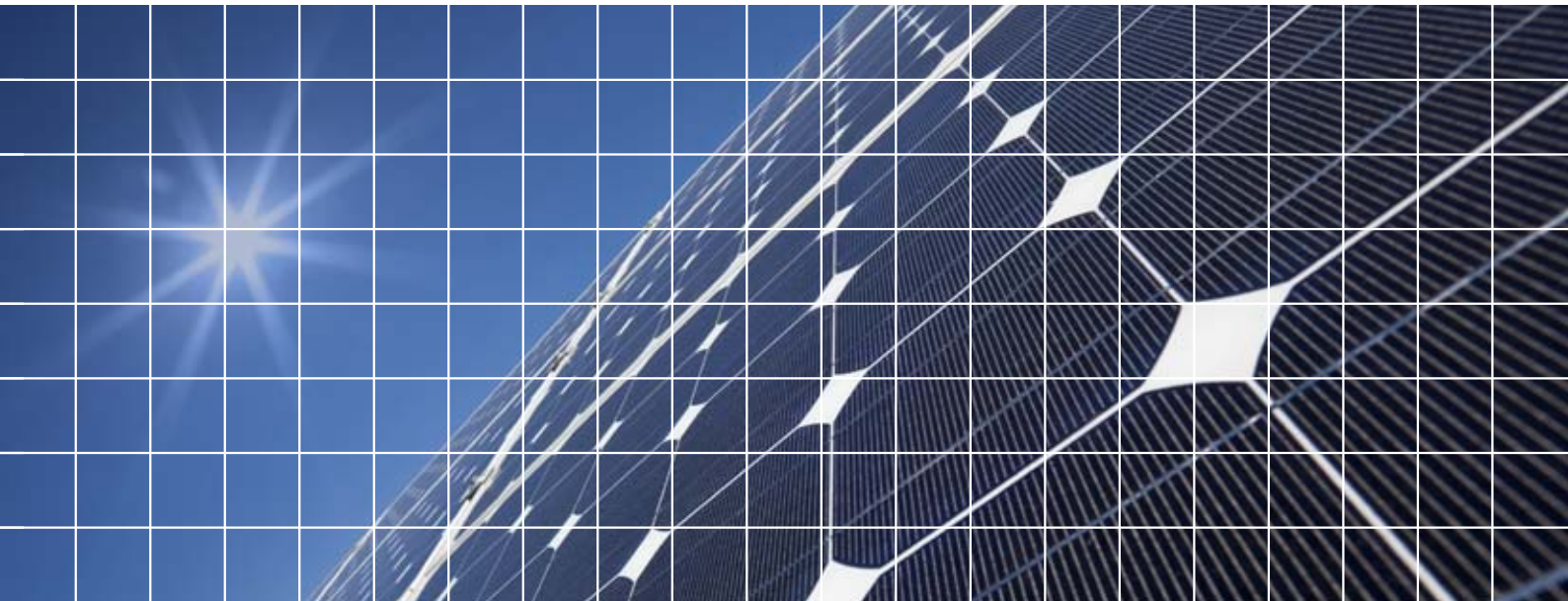


Unlocking low carbon potential with GIS

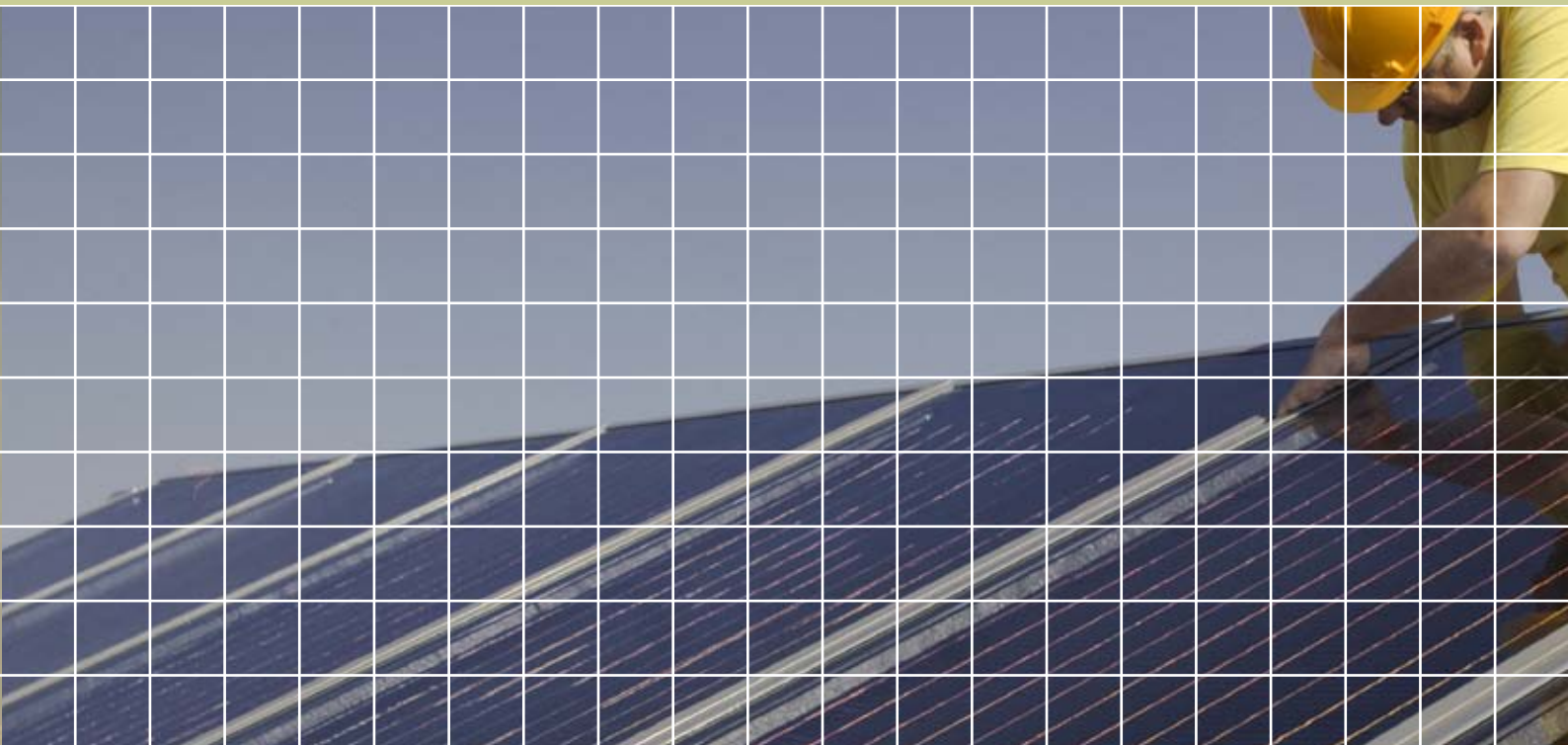


An ESRI (UK) White Paper

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Meeting the challenges and opportunities of a low carbon future



The transition to a truly low carbon economy is an ambitious endeavour. To achieve an 80% reduction in carbon emissions by 2050 will require a landscape change across the UK. Public and private sector organisations will need to work more effectively together to better understand the economic, environmental and social implications of low carbon investments. At the heart of these decisions will be high quality data and analysis related to geography.

Government policy will be central to the pace of change towards a low carbon economy. Just as the introduction of the Renewables Obligation resulted in a dramatic increase in wind farm applications and developments, Feed In Tariffs will increase the introduction of micro generation. Furthermore, if the new coalition government remains committed to the Renewable Heat Incentive, there will be a marked growth in community and domestic CHP and heat pump schemes.

Carbon awareness is growing in the UK

The Climate Change Levy and Carbon Reduction Commitment Energy Efficiency Scheme have increased awareness of carbon amongst big energy users. These organisations will not only have to understand carbon emissions, but also identify opportunities to reduce them. Over time, accountability will be key. Where currently local authorities are trialing carbon budgets, one could see a time where carbon budgets are allocated to private individuals.

This paper sets out ESRI (UK)'s vision for how geographic information systems (GIS) can play a major role in maximising the emerging opportunities in the low carbon economy for both public and private sector.

The importance of geography in a low carbon economy



The challenge of transitioning to a low carbon economy is inherently a geographical one. Large scale renewable energy producers need to understand local environmental resource availability such as wind. Those promoting micro generation need to understand other local aspects such as solar gain. Furthermore, for those interested in distributed heat schemes, there needs to be a clear understanding of the local distribution of heat demand and supply.

As the quality and quantity of geographical data increases, those responsible for the growth of a low carbon economy have opportunities to analyse, communicate and deliver lower carbon futures. Geographic information systems provide unique capabilities to bring together many location based datasets to deliver powerful insights. These insights can be communicated over the web to equip planners, customer service agents and the wider public with meaningful information. Furthermore, maps provide a common framework for analysing operational characteristics when low carbon technology is finally introduced.

This paper highlights the unique role and importance of geographical analysis in four key strands of low carbon development:

1. **Large scale renewable energy development:** where Utilities, Independent Power Producers and environmental consultancies focus on improving the productivity and success of their scheme submission process.
2. **Micro generation development:** where Local Authorities and Energy Suppliers are looking to promote uptake from communities and customers.
3. **Low carbon heat development:** where Local Authorities, Energy Suppliers and the wider planning community are seeking to identify opportunities for more environmentally friendly heat provision.
4. **Energy efficiency development:** where Local Authorities and Energy Suppliers are seeking opportunities for reducing energy consumption from buildings.

Across these four areas, ESRI (UK) has a wealth of knowledge and experience, which can be deployed within many of the key low carbon stakeholders such as Utilities, Independent Power Producers, Local Government and Central Government.

Large scale renewable energy development



The Crown Estate: A sustainable approach to maximising low carbon potential

The introduction of the Renewables Obligation in 2002 brought about a step change in interest in renewable energy production. Establishing a large scale renewable energy facility is a lengthy and complex process, involving a multitude of parties.

It poses a range of economic, social and environmental questions which rely heavily on geographical analysis. In addition to constraints analysis work, environmental impact assessments will need to be carried out prior to public consultations, followed by pre-construction work and mainstream operations and maintenance.



Potential wind farm sites can be identified using site selection applications.

The vast majority of the information managed by The Crown Estate has a location component and the development of a core geographic information system (GIS) was seen as integral to the successful planning and consenting of all future development projects. Using ESRI's ArcGIS, a new spatial database has been created containing 450 national data sets, with tools that allow non-GIS specialists to perform simple business analysis, in addition to delivering more complex information for wider consultation purposes.

Almost 90 different organisations' interests are being considered every time a site is analysed. Outputs are stored and published to a web portal for multiple users to view and query. The result is a sustainable planning capability that will serve The Crown Estate for many years to come.



The Marine Estate





West Coast Energy Limited (WCE) and Atmos Consulting: Streamlining site suitability and EIAs

Constraints analysis

In a fiercely competitive market for good renewable sites, organisations need ready access to high quality geographic intelligence. ESRI's ArcGIS Desktop provides the core capabilities to manage a wide variety of datasets and analyse this data through established tools and extensions. Over half of all energy generators utilise ESRI desktop tools and an increasing number are moving to server technology to facilitate improved data management and analysis.

As data volumes increase in size and projects increase in complexity, energy generators are looking for more effective means of managing data and leveraging the value of their intellectual property. ArcGIS Server provides access to a single repository of data across the organisation with powerful versioning tools that ensure data integrity. Easy to use model building tools within ArcGIS enable standard analytical models to be created and shared, facilitating best practice. This combination of improved data management and streamlined analysis significantly improves the operational efficiency of large scale renewable developers.

The West Coast Group of Companies were looking for a more scalable and efficient approach to GIS that would improve data management and allow GIS intelligence to be shared more easily. With the new company-wide solution from ESRI (UK), different users' demands are being met and new capabilities will make the services they deliver more proficient.

"Now we have a modern GIS underpinning the organisation that will improve how WCE submits planning permissions and how Atmos delivers EIAs to clients" explained Lucy Arnold, Senior GIS and Data Manager, West Coast Energy Limited. "With better access to GIS and the automation of spatial analysis, ESRI is giving us new ways of working which will help increase the efficiency of the business"





With ESRI (UK), organisations can now provide visitors to their websites with an understanding of the financial and environmental implications of investing in low carbon technology.

Environmental impact assessment

Environmental impact assessments are a critical component of any large scale renewable energy development proposal. Potential developers need to consider habitats, visual impact, noise implications and other factors. When it comes to environmental impact assessment, ESRI (UK) offers a range of mobile applications to facilitate detailed site surveys. Through ESRI's powerful software, field workers are able to view, query and sketch against map-based information. GPS integration improves the accuracy of data capture, whilst powerful editing tools reduce the need for back office processing, saving valuable time and reducing the potential for costly errors.

ESRI (UK) can offer a range of powerful tools to improve understanding of environmental factors like noise and visual intrusion. Developers can make use of powerful 3D visualisation capabilities which accurately model a site from many different perspectives, publishing the results via online services to support public consultations.

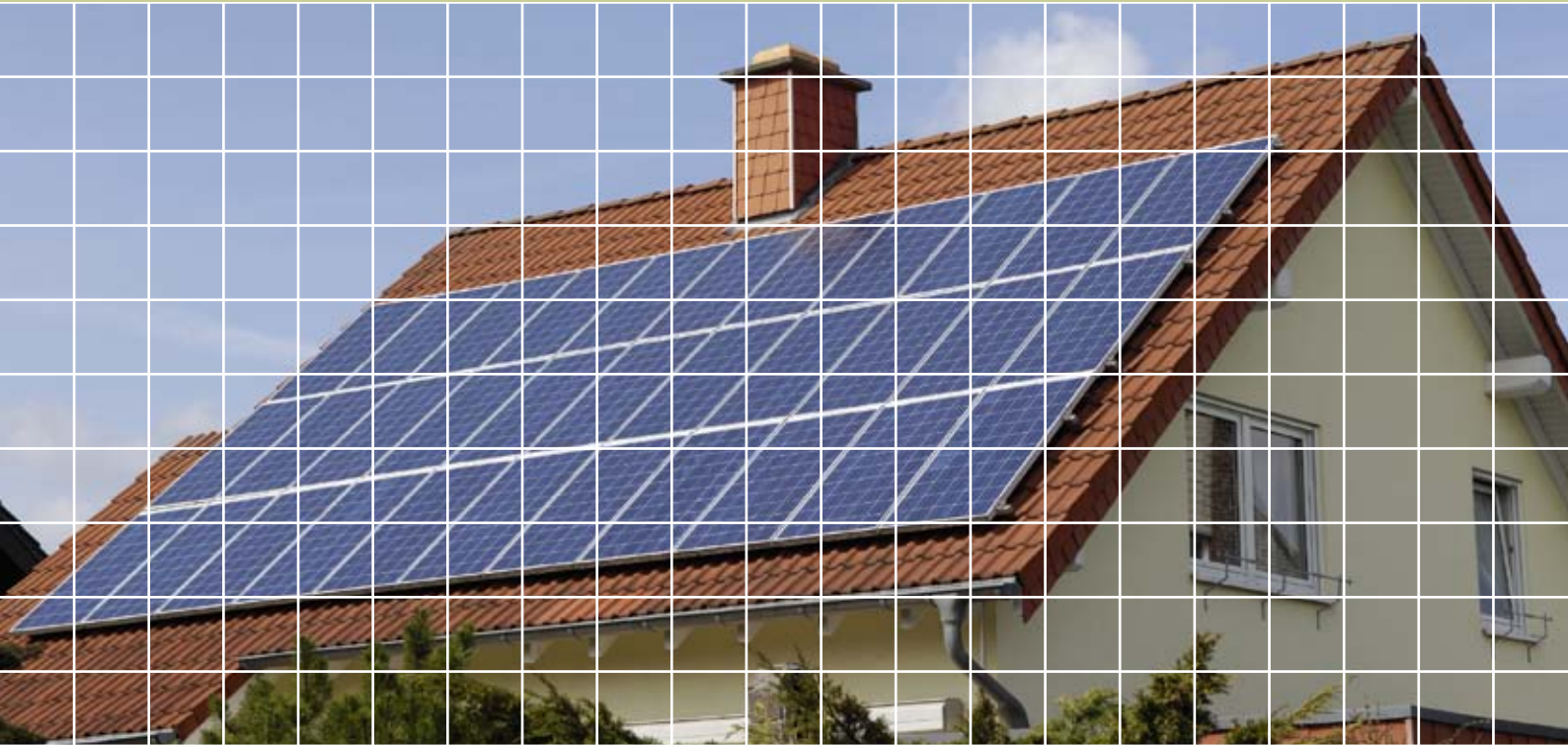
Pre – construction, construction, operations and maintenance

Having secured planning approval, a developer must engage with capital suppliers and land owners. These organisations will need a detailed understanding of requirements including a comprehensive site plan. ESRI software is used widely in the design of utility infrastructure. Established data models and intuitive tools allow a user to create and manage utility asset information. Furthermore, a designer can build and maintain relationships between these sets of data to improve the productivity and reliability of designs. This reduces the risk of error and misunderstanding with third parties which could otherwise lead to significant delays and costs.

In conjunction with other key business systems, ArcGIS Server has the potential to provide powerful insights in planning and operational environments. Many organisations have integrated this technology with supervisory control and data acquisition (SCADA) systems, asset management systems and customer

relationship management systems. This enables better management of operational large scale renewable sites and generates quick understanding of these assets.

Micro generation development



The introduction of the Feed In Tariff mechanism has delivered renewed interest in micro-generation from both public and private sector. Combine this with high energy prices, greater environmental awareness and green finance opportunities and one is faced with a market set for growth.

Local authorities, energy suppliers and financial services providers all share a common interest to better understand the most promising locations for the promotion of micro generation, whilst energy consumers will want to better understand the financial implications associated with any investment before adoption.



Solar radiation over a geographic area for specific time periods can be mapped through ESRI solar radiation analysis tools.

Understanding yields

At an analytical level, micro generation assessment work is similar to other renewable generation assessment work. High quality geographical data is now available to provide a very detailed understanding of physical terrain and the built environment. This in turn opens up new opportunities to carry out credible micro-generation assessments such as those relating to solar and wind energy. Through a data consulting team, ESRI (UK) is able to provide advice and access to a wealth of specific data relevant to low carbon development. Furthermore, ESRI (UK) can provide the analytical models that deliver a clear understanding of estimated yields based on interrogation of a range of geographical data.

Engaging with key stakeholders

Maps offer a very intuitive means of providing location based understanding. Through ESRI (UK) products, organisations are able to enhance their public facing websites and internal intranet sites with applications that allow customers, prospects, citizens and employees to

understand both micro-generation potential and the financial and environmental implications of investing in low carbon technology. ESRI's off-the-shelf gazetteering products allow stakeholders to enter a location, whilst standard templates allow users to secure meaningful insights relating to a micro-generation investment.

With intuitive web applications, employees and wider stakeholders are empowered with actionable data from which to base decisions. Micro-generation enquiries into advisory centres can be handled in a professional and prompt manner. Similarly websites can be enhanced to provide quick access to location specific data that will enable individuals to make more informed decisions for themselves. This can include specifics such as suitability, estimated energy yield, potential bill savings and rebates available.

Low carbon heat development



Heat demand accounts for approximately half of overall domestic energy usage. Any transition to a low carbon economy must therefore consider more intelligent opportunities for heat provision. Only by understanding the geographical distribution of heat demand can one assess the opportunities for waste heat usage, combined heat and power facilities and heat pumps. Continued commitment to the renewable heat incentive will further raise the profile of low carbon heat development.

ESRI (UK) offers the opportunity for organisations to create powerful heat maps for any geographical area. Heat density is a critical consideration in any low carbon heat assessment. Through the ArcGIS suite, organisations are able to better understand heat demand and supply. This can be critical in low carbon heat evaluation work, ranging from large scale CHP installations through to individual domestic assessments for an air source heat pump.

Estimating heat demand

There are a number of datasets currently available to allow organisations to better understand heat demand. These range from government census datasets through to third party datasets. By using location-based data in an intelligent way, organisations can build up an all-important understanding of heat distribution across given geographical areas. ESRI (UK) can provide data consultancy services to support this work, supplying raw data or pre-processed data to develop heat maps.

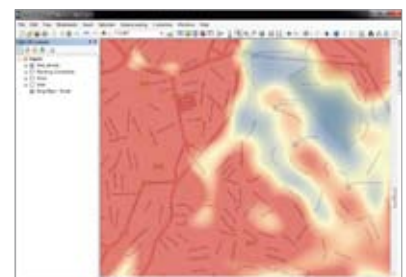
Understanding low carbon heat potential

Through its web application suite, ESRI (UK) enables organisations to utilise their heat maps internally and promote insight externally. Furthermore, through the establishment of modelling processes based on geographical data, employees and other interested parties will be able to understand the implications of making low carbon heat investments in any given area. These might address the financial benefits and the likely carbon savings, allowing quick and effective scenario planning to be conducted.

Low carbon heat investigations have distinct geographical considerations associated with them. Heat networks are most effective in tightly defined geographical areas and often rely upon anchor loads to make them economically viable. Combined heat and power investments need to consider the availability of a given fuel stock within the vicinity. Ground source heat pumps also have geographical demands associated with them, whilst air source heat pumps

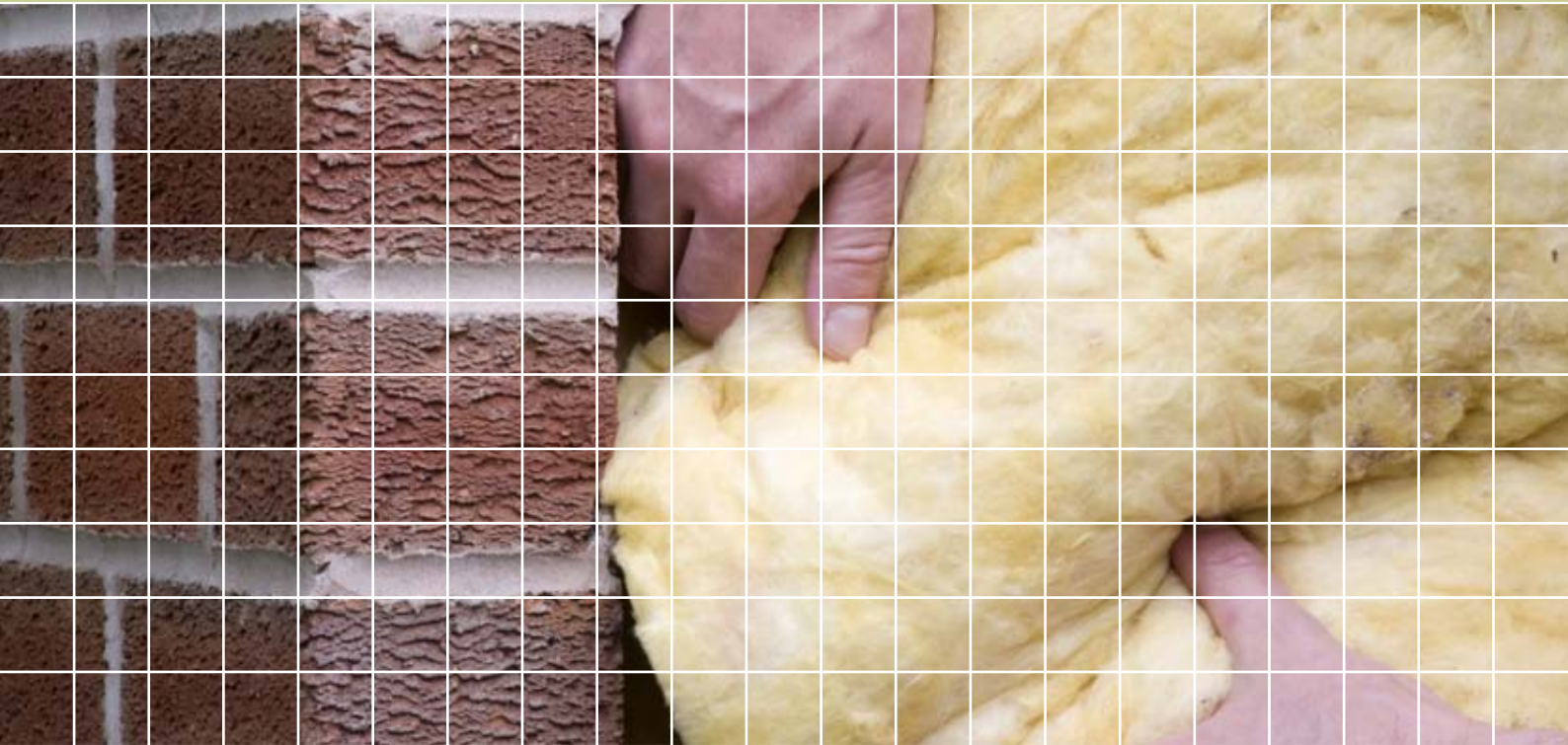
have noise considerations that could constrain their deployment.

ESRI (UK) is able to address these and other geographically important questions through a core product tool called ModelBuilder. This enables many different layers of geographically referenced data to be brought together and processed to deliver insight. Organisations are able to establish models for evaluating the implications of a low carbon heat investment.



Heat maps can be used to identify potential sites for community heating systems.

Energy efficiency development



Energy efficiency has a crucial role to play in the shift to a low carbon economy. Energy efficiency investments are wide ranging, covering installations such as roof and wall insulation, through to emerging technologies such as smart metering and home displays. Government commitment to the Carbon Emissions Reduction Target (CERT), the Community Energy Saving Program (CESP) and Zero Carbon Homes forces key stakeholders like Energy Suppliers to better understand energy efficiency opportunities.

Like other low carbon assessments, energy efficiency management has a distinct geographical dimension associated with it. Energy suppliers must consider defined areas with low income populations and identify opportunities to make a marked difference to energy consumption levels. This is where geographical information systems have a major role to play.



Mapping and analysing thermal infrared imagery for targeting energy efficiency schemes.

Defining energy efficiency opportunities

Geographically referenced data can deliver significant benefits in energy efficiency planning. Through the ArcGIS Desktop suite organisations are able to analyse a range of important data such as aerial thermal imagery, building outlines and socio-economic data. With easy to use analytical tools, users are able to quickly uncover areas of opportunity for energy efficiency programs.

Promoting energy efficiency opportunities

Maps are a highly intuitive means of providing information. Through the ArcGIS Server suite, organisations are able to offer advisory capabilities to citizens and other key stakeholders to explore energy efficiency opportunities. Gazetteers allow individuals to quickly drill down to a location, whilst embedded analytical tools and processes provide meaningful information to users.

Building thermal efficiency is one area where GIS is already playing a role in energy saving assessments. Here, local authorities are in a position to publish an indication of the 'leakiness' of properties through aerial thermal imagery. In addition, this data can be used to provide a citizen with information relating to the economic benefits of introducing a greater level of insulation and the environmental benefits.

Contact details

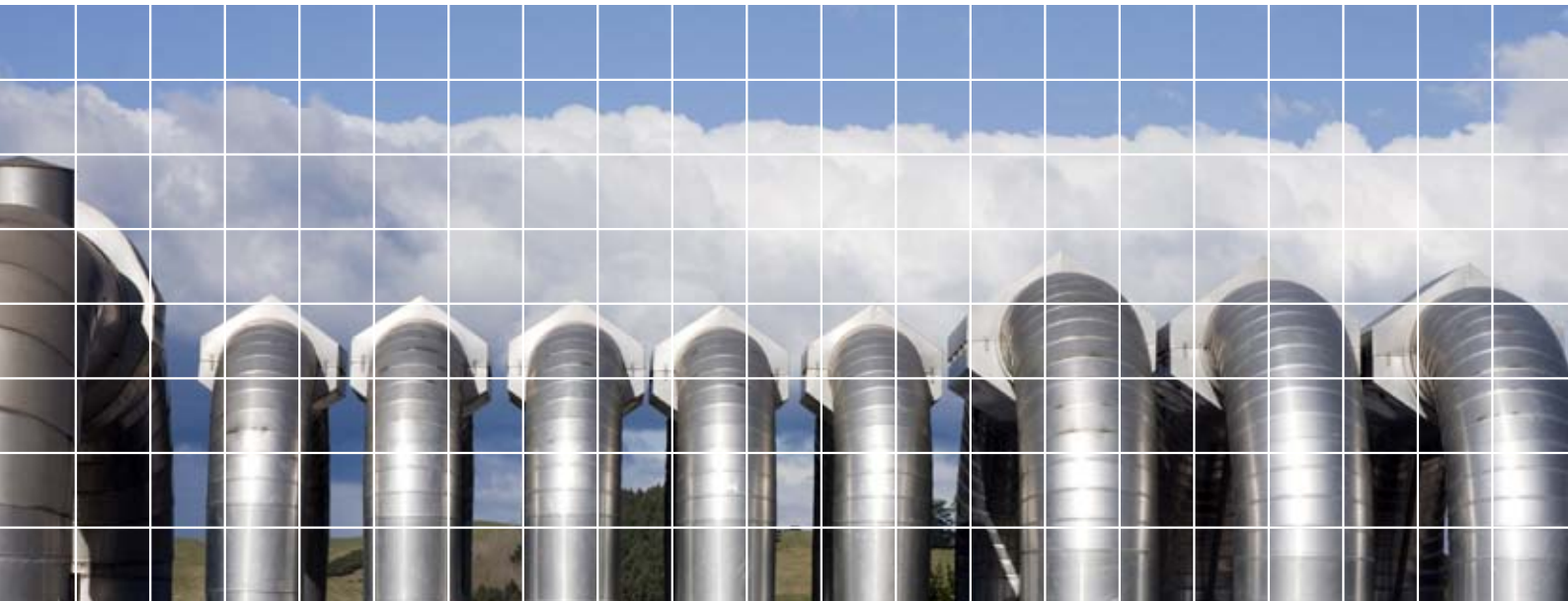


For more information on how your company could achieve lower carbon emissions, please email your contact details and a brief overview of your requirements to:

lowcarbon@esriuk.com

Further information can be found at:

www.esriuk.com/lowcarbon



About ESRI (UK) and Low Carbon Development

ESRI (UK) is highly active in low carbon development, working with a number of high profile clients such as The Crown Estate, ScottishPower Renewables, E.ON Renewables and Worcestershire County Council. Through a unique combination of world-class technology, domain expertise and implementation experience, ESRI (UK) is able to deliver tools that deliver against low carbon aspirations.

Find out more, please visit
www.esriuk.com/lowcarbon

We call this **Visionary Thinking**.