Essex Climate Action Commission

Energy and Waste Special Interest Group

Pre-reading pack
27th November 2020

Essex County Council

ENERGY & WASTE SIG MEMBERS

Commissioners

- Prof. Jacqueline McGlade – United Nations Environment Programme
- Prof. Adam Read – Chartered Institute of Waste Managers
- Rob Wise – National Farmers Union
- Right Rev. Roger Morris –Church of England
- John Henry – Mid and South Essex NHS Foundation Trust
- Cllr. Robert Mitchell – ECC Deputy Cabinet Member for Infrastructure & Highways

ECC

- Sam Kennedy - Director for Environment and Climate Action
- David Claydon – Program Manager
- Tom Day – Head of Energy and Low Carbon programme
- Jason Searles - Head of Strategic Development and Compliance
- Dale Radford – Commercial analyst, Energy and Low Carbon programme

INTRODUCTION

This pre-reading pack provides background information on the topics discussed in the Energy and Waste Special Interest Group including:

Energy

- Future Energy Scenarios
- Renewable Generation – scaling up
- Community Energy and the role of residents

Waste

- Waste Prevention
- Reuse and Recycling
- Biowaste
- Residual waste recovery and disposal

THE TEN POINT PLAN FOR A GREEN INDUSTRIAL REVOLUTION

On 18th November 2020 the Prime Minister published a 10-point plan of how Britain will lead the world into a new Green Revolution. It outlined the governments high level plans for the following 10 areas alongside several strategies and reviews that will provide further policy detail in the coming months.

Point 1
Advancing Offshore Wind

Point 2
Driving the Growth of Low Carbon Hydrogen

Point 3
Delivering New and Advanced Nuclear Power

Point 4
Accelerating the Shift to Zero Emission Vehicles

Point 5
Green Public Transport, Cycling and Walking

Point 6
Jet Zero and Green Ships

Point 7
Greener Buildings

Point 8
Investing in Carbon Capture, Usage and Storage

Point 9
Protecting Our Natural Environment

Point 10
Green Finance and Innovation

Government strategies to come:

- Energy White Paper
- National Infrastructure Strategy
- England Tree Strategy
- Transport Decarbonisation Plan
- Industrial Decarbonisation Strategy
- Net Zero Strategy
- Heat and Buildings Strategy
- Hydrogen Strategy
- HMT Net Zero Review
- Nature Strategy

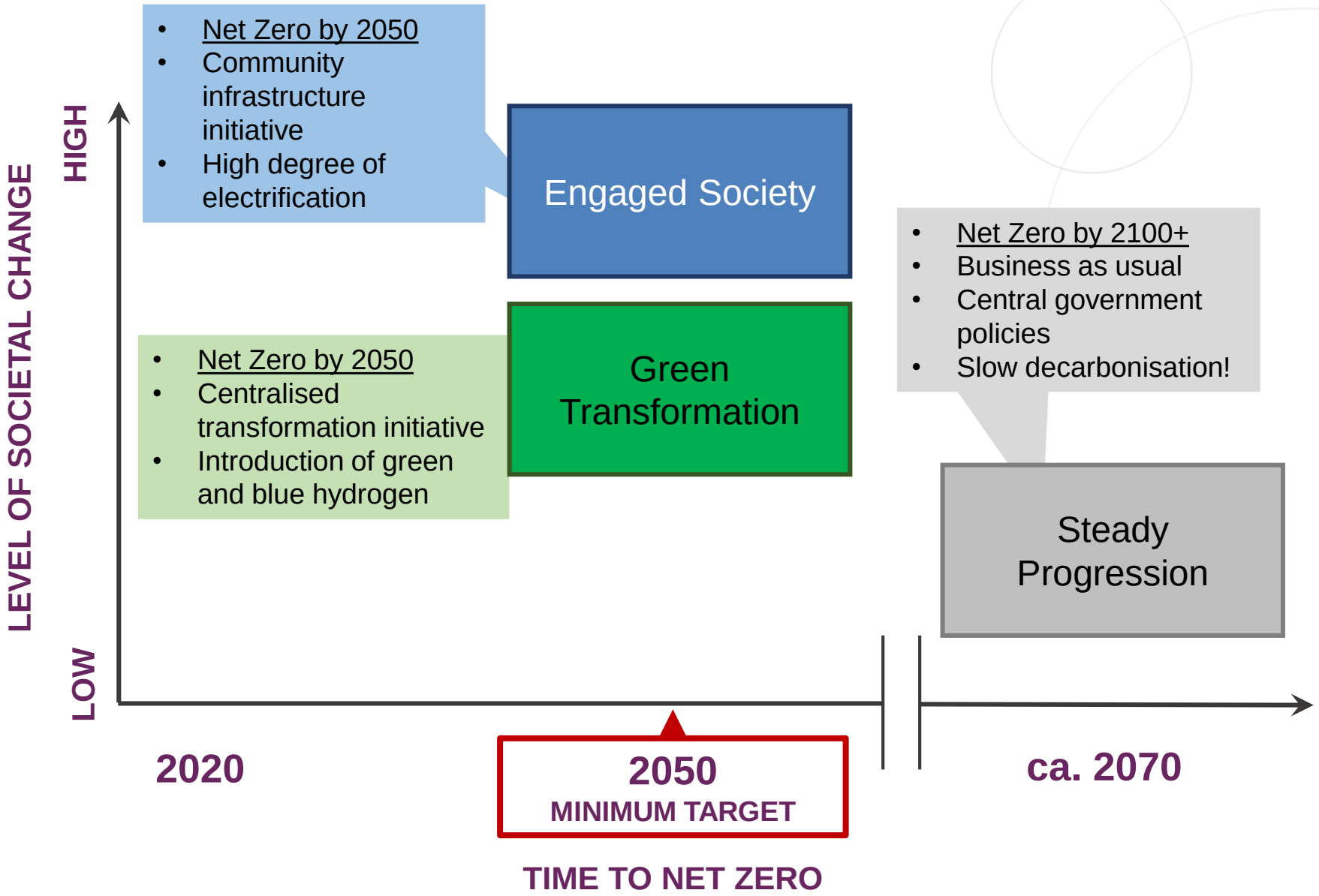
Link: https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution

FUTURE ENERGY SCENARIOS

elementenergy

Essex County Council appointed Element Energy to complete a study of the future energy scenarios in Essex.

To assess the different possible routes to decarbonisation element energy have modelled 3 different scenario worlds. Each scenario has different input assumptions and attributes.



FUTURE ENERGY SCENARIOS ASSUMPTIONS

elementenergy

The table outlines the different input assumptions for each of the three scenarios modelled.

Scenario world	Steady Progression	Engaged Society	Green Transformation
Net-zero by 2050?	No	Yes	Yes
Energy efficiency	Low	High	Medium
Building stock growth	Medium	Medium	Medium
Electric vehicles (cars and vans)	Low	Medium	Medium
Electric vehicles (other)	Baseline	High electrification	System transformation
Heating technologies	Medium electrification	High electrification	Low electrification with decarbonised gas
District Heat uptake	Low	High	High
District Heat supply	Decentralised scenario	Electrification scenario	Decarbonised gas scenario
Small scale solar PV	Low	High	Medium
Large solar PV	Low	Medium	High
Gas reciprocating engine	High	Low	Low
Onshore wind	Low	High	Low
Hydrogen generation	Low	Low	High
Other renewable generation	Low	High	Medium
Domestic battery storage	Medium	High	Low
I&C behind-the-meter battery storage	Low	Medium	Low
Co-located battery storage	Medium	High	Low
Grid-level battery uptake	Medium	Medium	High
Flexibility	Medium	High	Low
EV smart charging	Medium	High	Low

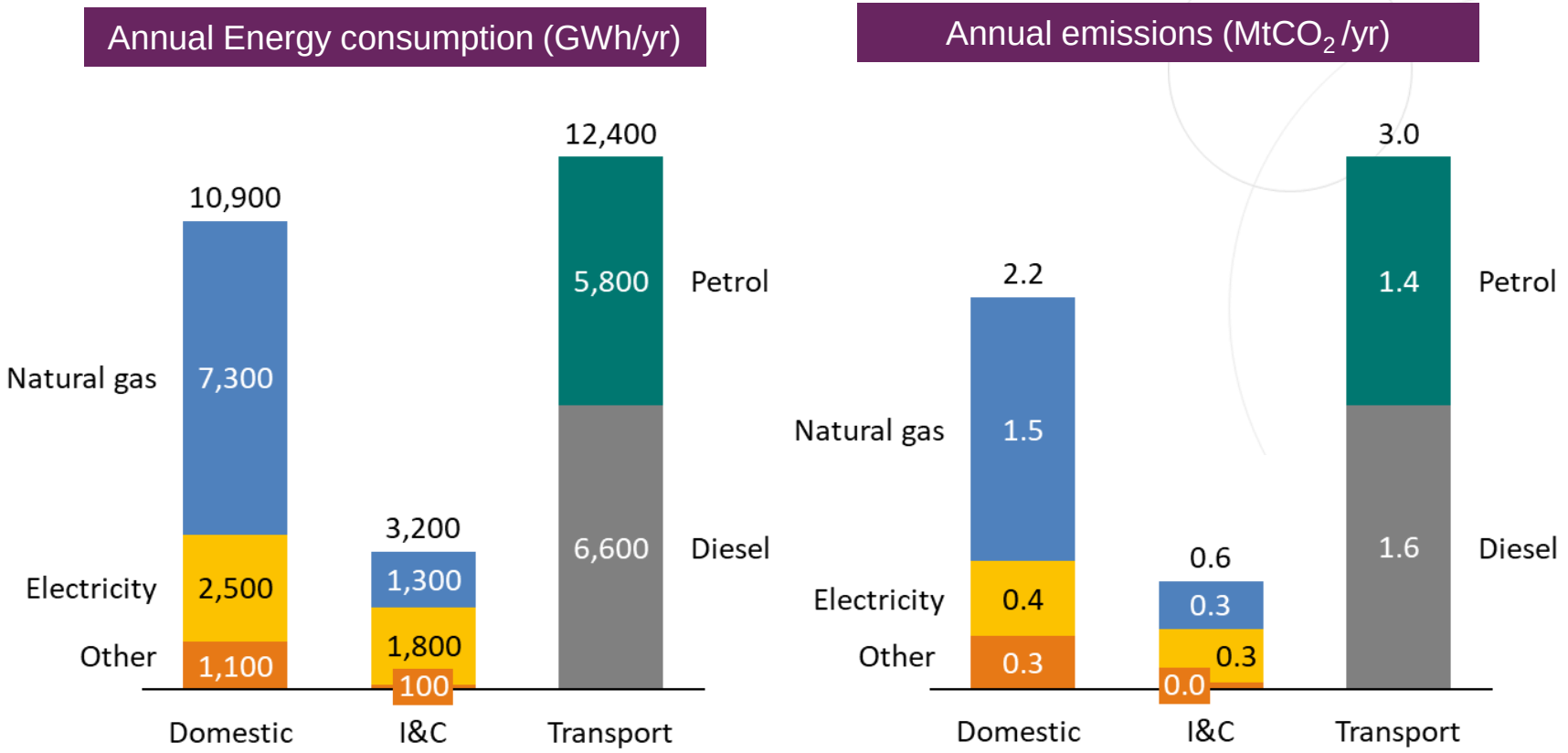
WHERE ARE WE NOW?

elementenergy

Essex's baseline emissions have been calculated. The graph on the left shows the baseline annual energy consumption broken down by sector and the graph on the right shows the equivalent annual emissions.

The **transport** sector is the **largest** energy consumption and emissions sector.

Natural gas consumption also produces a significant emissions. Overcoming the **decarbonisation of heat** in both **domestic** households is a big challenge for the county to met its net zero ambitions.



Annual energy consumption (Left) Annual emissions (Right) in Essex in 2019, broken down by sector: Domestic, Industrial & Commercial (I&C) and Transport. Element Energy 2020

Total energy demand = **26,565 GWh/yr*** Annual emission = **5.8 $MtCO_2$/yr***

*does not include emissions from land use or industrial processes, further work will be undertaken to include these sectors in the emissions figures

FUTURE ENERGY DEMAND

elementenergy

The graphs in the left column show **total energy consumption** (TWh/yr) between 2019-2050 by fuel type.

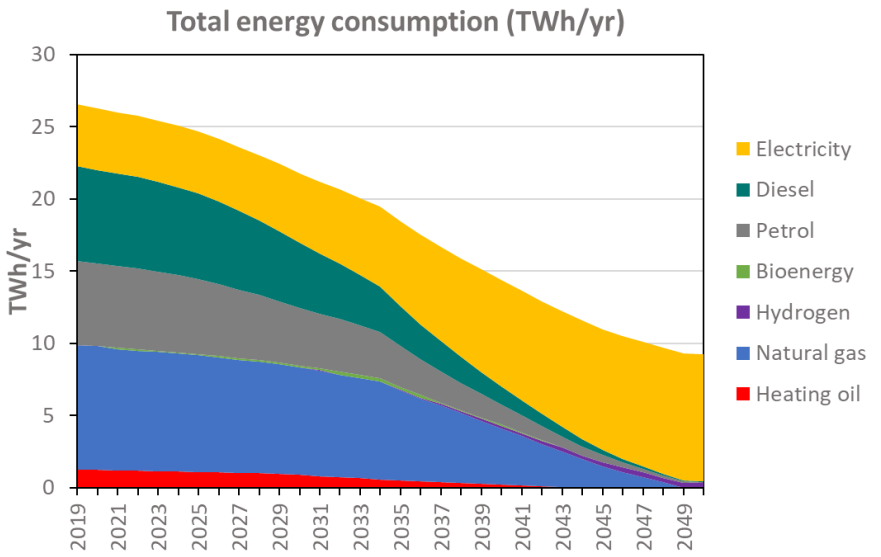
The graphs in the right column show **total emissions** ($MtCO_2$/yr) 2019-2050 by fuel type.

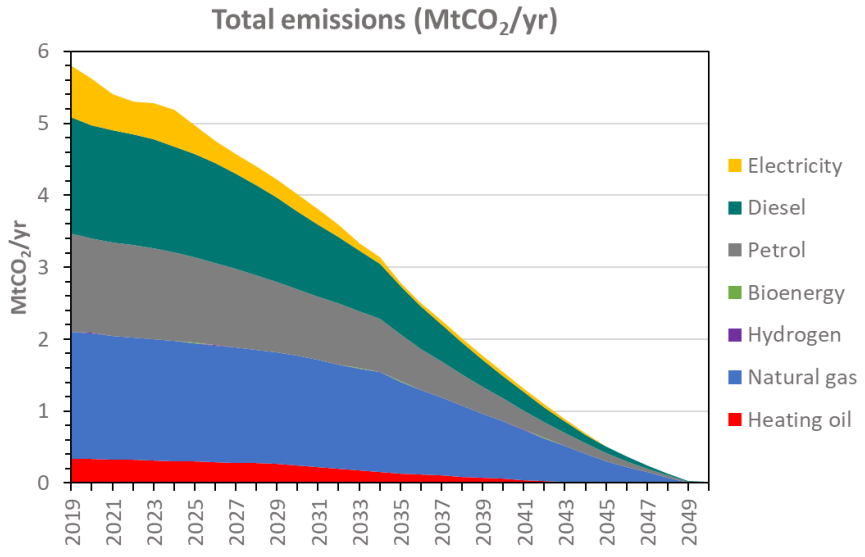
Both scenarios **meet net zero emissions by 2050** but utilise different technologies and fuel types to reduce the emissions.

Engaged Society relies on **significant electrification** of heating and transport.

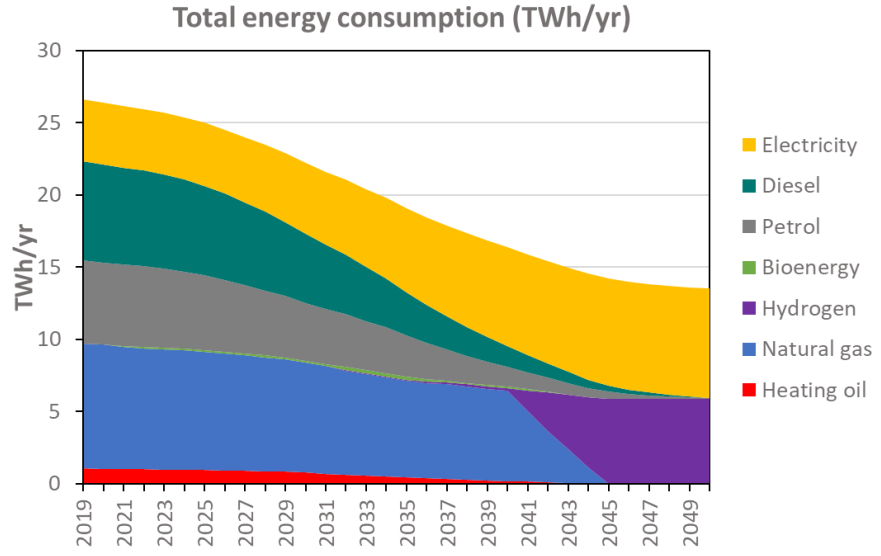
Green transformation relies on high levels of **electrification** *and a* switch to **hydrogen** for heating using the existing gas infrastructure.

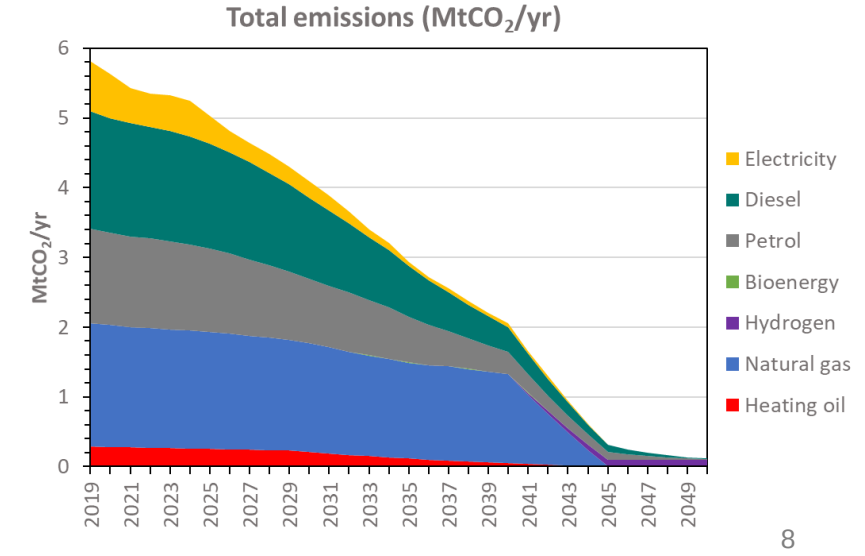
Engaged Society





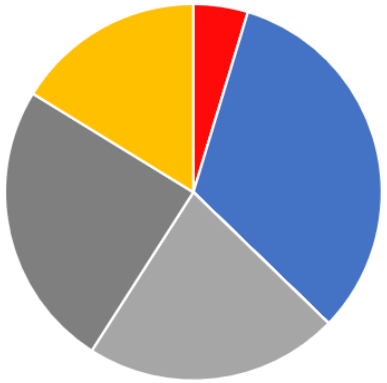
Green Transformation





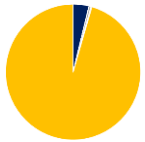
FUTURE ENERGY DEMAND – Where's the power coming from?

Baseline 2019



26,565 GWh/yr

Engaged Society 2050



9,506 GWh/yr

Green Transformation 2050

13,530 GWh/yr

Heating oil | Natural gas | Hydrogen | Bioenergy | Petrol | Diesel | Electricity

The above pie charts provide a comparison of where the power is being generated from. The left pie chart shows the **baseline fuel mix** for 2019. The centre and right pie charts represent the fuel mix in 2050 for the Engaged Society and the Green Transformation scenarios respectively.

Total **energy consumptions is reduced** in both scenarios by 2050. Electricity and hydrogen are the dominant fuel types, the proportions of each differ depending upon the scenario modelled.

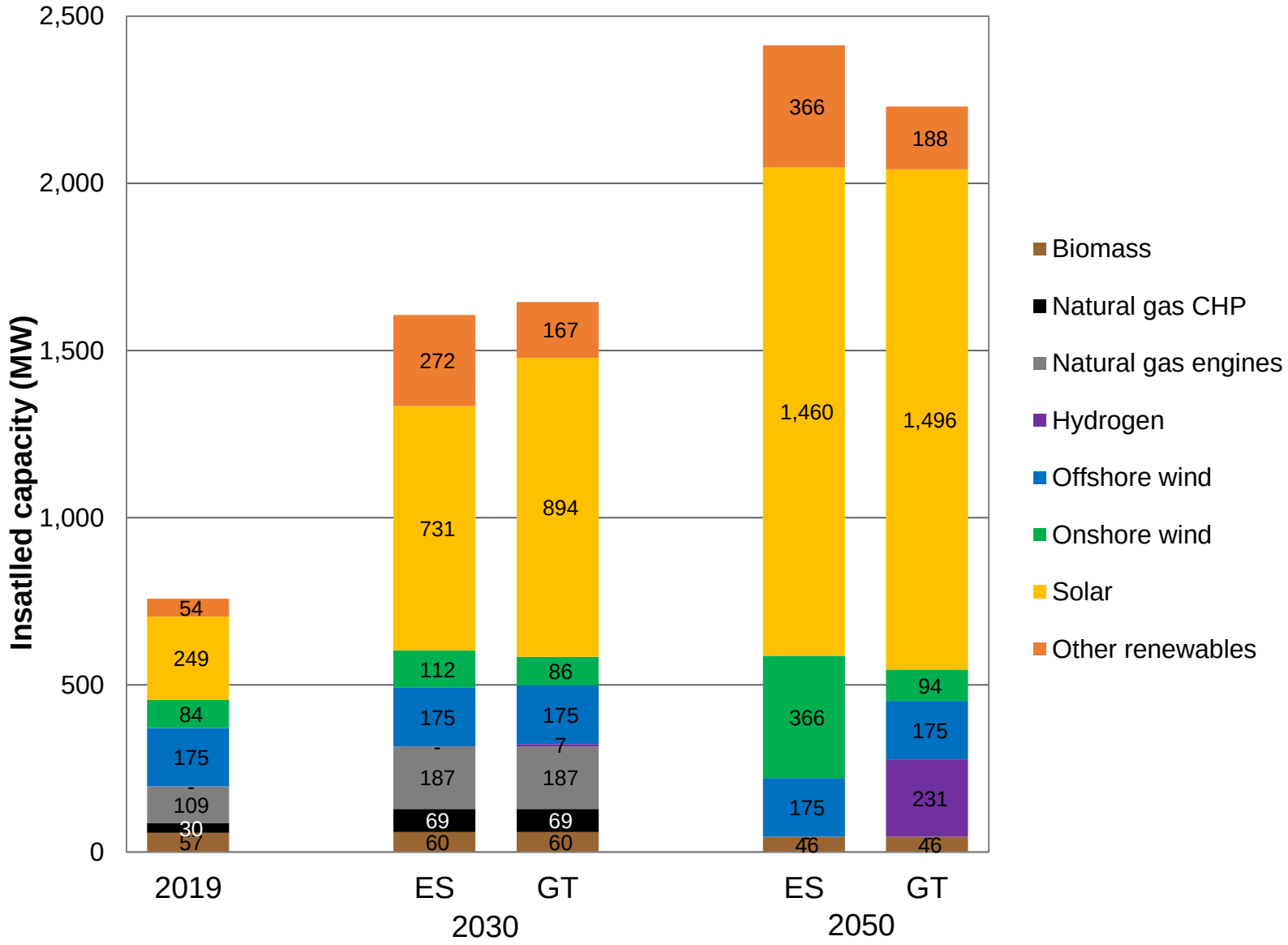
FUTURE ENERGY RENEWABLE GENERATION

elementenergy

The graph shows the estimated **distributed energy generation capacity** (MW) in Essex broken down by technology type. This has been modelled for each scenario and is presented for key dates: 2030 and 2050.

There is an **increase in distributed energy capacity** from 2019 to 2050, with big increases in capacity of **solar**, **onshore wind** and **biomass**.

Distributed generation capacity in Essex

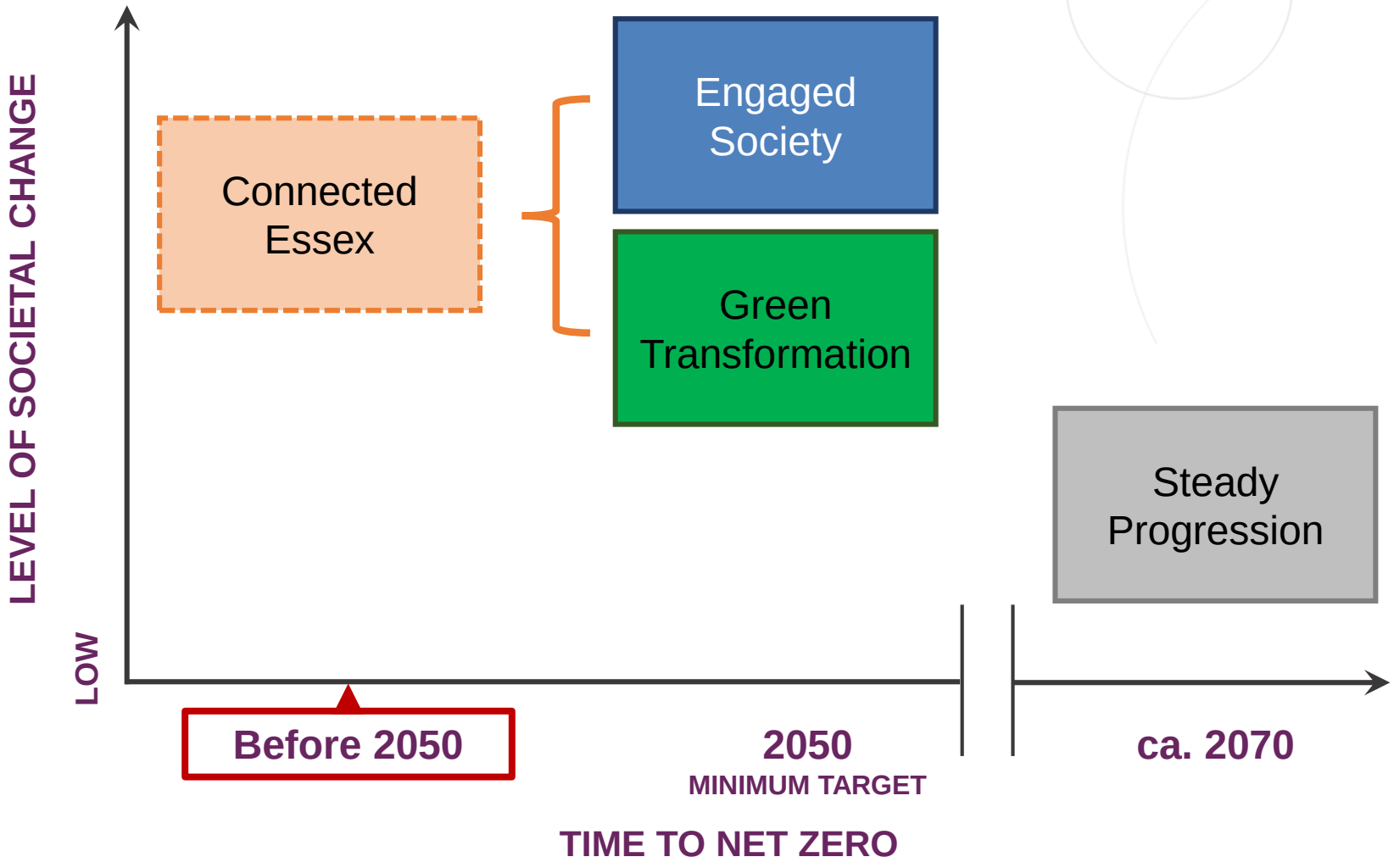


FUTURE ENERGY SCENARIOS

Element Energy have modelled two net zero scenarios; Engaged Society and Green Transformation. In practice Essex *could* take a hybrid route of the two.

Our ambition is **'how can we get Essex to net zero faster than 2050**'. The graph on the right suggests that route is via a **'Connected Essex'** scenario.

This scenario is yet to be modelled but will ultimately be shaped by the recommendations of the Essex Climate Action Commission.



GETTING TO NET ZERO FASTER– Connected Essex

Key message 1: Bring **clean energy** to Essex **at scale** and enough renewables to meet most, if not, all of the county's demand for energy.

Key message 2: Innovate to be at the cutting edge of renewable generation, and storage, creating new supply chains and new feedstocks.

Key message 3: It's going to involve everyone to get Essex to net zero. We must create a community infrastructure to and put Essex at the vanguard of climate action.

WHERE WILL WE GET ALL THAT POWER? – Solar

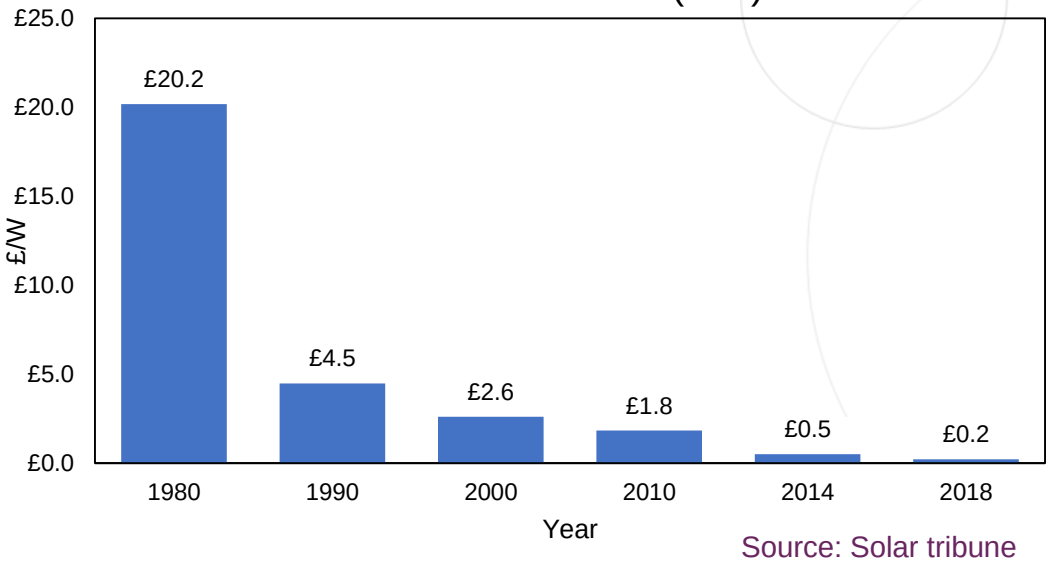
Solar PV is a **mature technology** that is proven to work and can be **deployed very quickly** at **relatively low cost.**

Over the past 4 decades the **cost** of solar has **significantly reduced**.

This period has also seen **significant improvements** in the technology efficiency making it one of the **most efficient** renewable technologies at converting the sun's energy into electricity.

The design and aesthetic of the panels have significantly improved helping with public perceptions of aesthetics.

Solar PV is very well placed to have a significant and immediate impact on meeting energy demand whilst reducing the emissions in Essex.



Source: Solar tribune

WHERE WILL WE GET ALL THAT POWER? – Solar

Recommendations

1.

Install Solar panels on every available roof on both domestic and industrial and commercial by 2050 - 25% of rooftops by 2030.

2.

Build 1.43 GW of large scale solar on available land without unduly compromising agricultural land by 2030.

3.

All new build houses and I&C units to have solar panel installed immediately.

4.

Essex produces enough renewable energy within the county to meet its own needs by 2040.

INNOVATION – Placing Essex at the cutting edge of renewable energy

Solar PV generation is just part of the solution.

Other generation technologies are required to complement solar and to reach **net zero** these include:

- Wind
- Battery storage
- Heat capture technologies
- Hydrogen
- Bioenergy
- Nuclear

WIND POWER

The **offshore wind** industry has gone from strength-to-strength over the past few years with **significant increases** in scale supporting the national energy generation infrastructure. The government 10 point plan announced support for up **to 60,000 jobs**, and **£20 bn** of investment by 2030 directly resulting in a 5% reduction of 2018 UK emissions.

Onshore wind has more of a local network impact however this has not followed the same scaling-up as offshore projects. This is often due to negative public perceptions and local objection to installations **preventing new capacity** being installed.

Despite this both onshore and offshore wind will play and **major role** in energy generation to **meet net zero** targets.

Essex has the largest offshore wind sector globally off it's coast so is well placed to **benefit** from **growth** and **innovation** of the industry.

BIOENERGY

Bioenergy is electricity or gas that has been generated from **biomass** (i.e organic matter) such as timber, biomass from energy crops, agricultural residue, food waste or sewage.

There are **limited supplies** of biomass resources whose uses are **diverse** and span **multiple sectors**. For example harvested timber could be used for bioenergy production, but also in place of cement, brick or steel for construction to provide a long-term store of carbon and displace emissions from the fossil-fuel intensive process for manufacturing those material.

The **'best use'** of bioenergy in the energy sector is:

1. To use as the fuel source in rural homes that are hard to decarbonise through electrification
2. **Bio-energy with carbon capture and storage (BECCS)** for electricity generation – combusting biomass to generate electricity whilst capturing and storing the emissions.

Case study: Large Scale Biomass

Drax Power Station Biomass Conversion

Since 2013 the North Yorkshire site has converted 4 of 6 electricity generating units from coal to biomass. These now generate energy by burning compressed wood pellets, significantly reducing the sites carbon emission.

This is a major demonstration project that is now looking to incorporate both battery storage and carbon capture into its energy generation process.

HYDROGEN – blue and green

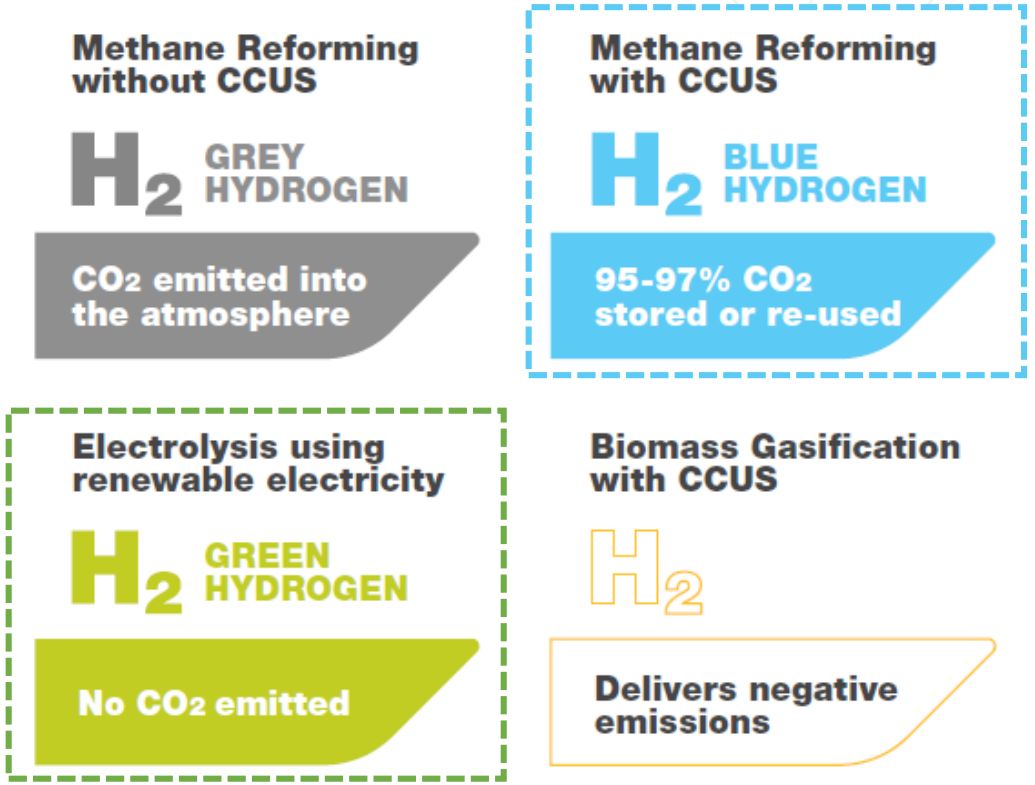
Hydrogen may have a role to play in the **decarbonisation of heating supply**. Combustion of hydrogen is a clean method of generating heat and is able to be **directly fed** into the existing gas infrastructure.

Currently the technology to generate hydrogen is in the **research and development stage** with major challenges to overcome in scale of supply, storage and economic viability.

Over the next decade it is expected that **demonstrator scale** hydrogen generation plants will be developed. The government's 10 point plan announced support for up to 8,000 jobs, £4 bn of investment by 2030 and up to 100,000 jobs by 2050. It is estimated that by 2032 low carbon hydrogen could directly reduce UK emissions by 9% of the 2018 level.

There are for main methods for the generation of hydrogen, it is anticipated that both **blue** and **green hydrogen** will have a significant role to play.

Hydrogen storage will also have a role to store excess renewable energy (wind and solar).



Methods of hydrogen generation
CCUS = Carbon capture, utilisation and storage

BATTERY STORAGE

Battery storage has emerged as a large scale **solution to store** renewable energy generation. Renewable generation (notably wind and solar) is **highly variable** due to changes in the weather, battery technology allows the **storage of energy** when too much is being produce and the **release energy** onto the grid in times of high demand.

Often batteries are **co-located** on the same site as the renewable energy generation inside shipping containers but can exist in stand-alone sites that provide grid balancing services.

The past few years have seen the cost of batteries **decrease significantly** all whilst performance has continued to improve.

As more and more renewable generation capacity is installed increased battery storage capacity will be required to ensure that energy generation can meet demand.

HEAT CAPTURE TECHNOLOGIES

There are opportunities to capture and **harness waste heat** that can be used to heat our **homes** and **workplaces**.

The sources of heat can vary and are very site-specific. Waste sources include:

- Industrial processes
- Wastewater
- Energy from waste
- Data centres
- Electricity substations
- Geothermal.

Case study: Electricity Substation

Tate Modern and UKPN (2013)

A joint project between UKPN and Tate Modern to supply the museums heating and hot water from the waste heat recovered from the co-located Bankside substation.

It is estimated to provide 7,000 MWh of heat and up to 1,400 tons of avoided carbon emissions per year.

Case study: Wastewater heat

Stirling Council and Scottish Water (2019)

The technology harnesses heat from the waste water at Stirling Waste Water Treatment Works. This heat will be used to power a number of key public building including leisure centres, a stadium and a school via a district heat network and is estimated to save at least 380 tons of carbon emissions per year.

INNOVATION – Placing Essex at the cutting edge of renewable energy

Recommendations

5.

Use bioenergy for all rural homes that are hard to decarbonise through electrification by 2030.

6.

Create facilities to produce green hydrogen to fuel heavy good vehicles on Essex roads by 2040.

7.

Create hydrogen storage facilitate to store excess renewable energy (off-shore wind and solar) by 2030.

8.

Make Essex a centre of innovation for emerging renewable technologies (e.g. small scale nuclear, & manufacturing of renewables products such as solar tiles).

9.

All waste heat from industrial and commercial use should be captured and reused (where local demand exists) by 2035

10.

All gas fired power in Essex should be repurposed to bioenergy (BECSS) by 2035

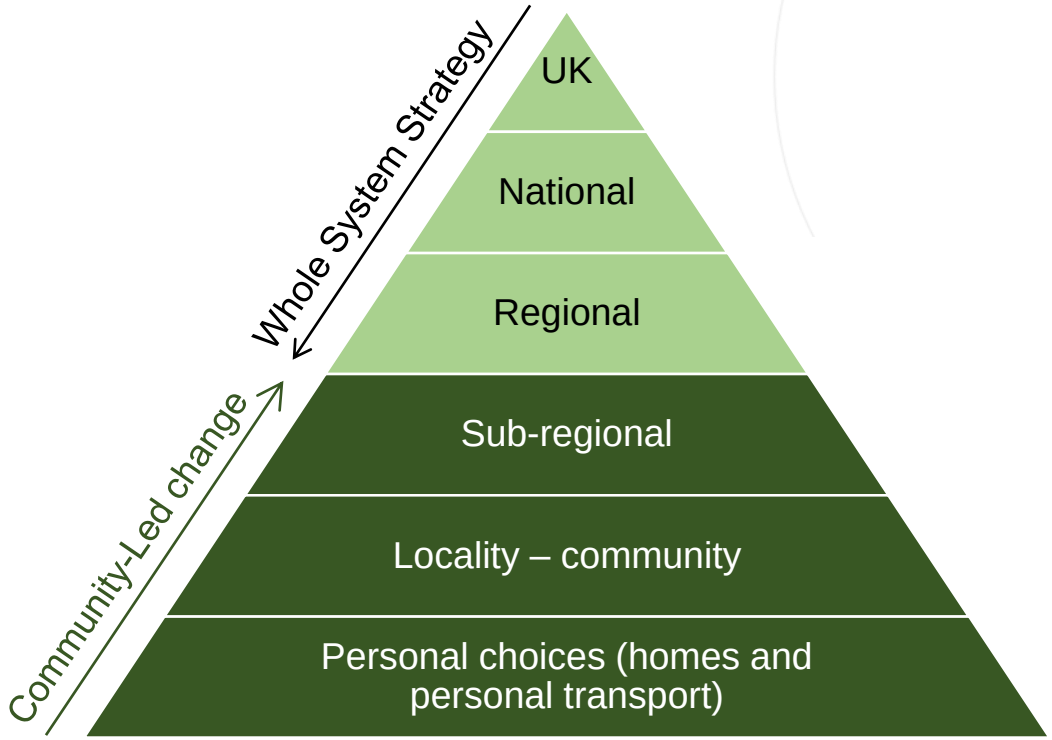
COMMUNITY INFRASTRUCTURE AND SMART LOCAL ENERGY SYSTEMS

To meet the UK energy system legal requirement to become net zero by 2050, three consumer macro trends will continue to develop. These are:

1. **Decentralisation** – seeing a shift from few large, centralised energy generation plants to a multiple of many smaller local renewable energy generation and storage facilities.
2. **Digitalisation** – to facilitate greater consumer engagement and to generate a smart flexible energy system – a new 'community infrastructure'.
3. **Democratisation** – giving consumers a greater share in the energy system by actively participating in it - supporting a shift from consumers to 'prosumers' and to **values led** behaviour change)

Value led change is key to a successful energy transition and climate action by investing in renewable and more sustainable energies, by choosing greener or more sustainable products or by individuals just changing their (consumption) behaviour.

Hierarchical structure of the UK energy system



Source: Energy Systems Catapult

SUB REGION PROJECT CASE STUDY: Project LEO

Project LEO is a good example of a large-scale community infrastructure project. One of the UK's largest smart grid trials in the project seeks to **unlock the benefits** from the **transition** to a smarter, flexible electricity system and how **households**, **businesses** and **communities** can realise its **benefits**.

Meeting net zero will require significant decarbonisation and an increased demand upon the electricity grid. Traditionally this would require costly network reinforcement. Project Leo aims to **balance demand** on the **local system** at different times through technology, and **support local renewable energy** sources. This will offer the opportunity to create a **decentralised energy system** and open up new **markets that communities**, businesses and households can benefit from by **generating**, **storing** and **using renewable energy** in the local area.

This will cover a range of different flexibility and energy services, relating to power, transport and heat projects. For example; developing small scale trials including Solar PV, battery, and electric vehicle combinations and mini-grids to improve their financial viability.

https://project-leo.co.uk/

SMART LOCAL ENERGY SYSTEM CASE STUDY: Feldheim, Germany

Feldheim is a **100% renewable energy self-sufficient**, climate neutral village. The village utilise **wind** and **solar** generation alongside a **biogas-fired heat generation** use pig manure as feedstock. This heat generation also produces **high-quality fertilizer** that the local agricultural cooperative uses.

Residents built there own mini smart grid to allow the locally **produces heat** and **electricity** to be **fed straight** into their homes. As part of this installed EV charging and energy storage to help balance the microgrid.

As a result the residents **energy prices have dropped by a third** and **99%** of the energy generated is **sold back to the grid**. The energy generation has also created local jobs as well as inadvertently creating a eco-tourism industry.

Link: https://www.greenbiz.com/article/why-small-german-village-bet-big-renewables

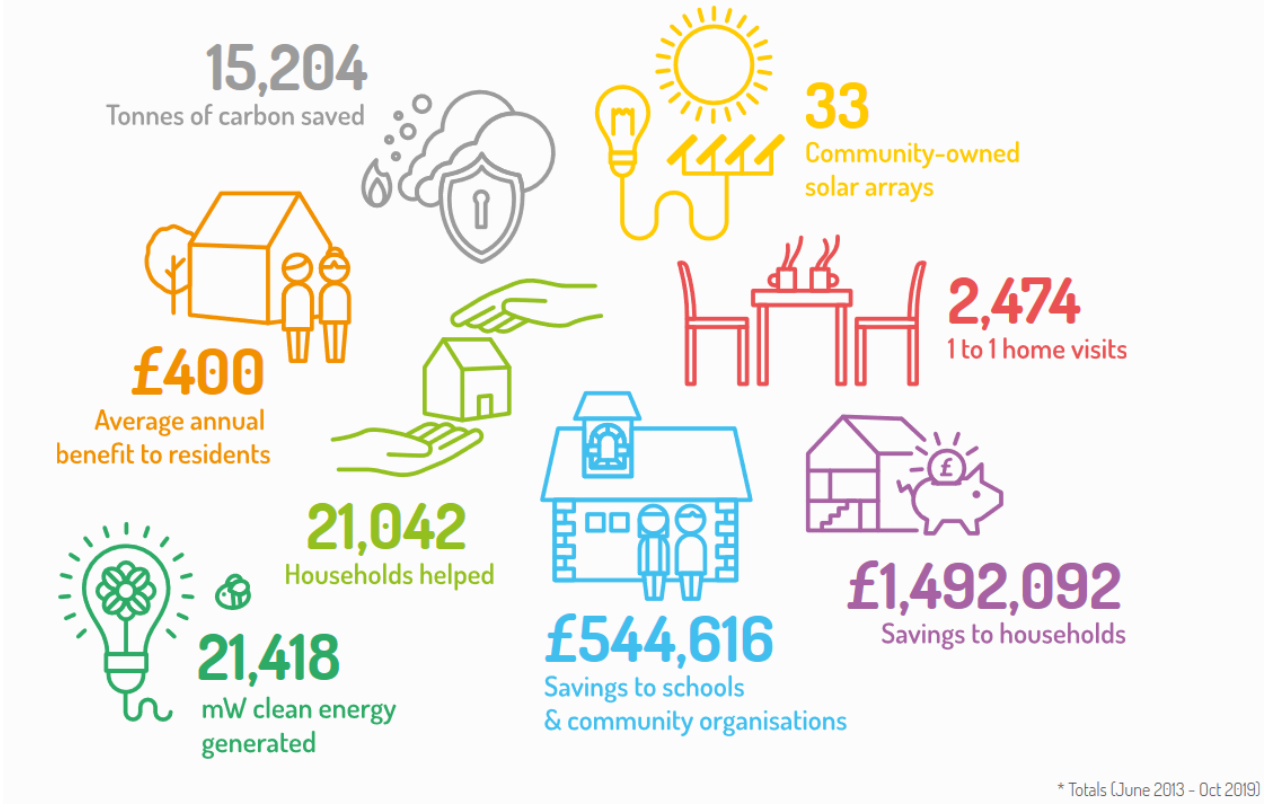
COMMUNITY BASED CASE STUDY: Plymouth Energy Community

Plymouth Energy Community is a Charitable Company Limited by Guarantee, a **member-led organisation** aiming to **empower** our community to create a **fair, affordable, zero carbon energy system** with local people at its heart. Its formal name is PEC Trust. This contains two subsidiary community groups, PEC Renewable and PEC Homes.

Set up on 2013 where Plymouth City Council recognised the role of community energy in **addressing fuel poverty** and carbon emissions.

In the past 7 years they have completed, **energy switch services**, fuel debt advice, **3 share offers**, solar roofs, volunteers programme, external wall insulation scheme, 4MW solar farm, Healthy Homes campaign, Warm and Well, Cold reality exhibition, climate active neighbourhoods, PEC Pals to name a few.

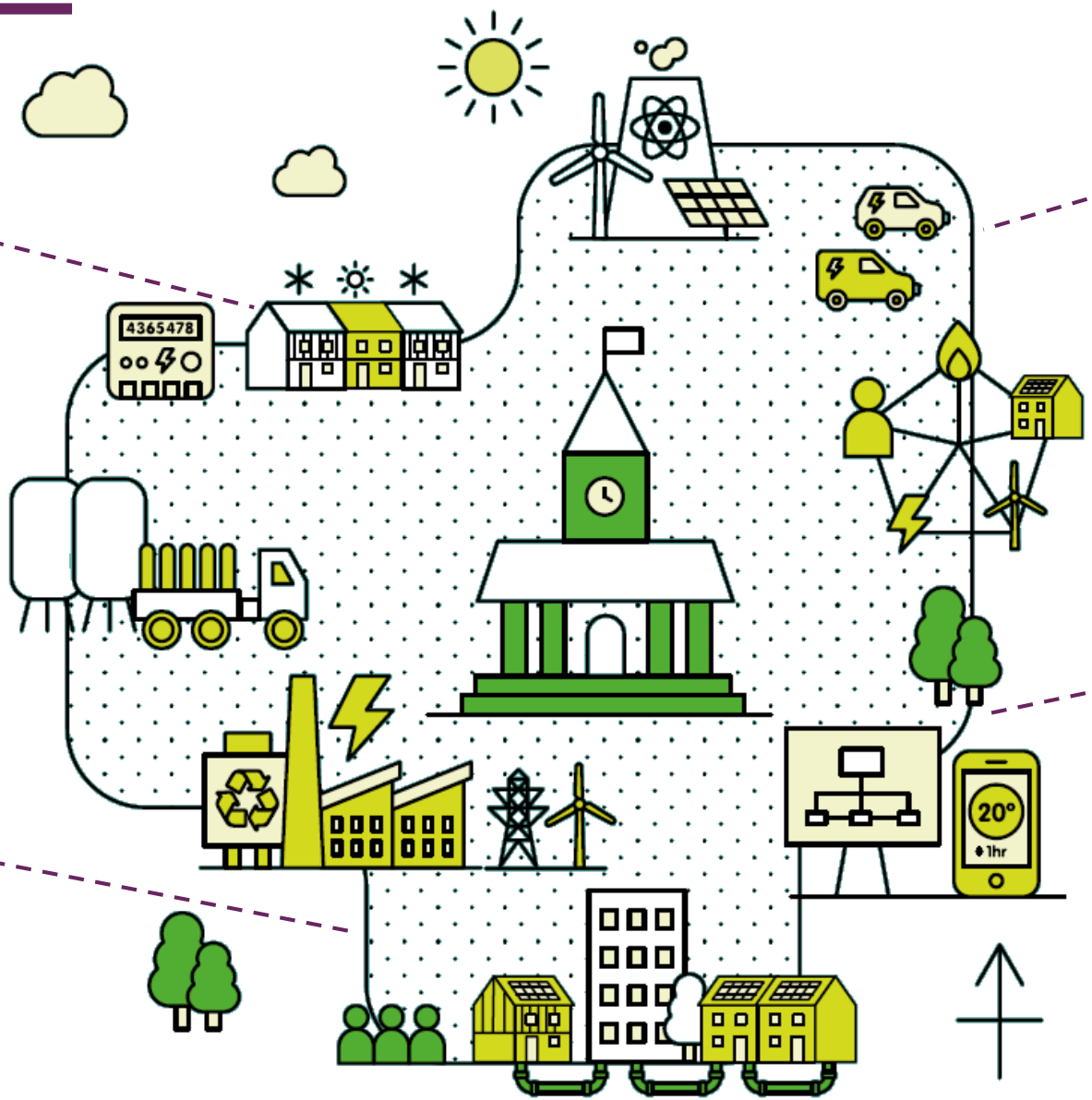
https://plymouthenergycommunity.com/



Plymouth Energy Community™

WE WILL NEED TO ELECTRIFY OUR PERSONAL CHOICES AND CREATE A NEW COMMUNITY INFRASTRUCTURE

We'll need to automatically trade electricity with our neighbours



By connecting our homes our cars to the grid we create the community infrastructure of the 21st century.

We need to harness waste heat from industrial processes and put it to good use for example in heating our homes.

We will need a whole systems approach to the decarbonisation of energy.

WE NEED TO ELECTRIFY OUR PERSONAL CHOICES

Recommendations

11.

Retrofit across the whole housing stock by 2040, introduce an incentive to accelerate the shift to low carbon heating solutions

12.

All large scale renewable developments should have an element of community ownership from 2021.

13.

Rapidly expand the EV charging network beyond UK national average, focusing particularly on rural locations.

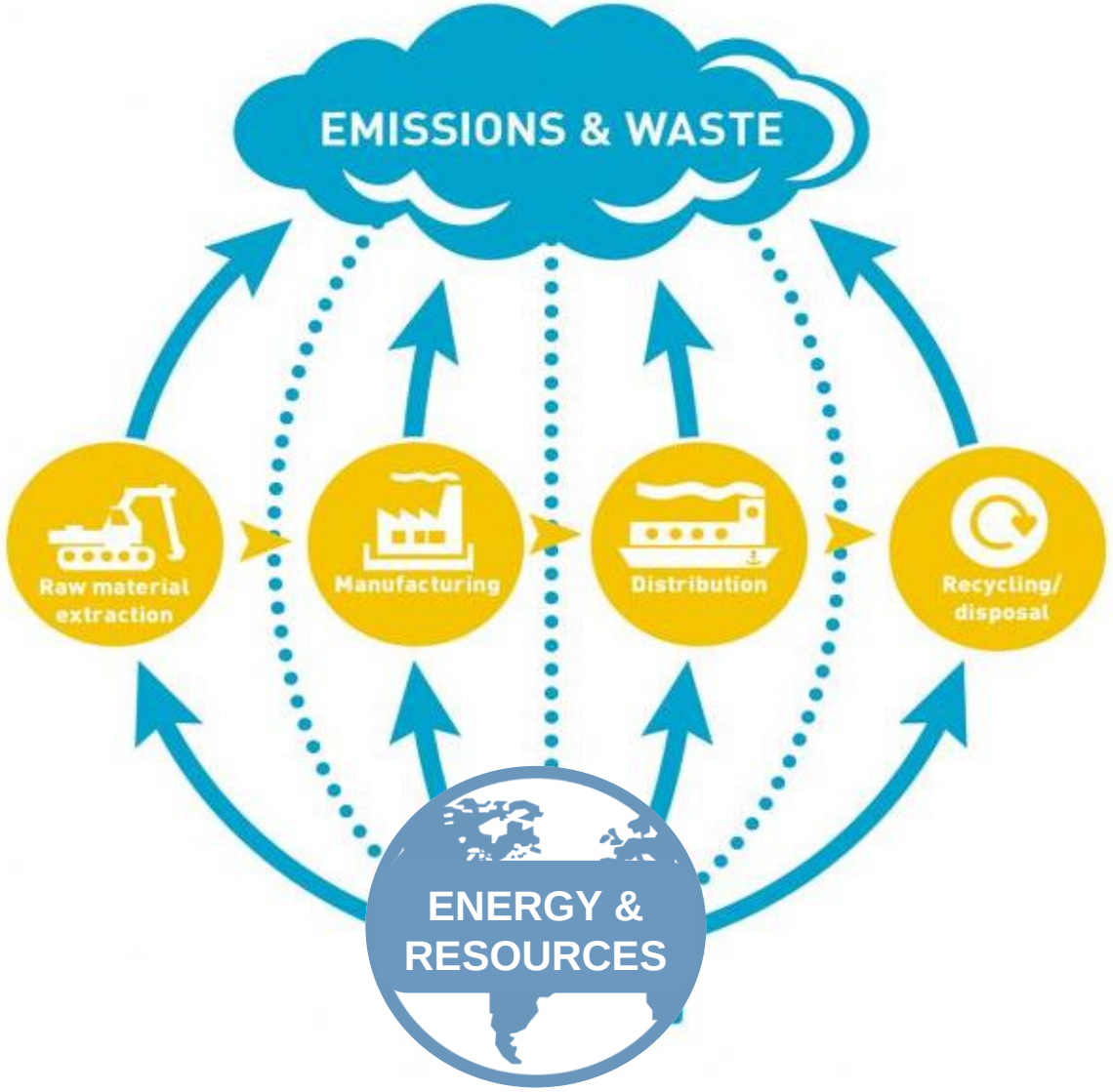
14.

100% of fuel poor households retrofitted and supplied with affordable renewable energy by 2030

15.

Build a network of community energy neighbourhoods across every district in Essex, to generate, store, share and use energy local by 2035.

WASTE AND RESOURCE EFFICIENCY



Managing waste better, improves resource efficiency. This reduces emissions across all sectors

Essex Councils deliver waste services, influence behaviour and provide community leadership. However, successful outcomes rely on engagement and ownership throughout society

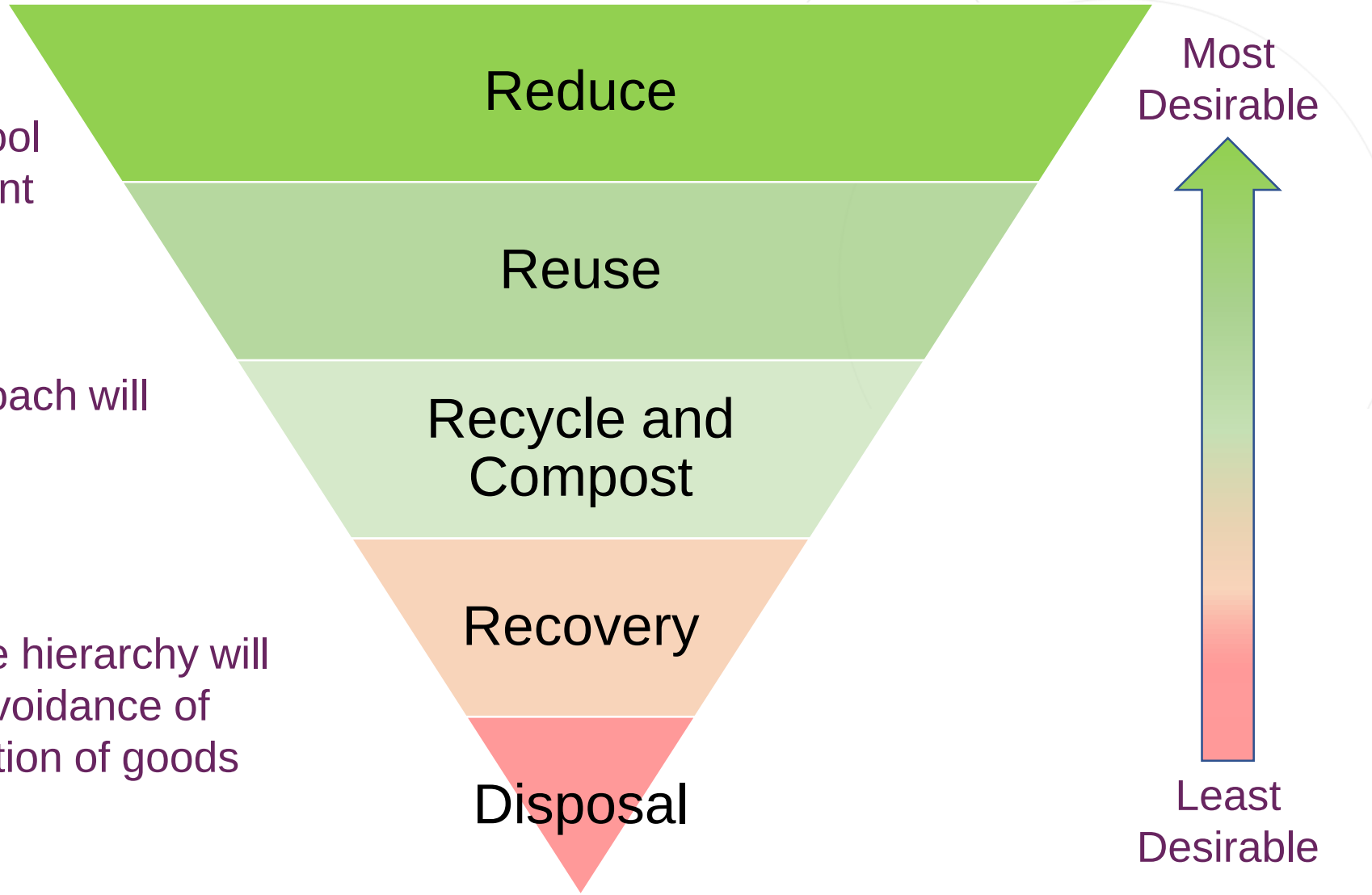
Monitoring and measuring outcomes is essential if the right decisions and progress are to be made

WASTE HIERARCHY

The Waste Hierarchy is a useful tool for prioritisation waste management

Adopting a Waste Hierarchy approach will **reduce climate change impacts**

Moving waste management up the hierarchy will **maximise benefits** through the avoidance of emissions associated with production of goods



LEGISLATIVE AND POLICY FRAMEWORK

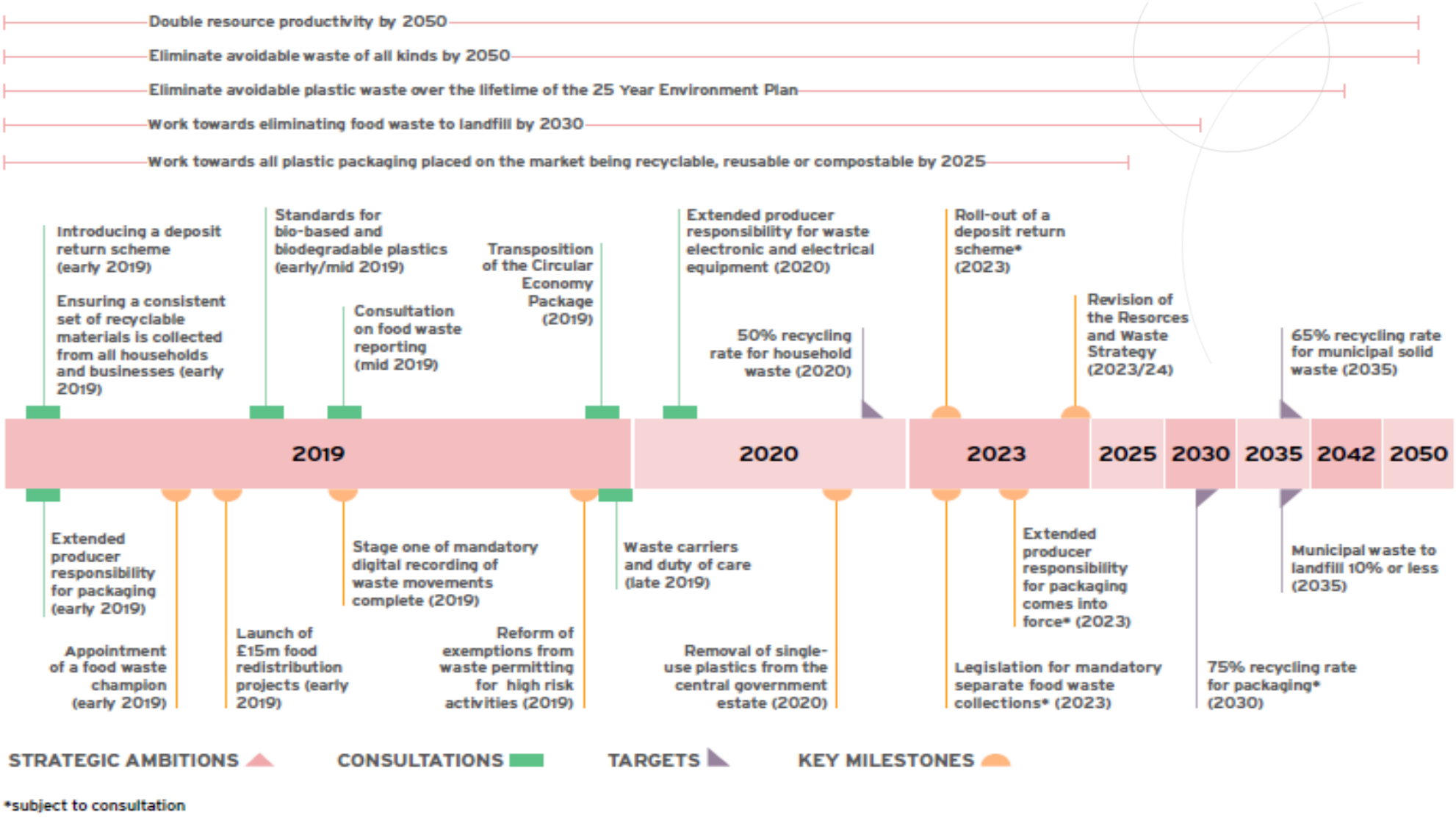
EU Circular Economy Package (European Green Deal) incorporates the following into its action plan:

- Designing sustainable products – durability, reusability, upgradability, repairability – and incentivising digitalisation and sustainability performance
- Incentivising product as a service and extended producer responsibility schemes where producers keep ownership of the product throughout its lifecycle

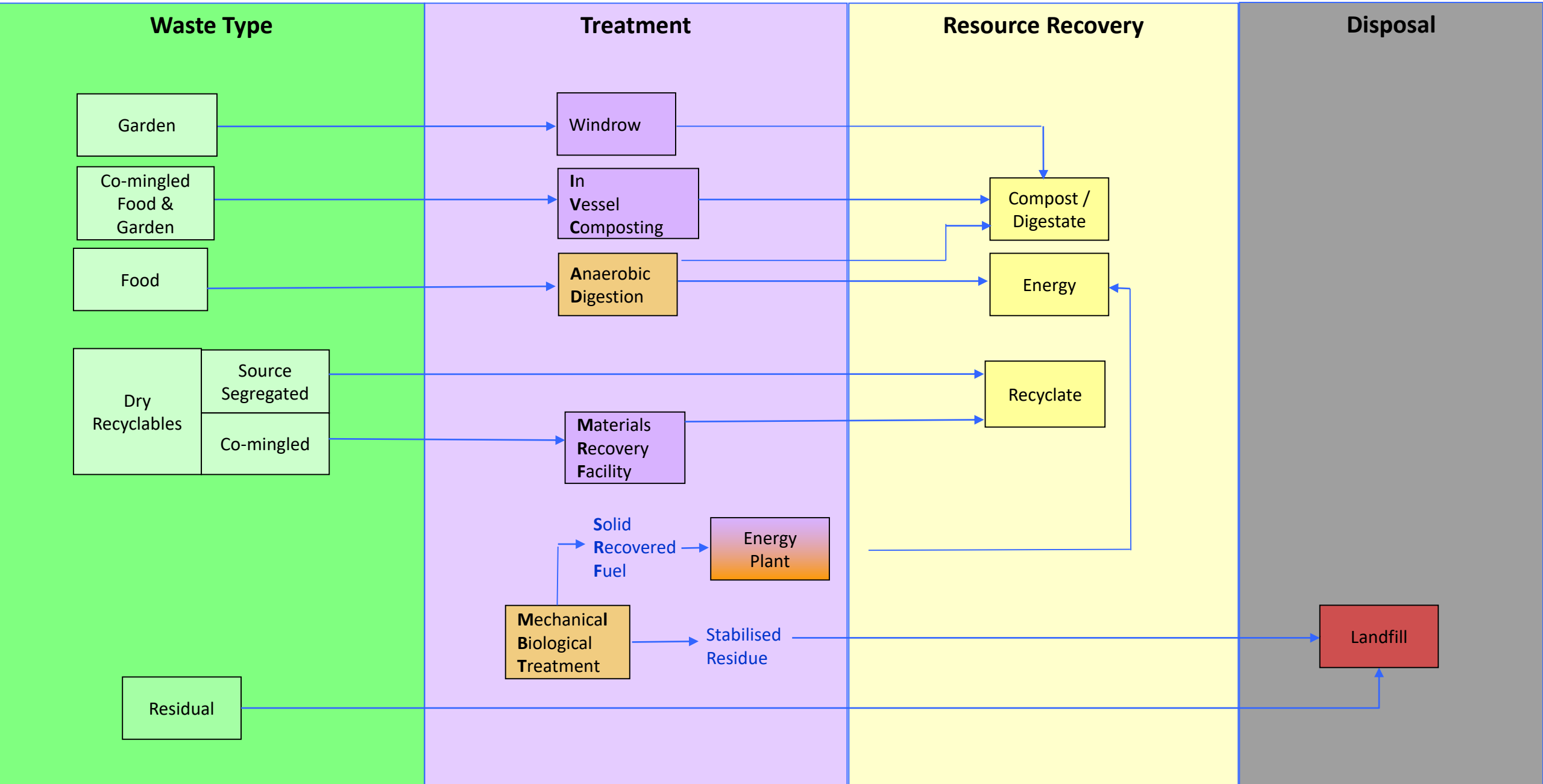
National Strategy - "Our Waste, Our Resources: A Strategy for England" published in December 2018.

- National policy that responds to the EU Circular Economy package.
- Environmental Bill – expecting Royal Assent in Spring 2021
- Key delivery milestones :
  - Mandatory recycling and bio-waste collections from 2023.24
  - Extended producer responsibility scheme comes into force in 2023
  - National Deposit Return Scheme 2023
  - Removal of single use plastics in central government estate by 2020
  - Tax on plastic packaging with less than 30% recycled plastic
  - Procure more sustainably in construction, infrastructure and capital investment
  - Commitment to UN Sustainable Development Goal to halve global food waste by 2030
  - Eliminate avoidable waste of all kinds by 2050
  - Double resource productivity by 2050

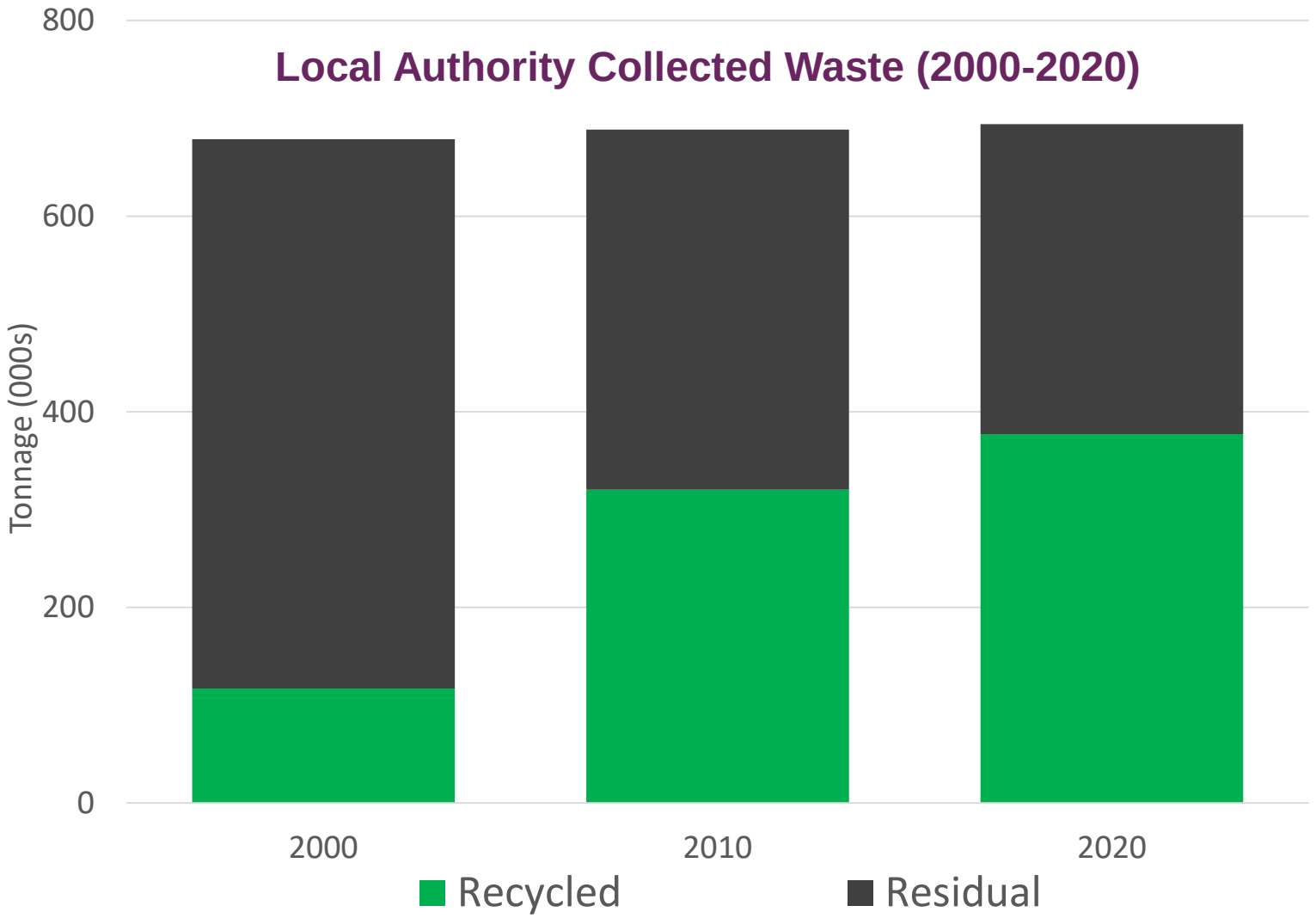
TIMETABLE FOR NATIONAL STRATEGY IMPLEMENTATION



Current Waste Flows for Essex



HOW ARE WE PERFORMING?

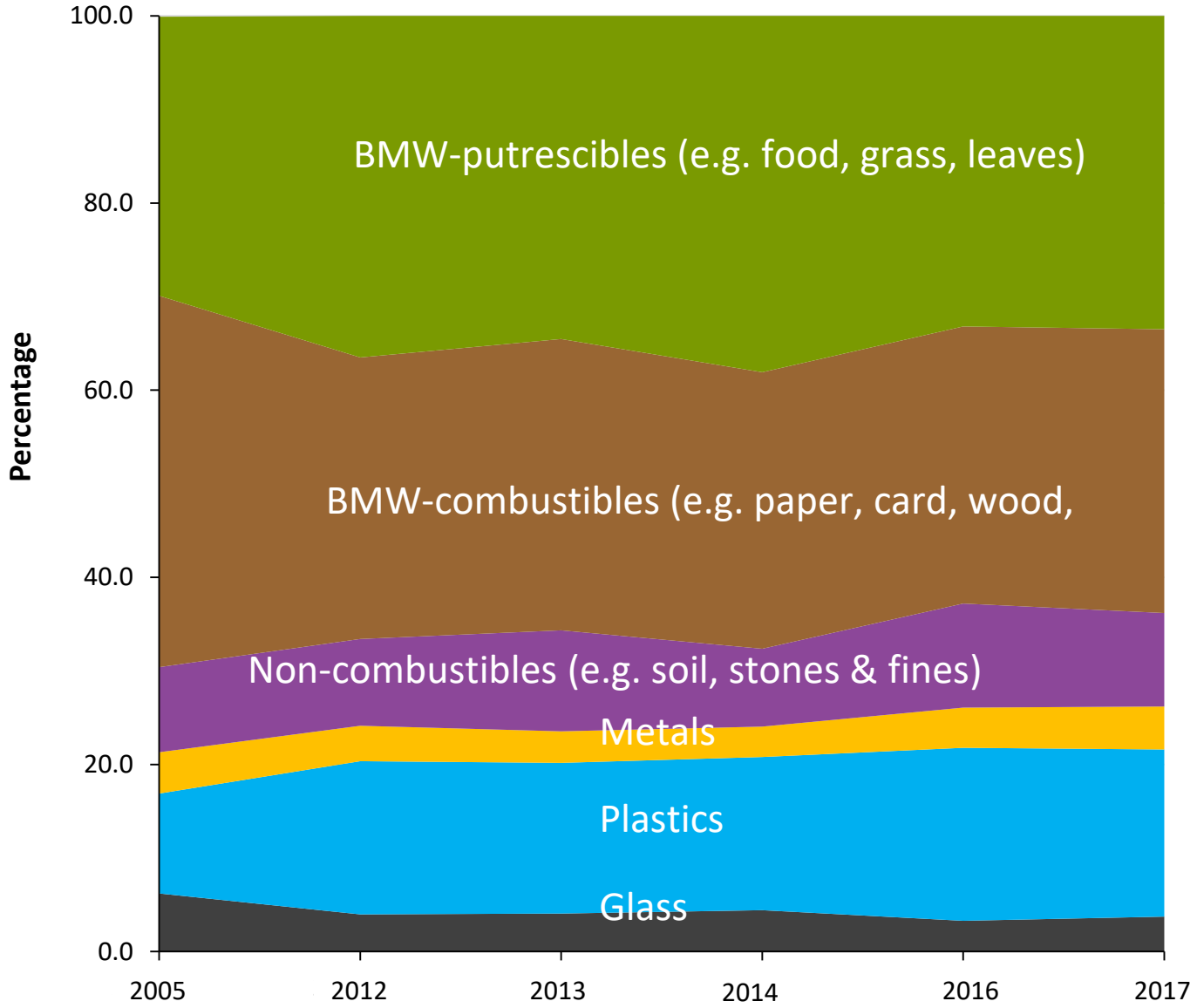


694,000 tonnes of waste is collected by Essex Councils, as much again is produced by Essex businesses.

54% is recycled, improvements in recycling are stagnating.

Total waste has **remained static** despite population growth. Product design improvements has driven this with some behaviour change

WHAT IS LEFT IN THE BLACK BAG?

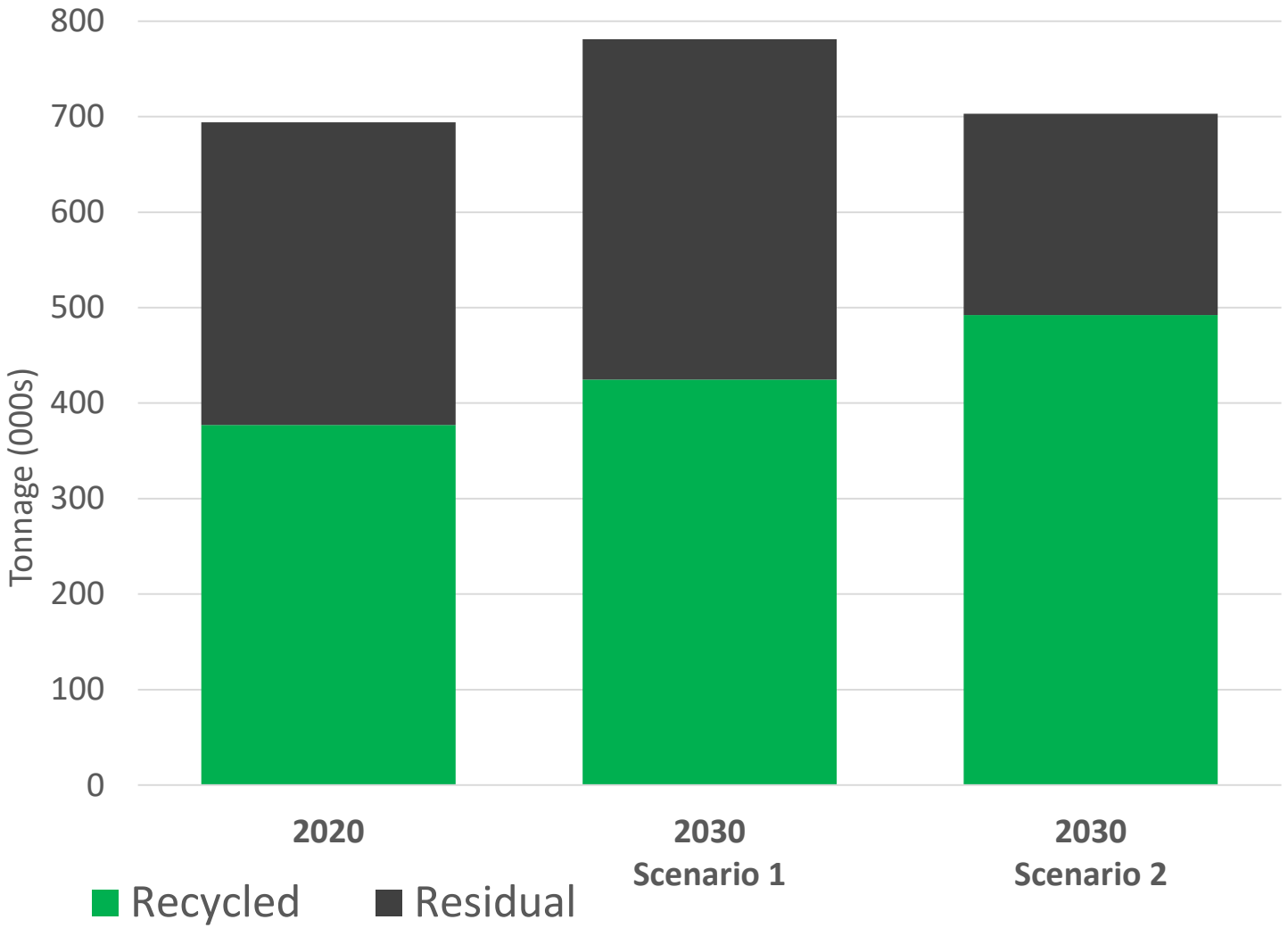


Although composition is largely unchanged in the last 15 years the proportion that **is plastic has doubled**

Significant proportion of residual waste is suitable for **composting**

Much of the waste that in the black could be **recycled through existing recycling systems**

WHAT COULD THE FUTURE LOOK LIKE?



Scenario 1: Static recycling, no waste minimisation
Scenario 2: 70% recycling & 10% less waste per household

Population growth will mean an extra **90,000 tonnes** of household waste a year by 2030 if we **do not** minimise waste

Waste reduction and accelerated improvements in **recycling** are both essential in tackling emissions

70% recycling and reducing every householders waste by 10% will deliver **zero total waste growth** and **reduce residual tonnage by over 40%**

CIRCULAR ECONOMY – MAXIMISING OUTCOMES

Councils normally focus on **recycling** and **residual waste** management – this is no longer enough

Influencing **design and manufacturing** will **maximise** benefits

Influencing **reuse, maintenance and consumption** is happening, but **more** must be done

CIRCULAR ECONOMY – DRIVING PROGRESS

National policy and the emerging Environment Bill provides greater opportunities for Essex to accelerate change in Essex

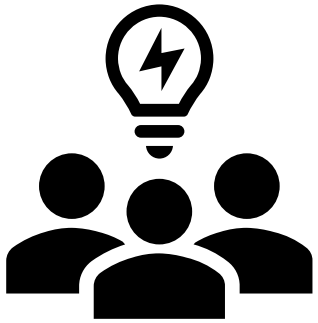
- Deposit return schemes for drink containers
- Extended producer responsibility for end of life products and packaging
- Increased access to funds and support
- Mandatory recycling services
- Plastic packaging tax to promote use of recyclate
- Increasing business and industry engagement opportunities

Essex must lobby and engage to maximise beneficial return

MOVING TOWARDS NET ZERO FASTER?

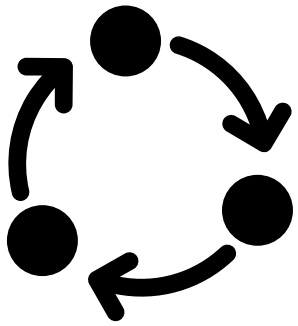
VISION FOR THE FUTURE

A shared vision with stretching targets and a trajectory for improvement is necessary to ensure momentum is maintained and actions can be resourced, prioritised and communicated effectively



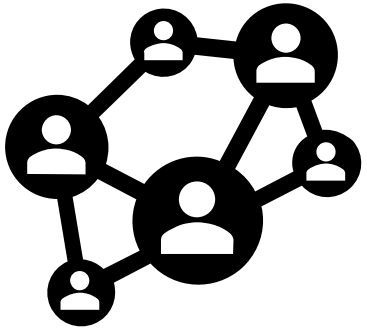
CIRCULAR ECONOMY

An approach embracing the Circular Economy will maximise benefits across all sectors. This needs to be embedded in all decision making to ensure it delivers change



ENGAGED SOCIETY

A clear vision with stretching targets and an improvement trajectory is necessary to ensure momentum is maintained and actions can be resourced, prioritised and communicated effectively



A VISION FOR THE FUTURE

Essex needs to be bold and move harder and faster if it is to achieve net zero. This will require a consistent shared vision and a clear roadmap to ensure progress and momentum is maintained.

Recommendations

16. Reduce per capita waste by at least 10% by 2030.

17. Accelerate recycling activity to achieve a minimum 70% recycling rate by 2030.

18. Ensure all biodegradable waste is put to beneficial use by 2025.

19. Zero waste to landfill by 2030

20. Adopt a strategy which reduces greenhouse gas emissions by embracing the circular economy.

A TRANSITION TO A CIRCULAR ECONOMY

Embedding and adhering to the principles of a Circular Economy in waste design and decisions will maximise gain and unlock joint opportunities with partners

Recommendations

21.

Adopt life cycle analysis so emission impacts are fully considered in waste system and service design.

22.

Evaluate emission impacts in all future procurement decisions; and develop a framework that can be adopted by others.

23.

Establish an Essex waste innovation fund, with an early focus on plastic substitution opportunities, and enhancing local reprocessing capacity.

24.

Develop the Essex Waste Partnership to fully engage with producers, industry, academia and research bodies.

ENGAGED SOCIETY

Achieving change requires a fully engaged society that understand the challenge, feels part of the solution and are excited by the opportunities presented. Good quality services which are designed round the needs of society and are flexible to changes are essential

Recommendations

25.

All Essex residents and businesses to have access to kerbside recycling services by 2025.

26.

Establish a network of community-based reuse and repair hubs in Essex by 2024.

27.

Ensure all new build housing are built to support high recycling and the circular economy.

28.

Provide comprehensive support to residents and businesses so they can make the right choices.