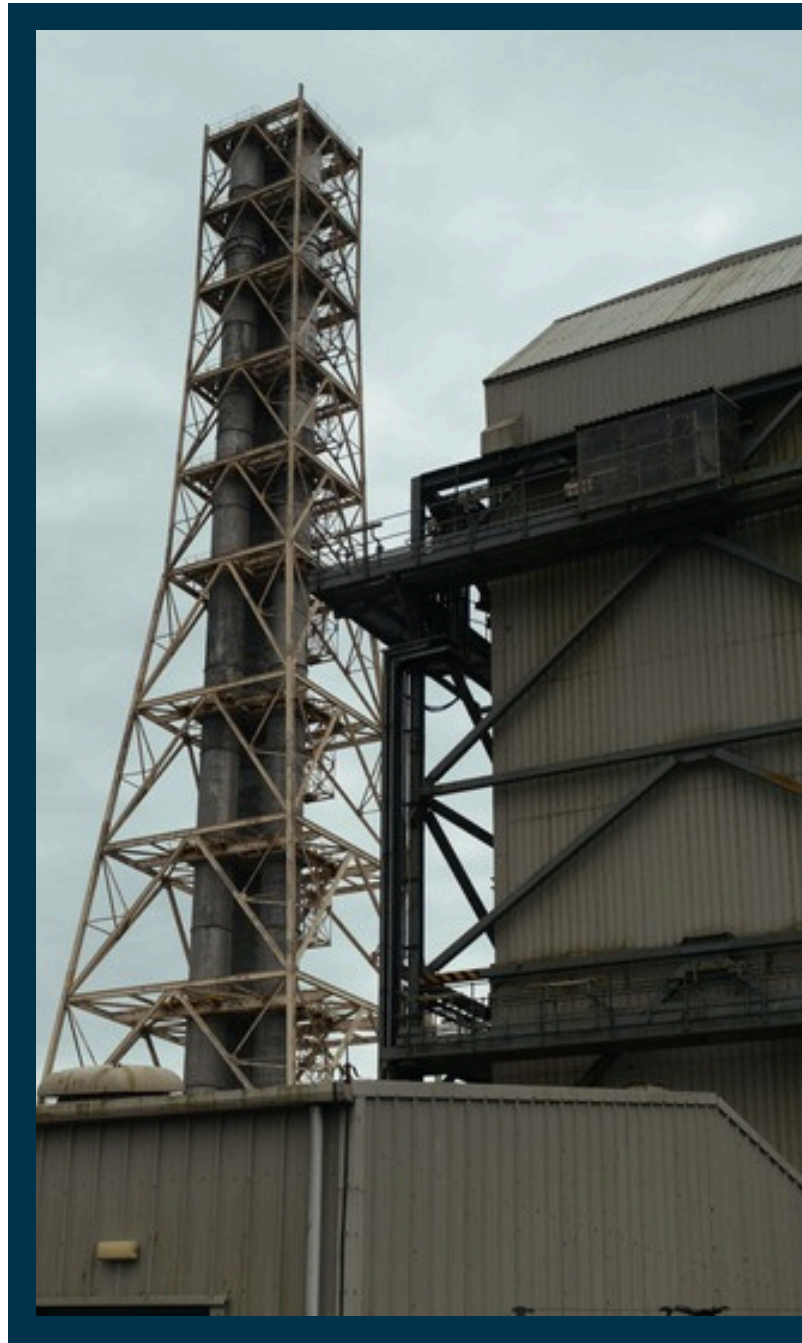
Vision:

Sustainable Agri-Food Innovation Showcase

To create a sustainable Agri-Food technology innovation hub that showcases, tests, and supports research and development of Agri-Tech innovations in a modular, small-scale setting, integrating technology, sustainability, education, and food innovation while supporting research, industry, and public engagement, transforming the future of food production and education.

Sustainability:

Carbon-neutral food production systems powered by renewable energy sources, minimising environmental impact while maximising yield.

Technology:

Cutting-edge agricultural innovations including automation, AI-driven crop management, and precision farming techniques.

Infrastructure:

Thoughtfully repurposed industrial facilities that preserve architectural heritage while creating functional growing spaces, capturing latent heat from data centres.

Community:

Creation of sustainable jobs and economic growth opportunities for local communities through skills development and innovation.

Mission

- Support Welsh Government commitments to Net Zero.
- Develop energy-efficient (data centre) infrastructure that powers and supports AI-driven Agri-Tech innovation.
- Pilot a compact vertical farming unit to test automation and precision agriculture technologies using precision agriculture and automation.
- Innovate in novel proteins and food production through Future Food R&D.
- Create a living laboratory where industry, researchers, students, and the public engage in the future of sustainable food.
- Establish a Future Food R&D Lab focused on 3D/4D bioprinting, alternative proteins, and precision fermentation.
- Deliver high-value education & training in Agri-Tech, AI, and sustainable food systems.
- Create a one-of-a-kind regional visitor destination showcasing food innovation, sustainability, and gastronomy.

Agri-Tech Action Plan for Wales

The challenge took into account the Welsh Government's Agri-Tech Action Plan for Wales published in 2023. This action plan has four priorities that were considered during the challenge:

- **Accelerating Welsh Agri-Tech Capabilities:** Evaluating small-scale infrastructure for R&D and fostering innovation through site-based partnerships.
- **Drive On-Farm Adoption:** Testing and demonstrating agricultural technologies on a small scale for local application.
- **Delivering Environmental Benefits:** Assessing renewable energy integration, carbon capture, and circular economy solutions for sustainable Agri-Tech.
- **Supporting Education & Skills:** Considering STEM engagement, Agri-Tech training opportunities, and small-scale visitor facilities to inspire future agricultural professionals.

These projects are not only vital for the region's decarbonisation and economic growth but also embody our commitment to responsible corporate values, ensuring every action contributes to long-term societal and environmental benefits.

While the challenges are significant, they are matched by opportunities to lead by example. Through pioneering renewable energy solutions, fostering next-generation employment, or ensuring meaningful stakeholder collaboration, we are laying the groundwork for a future built on resilience and innovation.

This plan is a testament to the strength of our partnerships and the clarity of our vision. With the ongoing support of our shareholders and the close cooperation of our stakeholders, Aberthaw is set to become a cornerstone of Wales' low-carbon economy and a model of sustainable industrial redevelopment.

Together, we will take this foundational step and continue the journey toward a low carbon and prosperous future.

Key Activities

- **Workshop Event at ICC, Newport**
  - Insights and presentations from key experts from government, 3/4D bioprinting, Modular CEAs, and tidal energy.
  - Participants engaged in structured roundtable discussions covering key areas such as technological integration, funding strategies, sustainability challenges, and regulatory concerns.
  - Expert teams were developed to test the feasibility of the technical solutions and a high-level project roadmap with a project management governance structure to support it.

- **Site Assessment and Preliminary Analysis**
  - Conducted a desktop analysis of the site, using existing maps, records, and aerial imagery to understand layout, constraints, and potential.
  - Performed a rapid on-site inspections to identify structural and environmental conditions.
  - Assessed renewable energy potential (e.g. tidal, solar, latent heat) through existing studies.

- **Stakeholder Engagement and Financial Analysis**
  - Conducted interviews or workshops with stakeholders to gather input and build partnerships.
  - Analysed costs and potential revenue streams for the Sustainability Innovation Park.
  - Explored funding mechanisms, such as public-private partnerships, philanthropic lending or blended financing, to scale the concept beyond feasibility.

Key Activities

- **Technology Viability Assessment**
  - Digital Twin Farming Feasibility: Consulted experts to evaluate sensor networks, data platforms, and AI integration costs and requirements.
  - 4D Bioprinting Feasibility: Conducted a desk review of emerging technologies, their scalability, and estimated costs for pilot implementation.
  - Modular CEA Systems: Analysed off-the-shelf and custom solutions for modular farms, focusing on costs, energy requirements, and operational needs.
  - Renewable Energy Integration: Identified solutions for integrating tidal, solar, or latent energy (or other renewable energy sources) to power modular farms.

- **Environmental and Economic Impact Analysis**
  - Conducted a high-level environmental impact assessment, focusing on carbon reduction, resource efficiency, and biodiversity improvements.
  - Performed an economic impact analysis, projecting costs, returns, and scalability.
  - Developed KPIs to measure long-term success, such as yield improvements, job creation, and carbon offset potential.

Rapid Site Survey

The site survey highlighted several advantages that support the development of sustainable hyper-local urban agriculture, including:

- **Small-scale development plots:** Providing opportunities for gradual expansion and the integration of advanced agricultural technology.
- **Proximity to major access points:** Ensuring efficient logistics and transportation.
- **Connectivity to green infrastructure and woodland corridors:** Allowing potential synergies with sustainable land use.
- **Suitability for diverse activities:** Supporting both commercial and educational agricultural initiatives.

Potential Components of a Vertical Farm as Agri-Food Innovation Centre:

- **Multi-floor internal growing space:** Optimising production efficiency.
- **Office and research facilities:** Supporting operational management and innovation.
- **Teaching and visitor area:** Facilitating educational and public engagement.
- **Hospitality and leisure:** Opportunity for visitors to sample the food grown on-site in restaurants and farm shop.
- **Delivery and packaging zone:** Strategically positioned for transport access (train and vehicle) and storage.

Delivering the Four Priorities

These are the specific initiatives that could be integrated into the Aberthaw Agri-Food Showcase solution:

1. Accelerate Home-Grown Welsh Agri-Tech Capabilities

- Test Agri-Tech technologies in a research-led, small-scale facility at Aberthaw designed to complement larger Agri-Food hubs in the region, fostering innovation in controlled environment agriculture (CEA), precision farming, and automation.

- Develop partnerships with Welsh universities and Agri-Tech startups to test and refine emerging technologies.

- Create an accelerator programme to support local Agri-Tech entrepreneurs in novel food production, such as 4D and 3D bioprinting.

2. Drive On-Farm Adoption for Productivity & Environmental Gains

- Pilot modular farms and smart greenhouses, showcasing energy-efficient, AI-driven farming techniques to build Welsh resilience in horticultural produce.

- Provide demonstration farms and testbeds for technologies like vertical farming, hydroponics, and soil health monitoring.

- Develop a Farming as a Service model for farmers and growers to test crops and grow produce year-round to supplement seasonality.

- Engage local farmers through knowledge exchange programmes that provide hands-on experience with Agri-Tech solutions.

3. Deliver Environmental Benefits & Transition to Net Zero

- Incorporate renewable energy sources (solar, wind, hydrogen) to power Agri-Tech operations at Aberthaw.

- Develop a carbon capture and soil regeneration program to sequester emissions and improve land fertility.

- Promote closed-loop systems, such as aquaponics and waste-to-energy initiatives, to minimise resource consumption.

4. Support Education & Skills Development in Agri-Tech

- Create a STEM & Agri-Tech education and training centre to upskill both next generation students and existing agricultural professionals.

- Offer certification programmes in precision agriculture, robotics, and data-driven farming in collaboration with Welsh universities and colleges.

- Develop an interactive visitor centre to educate the public and showcase the potential of Agri-Tech in Wales.

Innovation Missions
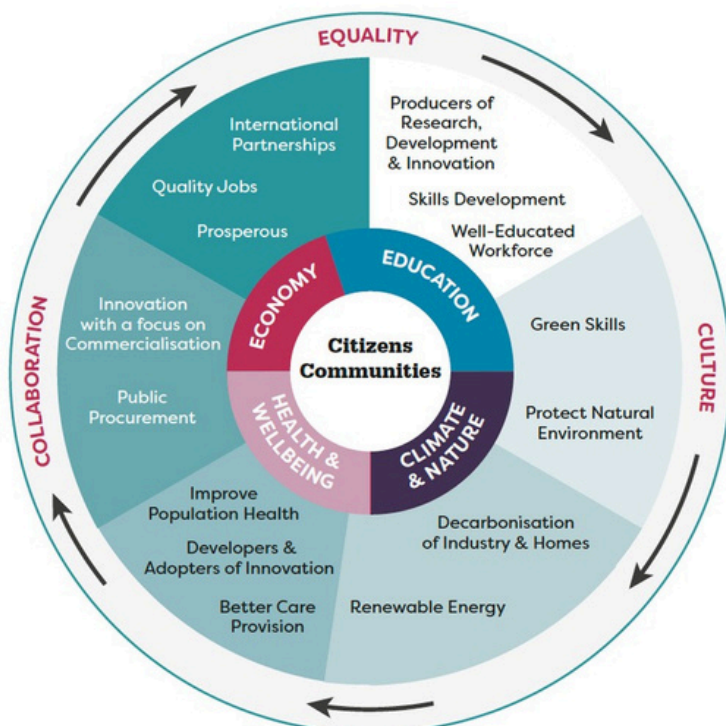
The proposed project model demonstrates these principles by harnessing waste heat from a data centre and off-grid tidal energy from a tidal lagoon to generate renewable power for an Agri-Food Technology Centre. This centre will deliver education and skills development, cultivating a highly skilled workforce equipped to decarbonise agriculture, produce healthy, nutritious food, and generate high-quality local employment. By integrating clean energy, advanced Agri-Tech, and workforce development, the project creates a holistic, sustainable pathway for transforming the future of food production and rural economies.

Alignment to Agri-Tech Challenge Priorities

Accelerate Home-Grown Welsh Agri-Tech Capabilities

- Establish a dedicated Agri-Tech R&D Hub at the Aberthaw site, fostering innovation in controlled environment agriculture (CEA), precision farming, and automation.
- Develop partnerships with Welsh universities and Agri-Tech startups to test and refine emerging technologies.
- Create an accelerator programme to support local Agri-Tech entrepreneurs.

Drive On-Farm Adoption for Productivity & Environmental Gains

- Pilot modular farms and smart greenhouses, showcasing energy-efficient, AI-driven farming techniques to build Welsh resilience in horticultural produce.
- Provide demonstration farms and testbeds for technologies like vertical farming, hydroponics, and soil health monitoring.
- Develop a Farming as a Service model to farmers and growers to test crops and grow produce year-round to supplement seasonality.
- Engage local farmers through knowledge exchange programmes that provide hands-on experience with Agri-Tech solutions.

Deliver Environmental Benefits & Transition to Net Zero

- Incorporate renewable energy sources (tidal, solar and wind,) to power Agri-Tech operations at Aberthaw.
- Develop carbon capture to sequester emissions from nearby industry.
- Promote closed-loop systems, such as aquaponics and waste-to-energy initiatives, to minimise resource consumption.

Support Education & Skills Development in Agri-Tech

- Create a STEM & Agri-Tech education and training centre to upskill both next generation students and existing agricultural professionals.
- Offer certification programmes in precision agriculture, robotics, and data-driven farming in collaboration with Welsh universities and colleges.
- Develop an interactive visitor centre to educate the public and showcase the potential of Agri-Tech in Wales.

Benefits of Feasibility Project and Potential Benefits of Full Implementation

Benefits of the Study

- Building a complementary pioneering expert team aligned to bring technologies together to develop a systems thinking approach that could be re-used in Wales, the UK, or globally.
- Valuable networking, leading to new collaboration for new joint ventures between growers, academia, industry, and commercial entities.
- Open and honest knowledge sharing between the partnership ecosystem to build trust and shared values for problem solving Agri-tech challenges.
- Bringing together the UK expertise and experience to develop and lead a global Agri-tech innovation hub in Wales.

Benefits to Future Farmers and Growers

- Provide demonstration farms and testbeds for Agri-technologies like AI modular vertical farming and novel proteins with access to expertise for trials.
- Develop a Farming as a Service (FaaS) model for farmers and growers to test crops and/or grow produce year-round to supplement seasonality.
- Knowledge exchange programmes that provide hands-on experience with Agri-tech solutions.
- Education and training centre for next generation farmers and existing agricultural professionals.
- Collaborative projects and local partnerships: farmers markets, farm shops, restaurants.

Benefits to Communities

- Opportunities for local communities to co-design the hub and benefit from educational programmes, events, and employment opportunities, fostering a sense of pride and ownership.
- FaaS and modular farms can be used for educational visits, allowing students to learn about sustainable food production, renewable energy, and the science behind vertical farming.
- Schools can visit the site or elements can be taken to schools for interactive workshops and guided tours that reiterate the importance of sustainability in agriculture.
- Green spaces and farming-based experiences that can have positive effects on physical and mental health, providing opportunities for relaxation, exercise, and connection with nature.

Conclusion

- This feasibility study has provided a comprehensive assessment of the potential for transforming a former coal-fired power station into a sustainable low-carbon destination, integrating Agri-Tech solutions.

- Based on the findings, the next steps will involve finalising the implementation masterplan, securing funding, and initiating construction and piloting the trials.

- This transformative project has the potential to create economic growth, environmental benefits, and a brighter future for the community.

- The initial financial model produced had a positive outcome for the development of this project.

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