Buckinghamshire Live Lab Trial

Final Business Case & Impact Assessment

Energy – Solar, Wind and Kinetic Road

WP4 – Impact Assessment, Energy

Strategic Case (1)

The Strategic Case sets out why the intervention is needed, how it furthers national, regional and local policy and whether there is a clear case for change.

National, regional and local policy fit	The Government's net zero 2050 target, alongside other government policy documents such as the Net Zero Strategy and 10 point plan. Buckinghamshire Council's Climate Change and Air Quality Strategy has targets of reducing carbon emissions by 75% by 2030, on the way to achieving net zero no later than 2050.
The case for intervention that meets those policy needs	These interventions will increase renewable energy generation to partially replace the use of grid electricity, thereby reducing carbon emissions.
The national, regional & local needs and challenges	Local needs and challenges were the need and the want to push innovative solutions and both increase renewable energy generation and reduce carbon emissions.
The wider case for the intervention	The interventions have used solar photovoltaic (PV) panels, wind turbines and a kinetic road prototype alongside battery storage to increase renewable energy generation that can be used when the street lighting is required at night. By replacing the grid electricity with renewable energy, this has reduced carbon emissions.

Strategic Case (2)

Social

Visibility of renewable energy deployment, even on a small scale, can help to raise awareness of wider social imperative for carbon emission reduction.

Technological

Kinetic road prototype is a technology developed by Lancaster University, this trial will help the assessment and commercialisation of this technology.

Environmental

Reduction in carbon emissions over time.

Legal

Will help to understand possible procurement and planning routes for micro-generation sustainable technologies and any potential pitfalls.

Economic

Excessive carbon emission can be considered a market failure which investment in renewable energy solutions can help to resolve.

Political

Helps to meet important political goal and mission which relates to political, economic, job growth and public opinion.

Strategic Case (3)

The following Logic Impact Models representing each of the energy generation technologies show how the inputs and activities carried out during the trial flow through to short, medium and long term impacts.

Where the technology did not achieve full operation prior to May 2022 due to programme delays, anticipated impacts are provided instead.

Solar PV Impact Logic Model

Inputs	Activities	Outputs
• Solar Photovoltaics (PV) lighting columns • Installation contractor • Capital costs • Procurement and Installation time	Installation and operation of solar columns	• Renewable energy generation • Pedestrian footpath lighting

Planned work

Outcomes – Impact		
Short-term	**Medium-term**	**Long-term**
Reduced carbon emissions and reduced cost of grid electricity for lighting	Reduced carbon emissions and reduced cost of grid electricity for lighting	Reduced carbon emissions and reduced cost of grid electricity for lighting

Intended results

Kinetic Energy and Wind Turbines Logic Model

Inputs	Activities	Outputs
Wind turbines, kinetic road technology, academic research of kinetic road development, installation contractor, capital costs, time for procurement and installation	Installation and operation of wind turbines, kinetic road and batteries	Renewable energy generation and lighting

Planned work

Outcomes – Impact		
Short-term	**Medium-term**	**Long-term**
Reduced carbon emissions and reduced cost of grid electricity for lighting	Reduced carbon emissions and reduced cost of grid electricity for lighting	Reduced carbon emissions and reduced cost of grid electricity for lighting

Intended results

Solar PV Columns – Trial images

Installation of solar PV columns with integrated batteries on pathway

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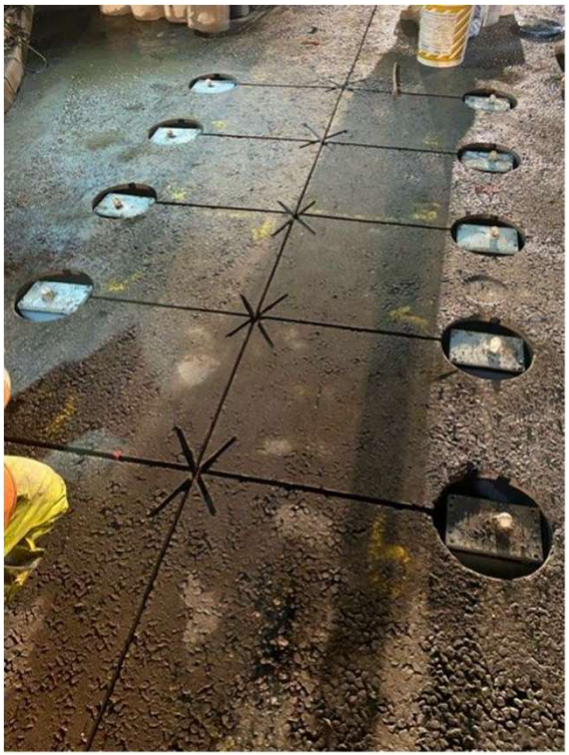
Kinetic Road and Wind Turbines – Trial images



Installation of kinetic road prototype units on access road to household waste recycling site

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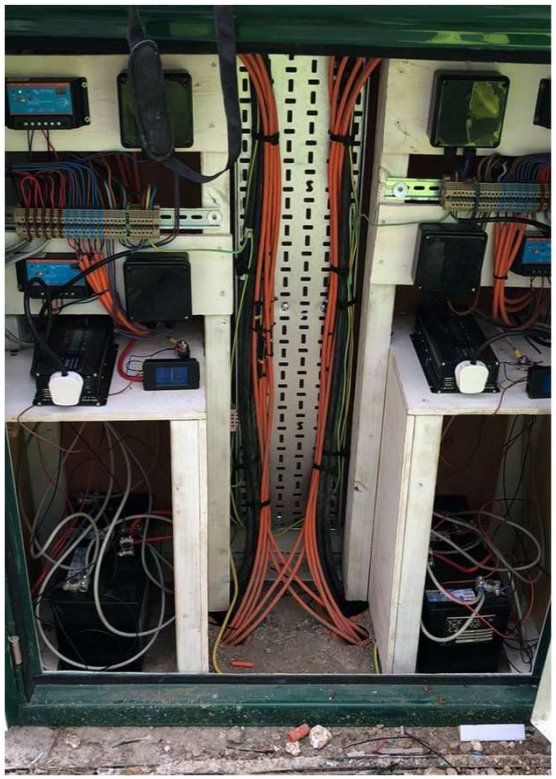
Kinetic Road and Wind Turbines – Trial images



Comprehensive electrical monitoring system for kinetic road and wind turbine trial

Wind turbine mounted on top of lighting column

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Economic Case – Costs

Solar PV columns

- Capital cost (4 columns): £21,000
- Total cost (4 columns incl. installation): £24,000
- Operational cost*: £250-500/yr
- Contingency**: £20,000-25,000 replacement every 10 years & £5,000 for unknowns

Wind turbines

- Capital cost: £7,300
- Total cost (incl. installation): £12,300
- Operational cost*: £500-750/yr
- Contingency**: £10,000-15,000 replacement every 3 years

Kinetic Road

- Capital cost: £200-300 per harvester (from Lancaster University)
- Total cost (incl. £5,000 est. installation): £11,000 (based on current design of 20 harvesters per installation)
- Operational cost*: £1,500-2,500/yr
- Contingency**: £3,000-6,000 , incl. install - replace half of harvesters every year (due to novel technology)

** estimated based on small renewable energy installations*

*** estimated based on knowledge of similar products*

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Economic Case – Benefits realised through the trial

Monetisable

- **Cost saving**: Renewable energy generated which reduces the amount of grid electricity required producing measurable decrease in energy bills.

Quantifiable not monetisable

- **Environmental**: Renewable energy generated which reduces the amount of grid electricity required producing measurable decrease in carbon emissions.

Qualitative

- **Innovation**: Increases knowledge base within council of using these technologies and developing innovative solutions. Multiple generation sources feeding batteries provide more reliable energy supply than single renewable energy generation source which can be variable.
- **Communication:** Produces visible story for the public of solar panels producing energy for lighting.

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Economic Case – Benefits realised through the trial

Kinetic Road and Wind Turbine

- Over the course of 50 hours, the kinetic road prototype produced power output when the devices were driven over. The wind turbine also generated power output when the wind speeds where high.
- The power generated by the kinetic road and wind turbine (in the form of measurable voltage outputs) was not sufficient to power the batteries in the harvesters.
- In summary, the devices can produce power but require further work on their mechanical durability and electrical setup in order to demonstrate their ability to charge the batteries in the harvesters.

Solar PV columns

- Remote monitoring will be in place to evaluate the output of the solar PV columns, however this information was not available at the time of the completion of the report.

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Commercial Case

Procurement journey

- The wind turbine supplier has since gone out of business. Therefore it will be necessary to find a new supplier if a wider rollout is pursued.
- This highlights the need to vet suppliers and supply chains for financial resilience, especially for more significant technology deployments. Site visits to suppliers could provide assurance and reduce risk.
- Principal Designer CDM responsibilities apply and capability should be vetted during procurement, including for trials involving academic organisations.

Commercial Case

Implementation efficiency

- Solar PV columns could be rolled out widely given that this is a commercial product, although they will need to be ensured that they stay on for long enough to ensure safety.
- The installation of the solar PV columns was different compared with the usual columns, which slowed the installation process in this case.
- The kinetic road technology consists of a university-developed prototype. This has raised challenges around understanding of electrical safety standards, durability and standardisation of the technology produced, as well as the question of where CDM responsibilities sit for design.
- Involvement of academic institutions should consider details relating to technical standards and the specifics of the installation (e.g. who will install and where will the technology be installed) as early as possible in the project.
- By working with an enthusiastic local contractor for the kinetic road and wind turbines installations, this has allowed an engaged implementation process, even with issues to resolve along the way.

Financial Case

Affordability

- Locally generated solar and wind technologies are affordable and provide certainty around the source of renewable energy generation.
- Alternative commercial models could be adopted, such as buying green energy from a third party. This may better suit the Council's willingness to green their energy supply but provide less certainty around the source of the energy. Ensuring that green energy purchased includes bundled Renewable Energy Guarantees of Origin (REGO) certificates can help with this issue.
- Kinetic Road technology is currently not an affordable solution at scale but it is in development and should become more viable once commercialised.

Financial model

- In future, for wind, the aim would be to link with council's other strategies and identify related funds which could support deployment.

Funding sources

- The partnership with Lancaster University resulted in the kinetic road energy generation prototype being trialled. In the future, Innovate UK grants can be applied for by the University to further develop the prototype which could allow for further trial deployments in Buckinghamshire.

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Management Case (1)

Project management approach

- Need signed agreements in place to clarify scope, as there were delays in delivery of solar columns which required moving to a different supplier.
- Departments who will be using the technology should be fully involved from the start of the trial.
- CDM roles and responsibilities must be clearly defined at the outset.

Delivery plan

- Visual impact of technology once installed needs to be considered.
- Delivery plans were over-optimistic, experience of managing risk around innovation is needed.
- Need to define use cases at outset.
- Need earlier buy-in and collaboration with internal BC functional teams which can aid use cases, delivery and legacy.
- Covid restrictions impacted ability to meet in person, impacting understanding, production status and collaboration.
- Need risk workshop with all stakeholders at the outset.

Management Case (2)

Project management team and qualifications

- Need experience of integrating solutions across a range of suppliers.
- Procurement and supplier management are key.

Benefit realisation and contract management plan

- Need to ensure closer liaison with strategy owners to develop use cases.
- Need buy-in from Bucks internal users and contribution to use cases and technology solution.
- Benefits realisation should be considered at an earlier stage, as this was not defined until four months into project

Evaluation strategy

- In future, solar and wind technologies would benefit from having more than one supplier so that performance, benefits and costs can be compared.
- Ability to monitor energy generation through remote metering was not included in the design for the kinetic road, although it was for the solar PV columns.