Enabling Growth in New Anglia Clean Energy Industry through Skills Development 2019-'36

LEP Officer Version

A Skills Plan for New Anglia

March 2019

NEWANGLIA
Local Enterprise Partnership for Norfolk and Suffolk

European Union
European Social Fund

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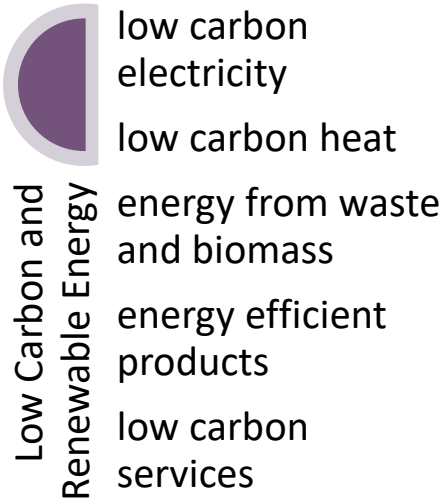
Executive Summary

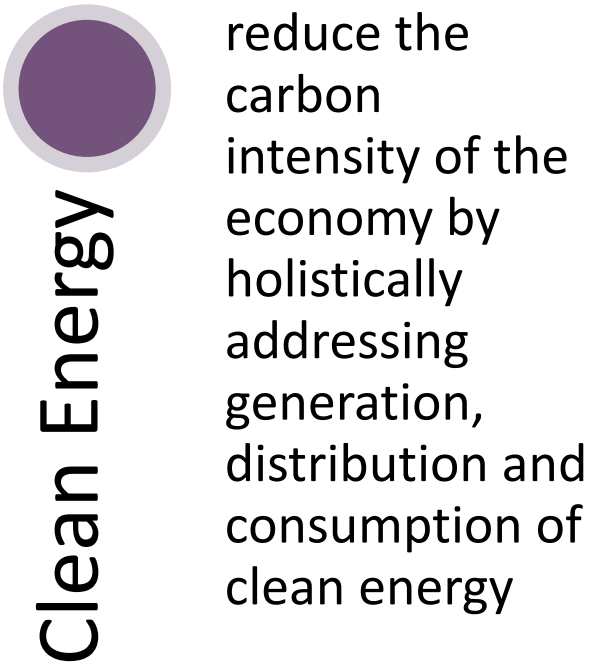
1. Introduction

Background

This document sets out a Skills Plan to support ambitions for the local Low Carbon and Renewable Energy sector, while also delivering against the bigger picture of Clean Energy, which has been identified as one of Norfolk and Suffolk's three key market opportunities for the Local Industrial Strategy, alongside Agri Food and ICT.

Local Industrial Strategies focus on distinctive economic strands where an area can demonstrate a competitive advantage and is able to play a significant national role in delivering productivity growth against the UK Industrial Strategy[1]





Ambitions

Norfolk and Suffolk has ambitions to build its reputation as a Centre of Excellence for Clean Energy skills, by developing best-in-class elements such as :

- Operations + Maintenance Excellence
- Skills transfer
- Inspiring Clean Energy Careers
- A local and diverse talent pipeline and workforce
- Test bedding for emerging skills needs
- Multi-disciplinary local learning programmes

[1] UK Government (2017), Industrial Strategy: The Grand Challenges

People are identified as one of the key pillars for growth in the UK's Industrial Strategy and by placing skills development at the heart of the Norfolk and Suffolk Clean Energy theme in the Local Industrial Strategy, economic ambitions will be supported by increasing the number of high value, higher skilled and higher paid jobs supported in Clean Energy, to increase Clean Energy GVA in Norfolk and Suffolk.

2. Economic analysis

World-leaders in clean energy

Norfolk and Suffolk is recognised nationally and internationally for its Low Carbon and Renewable Energy (LCRE) activities and for its contribution and commitment towards the broader agenda of Clean Energy, where the focus is on enabling a transition to a low carbon energy system through capacity building in low carbon generation, distribution and efficiency.

£1bn value

2,000 businesses

5300 jobs

£193K value per job

Norfolk and Suffolk renewable energy and low carbon economy, 2016

Nationally, the energy sector is in transition, with over 50% of power now coming from LCRE sources and further substantial expansion expected as the UK seeks to lead the world in decarbonising energy supply.

Norfolk and Suffolk is unique amongst UK regions in having strengths in the full range of major clean energy technologies and is a leader in:

- Offshore renewable energy
- Bioenergy and solar
- Nuclear

The strengths of the area as a leader in Clean Energy have been built upon:

- the natural advantages of its coastal and agricultural topography;
- A long history of investment in nuclear power generation at Sizewell and in the offshore oil and gas industry in the southern North Sea;
- The commitment made locally to invest in the low carbon and renewables sector from the start of the new Millennium

Local policy support for commercial investment has helped to establish Norfolk and Suffolk as national leaders in renewable energy, with specialist innovation centre Orbis Energy providing support and the East of England Energy Group and the New Anglia All Energy Industry Council giving a voice to the economy.

Currently, Norfolk and Suffolk generates 43% of the UK's animal biomass energy production and 27% of wind power and renewable energy generation increased overall by 48% between 2014-17.

48%

The increase in renewable energy generation in Norfolk and Suffolk between 2014-17

Building prowess : the opportunities for future economic success

The International Energy Agency has calculated that to meet the targets agreed by 195 countries in Paris in 2015, $13.5 trillion of investment is needed globally in new generation capacity, demonstrating the size of the global market and the huge export opportunities offered by the industry.

The national Clean Growth Strategy (2018)[2] highlights substantial growth in the UK's low carbon economy, reporting that since 1990 UK GDP has grown by 67%, the fastest rate in the G7, whilst carbon emissions have fallen by 42%, much faster than the 3% reduction seen in the G7 countries

The UK low carbon economy is expected to grow nationally by 11% each year through to 2030, which is four times faster than the overall economy, giving the potential for between £60-170billion of exports of low carbon goods and services by 2030.

Norfolk and Suffolk is the only region in the UK which is strong in all areas of LCRE energy generation and in building the market opportunity of Clean Energy through the Local Industrial Strategy, the objective is to support both the:

- **Energy Industry** - to grow the productivity and economic contribution of the energy industry to position Norfolk and Suffolk as a leading global centre for Clean Energy technology and deployment;
- **Wider economy** - to enable economic growth across the economy by ensuring that the area offers a modern energy infrastructure and affordable, sustainable energy supplies to facilitate growth.

The strategy for Clean Energy developments builds upon existing core strengths, including:
Wind
The Southern North Sea, with Norfolk and Suffolk at its centre, is currently the largest offshore wind development zone in the World with the Government's Offshore Wind Sector Deal[3] setting out ambitions to grow offshore wind capacity in the UK to 30GW by 2030 at a cost of £40billion.

[2] UK Government (2018), Clean Growth Strategy
[3] HMG (2019), Industrial Strategy, Offshore Wind Sector Deal

Of this, the East of England would deliver almost half of the capacity, representing a five-fold increase in installed capacity in just over a decade. This would add a further 27,000 jobs nationally by 2030 and the aspiration is for one third of the staff to be female by that time.

GLOBAL POTENTIAL

The case for clean energy

Predictions for long-term growth in global demand highlight the potential for exporting talent and technology world-wide

- Electricity consumption will double by 2050, with 50% from renewables by 2035
- Gas consumption will continue to grow until 2035 and then decline
- Oil demand will peak between 2025-30 and then decline

McKinsey

Biomass and Bio-energy

The Committee on Climate Change has reported that 15% of UK energy demand could be met by biomass by 2050, double the rate today. Norfolk and Suffolk is already the leading area for animal biomass installations, with a third of national capacity delivered through two major plants founded on the area's intensive livestock activities. There is also a strong and growing anaerobic digestion (AD) sector, and a number of power plants fuelled by straw and other biomass, all providing a springboard for further growth as this field expands. With some 8% of England's farmland, there is a large potential to increase the output of biomass in the area.

Solar

From 2012 to 2018 the installed UK solar capacity rose from 2GW to 13GW[4] and Norfolk and Suffolk has 4% of UK installations with an output of 0.5GW.

Since 2014, most of the increase in solar capacity has come from larger commercial (10KW+) installations, rather than domestic schemes. Norfolk and Suffolk is well placed to provide the large physical land area required to develop further commercial installations, with farmers keen to develop new income streams as agricultural policy change focuses them on diversifying their incomes.

$13.5 trn

The investment needed globally in new generation capacity to meet the objectives of the 2015 Paris Agreement on climate change

Nuclear

Sizewell in Suffolk is a significant asset in the local LCRE energy sector. Sizewell A is currently being decommissioned, whilst Sizewell B is still operational and generate 2.5GW of

[4] UK Solar capacity installed - BEIS (20th December 2018)
https://www.gov.uk/government/statistics/solar-photovoltaics-deployment

low carbon power. Plans for Sizewell C are well advanced and is projected to create 5,600 jobs during peak construction[5] in a plant which will generate 7GW of power

The implementation of the Nuclear Sector Deal[6] is currently being developed nationally, with New Anglia LEP working closely with government, alongside the Heart of the South West and Cumbria LEPs. The key areas of focus include cost reductions; increasing workforce diversity and securing more contracts for UK suppliers.

New technologies

Innovation is a constant feature of the Clean Energy industry and Norfolk and Suffolk has potential to build on existing strengths to grow the LCRE economy by investing in knowledge, skills and infrastructure to grow the LCRE economy in areas such as:

- Carbon Capture Usage and Storage (CCUS)
- Wave and tidal power
- Alternative high yield biomass crops such as algae
- Hydrogen generated through renewable power to produce a zero carbon fuel

Energy Efficiency Transformation

Alongside innovation in energy generation, continued gains in energy efficiency are needed, coupled to energy grids which ensure that end users have the clean energy needed to facilitate growth across the economy. With its clean energy generation potential, Norfolk and Suffolk is well placed to lead this work on behalf of the wider region.

This will require investment in energy grids, including smart technologies and new grid infrastructures. With much of the transformation in energy use is being enabled by Industry 4.0 and digitalisation, this is closely aligned with the ICT and Digital themes in the Local Industrial Strategy in Norfolk and Suffolk, which provides a strong foundation for the development of new smart, digitally facilitated energy systems.

An important opportunity for Norfolk and Suffolk lies in driving innovation around the transformation of transport to clean energy systems. The region is home to a major ports and logistics sector, with nearly 50,000 employees and a GVA of 2.3billion[7]. The potential to move to clean energy in rail and road freight is a significant opportunity where Norfolk and Suffolk can lead, with direct local impact and associated potential for technology and systems sales.

Capex and Opex

LCRE infrastructure and generation capacity requires a mix of capital expenditure (Capex) and operational expenditure (Opex). Much of the Capex is focused on comparatively short periods of time, from a few weeks for a solar farm to a few years for a wind farm, whereas Opex costs to maintain generation capacity will typically last for 25 years or more.

[5] Hardisty-Jones Associates (2018), Sizewell C Economic Impact Assessment, Executive Summary
[6] HMG Industrial Strategy (2018), Nuclear Sector Deal
[7] New Anglia (2018), Sector Skills Plan for the Ports and Logistics Sector Through Skills Development 2018-'25

Norfolk and Suffolk can develop capacity in the Capex phases of LCRE systems, focusing on those areas where it can develop globally competitive, exportable expertise, such as in the field of offshore wind energy. As the largest development zone in the world, Norfolk and Suffolk is well placed to develop capacity and expertise in areas such as environmental assessment, consultancy, grid infrastructure or financing as well as physical construction of turbines, with such capacity opening up substantial national and global opportunities as clean energy investment accelerates across the world. The area also has the potential to position itself as a global solutions provider for LCRE maintenance including emerging areas such as Industry 4.0-related remote monitoring and control of LCRE installations, with control rooms in Norfolk and Suffolk already being used to monitor wind farms in Scotland.

Job creation

Local and national projections suggest an additional 14-16,000 new jobs will be created in Norfolk and Suffolk by 2030 if the ambitions outlined here are realised.

This would be through direct jobs created in :

- 5,000 to 6,000 jobs in Offshore Wind
- 5,000 to 6,000 jobs in Nuclear
- 1,000 in other LCRE activities, such as bioenergy, solar etc

A further 3,000 Clean Energy jobs would be created indirectly across the economy.

Reflecting the innovation in the industry and Norfolk and Suffolk's ambitions to lead the development and deployment of new technologies, such jobs will make a significant difference to the skills profile of the area as they are likely to be:

- High value
- High skilled
- High tech
- High wage

3. Skills analysis

Skills profile

The skills opportunities and challenges underpinning this Skills Plan have been identified through a combination of desk-based research, drawing on national and local intelligence, and stakeholder consultations, including the newly-established New Anglia All-Energy Industry Council and other nationally-generated research and statistics such as the recent Sector Deals for Nuclear and Offshore Wind. These include, for example, the low number of women and ethnic minorities represented in the industry.

Feedback shows that energy is often not seen as a career route or valued source of jobs, with many associating the sector with heavy, labour-intensive jobs such as those on oil rigs.

A key backdrop to the skills planning of the energy utilities industry is the pressures surrounding an ageing workforce of Engineers and a mismatch with current entrants. Some 20% of the existing workforce are due to retire in the ten year period 2017-2027.

Skills gaps and shortages

Skills system gaps	**Current skills shortages**
According to UKCES, specific areas of higher skills reported by employers as not being well supported via existing training standards include: • Energy storage and management solutions • Data analytics • Installation, operations, testing and maintenance within energy infrastructure • Adoption of latest design, surveying and testing tools	These include: ▪ Graduate and Post Graduate Engineers ▪ Data Science ▪ Construction – both trade and professionals ▪ Logistics – on and offshore ▪ Commercial and Business Development

Skills demand

The skills demands of the industry are broad and complex and the pace of innovation means that future skills demand is relatively unpredictable.

A range of energy-related skills are needed by allied sectors as well as those directly employed in the energy industry – for example by those installing and maintaining LCRE technologies. Additionally, the pursuit of greater energy efficiency further broadens the range of job roles and skills needed e.g. within construction and the transport sector.

Alongside the requirement for traditional engineering skills, Industry 4.0 is behind rapid developments in sensor and control systems, which increases the focus on ICT skills. This also creates demand for analysts and business managers who can evaluate and make decisions on the data generated.

Skills development

There is a need to attract new entrants to the industry and to upskill the existing workforce as new technology and Industry 4.0 impacts across the sector.

Many of the skills development needs to support future growth in Clean Energy have been identified in two sector deals - Offshore Wind, March 2019, and Nuclear, June 2018. The result of industry input, these outline the major priorities for supporting *People,* one of the pillars for growth established in the UK's Industrial Strategy.

The sector deals headline several major skills interventions, which in turn support the existing priorities established within New Anglia LEP's related Skills Plans.

Offshore Wind Deal

- Enhancing definition & accreditation
- Better workforce insight
- Increasing workforce diversity
- Reforming Post 16 Technical Skills
- Higher level R & D Skills

Nuclear Deal

- Enhancing Leadership & Diversity
- Apprenticeships and Supplier investment
- Building subject expertise
- Supporting workforce flexibility
- Promoting STEM careers

In addition, the industry will require new skills to enable local ambitions for innovation and growth, where specific skillsets may be as yet unknown due to the fast pace of technological change and the innovation required to deliver on the Clean Energy agenda. The types of projects where this may be relevant include:

- The expansion of low carbon energy generation
- Energy efficiency technologies and systems
- Disruptive low carbon technologies in sectors such as transportation
- Developing the energy grid infrastructure
- Using digitalization and Industry 4.0 to facilitate innovative new energy systems

4. Skills Plan

In support of the economic ambitions for Clean Energy, and reflecting the skills demands and priorities identified, the Skills Plan will focus on seven key areas. Outlined below are some indicative key actions in each of these areas:

1 Sector Skills Plan Alignment

Why? To ensure that this plan adds value to the existing suite of New Anglia LEP's skills plans.

What? Develop connectivity and feed into other skills plans to ensure the needs of clean energy are met.

How? Identify and support skills actions being led through other sector skills plans. The closest alignments are with Energy, Advanced Manufacturing and Engineering, Digital Tech and Emerging Technology. Additionally, while clean energy relates to the whole local economy, major end-users of clean energy include three sectors with local skills plans: Ports and Logistics, AgriFood Tech and Construction.

2 Skills Passports

Why? To retain local talent and provide long-term local careers by supporting skills transition across the energy sector – for example from oil and gas to offshore wind.

What? Develop local retraining and accreditation initiatives to facilitate the transition of skilled workers between different elements of the energy production mix.

How? Review and build upon the local good practice examples coming through early targeted action, for example through East Coast College's Skills Deal pilot.

3 Strengthen Operations + Maintenance

Why? To capitalize on the position of Norfolk and Suffolk as a leader in both CAPEX and OPEX and particularly Operations and Maintenance (O+M) skillsets with the potential to provide long-term, quality, global jobs.

What? Develop a stronger supply chain of Operations and Maintenance engineers and technicians to support Norfolk and Suffolk's local, UK and global LCRE service development

How? Increase the capacity of local provision to train more O+M engineers and technicians by working with industry partners.

4 Inspire Clean Energy Careers

Why? To overcome the lack of local awareness amongst young people and the adult workforce of the high quality career opportunities available in the LCRE sector and across the clean energy agenda.

What? Develop a strategy to ensure that students, local residents and career influencers understand the scope, quality, value and growth potential of jobs in the local clean energy industry.

How? Build a strong positive identity for Energy Jobs locally in partnership with local businesses.

5 Increasing Local employment and workforce diversity

Why? To ensure that high quality opportunities realised through Clean Energy growth are accessible to the whole community

What? Norfolk and Suffolk positioned as a beacon of best practice in encouraging a workforce that is gender and BAME diverse to spearhead the national commitments in the Nuclear and Offshore Wind Sector Deals.

How? Support diversity and social mobility by developing new pathways for all into Clean Energy, working through pilots with partners such as DWP and progressive employers.

6 Technical Standards and Skills Reform

Why? To ensure high quality learning pathways and skills that match fast-developing areas such as bioenergy

What? Norfolk and Suffolk recognised as a Centre of Excellence for Clean Energy learning, skills and accreditation by leading the development of new industry defined standards

How? Identify routes to testbed new skills development for emerging occupations

7 Emerging Technology / Multi-disciplinary Skills

Why? To meet the needs of students and businesses in exploiting the full growth potential of new, disruptive technologies needed for Clean Energy

What? Ensure local course provision best positions students to build Clean Energy careers through a multi-disciplinary curriculum which builds on the foundations of energy engineering, through supporting the development of multi-skilled workers who can facilitate the transition to Clean Energy through Industry 4.0 and AI, environmental and project management skills

How? Work with local FE and Higher Education Institutes that deliver qualifications in energy and engineering-related disciplines to create multi-skilled works with the full range of skills needed in the rapidly evolving Clean Energy sector

Background Context

The Clean Energy Skills Plan has been developed by the industry in Norfolk and Suffolk, working alongside the New Anglia Local Enterprise Partnership, the New Anglia Skills Board and supported by SkillsReach.

SkillsReach was contracted to facilitate and prepare sector skills plans for the New Anglia LEP priority sectors. The project was commissioned by the Education and Skills Funding Agency, in partnership with New Anglia LEP, and funded through the European Social Fund. Each Sector Skills plan and supporting Data Pack has been developed in collaboration with local employers and other stakeholders.

The New Anglia Skills Board places employers at the centre of decision making on skills in Norfolk and Suffolk to ensure the skills system becomes more responsive to the needs of employers, and the future economy.

Whilst there is not a formal industry led group for Clean Energy for New Anglia, there are a range of bodies which collectively focus on and represent the energy industry. The energy sector in New Anglia is also now being supported by a new All Energy Industry Council, which will play a key role in overseeing the Clean Energy theme in the New Anglia Local Industrial Strategy.

SkillsReach is an established East of England-based strategic skills consultancy with an associate project team with extensive experience of developing skills plans.

Acknowledgements

The New Anglia LEP wish to thank the employers, training providers and stakeholders who contributed to the plan by attending events, being interviewed or by making referrals to employers and organisations in the sector. The skills plan was developed in 2018/19 by SkillsReach.

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1. Clean Energy Skills Plan Priorities

When determining the priorities for skills, in support of the Clean Energy Plan in the Local Industrial Strategy, the following elements have been assessed:

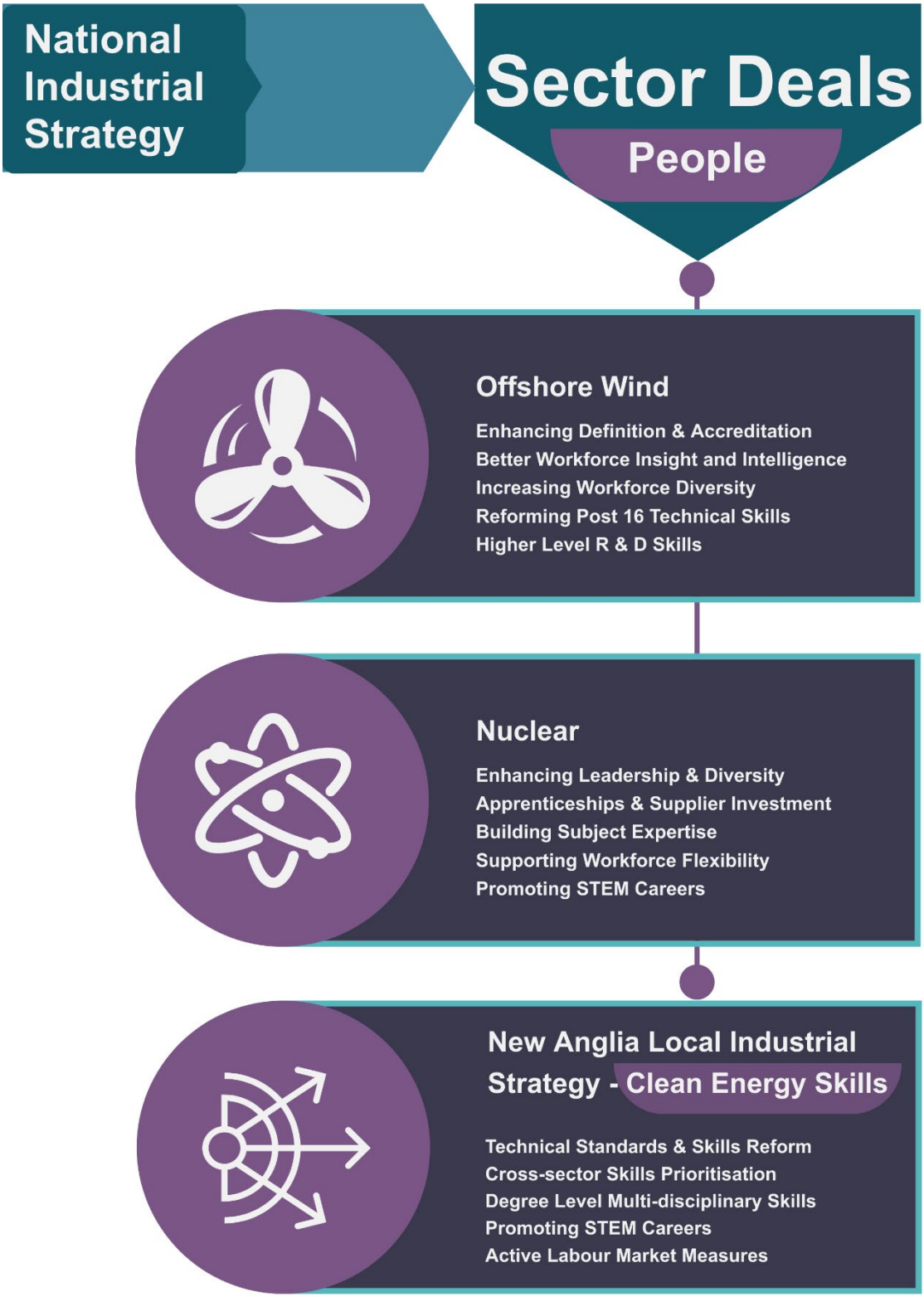
- The definition and economic growth opportunities for Clean Energy industries across New Anglia, recognising the relative strengths and competitive advantage of specific clean tech activities for the area;
- The context of identifying skills demands in relation to the Local Industrial Strategy and the scope of Clean Energy within it, consolidating the existing priorities defined within the Offshore Wind and Nuclear national Sector Deals;
- Existing national and local plans that summarise skills priorities for industries that will support the growth of the clean energy market, specifically the priorities recently defined across Skills Plans for the Energy, Advanced Manufacturing and Digital Tech Sectors;
- Assessing the policy landscape surrounding the reform of technical and post-16 skills, this includes an appraisal of the challenges within the existing skills system and the opportunities presented by New Anglia's Learning and Skills sector.

Sector Deals

The Offshore Wind and Nuclear Sector Deals agreed between industry and government outline the major priorities for 'People', one of the 'pillars for growth' established by government in the national Industrial Strategy. Both sector deals overlap on several major skills interventions, which in turn support the existing priorities established within New Anglia LEP's related Skills Plans. Specifically, for Nuclear and Offshore Wind, the process for developing the Energy Skills Plan (2018), included consultation with key employers – EDF, ScottishPower Renewables, Vattenfall and Siemens – to ensure the nascent development with national skills prioritisation via Sector Deals, could be cross-referenced with the Energy Skills Plan. Sector Deal priorities relevant for Clean Energy locally cover:

- Increasing the diversity of the workforce, with a focus on gender, social background and ethnicity;
- Developing processes to assess the existing workforce skillset and systems to better capture intelligence on patterns of skills demands across occupational areas;
- Reviewing the existing technical standards and ensuring gaps/emerging technical competencies can be defined and used to inform the development of new training products;
- Promoting STEM careers, addressing significant replacement demands and growth, in line with an ageing workforce and planned infrastructure developments;
- Recognition of the generic and interdependent workforce needs across a range of industries and sectors (construction, engineering, manufacturing etc) and developing schemes to allow the 'passporting' of the workforce in line with the demand cycles.

Figure 7 National Sector Deals and the Local Industrial Strategy



Reforming the Skills System- The Grand Challenges for Skills

Ultimately positioning 'People' as a pillar for growth and productivity for a New Anglia Clean Energy plan requires the skills system itself locally to be reformed. Much of the current and emerging skills demands for Clean Energy require industry to engage with the skills system to define and design new skills products. There are limitations on how the existing skills funding and accreditation system allows training and education suppliers to deliver skills solutions that meet the demands of industry, particularly within areas of niche technical demand that often involves short-burst technical training and does not accord within longer defined vocational qualifications that form the basis for apprenticeships and emerging T level qualifications.

Figure 8 The Grand Challenges for Skills

These challenges become exacerbated for SMEs, who often rely on statutory funded/subsidised funding of skills and training to enable them to invest in training itself, excluding construction and the construction engineering industries.

There is no levy system that affords a systemic industry led response to investment.

On the back of increasing localism there needs to be new strategic development and support that combines public intervention and support with industry investment in growth, productivity and business support. This has to include people and skills, including effective work organisation and skills utilisation as inherent elements; rather than the development of skills as a separate response.

Key elements to support a transformative skills system, include:

- The co-design of new standards and training products with industry, building on previous 'trailblazer' initiatives for apprenticeship and T Level reform.
- Developing routes for effective diagnostic and brokerage of skills needs for employers, particularly SMEs, which is responsive to the competitive market that skills providers operate in but is inherently employer driven. This has to be independent and able to advocate for new and flexible training solutions rather than focus on what is currently available on the training market.

- Developing new methods for capturing and defining labour market intelligence that is not reliant on existing SIC and SOC processes (because these are limited to traditional sector classification and occupational roles), rather than responsive to the market and transformative inter-disciplinary roles which are now becoming common. Such data can inform new product demand and strategies for developing careers and enterprise activity. Such data would act as a catalyst for investment in training and provide leverage with government on future funding initiatives that entail localised skills leadership. Essentially New Anglia would be developing unique, proprietary data that can inform policymaking at a national level.
- Developing joined up planning on skills between providers, industry and civic stakeholders to underpin the development of skills priorities which address sustainable planning/development, the growth in community energy and how skills can affect energy use behaviour change.

Alignment with other Sector Skills Plans

During 2016-'18 New Anglia developed a suite of other sector skills plans covering

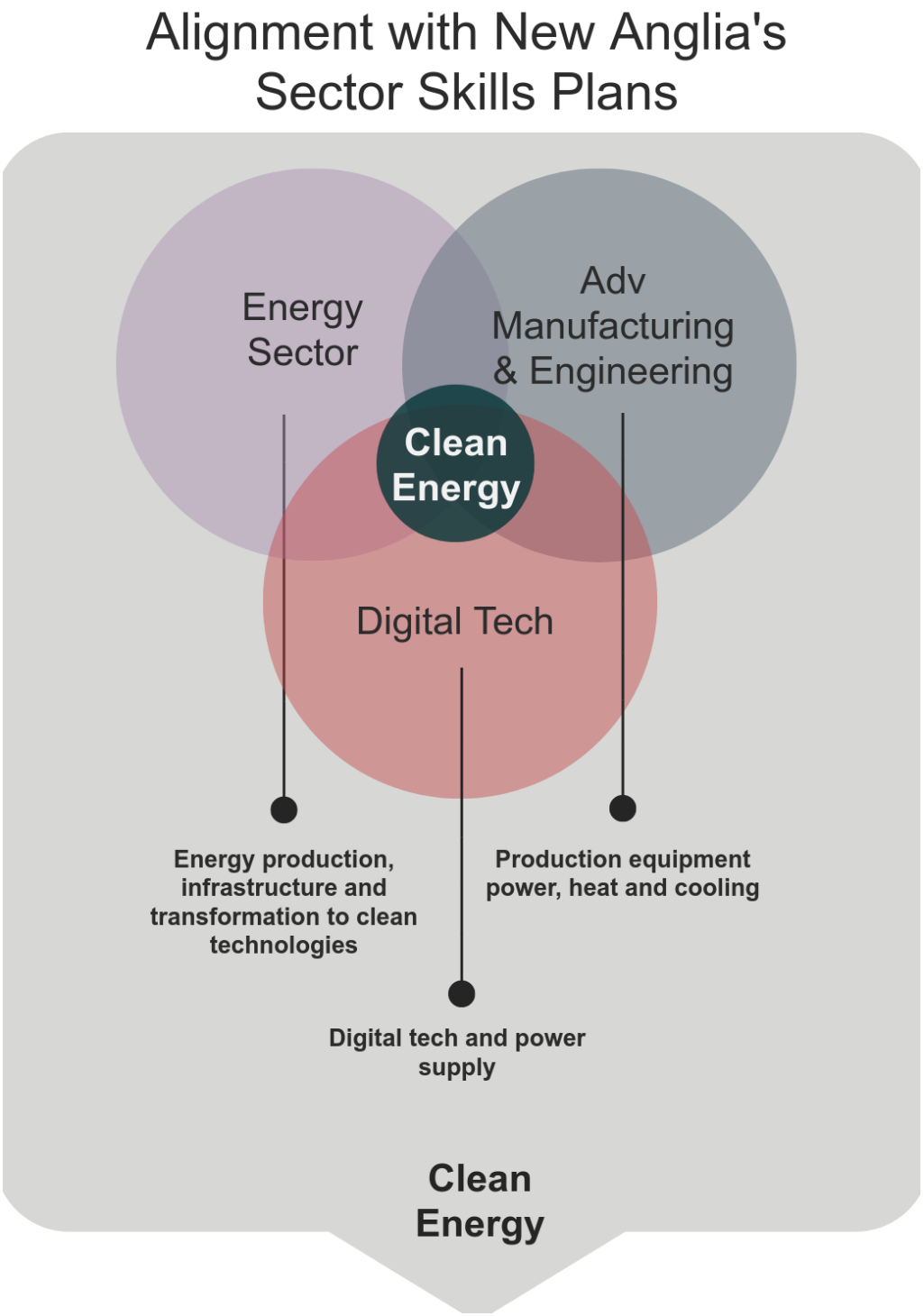
- Energy
- Emerging technology - smart grids, IoT, demand side response etc.
- Digital tech - totally dependent on power supply, plus ability to provide IoT frameworks etc.
- Construction - energy efficient construction methods, building energy performance
- Agri-food Tech - biomass, biofuel, AD, wind, solar
- Ports and logistics - motive power for transport
- Advanced manufacturing and engineering - production equipment power, heat and cooling
- Life Sciences & the bio-economy - biomass conversion technology, living energy systems (algae)
- Finance - investment needed for clean energy
- Culture – transport

The existing Sector Skills Plans on Energy and the Advanced Manufacturing and Engineering have a particularly close alignment with clean energy.

The Oil and Gas industry is strong in New Anglia and has already been covered in detail in the Energy Sector Skills Plan.

Furthermore, in parallel with the plan for Clean Energy, a plan for the skills required in Emerging Technology based on Industry 4.0 is being developed. This has a strong alignment with the move to smart energy systems which allow grid balancing, improved energy efficiency and which help to manage the inherent variability in some renewable energy technologies.

Figure 9 Alignment Between Clean Energy and Sector Skills Plans



Priority Skills Actions to be Taken

1 Sector Skills Plan Alignment

Clean Energy is dependent on workforce development and skills demands which have, to a large extent, already been evidenced in New Anglia's Skills Plans; specifically, for Advanced Manufacturing and Engineering, Energy and Digital Tech. It is important to reduce duplication and recognise the crosscutting nature of skills requirement inherent in clean energy. Existing skills demands for Clean Energy include:

- Engineering- both mechanical and electrical;
- Technicians- at L3/4+ in relation to installation, operations and maintenance roles;
- Craft technicians- linked to fabrication/manufacture and installation roles;
- Commercial and management;
- Industry 4.0 expertise.

There is growing potential, under the auspices of the Offshore Wind Sector Deal, to define New Anglia as an area of technical excellence for Operations & Maintenance (O&M). Skills within the context of People and Place, plays an important role in supporting an O&M strategy. As highlighted, the combination of skills recommendations across Energy, Advanced Manufacturing and Engineering and Emerging Technologies underpin the training demands for O&M roles overall. By ensuring that cross-sector alignment is managed the inherent O&M demands for Clean Energy can be supported.

In support of the Local Industrial Strategy these crosscutting areas require a high degree of integration. Furthermore, they are skills demands that run deeply through New Anglia's supply chains for related sectors such as agri-food, construction and transport/logistics

They represent a significant operating expenditure to ensure suppliers remain competitive in the market place and can in turn invest in effective skills development for New Anglia's workforce. It also important to plan for future demand and build resilience in supply chains through supporting the capital expenditure a business and industry cluster can make in training and development.

RATIONALE – The current and forecast skills needs for Clean Energy correlate greatly with the skills demands defined across several of New Anglia's priority sectors – specifically the Energy Sector, Advanced Manufacturing and Engineering and Digital

Tech. New Anglia's Skills Board is already overseeing a range of action emanating from sector skills plans, which represents an underpinning series of actions for Clean Energy.

AIM – To ensure that the existing skills priorities developing through partnership action cross-refer to Clean Energy, avoiding duplication and re-enforcing the aggregate demand for key skills – particularly technical, STEM related roles.

OUTCOME – The outcome of which is a joined up and highly responsive skills offer; ensuring Clean Energy industries can benefit from an appropriately skilled, flexible and buoyant local labour market.

THE APPENDIX INCLUDES A DETAILED ASSESSMENT OF THE KEY ALIGNMENT ACTIVITY, LINKING THE RECOMMENDED ACTIONS FOR CLEAN ENERGY WITH EXISTING SKILLS PRIORITIES.

RECOMMENDED ACTIONS

a. Establish a Cross-sector Clean Energy Skills Leadership Group (acting as a sub-group to the New Anglia All Energy Council), which can meet bi-annually to assess the progress made in addressing Clean Energy skills though existing Sector Skills Plans – with a particular emphasis on the progress made within the Energy Skills Plan (the scope of which however **did not** wholly cover onshore renewable and Clean Energy industry not related to nuclear or offshore wind). The aim of the group would be to provide a supportive "scrutiny and oversight role"; reviewing progress and identifying solutions at a strategic level linked to future investment in skills supply, at an operational and capital level. The group should consist of senior private sector representation and involvement from Sector Deal representation at a New Anglia level. The group should have the capability of lobbying/engaging with government directly on skills policy, focusing on outcomes linked to maximising local investment in Clean Energy skills for New Anglia.

MEASURING SUCCESS

- Strategically the priorities defined for Clean Energy are delivered via cross-sector working, with controls in place to manage change.

2 Skills Passports

Clean Energy is dependent on workforce development and skills demands which have, to a large extent, already been evidenced in New Anglia's Skills Plans; specifically, for Advanced Manufacturing and Engineering, Energy and Digital Tech. It is important to reduce duplication and recognise the crosscutting nature of skills requirement inherent in clean energy. Existing skills demands for Clean Energy include:

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3 Strengthen Operations + Maintenance

As the largest development zone in the world, New Anglia is well placed to develop operational and maintenance (O + M) capacity that can not only support local installations, but also compete to provide support nationally and globally. For example, control rooms in New Anglia already monitor wind farms in Scotland. In an arena where Engineers and Technicians are already in very short supply already, there is a need to strengthen the pipeline of skilled staff as a key part of any developing the local 'O + M service offer'.

RATIONALE – Local stakeholders recognise the huge potential in this field to export services and skills nationally and globally, and are keen to explore what the underpinning skill supply and development implications are, and develop a proactive skills response.

AIM - To support the area to build its reputation for CAPEX and OPEX investment services backed up by developing the locally-led based skillsets to support long-term operations and maintenance that can support energy installations locally, nationally and globally

OUTCOME -New Anglia builds a national reputation for excellence in O + M business services and the professional skills that underpin it

RECOMMENDED ACTIONS

a. Identify the current key job and skills elements of world-class O+M and audit the scale and scope of current local skills pathways (FE / HE / Apprenticeships) for those key job roles – including earlier pre-degree access-points
b. Agree a strategy to either establish new pathways, underpinned by the forecasted sector job growth or grow the scale of existing talent pipelines (e.g. Graduate entry / Apprentices) – particularly where known skill shortages exist
c. Identify whether there are opportunities locally to develop provision for O + M specialists in the newer emerging areas such as AD, Solar etc.

MEASURING SUCCESS

- An increase in the numbers entering O+M pathways In New Anglia and the numbers qualifying and ready to take up local vacancies in Clean Energy

4 Inspire Clean Energy Careers

The promotion of STEM careers and a more diverse labour market have been prioritised in several of the existing Skills Plans for New Anglia. The Learning and Skills Sector Skills Plan (2019 in Draft) highlights:

> "The production of the national White Paper on the Industrial Strategy coincided with an extensive re-focus on the efficacy of careers and enterprise delivery in education nationally. Since the implementation of the new National Careers Strategy in 2017[8] and the establishment of the national Careers and Enterprise Company (CEC), schools are encouraged to take a more proactive and strategic approach towards careers and enterprise delivery in order to equip the next generation of school

[8] Careers Strategy- Making the Most of Everyone's Skills and Talents (2017), DfE

leavers with the appropriate employability and enterprise development that employers will value. The national policy uses the Gatsby Foundation's key recommendations for developing careers and enterprise activity within schools, which includes promoting more opportunity for employer encounters for students, a greater understanding of the local labour market to inform careers choice and responding to the needs of each student."

Consultation with the learning and skills sector indicates a degree of concern regarding the production and dissemination of accurate labour market information and the planning for enterprise and careers guidance activities that can effectively support the adoption of the National Careers Strategy. The recent DfE Area Review[9] corroborated this issue, with a commitment from Norfolk and Suffolk County Councils and the New Anglia LEP to work collaboratively to develop good quality information on local employment, skills needs and key developments that may provide opportunities for learners to progress.

RATIONALE – The New Anglia Energy Skills Plan recommended the development of a STEM enterprise programme across New Anglia. This advocated the production of a STEM engagement plan, working jointly with the existing STEM ambassador programme and the Advanced Manufacturing Skills Plan to develop cross links with engineering sector bodies and existing STEM enterprise initiatives. The Clean Energy plan should seek to support the STEM activity captured in these reports, which in summary aim to improve the flow of intelligence on STEM careers across education and reorganise how STEM careers are promoted locally. As Clean Energy contains niche and emerging jobs it would be advisable to consider how specifically Clean Energy STEM careers can be featured in this planned activity.

AIM – To support the existing priorities for promoting STEM careers guidance and enterprise initiatives across education in New Anglia, ensuring specific Clean Energy careers are effectively promoted within careers delivery plans.

OUTCOME – Young people across New Anglia engaged with education are inspired and well prepared to pursue STEM careers; they can make informed choices regarding ongoing education routeways which can lead to Clean Energy jobs.

RECOMMENDED ACTIONS

a. Develop a STEM "careers prospectus" for Clean Energy to highlight a range of key career pathways in the industries that represent the most significant growth potential for New Anglia over the next decade (e.g. Offshore wind, Bio Energy);

[9] Norfolk and Suffolk Area Review (DfE 2017)

b. Work with the New Anglia Careers Hub and Enterprise Adviser Network to effectively promote Clean Energy in schools;

c. Build an 'Energy Jobs' identity locally – in partnership with local businesses

d. Consult with industry and education on how underrepresented groups can be positively encouraged into education and careers in the Clean Energy sector. This should involve close cooperation with the learning and skills community to promote equal opportunity and increased diversity in the Clean Energy workforce.

MEASURING SUCCESS

- The delivery of the Gatsby Recommendations that are STEM related
- The development of a Clean Energy Careers Prospectus
- Volume of Post 16 education destinations that are STEM related
- Volume of STEM graduates

5 Increasing Local employment and workforce diversity

There are no national or local labour market programmes that provide a formal 'intermediate labour market' route (the combination of pre-employment training and support involving subsidised wages/industry placement, targeted at unemployed, economically active, people) specifically for the Clean Energy sector.

A range of national and local initiatives offer the opportunity for unemployed people to benefit from **generic** employability interventions, including limited work focused training and the opportunity to experience work over a short-term voluntary period. For example, the Opportunity Areas and Talent Match programmes have provided targeted support for unemployed people across New Anglia focused in areas of relatively high deprivation. These programmes, however, have not had a specific sector-based focus for Clean Energy.

RATIONALE - Given the proximity and scale of the Energy sector overall across New Anglia, partners have indicated the importance of successfully maximising local job opportunities for local people and planning interventions that target opportunities, linked to training and employment, for areas which experience high levels of economic and social deprivation.

Much of the skills requirements for Clean Energy is highly technical and STEM oriented. However, several of the key industries defined as Clean Energy highlight that

the major barrier to employment is the financial cost of training for mainly non-accredited, short term courses; rather than the level of prior qualification. A plan for maximising the local employment opportunities for Clean Energy, specifically targeted at unemployed New Anglia residents would therefore be recommended.

AIM – To develop action that can increase the diversity of the Clean Energy workforce and provide greater employment opportunities for New Anglia residents.

OUTCOME – Clean Energy jobs are accessible to local people, with employers benefitting from a diverse local labour market supply.

RECOMMENDED ACTIONS

a. Undertake a consultation (establishing a representative sample) with Clean Energy employers to identify job roles which could be available for those with 'entry level' skills, to help increase recruitment into the sector.

b. Using the data from (a), work with DWP to develop a sector-based unemployment support package for the Clean Energy sector. This could build on sector-based work academy models already in operation, with further development of how Clean Energy pre-employment action can be developed.

c. Consult with the Community and Voluntary Sector and Local Authorities regarding local programmes and outreach activity that can maximise the reach of a Clean Energy Local Jobs strategy and build on existing practice aimed at combining employment support alongside social inclusion. The formation of action should consider multiple barriers into training and work, such as travel and rurality and work with Local Authorities and other relevant stakeholders to build an inclusive approach.

d. Consult directly with government and key industry connected with the Sector Deals and planned investment programmes, to identify how resources can be ring fenced to support a new Intermediate Labour Market programme for Clean Energy (involving the opportunity to train and earn whilst actively registered with DWP). There is no active intermediate labour market in place for the Energy Industry – the design of a scheme for New Anglia would need to leverage support and resources from government – following guidelines of benefit rules and wage subsidy and investment from the private sector through appropriate funding.

e. Assess how the priorities for building workforce flexibility/skills passporting and labour transfer between the industries in the Energy Skills Plan, can also support the growth and supply of entry level employment/skills for Clean Energy.

MEASURING SUCCESS

- Number of females working within Clean Energy industry
- Number of BAME working within Clean Energy industry

- Delivery of pre-employment routeways aligned to Clean Energy employment
- Subsidised employment placements (Intermediate Labour Market)
- Number of local people within Clean Energy jobs

6 Technical Standards and Skills Reform

Key industries within Clean Energy, as defined within this report, have highly technical and regulatory training needs linked to the development and operation of activities – for example within Anaerobic Digestion and Biomass operations. Training is often non accredited. This means it is not supported by existing standards for vocational training such as apprenticeship standards.

This impacts on the quality of provision, its availability and the cost of training itself and restricts skills acquisition for the workforce. Within the Offshore Wind Sector Deal, the auditing of technical competency and definition of new standards in support of skills reform has been positioned as a national priority. Both the Offshore Wind and Nuclear Sector Deals recognise that employer involvement and co-design of skills is of increasing importance in ensuring skills demands are met by a quality and accessible skills offer.

As the skills system itself becomes increasingly localised via devolved programmes (IoTs, National Colleges etc), local employer led skills partnerships become fundamentally important for identifying the gaps in technical standards and measuring the scale of demand in line with growth. Simultaneously, a devolved skills agenda is still reliant on centralised skills policy and funding systems. This remains a high-level, strategic challenge that runs across the national skills system.

Clean Energy is crosscutting by nature and contains highly technical, emerging and often niche skills needs: it is imperative that employers are effectively consulted and play a lead role at the local in developing the case for skills investment. Weaknesses in the skills system exacerbate the risk of a mismatch in skills supply affecting growth. These are national challenges, which require local advocacy and lobbying and can in turn lead to policy/political leverage and potential future investment in line with emerging skills reform policy, for New Anglia. **Essentially, developing skills for Clean Energy requires a strategic and comprehensive response.**

RATIONALE - Key industries within Clean Energy, as defined within this report, have highly technical and regulatory training needs linked to the development and operation of activities. The reform of skills – both vocational and academic – places a greater

emphasis on local employer led partnerships developing plans to support the investment in skills. There are however structural barriers within the 'skills system'. Training is often non accredited, this means it is not supported by existing standards for vocational training such as apprenticeship standards. This impacts on the quality, cost and availability of training – ultimately impinging the acquisition of skills and growth. Furthermore, there is a paucity of available labour market intelligence defined and made accessible to the learning and skills sector for Clean Energy jobs, this reduces confidence in the provision of training. Finally, the investment of capital investment costs to support the provision of training itself a key priority, involving cooperative resource planning between employers and providers.

AIM – To develop a local employer led skills strategy for Clean Energy, ensuring skills supply matches demand, that training is available locally and that training providers are supported to invest in the delivery of high-quality skills provision.

OUTCOME – The outcome of which is a skilled and capable Clean Energy workforce, technically competent and working in high performing, productive roles.

RECOMMENDED ACTIONS

Ongoing consultation with industry, including national Sector Deal stakeholders with significant interests in the New Anglia Clean Energy market, would help to develop the 'asks' of government nationally, in line **with** the consultative approach adopted to develop the Local Industrial Strategy. The key actions to address cover:

a. Create a 'Testbed' Model for developing and seeking accredited definition of new technical standards for Clean Energy industry. Using the economic evidence, determine the initial industry to define, recognising the role that new technical skills standards will play in driving competitiveness and growth. The stages to develop include:

    a) Establish an employer-led task and finish 'trailblazer' group to map and identify technical standards for key occupational areas. As the Offshore Wind Sector Deal has prioritised new standards within its forward plan, local stakeholders from the Offshore Wind industry should be consulted to seek advice on the progress they are making nationally, helping to inform Clean Energy standard definition for this plan.

    b) Define an occupational map to set standards for, following an agreed process like with the initial routes mapped for T Levels. **Cross-refer to the recommendations developed within New Anglia's Learning and Skills Sector Skills Plan, ensuring the learning and skills community can play a lead role.**

    c) Government should be lobbied, via an employer led partnership (for example the New Anglia LEP direct or the nascent All Energy Council) to support a

formal agreement of standards for technical skills. Furthermore, national trade association representatives should be consulted to gain maximum industry support, (for example for Biomass the Woodheat Association and for Anaerobic Digestion - the Anaerobic Digestion & Bioresources Association (ADBA)).

d) Guidance should be sought from the Institute for Apprenticeships (Department for Education) on the procedure for formal accreditation, in line with apprenticeship reform and the appropriate involvement of industry to agree on end point appraisal.

e) This initial task and finish group can act as the **Testbed model** for further technical standard development covering priority Clean Energy skills.

b. Consult with the offshore wind sector to firstly understand and then refine - at a New Anglia level, the methodology being developed nationally for capturing workforce development intelligence for key occupational areas and explore the potential for developing local intelligence systems to support the Clean Energy sector's key industries. This will provide proprietary data at a Norfolk and Suffolk level enabling the flow of workforce data to inform ongoing skills planning and support a range of planning and development priorities across the related sector skills plans. It could also serve to support the technical skills legacy planning work being developed via the Suffolk Growth Programme Board.

c. Develop a resource investment plan, steered via employer representation from Clean Energy and in consultation with the education sector, which aims to measure the level of resource required to respond to clean energy growth. An appraisal should consider costs in response to technical demands and include workforce development, investment in capital and training resources. Any appraisal must also cross-refer to the range of technical skills demands captured in the skills plans already approved by the Skills Board; thus, giving an aggregate perspective. The development of a resource plan can be used to inform national advocacy to leverage investment through government programmes supported by industry investment.

MEASURING SUCCESS

- An increase in the number of technical standards available for Clean Energy occupational roles.
- An increase in the delivery of vocational training qualifications for occupational roles aligned to Clean Energy industries.
- Quantifiable investment in training (capital and revenue) from government and private sources, which can directly support the delivery of Clean Energy skills priorities.
- The development of Clean Energy industry specific labour market intelligence

7 Emerging Technology / Multi-disciplinary Skills

The themes of automation and developing a resilient skills supply that responds to emerging technological demands are critical to Clean Energy's growth in New Anglia. The Electric Vehicle, CCUS and alternative fuel/energy storage industries highlight that a core engineering requirement at graduate level demand remains strong but must also come with multi-disciplinary capability. This covers the skills for areas including AI and advanced data management, testing and feasibility assessment of new energy investment programmes in highly sensitive environments and the challenge of innovation in the transportation, supply and storage of energy.

The Emerging Tech Sector Skills plan (2018) summarises the importance of responding to technology adoption:

> "It is this ability to adapt rapidly which is at the heart of the skills challenge which Industry 4.0 (and the Emerging Technology which is driving it) is creating across the economy.
>
> Evidence shows that there is a generic shortfall of workforce supply across the economy as the population ages, people spend more time in education and migration falls. The dependency ratio is also rising (i.e. the number of people who are dependent on each worker) and this means that society needs to focus on increasing productivity.
>
> Whilst the adoption of technology can increase productivity it will also lead to many job roles being completely or partially automated and this process needs to be managed. Evidence also suggests that new job roles will need to be undertaken to support the adoption of emerging technology.
>
> These new job roles could be to design, build, install and manage the new systems which are created, but are equally likely to be created by allowing end user sectors of the economy to develop new or enhanced services."[10]

The documented shortfall in STEM graduates into the energy sector (and so by definition Clean Energy too), is addressed by the Institute of Engineering and Technology (IET)[11], which advocates a new approach to engineering in higher education. Using case studies from HEIs across the UK, the IET calls for a 'shake-up' in the skills system to increase the flow of new STEM graduates, the quality of engineering higher education and the overall diversity of the future workforce. The IET establishes three key challenges that

[10] New Anglia (2019), Emerging Tech Sector Skills Plan (in press)
[11] "New Approaches to Engineering Higher Education", (2017), IET

require a response from FE, HEIs, employers and policymakers. These challenges focus on:

- Greater employer input in the development of education to ensure skills are responsive to industry needs;
- The promotion of more workplace experience to enable students to engage with 'real-life' industry experiences and build work capability alongside academic achievement;
- A greater focus on inter-disciplinary skills, via engineering frameworks developed on project-based activities with a greater emphasis on problem solving and adoption of modular approach toward the engineering disciplines studied.

RATIONALE – For Clean Energy technologies employers require flexible, multi-disciplinary skills. Traditional STEM based courses need to be responsive to automation and the convergence of electrical, mechanical and digital technologies. This requires more involvement of employers in supporting the planning and delivery of further/ higher education to ensure the skills output is fit for purpose and greater flexibility in the structure of courses to respond to changing demands.

AIM – To assess the multi-disciplinary skills required of Clean Energy employment and work in partnership with New Anglia's HEIs, FE and Clean Tech industry to plan for ongoing and emerging multi-disciplinary demands.

OUTCOME – The outcome of which is a highly innovative, cutting-edge Clean Energy New Anglia post-16 offer, creating a supply of STEM graduates adaptive to the multi-disciplinary demands of Clean Energy employment.

RECOMMENDED ACTIONS

a. Consult with FE and Higher Education Institutes in New Anglia that deliver qualifications in Engineering related disciplines and assess the impact the Clean Energy's key industries (as defined in this report) have on the structure and content of course content and delivery methodology. The assessment should consider:
    i. The multi-disciplinary skills requirement in each of the key industries within Clean Energy;
    ii. A methodology for assessing current content/delivery against (ii) above, which includes an assessment of the responsiveness of the content against industry needs.

b. The New Anglia LEP in partnership with New Anglia's HEIs should consider how to develop an innovation network to connect with national and international best practice in Engineering Multi-disciplinary standards in relation to Clean Energy. This

can build on the current progress being developed by the New Anglia LEP under the Innovation Board and Forum for key sectors. Furthermore, it could connect in with existing case studies highlighted by key organisations such as the IET and relevant Innovation Catapults/Partnerships for Clean Energy related industry active both in the UK and internationally.

MEASURING SUCCESS

- The definition of multi-disciplinary STEM courses at all levels
- The supply of STEM graduates and post-graduates into New Anglia Clean Energy employment
- Development of a Clean Energy Innovation Network and subsequent delivery of events that promote skills within a HE context

2. Defining the Clean Energy Theme and Growth Opportunity

Low Carbon and Renewable Energy (LCRE)

The LCRE sector is a significant and growing sector both in New Anglia and the UK economy. New Anglia is adopting Clean Energy as one of three themes on which it will focus its Local Industrial Strategy.

Clean Energy focuses on progressively shifting the mix of energy sources used so that a larger share comes from renewable and low carbon sources. It includes energy for:

- Heating and cooling;
- Power for machinery and processes (industrial, domestic, utilities, pumping etc.);
- Transport, including rail; air; boats; cars and motorbikes; trucks and vans; buses; tractors, land management and construction machinery.

The transition to cleaner energy also requires a focus on energy efficiency, including:

- Heat - energy efficient design, demand side response[12];
- Power - energy efficient design, demand side response;
- Reducing need for energy through system redesign e.g. reducing the need to pump water due to embracing new flood protection systems; urban farming systems etc.

This twin track approach backed up by a new report from Carbon Brief[13] (see Annex 3), which shows good progress in decarbonising the UK energy supply, both through changing the energy mix and by improving the efficiency with which energy is used.

This report argues that energy efficiency has made more impact than renewables to date (just over 50% of the gains since 2005), whilst government policy and funding has focused on renewables. It also reports that in 2018, just over half (53%) of UK energy supply can be classified as being LCRE, the highest ever recorded.

The third area of energy planning which needs to be embraced is the change needed in energy infrastructure to enable the efficient distribution of LCRE energy as new capacity is added, often in areas which have not traditionally generated energy, and to ensure that energy is available in the right places to support housing and commercial growth.

This pressure on the electricity infrastructure will increase in future given the move to low carbon transport. Whilst electricity use has seen a modest decrease in the UK, due to efficiency, it is expected to increase again once Electric Vehicle (EV) roll out accelerates.

[12] Demand side response facilitates the optimisation of energy use when it is available, thus helping to smooth peaks in demand or supply. This allows more use to be made of intermittent renewables.
[13] Carbon Brief (2019), Analysis: UK electricity generation in 2018 falls to lowest level since 1994

This will place increased demand on power generation and on the electricity grid which in many places lacks the capacity to meet growth in demand, particularly in rural areas[14].

National Support for the LCRE Sector

Renewable generation has been growing strongly and BEIS has committed to continued growth in this sector (Annex 2). This includes clean energy being a government commitment through a 'Clean Growth Grand Challenge', making it a priority across government. Specifically, the Industrial Strategy, states that[15]:

'We will maximise the advantages for UK industry from the global shift to clean growth – through leading the world in the development, manufacture and use of low carbon technologies, systems and services that cost less than high carbon alternatives. The move to cleaner economic growth – through low carbon technologies and the efficient use of resources – is one of the greatest industrial opportunities of our time. By one estimate, the UK's clean economy could grow at four times the rate of GDP[16]. Whole new industries will be created, and existing industries transformed as we move towards a low carbon, more resource-efficient economy. The UK has been at the forefront of encouraging the world to move towards clean growth. We are determined to play a leading role in providing the technologies, innovations, goods and services of this future.'

The strategy further outlies a desire to embrace both energy efficiency and new low carbon forms of generation. This broader definition is in line with ONS who define the low carbon economy as 'economic activities that deliver goods and services that generate significantly lower emissions of greenhouse gases; predominantly carbon dioxide'. The low carbon sectors recorded by ONS are:

- offshore wind;
- onshore wind;
- solar photovoltaic;
- hydropower;
- other renewable energy;
- bioenergy;
- alternative fuels;
- renewable heat;
- renewable combined heat and power;
- energy efficient lighting;
- energy efficient products;
- energy monitoring;
- saving or control systems;
- low carbon financial and advisory services;
- low emission vehicles and infrastructure;

[14] A 'Tesla' fast charger is broadly equivalent to the normal demand of 15 houses
[15] BEIS (2018), Policy Paper: The Grand Challenges
[16] UK Government (2018), Clean Growth Strategy

- carbon capture and storage;
- nuclear power;
- fuel cells;
- energy storage systems.

These low carbon sectors are then subsequently grouped into six low carbon groups:

- low carbon electricity;
- low carbon heat;
- energy from waste and biomass;
- energy efficient products;
- low carbon services;
- low emission vehicles.

UK Clean Growth Strategy

The national Clean Growth Strategy (2018)[17] highlights substantial growth in the UK's low carbon economy, reporting that since 1990 UK GDP has grown by 67%, the fastest rate in the G7, whilst carbon emissions have fallen by 42%, much faster than the 3% reduction seen in the G7 countries. This decoupling of carbon emissions from growth is seen as critical in securing public support for a transition to a low carbon economy.

The strategy also reports that whilst we have outperformed the 1st and 2nd and expect to outperform on the 3rd five-year carbon budget (the period to 2022), beyond this the challenge increases again as most of the easier gains have been made.

From 2010-'16 the share of low carbon electricity doubled to 47%. At the same time household energy demand has fallen by 17% since 1990, due to improved energy efficiency. Since 2000 cars have become 16% more energy efficient. The costs of low carbon and renewable technologies is also falling with energy efficient bulbs 80% cheaper than in 2010 and car battery pack costs falling by 70% in the same period.

This growth has translated into jobs, with ONS[18] in 2016 reporting that low carbon businesses and the associated supply chain employed 430,000 people in 2015.

The Paris agreement signed by 195 countries in 2015 agreed targets which aimed to keep global temperature rises to under 2 degrees. The International Energy Agency has suggested that to meet this $13.5 trillion of investment is needed globally between 2015-'30 by the public and private sector, with the UK government keen for the UK to benefit from the export opportunities from its leadership on low carbon energy technology.

The UK government (2018) expects the low carbon economy to grow by 11% per year over the period 2015-'30 (four times faster the whole economy) with the potential for between £60-170billion of exports of low carbon goods and services by 2030.

[17] UK Government (2018), Clean Growth Strategy
[18] ONS (2016), UK Environmental Accounts: Low Carbon and Renewable Energy Economy Survey

The Clean Growth Strategy (2018), sets out action in seven areas:

- Develop Green Finance to provide the investment needed in the UK and global LCRE sector;
- Improve business and industry energy efficiency (25% of UK emissions), by improving industry energy productivity and efficiency; international leadership of carbon capture and storage; stopping the use of high carbon heat by the 2020s; supporting heat recycling schemes;
- Improve domestic energy efficiency (13% of UK emissions), by: upgrading millions of homes to EPC Band C; smart meters; heat networks; stopping the use of high carbon forms of heat by the 2020s; delivering the RHI;
- Accelerate the shift to low carbon transport (24% of UK emissions) by: stopping the sale of petrol and diesel vehicles by 2040; focusing on EVs; increase cycling and walking for short journeys; moving freight to rail and last mile autonomous vehicles;
- Deliver clean, smart, flexible power (21% of UK emissions) by: improving the functioning of the grid; delivering Hinckley Point C and other nuclear stations; supporting continued growth in offshore wind;
- Enhancing the value of natural resources (15% of UK emissions) by: refocusing agricultural and land use policy; creating forests; reducing waste;
- Leading in the public sector (2% of UK emissions) by: reducing energy use.

Every theme also includes a commitment to support more investment in innovation, which is clearly closely aligned with the need to embrace skills and knowledge as key drivers of a low carbon transition. The government is investing £2.5billion in low carbon innovation between 2015-'21 focused as follows: 33% on low carbon transport; 25% on the power industry; 15% on cross sector work; 10% on smart energy systems; 7% on improving homes; 6% on improving business and industry energy efficiency; 4% linked to land use and waste management.

International Potential

A January 2019 report[19] from McKinsey, which reviewed the global energy market, reached five headline conclusions

- Global energy demand plateaus after 2035 despite strong growth due to efficiency;
- Electricity consumption doubles by 2050, with 50% from renewables by 2035;
- Gas continues to grow its share of consumption until 2035 and then declines;
- Oil demand peaks sometime between 2025-'30 and then declines;
- Carbon emissions decline, but the path to a 2°C temperature rise remains elusive.

[19] McKinsey (2019), Global Energy Perspective 2019: reference case

This analysis suggests strong long-term growth in global demand for technology which supports the clean energy transition, with substantial export potential for Norfolk and Suffolk's expertise in this area.

3. The New Anglia Local Industrial Strategy and Clean Energy

The Local Industrial Strategy

Local Industrial Strategies are intended to focus on distinctive areas where a LEP can demonstrate, with clear evidence, that it has a competitive advantage, can play a significant national role in delivering productivity growth and help deliver the Grand Challenges identified by Government in the UK Industrial Strategy[20] (AI and data, clean growth, ageing, future of mobility).

Government's aim is that the LIS should show how growth and productivity will be delivered over the medium to long term. Whilst not directly a bidding document the LIS will help to make the case for investment once the current round of local growth funding and EU funding ends.

The government is working with LEPs to ensure that each area has an agreed LIS by March 2020. The LIS will be developed locally and negotiated with government before final approval.

Clean Energy is one of three key areas of the New Anglia economy identified in the emerging Local Industrial Strategy (LIS), alongside Agri Food and ICT.

'Clean Energy' is broader than the Low Carbon and Renewable Energy (LCRE) sector, is diverse and increasingly complex, but has at its heart has the ambition to reduce the carbon intensity of the economy by holistically addressing generation, distribution and consumption of clean energy.

This will be delivered through three linked areas of action:

- Progressively **moving the energy generation mix towards low carbon sources of energy** including wind, solar, biomass and bioenergy, nuclear, wave and tidal;
- **Demand side management**, by: promoting energy efficiency so that total energy demand is managed; using SmartGrid technologies to deliver demand side response to manage energy load so that it can be aligned with generation, facilitating improved efficiency in the use of intermittent renewables such as wind or solar;
- **Developing the energy infrastructure** of the Norfolk and Suffolk so that it is able to meet the distribution and access needs of both generators and energy users. In the process there is a need to future proof energy infrastructure for anticipated changes in both where generation occurs (e.g. more distributed, local generation) and in demand (e.g. to enable EV or Electric Vehicle roll out).

[20] UK Government (2017), Industrial Strategy: The Grand Challenges

In developing the Clean Energy focus in New Anglia, the objective is to support both the:

- **Energy Industry** - to grow the productivity and economic contribution of the energy industry to position New Anglia as a leading global centre for Clean Energy technology and deployment;
- **Wider economy** - to enable economic growth by ensuring that across the LEP area a modern energy infrastructure and affordable, sustainable energy supplies, facilitate growth.

The Local Industrial Strategy is focused on a small number of priority areas in which it is believed the LEP area can deliver significant productivity gains.

The Clean Energy Plan needs to demonstrate areas in which New Anglia is distinctive and the challenges and opportunities in the energy sector, at the same time as setting clear ambitions and outlining how the plan can be delivered.

Where possible the Clean Energy Plan needs to directly support the delivery of the four national Grand Challenges (AI and data, clean growth, ageing, future of mobility). Three of the Grand Challenges are clearly very closely related to the Clean Energy focus:

- Artificial Intelligence and data - by using digital systems to support new business models and technologies to manage more efficient energy generation, distribution and consumption;
- Clean growth - by enabling economic growth without increasing carbon emissions;
- Future of mobility - by supporting the transition to low carbon transport systems.

The fourth area, ageing, is not directly linked to clean energy, but it could be argued that an ageing society will change the demand for energy and make it harder to secure the workforce needed in the industry. Its impact on the sector will thus be considered, particularly in relation to how the skills of the 'older' workforce could be used to help meet demands of the industry.

New Anglia has also been instrumental in leading regional work on the Local Energy East[21] strategy across the three LEP areas of: Cambridgeshire and Peterborough, Hertfordshire and New Anglia. This focuses on four areas: Facilitating clean economic growth; enabling development through ensuring energy grids support growth; providing access to secure, affordable, low carbon energy; facilitating the move to clean transport.

The New Anglia Clean Energy Plan will focus on enabling a transition to low carbon energy system by balancing investment in three areas (table 1):

- Energy generation
- Energy distribution systems
- Energy use efficiency

[21] Local Energy East Strategy: An Energy Strategy for the Tri-LEP Area, Winter 2018

Table 1 - New Anglia Clean Energy Supply Chain & Skills

Clean Energy objectives	Energy supply chain		New skills, innovation & investment needed in:
Expansion of New Anglia low carbon & renewable energy (LCRE) capacity Long term growth in % of energy supplied by LCRE	Energy generation	Supply chain systems, thinking & integration	Innovation and investment needed in: • Low carbon energy generation: wind; solar; bio-energy; wave; tidal; nuclear Key supporting skills areas include LCRE: • Generation technologies including small distributed & embedded systems • Project design, construction & management • Environmental impact & monitoring • Engineering & maintenance
Development of the New Anglia: Energy grid EV roll out infrastructure Energy storage systems	Energy infrastructure & distribution systems		Innovation and investment needed in: • New grid technologies • Expanded grid infrastructure to enable growth Key supporting skills areas include: • Engineering & technology for grid construction • Grid maintenance • Smart grid design for more distributed future energy generation model • Off grid & behind the meter systems • New financial & business models for the grid
Access to affordable, secure, low carbon energy to support sustainable economic growth	Energy Consumption		Innovation and investment needed in: • Demand side response (DSR) systems • Energy efficiency technology & systems Key supporting skills areas include: • New business models for energy contracts including digital e.g. distributed ledgers • Smart digital technologies managing real time demand & matching grid supply (DSR) • Energy efficiency technology & deployment for heat, power & transport systems • Energy storage including non-traditional sources (e.g. cold stores)

New Anglia LCRE History and Structures

New Anglia is already a significant area nationally and internationally for the LCRE sector. This strength is built on both the Norfolk and Suffolk's natural advantages: large agri-food sector; shallow long coastline; good light levels etc., and a proactive approach to development of this industry over many years.

It builds on a long history of investment in Nuclear (at Sizewell since 1961) and on the local expertise developed in offshore fossil fuel exploration and exploitation of the Southern North Sea which began in 1964. Norfolk and Suffolk therefore have a much longer history within the energy sector more generally.

The focus on renewable energy started in the early 2000s, when the East of England Development Agency (EEDA) commissioned the UK's first report on biofuels, followed by proposals for Renewables East which subsequently ran from 2003-'13 to spearhead the renewable energy sector in the East of England, from its base in Norwich.

Norfolk and Suffolk also hosted a Community Renewables Initiative (CRI East) which worked on community and third sector renewable projects and the Woodfuels East grant programme, a Forestry Commission led project to increase the utilisation of under managed woodland for fuel production (which ran until 2012).

The Orbis Energy centre (42 companies) was developed to support the sector and Norfolk and Suffolk has a long-standing trade body, the East of England Energy Group (EEEGr), which supports and promotes the wider energy sector. The recent creation of the New Anglia All Energy Industry Council, will provide a single voice for the sector.

This breadth of local policy support, programmes and a focus on commercial investment has helped position Norfolk and Suffolk nationally and led to continued strong growth, for example renewable electricity capacity grew by 100% from 2014-'17 to 3GW.

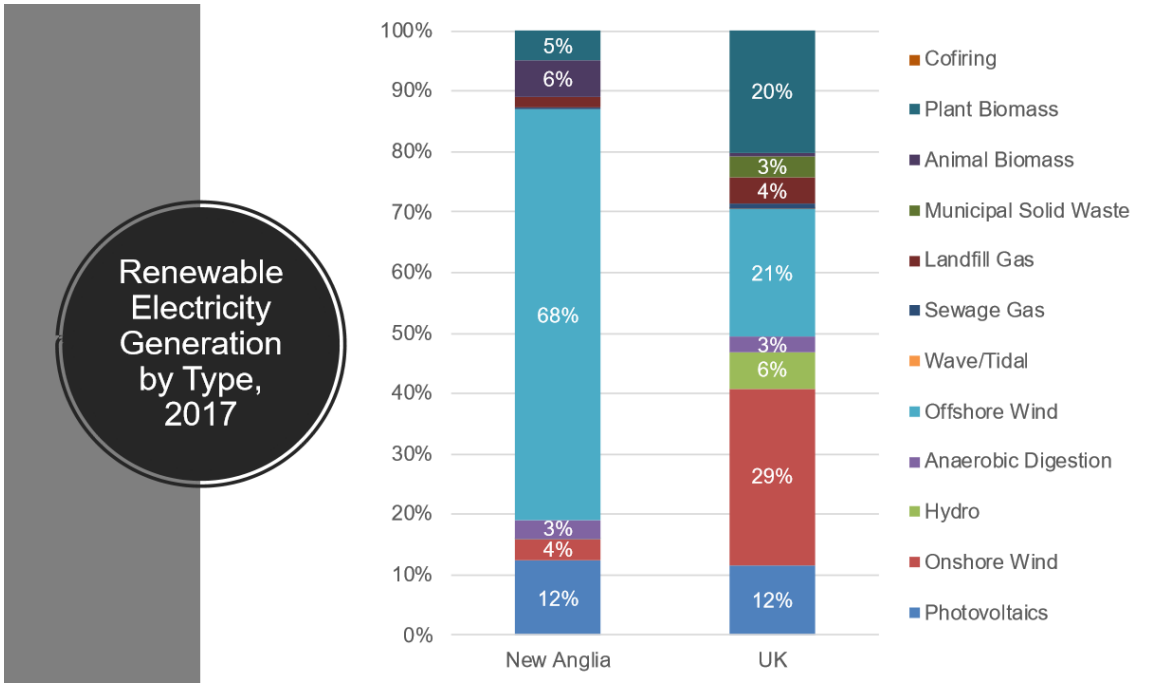
Renewable Electricity Generation

Comparing New Anglia to the national LCRE sector, it is clear that there are significant differences in the mix of energy generation types deployed. Whilst solar, at 12% of the renewable electric mix, is the same as nationally, for every other major type of renewable electricity generation New Anglia is significantly different (Figure 1):

- The share of offshore wind locally at 68% is significantly higher than the 21% share it has nationally;
- In every other area of renewable electricity, the % share locally is substantially lower than the national mix.

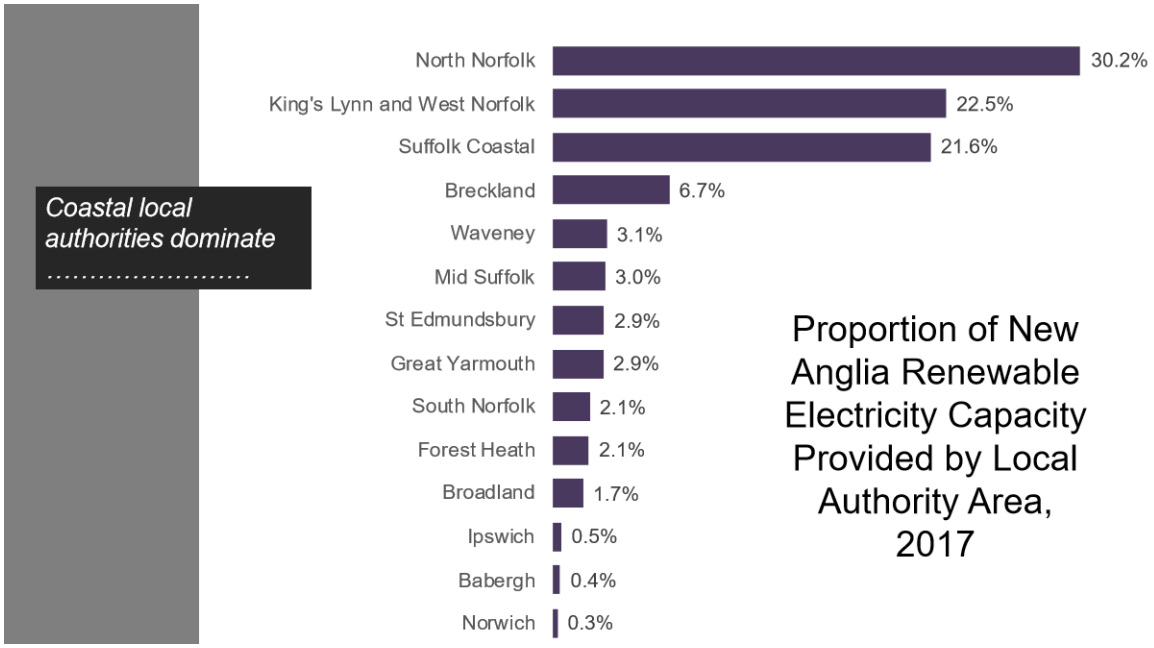
However, this reflects the nature of the coast, the established and very large-scale offshore energy industry and a dynamic local commitment to promote the growth of the offshore wind energy industry. The Southern North Sea, with New Anglia at its centre, is currently the largest offshore wind development zone in the World.

Figure 1 New Anglia and National Renewable Electricity Generation Mix



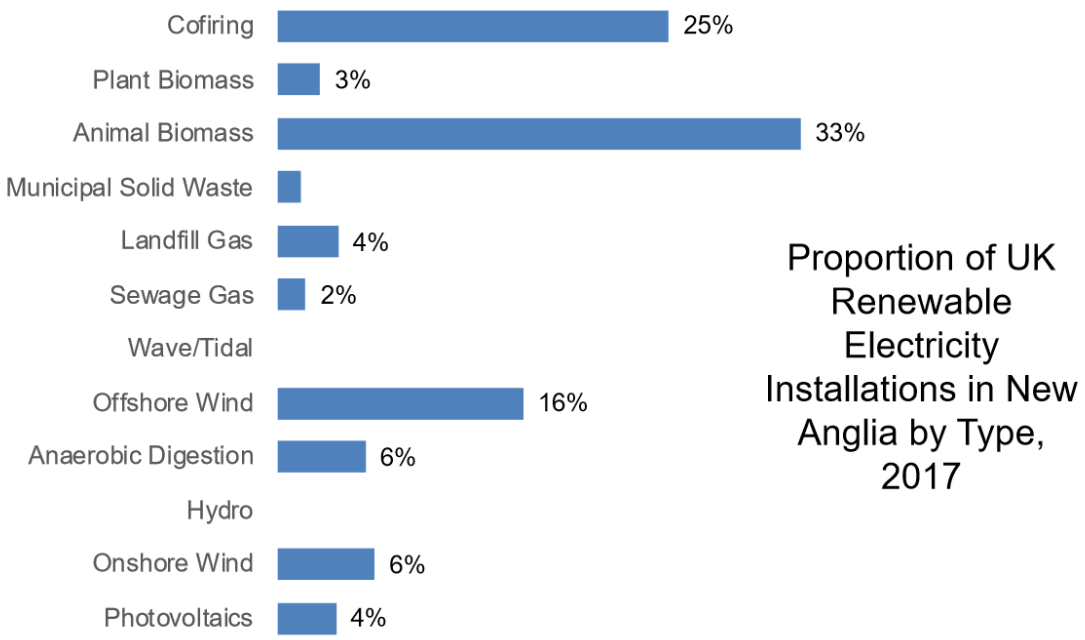
As a result of this focus on offshore wind, renewable electricity production is heavily concentrated in coastal districts, with three districts (North Norfolk, Kings Lynn and West Norfolk, Suffolk Coastal) accounting for just under 75% of total capacity (Figure 2).

Figure 2 New Anglia Renewable Electricity Generation by District



New Anglia has a higher share of UK renewable electricity installations than its share of the population or economy (2-3%) in all of the main generation technologies, with very large shares of animal biomass (33%), cofiring (25%) and offshore wind (16%).

Figure 3 New Anglia Share of UK Renewable Electricity Installations by Type



The offshore wind sector is projected to continue to see substantial growth in investment with the Southern North Sea having the largest concentration of this growth potential. This is recognised in the Offshore Wind Sector Deal[22], announced in March 2019, which sets out ambitions to:

- Grow offshore wind capacity in the UK from 8GW now to 30GW by 2030 at a cost of £40billion, of which the East of England would represent 14.5GW, or nearly 50%;
- Increase employment from 12-13,000 jobs now, adding a further 27,000 by 2030;
- Aspire for 33% of these staff to be female by 2030 with a stretch target of 40%;
- Develop new curriculum, with a focus on 'T' levels and apprenticeships;
- Ensure that at least 50% of lifetime capex and opex is from the UK (just under 50% currently), with a target to increase this to 60% by 2030, in turn creating a UK supply chain which can drive exports. The linked Whitmarsh Review (2018) looked at these issues to identify ways to increase exports from £0.5bn per annum to £2.6bn per annum by 2030.

[22] HMG (2019), Industrial Strategy, Offshore Wind Sector Deal

The Offshore Wind Sector Deal process includes a dedicated skills working group to work with the industry and the Offshore Renewable Energy (ORE) Catapult to drive innovation, knowledge exchange and skills.

Biomass and Bio-energy

In biomass there has been a rapid increase in this sector in Norfolk and Suffolk and, as noted below, outperformance on RHI installations. The low % of total generation capacity locally is, however, more a mathematical quirk given how large the offshore wind generation sector is in New Anglia. Norfolk and Suffolk are therefore still a major area for biomass and bio-energy (Figure 3).

In its report in December 2018 on Biomass energy[23], the Committee on Climate Change reported that share of UK energy demand met by biomass could increase to up to 15% of total demand by 2050, double the rate today. They estimate that the UK can produce 27million tonnes of sustainably produced biomass from 7% of current agricultural land.

Norfolk and Suffolk are the leading area nationally for animal biomass installations with a third of the national capacity, in two large plants. This builds directly on the large intensive livestock sector (pigs and poultry). Melton Renewable Energy Limited, is a national company with three bioenergy plants in Norfolk and Suffolk[24]:

- Thetford power station (poultry litter) with 38 staff
- Eye power plant (poultry litter) with 27 staff
- Just outside the LEP area is the Ely Straw fired power station with 40 staff, which takes straw from the area. It is the oldest straw fired plant in the UK and, when built in 2000, was the largest plant of its type in the World

Other major biomass energy sites locally include a straw fired plant at Snetterton[25]. The sector's growth has also led to the development of specialist straw sourcing companies to manage the supply chain, such as AF Biomass Ltd[26] and Anglian Biomass Ltd[27]

The strength in bioenergy in New Anglia is based on the scale of agriculture locally:

- New Anglia has 13.7% of England's crop output and 9% of the livestock output[28], in an industry worth nearly £2billion;
- New Anglia is the largest straw producing LEP area, with 313,000hectares of cereals and 60,000hectares of oilseed crops, with an estimated straw yield of 1.06million

[23] Committee on Climate Change (2018), Biomass in a Low Carbon Economy
[24] Melton Renewable Energy Limited, http://www.mreuk.com
[25] Snetterton Biomass, https://www.snettertonbiomass.com/
[26] AF Biomass Ltd http://www.af-biomass.co.uk/
[27] Anglian Biomass Ltd https://anglianbiomassltd.co.uk/
[28] DEFRA regional datasets and Agriculture in the UK data series

tonnes[29] per year. Not all this straw is baled, and some is used for livestock, but the scale of the industry can support a number of major energy plants.

Norfolk and Suffolk outperforms on the uptake of the Renewable Heat Incentive (RHI), 8.4% of England's domestic RHI deployment[30], substantially higher than Norfolk and Suffolk's share of the English population or economy. The take-up of woodfuel has been strong regionally and aligns with the high level of RHI installations for a range of reasons:

- Norfolk and Suffolk are one of the most rural in England with the majority of the population in rural and coastal communities (and in smaller towns) not having access to mains gas. Many households and businesses are thus dependent on oil or electric heating creating an incentive to look at cheaper and greener energy supplies;
- For this reason, the districts with the most domestic RHI installations are in rural areas such as Waveney and Kings Lynn and West Norfolk, both of which have over 500 domestic systems registered for RHI;
- Norfolk and Suffolk have actively supported the woodfuel supply chain for over a decade with Woodfuels East managing a delegated grant scheme to bring under-utilised woodland back into production until 2013. This has also been promoted by land based and farming organisations as a way for farmers to diversify their income stream or to meet their own energy needs.

More broadly the Committee on Climate Change (2018)[31], is promoting expansion of the biomass sector to support the low carbon economy. New Anglia is well placed to play a role in this with its strong agricultural and land-based sector, including forestry.

This report suggested that increasing woodland cover from the current 13% to19% by 2050 could increase carbon sequestration by an additional 21 MtCO2e per year from the atmosphere against current levels, equivalent to around 5% of current UK greenhouse gas emissions. They further suggested that 27 million oven-dried tonnes of sustainably-produced biomass from forestry and agricultural residues and energy crops could be produced in the UK by 2050, meeting up to 15% of UK energy demand.

Further detailed assessments of biomass, mainly wood is available from the Forestry Commission's biomass R&D collection[32] and the Energy Technologies Institute[33].

New Anglia has 34 AD plants (datapack), 6% of the UK total, with each having a capacity between 0.25 and 2.5MW and using between 2,000 to over 100,000 tonnes of biomass. These plants utilise both waste sources (normally food waste) as well as crops (most commonly maize) grown specifically for use in the AD plant. These schemes have been developed by utilities, food and drink and agricultural companies. These plants need a

[29] Calculated at an average of 3tonnes per hectare for cereals and 2tonnes per hectare for oilseeds
[30] Domestic RHI deployment data https://www.gov.uk/government/statistics/rhi-monthly-deployment-data-november-2018
[31] Committee on Climate Change (2018), Biomass in a low-carbon economy
[32] Forestry Commission, https://www.forestresearch.gov.uk/tools-and-resources/biomass-energy-resources/reference-biomass/documents-downloads/
[33] Energy Technologies Institute, https://www.eti.co.uk/library/?programme=bioenergy

guaranteed supply of feedstock and companies such as OJ Neill Contracting Limited, in Bury St Edmunds, have developed their capacity in this sector with this one business now supplying 162,000tonnes of biomass a year for 9 AD plants. AD technology is also used by Anglian Water for waste water treatment.

Due to Brexit, the UK is due to develop a new UK Agriculture Policy as set out in the draft Agriculture Bill[34]. This is signalling an end to direct payments with farmers having to compete in the global market. The policy calls for a focus on efficiency and identifies the use of crop co and by products for new markets, including energy as a key area. Specific energy crops, such as miscanthus, are also likely to become more attractive as farmers look to diversify their income stream.

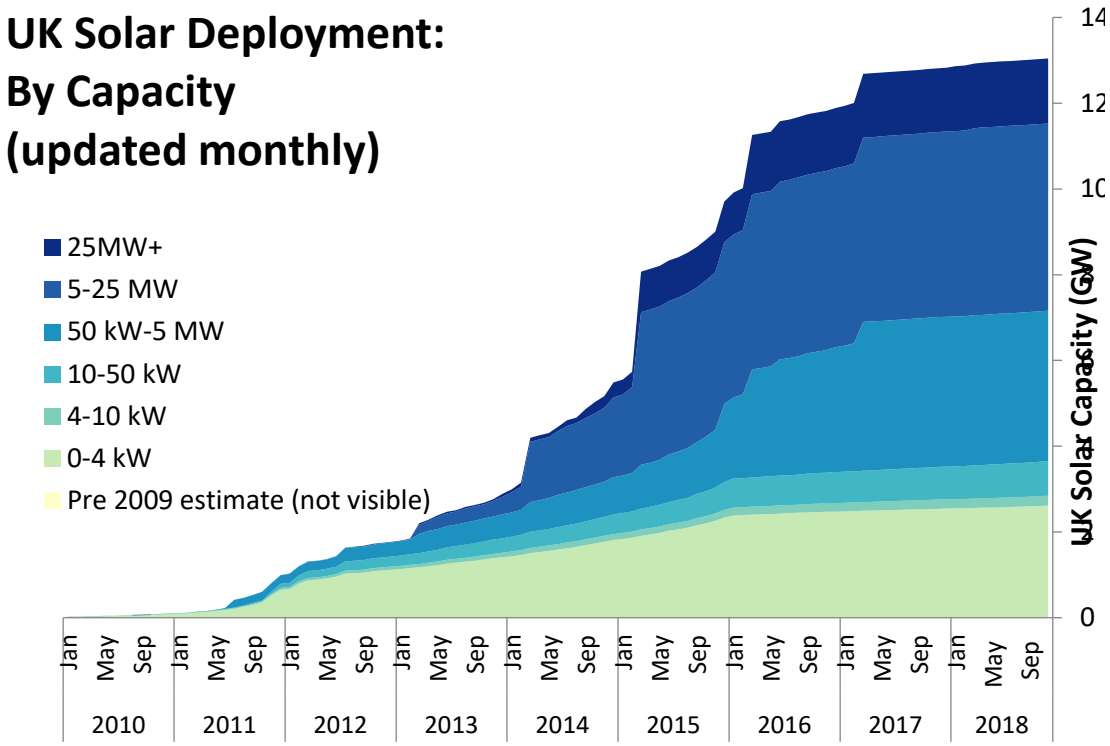
The government is committed to developing the bio-energy sector with the UK Bioeconomy Strategy (2018)[35], stating that: the biorefining and bioenergy industry has the potential to grow from £2.9bilion in 2013/14 to £8.6billion by 2035.

Solar

From 2012 to 2018 the installed UK solar capacity rose from 2GW to 13GW[36]. New Anglia has 4% of UK installations, giving an output of circa 0.5GW of solar power.

[34] DEFRA (2018), Agriculture Bill
[35] UK Government, Bioeconomy Strategy 2018-'30 https://www.gov.uk/government/publications/bioeconomy-strategy-2018-to-2030
[36] UK Solar capacity installed - BEIS (20th December 2018) https://www.gov.uk/government/statistics/solar-photovoltaics-deployment

Figure 4 UK installed solar capacity



What is particularly noticeable is that since 2014 the majority of the increase in solar capacity has come from lager commercial (10KW+) as opposed to domestic schemes (typically up to 4KW). New Anglia has seen significant investment in both large and small solar installation, with major schemes such as Scottow Moor Solar Ltd, developed with Norfolk County Council into a 50MW farm.

In 2017 the UK's first solar farm without subsidy was opened at Clayhill in Bedfordshire[37] and this milestone means t further substantial growth could be seen as costs continue to fall. This is likely to mean that other solar farms will be created by landowners seeking to diversify their income given changes to agricultural support. With large areas of relatively flat farmland[38], New Anglia is well placed to take advantage of this development.

Nuclear

Sizewell in Suffolk is a significant asset in the local LCRE energy sector. Sizewell A is currently being decommissioned, whilst the later Pressurised Water Reactor Sizewell B is still operational. Plans for Sizewell C are well advanced and, once developed, is

[37] BEIS (2017), https://www.gov.uk/government/news/subsidy-free-solar-comes-to-the-uk

[38] Norfolk and Suffolk has 708,000 hectares of farmland, almost all of which is flat and accessible and thus in theory suitable for land based LCRE generation through biomass or solar. At 7.8% of English farmland, this represents a large potential development area, DEFRA (20xx), County Datasets

projected to create 5,600 jobs during the peak construction phase[39]. Of these 2,000 would be drawn from Suffolk and the rest from further afield, with just over half of these jobs being in civil engineering and just under half in engineering. The development is also expected to generate additional local employment through accommodation services for visiting workers (£160m over the project development period) and support a supply chain spend of £1.5billion locally for goods and services supplied to the development.

Sizewell C will have a capacity of 7GW, which when added to 2.5GW at Sizewell B will more than provide all the power needed across Norfolk and Suffolk.

The implementation of the Nuclear Sector Deal[40] is currently being developed nationally, with New Anglia working closely with the Heart of the South West and Cumbria LEPs with government. The key areas the deal focus on include:

- Completing Hinckley C and supporting cost reductions of 30% per unit for other plants to enable further plants to come forward, including Sizewell C;
- Reducing the costs of decommissioning by 20%;
- Increasing the female proportion of the workforce from 18% now to 40% by 2030;
- An additional £2bn of domestic contracts for UK companies by 2030.

The deal is expected to include £30m for investment in the 'place' theme of the Industrial Strategy, with approximately a quarter of this for the New Anglia area. The deal also includes building on the 'Fit for Nuclear' programme[41], focused on helping supply chain companies prepare for work in the nuclear sector.

[39] Hardisty-Jones Associates (2018), Sizewell C Economic Impact Assessment, Executive Summary
[40] HMG Industrial Strategy (2018), Nuclear Sector Deal
[41] The Nuclear Advanced Manufacturing Research Centre (NAMRC), Fit for Nuclear programme, http://namrc.co.uk/services/f4n/

Future Technologies for Generation and Storage

The scale of the energy sector and its technical nature means that across the World innovation is a constant feature of the industry, as recognised in the government's Clean Growth Strategy (2018). The government also focused in this strategy on innovation to position the UK as a World leader in Clean Energy, to help support growth in technology exports into a market the International Energy Agency has estimated will be worth $13.5 trillion between 2015-'30.

Innovation is needed in all three areas of the New Anglia Clean Energy Plan: moving to low carbon generation; new energy distribution systems; and, energy efficiency.

Norfolk and Suffolk have the potential to continue to build expertise in all three areas but should also seek to strengthen its links nationally with the Catapult Centres. In doing this the focus should be on both those focused on clean energy, such as the Offshore Renewable Energy Catapult[42] and those such as the High Value Manufacturing (HVM) Catapult and its subsidiary, the Manufacturing Technology Centre (MTC)[43], which can bring manufacturing expertise to the clean energy engineering sector. The Catapults can bring national expertise and recognition and have been asked by government to increase their regional reach and engagement, thus providing a clear route by which they could be engaged in projects in Norfolk and Suffolk.

In relation to future generation technologies New Anglia has potential in areas including:

- Carbon Capture Usage and Storage (CCUS) - the large oil and gas sector in Norfolk and Suffolk creates potential for CCUS utilising redundant North Sea infrastructure, by generating lower carbon power from gas in which the carbon emissions are captured;
- Wave and tidal power which is currently being developed elsewhere in the UK. The coastline, estuaries and The Wash all offer potential for this industry. On shore micro hydro, which can now operate with heads as low as 2metres, also offers potential;
- There is considerable R&D interest in the production of algae, both on shore and offshore (seaweed) as an alternative high yield biomass crop. However, further investment is needed to commercialise this sector;
- Hydrogen can be generated from hydrolysis to produce clean fuel and if supplied by excess renewable power (e.g. solar, wind or tidal) can generate a renewable zero carbon fuel. There is potential for this to be generated offshore at wind farms and injected into the gas grid using existing infrastructure.

Whilst these technologies offer potential for future growth in the energy sector, they are all currently either at concept stage or have yet to be developed in Norfolk and Suffolk.

[42] Offshore Renewable Energy Catapult, https://ore.catapult.org.uk/
[43] Manufacturing Technology Centre (MTC), http://www.the-mtc.org/

For example, CCUS is a promising technology, and included in the Government's Clean Growth Strategy, but the latest data from ONS show that at present its employment is so small that it is officially recorded as zero[44].

The statistics for 2017 do show a small turnover on the CCUS sector, of £3m, suggesting that there is some activity, but that employment is below 50, and the data has therefore been suppressed to avoid identification. To put this scale into context, the total for the whole LCRE sector in 2017 was a turnover of £23.9billion and employing 76,000 employees. The same very limited scale at present is true for hydrogen.

Wave, tidal and marine algae production are being developed commercially on a pilot scale in other areas of the UK and globally but have not yet been developed locally.

For all these emerging LCRE technologies, further investment in close to market R&D, pilots and demonstration will be needed before they can be commercialised at scale.

There is a clear role here for the New Anglia Local Industrial Strategy (LIS), which is focused on high growth sectors. With Clean Energy one of three LIS themes, it is important to consider what focus is given to future growth of the already large and established LCRE technologies, such as offshore wind, biomass and nuclear, and how much focus to have on new and emerging technologies which are not yet commercialised.

In practice to futureproof the LIS whilst delivering growth in the short to medium term, it will be important to both support the growth potential of the established sectors, whilst ensuring that future technologies also receive some applied R&D and demonstration support.

Energy Efficiency Transformation

As well as innovation in energy generation, there is a lot of innovation focused on energy efficiency e.g. building design and light, heat and power systems. A major area for New Anglia to invest in for the future is to support the transformation of transport to clean energy systems. Norfolk and Suffolk have a large ports and logistics sector, including the UK's largest container port at Felixstowe. The sector has nearly 50,000 employees and a GVA of 2.3billion[45].

The potential to move to clean energy in rail and road freight is a significant opportunity which New Anglia should look to lead, with direct local impact and a large potential for technology and systems sales. This is identified in the New Anglia Ports and Logistics Sector Skills Plan (2018) and aligns with LEP work on infrastructure and in Local Energy East (LEE)[46], which identifies the roll out of Electric Vehicles (EVs) as a significant challenge and opportunity to decarbonise the economy.

[44] ONS (2019), Low Carbon and Renewable Energy Economy Survey, indirect and total activity estimates 2017
[45] New Anglia (2018), Sector Skills Plan for the Ports and Logistics Sector Through Skills Development 2018-'25
[46] Local Energy East Strategy: An Energy Strategy for the Tri-LEP Area, Winter 2018

The move to EVs is a global change that will mean the World continues to need more electricity, even beyond 2035, at a time when total global energy demand is projected to start to decrease due to efficiency increases. The move from fossil fuel to electric will on a net basis make big impact on the carbon emissions from transport, assuming that the electricity comes from LCRE sources.

Infrastructure and Energy Grids

The generation and distribution of energy is being transformed by the move to smart grids and energy systems which are employing new technology including Internet of Things (IoT) and demand side response. It uses a wide range of technologies which come with skills demands for engineering and control systems, as well as skills in management and finance to develop new market models. These technologies include:

- Heat networks;
- Behind the metre generation and off grid generation capacity, supported by smart grids and storage to assist with gird balancing.

Onshore utility infrastructure, including energy, is a key enabler of growth in the wider economy. Currently access to energy is a key issue for developers with concerns about physical grid capacity and costs being a major constraint for new energy suppliers, e.g. AD plants or solar farms, as well as customers developing new business or housing sites. The New Anglia Building Growth group are looking at this area and in 2018 a workshop stressed that developers need an energy environment which facilitates development by addressing regulations, connection costs and when these costs are incurred.

It is recognised that the rapid growth in both onshore and offshore renewable energy capacity presents challenges for existing infrastructure, particularly the electricity grid. New onshore generation capacity is dispersed and often relatively small scale, meaning that a critical challenge is both the accessibility and costs of grid connection.

Offshore the challenges are different, with major new wind farms needing access to the national grid to deliver large quantities of power to one point on the grid, over a grid infrastructure not originally designed to receive these large inputs at primarily coastal sites. Given the scale of wind farm development planned for the next decade in the Southern North Sea, substantial investment is needed in the existing grid and/or the development of new grid infrastructure specifically to support this offshore sector, as proposed by Nautilus Associates.

The Offshore Wind Sector Deal has recognised these problems and includes a systems integration group to look at how best to integrate large volumes of wind energy into the gird. It also proposes using technologies such as storage and grid balancing to smooth the integration process. To help facilitate this process locally it is important for New Anglia to work with the Offshore Renewable Energy Catapult who lead national work on innovation for the offshore industry.

New Anglia USP for Clean Energy

New Anglia is unique amongst UK regions in having strengths in the full range of major clean energy technologies (wind, solar, biomass, nuclear), coupled to well established support structures, now being focused through the All Energy Industry Council.

Current electricity demand in New Anglia (table 2), is 7.6GW. The proposed expansion of local offshore wind capacity by 2030 (to 14.5GW) on its own would make Norfolk and Suffolk a big net exporter of clean energy. With ongoing growth in solar, bioenergy and nuclear (potentially 9.5GW locally from Sizewell B and C), Norfolk and Suffolk will be able to meet the needs of multiple LEP areas as well as local demand. This will generate income, jobs and business in New Anglia.

Table 2 New Anglia Electricity Meters and Demand[47]

2017	Meters ('000)			Sales GWh		
	Domestic	Commercial	Total	Domestic	Commercial	Total
Norfolk	416	40	456	1,755	2,446	4,202
Suffolk	338	32	370	1,421	1,976	3,397
New Anglia	754	72	826	3,176	4,422	7,598
% of England	3.1%	3.3%	3.2%	3.5%	3.1%	3.2%

The Clean Energy plan should focus on growing generation capacity in the three areas in which New Anglia is a UK or global leader in clean energy:

- **Offshore renewable energy** - by delivering both on the potential medium to long term growth in offshore wind, whilst also investing in the long-term growth of new technologies such as wave and tidal, the creation of a future hydrogen economy fuelled by offshore renewable energy and the potential for Carbon Capture, Use and Storage;
- **Bioenergy and solar** - to recognise the large physical land area suitable for biomass or solar production, at a time when many farmers are keen to develop new income streams within the next 5-10 years as agricultural policy reform impacts the industry. This aligns with the agrifood theme in the New Anglia Local Industrial Strategy (LIS) by developing new income streams and the market for co and by product streams from agricultural production;
- **Nuclear sector deal** - by embracing the opportunities provided by the Nuclear Sector Deal and the long-term potential to develop Sizewell C. The expertise

[47] Summarised from: BEIS, Sub-national electricity sales and numbers of customers, 2017 https://www.gov.uk/government/statistical-data-sets/regional-and-local-authority-electricity-consumption-statistics

developed for Sizewell C also has potential in other developments, including one in Essex at Bradwell B.

New Anglia is also a rapidly growing area, and with its neighbouring LEPs should use the framework set out in the Local Energy East Strategy, to facilitate the move to a more efficient energy infrastructure which priorities energy efficiency (for power, heat and transport) and which supports economic growth. New Anglia with its clean energy generation potential is well placed to lead this work on behalf of the wider region.

This will require investment in energy grids, including smart technologies and new grid infrastructures. This is closely aligned with and draws on the ICT and digital themes in the New Anglia Local Industrial Strategy (LIS), through providing a clear and large-scale market for the application of digital technologies.

Finally, the Clean Energy plan in the LIS should support applied R&D and demonstration so that New Anglia is also at the forefront of new technologies, such as CCUS and wave or tidal power as they develop.

Capex and Opex

A key consideration in terms of the investment and skills focus for New Anglia in Clean Energy is the difference between capital expenditure (Capex) and operational expenditure (Opex). All LCRE infrastructure and generation capacity will require a mix of Capex and Opex, but the balance between the two will vary, for example an onshore solar farm has a high capex in terms of both costs and labour requirement during construction, but opex is low as there is little maintenance. In contrast offshore wind, bioenergy and nuclear all have substantial and continuing opex costs post construction.

Much of the Capex is focused on comparatively short periods of time, from a few weeks for solar farm to a few years for a wind farm, whereas for all the generation technologies Opex costs and thus workload will typically be for 25 years or more.

The Offshore Wind Sector Deal and the Nuclear Sector Deal both encourage the industry to try to secure a larger share of the total lifetime costs, Capex and Opex, for the local economy and UK, with a target for this to be 60% for offshore wind by 2030[48]. Arguably this is harder to achieve with Capex, given that the construction phase often calls on international specialisms or equipment supply where there are only a few global companies with the expertise needed e.g. none of the current round of nuclear plants under construction or proposed are led by UK companies.

New Anglia should seek to develop more capacity in the Capex phases of LCRE systems but should focus on those areas where it can develop real expertise, which is both globally competitive and ideally exportable.

As noted above, the International Energy Agency has calculated that to meet the targets agreed in Paris, $13.5 trillion of investment is needed globally between 2015-'30 in new generation capacity. As the largest development zone in the World for offshore wind energy in the next decade, New Anglia could use this Capex opportunity to develop local capacity and expertise which can then be exported. This Capex expertise could equally well be in environmental assessment, consultancy, grid infrastructure or financing as in the physical construction or supply of turbines.

All the new LCRE capacity proposed internationally will also need maintenance and operational support, Opex. With the largest offshore developments in the World, New Anglia will have to secure the workforce and expertise to deliver this before other areas. Investing in the expertise needed for Opex could open up substantial future export opportunities. For example, control rooms in New Anglia are already being used to monitor wind farms in Scotland and, given the rapid developments in Industry 4.0 and communications networks, it is perfectly conceivable to see Norfolk and Suffolk developing export potential in the monitoring and management of LCRE installations internationally.

In practice New Anglia should develop its capacity in both Capex and Opex, but to give long term careers and to reflect the fact that in many cases LCRE equipment will be

[48] HMG (2019), Industrial Strategy, Offshore Wind Sector Deal

sources overseas from World leading suppliers, a focus on building Opex capacity and the advisory services needed for Capex is believed to offer the greatest potential.

Over time both Capex and Opex per unit are expected to decline as efficiency, new systems and critical mass factors all combine to moderate costs. In 2017 a report in New Energy Update[49], suggested costs of both Capex and Opex of offshore wind would fall by 40% by 2030. However, this fall in unit costs is more than offset by the very large increase in the total size of the industry. In Nuclear, the sector deal[50] is proposing a 30% reduction in Capex and 20% reduction in decommissioning costs by 2030.

The Enabling Role of Skills and Innovation

There is an expectation that the LIS and thus the Clean Energy Plan, will address the five drivers of productivity identified in the Industrial Strategy[51]: ideas; people; infrastructure; business environment; places, all of which have a clear innovation and skills requirement.

A key feature of the emerging Sector Deals for the industry is the ambition to attract more females to the industry.

The energy sector is changing rapidly, and the development of new skills needs to be informed by innovation in energy systems. It needs to be delivered both as formal courses and via knowledge exchange activities for the wider community who use energy in the commercial and public sectors.

Many end users also now have onsite energy generation capacity (e.g. solar panels) or storage facilities (e.g. fixed batteries or those in EVs), which they need the skills to optimise. End users also need the knowledge to adopt clean and smart energy systems.

Changing how energy is generated, distributed and consumed will need new skills in:

- **The energy sector**, including additional employees or new skills to:
  - Support the expansion of low carbon energy generation;
  - Work with end users to deliver energy efficiency technologies and systems in public, commercial and domestic settings;
  - Support the development and deployment of 'game changing' technologies such as low carbon transportation;
  - Develop Norfolk and Suffolk's energy grid infrastructure so that it supports economic growth and the move to a low carbon economy;
  - Facilitate innovative new energy systems including the use of digitalisation and the application of Industry 4.0 in the energy sector.

[49] New Energy Update (2017), Offshore wind opex set to fall 40% by 2030 as suppliers dig deep
[50] HMG Industrial Strategy (2018), Nuclear Sector Deal
[51] Her Majesty's Government, The UK's Industrial Strategy, https://www.gov.uk/government/topical-events/the-uks-industrial-strategy

- **End users of energy** (in the public and private sector), including the skills to understand the energy supply and energy efficiency options available to them; specify their future energy needs; and, work with technology suppliers to implement a clean energy strategy for their operations.

Skills and innovation on their own cannot deliver the Clean Energy Plan and must be supported by investment in additional clean energy generation capacity, energy infrastructure and research and development. However, given the magnitude of technical, cultural and business change needed to deliver a clean energy economy, skills and innovation have to be at the centre of the Clean Energy Plan.

As noted above there is substantial growth potential in the skills demand for both Capex and Opex, not only locally but globally in the coming decades.

Developing local workforce capacity, in manufacturing, construction, operations and maintenance and the professional services to support the industry is therefore essential. In the long term, developing Opex expertise is believed to offer more potential than focusing on the skills for Capex, as this would enable Norfolk and Suffolk to develop a long-term market and thus high skilled jobs, in servicing both Norfolk and Suffolk's large LCRE sector as well as developments across the World.

4. Clean Energy Implications for Employment and Skills

Employment

Data on employment in the sector is complicated by the fact that beyond specific energy focused companies, a substantial proportion of the day to day management of LCRE installed capacity is operated by businesses in other sectors (e.g. food and farming, manufacturers and the public sector), who have installed renewable energy plants.

The staff in these other sectors will typically maintain the energy installation as part of a broader job role in which energy skills are only one component.

The same is often true for AD plants on farms and food companies, where they are part of the core infrastructure.

The potential skills issues in the LCRE industry are complex, given that:

- 'Energy' skills are needed by both those directly employed in the energy sector as well as those in other sectors which install LCRE technologies (in larger companies, they are very likely to undertake at least part of the maintenance and operation in house);
- The LCRE sector, as defined above, also includes energy efficiency which again broadens the job roles and skills needed;
- The sector is, in common with other technology led sectors, subject to substantial change as Industry 4.0 leads to the rapid development of new sensor and control systems. This is increasing the focus on ICT skills, alongside traditional engineering skills, as well as creating demand for analysts and business managers who can evaluate and make decisions on the data generated.

The skills issues in the industry also relate to both:

- The need to attract new entrants to the industry;
- To upskill the existing workforce as new technology and Industry 4.0 impacts across the sector.

A range of reports have reviewed the skills needs in the LCRE and energy sector more broadly, but except for the New Anglia Energy Sector Skills Plan (2018), many reports in the UK are now rather dated given the speed of change in the industry. There is, however, a relatively recent UK report (2017) on skills needs in the energy and utilities sector.

A number of groups are also looking at these issues e.g. the Institute of Engineering and Technology and the Renewable UK group is currently developing a skills group (but there are currently no details of its remit or function available).

The general consensus in these reports are that:

- Skills needs are changing, with a growing emphasis on system integration and the use of smart energy systems based on data and ICT;

- There is a challenge in recruiting the workforce needed which has been increasing as the scale and complexity of the LCRE industry grows;
- There is competition for skills across the engineering and utilities sector, with a convergence of needs meaning that these sectors are also competing with other sectors (such as retail) where the demand for STEM skills is accelerating rapidly from a low base as they embrace digitalisation;
- The East of England is one of four UK regions where the pressures on future workforce supply are most acute (see Energy Sector Skills Plan Data Pack);
- The demand for staff includes a significant replacement need given the large number of engineers who are expected to retire in the next decade.

Workforce and Skills

Key industries within Clean Energy, as defined within this report, have highly technical and regulatory training needs linked to the development and operation of activities. Training is often non accredited, this means it is not supported by existing standards for vocational training such as apprenticeship standards. This impacts on the quality, cost and availability of training – ultimately impinging the acquisition of skills and growth.

The Energy and Utilities Skills Group, which represents the major employers involved in the UK's energy infrastructure: across water, gas, power and waste management have established three priority areas for action for workforce development and skills[52], which align to provide an overarching theme of workforce sustainability and resilience. These priorities cover:

- **Sector attractiveness and recruitment** – including school engagement and promotion of careers targeted at underrepresented groups;
- **Maximising investment in skills** – apprenticeship investment (including via the levy) and promotion of skills investment through supply chains;
- **Targeted action** – more effective and longer-term workforce planning, improving the quality of training provision and the adoption of a skills passport system to support workforce mobility across industries.

A key backdrop to the skills planning of the energy utilities industry are the pressures surrounding an ageing workforce and a mismatch between overall demands caused through replacement and growth against current supply entrants; with 20% of the overall workforce due to retire over the next 10 years (2017-2027).

The UK Commission for Employment and Skills (UKCES) report[53] a fundamental challenge for the skills system itself to keep up with the pace of technical development across the energy sector (with the system referred to specifically here as a focus on the definition of standards). Using primary data gathered from employer consultation in the sector, employers report that the definition of training competency is too often defined at

[52] "Many Skills One Vision: Energy and Utilities Workforce Renewal and Skills Strategy: 2020", (2017), EU Skills Partnership
[53] "UKCES Skills Insight Report: The Energy Sector", (2015), UKCES

a generic occupational level and less so on "sub-sector specific" skills at a higher level. Specific areas of higher skills need, which employers report are not well supported via existing training standards, cover:

- Energy storage and management solutions;
- Data analytics;
- Installation, operations, testing and maintenance within energy infrastructure;
- The adoption of the latest design, surveying and testing tools, with a heavy reliance on emerging software development.

In terms of occupational demand, the UKCES summarise five key occupational roles that best represent workforce uptake across all industries: engineers, technicians, overhead lines workers, project management and sales/marketing executives. Their analysis aligns with the key findings captured in the New Anglia Energy Skills Plan, including a summary strategy that focuses on the key challenges of:

- Responding to an ageing workforce and the replacement demands forecast;
- The development and upskilling of the existing workforce and the ability to introduce mechanisms to promote the flow of skills and employment between industries based on shifting patterns of demand;
- A partnership between employers and education to promote future careers, diversification of the workforce and leveraging employer leadership in the definition and development of new training standards and qualifications, which address shortfalls.

Previous emphasis through UKCES policy and research[54] has focused on addressing STEM shortages across Low Carbon industries, recognising the importance of working to address how technical skills across the energy sector (e.g. oil and gas) plays an important role in responding to the skills demands of a growing low carbon economy, alongside promoting new higher-level STEM careers.

The European Centre for the Development of Vocational Training (CEDEFOP) published an updated assessment of skills for 'green jobs' in the UK in 2018[55], using a broad definition which focuses on the key enablers of the transition to a low carbon economy. This includes building on the low carbon and renewable energy (LCRE) and low carbon and environmental goods and services (LCEGS) policies published by the UK government since 2010. Their focus is primarily on the relevancy of green skills within the national Industrial Strategy and the implications of embedding transformative actions within skills delivery and planning at a local level via Local Enterprise Partnership and relevant sector based economic development. The conclusions summarise:

- The overall lack of a national audit of green skills leads to ongoing barriers to the planning of skills delivery and ultimately the growth of employment in low carbon renewable industries.

[54] "Strategic Skills Needs in the Low Carbon Energy Generation Sector", (2010), UKCES
[55] "Skills for Green Jobs", (2018), CEDEFOP

- The increased localisation of skills policy and encouragement of local sector led skills responses calls for a greater role for the private sector to help develop training programmes and define standards for occupational areas and routes that will inform the quality and volume of technical skills supply.
- The importance of the private sector working in partnership with LEPs and education to identify and define future skills demands, with the risk that current scrutiny is too short term. Recognising there is no national system for screening the supply and demand of skills for low carbon per se, LEPs, sector representative bodies and employers need to work together to lobby policymakers and develop localised solutions.

Investing in Existing Skills Demands and Building A Resilient Skill's Supply

To support a transformative strategic approach to skills, supply for the Clean Energy market, the existing industries in New Anglia's Energy sector and their skills demands should be supported. For example, securing the supply of critical skills for Oil, Gas and Off-shore is an important enabler of ensuring the growth and productivity of current and emerging clean energy technologies, due to cross-cutting technical demands.

Across the Energy industry, employers have highlighted the growing importance of aligning advanced manufacturing and engineering with energy in the context of Industry 4.0, particularly to support the increasing use of digital and cloud-based technologies.

Oil & Gas - Transitional Skills for Supply to Clean Energy

The oil and gas industry have traditionally required a broad engineering skill set across a range of key disciplines: installation, operations and maintenance, through electrical, manufacturing and civil/construction routes. Overall the industry requires a workforce that has a high level of accredited training (at least to a traditional HNC level/RQF 4) but with the adaptability to be able to specialise for key roles, such as- crane technicians and specialist metering technicians.

There is a paucity of labour supply within instrument technician roles, which has an increasingly aging (45+) workforce, with contractors often only available out of the area for specific project based cyclical demands. There is a robust 'generic' training offer up to foundation level but there is a lack of higher technical engineering routes, both via traditional graduate engineering programmes and through vocational training courses.

Decommissioning and late life work demands increasingly look for specialised technical roles linked to fault finding, niche servicing and operational requirements and the 'skills offer' lacked a 'deep rooted, working environment, technical discipline'. There is a need for a better supply of local, graduate level, mechanical and electrical engineering skills.

In addition, employers highlight the increasing commercial skills needed to engage with operations and maintenance demands through the primary Tier 1s, OEMs and suppliers- with the importance of financial skills in value chain management, marketing, sales and investment feasibility planning.

The advance of gas extraction techniques and marine exploration/surveying technology- employers highlighted the need for the workforce to demonstrate greater transferability of skills between digital, surveying, engineering/manufacturing and maintenance services.

The workforce and skills opportunities and challenges for the oil and gas industry have been evidenced in the New Anglia Energy Skills Plan (2018). A summary of which covers the need to increase the supply of graduate level engineers across electrical and mechanical disciplines. In addition, the investment in technical skills via vocational routes from Level 3 and 4 upward across industries which represent the oil and gas sectors key supply chains remains important. These include electrical engineering, construction and transport logistics. Technical craft skills linked to infrastructure projects – welders, draughtsman and fabrication skills – are also in high demand. The Energy Sector for New Anglia is keen to develop the training offer and availability of skilled workers for Norfolk and Suffolk. This forms an underpinning priority for the Energy sector overall: the need to maximise the availability of training, its delivery via local training/education providers and subsequent investment in building a talented New Anglia workforce.

Traditionally investment and development for the sector is project based, which involves a highly mobile workforce drawn from across the UK and EU. However, the technical demands and training need for oil and gas workforce development are relevant and important to other key industries locally. This includes offshore wind, nuclear and renewables. Baselining the skills and workforce issues for oil and gas and planning for a positive and practical approach regarding the retraining into other industries in line with project lifecycles; would aid the retention of skills to support the growth of the Clean Energy sector in New Anglia.

Carbon Capture, Use and Storage (CCUS)

In terms of skills and workforce development there is an inherent relationship between CCUS and the existing Oil and Gas industry. Existing assessment of the barriers toward growth in CCUS has recognised the competition that exists in leveraging skills and labour supply from the oil and gas sector.[56]

CCUS facilities around the world span a wide range of CO2 capture technologies and traverse a variety of geological formations and terrains. Industries deploying large-scale CCUS facilities include natural gas processing, power, fertiliser, steel-making, hydrogen-production (refining applications), plastics, and chemicals. The diversity of industries represented reflects the versatility of CCUS technology.

The UK is one of only five countries internationally that ranks the highest in terms of CCUS readiness, recognising the steps taken domestically in terms of policy and industrial infrastructure for mass adoption of CCUS investment.[57] New Anglia can be seen to have significant competitive advantage nationally and internationally to support

[56] "Barriers to the Implementation of CCUS: Capacity Constraints", (2012), IEAGHG
[57] "Global Status Report", (2018), Global CCUS Institute

the adoption and growth of CCUS industry. This includes the CO2 storage capabilities of the Southern North Sea basin and exploiting the existing gas terminal infrastructure at Bacton through to the Thames Gateway.

CCUS involves three major steps - capturing CO2 at the source, compressing it for transportation and then injecting it into a rock where it is permanently stored:

- Capture: the separation of CO2 from other gases produced at large industrial process facilities such as coal and natural-gas-fired power plants, steel mills, cement plants and refineries.
- Transport: once separated, the CO2 is compressed and transported via pipelines, trucks, ships or other methods to a suitable site for geological storage.
- Storage: CO2 is injected into deep underground rock formations, usually at depths of one kilometre or more.

Carbon capture can be applied to large-scale emissions processes, including coal and gas-fired power generation, ***natural gas processing*** and fertiliser production, as well as the manufacture of industrial materials such as cement, iron and steel. Pipelines are the most common method of transporting the very large quantities of CO2 involved in CCUS.

Overall shortages are primarily for technically advanced skilled personnel, specifically petroleum and gas engineers and geo-scientists (IEAGHG, 2012). These advanced technical demands are particularly relevant at the construction and transportation to storage phases. Assessment and feasibility testing for appropriate storage solutions are also complex – involving detailed data modelling, testing and monitoring of CO2 storage reservoirs. Furthermore, legal and regulatory knowledge linked to permissions and finance for carbon trading and financial risk appraisal, are regarded as specialist skills with a high level of existing energy industry experience required.

Wind, Wave and Tidal

The workforce demands for the offshore wind industry are project cycle based from the planning, consultation stages through to new build, operations and maintenance. Key skills need include project management skills linked to heavily oriented project-based work methods. The civil infrastructure investment stages require a mixture of key roles and trade-based skills from across construction and civil engineering, including digging, cabling/piping and onshore new build for power transmission.

Renewable UK – the renewable energy trade association which represents wind, wave and tidal – have mapped the key STEM career roles within their industries, highlighting key duties, qualification requirements and experience required. Careers are organised by three broad occupational groups:

Figure 5 Organisation of Careers

Planning and development – development, assessment and analytical roles linked to the planning phases of new infrastructure projects are start at a graduate level in an engineering related discipline or a higher apprenticeship within standards for instrumentation and control areas. Career pathways have been subsequently mapped across project management, development, site assessment specialists and R&D.

Construction and installation – a generic entry point at Level 3 as a mechanical or electrical technician, leads to Level 4 authorised technician roles for wind turbines and a Level 5 supervising technical role across offshore and onshore construction. Career pathways are mapped across construction engineering, site management and major project management.

Operations and Maintenance - maintenance technicians with a Level 3 in a mechanical or electrical discipline are expected to acquire a range of health and safety training for wind turbine operational activities. These include manual handling, working at height, first aid and working in confined spaces. Career pathways are mapped across management and senior engineering fields in electrical and mechanical roles.

The Hydroelectric Energy industry includes activities that help to extract energy from river and other water sources held in dams (as opposed to wave or tidal energy) that is used to drive turbines and generators. New Anglia does not possess the requisite geographical conditions (high degree of chalk in the bedrock and low head-flow in the river system) to support any significant growth in onshore hydroelectric schemes beyond a micro-generating level. There is however forward potential with the development of marine renewable technologies involving wave and tidal activity due to the shallow water conditions and relatively easy technological deployment via the existing port infrastructure.[58]

The skills which are relevant to Hydroelectric generation, including wave and tidal, are:

- Turbines: manufacture, supply, installation and maintenance of turbine generators, control systems, spares and structural supports and fittings.
- Pumping & lubrication: manufacture, supply, installation and maintenance of pumps, spares, storage and lubrication systems and spares.
- Electricity supply: manufacture, supply, installation and maintenance of power

[58] "Skills for Energy – Meeting the Energy Skills Challenge", (2012), Nautilus Associates

As with the relationship between oil, gas and nuclear, there is a relatively high generic demand for skills and experience across wind into wave and tidal. This includes engineering graduates, construction and maintenance of turbine related activity and project management skills.

Biomass

The Biomass Energy sub sector includes activities that convert biomass into energy. In addition to manufacturing (with the majority of the UK's biomass equipment imported) key industry activities include:

- Biomass furnace systems: supply, consulting, design, installation, engineering and other services for domestic, industrial and community applications.
- Biomass energy systems: supply, consulting, design, installation, engineering and other services for domestic, industrial and community applications.
- Biomass boilers and related systems including supply, consulting, design, engineering, installation and other services for boilers, cogeneration, heat exchange and packaged power systems for domestic, industrial and community applications.
- Technical and operational consulting.

Biomass installation usually requires a combination of gas accredited qualifications, combined with working within a 'wet' environment. HETAS (Heating Equipment Testing and Approval Scheme) provide a direct entry (with NVQ L2/3 pre-requisites) programme for biomass installation, with training available from its approved training centre in Sudbury, Suffolk.

The Wood Heat Association, an affiliated trade association of the Renewable Energy Association, is the national industry voice for the biomass industry and was previously involved in lobbying the government for the adoption of revised training standards for biomass installation technicians via the Trailblazer routes. There remains however no national standard for biomass to date. This in turn impacts on the cost and availability of pre-requisite training and vocational pathways into jobs, as training will be outside of Regulated Qualification Framework (RQF) mainstream funded provision. This means learners/business will be expected to wholly fund training and impacts on the adoption of delivery by the FE and independent training provider sectors.

Alternative Fuels & Electric Vehicles

The Alternative Fuel and Vehicles industry includes Low Carbon Fuel and technology activities that relate to (predominantly) automotive transport (with a focus on Ultra Low Electric Vehicles - ULEV). Activities can be divided into alternative fuels and other fuels and vehicles. Key activities cover:

- Alternative Fuels includes the production, supply and distribution of Natural Gas (Compressed or Liquefied), Synthetic Fuel and Auto Gas (LPG, LP Gas or Propane).

- Other Fuels and Vehicles includes vehicle technologies and fuel sources that are still at an early stage.
- Research, Design, Development and Prototyping activities are included for: Hydrogen fuel cells and hydrogen internal combustion, Electric, Hybrid Electric, Steam powered, Organic waste fuel, Wood gas, Solar powered and Air, Spring and Wind powered vehicles.
- Bio fuels for Vehicles: bio diesel, butanol, ethanol and vegetable oils. Mainstream Bio fuel applications (non-transport), bio diesel, butanol and ethanol.
- Other Bio fuels: biomass, methane, peanut oil, vegetable oil, wood and wood gas.
- Other fuels: Hydrogen.

The skills and training requirements for the electric vehicle industry are focused on the supply of electrical and mechanical engineers but with an adaptive skillset that can provide specialisms in a range of new hardware and software related areas, including:

- Battery specialisms;
- Hybrid engineers and engineers with knowledge of battery management;
- Software engineers and software powered upgrading/maintenance.

AI, data management, network engineering and advanced navigation/security control are also key elements focused on the software demands for ULEV technology and the shift to automation.

Solar

NICEIC (National Inspection Council for Electrical Installation Contracting) approved short courses are the standard training route for solar PV installation and maintenance, solar thermal and heat pump installation/maintenance activity. The training is delivered nationwide and there is a need for greater training opportunities in New Anglia.

New Anglia is home to large numbers of domestic renewable energy consulting businesses such as for air and ground source heating and solar installations. The workforce operating is locally sourced and is often sourced from a customer service background, up to graduate level. There are, however, no specific RQF accredited courses available linked to the domestic energy market.

Geo-thermal

The Geothermal Energy sub sector includes all activities related to the extraction and use of heat generated from the earth. It includes:

- Manufacture and supply of specialist thermally enhanced equipment- grout, heat pumps, pipes, flow control valves, drilling equipment, installation rigs and ancillary equipment.
- Whole systems manufacture and supply for industrial, residential and community geothermal energy applications.

- Component design and research- design services, component research and component recycling.
- Consulting & related services- architectural, construction, systems design, consulting, engineering, installation and project development services.

Key competencies required are electrical engineers, electricians, and skills in pipe and systems laying. Employees with multi skilled and flexible approaches are required.

Nuclear

Although the national Nuclear Programme for investment looks uncertain with the cessation of planned development from Toshiba (Moorside, Cumbria) and Hitachi (Wylfa, North Wales), the Sizewell development through EDF still remains part of the national investment pipeline. The assessment of the employment and training impact of Sizewell is still being finalised. However, there remains an ambition to maximise the growth and retention of a nuclear industry workforce at local level in New Anglia, working alongside the significant potential of supporting the wider supply chain that links to the Bradwell development.

The nuclear industry has highlighted challenges in terms of skills supply including:

- Control and instrument engineers;
- Specialist safety engineers;
- Commissioning engineers;
- Electrical engineers;
- Project and planning control.

Both the ECITB and the NSA for Nuclear emphasise the need for a mobile and flexible workforce. Cogent's Nuclear Workforce Assessment (2017) highlighted the overall skills demands linked to both the new nuclear programme and decommissioning. Engineering and trade-based disciplines are forecast to represent the most significant skills demands, with a strong emphasis on civil engineering- but it is the pooling of strongly related occupations that is highlighted as critical to meet fluctuating demands:

> "The nuclear industry renaissance is taking place against the backdrop of both a large, well-developed decommissioning activity, and a significant defence programme. Large parts of the supply chains are distinct, but equally strong overlaps exist. Whether on different projects within the same sector, or between civil and defence sectors, many of the skills requirements are the same, or similar. It follows that there is great benefit in ensuring that the development and utilisation of skills happens in an efficient and cost-effective manner. Understanding the mobility of skills, and how that knowledge can be applied to the phasing of projects, will be essential in supporting the industry and strengthening those skills currently regarded as fragile." (Nuclear Workforce Assessment, 2017, NSA Nuclear/Cogent).

The Nuclear Workforce Assessment classifies the skills needs of the nuclear industry into three bands:

- Band1 – subject matter experts equating to 1% of the overall workforce, representing the highly specialised skills for the nuclear industry;
- Band 2- nuclear specific skills equating to 18% of the overall workforce, representing nuclear specialised skills relevant to the industry, for example nuclear safety case engineers; and
- Band 3- generic skills equating to 81% of the overall workforce, which may also be at a higher skilled level but not nuclear specific.

Across the three bands are a range of 'fragile skills', highlighting the most at-risk types of skills including:

- Control and instrument engineers;
- Specialist safety engineers;
- Commissioning engineers
- Electrical engineers; and
- Project and planning control.

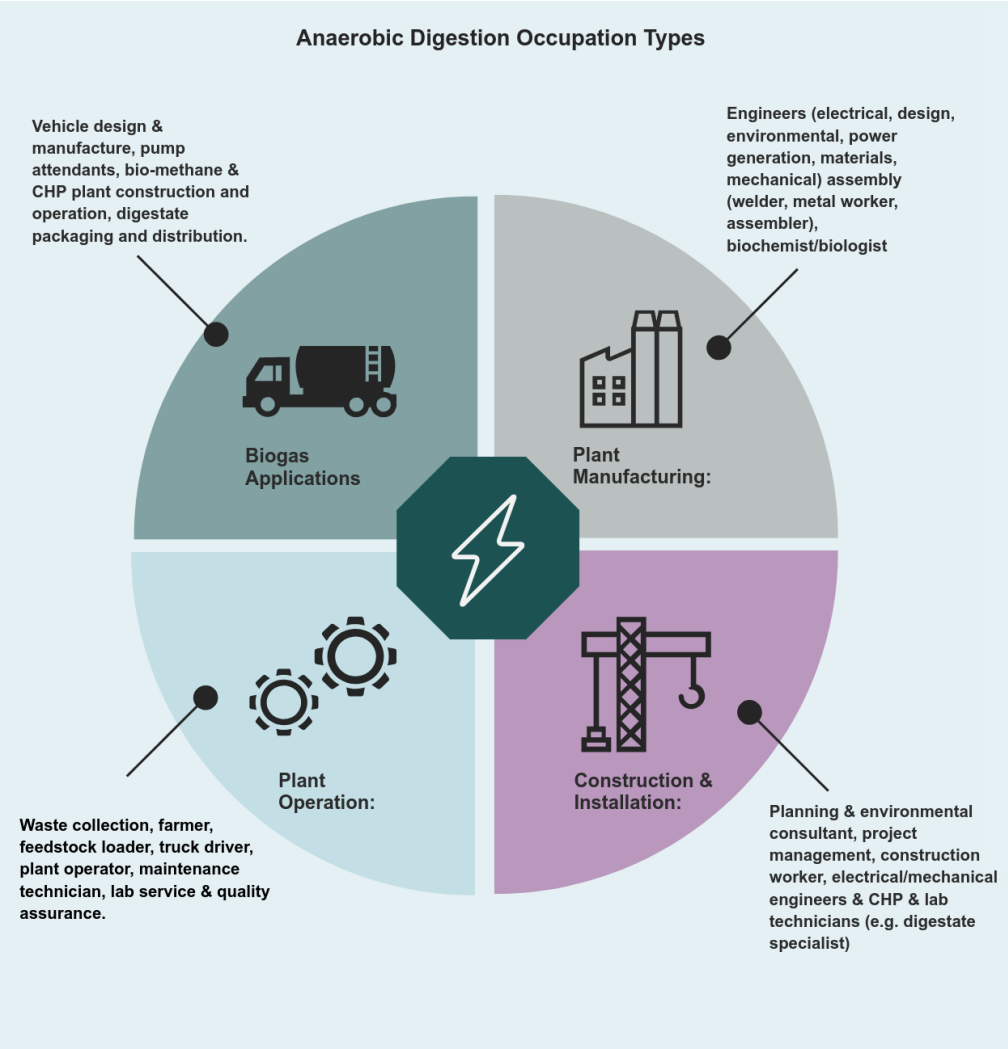
Feedback from EDF Energy through the consultation for the New Anglia Energy Skills Plan (2018) corroborates the national picture reported by NSA/Cogent.

Overall, New Anglia requires a workforce development programme for Nuclear that can enable the cross-referral to and from other key industries within the Energy sector and other relevant sectors in the local economy, namely construction and manufacturing. This allows a more resilient and flexible response to changing cyclical demands. This has to recognise the upturn in the new Nuclear programme, alongside offshore infrastructure development compared to the supply of key trades and roles within construction and horizontal workforce 'virement' from oil and gas.[59]

[59] "Energy Sector Skills Plan", (2018), New Anglia LEP

Anaerobic Digestion

Figure 6 Anaerobic Digestion Occupation Types



As summarised in the above diagram the AD industry requires very different levels of skills. In 2011 Defra noted that it was critical for the industry to ensure it achieved high levels of health and safety and environmental regulation for investors to have confidence in future investment[60]

Training is primarily focused on two key areas: Health & Safety (understanding how an AD plant works); and, legislative requirements.

Plant managers may only need to have an overall understanding of the processes involved in AD, but a good knowledge of health and safety and legislation. AD operators in the UK must comply with several regulations, around waste handling and

[60] "Anaerobic Digestion and Action Plan: A commitment to increasing energy from waste through Anaerobic Digestion", (2011), DEFRA/DECC

environmental protection. Under most circumstances, AD is regulated by General Regulation (environmental permitting, operator competence and duty of care) and Particular Regulation (thermal treatment guidance, animal by-product regulations and excise duty).

Training on legislation is formally available through the Chartered Institute of Waste Management (CIWM), with networking awareness support made available via ADBA- the Anaerobic Digestion and Biogas Association.

Knowledge of regulations is an integral part of the Environmental Permit application, necessary for running an AD plant that takes feedstocks consisting of, or containing, waste. AD operators must demonstrate their technical competence and legislative knowledge within the Environmental Permitting framework. The Chartered Institution of Waste Management (CIWM) and the Waste Management Industry Training & Advisory Board (WAMITAB) have jointly developed a course – the Environmental Permitting Operator's Certificate – that covers these requirements.

Currently, an AD plant that takes only non-waste feedstocks does not require an Environmental Permit. More specifically, operators do not require an environmental permit or exemption either for the operation of the plant or for the beneficial use of the digestate produced, provided that the plant only takes the following non-waste feedstocks: purpose-grown crops, or crop residues, or a mixture of the above. Crop residues have been very recently re-classified as non-waste, rather than as a by-product of food production. Conversely, the use of any AD feedstock or digestate that is classified as waste will require an environmental permit or relevant exemption.

In their 2013 report Cogent SSC [61] highlighted training for AD across four (non RQF accredited) levels:

- Level 1: general information and AD awareness;
- Level 2: AD competency training;
- Level 3: Operator Competency;
- Level 4: Higher education and R&D.

There are various undergraduate and postgraduate programme available that cover AD. Undergraduate degrees in waste management tend to cover AD. For example, Newcastle University has an AD plant in Cockle Farm Park, where its School of Agriculture, Food and Rural Development is based. The University of Glamorgan hosts the Wales Centre for Excellence for AD. The University of Southampton has a Bioenergy and Organic Resources Research Group, internationally recognised for its work on AD.

Currently there exist three postgraduate diploma & degrees that emphasise AD. These are:

- PG certificate in Energy & Fuel from Waste, Lancaster University;
- Biofuels Process Engineering Masters, Cranfield University;
- Renewable Energy and Resource Management Masters, University of South Wales.

[61] "Anaerobic Digestion: A Market Profile", (2013), Cogent SSC

NOTE:

Annex 1 – Clean Energy Skills Plan Action Matrix

The Skills Plan Action Matrix which follows here is an example of how action planning will be developed based on consultation feedback.

Annex 1 – Clean Energy Skills Plan Action Matrix

1 Technical Standards & Skills Reform

AIM – To develop a local employer led skills strategy for Clean Energy, ensuring skills supply matches demand, that training is available locally and that training providers are supported to invest in the delivery of high-quality skills provision.

OUTCOME – The outcome of which is a skilled and capable Clean Energy workforce, technically competent and working in high performing, productive roles.

MEASURING SUCCESS

- An increase in the number of technical standards available for Clean Energy occupational roles.
- An increase in the delivery of vocational training qualifications for occupational roles aligned to Clean Energy industries.
- Quantifiable investment in training (capital and revenue) from government and private sources, which can directly support the delivery of Clean Energy skills priorities.
- The development of Clean Energy industry specific labour market intelligence

EXAMPLE

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other Other**	**Additional Clean Energy Action**
1a(i)	Establish an employer-led task and finish 'trailblazer' group to map and identify technical standards for key occupational areas.	Consult with local representatives of the Offshore Wind sector deal to help develop the best method for developing a 'trailblazer'. An apprenticeship Charter of Cooperation is under development via the Energy Skills Partnership, with activity aimed at engaging local businesses promote the take up of new apprenticeship standards and gather ongoing intelligence regarding vocational training needs.		The **Learning and Skills Sector Skills Plan** recommends using the Skills Board to coordinate a gap analysis of technical standards against skills demands across all priority sectors.	Employer engagement in industries that have not currently been included in the scope of existing Skills Plans- for example Biomass and Anaerobic Digestion. Decision on the initial industry and standards to form a trailblazer for.
1a(ii)	Define an occupational map to set standards for, following an agreed process like with the initial routes mapped for T Levels.			Cross-refer to the recommendations developed within New Anglia's **Learning and Skills Sector Skills Plan,** ensuring the learning and skills community can play a lead role.	The definition of standards should focus on Clean Energy specific occupations. Mapping would have to follow national guidelines from DFE and with close involvement of industry, using a mix of local and national businesses (i.e. via trade associations).

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other Other**	**Additional Clean Energy Action**
1a(iii)	Government should be lobbied, via an employer led partnership (for example the New Anglia LEP direct or the nascent All Energy Council) to support a formal agreement of standards for technical skills.	Explore the optimum way to engage with government to gain support technical standards for the Energy sector and Skills, including Clean Energy; which in turn will help leverage funding should it be made available.			
1a(iv)	Guidance should be sought from the Institute for Apprenticeships (Department for Education) on the procedure for formal accreditation.				There is a set methodology and guidance process for accreditation, with a dedicated adviser made available via DFE.
1a(v)	This initial task and finish group can act as the **Testbed model** for further technical standard development covering priority Clean Energy skills	A Testbed Model for defining new technical standards can be applied to all sectors with technical skills demands.			Apply the Testbed Model to subsequent industries. prioritised under Clean Energy, by considering the economic value against the match and availability of skills provision; assessing gaps in technical standards.
1b	Consult with the offshore wind sector to firstly understand	Better workforce insight and intelligence is a key priority within the			The Offshore Wind model will inform the process for developing workforce intelligence for Clean Energy industries. A

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other Other**	**Additional Clean Energy Action**
	and then refine - at a New Anglia level, the methodology being developed nationally for capturing workforce development intelligence for key occupational areas and explore the potential for developing local intelligence systems to support the Clean Energy sector's key industries.	Offshore Wind sector deal. The sector should be consulted to ascertain their method in development nationally to capture workforce data and define training needs. An apprenticeship Charter of Cooperation is under development via the Energy Skills Partnership, with activity aimed at engaging local businesses promote the take up of new apprenticeship standards and gather ongoing intelligence regarding vocational training needs.			process would need to consider how to effectively consult with a representative sample of employers from specific industry clusters on a routine basis (annual) to baseline and define workforce data. Proprietary intelligence gathered will help gain further leverage nationally with Skills reform policy particularly linked to technical standards and local employer ownership programmes.
1c	Develop a resource investment plan, steered via employer representation from Clean Energy and in consultation with the education sector, which aims to measure the level of	Any investment appraisal must also cross-refer to the range of technical skills demands captured in the skills plans already approved by the Skills Board; thus, giving an aggregate perspective.			An appraisal should consider costs in response to technical demands and include workforce development, investment in capital and training resources. The development of a resource plan can be used to inform national advocacy to leverage investment through government

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other Other**	**Additional Clean Energy Action**
	resource required to respond to clean energy growth.				programmes supported by industry investment.

EXAMPLE

2 Alignment with other Sector Skills Plans

AIM – To ensure that the existing skills priorities developing through partnership action cross-refer to Clean Energy, avoiding duplication and re-enforcing the aggregate demand for key skills – particularly technical, STEM related roles.

OUTCOME – The outcome of which is a joined up and highly responsive skills offer; ensuring Clean Energy industries can benefit from an appropriately skilled, flexible and buoyant local labour market.

MEASURING SUCCESS

- Strategically the priorities defined for Clean Energy are delivered via cross-sector working, with controls in place to manage change.

EXAMPLE

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other**	**Additional Clean Energy Action**
2a	Establish a Cross-sector Clean Energy Skills Leadership Group (acting as a sub-group to the New Anglia All Energy Council), which can meet bi-annually to assess the progress made in addressing Clean Energy skills though existing Sector Skills Plans	Developing a higher technical offer – for Control and Instrument Engineers; Safety engineers; Commissioning Engineers; Electrical Engineers; and Project and planning control. A cross-industry and cross-sector planning framework is in development; shaped from Tier 1 led investment programmes, which can be made widely available to the supply chain, skills providers and the recruitment sector. This will support the development of generic skills route ways, maximising the accessibility and 'joining-up' of course provision across colleges (working with ESFA to agree allocation frameworks). Furthermore, it will identify barriers preventing effective pass porting of skills sets and	An Industry 4.0 Challenge Programme is in development, aiming to build Industry 4.0 into sector planning and the LIS – linking into NAAME and TechEast employer representation. Course development is under review to facilitate FE courses which allow engineering and ICT to be combined to meet the need for Industry 4.0 provision; New modes of delivery which are responsive to industry needs e.g. short block release, use of blended learning and filling gaps in current course provision e.g. applied engineering design.	New Anglia Skills Board and TechEast to work together to identify how the reform of apprenticeships - the Levy, Standards and Higher-Degree level pathways - can stimulate an enhanced, more diverse and sustainable local Digital Tech skills supply. Emerging Tech Skills Plan – to upskill existing sectors workforce to adopt Industry 4.0 - to develop awareness of Industry 4.0 amongst the existing workforce across all sectors. Emerging Tech Skills Plan- Integrate Industry 4.0 awareness	A Clean Energy skills group would meet bi-annually to review the progress made in delivering cross-sector skills priorities across the related skills plans, considering issues and risks for Clean Energy overall.

		NALEP Sector Skills Plans			
Ref	Action Point	Energy	Advanced Manufacturing & Engineering	Digital/Other	Additional Clean Energy Action
		labour supply (for example H&S accreditation) and design effective solutions. 'Fragile skills' gaps have been identified, with the Energy Skills Partnership developing a comprehensive response. Key areas include: • site fabrication engineers, • instrument engineers, • operational and maintenance engineering, • turbine installation and O&M, • decommissioning key engineering and project management functions, • operational and project management, • commercial and financial planning.		into all courses at school/FE/HE This requires: • The integration of Industry 4.0 adoption skills (technical, management of change and culture) into all programmes at all levels; • Digital and Industry 4.0 skills to be treated like Maths & English as foundational skills which are central to employability in every sector. Emerging Tech Skills Plan- upskilling existing workforce in adopting Industry 4.0, including a pilot phase for two end user	

		NALEP Sector Skills Plans			
Ref	Action Point	Energy	Advanced Manufacturing & Engineering	Digital/Other	Additional Clean Energy Action
				sectors and rollout from 2021/22.	

EXAMPLE

3 Degree Level Multi-disciplinary Skills

EXAMPLE

AIM – To assess the multi-disciplinary skills required of graduate and post-graduate Clean Energy employment and work in partnership with New Anglia's HEIs and Clean Energy industry to plan for ongoing and emerging multi-disciplinary demands.

OUTCOME – The outcome of which is a highly innovative, cutting-edge New Anglia Clean Energy HE offers, creating a supply of STEM graduates who are adaptive to the multi-disciplinary demands of Clean Energy employment.

MEASURES OF SUCCESS

- The definition of multi-disciplinary STEM graduate and post-graduate courses
- The supply of STEM graduates and post-graduates into New Anglia Clean Energy employment
- Development of a Clean Energy Innovation Network and subsequent delivery of events that promote skills within a HE context

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other**	**Additional Clean Energy Action**
3a	Consult with Higher Education Institutes in New Anglia that deliver degree and post-graduate qualifications in Engineering related disciplines and assess the impact the Clean Energy's key industries (as defined in this report) have on the structure and content of course content and delivery methodology.		The Tutor Development Programme aims to address the shortfall in and the skills available within the pool of trainers and lecturers in the AME sector by recruiting and training more tutors. It will: • Develop multifunctional roles for experienced, older or semi-retired staff in industry who could be used to tutor younger staff (whilst admin was dealt with by full time training professionals employed by Colleges); • Develop CSR programmes which link larger AME employers with training providers to support provision with experienced and skilled staff input, even if only a 'guest lecture' basis		The assessment should consider: b. The multi-disciplinary skills requirement in each of the key industries within Clean Energy; c. A methodology for assessing current content/delivery against (ii) above, which includes an assessment of the responsiveness of the content against industry needs.

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other**	**Additional Clean Energy Action**
			or by hosting training events on their premises; Developing AME Course Provision to build in Industry 4.0 readiness within HE.		
3b	The New Anglia LEP in partnership with New Anglia's HEIs should consider how to develop an innovation network to connect with national and international best practice in Engineering Multi-disciplinary standards in relation to Clean Energy.			This action can build on the current progress being developed by the New Anglia LEP under the Innovation Board and Forum for key sectors. Furthermore, it could connect in with existing case studies highlighted by key organisations such as the IET and relevant Innovation Catapults/Partnerships for Clean Energy related industry active both in the UK and internationally.	The development of an Innovation Network.

4 Inspiring Clean Energy Careers

AIM – To support the existing priorities for promoting STEM careers guidance and enterprise initiatives across education in New Anglia, ensuring specific Clean Energy careers are effectively promoted within careers delivery plans.

OUTCOME – Young people across New Anglia engaged with education are inspired and well prepared to pursue STEM careers; they can make informed choices regarding ongoing education ro uteways which can lead to Clean Energy jobs.

MEASURING SUCCESS

- The delivery of the Gatsby Recommendations that are STEM related
- The development of a Clean Energy Careers Prospectus
- Volume of Post 16 education destinations that are STEM related
- Volume of STEM graduates

EXAMPLE

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other**	**Additional Clean Energy Action**
4a	Develop a STEM "careers prospectus" for Clean Energy to highlight a range of key career pathways in the industries that represent the most significant growth potential for New Anglia over the next decade (e.g. Offshore wind, Bio Energy);	Aligning with Sector Deals and the national Careers Strategy, New Anglia should consider the further development of the New Anglia Youth Pledge, which can support the Gatsby benchmark model pushed through the national Careers strategy and define how the sector's needs are best embedded from KS3 upwards.		Learning and Skills Sector Skills Plan - recommends the design of an overarching plan for capturing and sharing sector intelligence. The plan should be developed in line with the national Careers Strategy and the Gatsby expectations; which the New Anglia Careers Hub has oversight in monitoring	Developing a Clean Energy Careers Prospectus – which would help promote careers within industries identified within Clean Energy. A prospectus should be disseminated via the existing enterprise and carers guidance activities and networks in place (e.g. the Careers Hub and Enterprise Adviser Network- see 4b).
4b	Work with the New Anglia Careers Hub and Enterprise Adviser Network to effectively promote Clean Energy in schools;	Careers awareness and work experience/internship programmes should be coordinated through a central ***'Securing the Future Energy Workforce'*** plan- working with established providers, such as primary NCS delivery, Enterprise Advisors and the icanbea...online platform. A STEM engagement plan should work jointly with the	A STEM engagement plan should work jointly with the STEM ambassador programme and the Advanced Manufacturing Skills Plan. The AME Plan focuses on a Careers for the Future Programme- working with local STEM engagement programmes, promoting AME case studies and influencing	The Digital Tech Skills Plan has prioritised the improvement of aspiration of younger people to access careers within the sector by building connectivity between industry and schools and colleges. Emerging Tech Skills Plan - Integrate Industry	

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other**	**Additional Clean Energy Action**
		STEM ambassador programme and the Advanced Manufacturing Skills Plan- developing cross links with engineering sector bodies and existing STEM enterprise initiatives.	curriculum/careers guidance within schools.	4.0 awareness into all courses at school/FE/HE - to ensure they understand how Industry 4.0 will impact their chosen career.	
4c	Consult with industry and education on how underrepresented groups can be positively encouraged into education and careers in the Clean Energy sector.			Develop a **shared portal** to promote the New Anglia Digital Tech sector, its opportunities/vacancies, challenge stereotypes and inspire career entrants. Ensure place-marketing for New Anglia has a specific focus on the Digital Tech sector, its unique infrastructure and the careers/skills opportunities it offers.	This should involve close cooperation with the learning and skills community to promote equal opportunity and increased diversity within the Clean Energy workforce.

5 Increasing Local Employment & Workforce Diversity

AIM – To develop action that can increase the diversity of the Clean Energy workforce and provide greater employment opportunities for New Anglia residents.

OUTCOME – Clean Energy jobs are accessible to local people, with employers benefitting from a diverse local labour market supply.

MEASURING SUCCESS –

- Number of females working within Clean Energy industry
- Number of BAME working within Clean Energy industry
- Delivery of pre-employment routeways aligned to Clean Energy employment
- Subsidised employment placements (Intermediate Labour Market)
- Number of local people within Clean Energy jobs

EXAMPLE

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other**	**Additional Clean Energy Action**
5a	Undertake a consultation (establishing a representative sample) with Clean Energy employers to identify job roles which could be available for those with 'entry level' skills, to help increase recruitment into the sector.				The Skills Board should be consulted on the process for defining entry level employment and existing employer led partnerships on the methodology for gathering evidence from a representative sample.
5b	Using the data from (5a), work with DWP to develop a sector-based unemployment support package for the Clean Energy sector.				This could build on sector-based work academy models already in operation, with further development of how Clean Energy pre-employment action can be developed.
5c	Consult with the Community and Voluntary Sector and Local Authorities regarding local programmes and outreach activity that can maximise the reach of a Clean	Social outcomes should be defined to fit with the overall recruitment and up skilling aims agreed by partners supporting the delivery of the Energy Skills Plan and the social mobility aspirations of Ipswich and Norwich Opportunity Areas.			The formation of action should consider multiple barriers into training and work, such as travel and rurality and work with Local Authorities and other relevant stakeholders to build an inclusive approach.

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other**	**Additional Clean Energy Action**
	Energy Local Jobs strategy and build on existing practice aimed at combining employment support alongside social inclusion.				
5d	Consult directly with government and key industry connected with the Sector Deals and planned investment programmes, to identify how resources can be ring fenced to support a new Intermediate Labour Market programme for Clean Energy (involving the opportunity to train and earn whilst actively registered with DWP)				There is no active intermediate labour market in place for the Energy Industry – the design of a scheme for New Anglia would need to leverage support and resources from government – following guidelines of benefit rules and wage subsidy and investment from the private sector through appropriate funding.
5e	Assess how the priorities for building workforce flexibility/skills	The Energy Skills Plan has prioritised building workforce flexibility and skills passporting:			

		NALEP Sector Skills Plans			
Ref	**Action Point**	**Energy**	**Advanced Manufacturing & Engineering**	**Digital/Other**	**Additional Clean Energy Action**
	passporting and labour transfer between the industries in the Energy Skills Plan, can also support the growth and supply of entry level employment/skills for Clean Energy.	• Develop generic skills route ways, maximising the accessibility and 'joining-up' of course provision across colleges (working with ESFA to agree allocation frameworks); • Identify barriers preventing effective pass porting of skills sets and labour supply (for example H&S accreditation) and design effective solutions.			

Annex 2 - Existing Course Provision for Energy and Clean Energy

Courses

(Taken from the New Anglia Energy Skills Plan (2018))

The current skills offer for the Energy sector is broadly distributed across the engineering, manufacturing and construction fields. Apprenticeships that contribute towards a career pathway within the sector also predominantly fall within existing frameworks aligned to these broader programme areas. EEEGR lists one specific 'energy industry' apprenticeship programme within its Education Pathway prospectus (Skills for Energy, EEEGR, 2017):

- ECITB accredited Level 3 in Engineering and Construction (up to 4 years)- delivered through East Coast College;

In addition, EEEGR and ECITB promote access to a 4-year Oil and Gas Technical Apprentice Programme (OGTAP) delivered initially out of area via accredited OPITO training. EDF Energy also offers an Engineering Maintenance Apprenticeship Scheme Level 3 over a four-year duration.

There is a relatively small but important overtly 'energy' specific cluster of provision at FE and HE levels on offer across New Anglia, captured below.

Course	Availability	Details
Level 2 Energy Skills Foundation Project	East Coast College	A foundation programme linked to some of the core disciplines within the sector, which has been endorsed by EEEGR, involving-welding, mechanical engineering and engineering construction activities. The yearlong course includes site visits and features strong employer support;
Level 3 Energy	East Coast College	A 1-year full time progression from the Level 2 foundation course with more detailed energy related training across the engineering and construction areas;
Advanced Petroleum (Oil) Tanker Training	East Coast College	A 5-day course focusing on oil tanker operations and environmental/health hazards-leading to an MCA approved certificate;
Tanker Familiarisation (Oil/Gas)	East Coast College	A 3-day course focusing on the hazards in petroleum, chemical and liquid gas transportation;
Offshore First Aid + refresher (HSE Approved)	East Coast College	A 4-day course that complies with the Offshore Installations and Pipeline Works (First Aid) regulations 1989;
Offshore Installation Manager Controlling Emergencies	East Coast College	a 5-day emergency planning training course assessed against pre-agreed OPITO endorsements;

Course	Availability	Details
Offshore Wind Farm Navigational Awareness	East Coast College	A 1-day course for marine coordinators, technicians, control room personnel and offshore wind managers to improve their knowledge and awareness of the conditions that crew transfer vessels and work vessels encounter when working within offshore wind farms;
Offshore Wind Emergency Management and Emergency Response	East Coast College	Short duration bespoke training based on client needs;
Offshore and Oil/Gas Assessor Training	East Coast College	
BEng Energy Engineering with Environmental Management	University East Anglia	An Energy Institute accredited 3-year full time course developed in partnership with EEEGR that builds on a common first year 'foundation' stage with pathways covering energy, mechanical, electronic and electrical (plus a mixed approach);
BEng Energy Engineering	University East Anglia	An Energy Institute accredited 3-year full time course developed in partnership with EEEGR that focuses on core engineering, maths and principles with later specialisms for nuclear, bio energy, environmental awareness;
MEng Energy Engineering	University East Anglia	An Energy Institute accredited 4-year full time course developed in partnership with EEEGR that focuses on core engineering, maths and principles with later specialisms for nuclear, bio energy, environmental awareness;
MSc Energy Engineering with Environmental Management	University East Anglia	A 1 year post graduate course combines investment in engineering with existing and substantial expertise across the Faculty of Science in the fields of applied mathematics, energy resources, environmental management and electronic engineering.

Beyond the energy specific courses on offer is a broad training pathway, mainly across FE and heavily oriented towards electrical, maintenance and manufacture engineering, an aggregated 'cross-section' of the training offer is captured below, which includes the related apprenticeship frameworks.

Discipline	Programme Overview	Availability	Typical Awards
Engineering	Basic Engineering Skills Maintenance and Installation Electrical Technicians (inc operations and maintenance) Extended Engineering Installation and Commissioning Technical Development Operations Engineering Civil Engineering	East Coast College West Suffolk College City College Norwich College of West Anglia Suffolk New College University of Suffolk	Apprenticeship Level 2-3 Level 1-3 Level 3 Extended Diploma Foundation Degree HND HNC Degree+
Engineering Manufacture	Welding and Fabrication Skills Manufacture Engineering Mechanical Manufacturing Performing Engineering Operations- Welding, Manufacturing, Machining	East Coast College West Suffolk College City College Norwich Suffolk New College Norfolk Training Services	Apprenticeship Level 2-3 Level 1-3 Level 3 Extended Diploma
Electrical	Installing Electro technical Systems Electrical Installation	West Suffolk College College of West Anglia	Level 1-3 Level 3 Extended Diploma
General	Bridge to Technology	College of West Anglia	NPTC Certificate

It is also worth noting that the above lists mainly capture the RQF accredited and FE short course delivered provision, however, there are a number of organisations operating within the sector that delivery technical training stationed within Norfolk and Suffolk or able to train peripatetically outside of region:

- **3sun** - through their purpose-built site at Great Yarmouth offer both bespoke and off the shelf training solutions primarily aimed at the oil, gas and offshore wind industries. This includes health and safety, working at height, hose management, hydraulic awareness, small bore tubing and forklift training.
- **Petans** - based in Norfolk offer training linked to maritime, helideck training, GWO initial and refresher Basic Safety Training, confined spaces training and first aid.
- **C-Wind** - specialise in the offshore wind industry, with a focus on health and safety, rescue training and equipment advice.
- **HETAS** - biomass installer training (located in Sudbury, Suffolk

Local short course and FE provision is focused in the:

- EEEGR Skills for energy programme https://www.eeegr.com/skills-for-energy/
- East Coast College Energy Skills Centre (2017) https://www.eastcoast.ac.uk/college-life/news-and-events/news/detail/2017/06/16/east-coast-college-get-project-underway-with-10-million-lep-investment

Further afield, there is some national provision for LCRE sector specific skills with major centres including:

- Scotland has established the Energy Skills Partnership, a collaboration between a number of Colleges to meet the energy industry's skills needs http://www.esp-scotland.ac.uk/
- The Green Skills Academy, which is a partnership between Bath College and Norton Radstock College http://www.bathnes.gov.uk/services/environment/sustainability/green-skills-academy
- British Gas have established a Green Energy Skills Centre in Tredegar - https://www.energy-uk.org.uk/energy-industry/lighting-up-britain/british-gas-green-skills-centre.html
- There is also a wide range of industry focused short courses e.g. Trade 4 U renewable energy courses https://www.tradeskills4u.co.uk/pages/renewable-energy
- Cranfield University offers an MSc Renewable Energy
- Nottingham University offers: MSc Sustainable Energy Engineering; MSc Sustainable Energy and Entrepreneurship

What is notable about this provision is that the largest focus on this area is in Scotland which has made the growth of the renewable energy sector a major focus of its industrial and energy policy.

In 2019 (closing date September 2019) the EU is running a competition for a project to:

- TOPIC - Stimulating demand for sustainable energy skills in the construction sector https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/lc-sc3-ee-3-2019-2020.html

This is interesting as it demonstrates the fact that energy skill needs exist in other sectors, such as construction, which would not normally be seen as part of the 'energy' workforce. Moves in the UK to green construction are likely to have a similar impact in stimulating energy skills in other sectors.

Local Support Programmes

In addition, there are local support programmes for the industry, including:

- EEEGR https://newanglia.co.uk/project/energy/
- Business Energy Efficiency (BEE) programme (ERDF) Norfolk and Suffolk (grants end in March 2019) http://www.beeanglia.org/
- East Institute of Technology (EIoT) bid includes the energy sector

Annex 3 - Energy Policy - Extract from BEIS departmental plan

4. Ensure the UK has a reliable, low cost and clean energy system (23rd May 2018)

4.1 Maximise the advantages for UK industry from the global shift to clean growth through the new Clean Growth Grand Challenge, and take action on climate change

How we will achieve this

Encourage investment in low carbon technologies and the efficient use of resources to support delivery of our new Clean Growth Grand Challenge, seizing one of the greatest industrial opportunities of our time - the move to cleaner economic growth

Work together with business, academia and civil society to deliver our Clean Growth Strategy, building on our already world-leading capabilities in areas including offshore wind, smart energy systems, sustainable construction and green finance. This will generate jobs and prosperity across the UK so the whole country benefits from low carbon economic opportunities (contributes to SDG 12)

Continue to support international action on climate change, while meeting our ambitious national targets (contributes to SDG 13)

Accelerate the growth of the heat networks market to help make it self-sustaining by investing £320 million of capital funding through the Heat Networks Investment Project

4.2 Ensure that our energy system is reliable and secure

How we will achieve this

Ensure we maintain adequate energy capacity, for example through the annual operation of the capacity market, to guarantee that we can cope with unexpected peaks in demand and enable a reliable supply of electricity and gas

Make our electricity system smarter and more flexible, creating the right environment for more storage, demand side response, smart grids, and interconnection

4.3 Deliver affordable energy for households and businesses

How we will achieve this

Improve business energy productivity by at least 20% by 2030 by developing a package of measures to support businesses to improve their energy efficiency, as set out in our Clean Growth strategy

Ensure that every household and small business in the country has been offered a smart meter by the end of 2020 (contributes to SDG 7)

Protect the interests of customers, by bringing forward measures to help tackle unfair practices in the energy market to help reduce energy bills

Support the take-up of energy efficiency improvements in the owner-occupied, privately rented, and social housing sectors, with a view to as many homes as possible reaching Energy Performance Certificate Band C by 2035 (contributes to SDG 12)

4.4 Manage our energy legacy safely and responsibly

How we will achieve this

Deliver safe, cost effective and environmentally sensitive decommissioning of offshore oil and gas infrastructure in the North Sea, while making sure that the UK benefits from the job opportunities this will create

Work with and through the Nuclear Decommissioning Authority to develop and deliver a robust plan for safe, cost effective, environmentally sensitive decommissioning of our civil nuclear waste through a geological disposal facility, creating jobs and opportunities for UK companies in the supply chain

Continually improve UK civil nuclear security and safety arrangements to ensure they are robust and effective, now and in the future

Ensure the ongoing safe and responsible management of our coal legacy, including administration of the concessionary fuel entitlements and personal injury claims for those previously involved in coal mining

Our performance

Between 2011 to 2012 and 2016 to 2017 International Climate Fund programmes have:

supported 34 million people to cope with the effects of climate change

provided 12 million people with improved access to clean energy

reduced or avoided 9.2 million tonnes of greenhouse gas (GHG) emissions (tCO2e)

installed more than 400 MW of clean energy capacity

mobilised £2.2 billion public and £500 million private finance for climate change purposes in developing countries

Source: Annual International Climate Fund results; results schedule: annual

Electricity generation from renewable sources

Quarter	Percentage of electricity generated
Quarter 2, 2017	29.8%
Quarter 4, 2017	30.2%

Source: Energy Trends Statistics; release schedule: quarterly

Annual Greenhouse Gas emission reporting against carbon budgets

468 MtCO2e 2016 total greenhouse gas emissions, meaning the UK was on track to meet the Second Carbon Budget (2,782 MtCO2e in 2013-17)

Source: 2016 Final estimates of UK greenhouse gas emissions 1990-2016; release schedule: annual

Smart and advanced meters operating across homes and businesses in Great Britain

Meters operating (by both large and small energy suppliers)	
Up until 30 December 2017	10.04 million
Up until 30 September 2017	8.61 million

Source: Smart Meters Statistics; release schedule: quarterly

Percentage of peak demand that could still be met if the single largest piece of infrastructure fails

127%

Source: Statutory security of supply report: 2017; release schedule: bi-annual

Nuclear Decommissioning Authority targets completed or on track to complete 92 out of 113

Source: Nuclear Decommissioning Authority Mid-Year Performance Report for 2017/18; release schedule: bi-annual

Annex 4 - Carbon Brief report

https://www.carbonbrief.org/analysis-uk-electricity-generation-2018-falls-to-lowest-since-1994

3rd January 2019

The amount of electricity generated in the UK last year fell to its lowest level in a quarter century, Carbon Brief analysis shows.

At the same time, output from renewable sources rose to another record high, generating an estimated 33% of the UK total in 2018. In combination with nuclear, low-carbon sources contributed 53% of UK generation in 2018, with the share from fossil fuels at its lowest ever.

Lower per-capita electricity generation and cleaner supplies have contributed roughly equal shares to the reduction in power sector CO2 emissions since demand peaked in 2005. This has helped to cut UK greenhouse gas emissions overall, even as the economy grows and population rises.

The reduction in the UK's per-capita electricity generation has saved 103 terawatt hours (TWh) since 2005, slightly more than the 95TWh increase in renewable output over the same period. If this electricity had instead been generated from gas, CO2 emissions for the entire UK economy would have been around 80 million tonnes (MtCO2, 20%) higher than the 368MtCO2 total seen in 2017. If it had come from coal emissions would have been some 180MtCO2 (50%) higher.

Carbon Brief's analysis of UK electricity generation in 2018 is based on figures from BM Reports, Sheffield Solar and the Department for Business, Energy and Industrial Strategy (BEIS). See the notes at the end for more on how the analysis was conducted.

Last year, Carbon Brief analysis showed that, for the first time, more than half of UK electricity generation was low-carbon in 2017.

Falling generation

Some 335TWh of electricity was generated in the UK in 2018, Carbon Brief analysis shows.

The last time UK generation was this low was in 1994, when Nelson Mandela became South African president and the apartheid era officially ended. That year also saw Tony Blair become leader of the opposition UK Labour Party, US president Bill Clinton deliver his first State of the Union address and Finland and Sweden voting to join the European Union.

The history of UK electricity generation since 1920 is charted in the graph below (blue line). Generation rose throughout the 20th century, barring the 1974 three-day week and the recession and miners' strikes of the early 1980s. It then levelled off in the early 2000s and has been declining since 2005, including before, during and after the 2008 financial crisis.

UK electricity generation 1920-2018, terawatt hours (TWh) per year (blue line) and what would have happened if per-capita generation had remained at 2005 levels (dashed yellow line). Sources: BEIS, BM Reports, Sheffield Solar and Carbon Brief analysis. Chart by Carbon Brief using Highcharts.

Generation in 2018 was some 63TWh (16%) lower than in 2005, a reduction equivalent to 2.5 times the output of the new nuclear plant being built at Hinkley Point in Somerset. This is despite the UK population increasing by 10% from 60 million to 66 million people.

If per-capita electricity generation had remained at 2005 levels then the UK total in 2018 would have reached 439TWh (dashed yellow line in the chart, above). This means the UK has saved 103TWh relative to constant per-capita generation, equivalent to four times the output of Hinkley C.

Overall, the amount of electricity generated per person in the UK has fallen by 24% since 2005, down to its lowest level since 1984 (34 years).

Growing economy

The UK trend since 2005 breaks with the economic orthodoxy that a growing economy must be fuelled by rising electricity use. Instead, the economy has continued to grow even as electricity generation has levelled off and then started to decline, as the chart below shows.

The yellow line shows changes in UK real GDP (economic output adjusted for inflation) relative to its level in 1980, since when the economy has expanded more than two-fold. Generation – shown in blue and also relative to 1980 – had grown some 40% by 2005 but is now up less than 20%.

Changes in UK real GDP (blue) and electricity generation (yellow) relative to their levels in 1980, which is set equal to 100. Sources: World Bank, BEIS, BM Reports, Sheffield Solar and Carbon Brief analysis. Chart by Carbon Brief using Highcharts.

The reasons for this decoupling are not fully understood. There are several known contributory factors to the decline in UK electricity generation and demand since 2005. They include product energy efficiency regulations, energy-efficient lighting, environmentally conscious consumers and economic restructuring, including offshoring of energy-intensive industries.

For example, low-energy lightbulbs can cut electricity use by up to 90% while newer "white goods" such as fridges, freezers and washing machines can use up to 75% less electricity each year than the oldest models. There is significant untapped potential to continue cutting electricity use by replacing old appliances at the end of their lives with the latest models, according to the Committee on Climate Change (CCC).

There will also have been some impact from rising electricity prices since 2003 in the face of rapidly increasing wholesale gas prices, economic hardship following the 2008 financial crisis and price increases due to the growing costs of government climate and social policies. [In contrast to rising electricity and gas prices, average UK energy bills have fallen overall since 2008.]

A similar, if less extreme version of the UK decoupling of GDP and electricity use has been taking place in many other developed countries as their economies shift away from energy-intensive industries towards services and high-value manufacturing. This includes the US, where electricity demand has been flat for a decade after more than half a century of uninterrupted growth.

Manufacturing accounted for 17% of the UK economy in 1990, but this fell to 11% by 2005, with services picking up the slack. Manufacturing has held steady at 10% of the UK economy in 2017. Moreover, UK manufacturing output has been growing steadily since the financial crisis.

This shift towards a service-led economy initially saw growing imports of goods and their associated CO2 emissions. However, the outsourcing of UK emissions stopped growing around 2007.

Fossil fuel decline

The sources of UK electricity have shifted dramatically towards cleaner sources as generation has declined, with low-carbon supplies making up a record 53% of the total in 2018.

This was mostly down to strong growth for wind, up 16% to 58TWh in 2018, as the chart below shows (green line and area). This is nearly 3.5 times as much as the 17TWh from coal (black).

Annual electricity generation in the UK by source (terawatt hours). Source: BEIS, BM Reports, Sheffield Solar and Carbon Brief analysis. Chart by Carbon Brief using Highcharts.

The capacity of offshore windfarms nearly doubled over the course of 2018, with more set to open this year. Solar generation increased by 11%, reaching 13TWh in 2018 (yellow in the chart, above).

Biomass generation also increased by 13% in 2018 to 36TWh. This was due to the former coal plant at Lynemouth in Northumberland reopening to run on imported wood pellets and Drax in Yorkshire converting a fourth unit to burn the fuel.

The CCC recently recommended that the UK should “move away” from large-scale biomass burning over time. Subsidies for biomass burning at Drax, Lynemouth and other sites will come to an end in 2027.

Meanwhile, the combined share of UK electricity generation from fossil fuels fell to 46% in 2018, its lowest level ever, as the chart below shows (grey line). This was primarily due to another 25% fall in coal, scotching fears it could make a comeback this year after precipitous recent declines.

Annual electricity generation in the UK by type of fuel (terawatt hours). Source: BEIS, BM Reports, Sheffield Solar and Carbon Brief analysis. Chart by Carbon Brief using Highcharts.

Coal plants continued to close in 2018 and remaining stations ran fewer hours, despite the fuel having been expected to be favoured by high gas prices this winter. The UK has pledged to phase out all its coal plants by 2025 at the latest.

Gas generation was down 4% in 2018 to 132TWh (blue line). It remains the single-largest source of generation in the UK, accounting for 39% of the total last year. Gas is expected to be overtaken by renewables in the early 2020s and must contribute no more than 25% of the total by 2030 if the UK is to meet its legally binding climate goals.

Nuclear generation fell 7% in 2018 to 65TWh after cracks were discovered at two of Hunterston's reactors, keeping the site closed for an extended period. Nuclear is the single-largest source of low-carbon electricity in the UK but is in decline as ageing reactors are being retired. Barring life extensions, all but one of the UK's current nuclear plants will have closed by 2025.

Climate contributions

In total, UK renewable generation has increased by 95TWh since 2005 while savings in per-capita generation over the same period avoided 103TWh of extra electricity being needed.

These contributions have each helped avoid around 40Mt of annual UK CO2 emissions, compared to generating equivalent amounts of power using gas. Without this dual contribution, UK CO2 emissions would have been some 20% higher than the 368MtCO2 seen in 2017. If the power had come from coal, emissions would have been nearly 50% higher (+180MtCO2).

Lowering electricity use is not an end in itself, given the useful services it provides. But energy efficiency and renewable energy are both key elements of most pathways to meeting UK and global climate goals.

Forthcoming Carbon Brief analysis, due to be published later this month, will show that reduced electricity use, and the rise of renewables have been the two largest contributors to cutting CO2 emissions from the power sector in the UK since 1990. Coal-to-gas switching is the third-largest factor.

While continued reductions in UK electricity demand are likely in the short term, the CCC and others expect UK electricity demand to increase in the medium term, if climate goals are to be met.

This is because continued improvements in energy efficiency would be more than offset by increased demand from electric vehicles (EVs) and electric heat pumps. In effect, the UK would be electrifying part of the energy demand it currently meets using fossil gas and oil.

For example, the CCC's central scenario to 2030 anticipates electricity demand of 365TWh, up around 8% on 2018 levels. This allows for 2m heat pumps and 20TWh for EVs. Demand from road transport could eventually reach more than double this level, if the whole UK fleet switches to EVs.

Generation and supply

The figures in this article and analysis are based on UK electricity generation. This is the amount of electricity produced at power plants within the UK's borders. It includes

generation at pumped hydro stations, even though these are net electricity users after accounting for what is needed to pump water to their uphill storage reservoirs.

These figures align with the widely reported numbers published by BEIS in its quarterly Energy Trends chapter 5. BEIS also publishes figures on the amount of electricity supplied to the UK grid after accounting for power used on site – for instance, to run nuclear plant cooling equipment or coal pulverisers. This includes electricity imported to the UK from overseas via interconnectors.

On this measure, the UK imported around 6% of its electricity supplies in 2018, Carbon Brief analysis shows. Most of the UK's imported electricity comes from France, via the 2 gigawatt (GW) electricity interconnector between the two countries that opened in 1986.

The UK imported 4-6% of its power in the 1990s via this link. The share of imports in UK supplies halved during the 2000s before rising back to its current level of 6%. The UK also has a 1GW link to the Netherlands and a 0.5GW cable to Ireland. A 1GW link to Belgium is to open early this year.

After accounting for imports, the amount of electricity supplied in the UK in 2018 is about the same as that seen in 1995. UK electricity demand has fallen significantly since 2005, though the 47TWh reduction is slightly lower than the 65TWh fall in generation. This is because of increased imports.

A large number of new interconnectors are being developed and government projections suggest imported electricity could supply as much as a quarter of UK power by the mid-2020s.

Projections from the CCC assume net imports will average out to zero across each year in future. Instead, interconnectors would help to balance supply and demand between countries over shorter timescales, from minutes through to seasons.