Essex County Council

Greater Essex Local Area Energy Plan

City Science®
Delivering decarbonisation

Contents

Executive Summary

Plan on a Page – Essex LAEP - Balanced Pathway

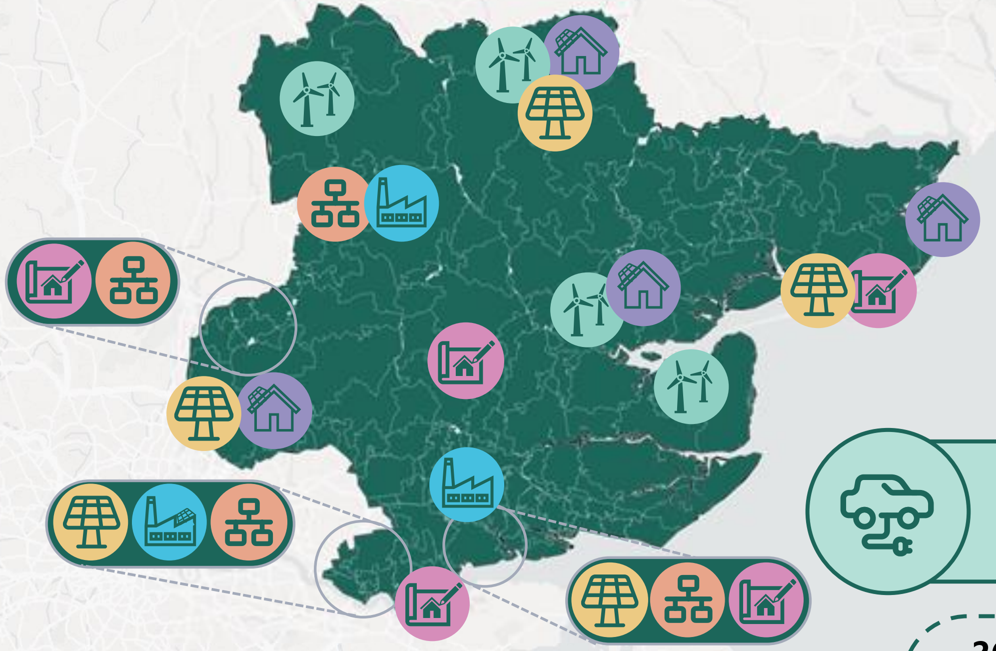
This page highlights the key milestones and interventions required for the Balanced Pathway. The map below presents a summary of the key identified Focus Zones for shallow retrofit, domestic and non-domestic roof-mounted PV, ground-mounted PV, onshore wind, and district heat networks (DHNs).

3,640 MW new and **4,540 MW** total onshore wind and solar by 2050

Total renewable generation will be **4,620 GWh/yr**, producing **28%** of 2050 electricity demand

56 ktCO₂e emissions remain in 2050

99.6% reduction from the baseline



Data centres could produce **5.8 TWhth** of waste heat, equivalent to **750,000** homes

16,800 GWh of electricity demand in 2050

Electricity demand is **2.56x** the baseline

1.32m EV cars by 2050

26,300 public EV charge points to install

144,500 shallow domestic retrofit measures by 2050

Focus Zones Key

- Shallow Retrofit
- Non-domestic Rooftop PV
- Domestic Rooftop PV
- Onshore Wind
- Ground-mounted Solar PV
- District Heating Networks

Executive Summary: Energy and Emissions

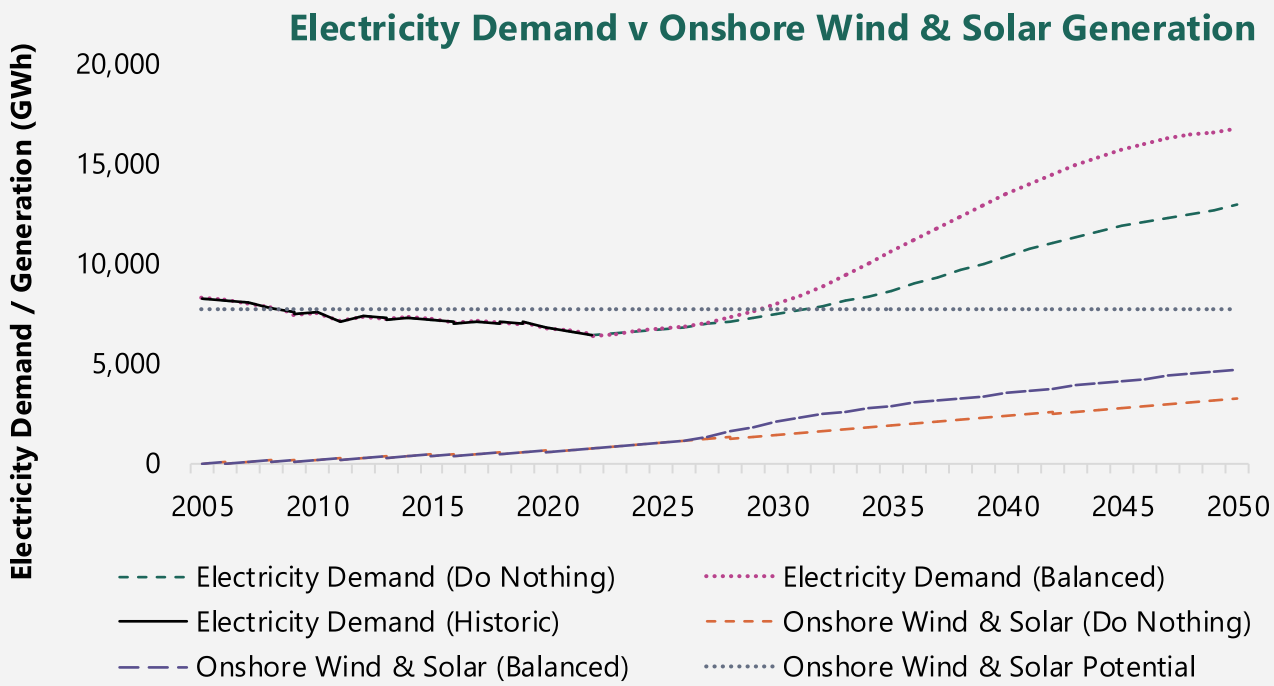
Essex County Council (ECC) has a commitment to a strong and inclusive economy, ensuring sustainable growth in Essex. The Local Area Energy Plan (LAEP) will form an important evidence base for regional energy planning, including the upcoming Spatial Development Strategy. It will also contribute toward targeting grid investments ahead of need by highlighting focus zones and supporting the unlocking of investment as part of the National Energy Systems Operator’s (NESOs) Regional Energy Strategic Plan (RESP) for the East region. This LAEP will further support ECC's ambitions for a just transition alongside health benefits such as cleaner air and warmer, healthier homes.

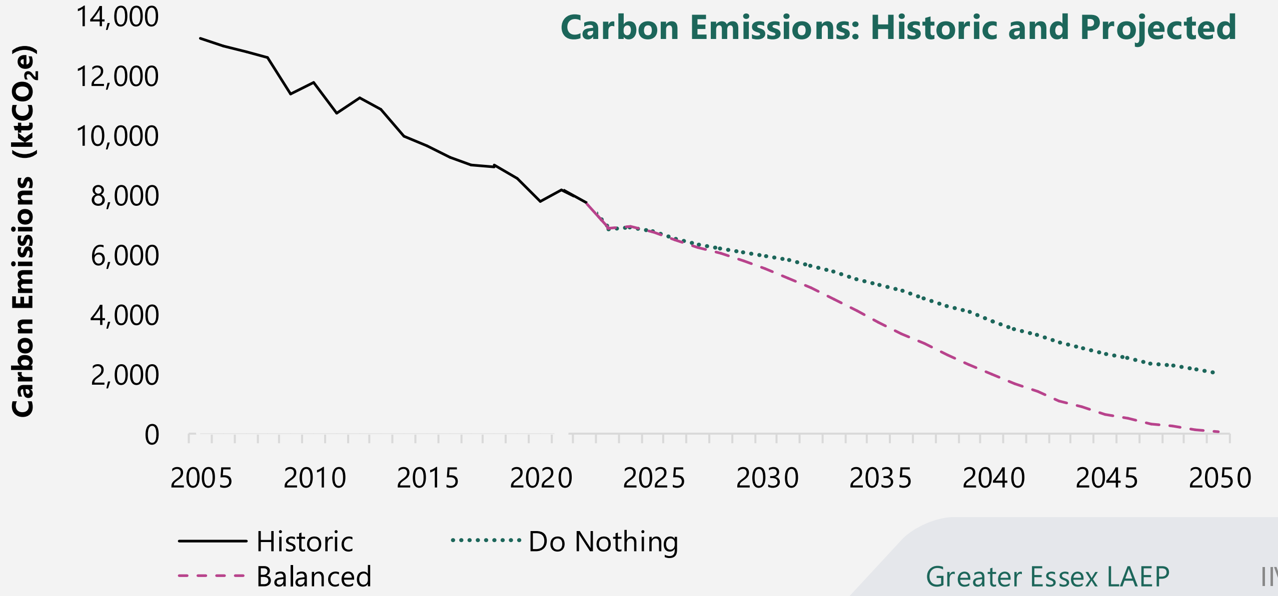
Balanced Pathway

The Balanced pathway set out in this LAEP sees the electricity demand increase **x2.56** from 2022 to 2050. Onshore wind and solar capacity increases **x4** with **3.6 GW** of new capacity, able to meet **28%** of all building and transport electricity demand. The remaining demand is met by other local renewables, offshore wind, and the transmission network.

2050 energy demand:
16.8 GWh,
down 49% from
33.1 GWh in 2022

2050 emissions:
56 $ktCO_2e$,
down 99% from
7 $MtCO_2e$ in 2022





Executive Summary: Technology Adoption

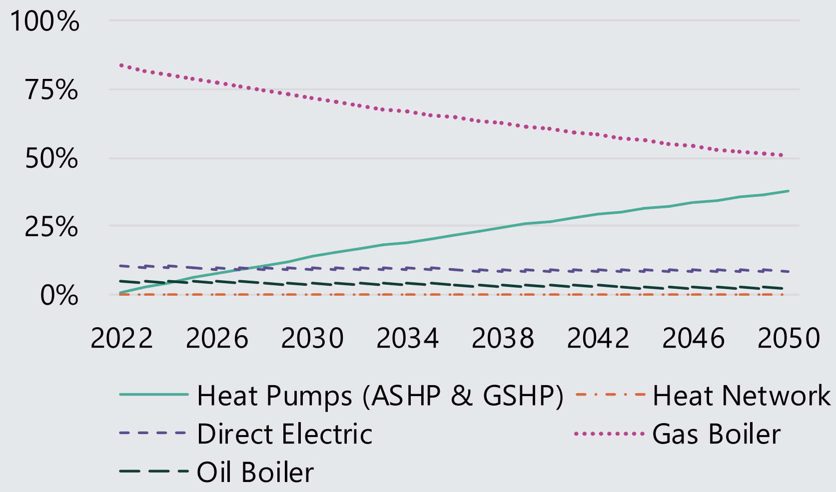
The uptake of heating systems, electric vehicles and charging infrastructure is visualised for the Do Nothing and Balanced pathways considered throughout this LAEP.

Heating Technologies

Technology Mix as % of Domestic Properties

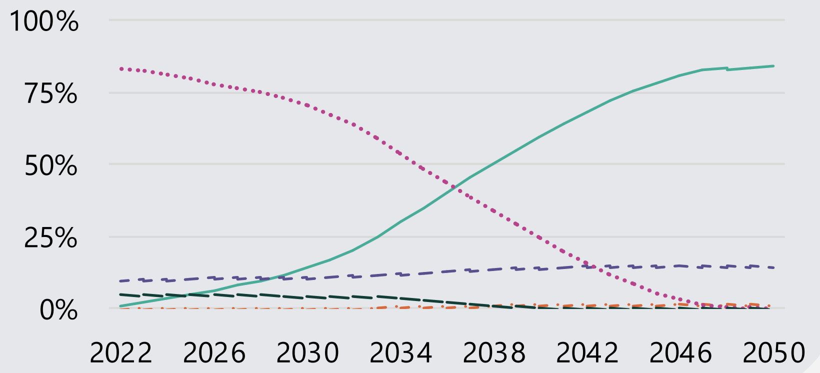
Do Nothing

Gas and oil boilers are partially replaced by heat pumps, with modest uptake rates. By 2050 there are still 54% properties being heated from fossil fuel boilers.



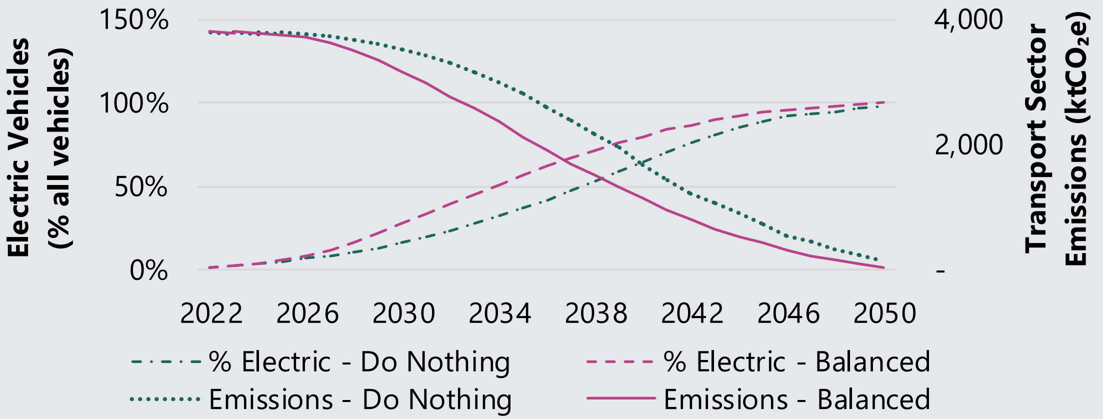
Balanced

Gas and oil boilers are fully phased out by 2050 as heat pump adoption increases sharply from 2030, with peak install rates of 44,000 per year in the mid 2030's.

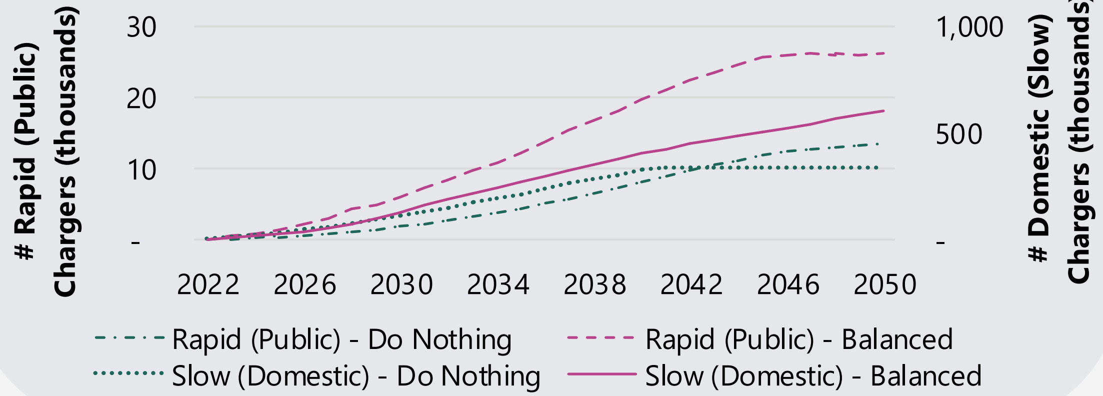


Transport

Electrification and Emissions



EV Charger Installations



1. Introduction

Introduction to the Document

This is the Local Area Energy Plan (LAEP) summary report for the Greater Essex area prepared by City Science on behalf of Essex County Council.

This LAEP was crafted through significant stakeholder engagement, adhering to the first five stages of Energy Systems Catapult's LAEP guidance[1]. This LAEP provides insights into regional and local focus zones, identifying a pathway to a low carbon economy and providing a knowledge base to engage with the market, develop a roadmap and a pipeline of projects. Earlier chapters provide a comprehensive overview of the current energy system in the Essex area. Later chapters consider future energy scenarios, and the nature of the potential energy system changes required, ultimately providing long term guidance on key interventions and areas of focus required to transition to a low-cost, low-carbon and secure energy future.

This report delivers technical insight in a format that is easily digestible. We first outline the modelling approach that we took before outlining our findings. We have also identified a set of "focus zones" and "quick wins" — practical, readily implementable measures that can deliver significant energy savings and improve the quality of life and conditions for residents and businesses across Essex.

Local Context and Energy System

Provides an overview of the local context (such as demographic and socio-economic factors), and the current energy system. The information provides a benchmark against which energy transition progress can be measured.

Decarbonisation Pathway

Presents a comprehensive vision for Essex's future energy system, outlining the pathway to a low-carbon economy, analysing energy, carbon and cost implications across buildings, road transport and local renewable generation.

Focus Zones

Identifies "Focus Zones": areas suitable for energy interventions on a large scale. This enables efficient and targeted analysis, support and market engagement in areas of highest suitability and impact.

Wider Factors

Understanding the non-technical barriers faced by the Council through workshops with key stakeholders across local authorities and the wider energy system, thematic analysis and a discussion of how these barriers may be overcome.

What is Local Area Energy Planning?

LOCAL AREA ENERGY PLAN (LAEP)

Sets out the changes required to decarbonise an area's energy system against a specified timeframe. This is achieved by exploring a range of technologies and scenarios through whole energy system modelling and analysis. By identifying the preferred pathway to a decarbonised energy system, additional benefits for the local area can be realised.

The LAEP Process

Three key delivery stages in the analysis are shown in the diagram below, each building on the previous, to develop a clear, evidence-based plan for implementation. By integrating these stages, this LAEP provides a practical roadmap for the transition to a sustainable local energy system.

Being data-driven and evidence-based, this LAEP uses a whole energy system approach that is led by local government and developed collaboratively with defined stakeholders. It sets out to identify a locally defined route to future energy security, as well as contributing towards meeting the national emissions reduction target.

Essex LAEP Approach →

Data, Mapping, Analysis & Stakeholder Engagement

Understanding the current system
"Where are we now?"

↓

Future Energy Systems
"What could happen?"
"Where are we going?"

↓

Developing a Transitional Pathway: The Balanced Pathway
"How do we decarbonise by 2050?"

Whole Systems Approach

By working closely with local stakeholders, incorporating their data, knowledge and future plans, a LAEP is built on a common evidence base. The outputs can then be used reliably by all stakeholders knowing they are working towards a common goal built on strong foundations.

Stakeholder Engagement

Engagement Process

Stakeholder Mapping & Planning Workshop
↓
Disseminate Modelling Approach
↓
Scenarios & Pathways Workshop
↓
Pathways Results Workshop
↓
Wider Factors Workshop
↓
Priority Interventions Workshop
↓
Final Presentations

Effective stakeholder engagement is essential to developing a high-quality LAEP. Securing buy-in from diverse stakeholders results in a comprehensive, balanced, and implementable plan that reflects the area's varied needs.

The extensive stakeholder engagement process used for this LAEP is shown on the left.

Scope of Essex LAEP

Local Authorities, alongside anchor institutions, local businesses and residents, have an important role to play and must work collectively to build a cleaner, healthier future for Essex. This LAEP assessed current energy consumption and associated greenhouse gas emissions, and projects future consumption in a defined area to 2050.

Local Area Energy Planning has less emphasis on aspects of the energy system which are expected to be overseen by central government, e.g. large electricity generators connected to the transmission network are aspects considered to be national rather than local. This LAEP confines its assessment to energy-related greenhouse gas emissions, which account for 89% of all emissions in Essex.

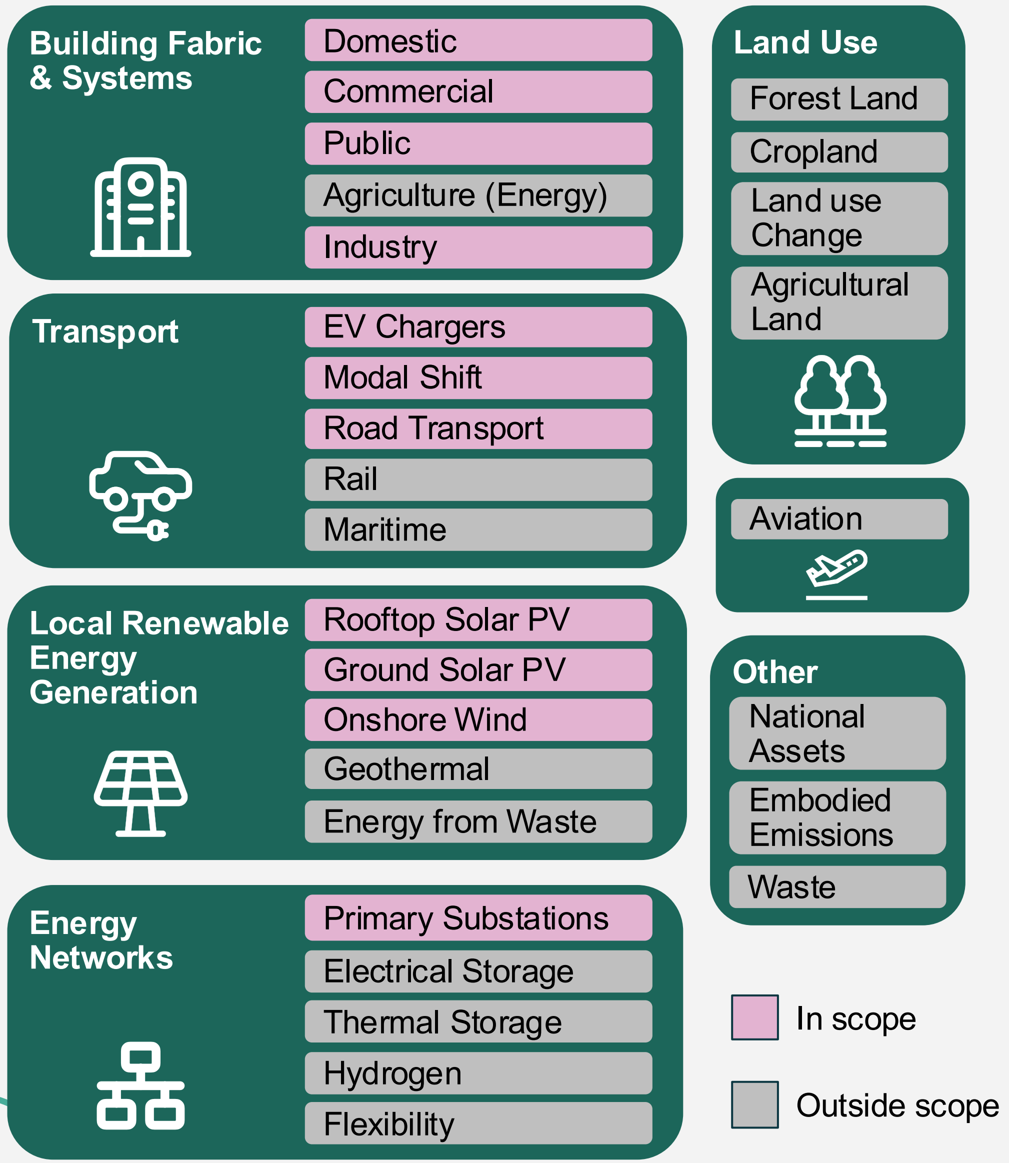
This LAEP considers the current energy system, planned changes, and changes which are needed to transition to a low-carbon economy. Site-specific data is used where available, with remaining areas covered by national datasets.

This Scope

This LAEP focuses on demand and generation sectors most relevant to Essex, ensuring that interventions identified from this analysis have the most relevance and impact for Essex. This study focused on:

- Building demand across all sectors, and how it is expected to change to 2050.
- Fabric improvements for domestic, public and commercial buildings.
- Road transport, with a focus on electrification.
- Renewable generation, including onshore wind, roof-top and ground-mounted solar PV at both grid- and local-scales.
- Electricity grid infrastructure, focusing on generation capacity constraints.

The scope of this LAEP considers **89%** of all energy related emissions in Essex.



Essex County Council

2. Baseline

Local Context & Characteristics

Greater Essex is the 7th most populous English county. The county borders Greater London, and its key centres sit within typical commuting range of the City: Basildon (40 km), Chelmsford (48 km), Southend-on-Sea (58 km), Colchester (80 km). Transport links along the A12/Great Eastern Main Line corridor and the Thames estuary have fostered strong functional ties to London. Land use is predominantly agricultural whilst urbanisation is polycentric and corridor-based, concentrated along the Thames Gateway (Thurrock, Southend-on-Sea, Basildon) and the A12 corridor (Chelmsford, Colchester)[1].

Average population density of **508** residents per km²

1.87 m Total population[2]

29% of the East of England population

County Key Employment Sectors[2]

15% Retail

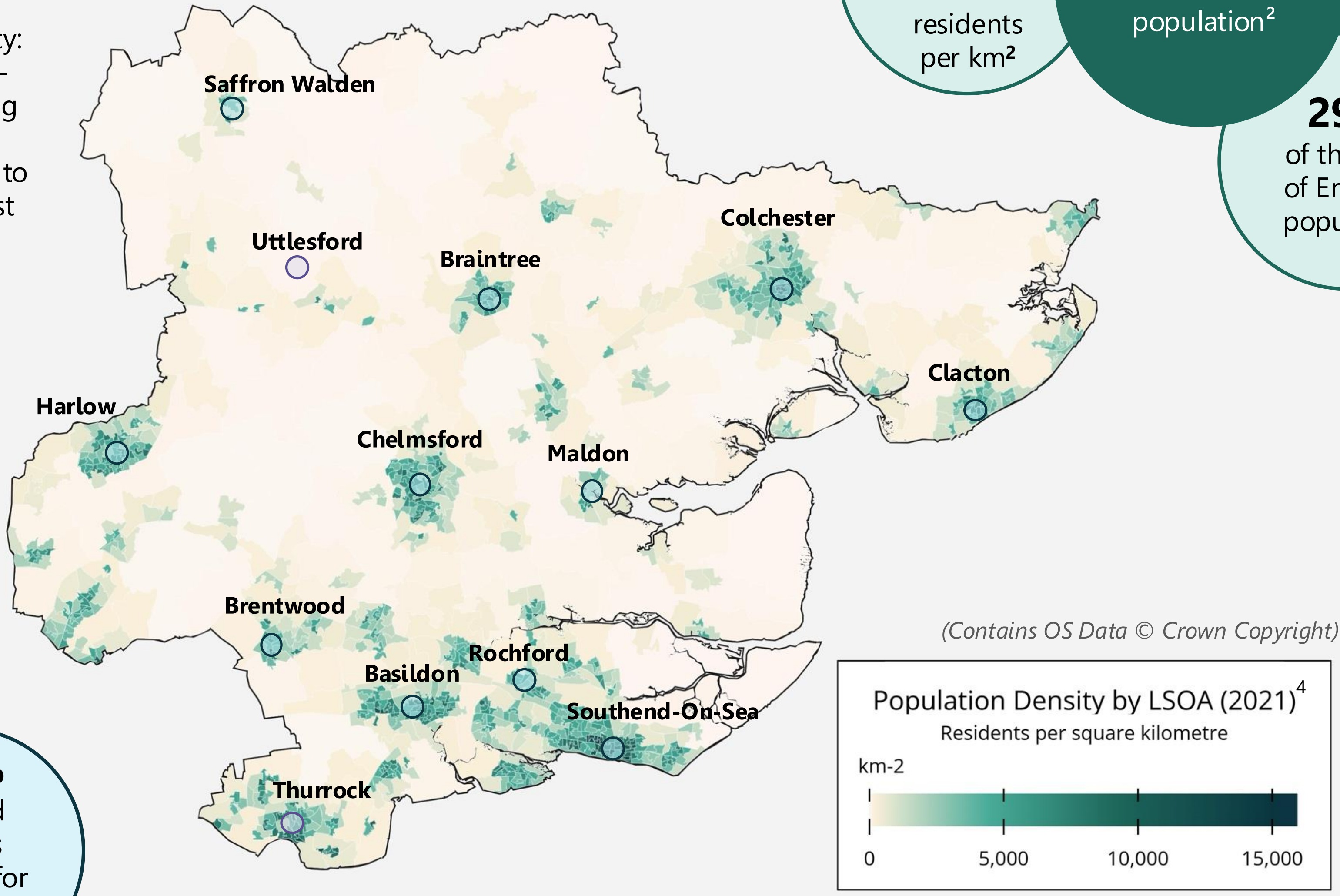
14% Health

12% Construction

61% of the total population is economically active

3,674 km² Total Land Area

68% of land area is graded for agricultural use[3]



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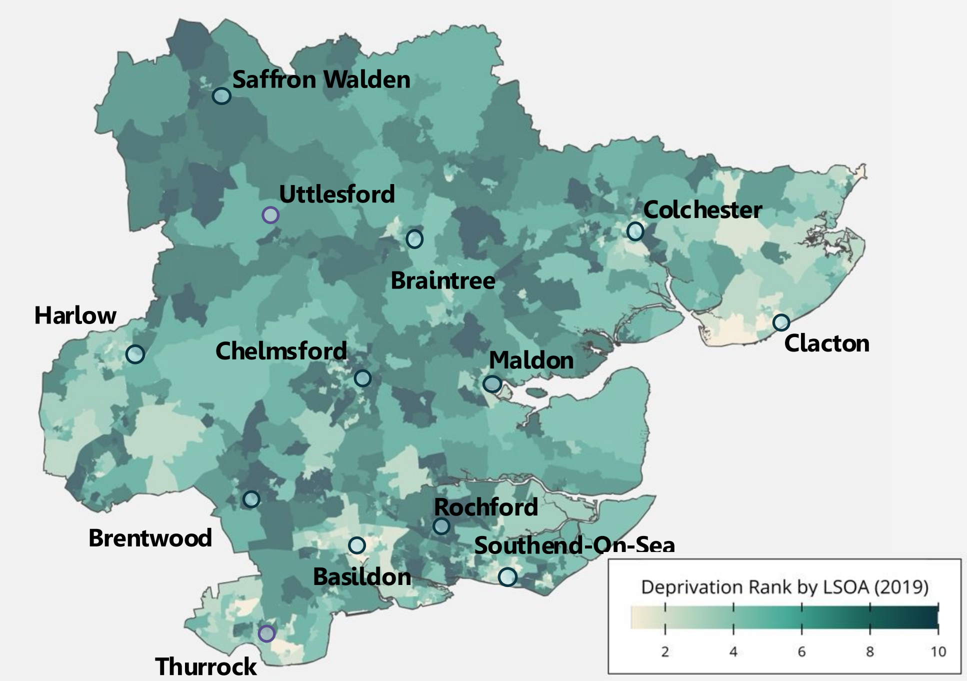
Fuel Poverty & Deprivation

** A household is under the fuel poverty line if its residual income, after housing costs and energy needs, is below 60% of the national median.*

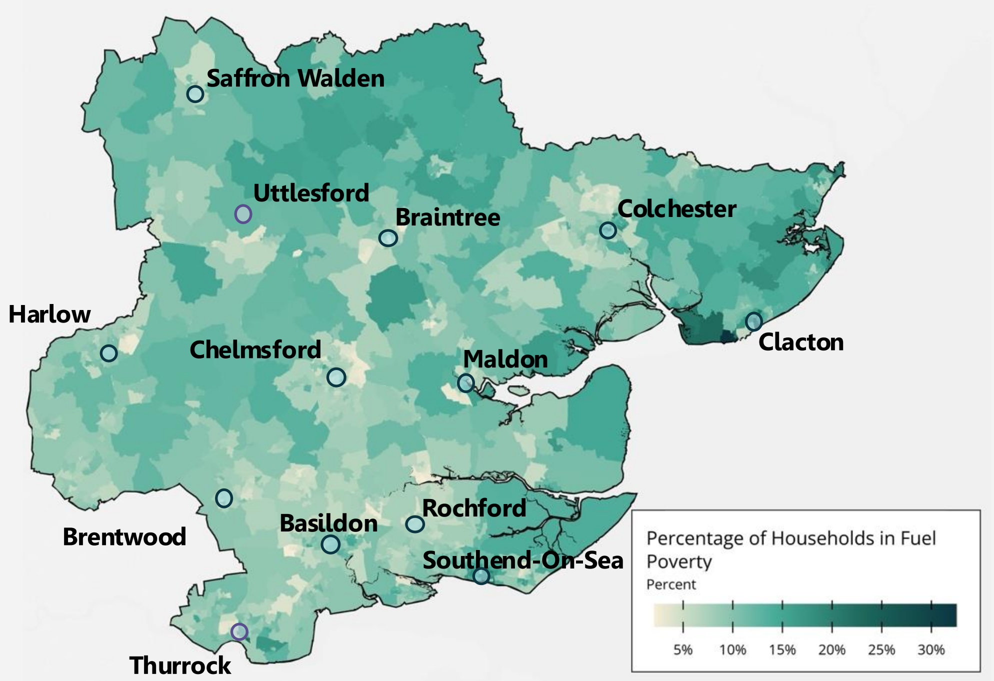
The level of deprivation in an area can be measured using the Index of Multiple Deprivation (IMD)[5]. This assesses deprivation across four dimensions: education; employment; health and disability; and housing. Across the Greater Essex area, 34% of households are deprived in at least one of these dimensions. The areas with highest percentage of households experiencing deprivation in at least one dimension include Uttlesford (58%), Brentwood (55%), and Chelmsford (54%).

Fuel poverty in England is measured using the Low Income Low Energy Efficiency (LILEE) definition: a household is fuel poor if it has a residual income below the poverty line* after housing and energy costs, and lives in a home with an energy efficiency rating of D or below. 10% of households (~75,800) were reported to be experiencing fuel poverty across Essex in 2024 (2022 data). This is the same as the East of England average (10%)[6].

Percentage of households deprived in at least one of the four dimensions of deprivation: **34%**



Percentage of households experiencing fuel poverty across Greater Essex: **10%**



Local Authorities with the highest percentage of households in fuel poverty:

- Tendring **14%**
- Southend-on-Sea **12%**
- Maldon **10%**
- Braintree **10%**
- Thurrock **9%**

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Greenhouse Gas Emissions

Summary

	Emissions Decline (2005-2022)	Percentage of Total (2022)
Total Emissions	41%	100%
Road Transport	14%	46%
Domestic	48%	30%
Commercial	62%	11%
Industry	59%	9%
Public Sector	59%	3%
Agriculture (Energy)	1%	<2%

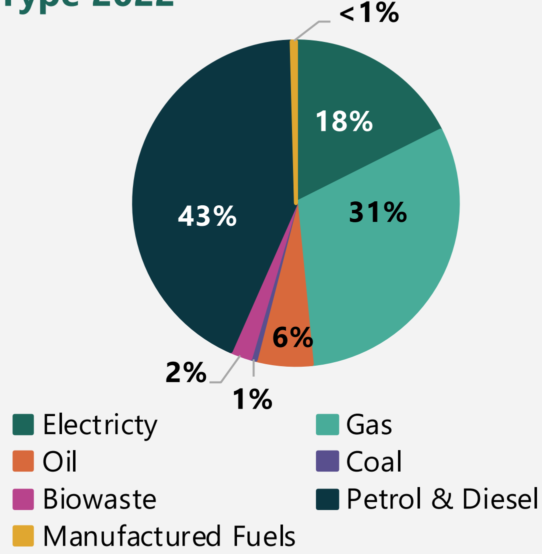
2022 has been used as the base year as this was the most recently updated year in the DESNZ data[8]*.

Essex County's Greenhouse Gas emissions have reduced by **41%** largely due to electricity grid decarbonisation

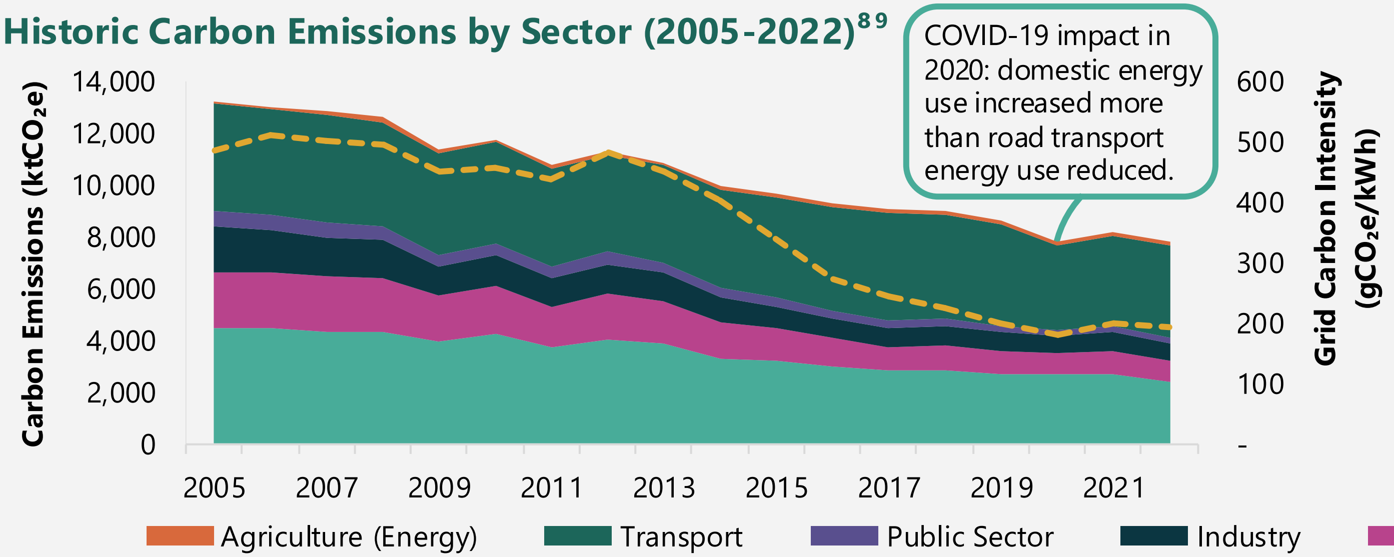
2005 ↓ 2022

7,800 $ktCO_2e$ emissions remain (2022)

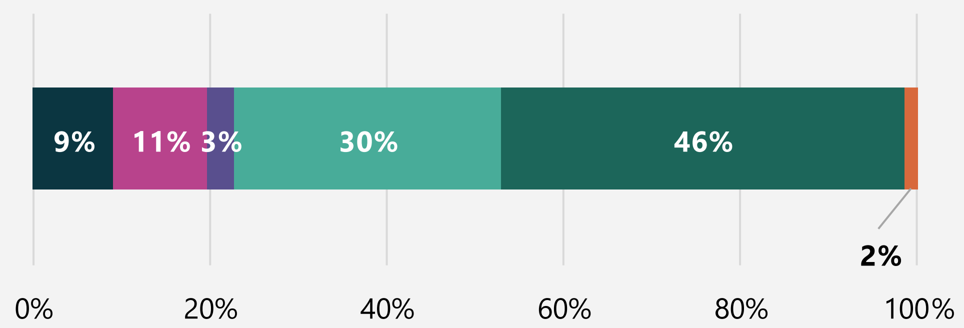
Carbon Emissions by Fuel Type 2022



Historic Carbon Emissions by Sector (2005-2022)[8,9]



Carbon Emissions Breakdown by Sector (2022)[8]



* *See Technical Annex for detail on data sources and methodology.*

Energy Demand

The largest sector of energy demand in Essex is from road transport, accounting for 15,000 GWh per year. Domestic and non-domestic gas consumption is in decline, resulting from energy efficiency interventions and installations of more efficient, low-carbon heating technologies.

Coal use has become negligible in Essex, and biofuels represent a small energy source. These patterns reflect technological improvements and a general trend towards electrification in heating. As electric vehicle (EV) costs continue to decline, it is expected to see transport fuel shift to electric.

Energy use across Essex **reduced** by

41%

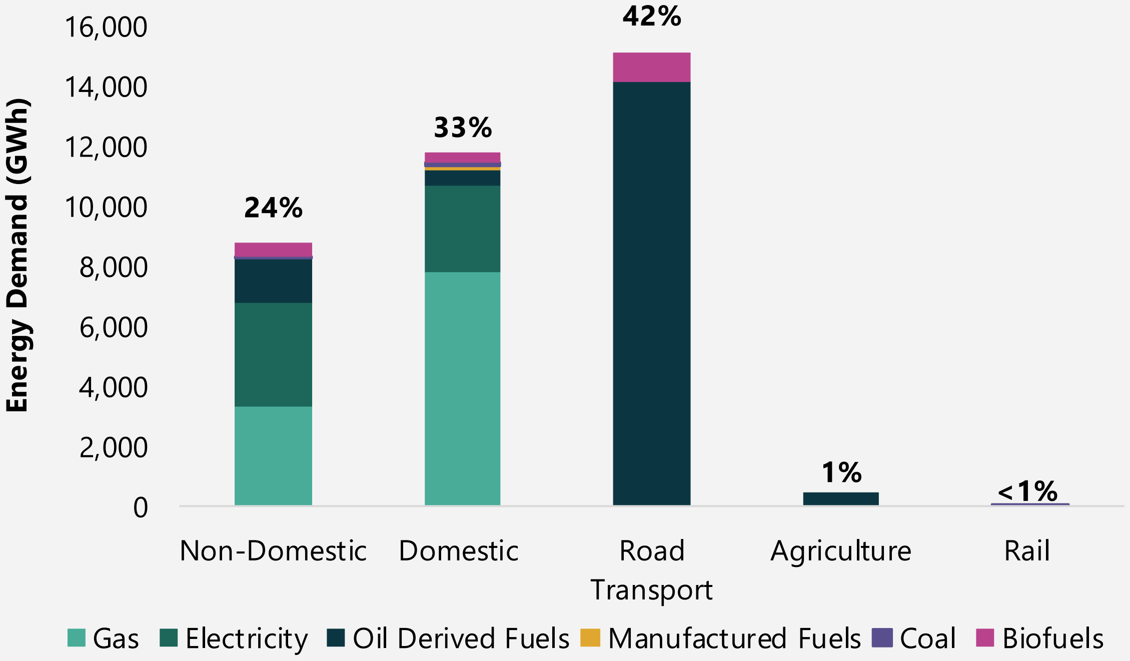
between 2005 and 2022.

Essex used: **36,170** GWh of energy in 2022

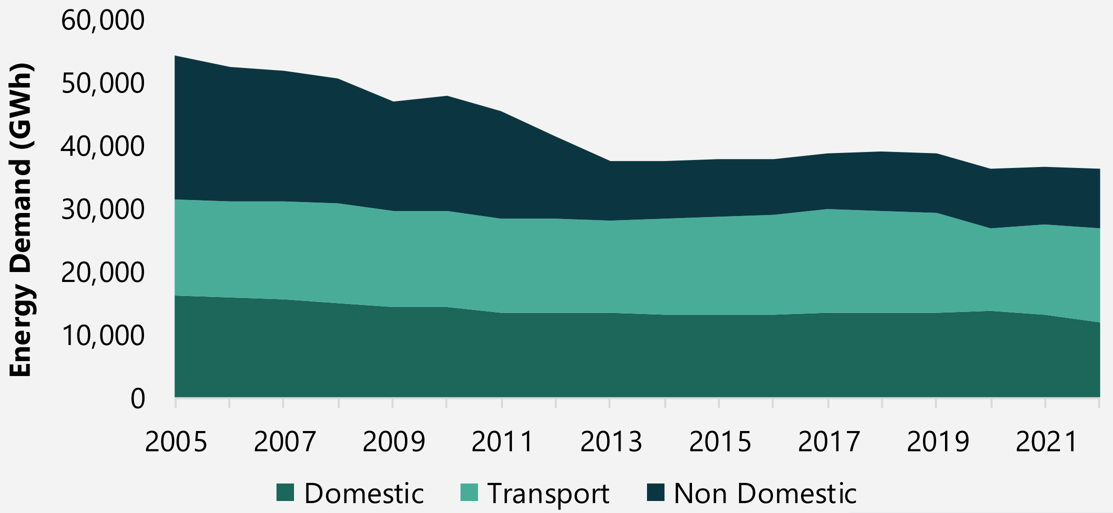
2.5% of the total energy consumed in England 2022

Essex consumes 27% of the East of England's' electricity

Energy Demand by Sector and Fuel Type (2022)[8]



Historical Energy Demand by Sector (2005-2022)[8]

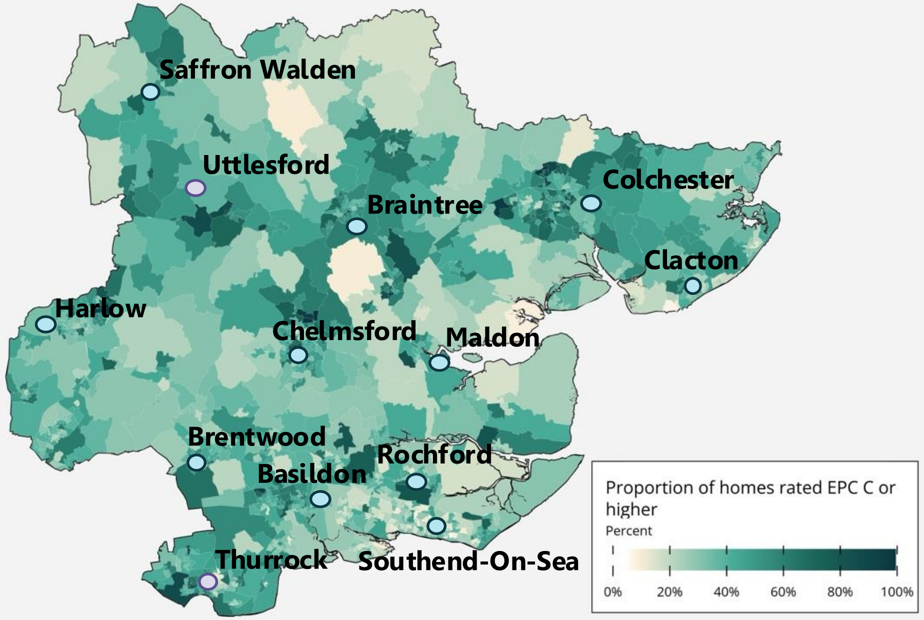


Energy Demand: Domestic Sector

Context

Energy Performance Criteria (EPC) Ratings: The proportion of the 839,000 domestic properties in Essex with an EPC rating of C or higher varies significantly between local authority districts. There are notable regional disparities, with areas with the lowest proportions (e.g. Castle Point (26.2%) and Southend-on-Sea (30.1%)) requiring further investment and policy focus to improve energy efficiency. Areas with the highest proportions are Colchester (54.2%) and Harlow (50.4%)[10].

Heating Systems: Gas is the dominant heating fuel, especially in the more urban South Essex, which is typical for the UK. Off-grid areas, especially in the North of Essex, are dominated by oil heating systems. Electric heating is dominant in some smaller urban Lower Layer Super Output Areas (LSOAs), often those with blocks of high-rise flats. Data sources, analysis approach, and assumptions used are outlined in the technical annex.



Energy Demand

Essex had 32% fewer retrofit installations, reported under the Energy Company Obligation (ECO) scheme, than the UK average between 2013 and 2024[11].

The domestic sector accounted for ~**33%** of energy use at

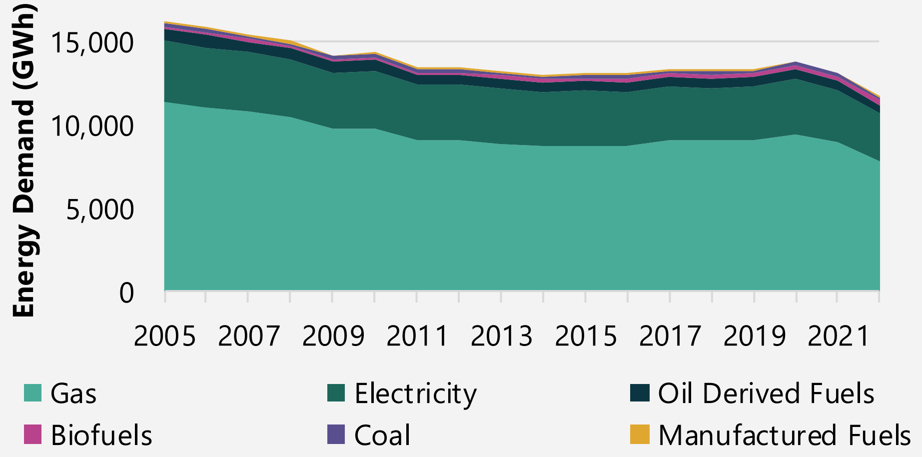
11,900

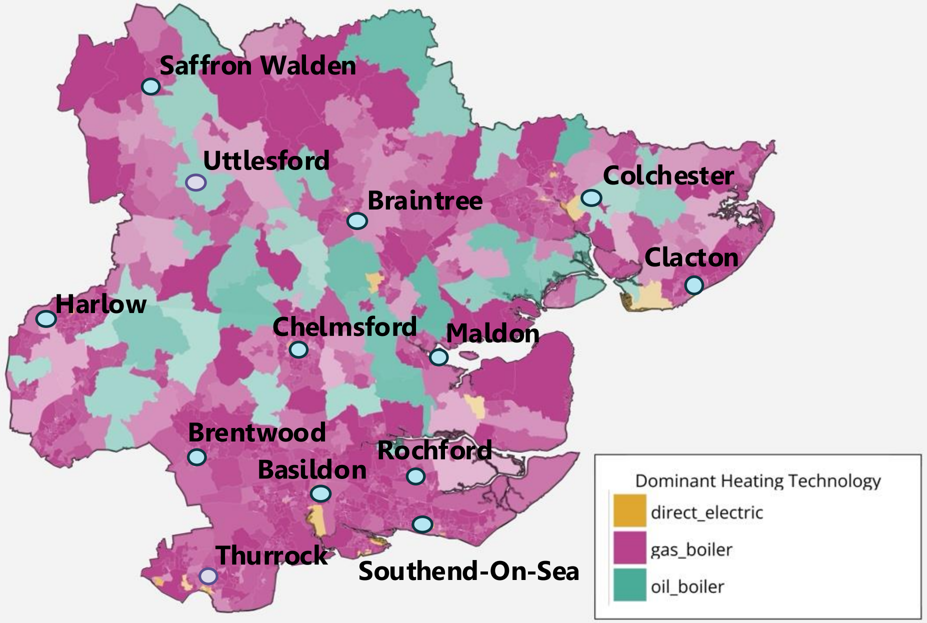
GWh (2022)

Energy use reduction of 29% from 2005 to 2022

84% gas
11% electricity
5% oil
<1% other*

Domestic Energy Demand (2005-2022)[8]





* By comparison, the UK average is 66% gas, 23% electricity, and 7% oil.

Energy Demand: Non-domestic Sector

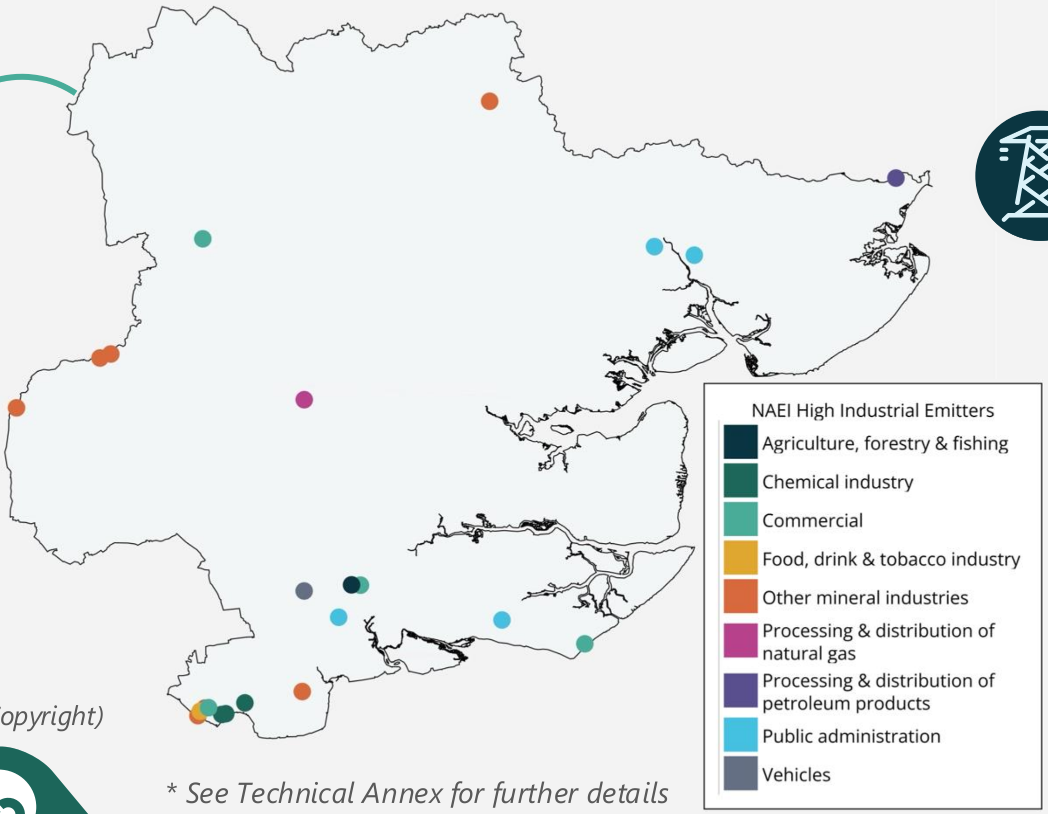
The non-domestic sector combined, accounted for ~**24%** of energy use at **9,210** GWh (2022)

This includes the industrial, commercial and public sector

Non-domestic electricity demand totalled **3,480 GWh** in 2022

Non-domestic gas demand totalled **3,320 GWh** in 2022

The National Atmospheric Emissions Inventory (NAEI) point-source emissions dataset[12] highlighted 21 large emitters in Essex County, producing 207 $ktCO_2e$ (11% of all non-domestic emissions)*. These emissions are from fuel combustion on-site.



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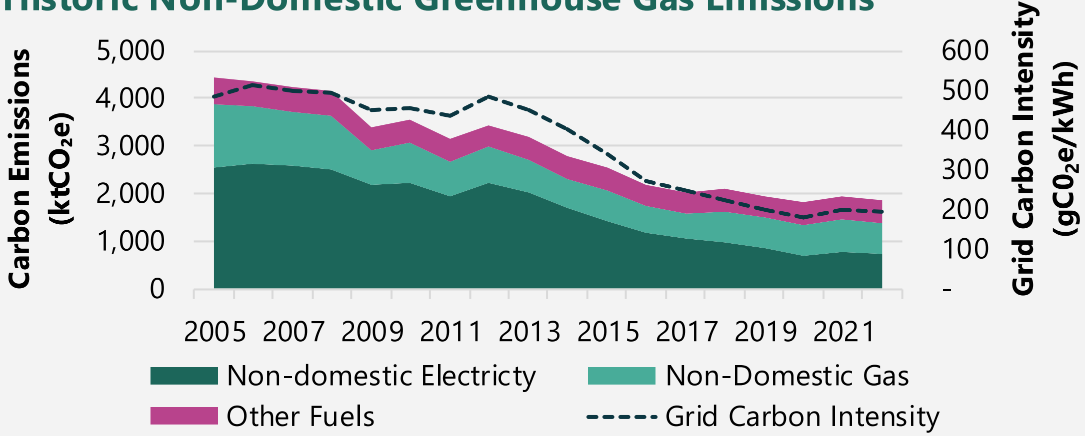
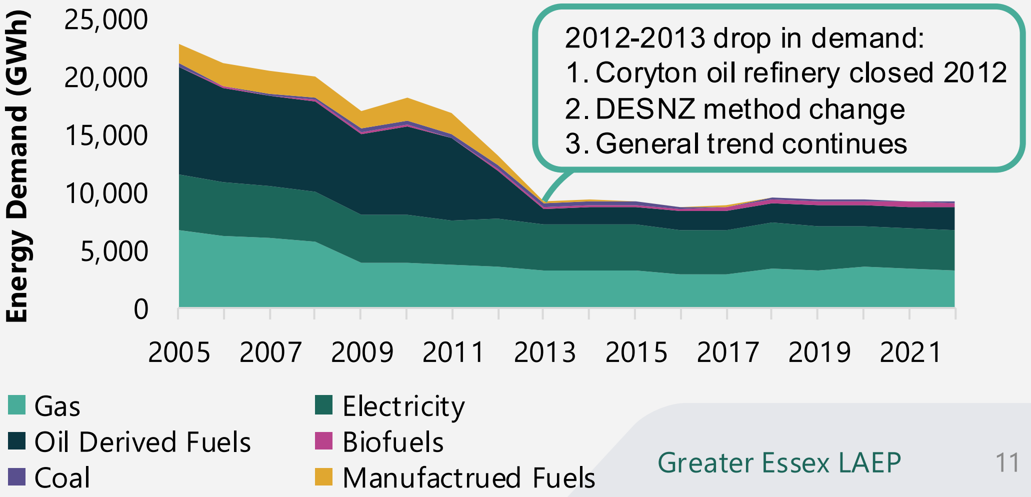
** See Technical Annex for further details on NAEI industrial emitters.*

Historic Non-Domestic Greenhouse Gas Emissions[8]



The non-domestic sector across Greater Essex experienced a **59%** reduction in emissions **(2,700 $ktCO_2e$)** between 2005 and 2022, primarily due to the decarbonisation of the national electricity system.

Historic Non-Domestic Energy Demand[8]



Energy Demand: Transport Sector

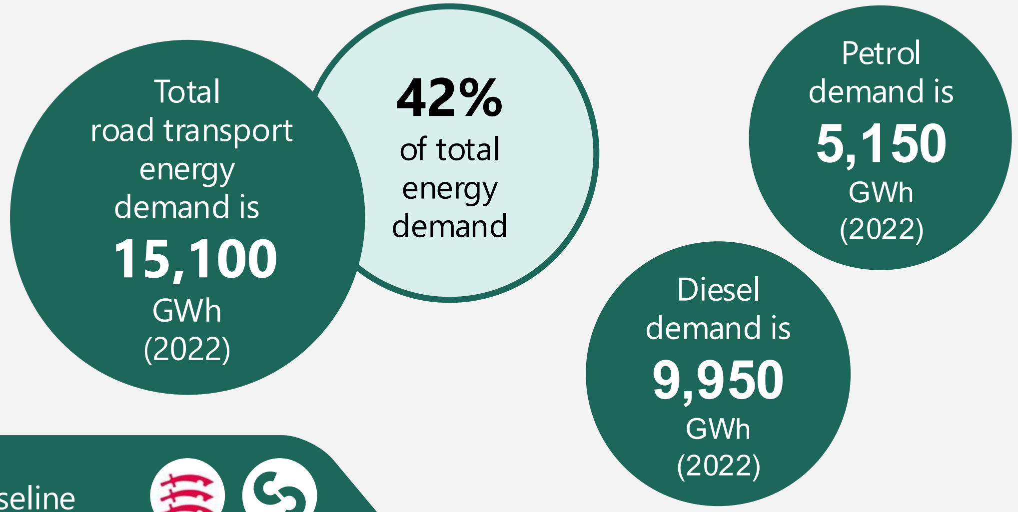
Context

Essex has a total of 1.2m vehicles, with <4% of them being plug-in vehicles (44,710). Of the plug-in vehicles, 24,540 are Battery Electric Vehicle (BEV) cars, 980 are BEV light goods vehicles (LGVs), 10 BEV heavy goods vehicles (HGVs), and 13 BEV buses or coaches[13 14].

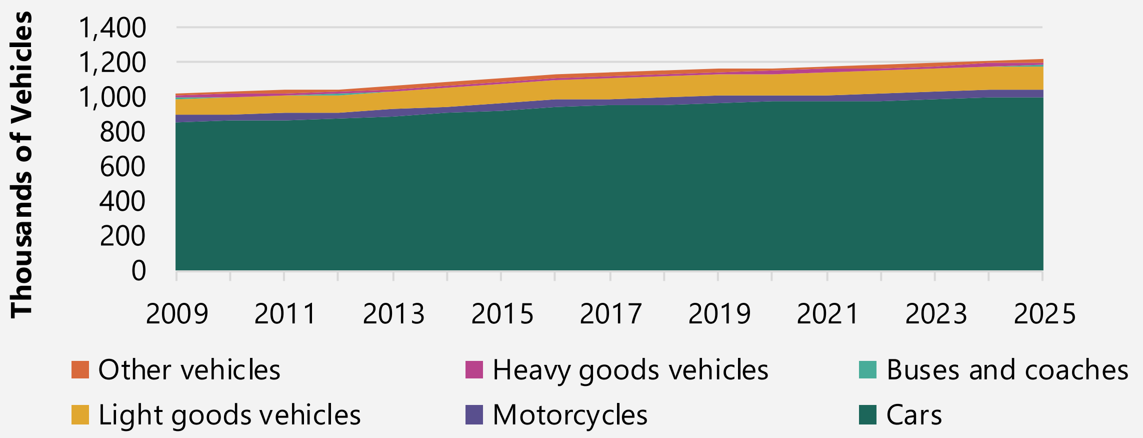
Energy Demand

Between 2005 and 2022, road transport energy demand was consistent, increasing by only <1%. However, there was a sharp decline in energy demand in 2020 due to the COVID-19 pandemic, which resulted in fewer transport journeys across the UK. Reduced road transport energy demand continued until 2022, when transport use returned to pre-2020 levels. Additional changes include:

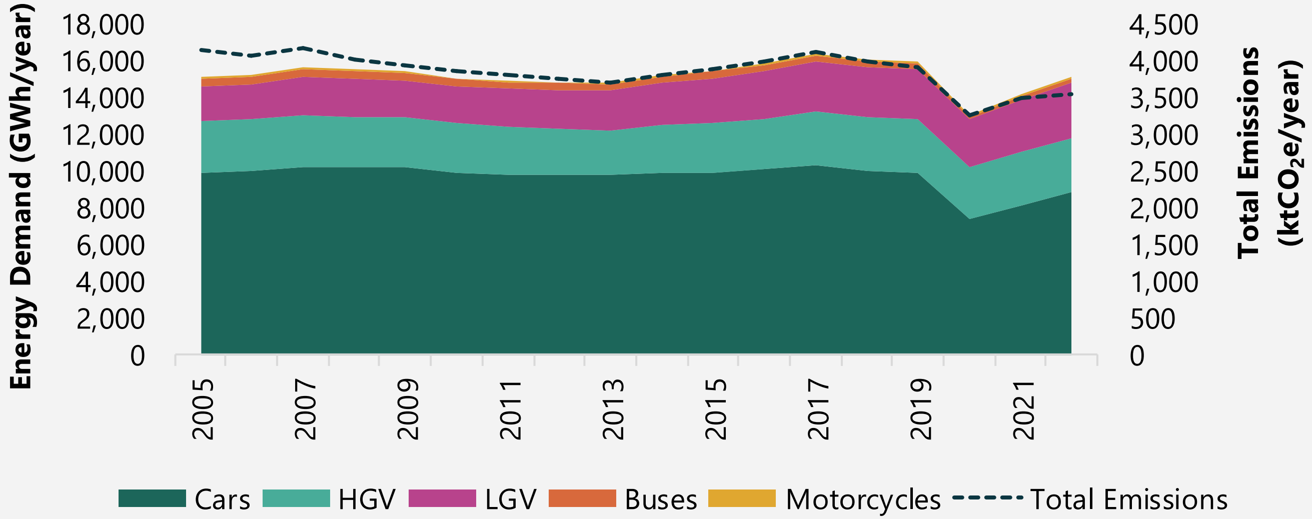
- Energy demand declined for cars (11%), motorcycles (18%) and buses (44%) between 2005 and 2022.
- LGVs and HGVs energy demand all increased (58%, 5% respectively)



Historical Road Transport Registered Vehicles by Type (2009-2025)[14]



Historical Road Transport Energy Demand by Vehicle Type (2005-2022)[15]



Renewable Energy Installations

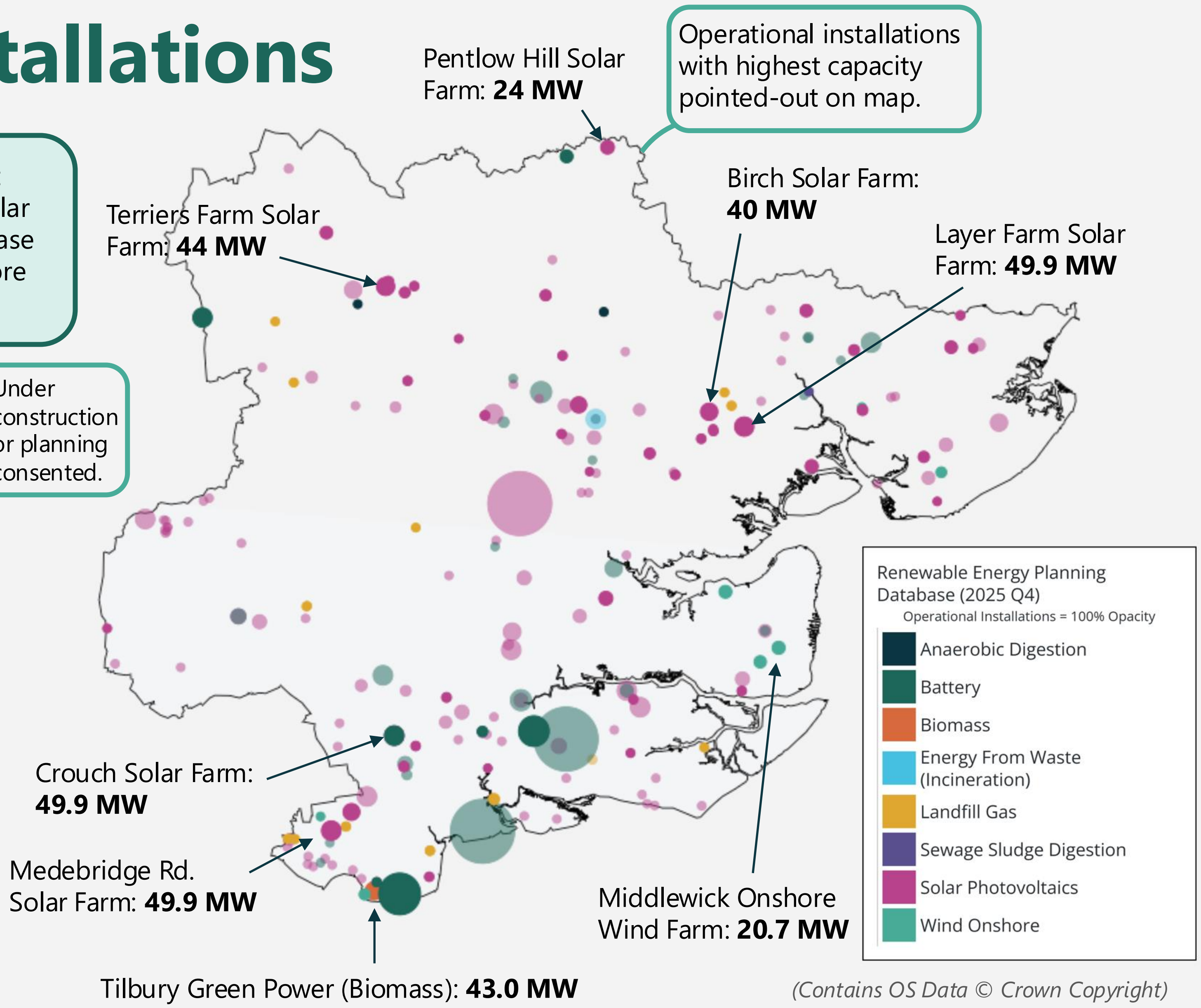
Essex county's total operational onshore renewable generation capacity is **1,038 MW**, of which **906 MW** comes from onshore wind, ground- and roof-mounted solar.

CCC 7CB[16] says that from 2024-2050, solar capacity must increase by 530% and onshore wind by 230%.

Operational Capacity by Technology[17 18 19]

Under construction or planning consented.

Technology	Existing	Pipeline
Ground-mounted Solar	459 MW	1,471 MW*
Onshore Wind	83 MW	0 MW**
Landfill Gas	79 MW	0 MW
Battery Storage	233 MW	935 MW*
EfW Incineration	0 MW	78 MW
Biomass	43 MW	0 MW
On-roof Solar	364 MW	24 MW
Offshore Wind	187 MW	0 MW**
Sewage Sludge	5 MW	0 MW



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** 500 MW of this ground-mounted solar and battery storage capacity is from Nationally Significant Infrastructure Projects (e.g. Longfield Solar Farm)*

*** North Falls (504 MW) and Five Estuaries (300+ MW) in planning*[20 21]

Energy Infrastructure: Electricity

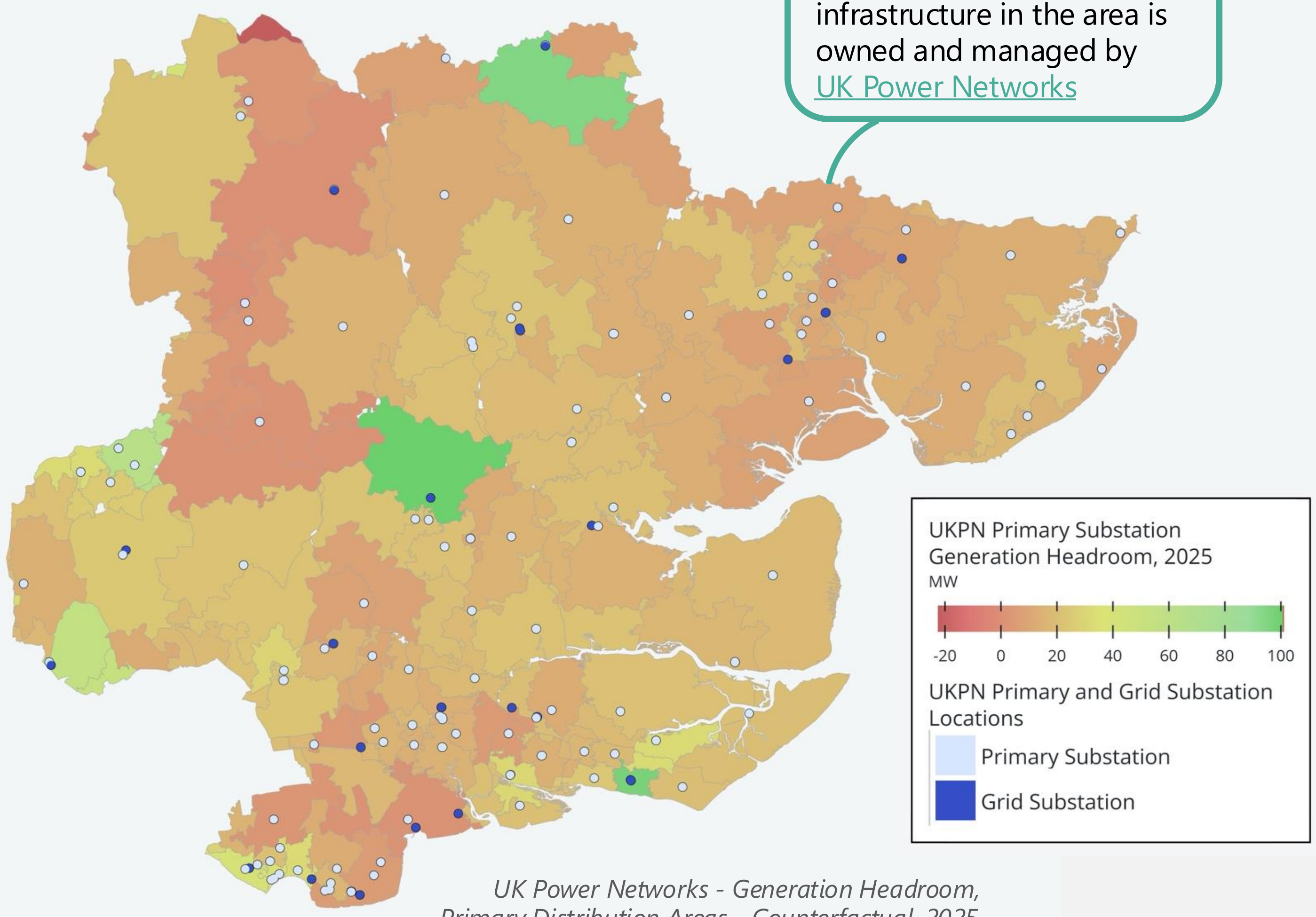
The generation headroom on the electricity grid infrastructure is mapped at primary substation level based on data from UKPN[22]. High headroom indicates an opportunity to connect a renewable generation project at 11kV to a primary substation. Primary substation headroom is indicative and may be reduced by upstream constraints; a formal G99 application is always required.

The total **3.32 GW** of available headroom across Greater Essex is sufficient to triple the existing capacity of renewables.

UKPN's LAEP+ platform contains additional grid data and electricity distribution infrastructure in the area is owned and managed by UK Power Networks

Primary Substation Constraints

- The Greater Essex area is served by **179** primary substations (11kV), **14** bulk supply points (BSPs, 33/66kV) and **5** grid supply points (GSPs, 132kV)
- **6** primary substations are more than 5% overloaded
- **3** primary substations are between 5% overloaded and 5% headroom
- **170** primary substations have more than 5% headroom
- Over the whole of Greater Essex, there is a total **3.32 GW** of generation headroom at primary substations under the UKPN Counterfactual scenario for 2025.
- The constraint season is listed as winter for 84% of primary substations.



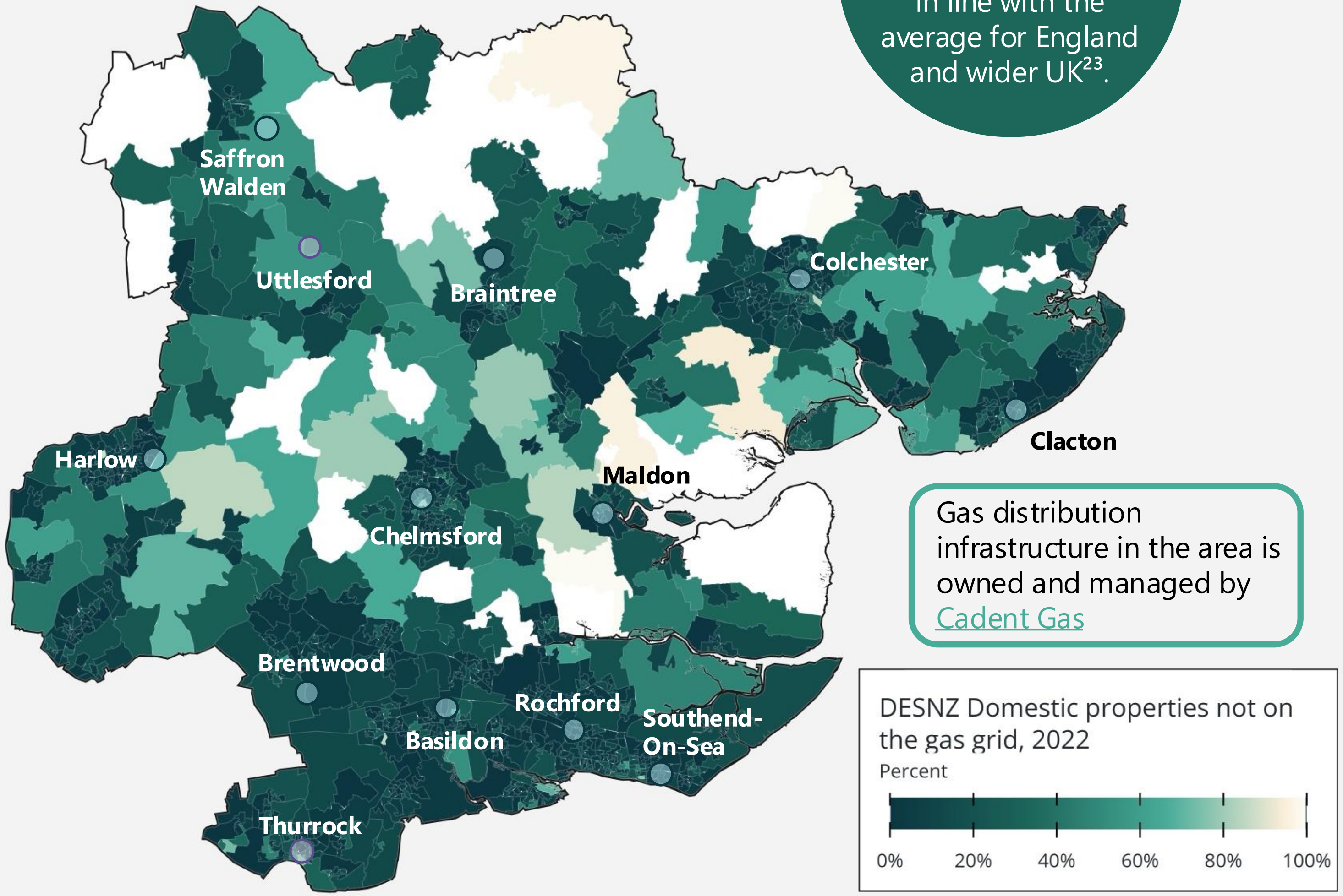
UK Power Networks - Generation Headroom, Primary Distribution Areas - Counterfactual, 2025 (Contains OS Data © Crown Copyright)

Energy Infrastructure: Gas

Summary

- Areas shown in white are areas which have no gas network connections.
- Properties in urban areas are most likely to be connected to the gas grid.
- There is therefore a notable difference in North Essex and South Essex, with a larger portion of rural, off-gas areas in the north and a higher density of urban, on-gas areas in the south.
- However, some LSOAs in urban areas have a high portion of off-gas properties, likely to be large blocks of flats heated by electricity.
- Rural homes are less likely to be connected to the gas grid, relying largely instead on electric heating, oil and liquified petroleum gas (LPG).
- These off-gas heating options tend to be more expensive than gas, making the transition to low carbon heating, such as heat pumps, more attractive for these properties.
- Urban areas with high population density and heat demand density are the most suitable areas for heat networks, with more of these areas in South Essex.

Homes **not** connected to gas grid:
16%
in line with the average for England and wider UK[23].



Gas distribution infrastructure in the area is owned and managed by Cadent Gas

Essex County Council

3. Pathways

Pathways: Transition to 2050

Pathways set out how the energy system is expected to change from 2022 to 2050. Two pathways are used to understand how Greater Essex's energy system could decarbonise: the 'Do-nothing' and 'Balanced' pathways.

- A Workshop was held to define the trajectories used in pathways modelling
- Decarbonisation targets were set
- Local insights were incorporated

Do Nothing

The counterfactual, presenting the future energy system with only existing decarbonisation pledges and current market trends, technology investments and uptakes. It excludes policies that aren't tangible and does not guarantee a fully decarbonised economy.

Balanced

Achieves renewable deployment that is consistent with targets set out in the Climate Change Committee (CCC) 7th Carbon Budget (7CB)[1], including the widespread uptake of heat pumps, electric vehicles (EVs), and rooftop photovoltaics (PV).

Pathway Assumptions*

Do Nothing

- Building growth projections aligned with local plans.
- Domestic new builds meet future homes standard (FHS).
- Limited shallow retrofit, heat pump adoption follows current trends, and no heat networks.
- EV Uptake follows National Grid System Operator (NESO) 'Falling Short' scenario[2].
- Growth in line with National Transport Projections "Core" scenario.
- Renewable installations follow historic trends.
- Steady solar and limited onshore wind deployment.

Balanced

- Growth aligned with local plan and new homes designed to Essex Design Guide[3].
- High shallow retrofit uptake, lower for deep**.
- Heating mostly from heat pumps and heat networks.
- Growth in line with National Transport Projections "Core" scenario, moderate mode shift in rural areas
- EV's dominate uptake with all road transport modes assumed to be fully electrified by 2050.
- Increased deployment of renewables, particularly for ground-mount PV and onshore wind.

** Further detail on pathway assumptions by sector can be found in the Technical Annex.*

*** Shallow retrofit: easy to fit measures (e.g. draft proofing, cavity wall and loft insulation), deep retrofit: harder to install measures (e.g. double glazing and external wall insulation)*

Pathways: Energy Consumption

From 2022 to 2050, total energy consumption reduces by 49% under Balanced and 29% under Do Nothing. Balanced sees greater electrification, benefiting from higher vehicle and heating efficiencies.

Transport energy demand falls under both scenarios by ~22% (to 4,800 GWh) due to modal shifts and vehicle fuel efficiency improvements. Balanced pathway sees greater overall electrification (100%) compared to Do Nothing (56%). The electricity demand due to transport increases dramatically for Balanced (x88) and Do Nothing (x85), requiring significant and targeted investment in grid and electric vehicle charging infrastructure across Essex.

Building energy demand falls by 36% overall, whilst electricity use increases by 182% under Balanced.

Balanced Pathway

Buildings account for ~**51%** of energy use at **11,680** GWh (2050).

Total electricity demand increases to 16,800 GWh by 2050

Building and transport are 100% electrified by 2050.

Do Nothing

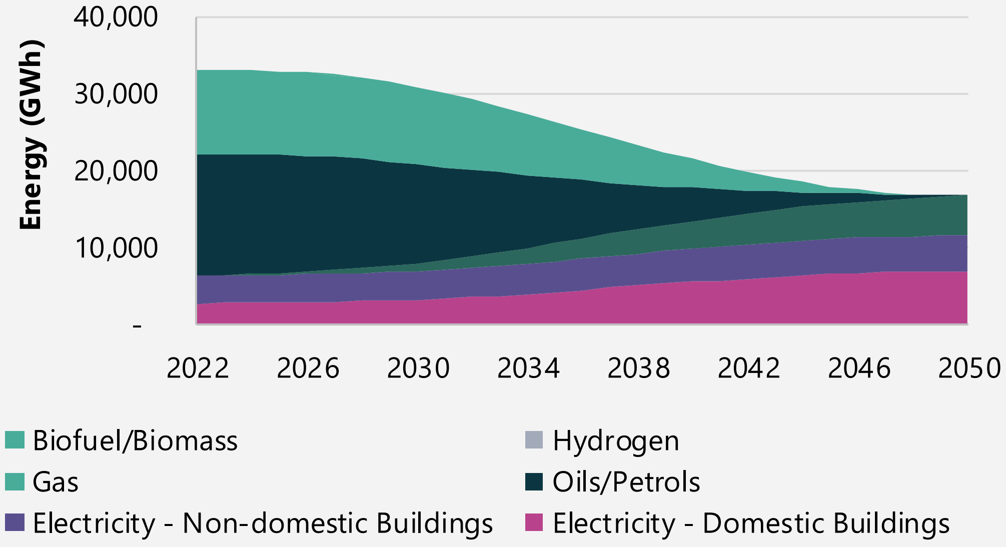
Fossil fuel consumption decreases, and electricity demand increases, as transport and heating continue to electrify at a steady pace.

Some efficiency gains in technologies and shifts in behaviour reduce demand.

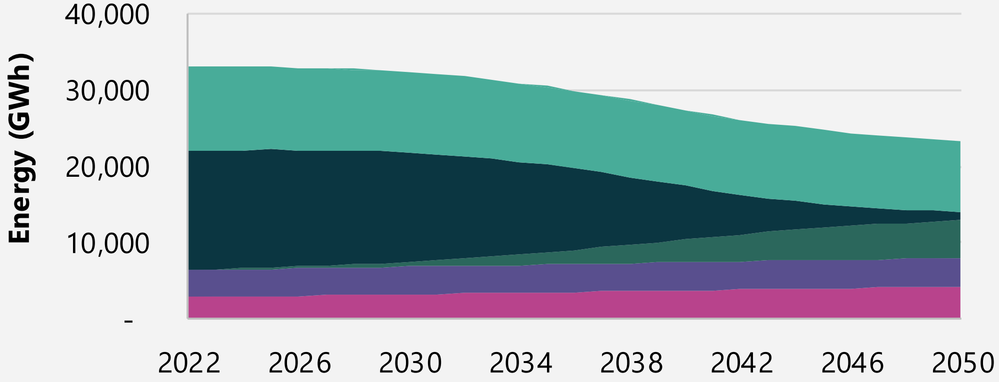
Balanced

Electrification of all heating and transport eliminates fossil fuel demand, whilst increasing electricity demand. Higher uptake of retrofit measures enhances further technological efficiency gains and modal shifts.

Energy Consumption by Fuel Type - Balanced



Energy Consumption by Fuel Type - Do Nothing

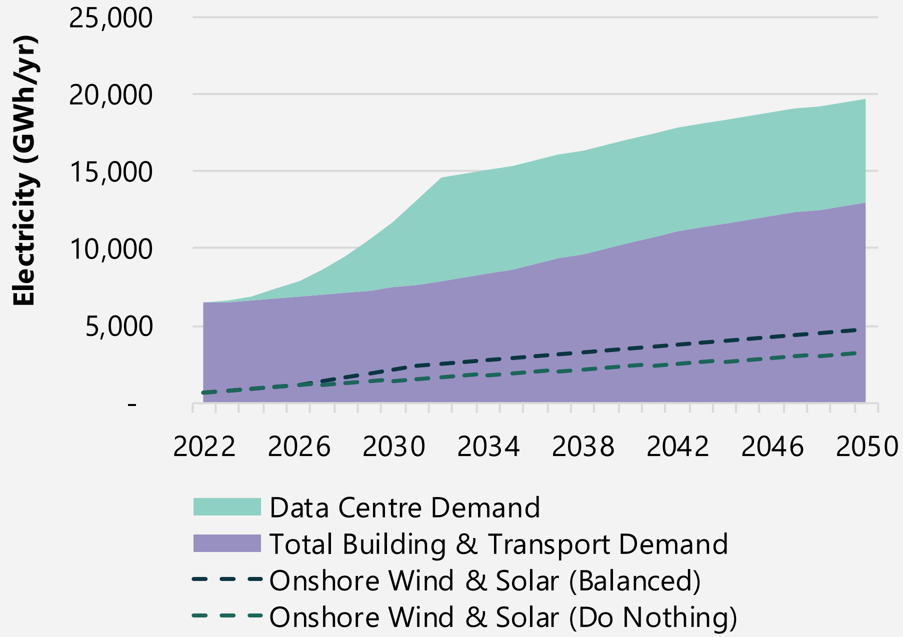


Sensitivity: Data Centre Demand

Five hyperscale data centres are in development or in planning (Basildon, Epping, Harlow, Thurrock). Given uncertainties in the likelihood, timing and energy strategies of each, they are assessed via sensitivity analysis rather than inclusion in the main Pathways modelling of Essex*.

Their combined electrical capacity is **780 MW,** which is **160%** of current Grid Supply Point (GSP) demand headroom across these LAs[4]. Their estimated electricity demand is **6.7 TWh/yr**, exceeding the combined 2022 electricity use of buildings and transport in Essex. If powered by on-site gas turbines, they would consume an estimated **16.8 TWh** of natural gas and emit **3.1 $MtCO_2e$** per year.

Ground-mounted Solar PV & Onshore Wind vs Indicative Data Centre Electricity Demand



Data Centres: Impact on Essex

Data centre power capacity as % of GSP capacity in LA:

B:540% | EF:156% | H:65% | T:186%

Electrical demand as a % of generation from grid-scale, renewable generation considering max potential in LA:

B:325% | EF:505% | H:No renewable potential | T:349%

Gas consumption (TWh_g) if generating electricity from gas turbines onsite:

B:2.8 | EF:5.6 | H:1.6 | T:6.9

Waste heat equivalence in number of homes:

B:124,100 | EF:246,300 | H:80,500 | T:304,000

Five data centres could produce
5.8 TWh_{therm}
of waste heat, equivalent to
755,000 homes heating demand

Total electricity demand from these DCs:
6.7 TWh_{elec}
Equivalent to **104%** of all Essex building and transport electricity demand and **428%** compared to the renewable generation potential for these LAs.

If generating electricity onsite from gas turbines, these DCs could consume
16.8 TWh_{gas}
of gas and produce
3.1 $MtCO_{2e}$ per year.

Key

- Basildon - B
- Epping Forest - EF
- Harlow - H
- Thurrock - T

** Further detail method and assumptions used to conduct sensitivity analysis for data centre demand can be found in the Technical Annex.*

Pathways: Renewable Potential

The maximum potential for implementing onshore wind and ground-mounted solar in Greater Essex was assessed to provide an upper limit on what is deemed to be commercially viable and practically feasible.

To assess the potential for onshore wind and solar farms across Essex, City Science's Renewable Potential model was used, which applies a 300m grid and excludes unsuitable areas such as protected landscapes (including national parks, AONBs, and conservation sites), high grade agricultural land, airspace restrictions, built up areas, transport infrastructure, waterways and railways. These constraints reflect both planning policy and practical considerations for turbine siting.

To establish the maximum potential for solar retrofit installations on individual buildings across Greater Essex, building suitability was modelled using geospatial mapping.

Ordinance Survey and Light Detection and Radar (LiDAR) data enabled a 3D representation of above-ground features, including buildings and trees. Roof pitch, aspect, useable area and exposure to sunlight (irradiance) provided the inputs to determine solar suitability.

The Renewable Potential describes the maximum capacity achievable in Essex, considering land and building constraints.

2.3 GW of onshore wind potential was identified, requiring **6.3%** of all land in Essex.

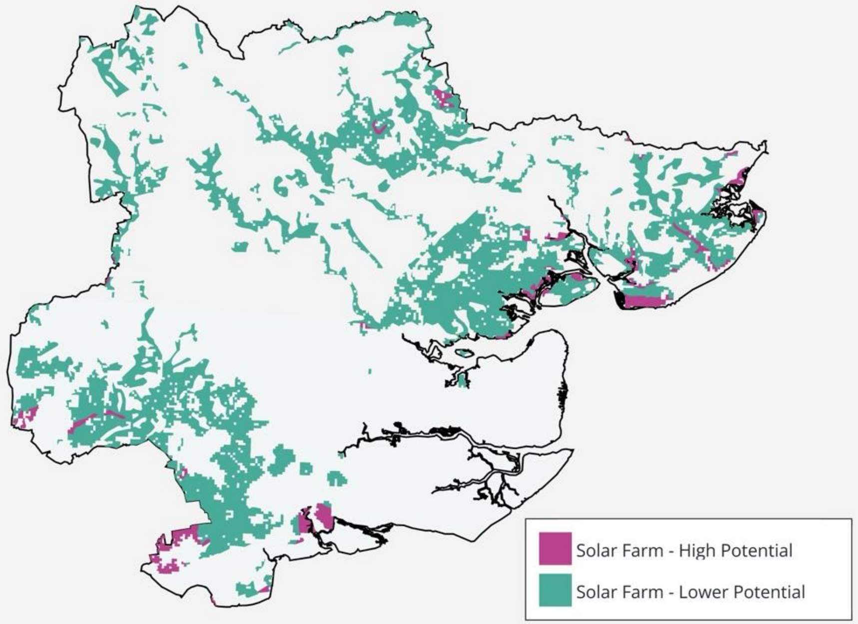
2.6 GW of solar farm potential was identified, requiring **1.4%** of all land in Essex.

1.1 GW of non-domestic roof solar potential was identified on existing buildings across Essex.

1.7 GW of domestic roof solar potential was identified on existing buildings across Essex.

Balanced Pathway

The Balanced pathway defined by this LAEP considers the Renewable Potential as the upper limit on what is possible, whilst setting targets based on the CCC 7CB[1].



Solar and wind resource is assessed and only sites of a suitable size and performance are considered to ensure commercial viability. Solar farms of above 2MW and onshore wind sites greater than 20ha (~5-8MW) are deemed viable.

Solar resource is assessed as well as roof suitability, geometry and surrounding buildings, trees, etc.

Satellite images were used to validate results from the model, spot checking the largest solar arrays.

Pathways: Renewable Generation

To meet CCC targets, **3.6 GW** new renewable capacity is required by 2050 (1.6 GW rooftop PV, 2.0 GW ground-mounted PV and 0.11 GW onshore wind*). This would meet **28%** of local demand, requiring **1.4%** of all land area in Essex. The remaining demand is met by other local renewables (e.g. Landfill Gas, Energy from Waste, Biomass), offshore wind and from imports via the national electricity transmission network.

Do Nothing

Historic installation rates continue. Solar installations across Essex remain high. Onshore wind has stalled since subsidies ended in 2017. From 2030 the Essex Design Guide[3] applies to new build homes, increasing solar capacity per installation.

Balanced

Essex has more renewables than the UK average, with 459 GW of additional ground mounted solar and a significant pipeline of projects. Historic installation rates for domestic PV outpace the Balanced pathway, while onshore wind will require supportive planning policy to deliver at the pace required.

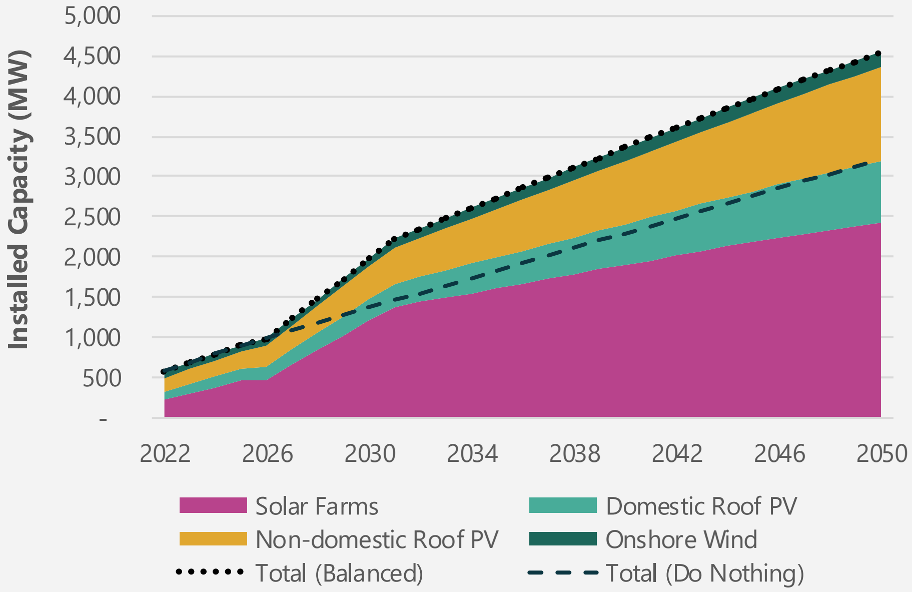
Technology	Domestic PV	Non-domestic PV	Ground-mount PV	Onshore wind
Existing capacity (MW)	143	221	459	83
Historic installation rate (MW/yr)	29	31	33	0
Balanced installation rate (MW/yr)**	25	38	79	4.3
New capacity by 2050 under Balanced (MW)	614	944	1,972	108
as % of the maximum Renewable Potential	36%	87%	77%	5%
Investment (£ million)	100	1,530	1,080	110

Balanced:
4.5 GW
total (new and existing) onshore wind and solar installed by 2050, meeting
28%
of building and transport demand.

Balanced:
2.0 GW new solar farms and **0.11 GW** onshore wind cover **1.1%** and **0.3%** of all land.

Max Potential:
2.6 GW solar farms and **2.3 GW** onshore wind cover **1.4%** and **6.3%** of all land.

Renewable Generation Capacity



* Results have been rounded and therefore may not add up exactly

** See the Technical Annex for an overview of how the installation rate was calculated.

Pathways: Transport

The CCC 7CB[1] was followed for the electrification of transport under our Balanced pathway. NESO's 'Falling Short' trajectory[2] was used for our Do Nothing scenario. Although it misses national Net Zero targets, Do Nothing still achieves high transport electrification due to current regulation and continued market momentum. Historic EV uptake data was not used in modelling future uptake as rapidly declining costs for electric vehicles is expected to result in increasing uptake in the market without the need for subsidies.

Do Nothing

NESO 'Falling Short' was modified to ensure that historic EV adoption data was reflected. By 2050, 98% of cars and LGVs, 88% of buses and 21% of HGVs are electrified.

Balanced

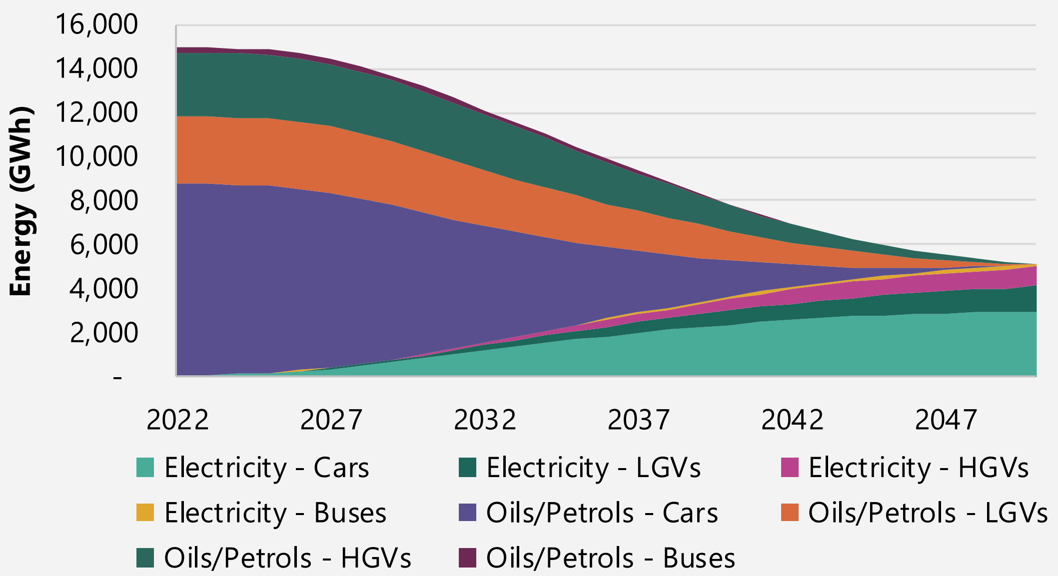
All road transport is 100% electrified by 2050. The CCC 7CB[1] Balanced pathway was used and modified to fit historic EV adoption data.

An estimated investment cost of **£1.56 bn** for **26,300 public, rapid EVC** is estimated.

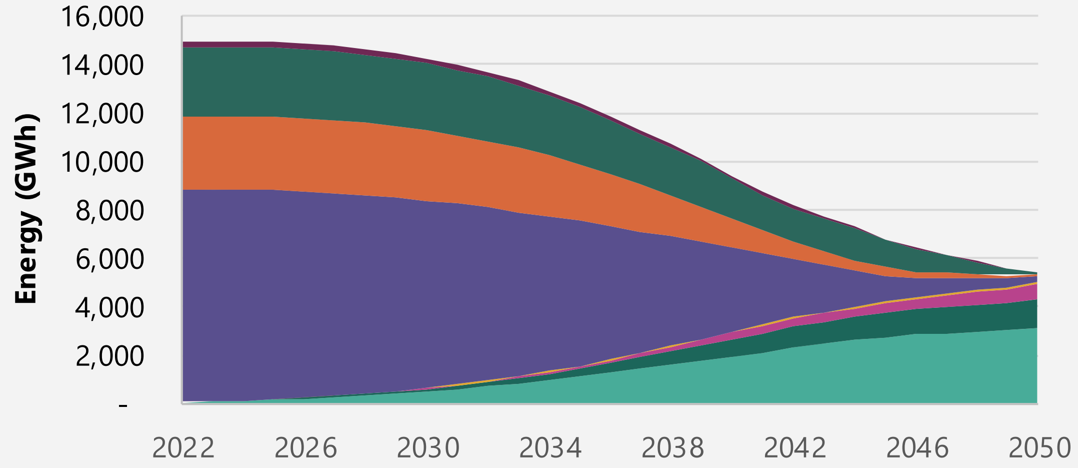
Under both pathways there will be **~1.3m EVs** **(98-100% of cars)** on the road in Essex in 2050, with **26,300** **rapid (public) EVC** under the Balanced pathway.

Energy demand reduces **~65% by 2050**, but electricity demand increasing from **59 GWh** (2022) to **~5,150 GWh** (2050).

Energy Consumption by Fuel Type and Transport - Balanced



Energy Consumption by Fuel Type and Transport - Do Nothing



Pathways: Retrofit Uptake

Do Nothing

Do Nothing assumes that retrofit measures continue in line with historic rates. This results in <7% of homes receiving shallow retrofits and 1% receiving deep retrofits across Essex.

Balanced

To meet the Balanced pathway, a significant increase in retrofits is required. This will require understanding which households are suitable and supporting retrofit adoption through information and funding schemes.

Balanced Pathway

144,500 homes are identified to be suitable for shallow and **281,700** for deep retrofits interventions.

The cost of shallow retrofits for all **suitable domestic properties:** **£189m,** reducing energy demand by **26 GWh** per year.

The cost of shallow retrofits for **14,500** non-domestic properties: **£207m.**

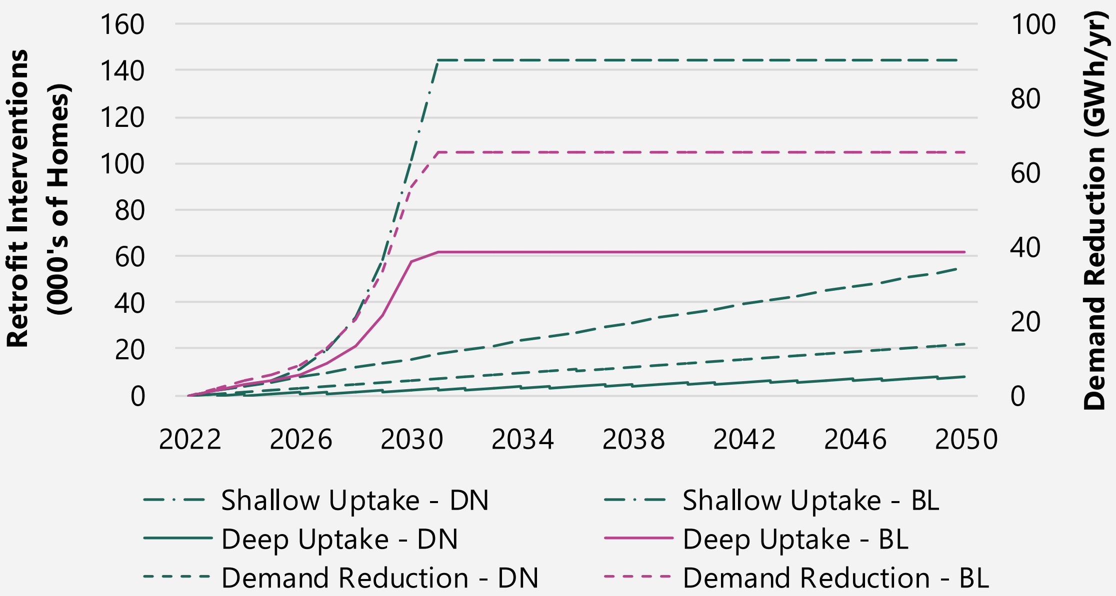
Shallow and Deep Retrofit Measures

Shallow retrofits are quick-wins: individual, simple, quick and cost-effective building fabric improvement measures. Shallow retrofits include loft insulation top-ups, draft proofing, lighting upgrades, smart thermostats, insulating pipes and water cylinders, and cavity wall insulation (CWI). Installation rates increase dramatically, stopping abruptly only when all suitable properties have been retrofitted.

Deep retrofits are complex, whole-house measures that require more investment and cause greater disruption. However, they also significantly reduce the heating demand for a household, lowering energy bills. Deep retrofit interventions include installing comprehensive insulation (external/internal walls, roof and underfloor), high-performance windows and doors, integrating smart controls and renewable generation and storage technologies. Insulation and air tightness should be prioritised first.

For many households, it is only once retrofit measures have been implemented that it is practical and effective to install highly-efficient, low-carbon heating technologies such as a heat pump, highlighting the importance of retrofitting.

Retrofit Uptake and Demand Reduction



* See Technical Annex for more detail on retrofit suitability and uptake.

Pathways: Domestic Heating Technologies

The electrification of heating uses high-efficiency equipment, such as air-source heat pumps (ASHP), to replace traditional fossil fuel boilers with low- or zero-emission alternatives, capable of reducing bills and carbon emissions.

Do Nothing

Historic installation rates are applied, with limited uptake in heat pumps due to higher capital costs and the high electricity tariffs. 50% of domestic buildings are heated by gas in 2050.

Balanced

Uptake of heat pumps and district heating follow the CCC 7CB trajectories[1], with 100% electrification of heat by 2050. This will require capacity building and unlocking capital through grants and loans.

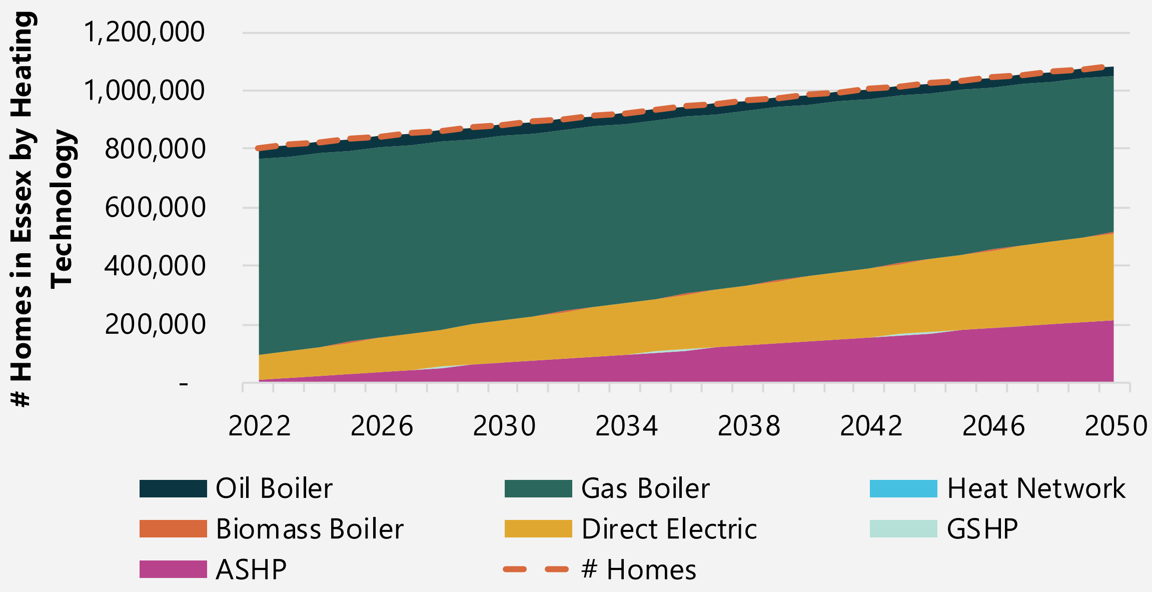
Balanced Pathway

Installation rates for ASHPs need to grow by **123%** compared to current trends.

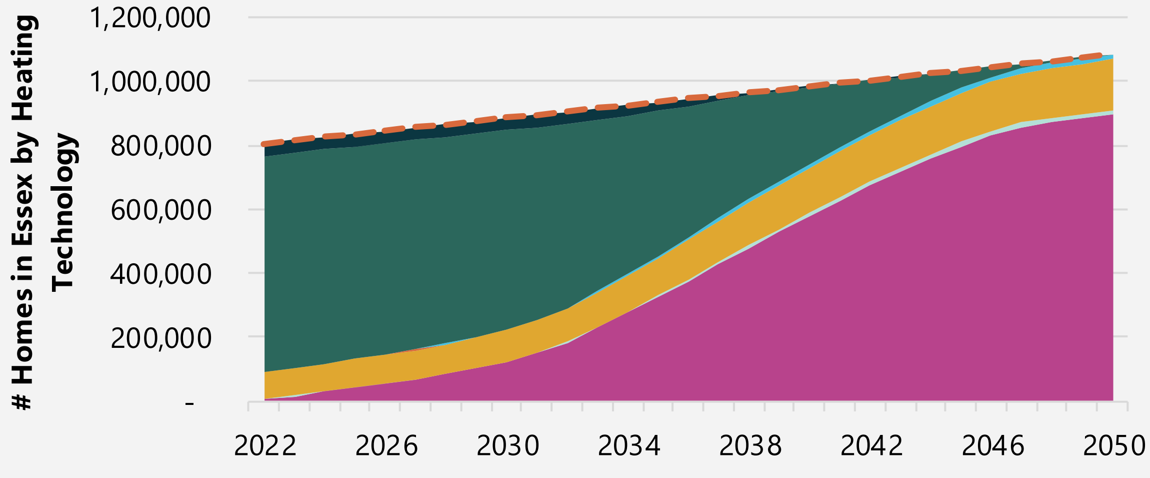
An estimated investment cost of **£6.5 bn** to install **913,700 ASHPs** by 2050.

Heating energy reduced by **53%** and **emissions** by **99%** compared to 2022.

Domestic Heating Technology Mix (Do Nothing)



Domestic Heating Technology Mix (Balanced)



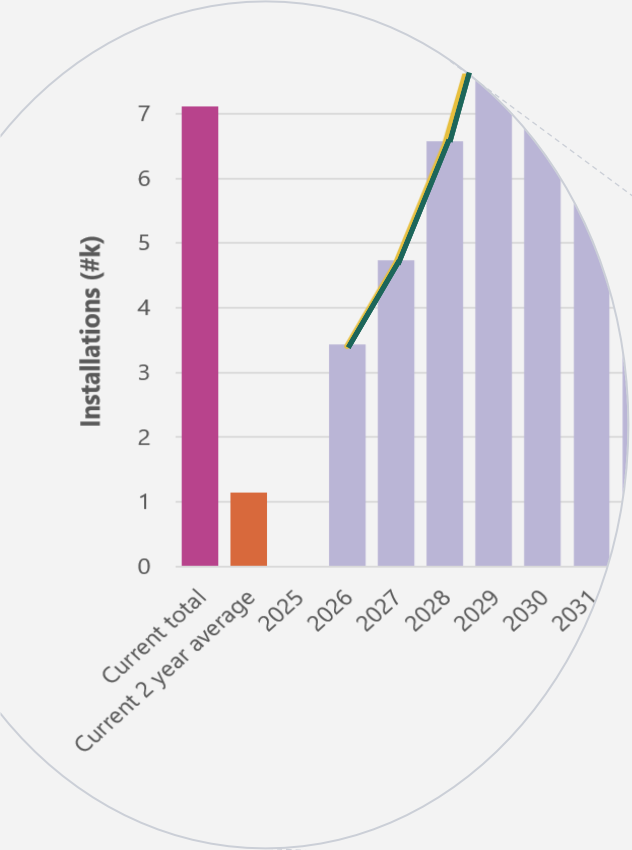
Pathways: Heat Pump Uptake

The annual heat pump installations required to meet the Balanced pathway (CCC 7CB[1]) trajectories are shown below. Installation rates need to increase significantly from historic averages, peaking in the late 2030s, requiring a skilled workforce of 900 full-time equivalent (FTE) people. From the 2040s there will be some replacements which will maintain some of the workforce.

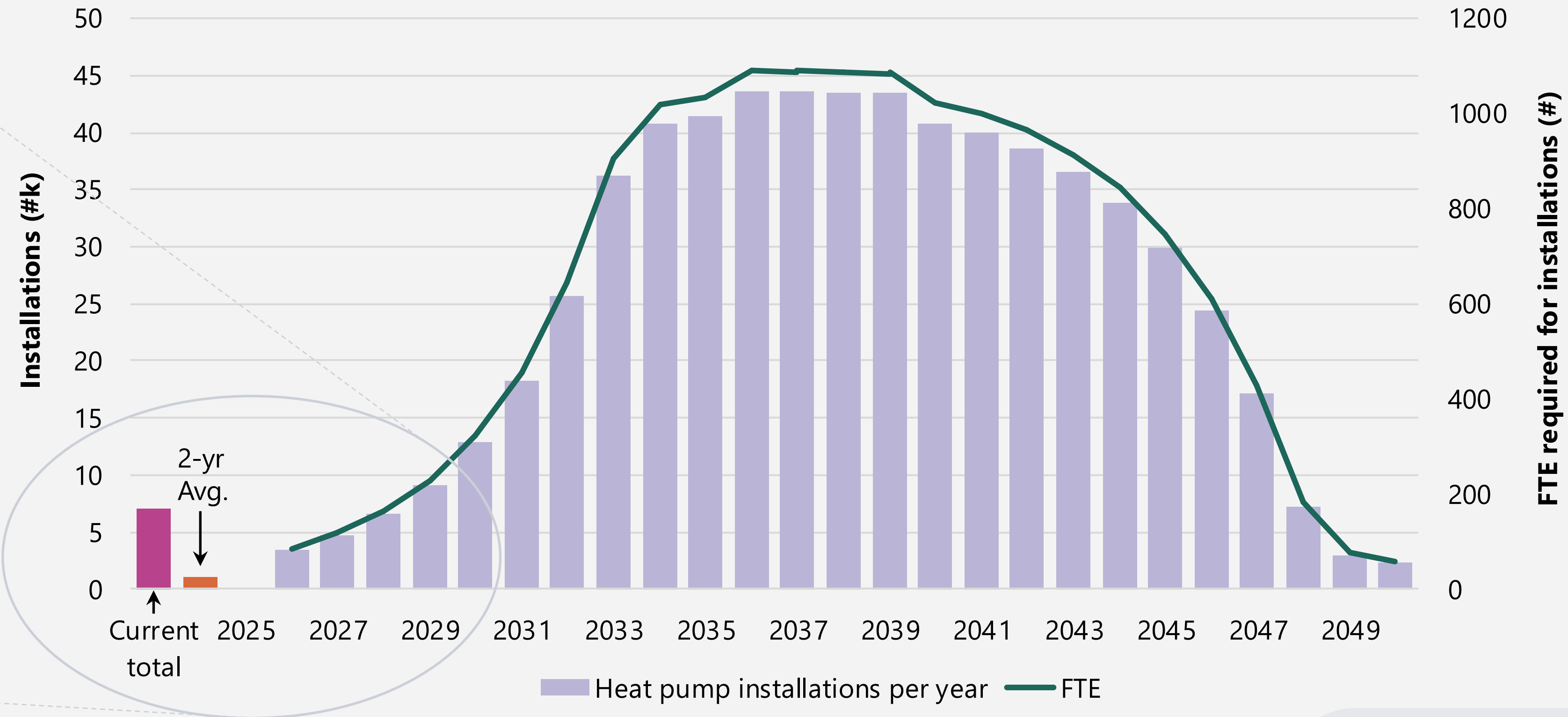
Balanced Pathway

Balanced sees **885,400** heat pumps installed from 2025 to 2050

From **1,100** per year in 2024, a peak install rate of **44,000** per year is required through the 2030s.



Required Heat Pump Installation Rates



** See Technical Annex for more detail on heat pump uptake.*

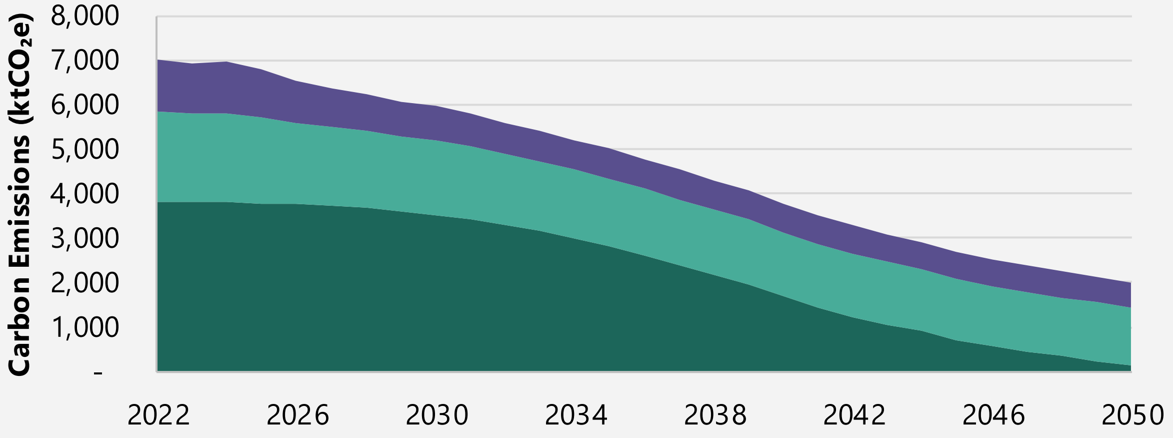
4. Impact of Measures

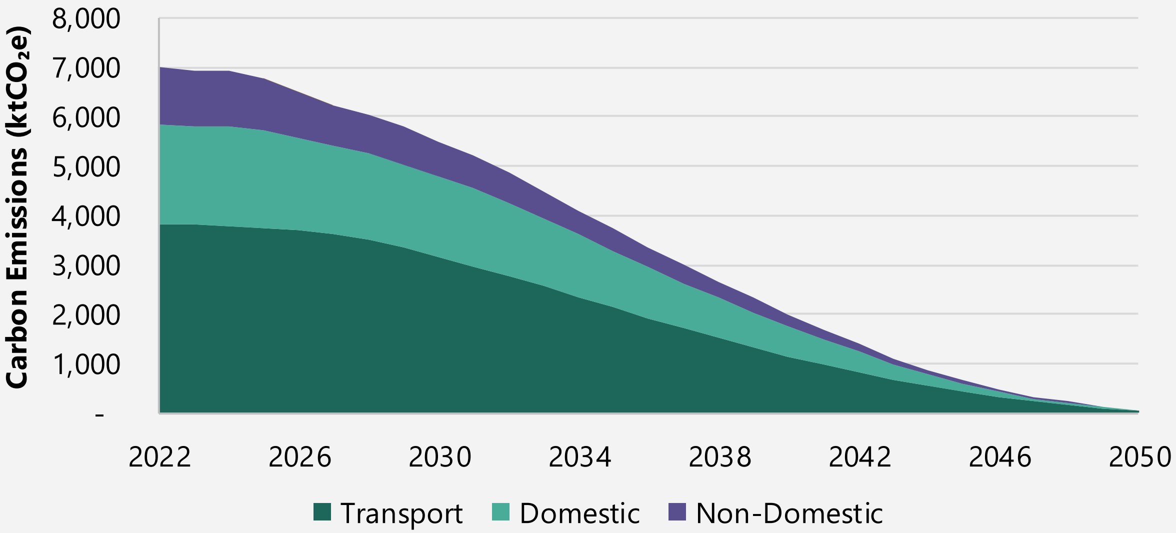
Impact of Measures: Emission Reduction

Both scenarios see significant carbon emission reductions as the national electricity grid is expected to decarbonise, and even under Do Nothing we expect 98% of vehicles and 46% of buildings to electrify.

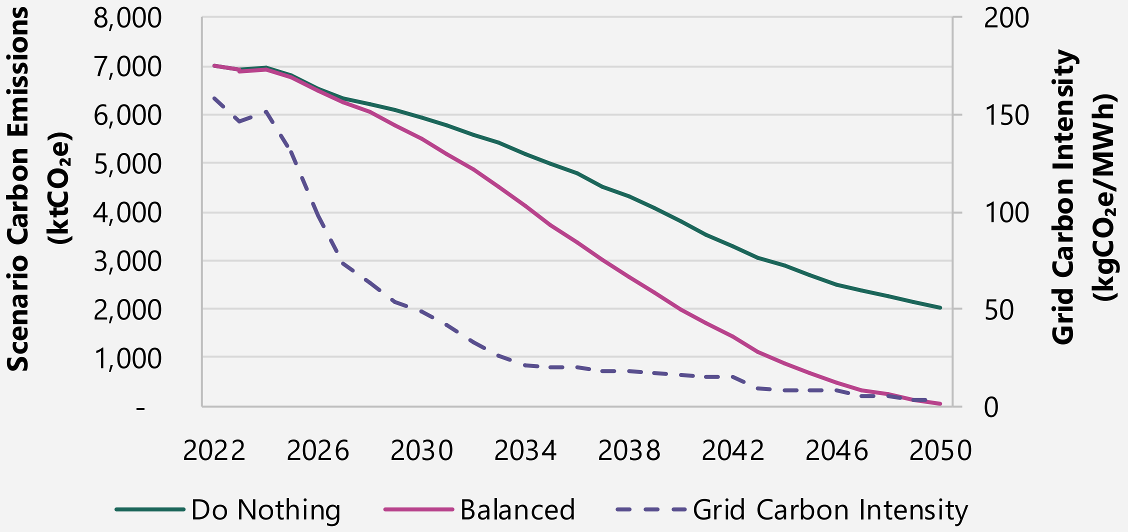
Do Nothing is not compatible with a decarbonised future, as it still has significant emissions in 2050 (2,015 $ktCO_2e$), whereas the Balanced scenario reaches a 99% reduction of emissions from 2022 levels by 2050. The remaining 56 $ktCO_2e$ relate to grid carbon intensity and may be balanced with removals.

Annual Carbon Emissions: Do Nothing (above) and Balanced (below)





Total Annual Carbon Emissions



Impact of Measures: Cost

Beyond reducing emissions, to investigate the potential benefits, or drawbacks, of a decarbonised energy system, the two pathways have been evaluated on the following metrics:

System Cost: The overall cost of transforming and decarbonising buildings and road transport was modelled to evaluate life cycle cost impacts to 2050.

Air Quality: The effect on air quality was modelled to evaluate the impact of reduced combustion on health and well-being.

Job Creation: The number of gross jobs created was estimated to highlight potential opportunities for employment and reskilling for growing sectors.

System Cost

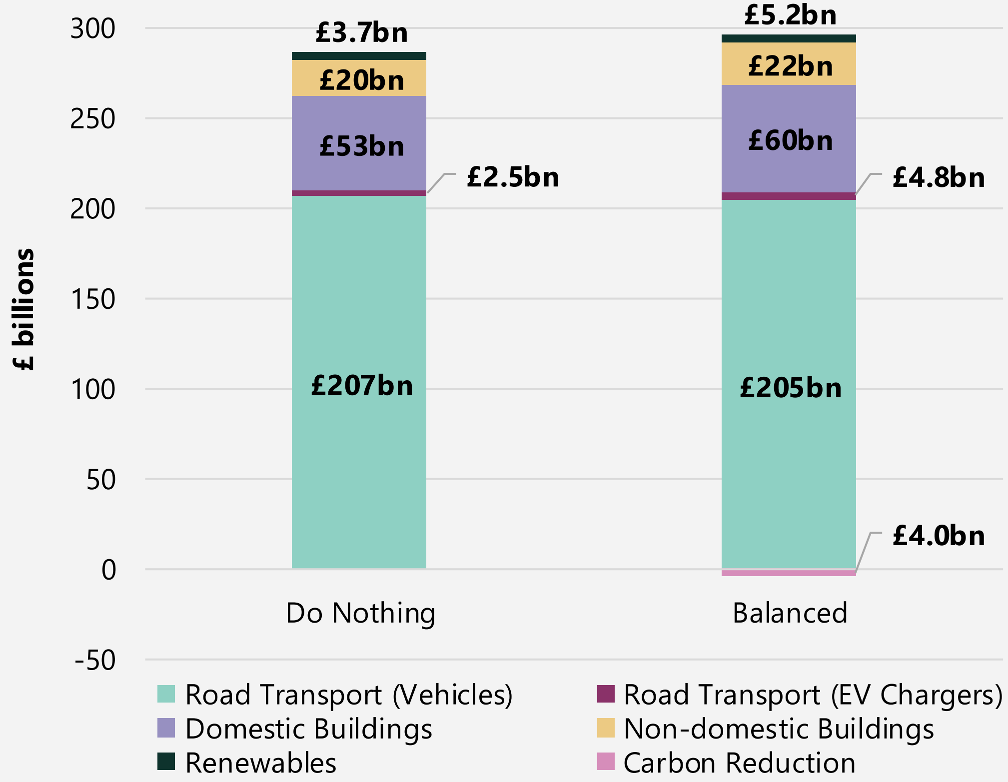
The cumulative cost over both pathways (2022 to 2050) has been assessed including capital cost of new technologies, capital cost of replacements (when technologies reach end of life), operation and maintenance, and fuel costs. Balanced has a total system cost of **£293bn**, which is an **uplift of £6.5bn** compared to Do Nothing.

These results are indicative and not reflective of the true transition cost-benefit, which includes social and environmental impacts, such as avoided climate damages and social value. We use Green Book price projections[1]; their relatively high electricity price compared to gas can understate electrification. The analysis omits wider environmental and social benefits and the value of flexibility (e.g. heat pumps and EVs on off-peak or time-of-use tariffs). Results are highly sensitive to the electricity and gas price assumptions.

The buildings sector has **£10bn** higher system costs under the Balanced pathway. Extensive retrofits and heat pump rollout require **£6bn** additional capital, whilst decreasing energy demand and improve heating efficiency.

The road transport sector has **£3bn** higher system costs under Balanced, with an uplift of **£1.1bn** for installing over **12,600 rapid** and **279,000 domestic EV chargers**.

Cumulative System Cost over the Pathways



* *See Technical Annex for details on cost assumptions*

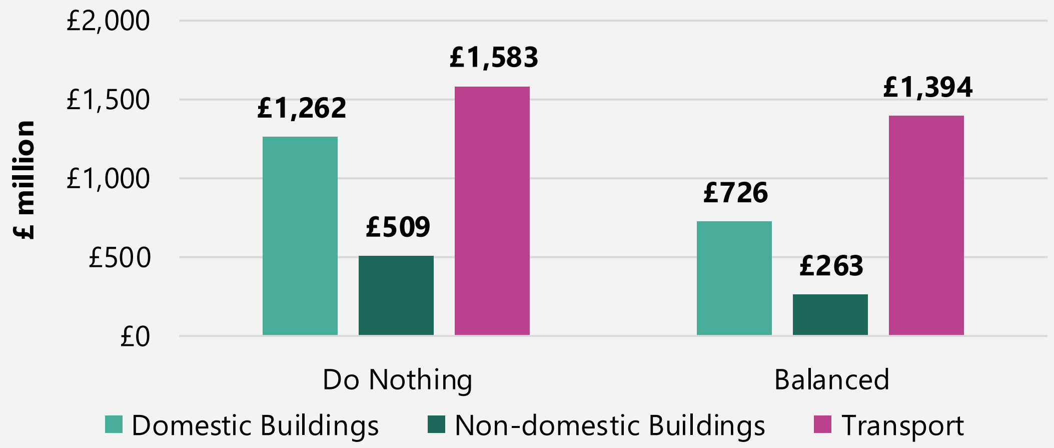
Impact of Measures: Health & Jobs

Air Quality Impacts

Reduced air quality due to combustion of fuels can have a significant impact on health and this has a financial impact on local services. This represents the damages on human health, productivity, well-being, and the environment. The chart on the right shows estimates of the cost impact of the combustion of heating fuels in buildings and fuel for road transport*.

Under the Balanced scenario, air quality damages are 29% lower than Do Nothing, a reduction of nearly £1billion between 2022 and 2050. The Balanced scenario has reduced combustion of fuels for heating and switches to electric vehicles earlier than Do Nothing.

Total Cost of Air Quality Damages (2022-2050)

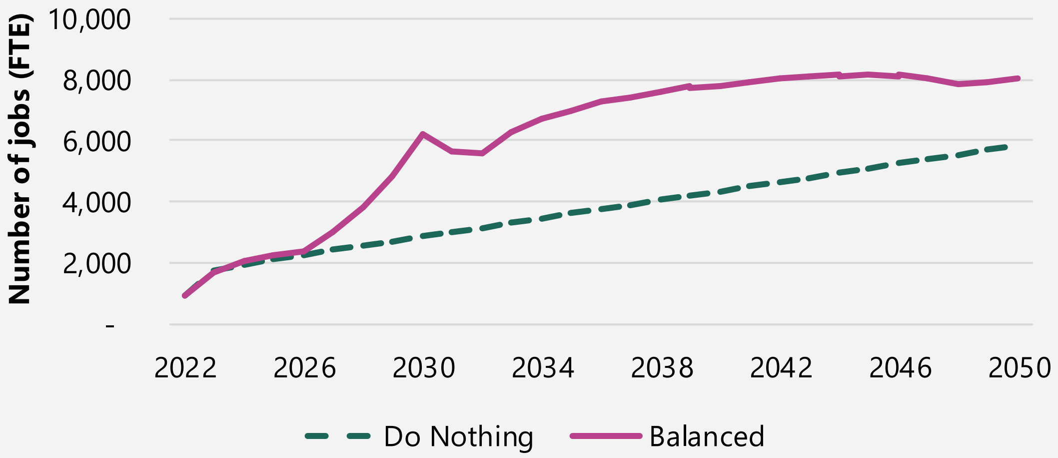


Job Creation

Decarbonising the local energy system will require jobs to support new technologies, namely the installation of building fabric upgrades, heat pumps and heat networks, and installation of renewables (e.g. ground PV and rooftop PV). The number of gross jobs created from the uptake of these technologies has been estimated*. The Balanced pathway requires more than 5,000 jobs to support the rollout of new technologies from 2029 onwards, as this period sees a rapid uptake of heat pumps and renewables. By 2050, the demand for green jobs is ~8,000 full time equivalent (FTE) people employed.

As existing technologies (e.g. gas boilers) are phased out, the number of jobs required to install and service them will reduce. Further work is required to see if there is a net job increase from the installation of low carbon technologies, but this analysis demonstrates the requirement and opportunity for reskilling to meet a decarbonised energy system.

New Jobs from Building Retrofit & Renewables



* See the Technical Annex for details on how air quality damages are monetised and how new jobs are quantified.

Essex County Council

5. Focus Zones

Intervention Areas

Specific interventions required to achieve a low-cost, low-carbon energy system under the Balanced Scenario were assessed across buildings and transport sectors within this LAEP. This is supported by a spatial analysis to understand which focus zones should be targeted to achieve high impact and to ensure that the energy transition is a just one.

The key intervention areas are shown below:

- Building Energy Efficiency
- Building Heating
- Heat Networks
- Transport
- Energy Generation

Electrification Challenge

Decarbonising the economy in Essex demands significant electrification, which will require increased capacity for both demand and generation on the electricity grid. A key focus after this LAEP will be to collaborate with UKPN to forecast and plan for future demand and generation to enable efficient grid upgrades. It is also recommended that all relevant stakeholders collaborate with NESO and RESP to help ensure that local areas get the energy infrastructure they need to meet local decarbonisation and growth ambitions.

Some of the key interventions required under the Balanced pathway are shown below:

Building Energy Efficiency

144,500 shallow retrofit measures implemented by 2050.

Building Heating

The Essex area will require 662,000 retrofitted domestic heat pumps by 2050, in 80% of homes.

Heat Networks

Several areas for further heat network analysis are identified: Lakeside, Mill End in Harlow, Thurrock, Southend and Basildon.

Transport

Most road transport will electrify, requiring supporting EV charging infrastructure (26,000 rapid/public and 604,000 slow/domestic new charge points by 2050).

Energy Generation

Onshore wind and solar produce 4,700 GWh, equivalent to 28% of 2050 electricity demand. Install rates for onshore wind capacity must increase to achieve this.

Focus Zones were identified for key intervention areas to provide spatial analysis of where recommended interventions should be prioritised, ensuring a ‘low regrets’ approach. The following page presents a summary of these Focus Zones, along with key insights from the interventions analysis, as illustrated overleaf in the Plan on a Page.

Greater Essex Focus Zones

Plan on a Page – Balanced Pathway

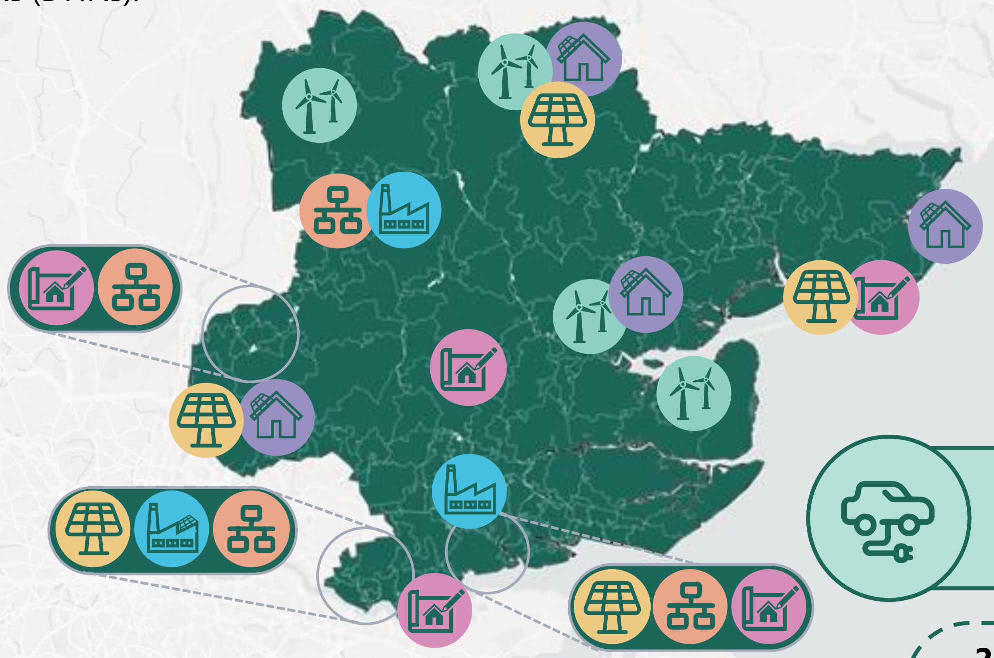
This page highlights the key milestones and interventions required for the Balanced Pathway. The map below presents a summary of the key identified Focus Zones for shallow retrofit, domestic and non-domestic roof-mounted PV, ground-mounted PV, onshore wind, and district heat networks (DHNs).

3,640 MW new and **4,540 MW** total onshore wind and solar by 2050

Total renewable generation will be **4,620 GWh/yr**, producing **28%** of 2050 electricity demand

56 ktCO₂e emissions remain in 2050

99.6% reduction from the baseline



Data centres could produce **5.8 TWhth** of waste heat, equivalent to **750,000** homes

16,800 GWh of electricity demand in 2050

Electricity demand is **2.56x** the baseline

1.32m EV cars by 2050

26,300 public EV charge points to install

144,500 shallow domestic retrofit measures by 2050

Focus Zones Key

- Shallow Retrofit
- Non-domestic Rooftop PV
- Domestic Rooftop PV
- Onshore Wind
- Ground-mounted Solar PV
- District Heating Networks

Shallow Retrofit Opportunities

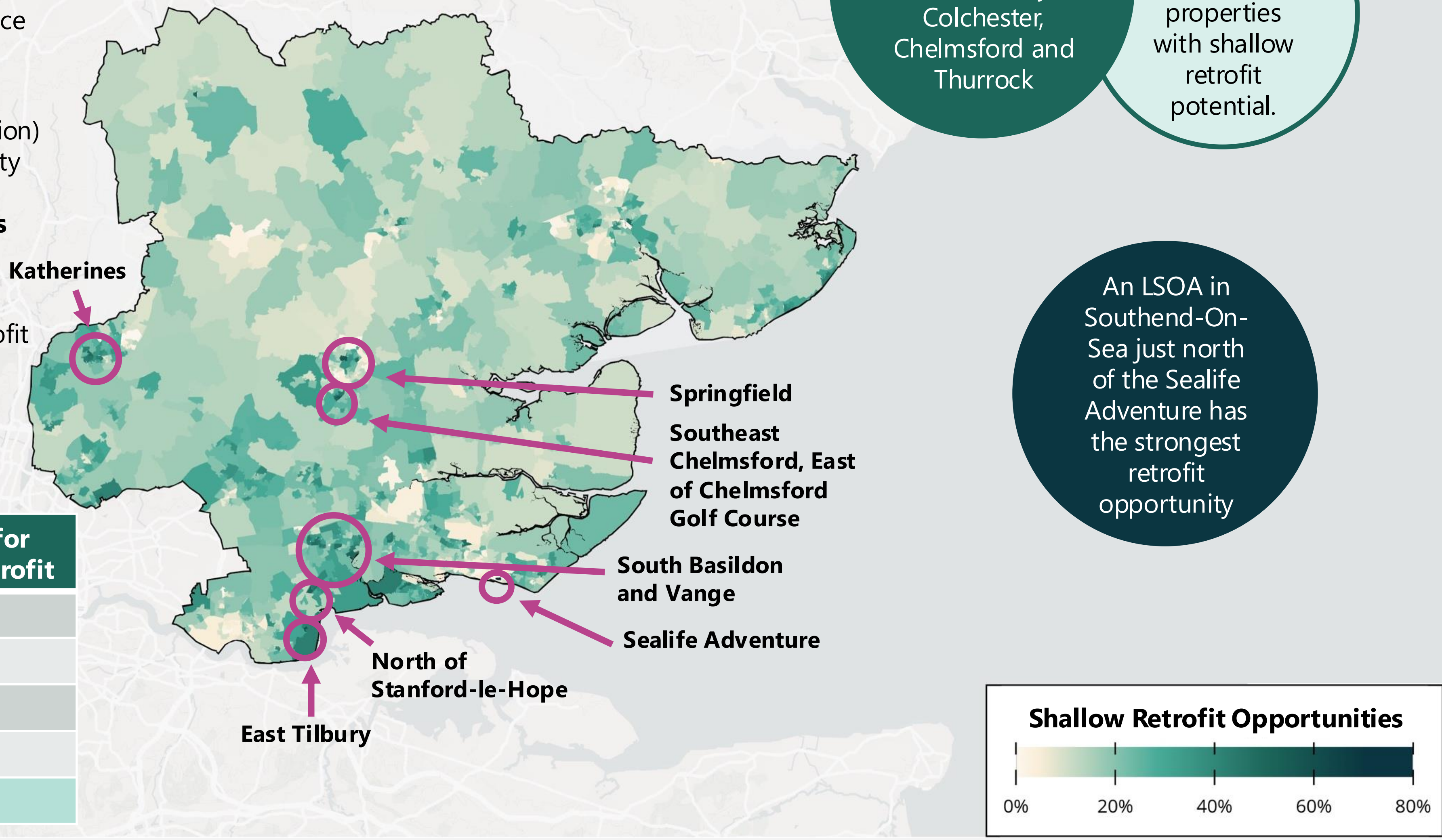
Shallow retrofit are building fabric improvements that have low-disruption and fast paybacks on investment. They are a low hanging fruit to reduce bills and emissions.

The number of properties suitable for shallow retrofit interventions (loft and cavity wall insulation) was mapped across Essex using outputs from City Science's LAEP modelling, based on EPC data. **A total 144,500 shallow retrofit opportunities were identified.**

The map illustrates the shallow retrofit potential across Essex. As shown, the level of shallow retrofit potential is quite spread out, with most LSOAs having between 11-25% of properties suitable for shallow retrofit interventions.

Shallow Retrofit Focus Zones

LA with most Focus Zones	# Suitable for Shallow	% Suitable for Shallow Retrofit
Basildon	20,000	25%
Colchester	15,300	18%
Chelmsford	14,370	18%
Thurrock	12,830	18%
Total	**144,500**	



Basildon has the most LSOA Focus Zones, followed by Colchester, Chelmsford and Thurrock

These four LAs account for 39% of all properties with shallow retrofit potential.

An LSOA in Southend-On-Sea just north of the Sealife Adventure has the strongest retrofit opportunity

Focus zone results are shown in the image.

Shallow Retrofit Potential in Fuel Poor Areas

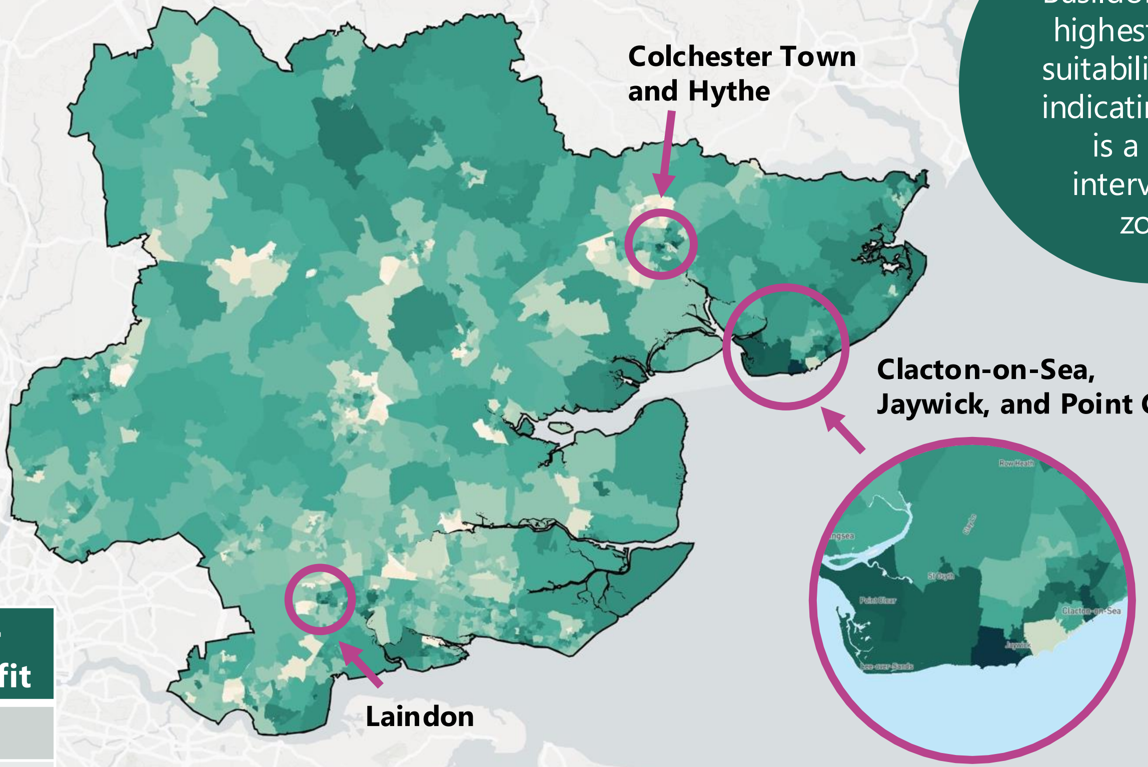
Shallow retrofit suitability and prevalence of fuel poverty[1] were mapped across Essex to identify focus zones of high retrofit potential in areas with high levels of fuel poverty.

The map on the right illustrates how shallow retrofit potential and prevalence of fuel poverty varies across Essex. As shown, there is a somewhat even distribution across Essex, with a few hot-spots in Clacton, Colchester, Hythe and Laindon.

Tendring, Colchester, Thurrock and Basildon are the Local Authorities that stand out with higher levels of fuel poverty and significant shallow retrofit opportunities. Home energy surveys could be delivered in these areas to identify quick-wins with high impact.

Shallow Retrofit in Fuel Poor Areas Focus Zones

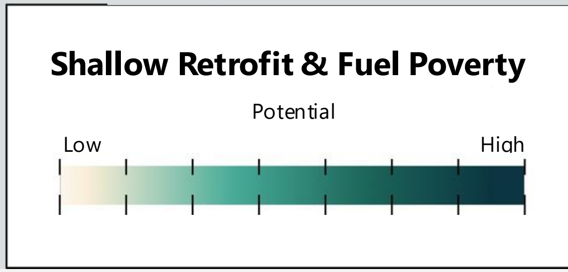
LA with most Focus Zones	% Homes in Fuel Poverty	% Suitable for Shallow Retrofit
Tendring	14%	19%
Colchester	9%	18%
Thurrock	9%	18%
Basildon	8%	25%



Laindon in Basildon has the highest retrofit suitability (25%), indicating that it is a good intervention zone.

Tendring has the most homes in fuel poverty (14%) but only 19% suitable for shallow retrofit.

The two Focus Zone LSOAs in Colchester Town and Hythe have high shallow retrofit potential and levels of fuel poverty.



Focus zone results are shown in the image.

Shallow Retrofit Potential in Areas with High Social Housing Mix

Shallow retrofit potential and social housing mix[2] were mapped to identify areas with high shallow retrofit potential that also have high proportions of social housing. Focus zones should be assessed in more detail, engaging with registered providers of social housing to target quick wins in high impact areas.

Several Focus Zones were identified, mostly in Basildon, Harlow, Tilbury and Greenstead.

Laindon and East Basildon are identified as the highest priority Focus Zones, with significant social housing and high retrofit suitability.

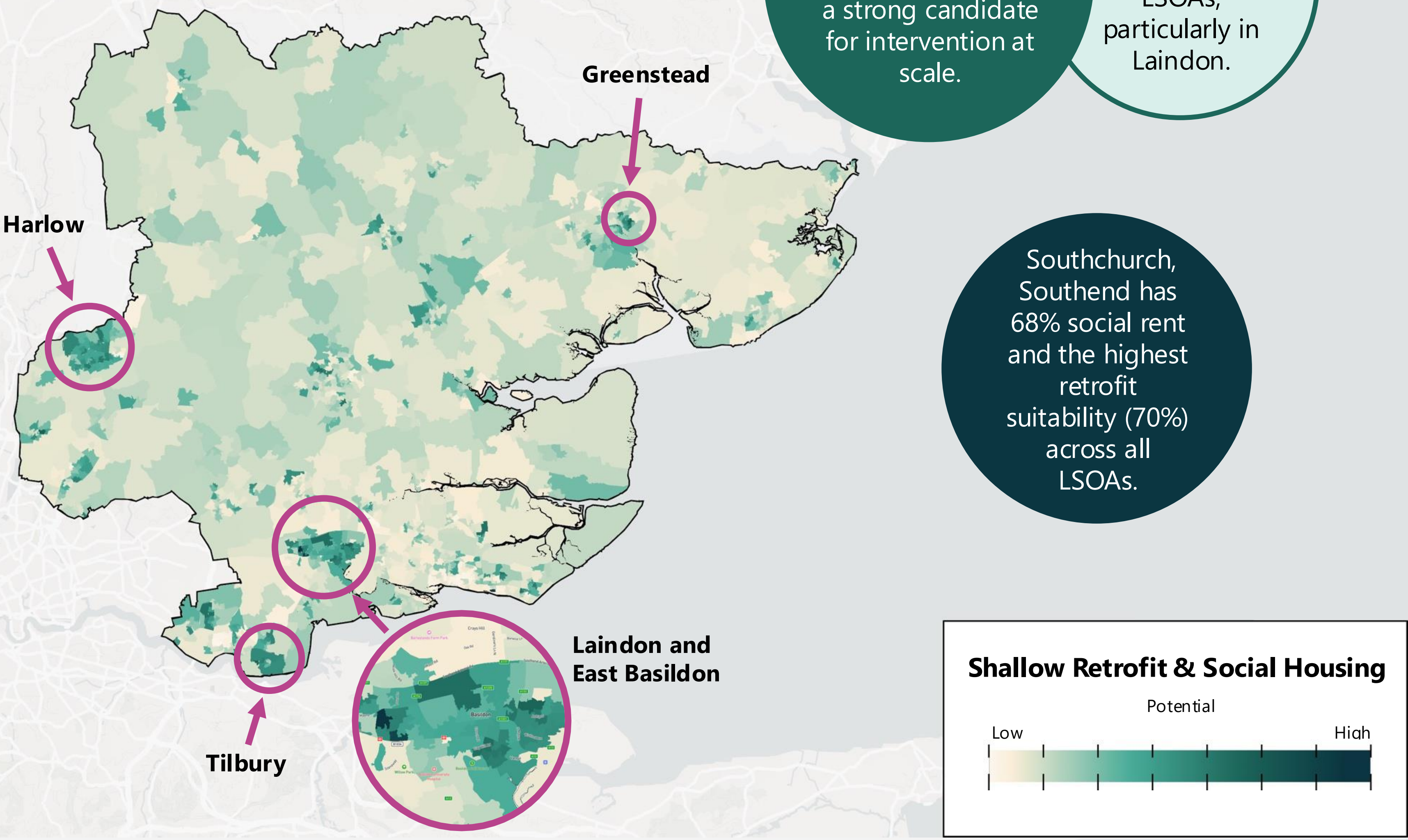
Shallow Retrofit with High Social Housing Mix Focus Zones

LA with most Focus Zones	% Social Rent	% Suitable for Shallow Retrofit
Basildon	21%	25%
Southend-on-Sea	12%	13%
Thurrock	18%	18%
Chelmsford	13%	18%

Basildon's proportions are the highest amongst the LAs, making it a strong candidate for intervention at scale.

Basildon has multiple high-priority LSOAs, particularly in Laindon.

Southchurch, Southend has 68% social rent and the highest retrofit suitability (70%) across all LSOAs.



Focus zone results are shown in the image.

On-Roof Solar Potential

On-roof solar potential in Essex was assessed at the building-level, building on 3D mapping results by Geospatial Insights[3], Ordnance Survey and LiDAR geometry data. Existing installations were excluded, providing retrofit potential estimates.

The total potential for new on-roof solar capacity on both existing domestic and non-domestic buildings is estimated to be 2,750 MW across Essex.

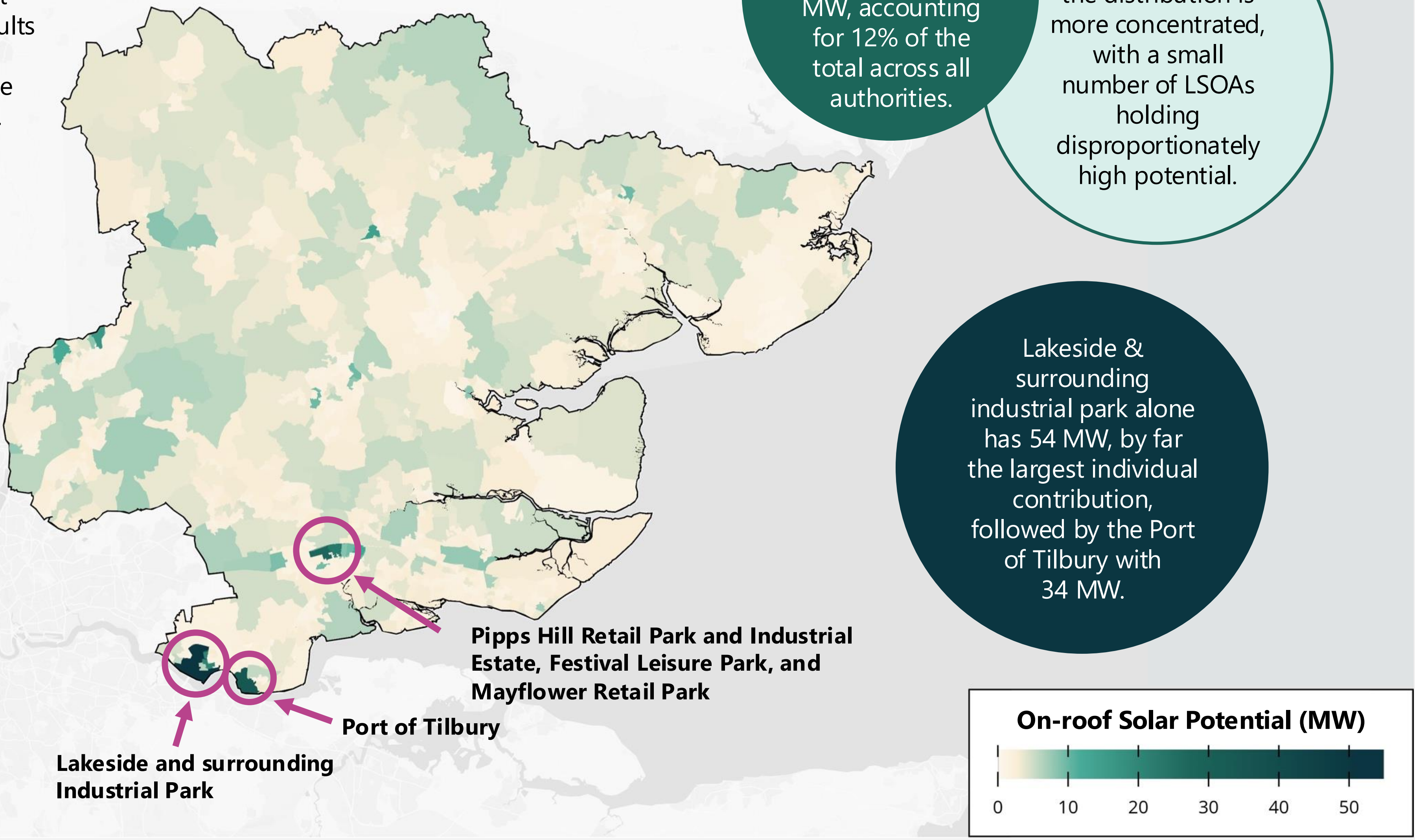
In the top 10 LSOAs there is 220 MW on-roof potential (11% of Essex-wide potential), with significant industrial and retail parks providing excellent structures for solar retrofits.

On-roof solar focus zones

LA with most Focus Zones	On-roof Solar Potential (MW)	% of Essex Total
Basildon	315	11%
Colchester	289	11%
Thurrock	288	11%
Chelmsford	271	10%
Total	**2,750**	

Basildon has the largest on-roof solar potential at 320 MW, accounting for 12% of the total across all authorities.

At the LSOA scale, the distribution is more concentrated, with a small number of LSOAs holding disproportionately high potential.



Lakeside & surrounding industrial park alone has 54 MW, by far the largest individual contribution, followed by the Port of Tilbury with 34 MW.

Focus zone results are shown in the image.

On-Roof Solar Potential & Electricity Demand

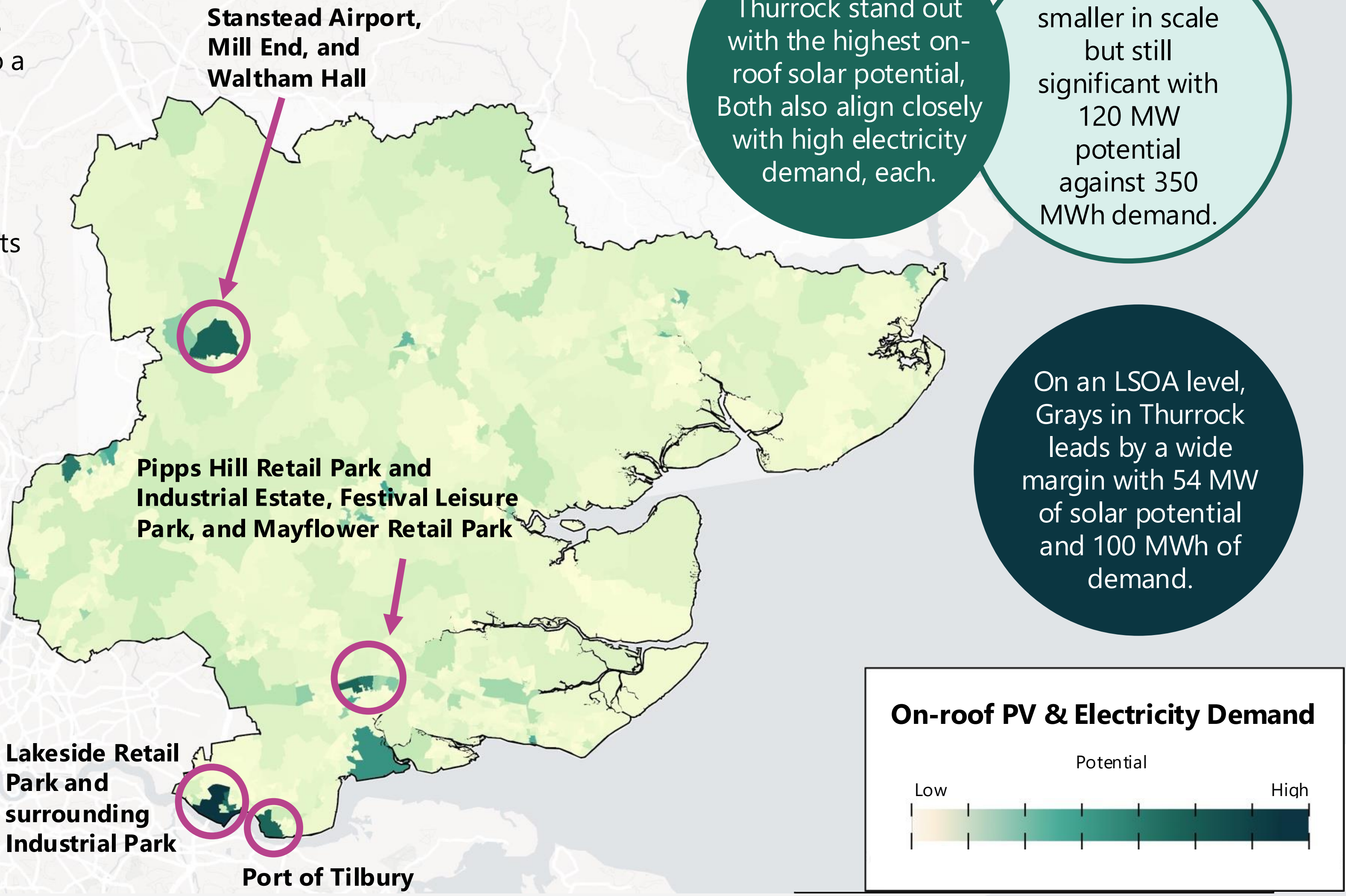
Areas of high existing building electricity demand located near to areas of high on-roof solar potential was mapped to identify opportunities for local generation, self-supply and private-wire supply – where one site sells low-cost, low-carbon electricity to a nearby site.

The inclusion of electricity demand in the Focus Zones only slightly changes the result when compared to on-roof solar potential alone. This is positive, as it demonstrates that generation potential generally maps to demand, which supports the business case for investments in solar.

There is significant electricity demand in areas of high solar potential. More detailed analysis and stakeholder engagement should be explored for these areas.

On-roof Solar Focus Zones

LA with most Focus Zones	On-roof Solar Potential (MW)	Building Electricity Demand (MWh)
Thurrock	290	566
Basildon	320	559
Harlow	120	349
Chelmsford	270	527
Total	**2,750**	**6,400**



Basildon & Thurrock stand out with the highest on-roof solar potential, Both also align closely with high electricity demand, each.

Harlow is smaller in scale but still significant with 120 MW potential against 350 MWh demand.

On an LSOA level, Grays in Thurrock leads by a wide margin with 54 MW of solar potential and 100 MWh of demand.

Focus zone results are shown in the image.

On-Roof Solar Potential: Domestic

Decentralised solar installations present an opportunity to lower bills for households, reduce strain on the electricity grid and decarbonise our energy system.

On-roof solar potential for existing domestic buildings was mapped to understand which residential areas of Greater Essex present opportunities to deliver new renewable generation capacity within residential communities. The map on the right illustrates the results. Overall, **1,720 MW solar PV potential was identified on existing domestic properties across Essex.**

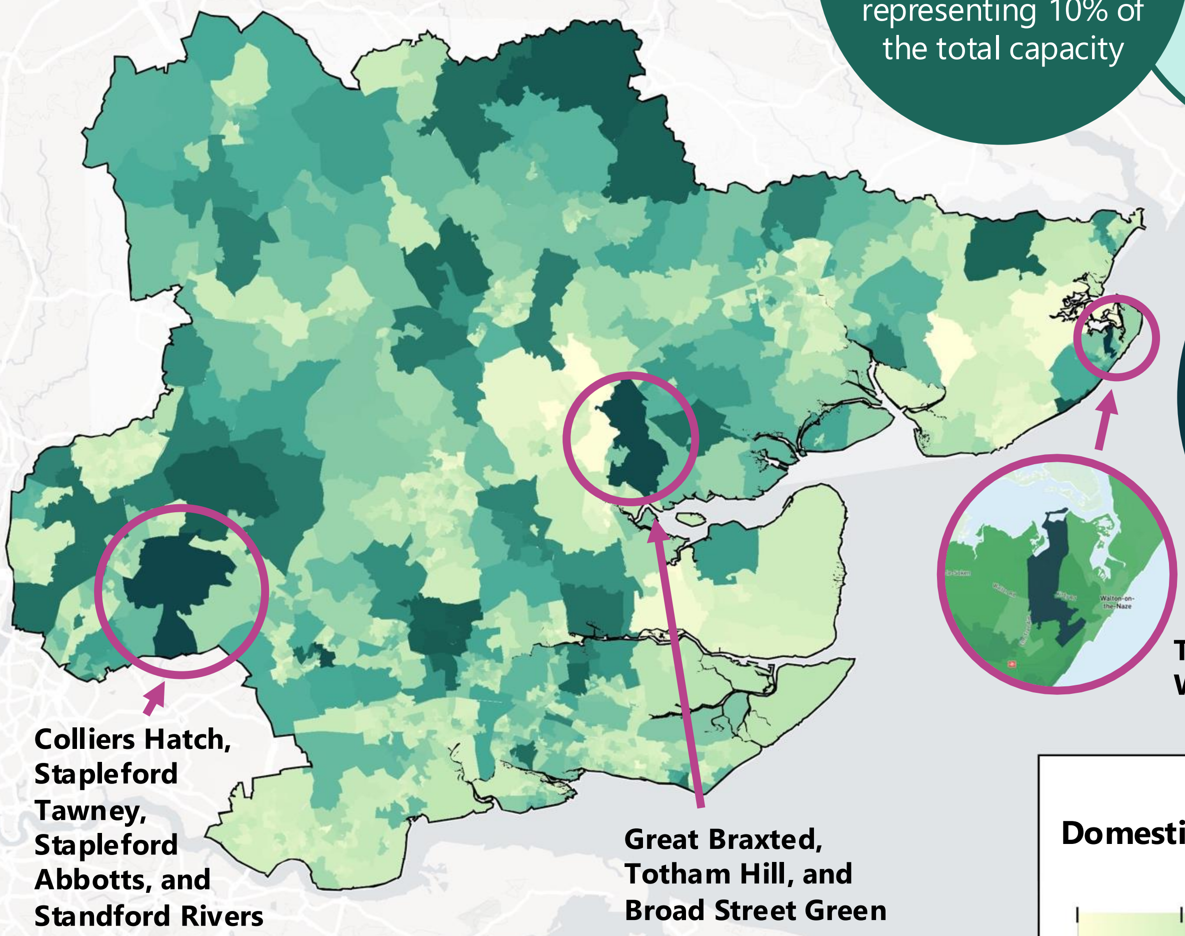
Solar potential is spread out, with little variation across LSOAs. Frinton-on-Sea has the highest concentration of on-roof solar potential.

On-roof Solar Focus Zones

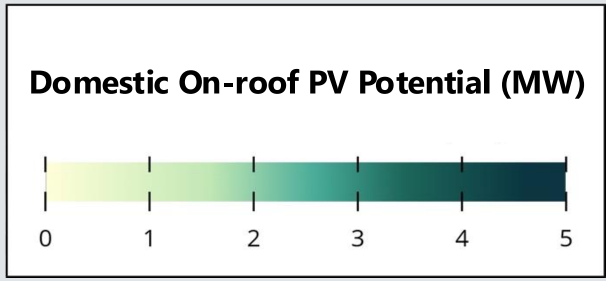
LA with most Focus Zones	On-roof Solar Potential (MW)	% of Essex Total
Basildon	180	10%
Chelmsford	170	10%
Epping Forest	139	8%
Braintree	138	8%
Total	**1,720**	

Basildon is the leading LA with 180 MW of on-roof solar potential, representing 10% of the total capacity

At the LSOA level, the distribution is more granular, with no single zone contributing more than 5 MW.



Collectively, the top 10 LSOAs make up only 2% of the total capacity, meaning that the LSOA contributions are dispersed.



Focus zone results are shown in the image.

Domestic On-Roof Solar Potential in Fuel Poor Areas

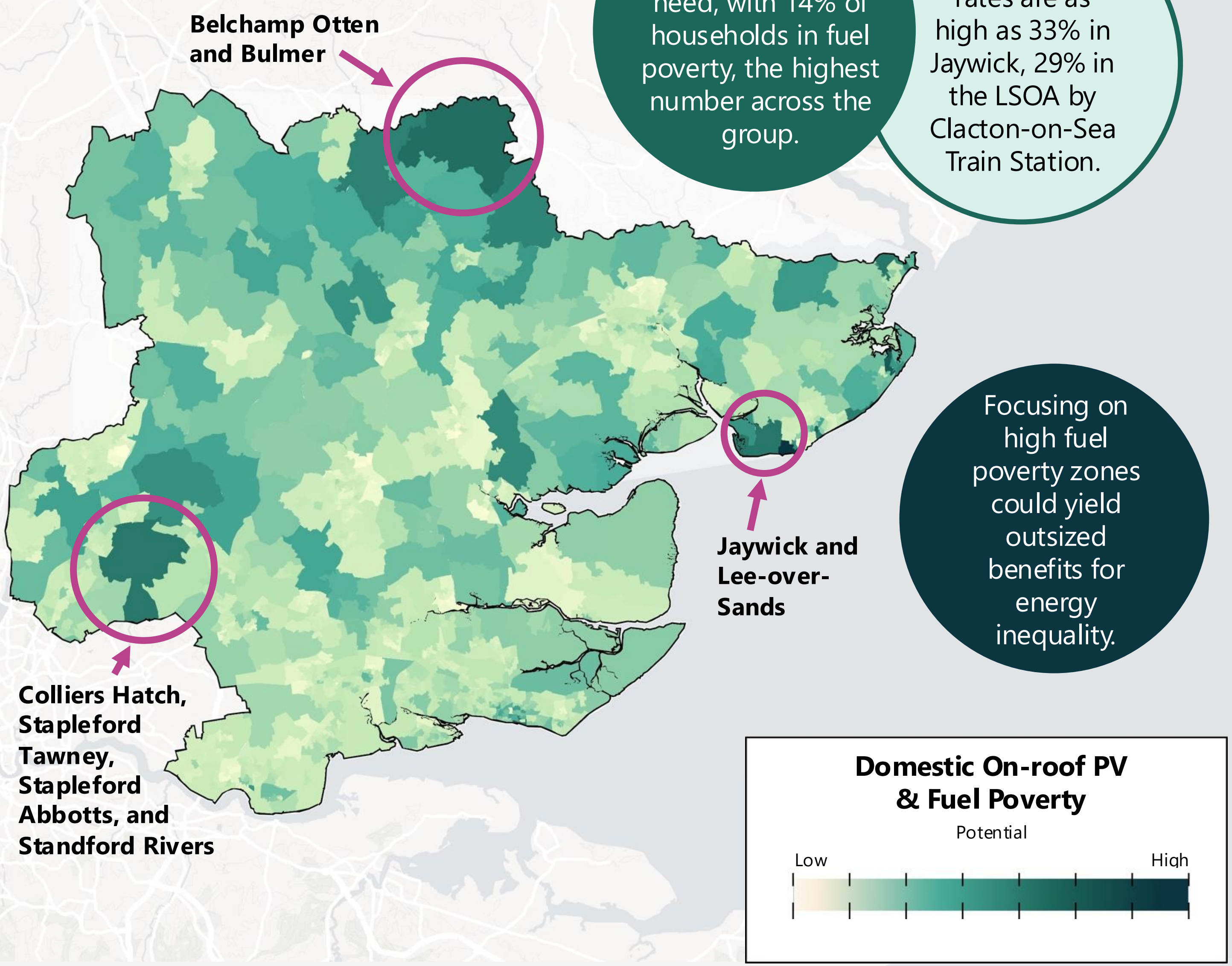
Focus Zones were identified by considering both domestic on-roof solar potential and fuel poverty prevalence[1]. The map on the right highlights (in darker colours) areas with high levels of fuel poverty that have high on-roof solar potential.

Tendring clearly stands out, with over half of all LSOA-level Focus Zones located in this Local Authority, demonstrating the high potential for solar in areas with high fuel poverty.

Braintree and Epping also show potential for identifying fuel poor households to support with solar installations.

Domestic, On-roof Solar Potential and Fuel Poverty Focus Zones

LA with most Focus Zones	On-roof Solar Potential (MW)	# Homes in Fuel Poverty	% Homes in Fuel Poverty
Tendring	123	10,900	14%
Braintree	138	7,190	10%
Epping Forest	139	5,130	9%
Southend-on-Sea	163	9,710	12%
Total	**1,720**	**79,800**	



Tendring stands out most in terms of need, with 14% of households in fuel poverty, the highest number across the group.

Fuel poverty rates are as high as 33% in Jaywick, 29% in the LSOA by Clacton-on-Sea Train Station.

Focusing on high fuel poverty zones could yield outsized benefits for energy inequality.

Focus zone results are shown in the image.

Domestic On-Roof Solar Potential in Off-Gas Areas

For properties not connected to the gas network, the installation of solar would support the electrification of heating, with most off-gas properties[4] in Essex currently relying on oil heating.

Areas with high proportions of off-gas properties in areas with high domestic solar potential were mapped, as illustrated to the right.

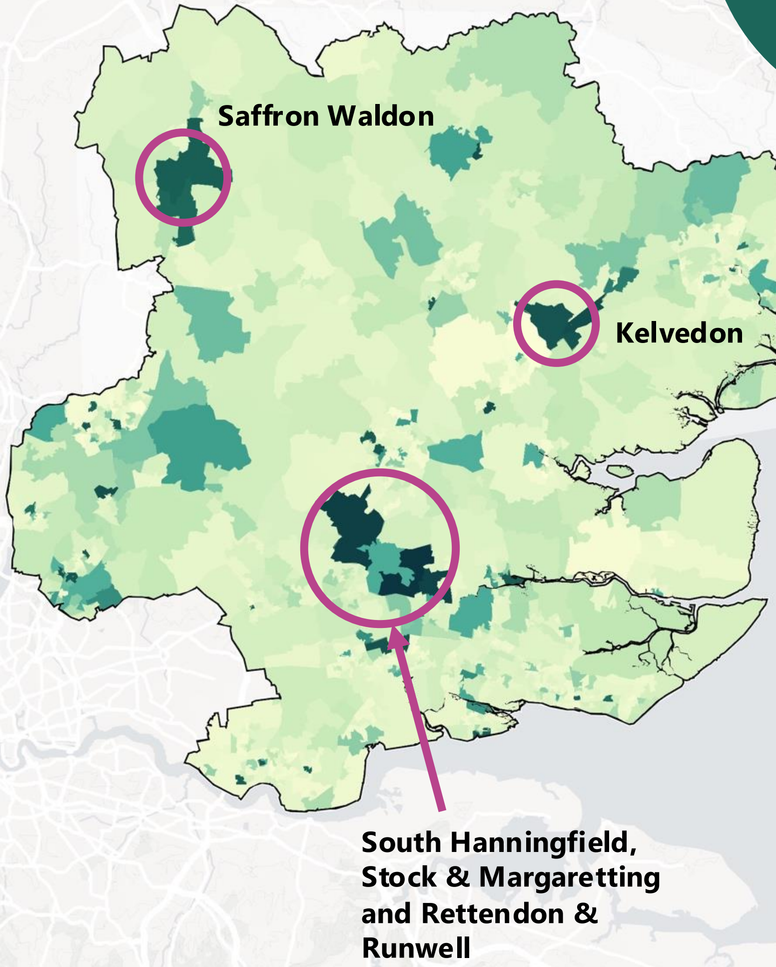
Focus Zones in Chelmsford include South Hanningfield, Stock & Margaretting and Rettendon & Runwell, all with high solar potential and large numbers of off-gas homes. Kelvedon, in Braintree, also stands out for further work to engage with local organisations and support off-gas households to decarbonise.

Domestic On-roof Solar and Off-gas Areas Focus Zones

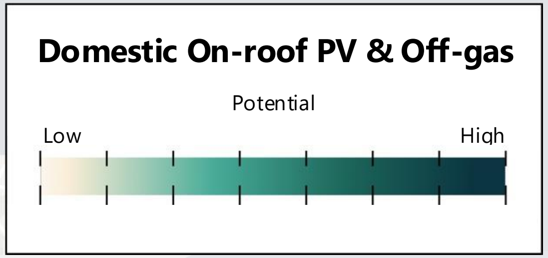
LA with most Focus Zones	On-roof Solar Potential (MW)	# Off-gas Homes	% Off-gas Homes
Chelmsford	170	16,930	21%
Braintree	138	13,290	19%
Epping Forest	139	15,320	26%
Basildon	180	12,960	16%
Total	**1,720**	**130,000**	

All four LAs listed combine notable on-solar potential with large off-gas housing stocks, highlighting the case for electrification and rooftop solar deployment.

Chelmsford has 170 MW of potential and the largest number of off-gas homes.



Braintree has multiple LSOAs each with 2 MW potential.



Focus zone results are shown in the image.

On-roof Solar Potential: Non-domestic

Decentralised solar installations present an opportunity for businesses to lower bills, reduce strain on the electricity grid and decarbonise our energy system.

On-roof solar potential on non-domestic buildings was mapped to understand which areas of Greater Essex present opportunities to deliver de-centralised, renewable generation capacity. **1,081 MW of on-roof solar potential was identified on existing non-domestic buildings across Essex.**

Focus Zones include large retail and industrial parks in Thurrock and Basildon, where there is potential for large-scale rooftop installations. Engagement with these businesses is recommended as a next step.

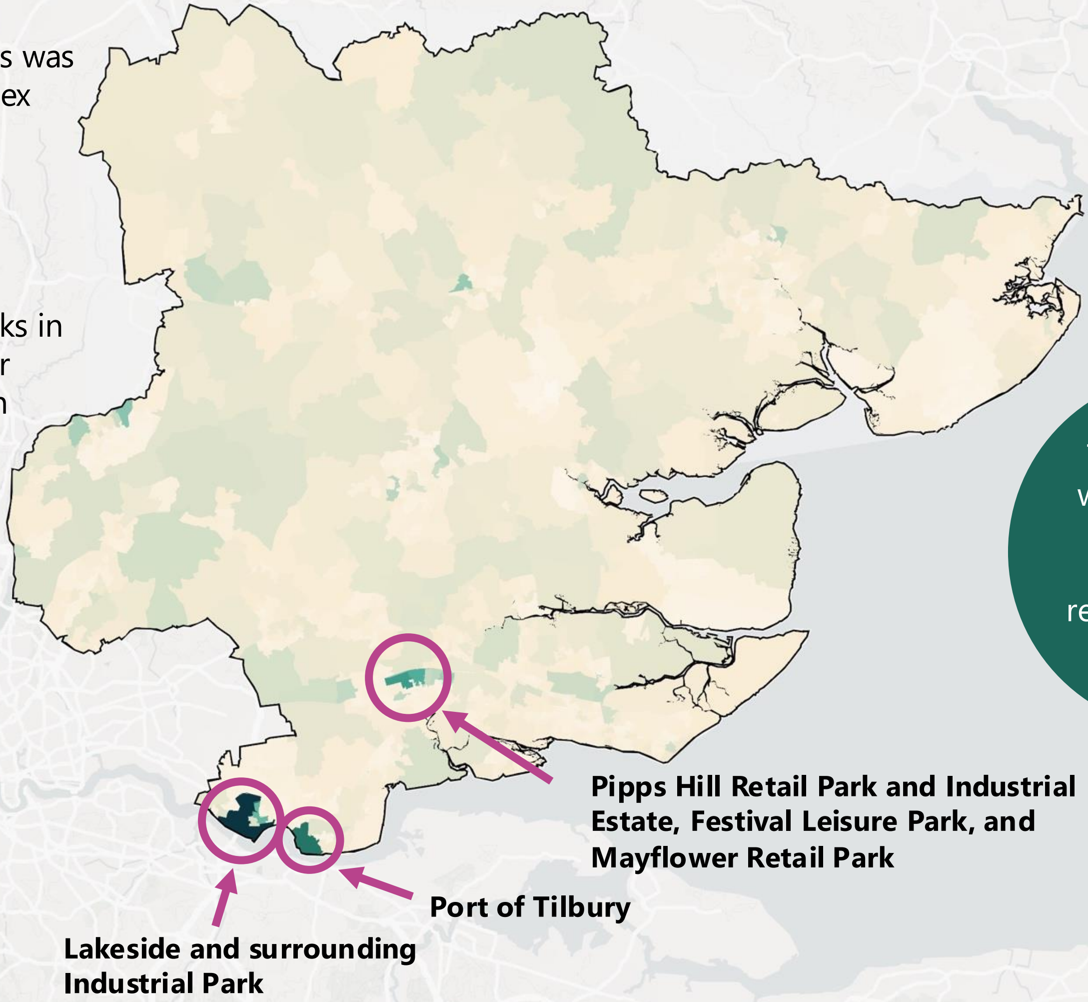
Non-domestic on-roof solar potential is strongly concentrated in a small number of LSOAs, particularly within Thurrock and Basildon.

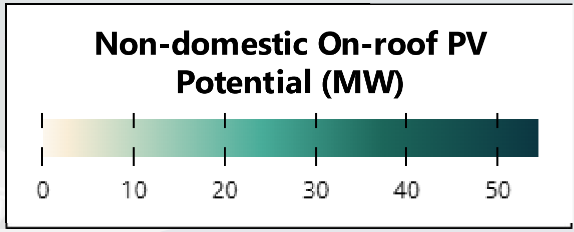
Thurrock leads with 170 MW of on-roof solar potential, representing 16% of the total.

Lakeside alone contributes 53 MW (5% of the total), and the Port of Tilbury adds a further 32 MW.

Non-domestic On-roof Solar Focus Zones

LA with most Focus Zones	On-roof Solar Potential (MW)	% of Essex Total
Thurrock	168	16%
Basildon	136	13%
Colchester	103	10%
Chelmsford	101	9%
Total	**1,080**	





Focus zone results are shown in the image.

Solar Farm Potential

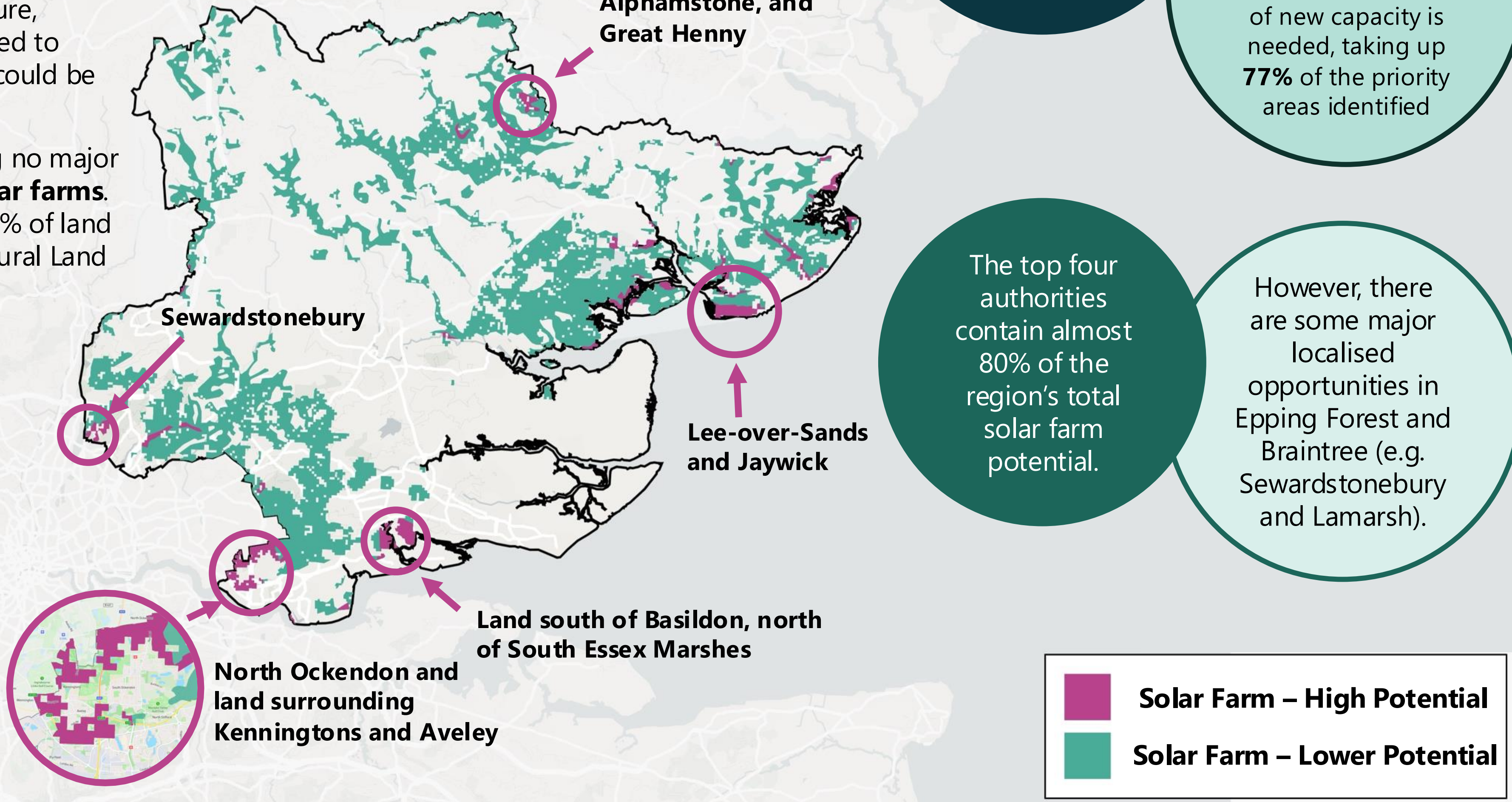
Solar farms generate low-cost, low-carbon electricity that can boost Essex's renewable supply, support the grid and lower bills for consumers.

Mapping of environmental, heritage, infrastructure, topology and planning constraints was completed to understand how much new solar farm capacity could be installed and where.

1.4% of land area in Essex, identified as having no major constraints, **could host up to 2,570 MW of solar farms**. Up to 39GW may be feasible across a further 20% of land (with lower potential) subject to further Agricultural Land Classification checks.

Solar Farm Focus Zones

LA with most Focus Zones	Solar Farm High Potential (MW)	Solar Farm Lower Potential (MW)
Tendring	785	5,600
Thurrock	623	2,830
Colchester	322	5,140
Basildon	295	1,620
Total	**2,570**	**39,600**



The total solar farm potential on land that is most suitable is **2,570 MW,** requiring **1.4%** of all land area

Under the Balanced pathway, **1,970 MW** of new capacity is needed, taking up **77%** of the priority areas identified

The top four authorities contain almost 80% of the region's total solar farm potential.

However, there are some major localised opportunities in Epping Forest and Braintree (e.g. Sewardstonebury and Lamarsh).

Focus zone results are shown in the image.

Onshore Wind Farm Potential

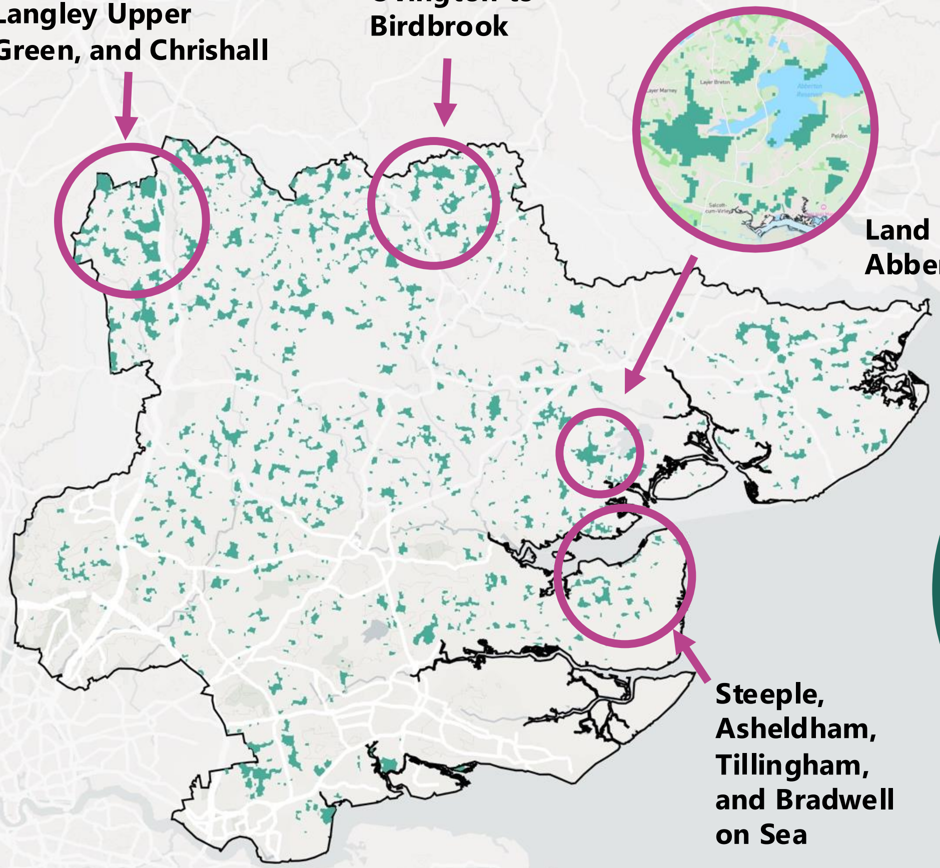
Onshore wind delivers more output per MW than solar and peaks at different times; a balanced wind–solar mix improves diurnal and seasonal coverage, maintaining supply at night and in winter when heating demand is highest.

The results of City Science's Renewables Potential mapping are shown on the right. **2,270 MW of onshore wind potential** is found, requiring **6.3% of Essex's total land area**.

The potential for onshore wind development is found to be spread across much of Essex, with 70% of all wind potential being found in Uttlesford, Maldon, Braintree and Colchester. The Dengie Peninsula is highlighted as a key area for further analysis.

Onshore Wind Farm Focus Zones

LA with most Focus Zones	Onshore Wind Potential (MW)	% of Essex Total
Uttlesford	548	23%
Maldon	431	21%
Braintree	399	17%
Colchester	182	9%
Total	**2,270**	



There is a total **2,270 MW** of onshore wind potential across Essex, requiring **6.3%** of all land

Under the Balanced pathway, **108 MW** of new capacity is needed, taking up **4.7%** of the priority areas identified

Uttlesford, Maldon, Braintree, and Colchester account for 70% of the region's onshore wind potential.

The area that contains Bradwell on Sea and Tillingham is the single highest-yield (99 MW, 6% of total).

Onshore Wind Potential Areas

Focus zone results are shown in the image.

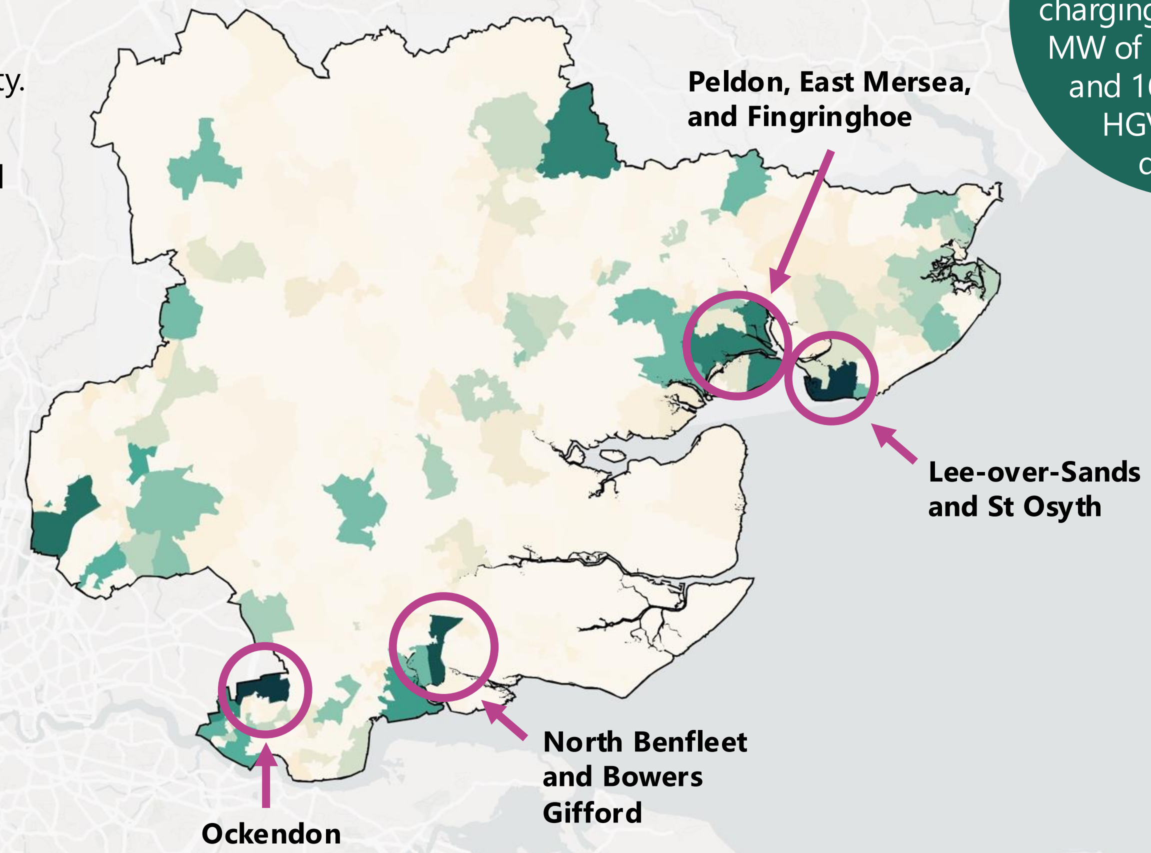
Solar Farm Potential & HGV Demand

As HGV charging demand increases across Essex, there may be opportunities to co-locate HGV charging facilities with large-scale renewable generation projects that can provide low-carbon, low-cost electricity to the charging facilities whilst also providing an attractive investment opportunity.

Locations of high solar farm potential in areas estimated to have high HGV charging are mapped to identify Focus Zones, as shown on the right. Local supply can support investment in decarbonisation of the transport sector.

Solar Farm & HGV Demand Focus Zones

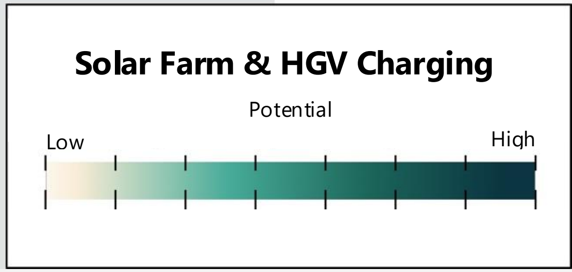
LA with most Focus Zones	Solar Farm Potential (MW)	2050 HGV Demand (MWh)
Thurrock	623	132,630
Epping Forest	270	124,570
Colchester	322	103,700
Tendring	785	42,370
Total	**2,570**	**848,150**



Thurrock is a prime location for an integrated solar-HGV charging hub, with 623 MW of solar potential and 16% of Essex's HGV charging demand.

Tendring has a lower HGV charging demand but its high solar potential could be suitable as a generation-export aera.

There are 3 strong dual-potential areas, in Ockendon, North Benfleet/Bowers Gifford, and Peldon/East Mersea/ Fingringhoe



Focus zone results are shown in the image.

Onshore Wind Potential & HGV Demand

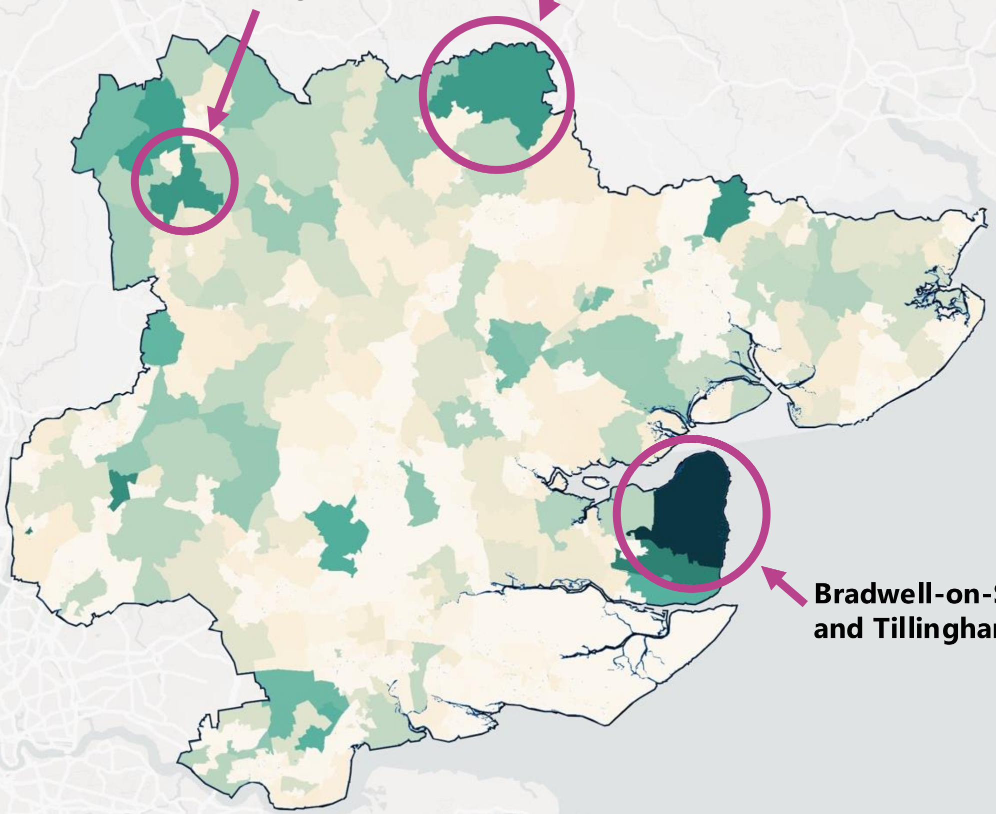
Onshore wind could supply HGV charging hubs with locally produced, low-cost and low-carbon power, reducing strain on the electricity grid and providing local investment opportunities.

Areas with high onshore wind development potential are mapped against areas with high forecasted HGV charging demand.

As shown on the right, Bradwell-on-Sea and Tillingham provide a key Focus Zone which should be explored in greater detail. As HGV charging stations are delivered, opportunities for local onshore wind development should be explored.

Onshore Wind & HGV Demand Focus Zones

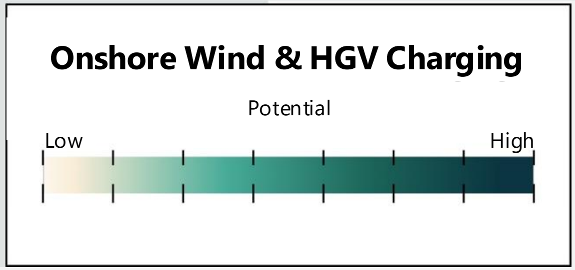
LA with most Focus Zones	Onshore Wind Potential (MW)	2050 HGV Demand (MWh)
Uttlesford	548	85,830
Braintree	399	87,330
Maldon	431	8,510
Epping Forest	128	124,570
Total	**2,270**	**848,150**



Uttlesford & Braintree are areas with high onshore wind potential and demand, while Maldon has high wind potential but low demand

Epping Forest is a major demand hotspot that will rely more on imported renewable generation due to limited potential for onshore wind

High HGV charging demand zones include Thornwood Common in Epping Forest, Langham in Colchester, Widdington in Uttlesford, and Horndon/Stanford in Thurrock.



Focus zone results are shown in the image.

District Heat Network (DHN) Potential

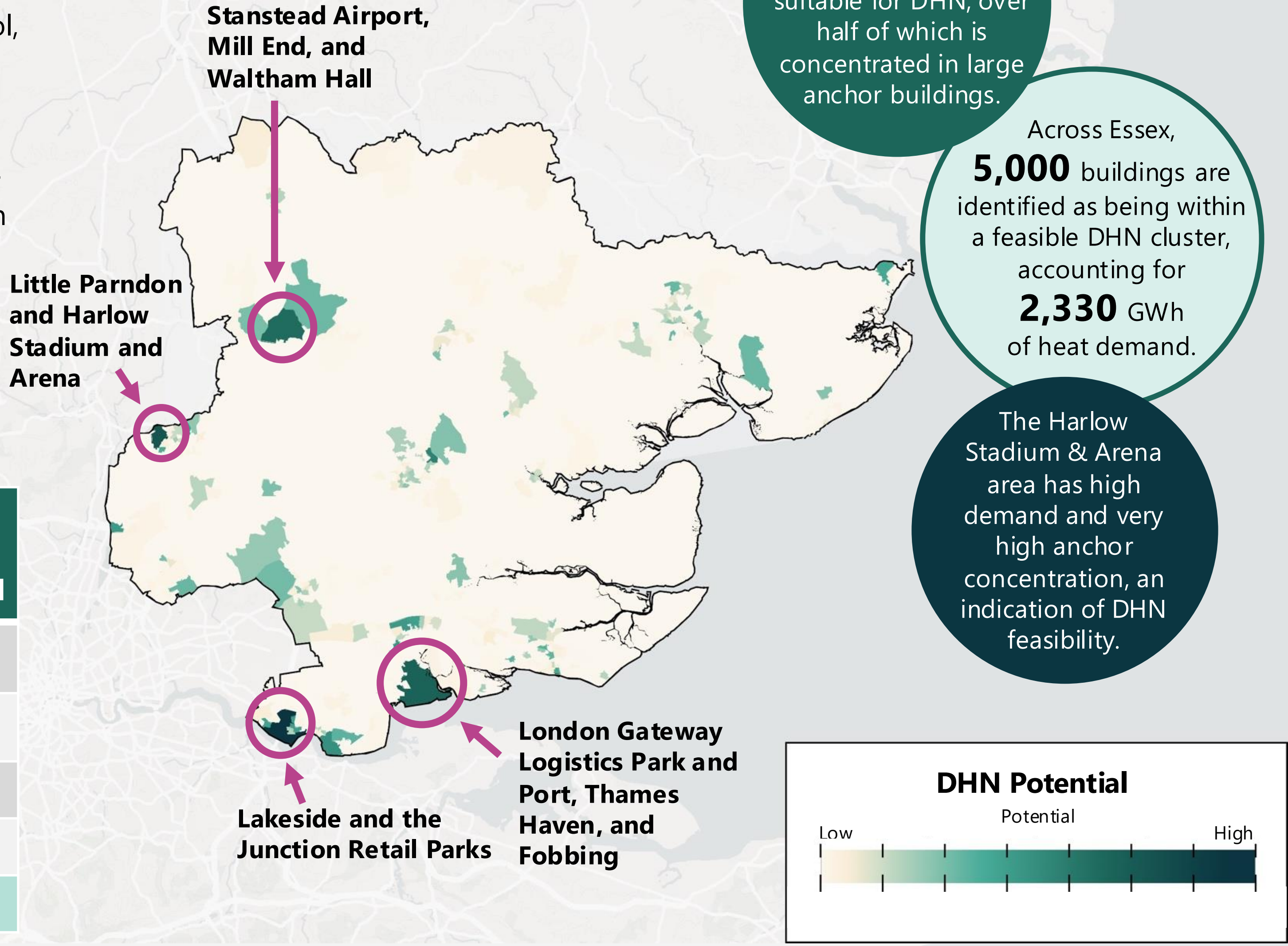
A DHN supplies heat from a central source, through a network of pipes, to many homes and buildings, offering an efficient, low-carbon alternative to individual boilers. Using City Science's DHN Feasibility tool, Essex was mapped to identify high heat demand clusters in areas with key 'anchor loads' (large heat users e.g. hospitals, schools or leisure centres) that strengthen commercial viability and economics.

Focus Zones were found around industrial parks, where high heating or cooling loads can act to initially anchor a DHN project before expansion into nearby residential areas. These areas should be explored in greater detail, engaging with key local stakeholders to explore feasibility and commercial delivery.

In addition to this analysis, there may be potential to utilise waste heat from data centres for district heating.

DHN Potential Focus Zones

LA with most Focus Zones	# DHN Clusters Identified	# Buildings in DHN Clusters	Demand in DHN Clusters (GWh)	Anchor Load vs Demand
Thurrock	12	590	425	55%
Southend-on-Sea	109	500	195	29%
Harlow	75	540	285	45%
Basildon	91	710	310	26%
Total	**1,090**	**5,000**	**2,330**	**34%**



Thurrock has the largest overall demand suitable for DHN, over half of which is concentrated in large anchor buildings.

Across Essex, **5,000** buildings are identified as being within a feasible DHN cluster, accounting for **2,330** GWh of heat demand.

The Harlow Stadium & Arena area has high demand and very high anchor concentration, an indication of DHN feasibility.

Focus zone results are shown in the image.

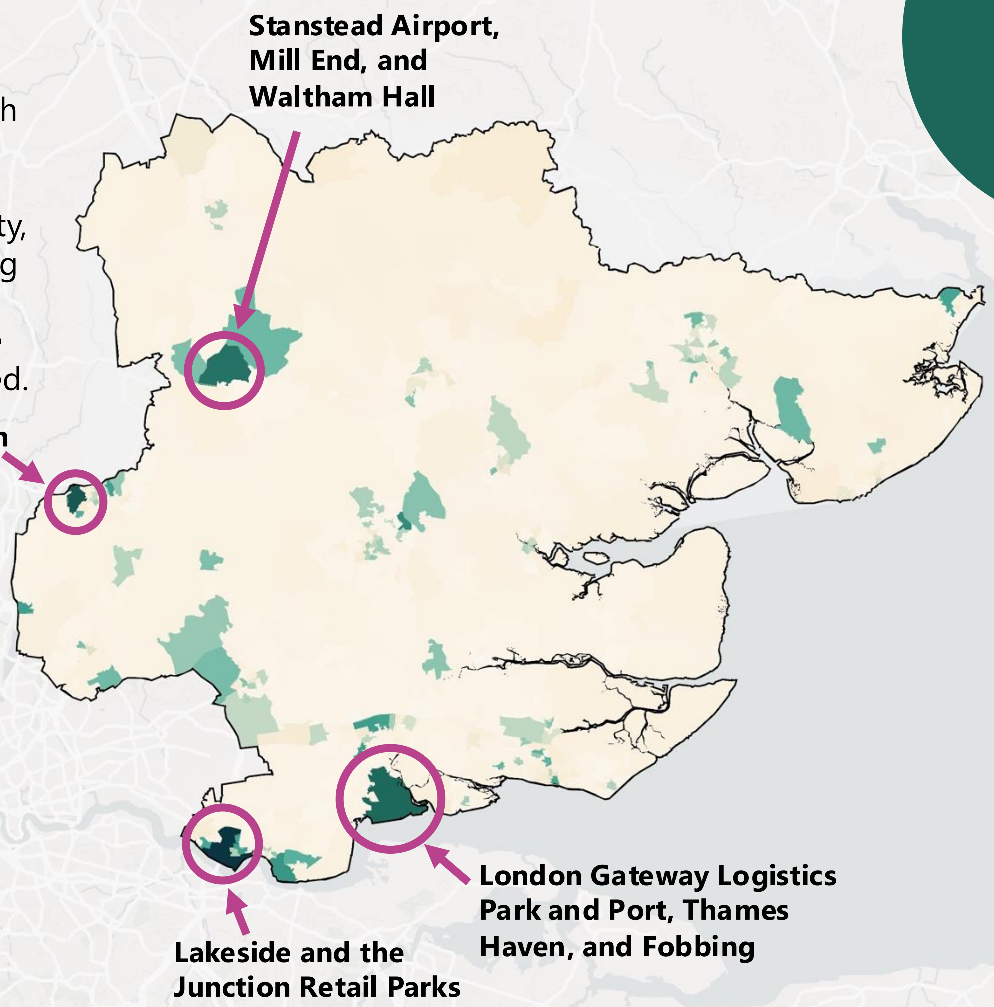
DHN Potential in Fuel Poor Areas

If implemented effectively, DHNs can deliver a lower cost of heating than conventional gas boilers, due to the economies of scale and the utilisation of highly efficient, centralised heat pumps.

Mapping DHN potential with areas experiencing high levels of fuel poverty enabled high-impact Focus Zones to be identified. The results map very closely on to DHN potential without considering fuel poverty, demonstrating that areas most suitable for delivering district heating are also areas with higher levels of fuel poverty. Again, opportunities to integrate waste heat from data centres should be further investigated.

DHN Potential in Fuel Poor Areas Focus Zones

LA with most Focus Zones	Number of Buildings in DHN Cluster	% Fuel Poverty
Thurrock	590	9%
Southend-on-Sea	500	12%
Harlow	540	8%
Basildon	710	8%
Total	**5,000**	



Thurrock is the strongest LA for DHN rollout, alongside a moderate fuel poverty rating (9%).

Southend-on-Sea has weaker technical conditions, but its higher fuel poverty rate means deployment here could bring higher social benefit.

Lakeside Retail Park and Little Parndon combine both technical feasibility and moderate levels of fuel poverty.

Focus zone results are shown in the image.

Essex County Council

6. Wider Factors

Wider Factors

City Science invited representatives from the 15 local authorities of Greater Essex to take part in a workshop to explore the wider factors that might impact the implementation of the LAEP. The session allowed the 30 participants to share their experiences of barriers, as well as to reflect on the challenges of aligning local plans with broader decarbonisation ambitions. The discussion also highlighted areas where practical solutions could help overcome these obstacles.

Public Sector Resources

Barriers	Solutions
Incomplete asset registers, poor metering and data collection, and under-used GIS skills. Lack of energy managers.	Provide training for officers in relevant areas. Create shared training resources using UKPN's LAEP+ toolkit.

Authority Capacity Limits

Barriers	Solutions
Smaller authorities are unable to respond quickly to policy and regulatory requirements.	Use rapid modelling, simple case studies, and pilot projects to demonstrate success.

Unclear Delivery Models

Barriers	Solutions
Clarity lacking about how the ideas set out in LAEPs will be delivered/who is responsible for implementation	Provide structured training for officers in relevant areas. Create shared training resources using LAEP+.

Inconsistent Policies

Barriers	Solutions
Inconsistent wording in government policies discourages authorities from progressing with plans.	Link LAEPs more clearly with statutory documents such as the SDS (to be prepared by the Greater Essex Mayor).

Timeline Urgency

Barriers	Solutions
Opportunities for definitive progress in climate equity risk being missed if action is not taken quickly.	Financial planning should work backwards from what is already being paid for under ED3.

Technical Knowledge

Barriers	Solutions
Teams can lack the technical knowledge to engage fully with LAEPs, and training budgets are often lacking.	Provide training for officers in relevant areas, using governance training, shared resources & funding partnerships.

Community Energy Rollout

Barriers	Solutions
Lack of funding. Site acquisition and tenure complexity. Limited pathways for local supply.	Large-scale activities that won't happen locally should be prioritised. Work with Southeast NZH and utilise their network.

EV Charging Rollout

Barriers	Solutions
Rollout stalls as there is no one-size-fits-all model. Authorities differ in site contexts, aims and capabilities.	Use a flexible, configurable playbook that allows authorities to tailor approach based on current needs.

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Glossary

Acronym	Definition
ASHP	Air Source Heat Pump
AONB	Area of Outstanding National Beauty
BEV	Battery Electric Vehicle
BSP	Bulk Supply Point
CCC	Climate Change Committee
DESNZ	Department for Energy Security and Net Zero
DHN	District Heat Network
ECC	Essex County Council
ECO	Energy Company Obligation
EfW	Energy from Waste
EPC	Energy Performance Criteria
EV	Electric Vehicle
FHS	Future Homes Standard
FTE	Full Time Equivalent
GSP	Grid Supply Point
HGVs	Heavy Goods Vehicles

Acronym	Definition
LAEP	Local Area Energy Plan
LiDAR	Light Detection and Ranging
LILEE	Low Income Low Energy Efficiency
LGVs	Light Goods Vehicles
LPG	Liquified Petroleum Gas
LSOA	Lower Layer Super Output Area
NAEI	National Atmospheric Emissions Inventory
NESO	National Energy System Operator
NZH	Net Zero Hub
PV	Photovoltaic
RESP	Regional Energy Strategic Plan
UKPN	UK Power Network
7CB	7th Carbon Budget

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Further information regarding the guiding methodology, data inputs and key modelling assumptions can be found in the Technical Annex

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