Socio-Economic Benefits Report to support a Local Area Energy Plan for EMCA (East Midlands Mayoral Combined Authority)

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DISCLAIMER

1. EXECUTIVE SUMMARY

Local Area Energy Planning (LAEP) has been identified as an important step to supporting climate ambitions across Derbyshire and Nottinghamshire and has the potential to further support increased devolution through a comprehensive plan that identifies the most effective pathway to decarbonising each district across D2N2. A Local Area Energy Plan sets out the change required to transition an area's energy system to net zero in a given timeframe. This is achieved by exploring potential pathways and considering a range of technologies and scenarios which, when combined with stakeholder engagement, leads to the identification of the most cost-effective preferred pathway and sequenced plan of proposed actions to achieving an area's net zero goal[1].

This report uses knowledge of council targets for energy system change across the proposed East Midlands Mayoral Combined Authority area and other publicly available data, to estimate the possible wider benefits that could be realised by some aspects of a full LAEP in advance of the LAEP process. The range and locations of the benefits assessment is limited by the data and local targets available but provides estimates of the value of the particular items identified using a 2050 end date. This assumes that they would be part of a wider strategy to achieve Net Zero by 2050.

The socio-economic benefits considered in this report are:

1) Reduced carbon emissions
2) Energy savings
3) Benefits to health and comfort from warmer housing and improved local air quality
4) Creation of new, green jobs as a result of low carbon investments in local areas

Three elements of decarbonisation are considered

1) Improvements to the thermal efficiency of housing
2) Electrification of road transport
3) Increased deployment of solar PV

Headline benefits that could result from the changes considered are shown in Figure 1. The total net benefit of the elements considered is £11b from an investment of £7.6b. This could save 51.5m tCO_2e to 2050 and create 4,500 local green jobs.

A full LAEP process could be expected to unlock significantly larger benefits through addressing other aspects of the local energy system that have not been considered here. For example, analysis completed by PwC for InnovateUK[2] found that taking a place-based approach to decarbonisation could reduce the investment required by as much as 70% whilst nearly doubling the wider social benefits that could be realised. Similarly, ESC analysis[3] has shown that a coordinated approach to LAEP is likely to deliver substantial whole system cost savings, in the order of 1% of GDP, relative to an organic, unplanned approach to achieving Net Zero. Prior to the pandemic[4] the average GDP per head across Nottinghamshire and Derbyshire was £25,075[5] suggesting that additional savings

[1] *Guidance on Creating a Local Area Energy Plan*, Energy Systems Catapult (2022)
[2] *Accelerating Net Zero Delivery*, PwC, Otley Energy, University of Leeds, 2022
[3] *Building a governance framework for coordinated Local Area Energy Planning*, Energy Systems Catapult, 2022.
[4] Data for 2020 has been published but is not yet available for 2021.
[5] https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/regionaleconomicactivitybygrossdomesticproductuk/1998to2020

of over £400m could be achieved through following a coordinated LAEP process across the whole of the area.

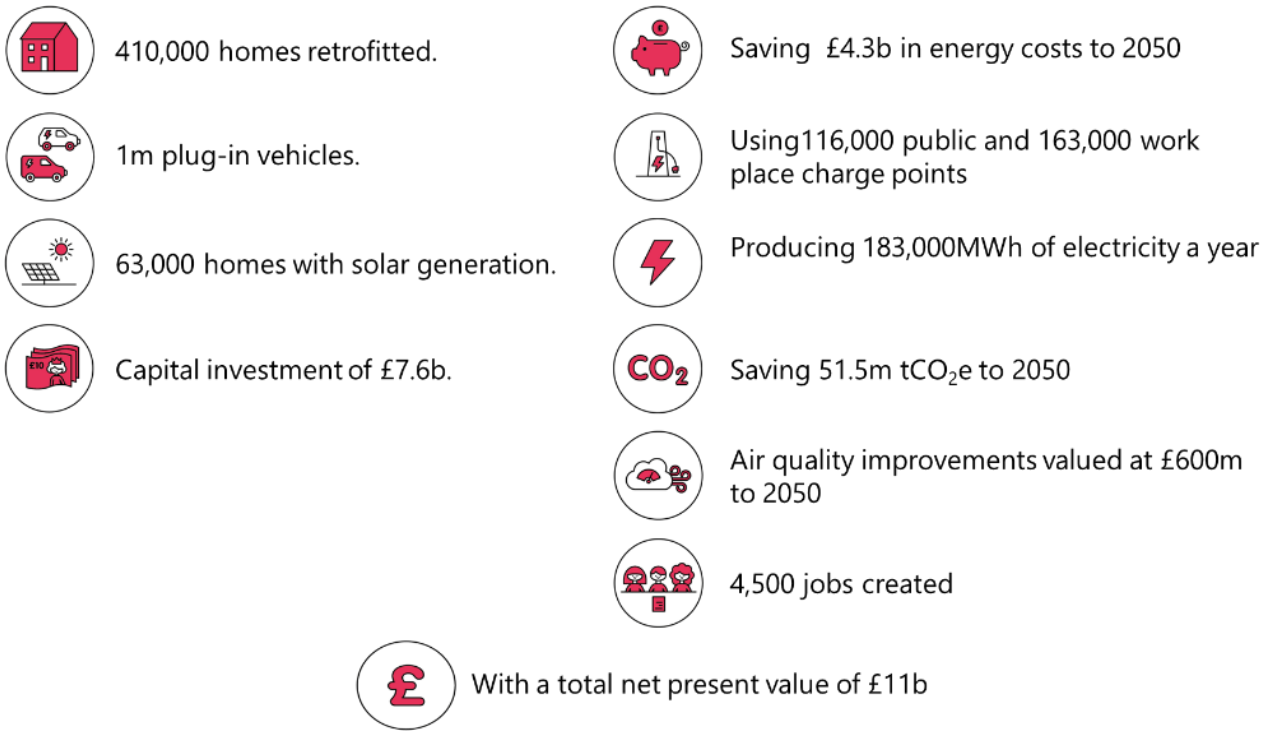

Figure 1: Headline figures for Nottinghamshire and Derbyshire

Some of the measures considered, such as decarbonising council owned vehicles and installing solar PV on council assets are in direct control of local government. In contrast other items such as housing retrofit and electrification of private cars are almost entirely dependent on the actions of local residents and businesses. In these cases, a collaborative approach will be needed to achieve energy system change.

More detailed results are shown in Table 1. A variety of local target end dates have been set to achieve different aspects of net zero. All decarbonisation programmes are assumed to start in 2023 with end dates as shown[6].

[6] For details of the sources of these local targets used in the analyses see the appropriate document sections

Table 1: Estimated benefits of four aspects of LAEP in Nottinghamshire and Derbyshire

Item	Housing Retrofit in Derbyshire and Nottinghamshire	Electrification of Derbyshire County Council fleet vehicles	Electrification of private cars in Derbyshire and Nottinghamshire	Increased deployment of solar PV in Derbyshire
Target completion date assumed	2030	2040	2050	2040
Potential carbon saving to 2050 (tCO_2e)[a]	24,350,000	14,000	26,800,000	300,000
Value of potential carbon saving to 2050 (£m)[b]	£4,630m	£3.7m	£4,760m	£62.5m
Potential value of energy savings to 2050 (£m) [b]	£4,300m	£0.98m	£7,850m	£940m
Potential air quality benefit to 2050 (£m)[b]	£215m	£0.8m	£380m	-[e]
Estimated Capital Cost (£m)	£2,100m	£11.1m	£4,985m[f]	£571m[g]
Jobs created [c]	4,000	-	205	295
Estimated Net Present Value (£m)[b]	£9,750m	£24.2m	£8,009m	£433m

a) Total carbon savings to 2050 depend heavily on the rate of change achieved. These estimates are in line with local ambitions where these were available.
b) All future values are discounted to 2022 values. Discounting is a financial process which aims to determine the "present value of future cash flows". It enables consistent comparison of costs and benefits occurring over different periods of time, or in other words: calculating what monies spent or earned in the future would be worth today.
c) These are estimates of the number of jobs that could be created through the capital investments required. Where the expected investment varies over time, they represent the period of peak investment.
d) This is the total for all solar PV on homes, council buildings, commercial buildings, and ground mounted.
e) Increased use of solar PV generation is assumed to have no benefit on local air quality as the location of emissions displaced from national generation cannot be known.
f) This includes the capital costs of vehicles as well as workplace and public charge points.
g) This includes the capital costs for PV installations on homes, public and commercial buildings as well as ground mounted solar farms.

A range of abatement costs (£/tCO_2e) can be seen in Table 1. There are several reasons why some items appear to have much better benefits than others when considered in this way.

1) The costs and benefits of different decarbonisation technologies are different depending on how they achieve change. For example, electric vehicles are significantly more efficient than fossil fuel equivalents since they use the energy directly to power an electric motor whereas a combustion engine produces significant quantities of heat through the process of burning fuel. As a result electric vehicles can achieve large reductions in running costs by changing from liquid fuel to electricity. In contrast an improvement in the thermal efficiency of housing reduces consumption of the same fuel rather than switching to a low carbon fuel. In addition it is also subject to comfort taking which reduces some of the benefits seen.

2) The timing of technology deployments – where technologies have been assumed to be deployed at later dates discounting means that deployments that occur in later years (e.g. electrification of private cars) will have lower costs when expressed as a present day value than deployments in early years (e.g. housing retrofit). Under the Green Book methodology, a change that occurs in later years will appear to be cheaper than the same change occurring in earlier years.
3) Changes that displace fossil fuel use (e.g. electrification of transport) achieve larger carbon reductions than increased use of local renewable generation which displaces electricity use with an alternative source of electricity. This is because the Green Book assumes that national electricity generation will be decarbonising through to 2035 with very low emissions after that date. Increased use of solar generation can, however, be highly cost-effective as it displaces energy that would otherwise have to be paid for.

MOVING FORWARD

With this initial analysis and other work already completed across Nottingham and Derbyshire the D2N2 region is well placed to prepare for a coordinated and successful programme of Local Area Energy Planning to realise the potential benefits identified here. A regionally coordinated delivery approach is recommended to maximise impact and efficiency. Regional coordination can also ensure that aspects such as procurement, governance, stakeholder management, decision making, programme consistency and quality assurance are steered effectively. This report recommends a delivery option based on the provision of 8 LAEPs (merging some local authorities into combined LAEP areas) supported by a technical advisor role to coordinate and oversee delivery. Taking this approach can also ensure that both local and regional priorities can be considered when developing LAEPs, reducing potential conflicts from an uncoordinated approach. Finally, regional coordination can lead to the aggregation and scale up of local opportunities, projects and action that is more likely to attract interest from the organisations that will support the implementation of the LAEPs and associated activity.

A series of next steps (summarised in Figure 2 below) have been provided in Section 8, these provide the region with activities that could be progressed over a 5 or 6 month period to prepare for a regional LAEP programme. The steps are not necessarily chronological and can be carried out simultaneously.

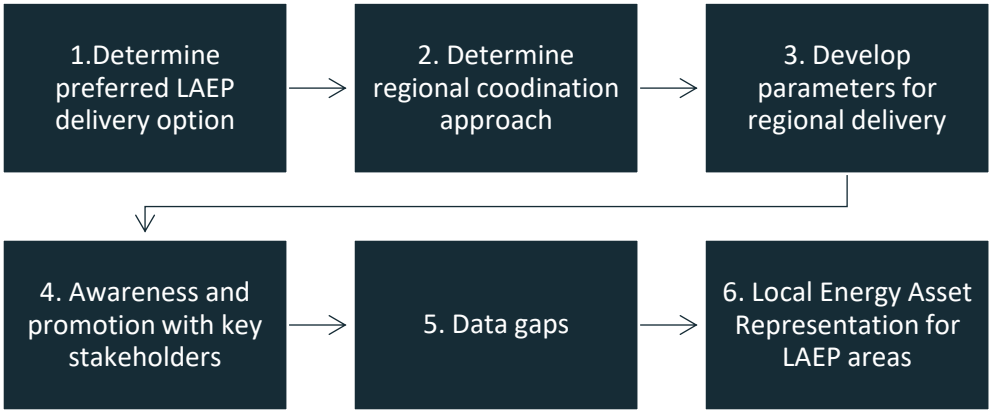

Figure 2 – Series of recommended next steps to prepare for a LAEP programme

2. INTRODUCTION

The four local authority areas of Derby City Council, Derbyshire County Council, Nottingham City Council and Nottinghamshire County Council (D2N2) have been identified in the UK Government's Levelling Up White Paper as pathfinder regions for greater devolution of powers from Westminster. Subsequently the areas of Nottinghamshire and Derbyshire have combined together to put forward a vision for devolved powers and improved services across the region, resulting in an initial application for combined devolution. This is being led through stakeholders comprising of the D2N2 Local Enterprise Partnership (LEP), Nottingham City Council, Derby City Council, Nottinghamshire County Council and Derbyshire County Council, the Midlands Net Zero Hub and representatives from the districts and boroughs.

Subject to further application and evidence submission, a successful bid will create a new East Midlands Mayoral Combined Authority (EMCA) with increased decision making across a range of services and more funding for the region. Underpinning this application are the climate emergency declarations and resulting net zero targets that will see much of Nottinghamshire and Derbyshire become carbon neutral well before the UK Government's mandated 2050 date.

Local Area Energy Planning (LAEP) has been identified as an important step to supporting these climate ambitions across Derbyshire and Nottinghamshire and has the potential to further support increased devolution through a comprehensive plan that identifies the most effective pathway to decarbonising each district across D2N2. Local Area Energy Plans utilise place-based data to provide regional stakeholders with a comprehensive plan that supports the identification and delivery of a range of regional decarbonisation projects. Scope for a typical LAEP addresses electricity, heat, and gas networks, future potential for hydrogen, the built environment (industrial, domestic, and commercial) its fabric and systems, flexibility, energy generation and storage, and providing energy to decarbonised transport e.g. electricity to electric vehicles and associated charging infrastructure.

The identification and delivery of a programme of decarbonisation projects across the region will bring wider socio-economic benefits that go beyond energy and carbon savings. These include improved air quality, comfort and wellbeing, improved quality of life and health benefits and supporting local job creation amongst others.

It is not possible to estimate the full potential of the wider benefits that could be realised in advance of the LAEP process. However, this report uses knowledge of council targets for energy system change across the proposed EMCA area and other publicly available data to estimate some of the possible wider benefits that could be realised by some aspects of a full LAEP.

In all cases Treasury Green Book[7] methods have been used along with associated assumptions[8] for the following:

1) Value of carbon dioxide
2) Air quality damage costs
3) Emissions factors for different sources of energy
4) Future energy costs

[7] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-govenent

[8] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

All future costs and benefits are discounted to 2022 values in line with Green Book assumptions of 1.5% for health benefits and 3.5% for all other costs and benefits. In all cases it is assumed that energy programmes are started in 2023.

3. WHY IS LOCAL AREA ENERGY PLANNING VALUABLE?

Delivering net zero (by a specified target date) cost effectively for local areas will require significant transformational change to a local areas energy system, built environment and other infrastructure. This major transition needs to be considered through a whole energy system approach, to consider the decarbonisation of heat, transport, industry, energy generation, storage and the infrastructure alongside one another.

Energy Systems Catapult developed the concept of LAEP to provide a whole energy system approach that enables local areas to have an active and leadership role in the net zero transition; working collaboratively with other primary stakeholders (for example energy network operators) to develop a plan that is supported by the organisations that will have a key role in supporting delivery. This recognises that local actors are best placed to support the transition rather than a top-down approach. These principles (whole energy system and locally driven) are recognised by national, devolved government, regional and local stakeholders, where LAEP is now an established practice with multiple local areas either having, undertaking or working on the implementation of LAEPs (as illustrated in Figure 3 below which shows the journey of several areas).

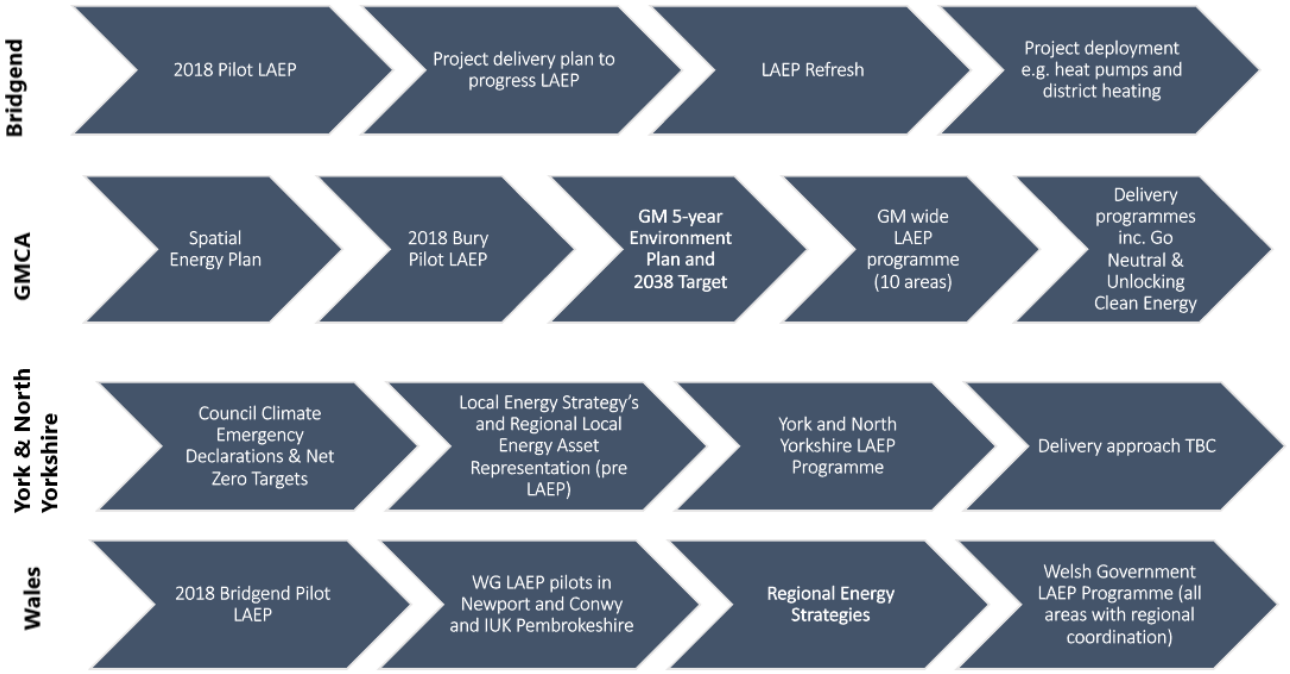

Figure 3: An example of the journey of LAEP and associated activity by local areas

As well as providing local government and their partners with a plan to guide activity, stakeholder engagement is a key part of the process, so that stakeholders are fully engaged throughout the process and presented with clear outputs to support decision making, for both technical/economic and non-technical aspects, of options to agree a pathway that primary stakeholders support; it is essential that a LAEP is built on an evidence-based process of evaluation.

Throughout the LAEP process, work is undertaken to determine the most appropriate zoning and granularity of outputs that represent the many communities and characteristics of the D2N2 area. Getting this right is essential, to ensure the LAEP clearly identifies and illustrates what action is needed and where. The aim is to provide the information to support the progression of projects, action and activity for the public sector and other organisations (e.g., the network operators) who will be involved with progressing and implementing the LAEP. Outputs would be supported by a

pathway (made up of near-term and long-term components) that sequences all of the interventions to achieve net zero. Other outputs can include:

- A visual 'plan on a page' that provides an at-a-glance impression of the scale of least regret interventions across the different geographical zones of the local area. Pictograms can be used to show the number of each type of intervention, for example heating system installations and public EV chargers. Illustrating focus zones, priority actions, and areas of grid constraint or spare capacity can be highlighted with icons,
- Visual focus zones for all the prioritised activity associated with the main individual (or combined) components of the proposed energy system, a lower and more granular level of detail than the 'plan on a page', covering building efficiency, low carbon heating, industrial/non-domestic, transport, local generation, network impacts etc,
- Outline Priority Projects,
- Breakdown of investment to decarbonise the local area aligned to the main components,
- Next steps/actions.

4. SOCIO-ECONOMICS BENEFITS APPROACH

As a first step a discovery phase was conducted to understand the types of energy related information and data that are held within D2N2. From this phase three items were identified to focus on for an analysis of the potential socio-economic benefits that could be realised from implementing a local area energy planning process. These were, fabric retrofit of existing housing, switching to low carbon road transport and deployment of renewable generation.

In each case the same process, shown in Figure 4, was followed.

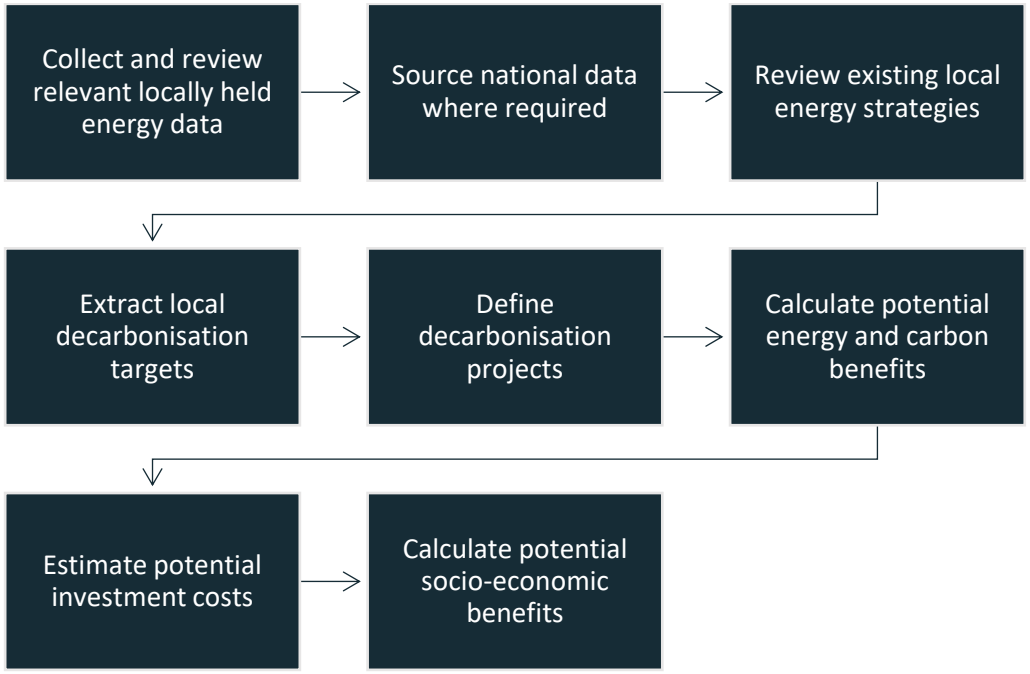

Figure 4: Modelling approach

Existing decarbonisation targets have a range of dates for when projects are planned to be completed. In order to allow comparison of the relative scale of the potential benefits of the different decarbonisation projects two different sets of calculations were performed:

1) The annual benefits realised after each project is completed
2) The total costs and benefits for each project to 2050

The following sections give details of the approach taken for each decarbonisation project and the results of the analysis as well as providing examples of how LAEP can help to achieve these benefits.

5. HOUSING RETROFIT

Improvements to the thermal efficiency of housing are a core aspect of Local Area Energy Planning. These have a series of direct energy system benefits such as reducing energy consumption and enabling the introduction of low temperature heating systems which have the potential to reduce carbon emissions. These include heat pumps, which operate most efficiently at lower supply temperatures. The ability to provide sufficient warmth at these lower radiator temperatures is increased if the heat loss rate of the building is reduced through increased insulation.

In addition, to energy system benefits other benefits from reducing heat loss from homes include:

1) Lower bills and an associated reduction in fuel poverty
2) Comfort taking[9].
3) Improved health through warmer homes.
4) Improved air quality through reduced burning of fossil fuels to provide heat.

Across Nottinghamshire and Derbyshire there are currently around 962,000 homes. The D2N2 Energy Strategy (D2N2, 2019) contains targets that the number of households experiencing fuel poverty should be below the national average and that all buildings should be EPC[10] C or above by 2030. The Derbyshire Spatial Energy Study (Scene, 2022) states that local authorities should focus on meeting national target EPC levels of C.

Based on existing EPC data the proportion of the housing stock that has potential to achieve different levels of EPC rating improvement is shown in Figure 5and Table 2**Error! Reference source not found.**. This shows that it will be extremely challenging to get all buildings to EPC C as defined in the strategy documents with around 10% of buildings showing potential to only get to EPC D or below.

Figure 5: Proportion of current stock that can achieve each EPC rating improvement

[9] When the costs of heating a home are reduced through improvements to its thermal efficiency consumers will generally use some of the savings to improve their comfort through increasing temperatures or using more energy in other ways.
[10] Energy Performance Certificates

Table 2: Proportion of current stock that can achieve each EPC rating improvement

Start EPC Rating	Potential EPC Rating	Proportion of Housing Stock[11]
D	A	0.8%
	B	36.8%
	C	25.4%
E	A	0.4%
	B	10.8%
	C	10.9%
	D	7.1%
F	A	0.1%
	B	1.6%
	C	2.1%
	D	1.2%
	E	1.5%
G	A	0.0%
	B	0.2%
	C	0.3%
	D	0.2%
	E	0.2%
	F	0.2%

For the purposes of assessing the potential benefits of improving the thermal performance of the local housing stock it was assumed that all properties whose EPC rating is currently in bands D to G (approximately 410,000 properties) would be improved to the maximum potential identified in their EPC.

Data was provided that gives the total number of buildings in each EPC band for each local authority in Nottinghamshire and Derbyshire. EPCs do not exist for all these properties. For properties that do not have a current domestic EPC the average improvement potential for buildings in the same local authority area and same EPC band (based on the data provided) was used. It was assumed that this programme of retrofit would start in 2023 and be completed in 2030.

The costs and benefits associated with these combined changes in thermal performance are shown in Table 3. Totals to 2050 include cumulative benefits to 2030 as transition occurs and then benefits seen from then to 2050.

[11] The total shown here is slightly under 100% due to rounding of values for presentation purposes.

Table 3: Estimated costs and benefits of improving the thermal performance of housing across Derbyshire and Nottinghamshire

Economic Benefit	From 2030 (per year)	Total to 2050
Carbon saving (tCO_2e)	990,000	24,350,000
Value of carbon saving	£180m	£4,630m
Electricity saving (MWh)	547,000	13,400,000
Fossil fuel saving (MWh)[12]	4,919,000	120,500,000
Comfort taking (MWh)	820,000	20,100,000
Value of energy saving[13]	£161m	£4,300m
Value of comfort taking	£43,000	£784m
Value of health benefits[14]	£74m	£1,892m
Value of air quality improvements[15]	£8.5m	£1,890m
Investment cost		£2,100m
Overall Net benefit		**£9,750m**

It is estimated that 4,000 jobs will be created during the assumed period of change i.e. 2023 to 2030. If the change takes longer then less jobs would be expected to be created over a longer period.

Development of a LAEP can help to:

1) Gain a detailed understanding of local housing stock in more detail than that available using EPC data.
2) Identify which properties and property types are most suitable for fabric retrofit improvements and how these relate to future options for low carbon heating systems.
3) Prioritise areas for early action based on technical suitability, cost effectiveness, fuel poverty benefits and the implications for energy networks.

Figure 6 provides an example of identification of focus zones for roll out of fabric retrofit; illustrating an example of the outputs provided in a LAEP.

[12] This will generally be gas consumption but includes other fuels such as heating oil and LPG for some properties typically off the gas network.
[13] Future energy costs are taken from Green Book assumptions https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[14] Warmer, drier homes improve the health and wellbeing of residents. This is an estimate of the value of that improvement based on a value of £60,000 per additional quality of life year.
[15] This is the value of the air quality improvement that results from burning less fossil fuel. It is an additional benefit to the health benefits resulting from warmer homes.

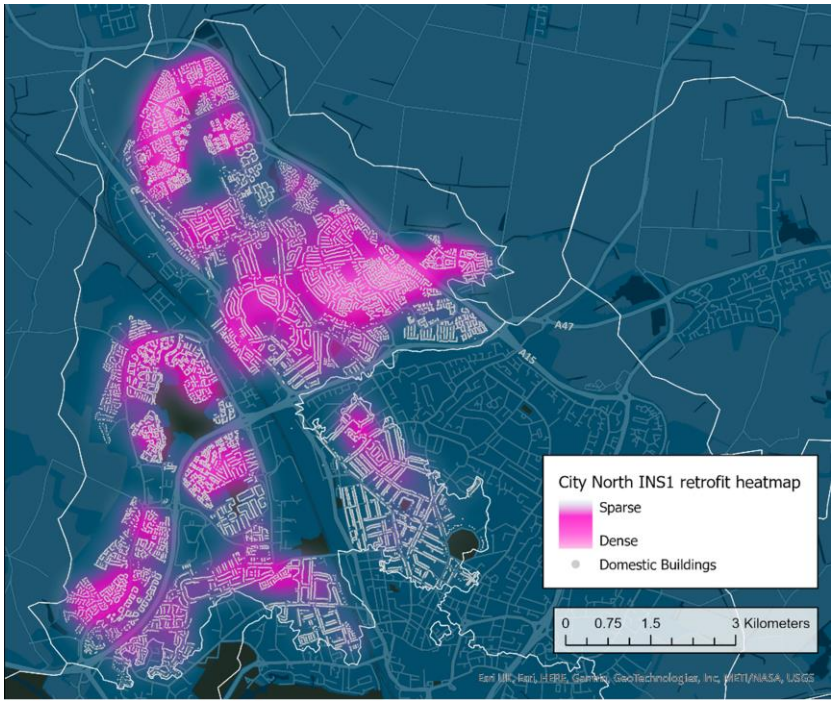

Figure 6: Example of identification of focus zones for building fabric (INS1 = basic insulation measures)

One example of this process in action comes from Bridgend where the County Borough Council is using results from its LAEP to identify and target areas to be included in BEIS's Heat Pump Ready project[16].

CONCLUSION

- Based on the data assessed, circa 90% of the region's housing stock has potential to reach the regional target of EPC band C, whereas the remaining circa 10% would be more challenging.
- This could provide several benefits including an overall estimated net financial benefit of £9,750m between now and 2050 along with the creation of 4,000 jobs.
- Undertaking a LAEP programme can provide building stock and socio-economic outputs in the early stages of the LAEP process to support the development of any housing retrofit programme activity e.g. providing information associated with dwelling type, current condition, EPC ratings and socio-economic data.
- On completion, LAEPs can be used to target delivery and implementation of housing retrofit programmes through identifying target/focus zones for cost effective housing retrofit.
- The LAEP process can also consider the trade-offs of achieving housing retrofit targets, or exceeding them, when considered alongside other interventions, understanding where and when it would and wouldn't be cost effective to increase level of retrofit.
- The LAEP process would provide a breakdown of investment costs for housing retrofit, supported by outlining the associated impacts on energy costs (to consumers); supported by providing improved estimates of expected wider social benefits than discussed in this document.

[16] https://www.gov.uk/government/publications/heat-pump-ready-programme-successful-projects/heat-pump-ready-programme-stream-1-phase-1-projects

6. TRANSPORT

COUNCIL FLEET

Local authorities can have a direct influence on their carbon emissions and operational costs as well as help to improve local air quality through programmes switching their vehicle fleets to low carbon alternatives. The Derbyshire Spatial Energy Study (Scene, 2022) says that local authorities in Derbyshire should identify and implement opportunities for internal low carbon transport improvements.

Whilst it is highly likely that cars and vans will follow the route of electrification to decarbonise the technology options for medium and heavy-duty vehicles are less clear. Short term benefits can be achieved through improved engine efficiency, hybridisation, switching to gas engines and better aerodynamics[17]. In the longer term, both electrification and hydrogen are options for reaching net zero. These technologies, for medium and heavy-duty vehicles, are still in the research, development and demonstration stages. The costs of current research and demonstration programmes are not, generally, published and do not provide an indication of likely future costs and benefits for large scale deployment which remain highly uncertain. As a result the estimates for future costs and benefits given here are likely to change significantly as low carbon heavy duty vehicles are developed. The costs and efficiency values used for this work were based on the ESC's Energy System Modelling Environment[18] whole energy system model. A wide variety of data sources[19] are used to develop the input data set to ensure independence from sector interests. These have been checked and validated by appropriate industrial partners.

Data on annual vehicle mileage from Derbyshire County Council was used to estimate the potential benefits of fleet decarbonisation. It was assumed that the programme would start in 2023 and that the fleet would not be fully decarbonised until 2040. Due to the tight timescales associated with this project data was not provided for Nottinghamshire County Council or any of the local councils.

It was also assumed that:

1) All vehicles switch to a full electric solution.
2) In each year a proportion of each vehicle type in the fleet is replaced with a low carbon alternative such that some of all vehicle types switch in every year from 2023 to 2040. This assumed that a proportion of the fleet will reach end-of-life or end-of-lease in each year.
3) All vehicles in the fleet would need to be replaced between 2023 and 2040 so the cost shown is the additional cost of electric vehicles over their fossil fuelled alternatives.
4) Electric vehicle costs are expected to reduce between 2023 and 2040 such that the incremental cost of replacing diesel vehicles with electric versions decreases over time.

Cost estimates do not include the costs of charging infrastructure in depots. Work is ongoing at the Midlands Net Zero Hub to understand this in more detail[20].

[17] For examples see https://www.csrf.ac.uk/

[18] The internationally peer-reviewed Energy System Modelling Environment (ESME) is the UK's leading techno-economic whole system model – providing in-depth evidence for industry, academia, the Climate Change Committee (CCC) and the UK Government. See https://es.catapult.org.uk/tools-and-labs/our-national-net-zero-toolkit/energy-system-modelling-environment/ for more details.

[19] https://es.catapult.org.uk/guide/esme-data-references-book/

[20] https://www.midlandsnetzerohub.co.uk/energy-projects/electrification-of-depots/

Table 4: Estimated costs and benefits of decarbonising Derbyshire County Council's vehicle fleet

Economic Benefit	From 2040 (per year)	Total to 2050
Carbon saving (tCO_2e)	1,800	14,000
Value of carbon saving	£16,000	£3.7m
Fuel saving (litres)	770,000	15,000,000
Value of fuel saving	£229,000	£4,500,000
Electricity consumption (kWh)	3,200,000	63,000,000
Cost of electricity consumption (£)	£175,000	£3,500,000
Net fuel cost saving (£)	£55,000	£1.0m
Value of air quality improvements	£50,000	£0.8m
Investment cost		£11.1m
Overall net benefit		**£24.2m**

Development of a LAEP could help to understand:

1) Possible timelines for decarbonising council owned vehicles and how this might help with meeting air quality targets.
2) The most suitable options for different vehicle types.
3) The network implications of electrification of the council fleet.

PRIVATE CARS

Whilst households make individual decisions on the types of private cars they own and operate local authorities can help to unlock electrification of private vehicles by enabling installation of new public charge points. The Derbyshire Spatial Energy Study (Scene, 2022) states that local authorities in Derbyshire should ensure that infrastructure planning in Derbyshire prioritises low carbon travel options. In addition the D2N2 Energy Strategy (D2N2, 2019) has a target that over 70% of vehicle miles should be ultra-low emissions by 2030. Considerable work is already underway in this area with nearly 400 public chargers (rapid and fast) already installed across Nottinghamshire and Derbyshire and online tools such as ZapMap[21] available to help consumers locate them.

To understand the wider implications of these ambitions, estimates have been made of the potential benefits of electrification of private cars using the number of licenced vehicles in Nottinghamshire and Derbyshire[22] and internal ESC data relating to:

1) The roll out of electric vehicles required to meet a 2050 net zero target.
2) The number of public and workplace charge points likely to be required to service the growing electric vehicle fleet.
3) The costs of charge points.
4) Projected future additional costs of plug-in vehicles compared to petrol and diesel alternatives.

To allow for the time between purchase and retirement of vehicles it was assumed that it will take until 2050 for the whole vehicle fleet to switch to low carbon vehicles.

[21] https://www.zap-map.com/

[22] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1090486/veh0105.ods

Table 5: Estimated costs and benefits of switching Derbyshire's and Nottinghamshire's private cars to plug-in vehicles

Economic Benefit	From 2050 (per year)	Total to 2050
Carbon saving (tCO_2e)	1,770,000	26,800,000
Value of carbon saving	£265m	£4,760m
Liquid fuel saving (litres)	735,640,000	11,254,000,000
Value of liquid fuel saving	£112m	£2,000m
Electricity consumption (MWh)	2,600,000	41,440,000,000
Cost of electricity consumption	£123m	£2,700m
Net energy cost saving	£434m	£7,850m
Value of air quality improvements	£16m	£380m
Vehicle investment cost		£4,820m
Workplace charge point investment costs		£97m
Public charge point investment costs		£68m
Overall net benefit		**£8,009m**

All values are compared to an alternative where current vehicles continue to be used all the way to 2050. It should be noted that the ban on conventional petrol and diesel car sales from 2030 is likely to be the primary factor in the switch to electric vehicles and will mean that a future with fossil fuel cars predominating will not be realised. Accelerating the deployment of electric vehicles could realise larger benefits. However, if local authorities in Derbyshire and Nottinghamshire enable investment of around £70m in public charge points between now and 2050 this can help to realise the large benefits shown and could create around 85 jobs in installations in the early 2030s.

It was estimated that the number of jobs created through investment in workplace and public charges would be 205 in peak year[23]. Additional, ongoing jobs would be created associated with maintenance and back-office operations.

Including electric vehicle charging and vehicle to grid options as part of a wider LAEP can ensure that the implications for electricity network reinforcement can be considered alongside any reinforcement that might be required due to electrification of heating in homes and businesses and their associated options for provision of flexibility services. This can help identify the best, and cheapest net zero network solutions. An example of identification of focus zones for roll out of EV chargers is shown in Figure 7.

[23] Made up of 85 from public charge point investments and 120 from workplace charge point investments

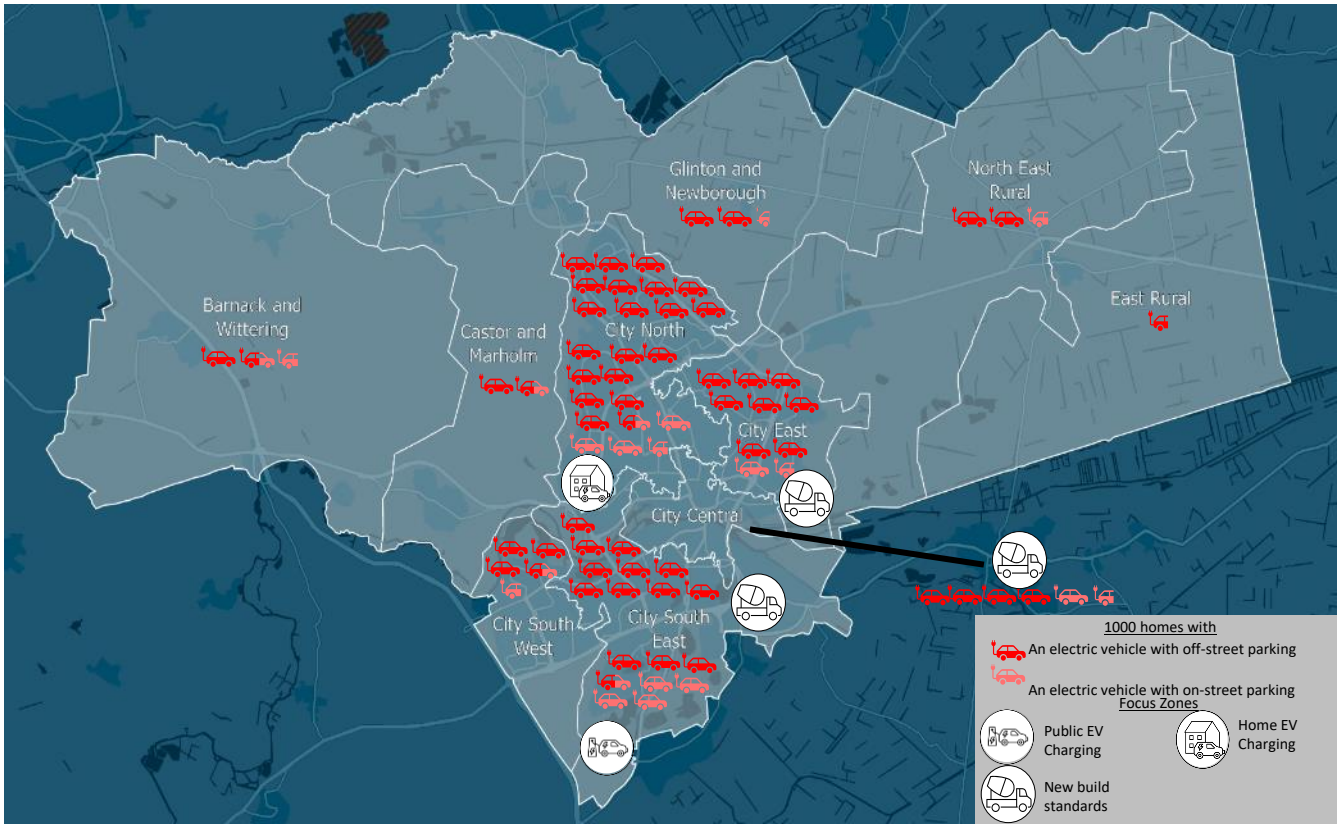

Figure 7: Example of EV uptake across Peterborough

The Energy Superhub Oxford project[24] provides an example of how provision of public charge points can be linked to wider energy system changes and opportunities through effective whole system planning. As of July 2022, the project has resulted in Europe's most powerful EV charging hub. LAEPs will provide locational targets for the D2N2 region to consider comparable projects; providing the evidence base to establish priority project opportunities.

CONCLUSION

- This analysis has estimated several benefits including an overall net financial benefit of £8,009m between now and 2050 associated with the transition of private cars to electric vehicles.
- Derbyshire and Nottinghamshire can directly lead on the decarbonisation of transport through transitioning their own public sector fleet whilst realising other benefits such as reduced operating costs and improved air quality.
- LAEPs can be used to understand the impact on energy demands resulting from vehicle decarbonisation and plan the provision of associated infrastructure optimally, considering vehicle charging alongside other aspects that will also impact the energy system (particularly heat decarbonisation).
- LAEPs can be used to highlight and prioritise areas for public charging points and hubs in addition to home/workplace charging infrastructure.
- Taking a coordinated approach should help to facilitate investment and support funding opportunities.

[24] https://energysuperhuboxford.org/technologies/electric-vehicle-charging/

7. RENEWABLE GENERATION

The D2N2 Energy Strategy (D2N2, 2019) has a target for 100% low carbon energy supply with 60% of D2N2 electricity consumption generated by local low carbon sources by 2030. The Derbyshire Spatial Energy Study (Scene, 2022) gives indications of the technical potential for generation using solar PV and has a target of 20% of homes with PV by 2030. Derbyshire County Council also have a target of 200MWh of renewable generation from their own estate by 2032. In addition to these targets, the following potentials for PV deployment from the Derbyshire Spatial Energy Study were used.

- 530MW_p from commercial and industrial buildings
- 327MW_p from ground mount PV

It was assumed that 50% of these potentials will be realised by 2040 alongside achievement of the targets shown above. Focus was on fitting solar PV to existing buildings (to match the focus of LAEP) rather than considering new buildings which are more likely to be defined through building regulations and planning processes. Whilst no targets were available to perform a similar analysis for Nottinghamshire it is likely that a similar scale of benefits could be achieved. Development of LAEPs across the D2N2 area would identify the potential scale and location of opportunities for solar deployment and identify areas of focus for initial activity.

Calculations assume that ground mount PV saves generation-based emissions whereas roof mounted PV is assumed to save consumption based emissions which are higher due to network losses.

Ground mounted PV on agricultural land is likely to be the result of private investments. As such the value of energy savings from these installations was assumed not to benefit local people. If local community energy schemes are set up to build solar farms, then additional benefits could be realised by retaining the full value of energy sales for local people. In contrast, benefits from domestic, council and commercial building installations will be realised locally by the building owners and operators. The value of these energy savings is included in the calculations. In terms of carbon savings and the investments required all installations were included in the calculations.

Table 6: Estimate costs and benefits of installing solar PV in Derbyshire

Economic Benefit	From 2040 (per year)	Total to 2050
Total new domestic PV capacity (MW_p)	-	190
Domestic PV cost	-	£270m
Total new council building PV capacity (MW_p)	-	0.16
Council building PV cost	-	£0.13m
Total commercial building PV capacity (MW_p)	-	265
Commercial building PV cost	-	£201m
Total ground mount PV capacity (MW_p)	-	164
Ground mount PV cost	-	£100m
Carbon saving (tCO_2e)	9,000	300,000
Value of carbon saving	£0.9m	£62.5m
Domestic energy savings (MWh)	183,000	4,500,000,000
Domestic energy cost saving	£16m	£550m
Additional council building energy savings (MWh)	150,000	3,500,000
Additional council building energy cost saving	£9,000	£0.3m
Commercial building energy savings (MWh)	255,000	5,000,000,000
Commercial building energy cost saving	£16m	£390m
Jobs created to 2030	800	
Jobs created 2030 to 2040	295	
Overall net benefit		**£433m**

It is estimated that around 800 jobs could be created to 2030 (based on the target date for 20% of homes having PV installed by this date). Between 2030 and 2040 around 295 jobs would continue to exist in order to continue the roll out of PV systems on council and private buildings and for ground mounted systems.

Total electricity generation is estimated to be around 600GWh per year. This compares to total local demand of 4,550GWh for Derbyshire and 4,050GWh/year for Nottinghamshire[25] in 2020 meaning that the solar PV capacity that has been assumed for Derbyshire makes up 13% of Derbyshire's current demand in contrast to the D2N2 target of 60% from local low carbon sources. Future demand reductions and alternative sources of local generation are likely to be required to meet the target. The gap could be closed through

- Higher deployment of solar PV than the values assumed in this work
- Projects to reduce demand by improving efficiency
- Development of other local renewable generation projects such as for wind generation

Identification of local opportunities for renewable generation is an integral part of LAEP. Figure 8 provides an example of the opportunities identified in Peterborough's Local Area Energy Plan; this illustrates overall (area wide) opportunities which would be supported in LAEPs with more detailed and granular outputs and information to support project identification opportunities. Increased benefits are likely to be realised when it is considered in this way alongside increased demand from electrification of heat and transport as well as opportunities for local battery storage and the implications for electricity networks. This allows the most cost-effective solutions to be identified and can help to match local generation with likely future demand.

[25] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1043467/subnational_electricity_consumption_statistics_2005-2020.xlsx)

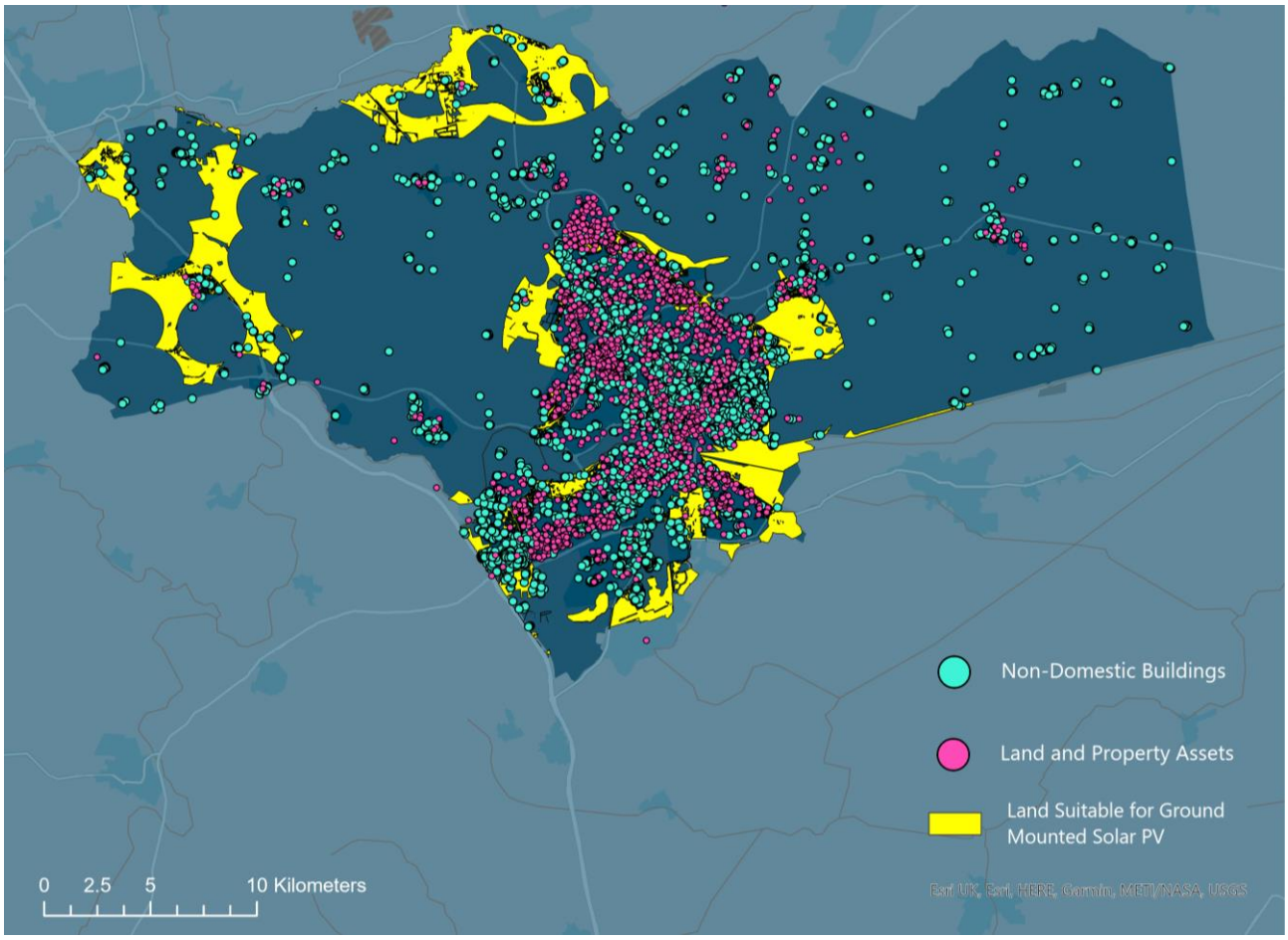

Figure 8: example of identification of opportunities for solar PV deployment in Peterborough and surrounding areas

CONCLUSION

- The D2N2 Energy Strategy (D2N2, 2019) has a target for 100% low carbon energy supply with 60% of D2N2 electricity consumption generated by local low carbon sources by 2030.
- Analysis has estimated that there is potential for 620MWp of Solar PV generation that could be installed in Derbyshire[26], which would meet in the region of 13% of Derbyshire's electricity demand (whilst significant there is a notable shortfall from the 60% target); providing an estimated net financial benefit of £433m between now and 2050.
- Undertaking a programme of LAEP in the region would provide a more detailed assessment of potential for local low carbon generation, understanding the trade-offs between increasing volume and other energy system options (e.g. demand management and flexibility).
- LAEPs can also be used to prioritise deployment (providing what, when and where) when considering other aspects of the energy system such as integration with the electricity network, land use and increasing electricity demand through heat and transport electrification.

[26] Information was only available to assess potential in Derbyshire for this study

8. PREPARING FOR LOCAL AREA ENERGY PLANNING

This report has set out the value for taking a place-based approach to decarbonise the D2N2 region. Followed by establishing how LAEP can be used to unlock the identified benefits, whilst ensuring that the region and its local areas play an active and leading role in directing the net zero transition; so that it is cost effective but also to understand what opportunities and benefits can be locally achieved.

In addition, during the analysis that was used to establish the potential socio-economic benefits described in the preceding sections (Housing Retrofit, Transport and Renewable Generation), a series of data gaps have been identified that would need to be completed to undertake a regional programme of LAEP; these are summarised below.

DATA GAPS

The analysis presented here has been constrained by local and national data that was readily available at the time of analysis. ESC has developed a sophisticated process to use both national and local data to produce a Local Energy Asset Representation[27]. This can help to provide a good first step in understanding of the energy system in a local area. The data produced can be used as foundation stone on which to develop and explore options for decarbonisation.

To get the maximum value from this process and enable development of a LAEP several pieces of local data are useful.

1) Clear agreement around, and definition of, any target dates set to achieve net zero is essential.
2) Information on council owned assets (buildings, land and vehicle) and local social housing from existing asset registers. Since achieving change is often easier for these areas than for privately owned assets, they are often areas that are part of early steps towards net zero so detailed data is valuable in allowing improved understanding of options to enable rapid action. Ideally these asset registers should identify individual buildings and provide information on their current use and energy consumption.
3) Local transport information from traffic surveys or local transport modelling is useful to improve investigation of EV charging options. This should identify
    a. Number of journeys
    b. Journey origin – destination pairs (as LSOA)
    c. Distance travelled
    d. Mode of transport
    e. Journey time of day – arrival and departure times
    f. Reason for travel
4) Information on existing district heat networks from operator asset registers including which buildings are connected, how heat is produced and annual energy consumption is essential.
5) Details of any local manufacturers that have high energy consumption and might be useful sources of 'waste' heat is useful for improved understanding of future options.
6) Information on local electricity networks from local Distribution Network Operators including substation locations and nameplate capacities as well as any connection data that the local Distribution Network Operator is willing to provide[28]. This data is essential to understanding any local network reinforcements that might be required.

[27] https://es.catapult.org.uk/tools-and-labs/our-place-based-net-zero-toolkit/local-energy-asset-representation/

[28] This is more likely to include details on connections between HV and LV substations rather than customer connection data, which can be subject to GDPR concerns.

7) Information on local gas networks from local Gas Network Operators. For each pressure tier it is useful to understand the lengths of pipe for different type of pipe material. This data is often provided in GIS format and is essential to produce estimates of the costs associated with re-purposing the gas network for hydrogen. Without this data good understanding of the options for local use of hydrogen will be limited.
8) Details of planned local developments (e.g. housing, business parks) from local authority planning departments with expected number of units, delivery dates and build standards is essential to understanding future network requirements.

A coordinated regional approach could be used to collate the data described above; this could incorporate establishing a data schema to support the process. Taking such an approach can ensure that activity can be completed in a timely manner and also ensures the process is carried out efficiently.

INDICATIVE DELIVERY OPTIONS FOR LAEP

To gain the benefits identified in this report a programme of Local Area Energy Planning needs to be undertaken in the D2N2 Local Enterprise Partnership area. Delivering local area energy planning across the entire D2N2 area would be the largest programme to date in England and is comparable in scale only to the new Welsh Government programme funding LAEPs for all Welsh local authorities (18 new LAEPs being produced, with a Technical Advisor role ensuring they are delivered to a consistent, high standard). Three options are described below.

Option 1 –17 Independent 'Lite' LAEPs, one for each Local Authority area

A budget of £1.2m gives around £70k per LAEP for 17 LAEPs. This would result in the provision of a partial LAEP that would not meet current standards[29] ; we understand that LAEPs delivered to date by a variety of organisations have all required higher budgets. Therefore, it is likely that additional funding would be required to complete the LAEP and produce the key outputs that provide the local areas with the sequenced plan of proposed actions to achieving an area's net zero goal. In addition, the delivery of 17 LAEPs is likely to be beyond the capabilities of any one organisation, and so instead, different delivery organisations would need to be involved. This limits the economy of scale benefits that could be achieved through a wholly coordinated approach, for example, similar activities such as data analysis and engagement would get repeated multiple times, with some stakeholders e.g. network operators having to engage with different actors. Due to the nature of undertaking a regional programme of LAEPs, a Technical Advisor role would be recommended, to ensure there is a consistent approach between them, so that the plans can have impact at the regional and D2N2 level and issues at the boundaries between the areas can be considered; it is unlikely that this would be possible within budget for this option. However, taking this approach would mean that every local authority area would go through a similar process of:

- Establishing primary stakeholders, understanding stakeholder needs, priorities and objectives
- Build a representation of the current area and its energy system and develop future projections of energy demand and emission; this in itself can be used to target some but limited projects and activity
- Undertake some initial modelling to understand what the area's net zero transition could look like
- However, as already stated further funding would be required to complete the LAEP process (generally aligned to Stage 5 to 7 of the Guidance for Creating a LAEP)

[29] https://es.catapult.org.uk/guide/guidance-on-creating-a-local-area-energy-plan/

Option 2 – Grouping Local Authorities together to produce 10 complete LAEPs

A budget of £1.2m would allow 10 LAEPs at £120k each; a budget that would be appropriate for a completing a LAEP aligned to current guidance/standards. This option would allow the development of plans that covered two local authorities at once (with Derby and Nottingham staying separate because of their size). This budget per LAEP may not allow the results and reports to be broken down into the individual local authorities and would be on the basis of a single report per LAEP area. In addition, this allocation of budget is unlikely to be able to support a Technical Advisor role, and so there is a risk that the LAEPs delivered will not be consistent enough in approach, to allow the findings to be combined and scaled up, and not benefit from taking a coordinated regional approach. However, this option would provide full LAEPs for each area; identifying and illustrating what action is needed and where and providing the information to support the progression of projects, action and activity. Outputs would be supported by a pathway (made up of near-term and long-term components) that sequences all of the interventions to achieve net zero.

Option 3 – Grouping Local Authorities together to produce 8 complete LAEPs – coordinated regionally and overseen by a Technical Advisor.

This option looks for further economies of scale by building on the grouping local authority approach described in option 2, so that one set of analytical work that covers the group of local areas is undertaken. In addition, further efficiency is achieved through coordinating engagement and other activities aligned to the process of creating a LAEP. In most cases the local authorities are grouped in sets of 2 or 3, but Nottingham and Derby are by themselves, getting a LAEP each due to their size. There are different methods of assessing an area's size or complexity for a LAEP, including land areas, numbers of buildings or substations. Considering the number of domestic buildings, the approach outlined in the map means six of the eight areas contain between 66,000 and 86,000. Two are higher than this, with largest being Nottingham with 120,000. The suggested groups are all local authorities that are adjacent to each other and avoids making any groups that cross the Derby and Nottingham County boundaries. This grouping reduces the amount of duplicated analysis and stakeholder engagement.

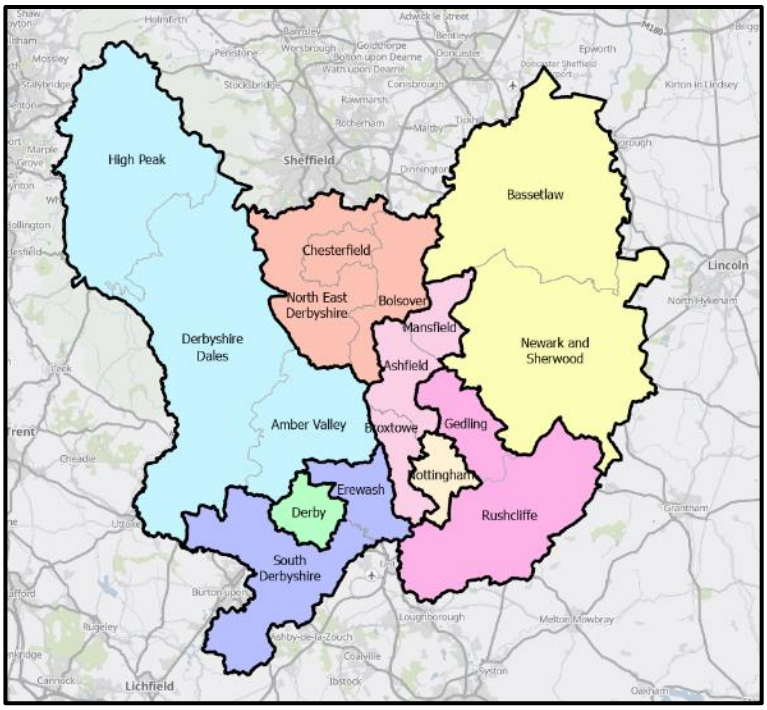

Figure 9 - Provisional grouping of LAEPs to split the area into 8

When considering which areas to combine into the same LAEP it would be good to consider whether particular areas commonly work together, or where different areas share very similar ambitions. This has not been considered at this stage but should be part of conversations with the local authorities before a grouping was finalised. In addition, there are three electricity network operators (i.e. Electricity North West, Northern Power Grid and Western Power Distribution) serving the D2N2 area, and ideally the approach would minimise the number of different LAEPs they each needed to work with. The split proposed in Fig 10 restricts the Electricity North West input to one LAEP, but requires input from Northern Power into 3, and Western Power distribution would be required to input into all 8.

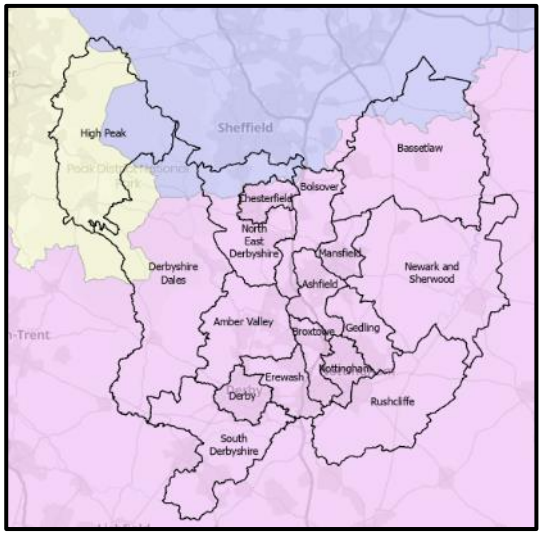

Figure 10 - DNO network areas across D2N2 - Electricity North West in yellow, Northern Power Grid in blue and Western Power distribution in pink

If delivering 8 LAEPs, a proposed budget of £1.2m would allow two further enhancements:

- Although the analytical work would be done for the local areas in their groups, the budget would allow the reports to clearly break out the findings for each local authority, so each local authority could have its own set of outputs or chapter of a plan.
- The budget would allow an organisation to take a technical advisor role, potentially in addition to delivering some of the LAEPs. This role would be to ensure the LAEP's were delivered in a consistent way and to appropriate quality standards by assisting with procurement, method development, checking of outputs and coordination between the different areas. By ensuring consistency it is then possible to scale up the findings to county and D2N2 scale at a regional programme level.

RECOMMENDATIONS

There is a balance between providing as much detail as possible for each local authority, maintaining high quality and consistency and remaining within the budget. It is our opinion that **Option 3** is likely to prove the most cost effective, with the budget allowing for eight sets of LAEP analysis, with results presented for each local authority individually; whilst also allowing an organisation to take the role of Technical Advisor, ensuring consistency and quality are maintained. Whereas, attempting to produce a 'Lite' LAEP for every local area (as per option 1), would result in a partial/incomplete LAEP; this would exclude vital aspects such as limiting granularity and optioneering, ensuring that stakeholders are bought into the plan and providing a sufficiently developed roadmap/sequenced plan of proposed actions and projects to achieve an area's net zero goals.

Furthermore, there are multiple aspects of the LAEP process that can be made more efficient through an approach aligned to Option 3, particularly around the data collection and analysis that is required to build the representation of the local areas-built environment, transport and energy systems'; followed by the modelling approach, assumptions and other factors considered when assessing options and scenarios.

The aspects described above can then be further optimised through the provision of a technical advisor to oversee the delivery of a regional programme. A technical advisor or similar role is key to maximise impact given the scale and ambition of the programme; both for considering the efficiency aspects described but also to ensure a regionally coordinated approach. Regional

coordination can focus on areas such as maximising efficiency, procurement, governance, stakeholder management, decision making, programme consistency and quality assurance, it can allow local priorities to be considered alongside regional ambitions and highlight potential conflicts from an uncoordinated approach. Finally, regional coordination can lead to the aggregation and scale up of local opportunities, projects and action that is more likely to attract interest from the organisations that will support the implementation of the LAEPs and associated activity.

9. CONCLUSION & NEXT STEPS

A Local Area Energy Plan (LAEP) sets out the change required to transition an area's energy system to net zero in a given timeframe. This is achieved by exploring potential pathways and considering a range of technologies and scenarios which, when combined with stakeholder engagement, leads to the identification of the most cost-effective preferred pathway and sequenced plan of proposed actions to achieving an area's net zero goal[30]. This allows local areas to develop an action plan with clearly identified next steps that can achieve real progress towards local energy ambitions.

Whilst this work does not cover the full analysis required to create a LAEP we have looked at housing retrofit, electrification of private cars and increased deployment of solar PV across Nottinghamshire and Derbyshire as well as decarbonisation of Derbyshire County Council's vehicle fleet to estimate the possible costs and benefits that could be realised through following a full LAEP process. This has shown that, for these aspects alone, the total net benefit to 2050 could be £11b from an investment of £7.6b. This investment could save 51.5m tCO_2e to that date and create 4,500 local green jobs. Details are given in Table 7.

Table 7: Estimated benefits of four aspects of LAEP in Nottinghamshire and Derbyshire

Item	Housing Retrofit in Derbyshire and Nottinghamshire	Electrification of Derbyshire County Council fleet vehicles	Electrification of private cars in Derbyshire and Nottinghamshire	Increased deployment of solar PV in Derbyshire
Target completion date assumed	2030	2040	2050	2040
Potential carbon saving to 2050 (tCO_2e)[a]	24,350,000	14,000	26,800,000	300,000
Value of potential carbon saving to 2050 (£m)[b]	£4,630m	£3.7m	£4,760m	£62.5m
Potential value of energy savings to 2050 (£m) [b]	£4,300m	£0.98m	£7,850m	£940m
Potential air quality benefit to 2050 (£m)[b]	£215m	£0.8m	£380m	-[e]
Estimated Capital Cost (£m)	£2,100m	£11.1m	£4,985m[f]	£571m[g]
Jobs created [c]	4,000	-	205	295
Estimated Net Present Value (£m)[b]	£9,750m	£24.2m	£8,009m	£433m

A full LAEP process could be expected to unlock significantly larger benefits through addressing other aspects of the local energy system that have not been considered here. For example, analysis completed by PwC for InnovateUK[31] found that taking a place-based approach to decarbonisation could reduce the investment required by as much as 70% whilst nearly doubling the wider social

[30] *Guidance on Creating a Local Area Energy Plan*, Energy Systems Catapult (2022)
[31] *Accelerating Net Zero Delivery*, PwC, Otley Energy, University of Leeds, 2022

benefits that could be realised. Similarly, ESC analysis[32] has shown that a coordinated approach to LAEP is likely to deliver substantial whole system cost savings, in the order of 1% of GDP, relative to an organic, unplanned approach to achieving Net Zero. Prior to the pandemic[33] the average GDP per head across Nottinghamshire and Derbyshire was £25,075[34] suggesting that additional savings of over £400m could be achieved through following a coordinated LAEP process across the whole of the area.

Many other local areas have already embarked on the journey of completing a local area energy plan and moving forwards with actionable plans for local decarbonisation as outlined in Section 3.

The following series of next steps are recommended in support of preparing the region for a programme of LAEP activity. These activities can be carried out over the next 5 to 6 months:

- Determine preferred LAEP delivery option from the options described in Section 8 (where option 3 has been recommended).
- Determine how the region would want to coordinate delivery, where a regional coordination approach is recommended to oversee the set up and delivery of a LAEP programme. Given the scale and ambition of the region, a technical advisor role is recommended to support this activity. A technical advisor role should support aspects such as:
    - Determining objectives, scope and methodology requirements that are bespoke to the region
    - Developing the specification for delivering LAEPs along with any procurement support
    - Determining the approach for regional coordination
    - Provide steering through a client/technical advisor function to the region, the local areas and any organisations supporting the creation of LAEPs
    - Ensuring quality and consistency and that delivery achieves the regions requirements and objectives
- Develop the region's parameters associated with a regionally coordinated approach, such as establishing initial views on procurement, governance, stakeholder identification and management, objectives, scope and resource and support to local areas
- Carry out awareness and promotional sessions with key regional stakeholders; achieving buy in from decision makers within respective organisations
- Undertake activity to complete data gaps, maximising the benefit and efficiencies of coordinating activity regionally
- Where data gaps can be filled, along with providing additional data sets, the region could proactively prepare for a programme of LAEP by producing a Local Energy Asset Representation for the LAEP areas. This is one of the main stages of the LAEP process. However, outputs can also be used to inform funding and project activity ahead of a LAEP.

The steps are not necessarily chronological and can be carried out simultaneously.

[32] *Building a governance framework for coordinated Local Area Energy Planning*, Energy Systems Catapult, 2022.
[33] Data for 2020 has been published but is not yet available for 2021.
[34] https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/regionaleconomicactivitybygrossdomesticproductuk/1998to2020

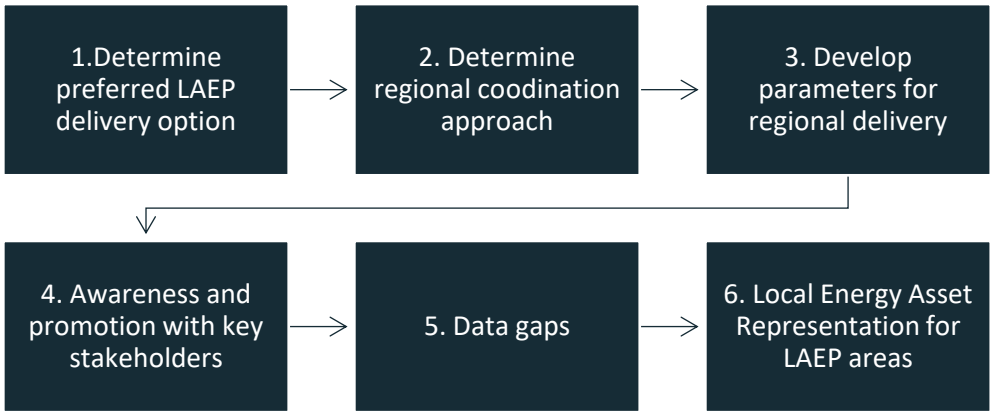

Figure 11 - Series of recommended next steps to prepare the region for a programme of LAEP activity

Undertaking the proposed recommendations would result in a more effective LAEP programme within the region, providing the foundations for a programme that could be delivered efficiently and at pace.

10. REFERENCES

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