
ENERGY STRATEGY 2019-2030










D2N2 Clean Industrial Revolution



A view on D2N2's Clean Growth future

D2N2 2017/18

D2N2 2030

 Population - 2.2 million residents	A sustainable and clean growth economy
 Economy - £45bn generated each year	
 77.8% of vehicle miles were by cars	Over 70% of vehicle miles to be Ultra Low Emissions
 An average of 7.4 days per site, when air quality exceeded 'moderate' or higher thresholds	To comply with, and exceed where possible , applicable air quality standards in all locations
 12.1% of households experiencing fuel poverty	Households experiencing fuel poverty to be below the national average and all buildings to be EPC C or above
 Carbon intensity of turnover 348 Tonnes CO2/£million annual GVA	Carbon emissions decoupled from growth - 50% reduction in carbon intensity of turnover to under 210 Tonnes CO2/£million annual GVA
 CO2 Emissions Per Capita 7.1 Tonnes	50% reduction, or greater, in CO2 Emissions Per Capita to < 3.5 Tonnes
 In 2016 11.6% of D2N2 electricity consumption was generated from local low carbon	100% low carbon energy supply with 60% of D2N2 electricity consumption generated by local low carbon sources
 D2N2 spends an estimated £3,690 million on all of its energy and fuel bills*	Investing in all profitable energy efficiency and low carbon options, could cut total energy bills by £1,030 million a year in D2N2

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* <http://www.candocities.org/energy-and-carbon/derby,-derbyshire,-nottingham-and-nottinghamshire>

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Glossary

BEIS – Department of Business Energy and Industrial Strategy

BTM – ‘Behind-the-meter’

CO2 – Carbon Dioxide

CHP – Combined Heat and Power

D2EE – Derby and Derbyshire Energy Efficiency Grants and Energy Advice for SMEs

D2N2 – The Local Enterprise Partnership for Derbyshire and Nottinghamshire, and their respective cities, Derby and Nottingham

DSR – Demand Side Response

EPC – Energy Performance Certificate

ERA – Energy Research Accelerator

ESC – Energy Systems Catapult

ETRI – Energy Technologies Research Institute

GHG – Greenhouse Gas

GUL – Go Ultra Low

GVA – Gross Value Added

ICE – Internal Combustion Engine

IPCC – Intergovernmental Panel on Climate Change

LAEP – Local Authority Energy Partnership

LCEGS – Low Carbon, Environmental Good and Services

LCRE – Low Carbon and Renewable Energy sector, ONS data classification

LEP – Local Enterprise Partnership

LEVEL – Low Emission Vehicle Enterprise and Learning

MaaS – Mobility-as-a-Service

NG – National Grid

ONS – Office of National Statistics

SIA – Science and Innovation Audit

TD – Two Degree (scenario)

UTC – University Technical College

V2G – Vehicle to Grid

A Vision for D2N2 – energising the Midlands Economy



Within the birthplace of the Industrial Revolution, a clean growth revolution is now underway. One that harnesses the region's world-renowned heritage and nature with effective and sustainable use of local resources.

This revolution will be accelerated by the region's ability to undertake cutting-edge research and development, a proactive public sector and a highly-skilled workforce. By 2030, D2N2 will be a national pioneer in clean growth and a test-bed for world class energy systems innovation.

Energy is central to everything we do; our homes, work, water, food, communications and transport. It's fundamental to our quality of life, our environment and our economy. Each of these relationships with energy will be increasingly transformed and interlinked in the coming decade. The future of the economy relies on addressing the need to reduce carbon and energy costs, and being able to capitalise on growing markets will deliver this. D2N2 should aim to increase participation in the global market through driving the shift to a clean economy. Energy investments, when targeted and thought-out, will deliver a range of benefits. Adopting a more holistic and systems thinking approach will overcome silos of work and prevent wasted opportunities. By working across sectors and aligning to other key regional priorities, D2N2 can identify approaches and business models that are sustainable in every sense and address the core problems faced by people and organisations in the region. This way, the region's energy strategy delivery will create equal benefits for all stakeholders to prevent the inequity that innovation has often fostered in the past.

D2N2 will progress ambitions using its range of strengths, including natural assets, a high-value engineering and manufacturing economy and supply-chains, strong energy leadership and excellent research capabilities.

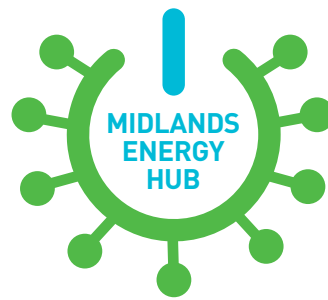
The region will be one of the most dynamic carbon neutral economies in the UK and internationally, attracting significant inward investment and tens of thousands of new jobs. It will be the UK's premier location for developing, trialling and implementing innovative energy systems approaches at scale. It will build and use its capacity to deliver against its own energy and carbon priorities and export services and products to help other regions, across the UK and beyond. A cross sector approach that integrates lifelong learning and educational links will ensure that the development of services and provision of skills is always ahead of the curve.

The future of this region will see predominantly electric energy for heating, lighting and transport, leading to lower carbon emissions and better air quality as renewable generation increases. These systems will be highly integrated, flexible and dynamic. Assets provide multiple uses as houses become power stations, vehicles are mobile batteries and waste becomes resource. Consumers can become producers. The D2N2 region will be somewhere communities and businesses can experience and participate in high quality energy infrastructure that delivers energy that is affordable, secure and low-carbon. These communities will be active and collaborative participants in the flexible generation, distribution and management of energy.

This provides unprecedented levels of control, empowering a wider set of engaged stakeholders, all underpinned by advances in smart technologies and big data. The challenge of changing behaviour to shift demand practices and increase efficiency will be enabled by system leadership at all levels and networks of support. Advances in artificial intelligence (AI) and big data will allow radical new approaches to planning energy investments, identifying efficiency and creating new services that can operate in close to real-time.

D2N2 should not be afraid to go beyond minimum standards and aim higher; for where others see risk, this region should see benefits from early adoption and the opportunity to become a more attractive place to live, work and study. De-carbonising our housing will go hand-in-hand with tackling the pressing issue of fuel-poverty and creating high quality, healthy homes. The best way to enable this is to treat new housing and retrofitting as key infrastructure projects. Advances in sustainable construction will allow new buildings to be net energy positive and developments carbon neutral, and connect occupants to a range of energy and transport services. Older houses will be retrofitted using whole-house techniques integrated with renewable generation and energy storage. The scale of the work required will sustain significant new numbers of jobs and drive innovation and supply chain development. Town and country planning will enable, not restrict, energy efficient practices and foster the best use of natural resources. Standards will be raised and enforced, and the gaps between design and build performance will be closed to ensure we don't miss these vital opportunities.

The D2N2 clean growth themes highlight the importance of the energy trilemma, namely carbon, security and price, and the opportunities that arise from addressing it. There is an international imperative to go further and faster with efforts to live within planetary boundaries and avoid the worst impacts of climate change. D2N2's Energy Strategy and the work of its partners will be at the forefront in revolutionising the local economy and revitalising the region's infrastructure and assets. Enacting this vision will see the D2N2 region energise the Midlands' economy.



The Midlands Energy Hub – D2N2

The Midlands Energy Hub is funded by the Department for Business, Energy and Industrial Strategy as part of the Clean Growth Strategy. The role of the Midlands Energy Hub is to support the capacity of Local Enterprise Partnerships and Local Authorities to identify and deliver local energy strategies and projects. There are nine Local Enterprise Partnerships areas across the Midlands and each LEP area will have a locally based Senior Energy Project Officer available to provide support on Energy Projects that are identified from the local LEP Energy Strategies.

The key objectives of the Midlands Energy Hub are to:

- 1 Increase number, quality and scale of local energy projects being delivered
- 2 Raise local awareness of opportunity for and benefits of local energy investment
- 3 Enable local areas to attract private and/or public finance for energy projects
- 4 Identify working model for teams to be financially self-sustaining after first two years

The Midlands Energy Hub is expected to facilitate a wide range of low carbon energy projects in the next two years through BEIS funded Local Capacity Support programme across different LEP areas. It is aiming to share knowledge and best practises around energy projects across the Midland region as well as creating collaboration and joint venture opportunities between the LEPs, Local Authorities and private organisations.

D2N2 will look to engage with the Midlands Energy Hub to utilise the resources available to help in the delivery of their Energy Strategy.

National and D2N2 Scenario Targets

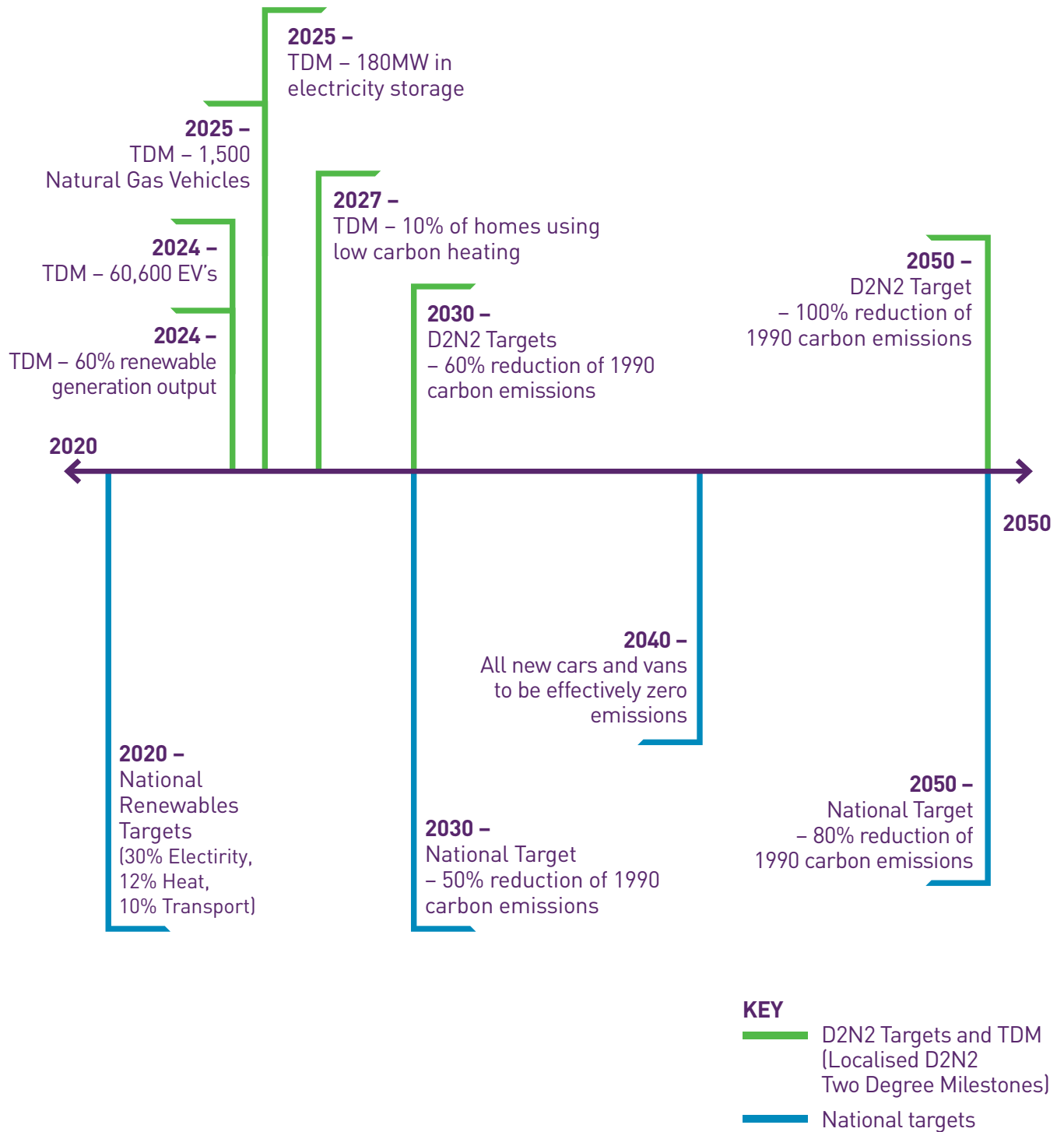


Figure 1. The targets correspond to national objectives and aim to implement the National Grid Two Degree scenario milestones (TDM) at a local level to achieve the energy transformation required



D2N2's 2030 Energy Aspirations for Clean Growth



This strategy sets out a suite of linked targets and actions that align with the national Clean Growth objectives, local aspirations and stakeholder feedback. This approach outlines the local opportunities and priorities for D2N2 to pursue and explore, and through it the D2N2 can enact its vision and central aims by 2030. The long-term recommended actions below are the premise to develop a more comprehensive action plan for the period 2019-2021 which will follow the publication of this strategy, in conjunction with the local capacity-building work of the Midlands Energy Hub.

CLEAN GROWTH THEMES



ASPIRATIONS



TARGETS



D2N2 2030 Targets

T1	100% avoidance of recoverable materials going to landfill
T2	At least a 60% reduction against 1990 carbon emissions per capita and a 15% reduction in per capita energy demand
T3	15% of buildings using low carbon heating and all current building stock be Energy Performance Certificate level C or above where possible
T4	To comply with, and exceed where possible, applicable air quality standards in all locations
T5	100% low carbon energy supply with 60% renewable generation output and increase of 180MW in electricity storage
T6	Increase the provision of smart transport infrastructure to support a target of 70% of vehicle miles to be Ultra Low Emissions
T7	100 new businesses in the Low Carbon and Renewable Energy sector and 1000 new jobs
T8	Decouple carbon from growth through the reduction of carbon intensity ratio of growth by 50%
T9	Secure at least £100m of investment in local energy projects with adequate funding for infrastructure development and resilience
T10	15MW of community energy installed and two industrial sites brought into low-carbon energy generation and innovation

Recommended Clean Growth and Energy Actions for D2N2

Recommended Clean Growth and Energy Actions for D2N2		TARGET
ACCELERATING CLEAN GROWTH	Improve local insight and identify gaps in the energy and low-carbon evidence-base to accelerate clean growth	T7, T9
	Support regional plan for energy systems resilience against threats from cyber-attacks, climate change and infrastructure failures	T9
	Adopt the recommendations of the 'Key skills and training needs of the D2N2 Low Carbon and Environmental Goods & Services Sector' report, working with Sector Skills groups and other partners to identify immediate skills and recruitment shortages, and support low-carbon leadership development	T7
	Support adoption of Cost Benefit Analysis methodologies to strengthen the business case for Clean Growth	T7, T9
	Map out and support Low Carbon, Energy and Renewables sector supply chains with academics, economic partners and procurers	T1, T5, T7, T8,
IMPROVING BUSINESS AND INDUSTRY EFFICIENCY	Develop business models for recycling funds for energy efficiency investments for properties, including potential offset funds for where interventions are not practicable (e.g. World Heritage sites).	T3
	Identify funding to extend Derbyshire and Nottingham ERDF SME energy support programs to provide a more comprehensive offer to businesses	T8
IMPROVING THE ENERGY EFFICIENCY OF OUR HOMES	Develop a scalable business model of whole building retrofit and integrated PV/storage systems for all tenures	T5
	Support innovation in person-centred energy efficiency and energy-as-a-service models to tackle fuel poverty	T3
	Identify resources to ensure that buildings being constructed meet or exceed design performance in operation and meet agreed quality standards	T2, T3
ROLLING OUT LOW CARBON HEATING	Develop a plan for affordable decarbonisation of domestic heat in the region that addresses fuel poverty and urban and rural requirements, with a focus on non- fossil fuel sources such as heat pumps, heat networks and alternative fuel sources	T2, T3, T4
	Support the D2Grids project and develop other initiatives that investigate the utilisation of local geological features for energy generation and storage	T5
	Support the development and expansion of heat networks and their integration with energy storage and low/zero carbon generation	T3, T5
ACCELERATING THE SHIFT TO LOW CARBON TRANSPORT	Coordinate and support the rollout of smart vehicle charging to continue the success of Go Ultra-Low and the D2N2 EV Charging Network in delivering EV infrastructure capacity	T4, T6
	Expand upon the Vehicle-to-Grid (V2G) Clean Mobil Energy pilot project to develop integrated energy and transport infrastructure provision	T6
	Coordinate action with the ICE motor engineering, repair and trade sector for the transition to hybrid, fully electric and hydrogen vehicles	T6

Recommended Clean Growth and Energy Actions for D2N2		TARGET
DELIVERING CLEAN, SMART, FLEXIBLE POWER	Identify, support and provide funding for rural community energy projects in D2N2, for example the proposed Rural Community Energy Fund	T10
	Establish an appropriate body for proactive energy infrastructure development	T9
	Updating the evidence base for renewable energy opportunities through integrated spatial-planning and physical mapping	T5
	Coordinate Hydrogen infrastructure feasibility studies for scalable low-carbon heating, storage and transport	T3
ENHANCING THE BENEFITS AND VALUE OF OUR NATURAL RESOURCES	Improve efficiency of Energy from Waste (EfW) plants	T3, T2
	Examine landfill mining potential to restore landfill sites and maximise recovery of waste materials for circular economy and energy generation	T3
	Increase the utilisation of regional natural capital for energy generation, efficiency and storage	T5
LEADING IN THE PUBLIC SECTOR	Empower local authorities to reduce costs and generate income through utilising their assets to install energy saving and energy generating technologies	T2, T3, T5
	Adopt the whole-system Local Area Energy Planning approach and develop consistent Planning provisions to increase onsite low-carbon energy generation and reduce the demand for energy	T9
	Align sustainable procurement tools and the Public Social Value Act 2012 with the new Green Government scorecard to drive forward clean growth aspirations	T2, T5
	Support and develop community action and public/business behaviour change initiatives	T2, T6
D2N2'S LEADERSHIP IN DRIVING CLEAN GROWTH AND HOUSING	Coordinate national and European low-carbon and energy funding applications	T9
	Drive forward exemplar sector-leading sustainability standards in large scale new developments such as garden villages and development for the proposed HS2 station	T9
	Facilitate the work of developers, plant owners and planning authorities in delivering opportunities for clean generation and sustainable developments in obsolete fossil fuel power plants	T9
	Work with the Midlands Energy Hub and local partners to build delivery capacity for energy projects by identifying appropriate delivery bodies and financing models	T9

Introduction



Once at the heart of the Industrial Revolution, Derbyshire and Nottinghamshire, and the two cities, Derby and Nottingham (D2N2), are looking to spearhead a new industrial revolution that creates a clean growth economy for the benefit of all. This strategy aims to address the key energy issues and challenges for the area, identify and support the energy supply chain located in D2N2 and establish large-scale project concepts and investment opportunities.

This strategy links four fundamental D2N2 strategic areas for the LEP which are to:

- Direct funding to where it is needed
- Support and inform bids and encourage inward investment
- Influence the approach, strategies and spending of local partners
- Provide confidence for long-term business planning and investment.



Figure 2. Local policy aligning with the energy strategy

The D2N2 Science and Innovation Audit (SIA), which identifies and aims to capitalise upon innovation capabilities to improve productivity and economic growth in regions, has identified Low Carbon and Energy as one of its four areas of existing or emerging market priorities. D2N2 is strongly positioned to build on past success and aims to further drive the low carbon agenda across all sectors. The work from the Strategic Economic Plan (SEP) shall feed into the D2N2 Local Industrial Strategy, which is a document produced jointly with Government setting priorities for the long-term, based on clear evidence and aligned to the National Industrial Strategy.

Alongside this Energy Strategy, D2N2 have commissioned an Infrastructure Plan that assesses infrastructure proposals that facilitate economic growth over the next ten years.

The transition to a low carbon economy will support sustainability, constructing a pathway towards delivering economic, environmental and social progress. The generation, distribution and use of energy are all changing, owing to a range of factors. This includes rapid technological advances and concerns over how the following is addressed: energy security, affordability and climate change.



Reflecting the UK's aspirations and commitments to tackling climate change, the recent UN Intergovernmental Panel on Climate Change's (IPCC) special report on the impacts of global warming of 1.5C¹ highlighted the need to go further and faster with our carbon reduction efforts, setting a 2050 deadline for becoming net zero. Whilst a global issue, the impacts of climate change are being, and will continue to be, felt locally. This is both directly through more extreme weather, wetter winters and hotter drier summers, and, indirectly, through interruptions to resource supplies, communications and the movement of goods and people here and outside of the UK. Public opinion is changing towards climate change and pollution, particularly plastics, and there is consistent public support for renewable energy.

However, wider awareness of the Government's Clean Growth agenda remains low, and the case needs to be made locally to align the economic direction and build momentum to facilitate cleaner growth. Between 2015 and 2016, the UK Low Carbon and Renewable Energy (LCRE) economy grew by 5.0%. Energy efficiency was the largest contributor to both turnover and employment in this sector². However, nationally there was a 56% fall in renewables investment between 2016 and 2017. This provides a context for what is an immense challenge, both of a technical and social nature, and a huge opportunity for the sub-region. This strategy aims to create the best environment for all sectors to innovate and invest in the clean growth.

¹ <https://www.ipcc.ch/sr15/>

² UK Environmental Account: Low Carbon and Renewable Energy Economy Survey: 2016 final estimates

Established in 2010, the D2N2 Local Enterprise Partnership has a strong tradition of cross-boundary collaboration. The respective rural and urban areas possess similar geographies and resource demands, covering 2.2 million residents and generating £46.5bn each year. It is one of the largest LEPs in England and by 2030 aims to have a transformed high-value economy, which is prosperous, healthy and inclusive, and one of the most productive in Europe. It will be the spark in the engine that powers UK growth. D2N2 is a national hub for high-value engineering and manufacturing, renowned for planes, trains and automobiles. It has a sizeable base of highly skilled employees and SMEs in the supply chain around the key international manufacturing anchors of the local engineering economy.

In conjunction are high concentrations of logistics capacity, relevant expertise and energy services, and an impressive track record of low carbon innovation and research. The region also blends a thriving life sciences economy and a digital technology innovation ecosystem, alongside more traditional industries such as aggregates and other natural resource extraction. The area has significant natural assets with the Rivers Derwent and Trent, the Peak District National Park, World Heritage Sites and Sherwood Forest, which attract a high volume of tourism. Additionally, D2N2 is home to a number of strong industries including food services and livestock and arable farming, and significant natural resources.

It is important for D2N2 to recognise that future energy provision, both supply and demand, is a major opportunity to unlock regional growth. The UK's low carbon economy could grow at 11% a year to 2030, four times the average growth for the UK overall economy³. From 2016 to 2017, the UK low carbon and renewable energy (LCRE) economy grew by £2.8 billion (6.8%)⁴. Energy is a big part of the region's history through the legacy of coal mining and power generation.

However, this area is now committed to clean generation and growth, with both cities committed to UK 100 aspirations:

- Devise plans to achieve 100% clean energy at city/local level by 2050 that are ambitious, cost effective and take the public and business with them
- Work with business allies, bringing private and public sectors together
- Collaborate across a peer-to-peer network, learning from each other
- Deliver climate action by promoting co-benefits of economic growth and health and well-being
- Work together to influence national policy.⁵

There is a momentous drive for renewable generation, demonstrated by the 11.6% of D2N2 electricity consumption generated from local low carbon sources in 2016⁶. This strategy outlines a clean growth response to the legal and political requirements to reduce carbon and increase renewable energy generation. It identifies six strategic energy and clean growth themes to support the region's Clean Growth aspirations. These themes include the energy trilemma of security, affordability and decarbonisation.



Figure 3. Local priorities in relation to Clean Growth agenda

⁴ <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2017>

⁵ <https://www.uk100.org/members/>

⁶ Calculated from <https://www.gov.uk/government/publications/sub-national-electricity-and-gas-consumption-statistics-analysis-tool> and <https://www.gov.uk/government/statistics/regional-renewable-statistics>

An Energy Revolution: addressing the global climate challenge through clean growth



How energy is generated and used is changing, and will continue to change over the next 30 years. The current energy revolution is not simply due to new fuel, but a societal need for change through a whole systems approach towards affordable decarbonisation⁷. This has been enabled through increases in renewable technology and storage, as well as through resource efficiency, which is evident in improved transport and building energy efficiency measures.

Renewable technologies offer new supply chain opportunities and are less time-constrained for implementation than other fuel types. This is evident in the increase of national and regional renewable generation. Change can offer opportunity, but if uncoordinated it will not achieve optimal outcomes or the level of decarbonisation necessary.

By encouraging the uptake of low carbon and renewable technology by all sectors, the region can collectively become an active part of national and local energy systems

Change in energy infrastructure and generation is vital to deliver cheaper, cleaner and more reliable energy services that help build productive, decentralised local systems which can serve local communities. Industrial growth requires investment in infrastructure to generate and distribute secure and affordable energy and meet demand. By encouraging the uptake of low carbon and renewable technology by all sectors, the region can collectively become an active part of national and local energy systems.

It is an opportunity for business to become embedded into the local community; making them less likely to relocate. Particularly if they can benefit from low energy prices and / or profit from exporting surplus electrical or heat energy.

New cultures of work, innovations in ownership and impacts of evolving digital technologies are changing business models. Sharing and collaboration is increasingly common, for example with the emerging Mobility-as-a-Service (MaaS) models in transport. On-demand services, supported by advances in ICT and data streams, are part of the present and future scenarios for the region.

Energy aggregation offers opportunities for new ways to balance the grid more effectively and avoid additional peak time generation capacity. It does so through using technology and smart metering to combine smaller individual amounts of energy generation or demand to a scale where it can bear upon the energy market and grid balancing. It can also bring benefits to a range of consumers, making them producers. The challenge with this approach is coordinating the various groups. Some reports suggest that 'Behind-the-meter' (BTM) flexibility is the best way to approach carbon reduction in domestic power consumption, and might save up to £6.9bn⁸.

⁷ Rob Saunders, (2018). The fine line between an energy transition and an energy revolution, Innovate UK blog.

⁸ OVO Energy and Imperial College London (2018). Blueprint for a post-carbon society: How residential flexibility is key to decarbonising power, heat and transport.

Businesses can use Demand Side Response (DSR) to generate an additional revenue stream that can then be reinvested in renewable energy and storage, further increasing their ability to react to, and take advantage of, fluctuations in supply and demand. An organisation taking the DSR approach commits to reducing, shifting or increasing its energy consumption when electricity demand from the Grid isn't balanced with supply. Their flexibility is financially incentivised.

These advances give rise to the notion of 'prosumers' in which citizens and organisations are both producers and consumers of energy. This radically changes the way in which energy grids work, and Distribution Network Operators (DNOs) are becoming Distribution System Operators (DSOs) to accommodate this more dynamic arrangement. It is important to encourage distributed generation through micro generation, community generation and district heating⁹.

Two areas within D2N2 were used in the Western Power Distribution PV Impact on Suburban Networks test to determine the effect of PV on distribution substations. Effectively a requirement to balancing energy flows, this will create opportunities for new technologies and services and place greater importance upon data and analytics. The network must develop to support this. It is envisaged that there will be a transition from a heavily centralised energy system to one with many stakeholders, reduced costs and lower carbon. D2N2 seeks to work with the DNO through their Incentive on Connections Engagement document and other stakeholder engagement to help identify locations for future industry, generation and storage.

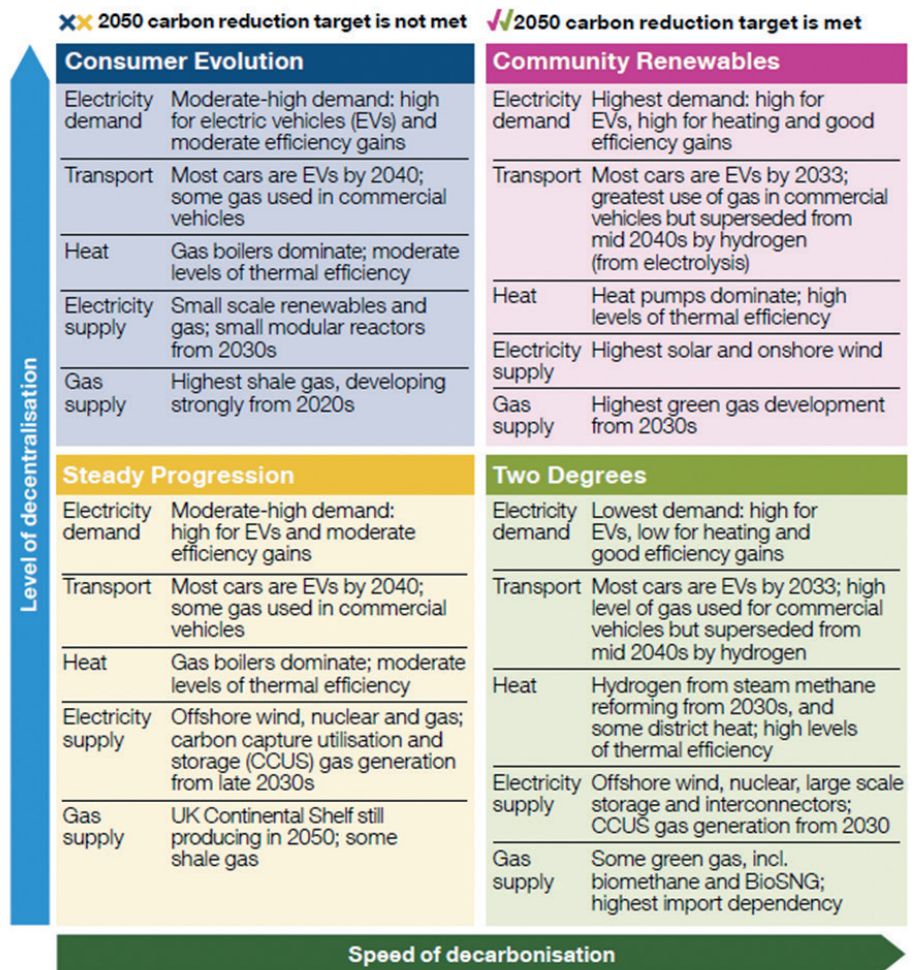


Figure 4. National Grid 2018 Future Energy Scenarios in Five Minutes

The UK has been a global leader in low carbon growth. Overall, UK emissions are down 43% compared to the 1990 baseline, while the economy has grown considerably over the same period¹⁰. Most of the excellent progress has been in reducing emissions from electricity generation.

The majority of UK LCRE turnover in 2017 was driven by the production of electricity industry. However, the biggest increase in the number of employees working directly in the LCRE economy was within construction¹¹.

To meet the local share of national and international ambitions, and to be at the forefront of this energy and carbon revolution, this strategy aligns itself with meeting or exceeding the Two Degrees (TD) scenario from the National Grid's 2018 Future Energy Scenarios (see Figure 2. page 10).

⁹ Kelly, S. & Pollitt, M., 2011. "The Local Dimension of Energy", Cambridge Working Papers in Economics 1114, Faculty of Economics, University of Cambridge

¹⁰ <https://www.theccc.org.uk/publication/reducing-uk-emissions-2018-progress-report-to-parliament/>

¹¹ <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalesimates/2017>

It is essential, especially given the recent revised picture on climate change from the IPCC, that energy and climate ambitions deliver decarbonisation at the pace required to decrease the risk of unsafe levels of climate change.

The Two Degrees scenario delivers carbon reduction in accordance with the international Paris Agreement's two degree limit. The requirements of the Community Renewables Scenario to remain flexible for the degree of decentralisation of the energy system that the region may wish to pursue are also considered. The National Grid estimate that up to 65% of electricity generation could be produced locally by 2050. Peak demand is forecast to increase across all scenarios by 2030 and 2050 against 2017 figures, along with installed capacity and annual demand of electricity. The use of established scenarios allows the region to identify how quickly actions need to be taken, what to address and where to avoid lock-in.

The National Infrastructure Commission (NIC) modelling has shown that a highly renewable generation mix is a low-cost option for the energy system¹². It is hypothesised that the services of 2050 can be delivered by low carbon renewable energy systems at the cost consumers currently pay on average today. The cost would be comparable to building further large-scale nuclear power plants after Hinckley Point C, and cheaper than implementing carbon capture and storage with the existing system. The National Infrastructure Assessment does not support further nuclear power stations before 2025. The high cost makes large scale nuclear unlikely to be supported at the regional level currently, but it is important to acknowledge its national potential to meet energy demand, and to consider the future possibilities of Small Modular Reactors (SMRs) at the local/regional scale.

Longer-term, there is the potential for sub-Gigawatt Advanced Modular Reactors and Nuclear Fusion facilities to provide low-carbon regional base-load requirements - and the Midlands region is well placed to deliver this. Both scales of civilian nuclear energy generation may also have sizeable global markets as economies decarbonise and, as such, will require the development of centres of excellence, such as the Nuclear Advanced Manufacturing Research Centre (Nuclear AMRC), and the supply chains to service national and international markets at Infinity Park, Derby.

This strategy aligns with the view that the future energy generation system should be based upon renewables, along with the physical and market-based instruments for flexibility to enable this. However, it is vital to keep a range of options and interests active and available, serving both local energy needs and the wider energy markets' requirements. With the pressure to reduce carbon emissions as quickly as possible to meet set targets, options for managing a 'net-zero' carbon outcome must be considered.

These options include increasing natural carbon sinks through land-use changes and tree planting and technological approaches such as Carbon Capture and Storage (CCS).

This strategy takes heed of the following high-level National Infrastructure Assessment recommendations for low-carbon infrastructure¹³:

- At least 50% renewable electricity generation by 2030
- Pilots to test hydrogen and heat pumps as low-carbon heating options
- Buildings which requires less energy to heat
- Flexibility
- Improving sustainable and environmental standards through implementation of new infrastructure.

Decarbonising heat is one of the most significant challenges for both the country and the region in addressing climate change goals. It is a function of user behaviours, changes to climate, building efficiency and heating source and delivery. The renewable heat sector saw the biggest growth out of the LCRE economy in terms of turnover, with an increase of £1.2 billion in 2017 from 2016¹⁴. There are a range of technologies and options, many of which are specific to users' needs, and local context. The National Grid's Future Energy Scenarios suggests up to a third of homes might be heated using Hydrogen by 2050, and 60% might be heated through heat pumps. For this to transpire, however, there must be both a clear policy direction and the right market conditions.

¹² <https://www.nic.org.uk/assessment/national-infrastructure-assessment/low-cost-low-carbon/>

¹³ https://www.nic.org.uk/wp-content/uploads/CCS001_CCS0618917350-001_NIC-NIA_Accessible.pdf

¹⁴ <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2017>



Annual and peak demand for gas is forecast to decrease substantially in 2030 and 2050 against 2017 figures. Hydrogen is forecast to rise markedly by 2050 in the TD scenario, with no shale production contributing at any stage. The key milestones of this scenario are incorporated into the Targets Timeline (Figure 9) in the D2N2 vision.

Combined heat and power (CHP) district heating networks provide affordable and manageable onsite energy generation and distribution. In addition, heat networks provide increased energy security because they can be operated in island mode (independent from the grid), but also because when local low carbon fuels are used, susceptibility to the volatility of international energy markets is mitigated. There is an opportunity to build on established networks as they provide affordable heating and electricity to reduce energy costs and alleviate fuel poverty. This proven technology has the potential to reduce CO2 emissions through energy efficiency gains and combustion of low carbon fuels such as biomass and waste.

It is not only energy scenarios that must be considered, but also broader political and socio-economic ones that will heavily influence the evolution of energy markets and preferences. D2N2 will acknowledge different policy and market scenarios in the development of the actions plans and overall roadmap to ensure that it is able to adapt to change and deliver its objectives. What it highlights is again the need for flexibility, responsiveness and evolution to avoid one-size-fits-all approaches.



The Strategic Context



The Climate Change Act (2008) provides both a national and legal commitment to decarbonisation; with the target of 50% reduction from 1990 levels by 2030. The Clean Growth Strategy (2017) aims to maintain economic growth while cutting greenhouse gas emissions. Achieving clean growth, while ensuring an affordable energy supply for businesses and consumers, is at the heart of the UK's Industrial Strategy (2018). Implementing these policies locally will increase productivity, create good jobs, boost earning power, and help protect the climate and environment upon which society depends.

D2N2 should support the BEIS Smart System and Flexibility Plan, helping remove barriers to smart technology to increase uptake and maximise market flexibility. The National Renewable Energy Action Plan sets out the national vision of a 30% GHG emissions reduction by 2020 and ambition to achieve 15% of all UK energy consumption generated from renewable sources by 2020. In 2016, 11.6% of D2N2 electricity consumption was generated from local low carbon sources.

The timeline below illustrates relevant local and national policy timeframes and key dates.

The Electricity Market Reform introduced in the 2010s created two key mechanisms for financing electricity projects to support decarbonisation and energy security¹⁵:

- **Contracts for Difference (CFD)** – ensuring stability in costs for low-carbon projects by getting an agreed price for future generation;
- **Capacity Market** – a system for payments to organisations that can respond quickly to balance the grid through changes in either supply or demand.

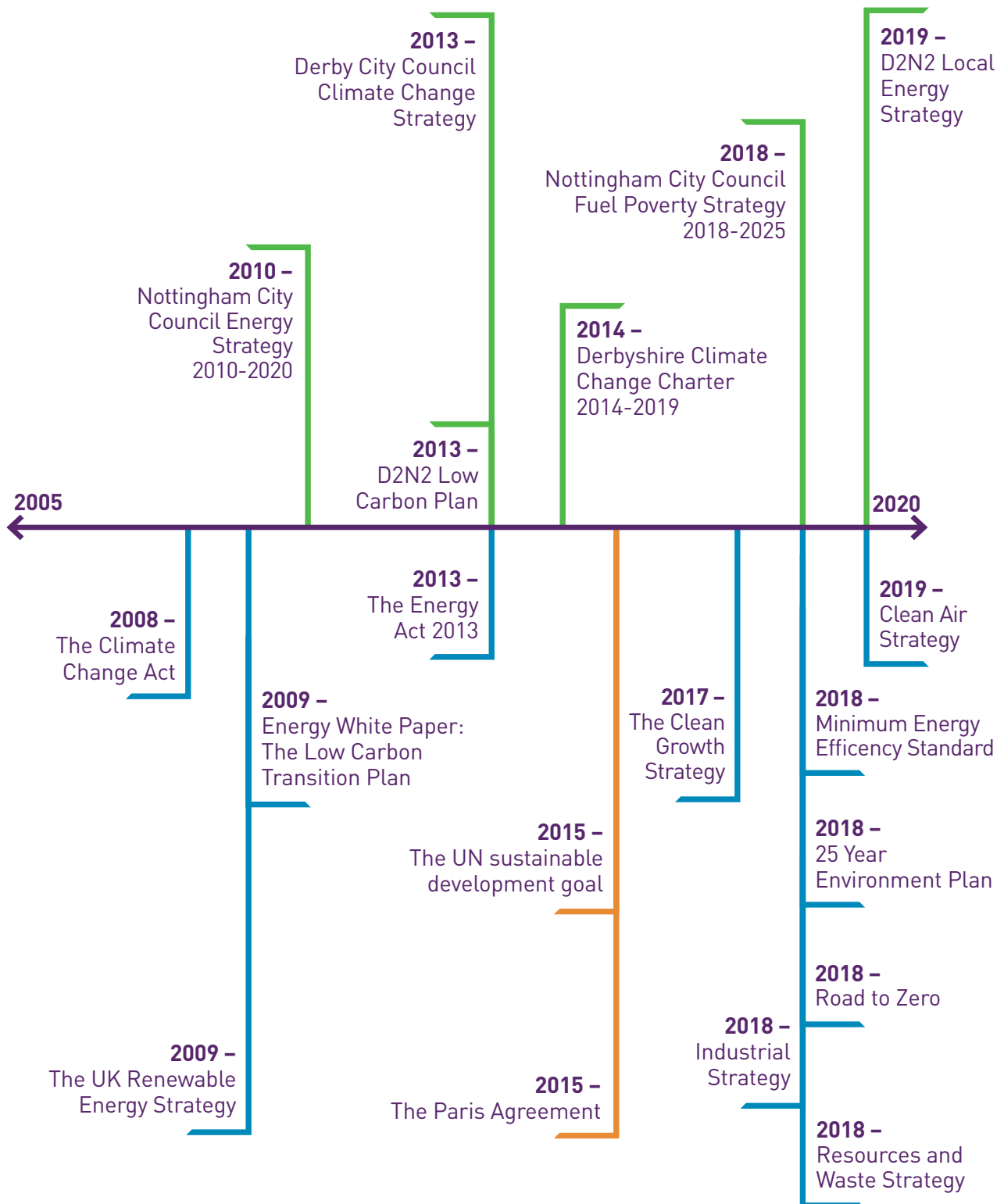
The national 25 Year Environment Plan aspires to maximise 'available resources, doubling resource productivity by 2050', and aspires to a more effective management and usage of natural capital¹⁶. The new national Resources and Waste Strategy also deploys the concept of natural capital. It sets out to maximise the value of resource use and minimise waste related environmental impacts, by eliminating avoidable waste of all kinds by 2050. The Resources and Waste Strategy aims to make all plastic packaging placed on the market recyclable, reusable or compostable by 2025 and eliminate food waste to landfill by 2030.

The Clean Air Strategy 2019 sets out the Government's approach to improving air quality by describing the actions to be taken in the areas of transport, farming, industry and at home. It aims to show the trade-offs between energy and public health when developing strategies to meet air quality and carbon targets. The strategy will give local authorities new powers to act in highly-polluted areas and will consider changes to the building regulations to tackle the build-up of harmful indoor air pollutants.

¹⁵ <https://www.gov.uk/government/publications/2010-to-2015-government-policy-uk-energy-security/2010-to-2015-government-policy-uk-energy-security#appendix-5-electricity-market-reform-emr>

¹⁶ <https://www.gov.uk/government/publications/25-year-environment-plan/25-year-environment-plan-our-targets-at-a-glance>

National, Regional and Local Policy



- KEY**
- Regional and local policies
 - National policies
 - International policies

Figure 5. International, National, Regional and Local Policies

Headline policies and targets include¹⁷:

- Reducing emissions from rail, including by 2040, the phase out of diesel trains;
- £19.6 million to develop of cleaner technologies, and as part of this Innovate UK have run a £5 million Small Business Funding competition to promote and procure industry-led research and development;
- £3.5 billion to tackle poor air quality for local authorities and LEAs.

Transport nationally accounts for 40% of current energy demand

Shifts in consumer demand are changing how cars are powered, while technology is changing how they are driven. Globally, between 2011 and 2016, the number of electric vehicles on the road has increased thirtyfold, and the Government's ambitious target is driving further uptake. In 2017, exports from the low emissions vehicles accounted for over half of total UK LCRE economy exports¹⁸.

The Road to Zero strategy sets out ambitions for¹⁹:

- at least 50% — and as many as 70% — of new car sales to be ultra-low emission by 2030
- up to 40% of new vans sales to be ultra-low emission by 2030
- the roll-out of infrastructure to support electric vehicle revolution.

While electric vehicles support decarbonisation, they will potentially increase electrical demand by 2030 and beyond.

One of the stated aims of the Industrial Strategy is the decarbonisation of the heat supply

Of the total energy consumed by UK industry, over 70% is used to provide heat, predominately from fossil fuels²⁰. Of the total heat demand from industry, 64% is from six key industrial sectors. There is a national action plan specifically aimed at energy-intensive businesses. D2N2 and its partners will need to identify and engage local energy-intensive businesses with research and development and funding opportunities to support their transition in a manner that does not impede growth.

The Government is reviewing ways to cut carbon emissions from heat in the 2020s, in conjunction with improved building efficiency. The Renewable Heat Incentive (RHI) currently provides payments for 7 to 20 years for domestic and non-domestic respectively, including support for technologies such as solar heating, certain heat pumps and domestic biomass boilers – though this is under review. National milestones have also been set for energy ratings through a minimum standard for domestic and non-domestic private rented sector from April 2018.

The Department of Business Energy and Industrial Strategy has an objective to ensure the nation has a reliable, low-cost and clean energy system. At national level there is acknowledgement of the importance of local intervention requirements to address fuel poverty, achieve decarbonisation support industry and improve energy efficiency. At the local level, councils are working together on energy projects and climate change through the established D2N2 Local Authorities Energy Partnership (LAEP). The LAEP promotes sustainability and climate change mitigation through its communication service and membership of local authority officers.

¹⁷ <https://www.gov.uk/government/publications/clean-air-strategy-2019/clean-air-strategy-2019-executive-summary>

¹⁸ <https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2017>

¹⁹ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/739460/road-to-zero.pdf

²⁰ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/190150/16_04-The_Future_of_Heating-ExSUM_Accessible.pdf

The recent Committee on Climate Change report, UK Housing Fit for the Future²¹, identifies some key findings for the domestic energy efficiency agenda:

- “the UK’s legally-binding climate change targets will not be met without the near-complete elimination of greenhouse gas emissions from UK buildings
- emissions reductions from the UK’s 29 million homes have stalled, while energy use in homes – which accounts for 14% of total UK emissions – increased between 2016 and 2017
- efforts to adapt the UK’s housing stock to the impacts of the changing climate: for higher average temperatures, flooding and water scarcity, are lagging far behind what is needed to keep us safe and comfortable, even as these climate change risks grow.”

Local authorities are well positioned to support the energy transition towards clean growth

They can promote and maintain commitment to the low carbon agenda which will drive the changes needed to mitigate the risks of climate change. D2N2 can look to transpose the national Clean Growth themes to enable a regional energy revolution and embed national aspirations that deliver better quality of life for their citizens.



Completed in 2012, Derby City Council’s hydroelectric power station generates clean, renewable power from the city’s biggest natural resource – the River Derwent. At full capacity it can generate a significant amount of the Council House’s demand, with excess going to the grid.

The scheme has a generating capacity of 230KW and has the potential to generate 1.2million kWh per year (enough to power 300 average homes). It was constructed by Balfour Beatty Construction, Faithful & Gould and Derbyshire based Derwent Hydro, in close consultation with the Environment Agency.

The project has a long-term payback, utilising Feed-in-Tariff income and savings to the Council. It helps deliver against Council carbon reduction objectives and includes features such as a fish-pass to ensure ecological impact is appropriately addressed.

For more information please see our website: [http://apse.org.uk/apse/assets/File/APSE%20Derby%20hydro%20presentation%20\(v2\).pdf](http://apse.org.uk/apse/assets/File/APSE%20Derby%20hydro%20presentation%20(v2).pdf)

CASE STUDY:
**Derby City
Council Hydro**

²¹ <https://www.theccc.org.uk/publication/uk-housing-fit-for-the-future/>

D2N2's Low Carbon and Renewable Energy economy



The LEPs have an increasing role to play in the capacity of regional and local energy. The Midlands Energy Hub is funded by BEIS as part of the Clean Growth Strategy. The role of the Midlands Energy Hub is to support the capacity of LEPs and partners to identify and deliver local energy strategies and projects. There are nine LEP areas across the Midlands and each LEP area will have a locally based Senior Energy Project Officer available to provide support on energy projects that are identified from the local energy strategies. These strategies will build on capability, facilitate implementation and align with LEP economic, social and environmental objectives, e.g. the D2N2 Science & Innovation Audit, Infrastructure Plan and Strategic Economic Plan.

Overall, the D2N2 LEP has a strong history of supporting the low carbon sector, giving it a prominent place in key strategies from the outset.

In 2016's 'Fit for Future? Review of all 39 LEPs' commitments to tackling climate change and enabling a low carbon economy, D2N2 performed well:

- Third out of the 38 LEPs (with 63%) for 'commitment to climate change' (average score for adaptation, mitigation and the low carbon economy);
- Third (with 80%) for 'LEP commitments to the low carbon economy';
- Fourth (73%) for 'LEP commitments to climate mitigation'²².

This new Energy Strategy builds upon previous work developed in the two D2N2 Low Carbon Plans from 2013 and 2015²³. The second of these identified that the low carbon economy had seen significant increases in gross value added (GVA), turnover and employment, and that D2N2 should aim to be the natural home for "green collar" jobs.

The plan also reflected the shift in attitudes towards procurement, use of resources and working practices that reduce carbon and lower environmental footprints. Back in 2011/12, the number of people employed in the Low Carbon Environmental Goods and Services Sector (LCEGS) was 28,716, across 1556 businesses. Regional analysis for the East Midlands showed that showed that the bulk of these jobs lay in 'recycling and recovery of waste material' and 'insulation' categories. The level of employment in insulation and other retrofit areas reflects the magnitude of works addressing domestic properties at that period of time. However, that sub-sector has been disadvantaged by changes in government policy and financial support for national and local initiatives in the years since these figures. Within D2N2, there are a range of energy, low-carbon and sustainability related companies providing products and services which operate at different scales and sizes; from hydropower consultancy to international low-carbon vehicle manufacturing, and large and small energy suppliers.

²² <https://www.d2n2growthhub.co.uk/news/high-ranking-for-d2n2-in-green-report-on-39-local-enterprise-partnerships/> & <https://www.sustainabilitywestmidlands.org.uk/wp-content/uploads/SWM-LEP-Report-Final-14-Jan-20162.pdf>

²³ http://www.d2n2lep.org/write/D2N2_Low_Carbon_Action_Plan.pdf

Regional research from the University of Derby Business School's Sustainable Business and Green Economy Research Cluster²⁴ suggests that despite the nascent market for low carbon and energy service and products, nearly a quarter (24%) of businesses in 2017 saw some level of turnover from Low Carbon Environmental Goods and Services (LCEGS). Of these, with more than 1 in 10 had 20% or more of their turnover from LCEGS and 1 in 20 had turnover levels of 80% or more from LCEGS. The greatest activity for LCEGS was found in the construction sector.

Initial findings from the latest 2018 data of the East Midlands Chamber of Commerce Quarterly Economic Survey suggests that around 40% of SMEs are participating in LCEGS in the wider region. Whilst these figures are provisional, they nevertheless provide a strong indication that the low carbon market is growing rapidly, and that SMEs are increasingly ready to engage in developing and selling innovative energy saving and emissions-reducing products and services.

The University of Derby research also suggests that there is a low-carbon offer from businesses in every sector, and that there are different needs in the various 'pro-environmental niches'.

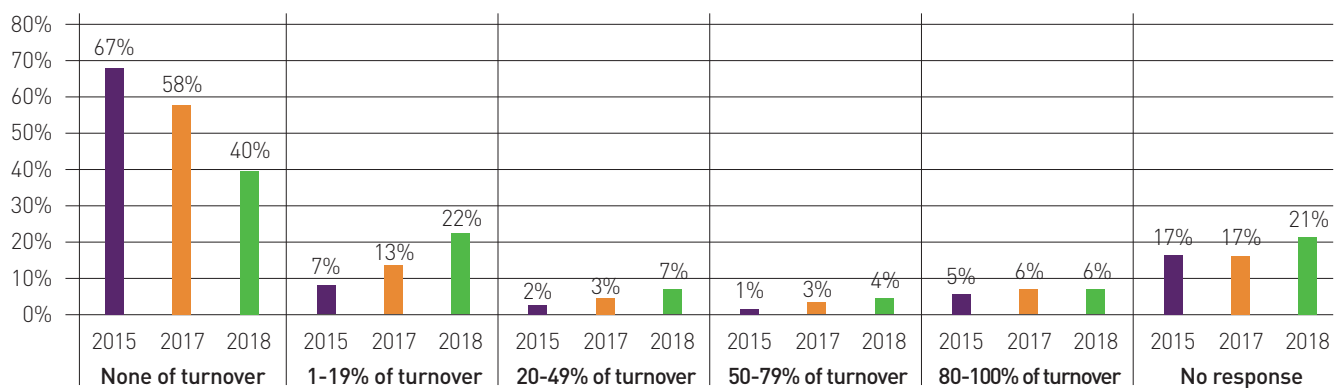
Energy and Low Carbon is a major influencer on developments identified in the D2N2 Local Enterprise Partnership (LEP) Strategic Economic Plan (2019 – 2030) and Science & Innovation Audit.

The 2018 D2N2 Economic and Policy Review identified data and decarbonisation as two of the three key trends for future growth in the next 10-15 years²⁵. Elsewhere in this review, improving productivity was identified as a core priority alongside embracing digitalisation and the fourth industrial revolution.

This digitalisation aspect covered four key trends that are all relevant to the energy revolution:

- 1 Artificial intelligence (AI), machine learning, and automation
- 2 'Rapid changeability' to meet customer needs; the ability to rapidly develop prototypes and decentralise manufacturing
- 3 New digital platforms and the relationship between providers of goods and services and the providers of their routes to customers – inc. the 'servitisation' models of provision.
- 4 The use of data to effect behaviour change²⁶.

In 2018 the LEP published an LCEGS skills and training needs report²⁷ which feeds into this Energy Strategy as an evidence base for the skills needs in the sector. The report recommends that each key sector identifies the niches of 'pro-environmental' business activity and the key skill requirements associated with growth of 'low carbon' supply.



KEY:
■ 2015 ■ 2017 ■ 2018

Figure 6. 'What percentage of your turnover is derived from low carbon goods or services? n>320 each year

²⁴ Paterson et al (2018) Key skills and training needs of the D2N2 Low Carbon and Environmental Goods & Services Sector; Abridged Final Report. University of Derby

²⁵ http://www.d2n2lep.org/write/Documents/Research%20Reports/Evidence_Review_final_draft.pdf

²⁶ Adapted from section 2.4 http://www.d2n2lep.org/write/Documents/Research%20Reports/Evidence_Review_final_draft.pdf

²⁷ <http://www.d2n2ta.org/media/1428/d2n2-skills-study-final-published-version.pdf>

D2N2's Energy Usage and Carbon Emissions

The D2N2 area has seen a reduction in carbon emissions, with CO₂ emissions per capita now at 7.1 tonnes, and CO₂ emissions per £m of annual GVA at 347.7 tonnes. Looking at the local picture, D2N2 consumes around 4,000²⁸ ktoe (46520 GWh) of energy per year, with the split across industry, domestic and transport roughly one third (ONS, 2016). The below graph (figure 7) illustrates how energy is consumed in the area. Petroleum products and gas dominate the total consumption, followed by electricity. It highlights the challenge for low-carbon electricity generation in the region in switching from gas for heating and petroleum for transport, even with efficiency savings.

D2N2 Final Energy Consumption by Fuel

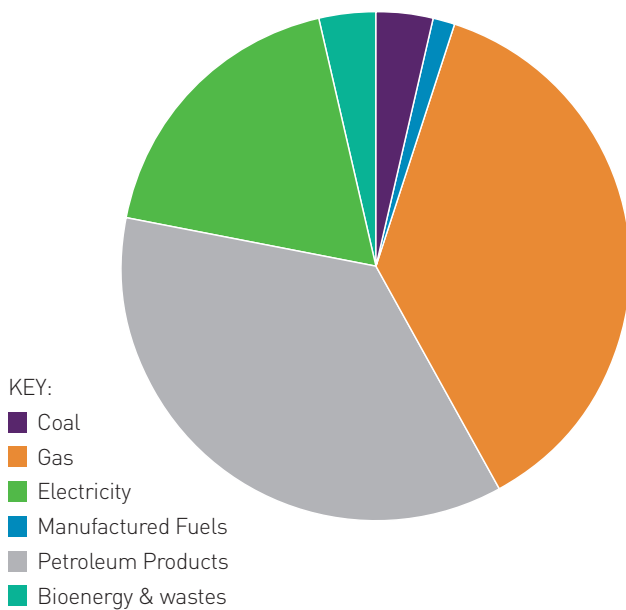


Figure 7. Regional representation of final energy use by fuel ONS 2016.

The scale of energy currently using for heating and transport is the reason why a significant increase in electricity demand is still expected, despite increases in energy efficiency.

While regional consumption has declined over the last decade, reduction in demand has stalled.

The regional performance on carbon emissions reduction can be seen in Figure 8 below, along with a linear projection for the current levels of reduction through to zero emissions.

It should be noted that it is extremely unlikely that progress will be linear, as the easier to tackle interventions are made first. However, it does indicate current progress and the scale of the challenge ahead. According to this linear projection, there would be a reduction of over 6 million tonnes CO₂ by 2030, and a theoretical carbon neutral status would be reached in 2048.

Total D2N2 carbon emissions (Source: BEIS 2018)

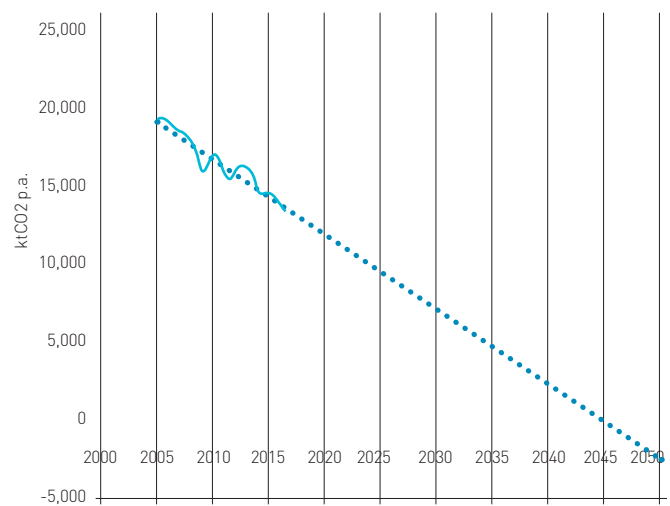


Figure 8. Regional Carbon Emissions 2005-2016 and projection to 2050 = Source BEIS (2018)

²⁸ kilotonnes of oil equivalent – a standard unit for energy consumption

Role of Public Sector

The Clean Growth strategy places importance on the public sector to be a leader in Clean Growth and provides long-term targets. This includes bodies such as councils, the NHS, educational establishments, and other service providers who may have significant estates, staff bodies and purchasing power. Public bodies have extensive direct and indirect energy impacts, through what they consume, how they influence transport and infrastructure, and the performance of their assets, etc. Many large public sites have energy centres and significant energy loads. Certain public bodies can also access attractive financing for energy-to-save projects which can stimulate local demand for LCRE services.

Councils, as local authorities, also have a key role in planning, policy, strategy and coordination of infrastructure. Derby's Climate Change Strategy aims to ensure residents have energy efficient homes and that the city has a secure local and renewable energy supply. The city also aspired to develop regional partnerships to attract investment and secure research to provide evidence for decentralised energy initiatives. Nottingham City Council is on track to meet its 2020 target of 20% of the city's energy generation from low carbon sources. This is thanks to a combination of energy demand reduction and an increased renewable energy projects delivery programme implemented by Nottingham City Council's Energy Services. Nottingham will launch new citywide Energy and Climate Change strategies in 2019/20 to support its recent ambition to become carbon neutral by 2028²⁹ and its general aim of being the UK's leading Smart Energy City.

Nationally, Nottingham City Council is at the forefront in terms of municipal energy services provision, with its in-sourcing model that has positioned energy as a means of achieving strategic aims, generating revenue, saving costs and sustaining capacity. This accelerates both the internal work across its estate, as seen with the solar PV rollout, and increases the commercial offer to local, regional and national business and partners.

²⁹ <http://www.mynottinghamnews.co.uk/nottingham-aims-to-be-first-carbon-neutral-city-in-the-uk/>

³⁰ <https://enviroenergy.co.uk/about-us/>

³¹ <https://eemonitor.co.uk/>

³² <https://robinhoodenergy.co.uk/>

³³ <http://www.mynottinghamnews.co.uk/nottingham-named-britains-smartest-city-for-energy/>

The Council also owns its heat network through Enviroenergy³⁰, and the smart heat meter it provides (EEMonitor³¹). It set-up the not-for-profit energy supplier Robin Hood Energy³² with the aim to make energy more affordable for all. The Council has been successful with a range of awards in recent years, covering everything from the work on solar generation, to innovation in retrofit and being named, in collaboration with key city partners, as Huawei's leading Smart City for energy in 2017³³. The work of the Midlands Energy Hub will look to emulate Nottingham's success across the D2N2 area and wider region.



Nottinghamshire Community Energy (NCE) was formed in late 2015 as a Community Benefit Society set up to deliver community-owned renewable energy, low carbon energy and energy efficiency projects. Its 130 members, along with Nottingham Energy Partnership, own a 5MW Solar Farm near Colston Bassett with a target generation of 4,700MWh per annum.

Finance of £1.6m has been provided by members and NEP, almost £3m came from Triodos Bank and, particularly notable, £1.5m was invested by Nottinghamshire Pension Fund.

For the last 3 years NCE has met its commitment to members with an annual dividend of 7% whilst donating £70,000 to its Community Fund.

CASE STUDY:
Nottinghamshire
Community
Energy

Community Initiatives

There are a range of community-based initiatives across the region, with several Transition Town groups, community interest companies, and community-owned energy organisations and installations that have been developing, and delivering, low-carbon and energy projects. A couple of notable examples are an Industrial and Provident Society called Amber and Derwent Valley Community Energy (ADVCE) Limited <http://www.advce.co.uk/index.html>, and the Torrs Hydro at New Mills <http://www.torrshydro.org/>. Two wind turbines, near Chesterfield generating 2,514 MWh per year have been installed through the Four Winds Energy Co-Op. Profits from the turbines are distributed to community funds in the local area <https://www.fourwinds.coop/>. Community initiatives often require additional funding to develop feasibility studies and assistance with business model development and access to finance to make projects viable and sustainable, particularly for energy generation since the reduction in available tariffs. Many initiatives have taken to crowd-funding platforms in recent years as a means of bridging finance gaps. The Derby, Derbyshire, Nottingham and Nottinghamshire Local Authority Energy Partnership (LAEP) supports and promotes a Community Climate Action Network which can assist community energy projects <http://www.everybodys-talking.org/communities-area/community-support>.

Domestic Energy and Energy Efficiency

In D2N2 in 2016, 125,308 (14.2%) of households were experiencing fuel poverty, and tackling this issue remains a local, regional and national priority (LIHC indicator). A household is said to be fuel poor³⁴ if it has required fuel costs that are above the national median level and, were they to spend that amount, they would be left with a residual income below the official poverty line.

The government estimates that for households there is a fuel poverty 'gap' of nearly £900 in the oldest properties (pre-1850) to around £180 in the newest (post 1990) dwellings³⁵.

³⁴ <https://www.gov.uk/government/collections/fuel-poverty-statistics>

³⁵ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/639118/Fuel_Poverty_Statistics_Report_2017_revised_August.pdf



The Energy Research Accelerator (ERA) is investing in projects which demonstrate the generation, storage and use of new technologies. One of ERA's demonstration projects is at Trent Basin in Nottingham.

Trent Basin is a housing development in Nottingham which provides the full-scale demonstration of an integrated energy system using solar, battery and thermal ground source energy generation. The project involves the University of Nottingham and the developer Blueprint, with support from Nottingham City Council.

People living in Trent Basin benefit from renewable energy being produced through a solar farm on the site. The energy generated through this is stored in a battery, supplied by Tesla, the largest community battery in Europe. It can store 2.1 MWh of energy, delivering 500kW of power - enough energy to boil 170 kettles simultaneously for four hours!

Local energy generated and stored on site is managed by a community energy company which provides energy services to residents. This includes storing and selling locally-generated energy to the grid at peak times. Profits made by the energy company helps to cut energy bills for residents.

For more details about Trent Basin visit:

<https://www.era.ac.uk/case-studies/trent-basin>

CASE STUDY: Trent Basin

Enabling communities to manage
their own electricity

Across the entire region, this constitutes an appreciable economic impact.

Approaches³⁶ to tackling fuel poverty typically involve some combination of maximising income, reducing energy bills and increasing energy efficiency of properties. This strategy can work towards reducing energy bills and increasing energy efficiency. Local work through Local Authorities, the LAEP, Citizens Advice, Nottingham Energy Partnership, AGEUK and other services are making progress towards the Government's aim to eliminate E, F and G EPC rated homes occupied by fuel poor households by 2025, where practicable, and enforcing new legislation to protect renters through Minimum Energy Efficiency Standards.

The ability to address domestic energy efficiency is affected by resource issues, facing uncertainty in both short-term and long-term funding. The UK Housing Fit for the Future report³⁷, suggests that the performance gap in both new-build and retrofit works could be costing households between £70 and £260 each year. Looking at the latest quarter (2018 Q4)³⁸ of Energy Performance Certificates across D2N2 shows that, across new-build homes and retrofit, only 6 out of 9,804 properties were of an A rating, with 59 possessing a G rating. This highlights the scale of the challenge given the number of houses in the region is around 1 million.

Research and development capabilities

D2N2 possess a significant amount of relevant low-carbon and energy research and development expertise, not least across its three universities: The University of Derby, Nottingham Trent University and the University of Nottingham. There is further expertise located within the local 'trains, planes and automobiles' and high-value engineering and manufacturing sectors, and their extensive supply chains, led by anchor businesses such as Bombardier, Rolls Royce and Toyota.

The combination of the research and development capabilities with the local production of low-emission vehicles can significantly boost the export potential for the region to contribute to national and international carbon objectives.

There are a range of regional institutions that can play a vital role in delivering and supporting the research and development requirements for regional, national and international markets:

- British Geological Survey
- Institute for Sustainable Engineering
- Energy Research Accelerator
- Low Emission Vehicle Enterprise and Learning Network
- Derby Manufacturing UTC
- Nuclear AMRC
- Energy Technologies Research Institute (ETRI)
- HSE's Health and Safety Laboratory's Centre for Energy Innovation in Buxton
- Nottingham Trent University national doctoral training alliance in energy research
- Integrated Water, Energy and Food (IWEF) Centre

The new Nuclear AMRC at Derby Infinity Park is supported by BEIS and led by the University of Sheffield and University of Manchester, with Rolls Royce as a key industrial partner. Rolls Royce is leading a national consortium for the development of Small Modular Reactors, including civilian energy generation applications³⁹. It will contribute towards the Midlands Engine aspirations and national low-carbon energy aspirations that tie into the recently announced £200 million nuclear sector deal.

The Energy Research Accelerator is pursuing opportunities for Hydrogen research, building on the expertise at Nottingham University.

Research and development initiatives are also carried out by, and with, local authorities. Nottingham City Council is currently involved with a three year European funded Interreg project in collaboration with partners across North-West Europe. The Clean Mobil Energy project⁴⁰ will develop a Smart Energy Management System, integrating Renewable Energy and Electric Vehicles, using vehicle-to-grid (V2G) charging systems, and see a number of commercial electric fleet vehicles procured and smart charging units installed.

³⁶ <https://www.nottinghamcity.gov.uk/housing/fuel-poverty-strategy/>

³⁷ <https://www.theccc.org.uk/publication/uk-housing-fit-for-the-future/>

³⁸ <https://www.gov.uk/government/statistical-data-sets/live-tables-on-energy-performance-of-buildings-certificates>

³⁹ <https://www.rolls-royce.com/products-and-services/nuclear/small-modular-reactors.aspx#leading-the-consortium>

⁴⁰ <https://www.nottinghamcity.gov.uk/community/clean-mobil-energy/>

The project aims to maximise the use of on-site renewable generation to reduce carbon emissions and costs, as well as reducing peak demand on the energy network.

The award-winning Derby and Derbyshire Energy Efficiency project (D2EE), a partnership with the University of Derby and Derbyshire County Council, continues to be highly successful. The Council provides bespoke energy consultancy and grants to help small and medium sized businesses (SMEs) save energy and carbon emissions and reduce the cost of their energy bills.

So far the project has completed 330 energy audits and advisory reports for SMEs and awarded 136 grants totalling £845,000. This will save SMEs an estimated £325,000 per year on energy bills and 1,169 tonnes of Greenhouse Gas (GHG) emissions. Over £1m of private sector investment in energy efficiency has been leveraged.

D2EE runs until 31st October 2019.

For more information please see our website: www.derby.gov.uk/d2ee

CASE STUDY: D2EE

Award-winning Derby and Derbyshire Energy Efficiency project

Low Carbon and Renewable Energy Business Support

The D2N2 region has supported business with low-carbon and energy improvements over the past decade through a range of initiatives. This has included European funded programmes, such as Derby City Council's BESPOKE SME energy efficiency programme, Nottingham Trent University's Future Factory SME sustainable innovation project, NEP Energy Services' audits and Investors in the Environment (IiE) scheme, and the University of Nottingham's Energy for Business grants, Accelerating a Low Carbon Economy (ALCE) and Environmental Technology Centre initiatives.

⁴¹ <https://www.lowcarbonbusiness.net/>

⁴² <https://www.emc-dnl.co.uk/helping-you-influence/sector-forums-and-conferences/sustainability-conference2/>

⁴³ <http://www.chargeyourcar.org.uk/d2n2/>

Current energy efficiency advice and grant schemes for SMEs in the region include Derby and Derbyshire Energy Efficiency (D2EE) and Nottingham and Nottinghamshire Energy Grants (N2EG). One N2EG client had LED lighting fitted, changed their electric heating to gas central heating and installed cavity wall and loft insulation. This resulted in the reduction of their first quarter utility bills from £2,771 to £949. The work of the D2N2 Growth Hub has also helped with the development of low-carbon businesses like WEGO couriers in Nottingham.

D2N2 has also seen the establishment of new business accommodation and support networks in the same period. The Markham Vale Environment Centre for businesses in Derbyshire was established in 2006 and extended in 2015, whilst the Nottingham CleanTech Centre (now Castle Cavendish Enterprise Centre) provided space to numerous low-carbon and energy start-ups over the years. Nottingham Sustainable Enterprise Centre and the technology-focussed Infinity Park Derby (located within an Enterprise Zone) also complement the business accommodation and clustering offer.

In addition to the initiatives above, businesses have been supported through networking and collaboration by the University of Derby's Low Carbon Business Network ⁴¹, the East Midlands Chambers of Commerce's Sustainability Forum and their Sustainability Summit ⁴², and other fora.

Low Emission and Low Carbon Transport

The region has a history of collaborative working on electric vehicle infrastructure. The Plugged-in-Midland scheme brought D2N2 and wider regional partners together to establish necessary infrastructure to support a nascent EV market. The present-day Go Ultra Low (GUL) initiative aims to promote the uptake of ultra-low emission vehicles. GUL leads the new D2N2 electric vehicle charging network ⁴³ ensuring coverage across the two counties and cities. This network, which includes local Councils and Charge Your Car in association with Chargemaster, offers local residents reduced tariffs and includes the delivery of 230 new charging points.

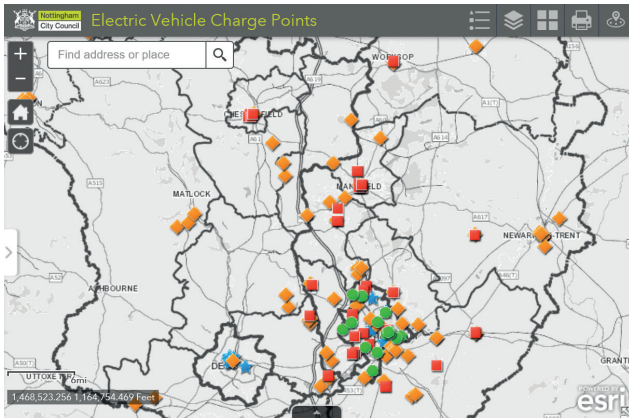


Figure 9. D2N2 EV Charging Network 2018 – screenshot from <https://www.transportnottingham.com/projects/charge-point-project/>

Addressing the wider aspects of low-emission vehicle supply and demand, the LEVEL initiative⁴⁴ (Low Emission Vehicle Enterprise and Learning) has delivered training courses, skills workshops, master classes and conferences. It also has facilitated project collaborations and brought innovative ideas for intelligent mobility solutions to the area. This is a collaboration between Derby City Council, Nottingham City Council, Cenex and CleanTech Business Ltd and receives funding via OLEV's Nottingham Go Ultra Low (GUL) programme.



Nottingham leads the way in sustainable transport. It is the first city in the UK to have a stringent environmental standard for all buses entering the city centre.

⁴⁴ <https://www.level-network.com/>

⁴⁵ <https://www.hs2.org.uk/stations/east-midlands-hub/>

⁴⁶ <https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract>

Nottingham City Council has a fleet of 50 Electric buses to serve existing link services and two park and ride bus services. Electric buses are zero CO₂, NO_x and PM, 50% less well to wheel CO₂ than diesel counterparts.

The region is active in the rail sector with several rail engineering companies alongside the presence of Bombardier, Network Rail and East Midlands Trains.

D2N2 will seek to take full advantage of the business and development opportunities which HS2 may provide in conjunction with the electrification of rail in the Midlands that has been proposed previously. This will result in air quality and carbon reduction benefits. It would, however,, require further additional electricity generation capacity and infrastructure reinforcement. The proposed HS2 route through the D2N2 area includes a new Hub Station at Toton to serve Derby and Nottingham⁴⁵. The station at Toton is expected to be within 10 minutes reach of both cities and be accompanied by a range of development, potentially including around 500 homes.

Local Low Carbon and Renewable Energy Generation

Data from BEIS indicates D2N2 electricity consumption for 2016 was 7799 (GWh) and total D2N2 renewable electricity generation in 2016 was 905 (GWh), giving an effective rate of 11.6% of D2N2 electricity consumption generated from local low carbon sources. Figures from the national Renewable Energy Planning Database (REPD) suggest a locally-installed electrical generation and storage capacity of 562.6 MWe as of December 2018's data release⁴⁶. There are 11 major wind installations with a capacity of 62.1 MWe, and 55 large solar installations with a capacity of 366.5 MWe. Solar sites range from 1 to 27MWe in size, whilst there are four major Anaerobic Digestion plants with a combined capacity of 9.2 MWe.

The REPD covers the inception, planning, construction, operation and decommissioning status of major renewable electricity projects, so will not cover the many smaller private and domestic installations in the region.

It also provides a spatial dataset, which will aid the monitoring of renewable energy planning in the region. REPD data covers Advanced Conversion Technologies, Anaerobic Digestion, Battery, Biomass, EfW Incineration, Landfill Gas, Small Hydro, Solar PV, and onshore Wind. Regionally, wind energy is predominately to the North and East of Nottinghamshire and installed at Medium scale i.e. 500kW and some small wind farms. Rushcliffe, Newark and Sherwood District Councils have adopted supplementary planning guidance on wind energy development.

The National Grid's 'two-degree' scenario milestones estimate a 50% increase in electricity consumption by 2030 to meet demand from urbanisation, and for transport and heating switching to electric. To meet regional electricity demand in 2030, D2N2 needs to generate 13 times the amount of renewable electricity generation in 2016. This will require support to move away from fossil-fuel and solid fuels for heat to an appropriate combination of electric heat pumps, bio-fuels, energy-from-waste and hydrogen. Energy-from-waste that can be connected to heat networks will contribute to both local and national objectives to reduce carbon emissions and waste to landfill. Both Nottingham and Derby have energy-from-waste plants.



Toyota's Burnaston vehicle assembly site in Derbyshire is a regional example of private sector large-scale renewable energy provided on-site, with some 17,000 solar panels in a giant 4.1 MW array as part of the company's Sustainable Plant ambitions ⁴⁷.

⁴⁷ <https://www.toyotauk.com/environment/sustainable-plant.html>

⁴⁸ <http://www.emcouncils.gov.uk/Renewable-Energy-Study>

Severn Trent Water is another large organisation to have invested in renewable energy on their sites, with a new anaerobic digestion plant to be launched in Derby in 2019, and two 130m-tall wind turbines in Spondon. In Nottinghamshire, there has been a partnership between the energy supplier, Ecotricity, and B&Q to provide 100% renewable energy to B&Q's main distribution centre in Worksop.

Local renewable generation can help to maintain competitiveness, improve resilience and efficiency of the economy as well as reducing carbon emissions. In 2011 there was a major low-carbon energy study conducted by Land Use Consultants, the Centre for Sustainable Energy and SQW consulting on behalf of East Midlands Councils. The resulting report on Low Carbon Energy Opportunities and Heat Mapping for Local Planning Areas Across the East Midlands ⁴⁸ remains the most comprehensive available report at this time, and indicates a need for updated accessible information. Having said this, the report is an extensive piece of work, and as such, it's worth repeating some of the broader Derby/shire and Nottingham/shire conclusions.

The report suggests there was 'considerable potential for microgeneration' in D2N2, principally 'heat pumps, solar thermal and solar PV', although the authors acknowledge that solar PV figure is probably an overestimate. There was thought to be some commercial wind potential in several districts in both Derbyshire and Nottinghamshire, whilst the Peak District and some areas close to it, were heavily constrained for wind potential. Areas in Nottinghamshire were also constrained by infrastructure, properties and bird sensitivity issues. Across both counties there was the potential for biomass energy generation. D2N2 is home to leading expertise and existing sites in hydroelectric generation, but the local scope for future sites is limited. Environmental, infrastructure and hydrological restrictions are the key challenges, in addition to weakened business models following the reduction in supportive tariffs.

Local Energy Infrastructure Legacy

The UK is committed to phasing out coal-fired power stations by 2025 in line with climate commitments⁴⁹. There are three operational coal power stations in Nottinghamshire; some of the last sites remaining in the country. All of these have significant transport, power and natural resource infrastructure linkages. The Cottam power station site, owned by EDF energy, has recently announced it will close in September 2019 due to a challenging market. EDF Energy also own the West Burton site, where West Burton A, a coal power plant, sits alongside a more recent Combined Cycle Gas Turbine (CCGT) plant⁵⁰. The third site is the Uniper-owned Ratcliffe-on-Soar power station, adjacent to the River Trent. The closure of these plants in the coming years, unless there are significant advances in Carbon Capture and Storage (CCS), could result in hundreds of job losses in the short-term, and a loss of some 6GW of electricity generation capacity. However the phasing out of these coal station sites could also present an opportunity to repurpose the land, utilise the available infrastructure on these sites for other forms of lower-carbon generation and ensure there is minimal economic disruption to those areas. In the process this would reduce regional emissions in the order of millions of tonnes of CO₂.



Derbyshire has seen the closure of two major coal power station sites in the last two decades at Willington and Drakelow. The Willington site is currently owned by Calon Energy, with the potential for a new gas power station; an idea that was first supported by government in 2011. The Drakelow site in South Derbyshire closed in 2003 and is one of the largest brownfield sites in the region. The site was home to three power stations and a variety of infrastructure. As a potential case study for the other sites in the region, Drakelow has been considered as a focus for the promotion of alternative energy, along with mixed-use developments.

The Drakelow site encompasses some 282 Ha, most of which is potentially developable. An existing electricity substation and associated landscaping covering some 27 Ha is to be retained, together with a nature reserve. Permission exists for 'Drakelow Park', a 110 Ha new settlement, on the northern part of the site. The remaining 96 Ha adjacent to the power station is likely to be developed for employment/commercial uses. The size of the site, the National Grid connection and the potential water extraction opportunities have attracted interest for energy-related uses. There is an existing solar park on the site. Permission has recently been granted for a biomass generation plant. There is also a long-standing permission for a 1200 MW Combined Cycle Gas Turbine (CCGT) powerstation and connection to the National Grid High Pressure Transmission System. There have been plans put forward for a Renewable Energy Centre and Energy-from-Waste plant.

Alongside the coal power stations, the mothballed Derwent Power Station site in Spondon, Derbyshire, has been acquired by Peel Environmental and is expected to be producing electricity from a gas fired plant in 2019. Regionally, there is an opportunity to build on the success of recent heat developments, which have included heat pumps. Another innovative solution being investigated in the area is the potential harnessing of geothermal energy available from mine water through the forthcoming international D2Grids project which will comprise involvement from Nottingham City Council and the Midlands Energy Hub.

⁴⁹ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/672137/Government_Response_to_unabated_coal_consultation_and_statement_of_policy.pdf

⁵⁰ <https://www.edfenergy.com/energy/power-stations/cottam-west-burton-a>

National energy and carbon modelling has suggested that it will be necessary to develop and extend heat networks to decarbonise heat and potentially produce low-carbon cooling for the expected hotter summers. Nottingham has one of the oldest and largest heat networks in the country, serving a range of organisations and around several thousand domestic properties. Where heat networks are in place, there is an opportunity to upgrade and expand. With older networks such as Nottingham's, there are long-term maintenance costs that can also drive innovation and new market opportunities. Nottingham Trent University have established a Smart Heat Network⁵¹ to help identify gaps and increase efficiencies in the heat network supply chain.

Across the region there are both biomass energy expertise and a range of actual and potential sources. However, there are challenges in terms of scale of supply, overall environmental footprint and air quality for some uses of energy from biomass, as well as concerns about long-term sustainability. There are reported to be rising costs associated with importing biomass material, such as timber⁵².

Cross-sector Challenges

To inform the development of the objectives, and actions, the energy requirements of D2N2 across all sectors (private, domestic, third/community and public) have been assessed. This was complemented by other relevant generic local and national challenges. This collation of the challenges, issues and requirements feed into the identified key emerging markets, opportunities and business models for D2N2's energy aspirations.

A key challenge, both nationally and regionally, is the availability of funding and financing to support investment. Uncertainty around funding sources and subsidies, government priorities and legislation hinders growth in the low carbon economy. The degeneration of Feed-in-Tariffs and collapse of the Green Deal programme are two key examples that have affected businesses and domestic users alike. The current Smart Export Guarantee consultation is setting out a new intended direction for the export of small-scale

low-carbon electricity generation. It remains difficult to make the business case for some areas of the low-carbon energy transition due to the continuing low cost of fossil fuels like gas; in part due to the historic array of subsidies when compared to renewable and low carbon alternatives. Nottingham Energy Partnership have reported a lower uptake of solid wall insulation in the area due to the reduction in grants and other financial assistance. The focus is now on financial incentives and return on investment. For certain interventions, such as the retrofit of hard-to-treat houses, there may not be funding available and the return on investment may be poor or unachievable.

Another aspect of the energy transition to consider is the rate of change in developments. Infrastructure, assets and regulations usually have long lifetimes and lock-in, so innovation in services and new technology may be unable to be applied easily or to scale appropriately. With it being a system transition, it requires a number of areas of innovation to occur simultaneously. Coupled with this are broader changes in culture and attitude, particularly around risk, for clients and providers. It also requires wider engagement and education.

Energy plays a critical role in our lives and economy, so gauging and balancing risks can be difficult; particularly understanding who is best placed to shoulder those risks. If there is too much caution, being risk-averse may slow down investment in new technologies and approaches, and in the process hold back market and infrastructure transformation.

The impacts of any transformation can be difficult to manage and schedule, particularly in a system as complex as our energy infrastructure. As detailed above, the prospective closure of coal power stations in the region in the run-up to 2025 could lead to a loss of generating capacity, jobs and useful infrastructure in the region, unless managed effectively by a range of stakeholders. Related to this is the continuing role of planning. Much of the role of planning authorities is governed by the National Planning Policy Framework, along with Local Plans and supplementary planning guidance.

⁵¹ <https://www.ntu.ac.uk/research/groups-and-centres/groups/smart-heat-networks>

⁵² <https://www.forestresearch.gov.uk/tools-and-resources/statistics/statistics-by-topic/timber-statistics/timber-price-indices/>

There are additional restrictions imposed by conservation areas, World Heritage Sites, Areas of outstanding Natural Beauty and other designations that curtail or impede certain types of development because of the unique site characteristics.

However, in 2018, the Government clarified that the NPPF 'Framework does not prevent local authorities from using their existing powers under the Planning and Energy Act 2008 or other legislation where applicable to set higher ambition.

In particular, local authorities are not restricted in their ability to require energy efficiency standards above Building Regulations⁵³. The ability to take advantage of this will depend on the capacity and skills in local planning authorities, and to the extent with which councils can collaborate and share learning. Many planning departments have suffered from a loss of resources in recent years.

The region's extensive rural nature means it encompasses significant areas where energy infrastructure connections and types can be difficult to install, connect or make viable, at least without financial support. For example, the large number of 'off-gas' domestic and commercial properties. In addition to this, the combination of historic areas and old town and city developments means there are a large number of solid-wall properties which are difficult and expensive to retrofit to bring up to required energy performance standards.

The following cross-sector challenges represent urgent and important areas of work for the region to address:

Grid capacity and connections across sectors

Inequality from access to low-carbon innovation

Smart Meter delays and engagement

Oveheating and underheating

Decarbonisation of heat, and heat services

Waste hierarchy and systemic issues in waste management

Turning awareness into actions and behaviour change

Disconnect between bill payers and energy users

Poor energy efficiency of domestic and commercial premises

Securing finance and developing sustainable business models for retrofit works

Connectivity, infrastructure and place-making

⁵³ <https://www.ukgbc.org/news/government-confirms-local-authorities-can-set-energy-standards-beyond-part-l-in-nppf/>

Enabling the Region's Potential



D2N2's Energy Strategy will act as an enabler to start the project development process through identifying need, as Figure 10 below illustrates. This can be achieved by building on existing collaborative working practices across all sectors in the D2N2 LEP area. Working together to build on the vision of the Energy Strategy, D2N2 and its partners will develop and implement innovative energy projects that will drive clean growth in the region.

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Nottingham City Council have demonstrated that the journey towards a low-carbon city can be successfully commercialised, generating jobs and clean growth. This could be replicated on a regional scale through capacity support provided by the Midlands Energy Hub. Covered below are some of the key areas for attention to ensure that the potential in the region can be delivered and the transformation of the energy system is managed responsibly.

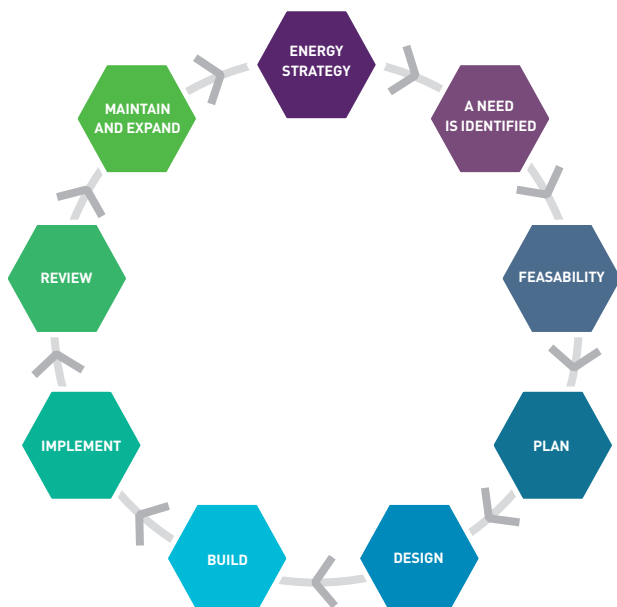


Figure 10. Proposed delivery lifecycle

The D2N2 region will take multiple approaches to resolve the energy trilemma depending on local context, including demand variations and differing challenges, particularly in rural areas. However, the overall objective will remain the same and any of the lessons learned can be shared.

Governance and Delivery

The strategy will progress through formal collaborative working that benefits from the scale, diverse needs and strengths of the D2N2 area. The strategy will be governed by D2N2's Energy Steering Group along with the involvement of key sector stakeholders to maximise resources and avoid duplication. D2N2 will identify and respond to changes in its actions plans, whilst supporting others to undergo this energy transition. Implementing the strategy will require investment or access to funding which can be time- and context-specific.

As with the current D2N2 Low Carbon Plan, D2N2 will work with the local universities, as well as other key partners such as Chambers of Commerce, to capture and analyse growth in the local LCRE economy. Additionally D2N2 can engage with the Office of National Statistics and the Energy Data Task Force to identify how best to monitor other forms of progress alongside the targets outlined in this document.

Engagement

The strategy will be facilitated by the D2N2 Energy Group and through engagement with key stakeholders. There is a need to engage with the wider community including local residents, Community and Voluntary Sector (CVS) groups, entrepreneurs, energy managers, business owners, procurers and innovators. This engagement must be in the form of two-way communication to maximise participation and ensure impact and learning. Affordability and equity are important to citizens, and they will need to play a more active role in the design and delivery of future energy services and infrastructure. Effective stakeholder engagement will keep the strategy live and relevant to the region's needs and aspirations, and better enable successful implementation.

Midlands Energy Hub

D2N2 is part of the Midlands Energy Hub and will aim to play a key role in the development of low carbon infrastructure in the region. A function of the Midlands Energy Hub is to encourage collaborative work and the sharing of good practice. D2N2 have a successful track record of developing a range of energy initiatives, and becoming an active partner of the Midlands Energy Hub provides a perfect opportunity to identify projects that can be delivered on a larger scale across the region. Joint venture work can bring project costs down through economies of scale and result in a project portfolio that is attractive to all sectors.

Local Authorities

Local Authorities alongside the D2N2 have an important role working with local businesses to facilitate the move to a low carbon economy. Assistance will be needed to remove barriers, particularly around planning, policy and strategy, to help enable the enactment of the clean growth aspirations. Local authorities, along with the D2N2, can have a positive impact in educating businesses and facilitating the development of appropriate business networks for mutual support through the transition, while maintaining profitable growth. At present, it is difficult for local authorities to use local financial incentives to stimulate or nudge energy efficiency behaviour, but there are models being examined throughout Europe.

The national Clean Growth strategy sets out an ambitious role for the public sector to play in the energy transition. Regionally, this will mean working toward national public sector targets of a 32% reduction in carbon emissions by 2019/20 from 2009/10 baseline, and a 2050 target of zero emissions and 100 % clean energy.

Energy Advice and Grants

SMEs are often keen on energy efficiency measures, but may not possess the time, capacity or capital to make significant improvements. They often choose interventions such as LED light replacement and other straightforward measures which limit disruption to operations, save money and see a quick return on investment. This approach does not allow for the full scope of resource efficiency measures to be implemented in the short term. Often it is the case that technologically advanced and innovative solutions are perceived as risky. Changing these perceptions can be addressed with enhanced advice, guidance and practical demonstrations.

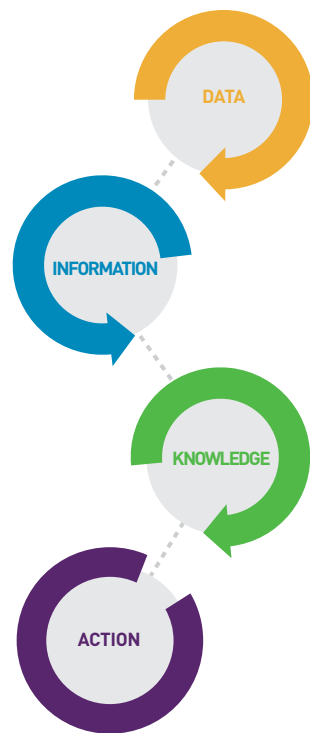
Energy advice and grants, particularly to SMEs, has been a regional success, and continuing with this provision will help more businesses be aware of and access support. The provision of audits, and basic advice for free, helps reconnect energy users to bills and elevate energy as a priority in organisations. It can also break down barriers for businesses to make steps towards energy efficiency and decarbonisation improvements. This stimulates the local market for capital and consultancy works. It is also critical that businesses understand the importance of being actively involved in the shift towards a low carbon economy and the potential economic opportunities available.

It's vital to look at what is required in the domestic sector too; especially given the extent of fuel-poverty and the energy performance gap between design and build. Therefore, it is important to reduce consumption through behaviour change (where appropriate), increase uptake of energy efficiency measures and optimise the use of renewable energy to help reduce domestic fuel costs. Whole house solutions being trialled, such as Energiesprong in Nottingham, require a change in our current thinking and approaches towards business models.

New and innovative business models for able-to-pay and those in fuel poverty are needed to stimulate greater investment in measures like solid wall insulation, where financial returns may be over a longer term.

Data

Data is essential for better understanding, planning and management of energy systems, effective retrofit and developing new energy services and products. Advances in the types of data that can be collected to provide evidence and insight will be essential for the region's energy revolution. As a result of local consultation, it is apparent that there are data and evidence gaps that need to be addressed, some of which can be addressed through national programmes. The Energy Data Taskforce⁵⁴ have acknowledged the importance of data to a low-carbon, affordable energy system. Data is a vital part of future energy systems. D2N2 wish to work with local and national partners such as the Energy Data Taskforce to identify and bridge current data gaps.



Quality and timely data is needed for:

- Spatial planning for energy infrastructure
- Location specific assessments for suitable energy interventions
- Designing cost-effective retrofit programmes
- Grid Balancing and Demand Side Response services
- Aggregation services
- Energy-as-a-Service (EaaS) approaches
- Identifying inefficiencies and losses
- Monitoring energy spend and usage-time profiles
- Mobility-as-a-Service and efficient transport systems operation

⁵⁴ <https://www.gov.uk/government/groups/energy-data-taskforce>

Cost Benefit Analysis

Cost Benefit Analysis can be a useful way to analyse data and assess future, current and previous interventions. This can be carried out on small-to-medium scale projects, to make well-informed, rational decisions on the viability of projects. Nottingham City Council are working with national partners to evaluate a Cost Benefit Analysis (CBA) model that incorporates a range of factors including social, economic and environmental benefits. This can help make a stronger case for a project to highlight the multi-dimensional benefits of energy projects. The financial benefits of social and environmental impacts can be hard to assess but it is acknowledged that there can be a financial saving because of reduced demand on services e.g. the health service, if fuel bills are lower and homes are warmer.

Replication and upscaling of successful projects

Through sharing success stories and good practice, D2N2 and its partners can identify replicable approaches that deliver maximum concurrent benefits across social, environmental and economic criteria and address multiple objectives that can converge; for example, the REMOURBAN / Energiesprong retrofit project detailed in the case study opposite.

Innovation

Innovation in the low carbon economy can be supported through market design. A key task is to match unmet energy needs and create regional bespoke solutions with innovators and entrepreneurs. Energy efficiency technologies moving from innovative ideas into market-ready solutions require ongoing support. There is a strong need for collaboration, and it is imperative to include vulnerable citizens in the energy transition. There are, however, challenges to innovation: attitudes to risk, resources for investment, technical failure and human error.

The three D2N2 Universities, in collaboration with a strong leading Local Authority model and other local actors, have a track record of developing and delivering innovative projects by using technical and implementation expertise to help to de-risk innovative interventions. While innovation

does pose risk, it offers many opportunities⁵⁵ and the chance to be at the forefront of the energy transition; for example, the rise of electric vehicles and implementation of vehicle to grid technology to enhance local energy security through control and flexibility. There are opportunities to build on past success through supporting further roll out of innovation across the region. Innovation in clean growth is a key government priority, providing the opportunity for funding in the region through a mix of grant and private investment.



Nottingham City Council adopted the Energiesprong approach to create near net-zero housing; upgrading homes in its social housing stock with energy generating and saving measures. These included new outside walls and windows, a solar roof and a state of the art heating system including ground source heat pumps. The pilot was partly funded by REMOURBAN / EU Horizon 2020 innovation funding and the city is now replicating the pilot with a rollout across 150 Council owned homes, and a school. The works are partly funded by European Regional Development Funding and an objective of the rollout is to create a self-funding procurement model to ensure that many more homes in the UK can benefit from Energiesprong.

CASE STUDY: Energiesprong The UK's first pilot

Behaviour change

It's important to recognise that energy and resource consumption is influenced not just through building efficiency measures but also the people occupying and using them⁵⁶. Behaviour change is about raising peoples' awareness of their energy and resource use, and encouraging more conscious consumption and habitual efficiency. This covers both staff in public and commercial buildings and citizens in the domestic setting. Such approaches with staff can not only reduce energy bills and carbon emissions, but also improve overall comfort conditions to enhance workforce wellbeing and productivity. This usually requires tailored campaigns according to the specific needs of the staff and challenges of the building in question, some of which can be achieved by sharing best practice in organisational networks. It is also advised that the success of behaviour change initiatives is measured quantitatively through consumption data to provide greater insight.

Consumer behaviour and prosumerism

Fostering public behaviour change is more problematic and usually more difficult to measure, but will be needed to adopt new practices and technologies in energy systems and services. A prosumer both produces and consumes energy, and can allow much greater control of domestic energy systems. It is vital for cross-sector collaboration and user co-creation to identify how consumers can be empowered and enabled to embrace low-carbon energy solutions. Engaging and educating citizens on energy and resource efficient behaviours has already been shown to help them provide affordable warmth, improve physical and mental wellbeing and save money. There are many channels for promoting behaviour change, including social media, advice stalls, community events and home visits. Much of this currently happens in the region through the activities of the CCAN, the LAEP (and its website <http://www.everybodys-talking.org/>), community groups and other providers. The collaboration of partners is recommended to pool resources and expertise while expanding potential outreach. Nottingham City Council is driving behaviour change among staff and citizens. It is in its second year of an innovative eTEACHER project

⁵⁵ Webb, J, Hawkey, D & Tingey, M 2016, 'Governing cities for sustainable energy: The UK case' Cities, pp.28-35

⁵⁶ Janda, K. B., 2011. Buildings don't use energy: people do. Architectural Science, 54(1), pp.15-21.

which is building an app to empower building users to become more energy efficient. Meanwhile, the National Ice Centre is continuing its well-established behaviour change programme which achieved a 9% total bill saving in its first year.

Grow existing energy service provision

Responsible job creation requires the enabling of a sustainable pipeline of future of work. The project development process is demonstrated in Figure 11. If, after a period of rapid growth, the demand for a product or service decrease before the cycle is renewed, there is the potential for a void that can result in job losses and a decline in investor confidence. This was evident in the Solar PV market where, after initially high uptake and rapid job growth, it suffered a fall in demand and jobs were consequently lost. However, if uptake had been staggered there would have been more work available in the operation / maintenance and repair section of the circle to enable sustainable long-term growth within the sector.

Collaboration and support networks

The Low Carbon Business Network, LEVEL, and the East Midlands Chamber Sustainability Forum are examples of relevant low-carbon support and collaboration networks, and D2N2 has had a range of clean growth initiatives in the last ten years.

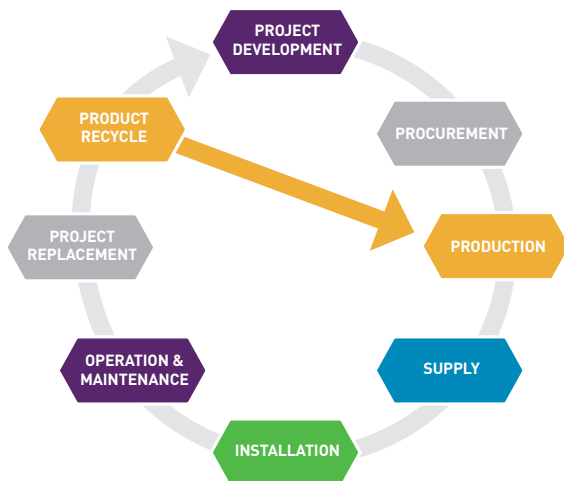
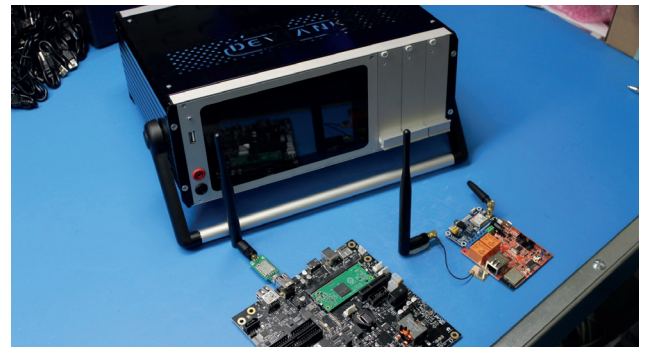


Figure 11. Project development process

The Low Carbon Business Network continues to grow at a rate of around 5% per month. Smaller, 'interest focused' sessions are proving as popular as larger and more general opportunities to engage with larger organisations like the universities and corporates, to catch up on the latest innovation and insights.

Experience from the previously mentioned networks also indicate the importance of collaboration between organisations at different scales i.e. councils, universities and corporates collaborating directly with much smaller business entities. Engagement sessions with businesses provide opportunities to gain much needed insight into the efficacy of local and national policy initiatives and how best to tailor support packages to SMEs. They can also identify the specific market and business support required by those businesses looking to grow or establish themselves in the LCRE sector.



The ERDF Low Carbon Business Network team at University of Derby Business School is working in partnership with Lindhurst Engineering Ltd. in Sutton-in-Ashfield to create a Smart Factory System.

The use of data and information throughout the production lifecycle creates flexible manufacturing processes that respond rapidly to changes in demand. This drives better quality, productivity and flexibility and helps the company to deliver customised products in a sustainable way, at large scale and with better resource consumption and energy efficiency. CEO, Martin Rigley has set ambitious environmental targets and aims to improve the firm's operational and environmental performance by improving its resource and energy efficiency whilst ensuring a safe and healthy work environment.

For more information please see our [website: www.lowcarbonbusiness.net](http://www.lowcarbonbusiness.net)

CASE STUDY: Smart Factory System

Skills and education

The University of Derby Skills Report ⁵⁷ offers suggestions to ensure that the capacity and capabilities required to deliver the Energy Strategy are put in place:

- 1 Invest in cross-sector opportunities to build local leadership capacity to accelerate the shift to a local low carbon economy.
- 2 Establish regular economic data capture and reporting protocols to monitor pro-environmental business activity and skills through collaboration of regional stakeholders. Namely, Growth Hub, LEP Sector Groups, East Midlands Chamber, Local Councils, Universities et al.
- 3 Sector Skills Groups to take responsibility for identifying and monitoring pro-environmental business activity and skills needs in each priority sector.
- 4 Sector Skills Groups review current and future skills needs to establish priority areas and make recommendations for skills provision in each priority sector.

The recommendations make the link between the Energy Strategy itself and the broader skills agenda. Here, the suggestion is that all priority sector strategies contain a section that deals with the implications of energy efficiency and carbon emissions reduction, as well as a section on the needs and opportunities of the 'pro-environmental niches' in each sector. This will clearly require explicit attention to the issue of capacity building to secure such an integrated and powerful cross-sector approach. For example, additional training is required in construction to deliver the most effective retrofit installations. It follows that there needs to be an aim to build an adaptable workforce with the skills needed to be competitive.

Ensuring Successful Delivery

It is essential to envisage and investigate future shocks, effects and so-called 'black swan' events that will delay, disrupt or damage plans and infrastructure. The scenarios analysis shows that, whilst there are two broad energy scenarios that will deliver the carbon reduction required, there are multiple socio-economic and political scenarios that will heavily impact upon the direction of travel. Whilst there are fixed timescales to reduce carbon emissions due to the nature of carbon budgets, there is a great deal of uncertainty around other key factors. For example, which technologies will emerge, the policy direction, general economic performance and the price of carbon. It is imperative then that the approach D2N2 takes utilises a range of market, policy and behaviour change levers to achieve its vision. It reinforces a message of ensuring the region possesses the ability to foresee, plan, adapt and react, and keep flexibility at the core.

It is vital to avoid lock-in physically and economically, to systems that may become stranded and obsolete. This must be balanced with ensuring there is adequate progress in our energy transition as quickly as possible. There may also be counter-intuitive situations where success in reducing demand may affect the viability of energy infrastructure and assets. It follows then, that any plan for the region is flexible in terms of the pathways to meet the ultimate objectives and also deems flexibility as inherent systemic architecture. Integrated infrastructures with low levels of redundancy may allow for failure cascades through interdependencies.

There is also a risk that the fuel poor and smaller organisations and businesses, in this and all regions, will be left behind with the development of new technologies. In the next ten years, there is likely to be a rapid change in the technology used to control and generate energy in the home and at work, and those that can afford to adopt early may maximise their benefits. It is important then to understand the business models for services and products that can deliver benefits from this change to a much larger audience.

⁵⁷ Paterson et al (2018) Key skills and training needs of the D2N2 Low Carbon and Environmental Goods & Services Sector; Abridged Final Report. University of Derby

⁵⁸ <https://ukclimateprojections-ui.metoffice.gov.uk/>



Vulnerabilities today may not be the same for the fuel poor by 2050; instead, the ability to interact with the new types of energy systems will be critical for the fuel poor to prevent growing inequality.

More detailed work on the local impacts of climate change is needed, and how that affects energy systems, with the UKCP18⁵⁸ updated climate change projections being a vital tool. Hotter drier summers, and warmer wetter winters, along with more extreme heat and rainfall events and the possibility of high winds, are expected. This ultimately brings impacts such as storm damage, flooding, drought, heat stress. Local authorities are uniquely placed to achieve climate change mitigation by acting on their own estates and motivating the wider community based on their understanding of local priorities, risks, and opportunities. For now, the emphasis is on the methods and principles that the D2N2 region must set to avoid exposure to multiple risks to energy systems and their assets, and implementation of the plans put in place. These must adapt as risks change and learning from interventions becomes available.

Additional risks will need to be fully identified and assessed for the region's plans. This will likely include factors such as the increased dependency on data and communications in energy systems, and how this exposes the region to cyber-attacks and system failures.

This, with the potential increase in demand, could lead to energy shortages due to a lack of capacity. The outcome of Brexit and stability of the global market will also influence the clean growth agenda. Certain national level matters such as economic uncertainty, risk of recession and institutional collapse, must also be considered. A recommended suite of actions should be developed to protect delivery of regional energy infrastructure and services.

Suggested immediate mitigation measures to explore include:

- Mapping climate vulnerabilities for key energy assets and reducing exposure to climate risks
- Increasing efficiency & energy self-sufficiency in energy, including additional generation capacity, within D2N2, and across its businesses and organisations
- Improving local energy data collection and sharing to understand demand and usage
- Network investments and diversified portfolios
- More locally or community-owned services and infrastructure to give greater control of assets
- Adaptation & flexibility embedded across key LEP and local authority strategies

Conclusions and recommendations



Recently announced aspirations towards becoming carbon neutral illustrate both the regional ambition and growing international drive towards a low-carbon energy future; a future that delivers a range of essential quality of life benefits and touches upon almost every aspect of our lives. Decarbonisation of energy is no longer simply a cost, but an investment that can provide a worthwhile return and improve our resilience through greater efficiency and energy security. In pursuit of this, it's important to ensure the region capitalises on, and sustains, its natural and heritage assets for clean growth, which are of national and even international importance. Aligning D2N2's approach with the National Grid Two Degree scenario has provided a timeframe and a series of high-level milestones. This has been coupled with local economic and national clean growth objectives.

It is recommended that the LEP support the view that the future energy generation system should be based upon renewables, and support the physical and market-based flexibility instruments to enable this. It's advised that the region adopts the high-level National Infrastructure Assessment recommendations for low-carbon infrastructure, and seeks to work closely with government on their implementation:

- **At least 50% renewable electricity generation by 2030** – This would need to be supported by energy storage, Demand Side Responses and smart grids to manage the fluctuation of supply against the fluctuation of demand.
- **Pilots to test hydrogen and heat pumps as low-carbon heating options** – To remain at the forefront of the learning curve D2N2 should welcome the opportunity to enable and host pilots and community trials on re-purposing the existing gas infrastructure, and explore other low-carbon heating options at scale as part of a broader energy system transition. The region has the delivery and research partners to make this feasible.
- **Buildings which requires less energy to heat** – Minimising energy demand is critical in reducing carbon and fuel poverty, and to enable the effective use of renewable and low carbon sources of energy. Energiesprong is an example of retrofit work within the region, demonstrating the advantages of deep retrofit.
- **Flexibility** - With the current and expected growth in innovative solutions to meet the uncertain and evolving energy demands, it is important that there is not an over-investment or reliance on a small set of current technologies. Forward planning and the development of reserve capacity, for growing or adapting existing assets to meet changing demands, will be critical in ensuring that the infrastructure installed now can be readily maintained and improved throughout the journey to our low carbon future.
- **Improving sustainable and environmental standards through implementation of new infrastructure** e.g. The sustainability and environmental standards being promoted by HS2 could help raise standards across the construction and civil engineering supply chains. This should also be true of the Garden Villages, and help raise the bar for the whole construction sector across the region.

The region's current progress and capacity must be accelerated in the critical decade ahead. This requires a high level of focus and coordination through the LEP, across all sectors. The scale of the energy transformation required necessitates a whole systems approach towards decarbonisation and societal changes in behaviour and consumption; recognising that a strategic combination of technologies and infrastructure upgrades are needed to make progress towards a low carbon future.

To achieve industrial growth, D2N2 requires significant investment in its regional infrastructure to generate and distribute secure and affordable energy to meet demand: failure to do so will harm growth.

Enacting the Energy Strategy requires balancing many demands whilst delivering the degree of decarbonisation necessary to minimise the impact of climate change. The loss of key energy generation plants, as the grid moves away from fossil-fuels, is evidently an urgent challenge, and it's recommended that the LEP prioritise these sites for engagement and development.

With the expected switch towards electric transport and heating, it is essential to act now to meet regional electricity demand in 2030 through upscaling the amount of renewable electricity generated.

The advantage of many renewable technologies is a relatively short implementation period relative to conventional energy generation; provided the grid infrastructure can accommodate the technology. Along the way, to minimise costs and carbon emissions, it's essential to reduce demand through domestic and commercial energy efficiency interventions. If this demand reduction can be coupled with investment in storage and other demand side methods, then the overall generating capacity required can be reduced, making better use of the assets we have.

The region has huge potential, with a substantial base of expertise, assets and momentum to capitalise on, across all sectors. Whilst this report has highlighted that there is substantial Low Carbon and Renewable Energy (LCER) activity in the region, there are a number of gaps and challenges that must be addressed to unlock further progress. There is clearly a need to build the capacity to identify, develop, and support energy projects. Activity needs to be coordinated and aligned with the right stakeholders and a proactive planning approach. It is necessary that the LEP supports the Midlands Energy Hub in building the capacity to develop and deliver energy projects that align with the high-level aspirations, targets and actions of this Energy Strategy.

Context is key: whilst there are unifying challenges across D2N2, there needs to be a plurality of approaches to meet local needs and aspirations. It is this flexibility-by-design ethos that will allow the region to best capitalise on changes to energy market conditions and to ensure that the strategy remains valid and viable. It is advised that detailed D2N2 action plans for the Energy Strategy are reviewed and refreshed every three years. The first should closely follow the publication of this strategy.

Uptake of low carbon and renewable technology by a range of actors will see them become an active part of the energy system. New cultures of work, innovations in ownership and impacts of evolving digital technologies will change business models, for example the emerging Mobility-as-a-Service (MaaS) models in transport. On-demand services are also part of the present and future scenarios for the region. Around this is the requirement for innovation in services, production, and construction, and through greater access to data, Artificial Intelligence and analytics capabilities.

It is recommended that D2N2 treat housing retrofit and new domestic builds as major infrastructure projects; to close performance gaps, turn homes into essential parts of the new energy system, and use decarbonisation to address the significant issue of fuel-poverty in the region.

This can provide consistent opportunities for growth in domestic energy efficiency services and jobs. With effective coordination of a pipeline of projects, it will be possible to grow the low carbon energy and renewables sector; thereby creating sustainable jobs and maintaining and attracting investment in the D2N2 region. To achieve this, there will need to be significant investment in skills and training at all levels, and so it is suggested that D2N2 fulfil the recommendations in “Key skills and training needs of the D2N2 Low Carbon and Environmental Goods & Services Sector; Abridged Final Report”, cited in this strategy.

An overarching requirement for D2N2 and its partners is the enablement of all stakeholders to move towards, and benefit from, the transition from energy network to energy system. It is essential that this approach leaves no-one behind and integrates successfully with key infrastructure and economic plans.

Many existing employment positions will see radical changes in how and what they deliver; not least the move away from fossil fuel transport and heating systems. There must be support provided to manage this transition of roles such as heating and network engineers, and motor mechanics. These recommendations provide the necessary guidance to assist the D2N2 region work towards its visionary, sustainable low carbon future, whilst growing the local economy and facilitating job creation.

D2N2, acting as a test-bed for world class energy systems innovation, can energise the Midlands Economy and become a national pioneer in clean growth - creating sustainable jobs and maintaining and attracting investment in the region.





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