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Basics of Decarbonisation

Part of the Low Carbon Lincolnshire Programme

David Knight

Principal Environmental Consultant at PECT

We're working on behalf of Business Lincolnshire to deliver the Low Carbon Lincolnshire programme.

PECT
CREATING SUSTAINABLE PLACES

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Low Carbon Lincolnshire

A programme to help small-medium businesses in Lincolnshire and Rutland with their journey to Net Zero.

- One-hour introductory webinars in February.
- Half-day workshops in Lincoln, Grantham and Market Rasen.
- Virtual workshops.

All open for registration on the Business Lincolnshire website now.

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The Net Zero Agenda

Paris Climate Agreement 2015 – to limit warming to well below 2°/1.5°C above pre-industrial levels

The UK has set, in law, their goal of becoming **Net Zero by 2050.**

- *'Reaching Net Zero emissions; the activities within* ***the value-chain*** *result in* ***no net impact on the climate****…*
- *This is achieved by* ***reducing emissions****…* ***balancing*** *any remaining emissions through* ***carbon removals****.'*

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What you can do to get to Net Zero

1. Make a pledge by **joining the internationally recognised SME Climate Commitment**.
2. **Measure your carbon emissions** using a **free carbon calculator**.
3. Use the **Calculate the cost of your carbon emissions** page to find out how much you could save by switching to greener business practices.
4. Make a plan to reduce your carbon footprint
5. Reduce your carbon footprint now – you can take no-cost or low-cost actions to reduce energy costs now
6. **Involve your team**
7. Get your team involved to engage them in initiatives that reduce carbon and save on energy costs.

UK Business Climate Hub - find advice on energy saving and net zero for SMEs

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What is a Carbon Footprint?

- Use of fossil fuels and gases emit Greenhouse Gases (GHGs) into the environment – the measure of these is our carbon footprint
- Seven recognised GHGs – some naturally occurring, but continuous burning of fossil fuels puts significantly more into the atmosphere
- GHGs each have a "Global Warming Potential" (GWP) which reflects the different impacts each has in terms of their contribution to the warming effect, both in damage and longevity
- CO2 is used as the reference gas with a warming potential of 1, and other GHGs are expressed as an equivalence to CO2 – hence the term "Carbon" footprint (as a catch all)
- Emissions are reported therefore as CO2'e' – 'e'quivalence representing the total GHG impact in our calculations

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1

Scope 1:

Direct GHG emissions from sources a company owns or controls.

- Emissions from boilers / furnaces
- Emissions from vehicles (fleet)
- Fugitive emissions of F-Gases / Process emissions

2

Scope 2:

Indirect GHG emissions from purchased energy

- Electricity
- Heat (district heat network)
- Steam (less common)

3

Scope 3: All other GHG emissions from sources not owned or controlled by the reporting company but that the organisation indirectly impacts its value chain

- Procurement
- Waste management
- Business travel (public transport or grey fleet)
- Investments

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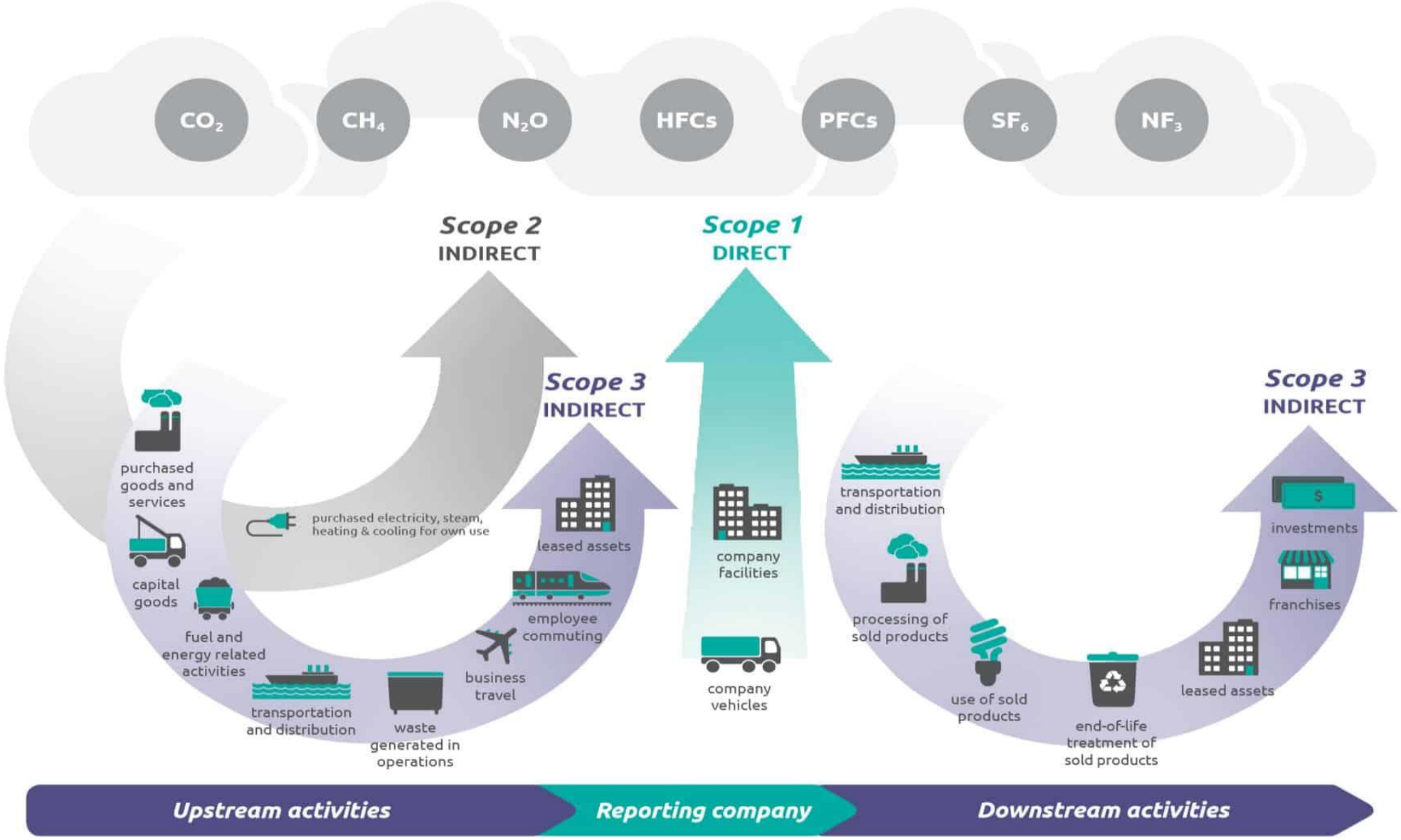

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Reporting

There are five principles to consider when completing your GHG Accounting:

- Relevance: Needs to be an appropriate reflection of your company's impact, so decision makers are well informed of performance
- Completeness: All relevant sources and activities that make-up your GHG emissions must be accounted for and reported on, any exclusions need to be justified
- Consistency: Consistently use the same methodology for a relevant comparison over time, any changes are transparently documented
- Transparency: Where possible, to be factual and coherent, with a clear audit trail. Methodologies, data sources, estimates, should be clear and available
- Accuracy: Ensure that GHG emissions calculations are accurate, and reduce any uncertainties as far as is practicable

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Organisational boundary

Control Boundary

Company accounts for 100% of GHG emissions from operations over which it has control

Operational – you have authority and total control on all decisions, including financial

Financial – you have financial control and can direct operations through financial mechanisms

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GHG calculations

Activity or spend-based data

kWh, miles travelled, litres purchased, etc.

Emissions factor

Appropriate emission factors for example, kgCO2e / kWh consumed

Greenhouse gas emissions

tCO_2e

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1

Scope 1:

Natural Gas (meter / utility bills)
Fuels – burning oil, LPG (invoices)
Petrol / Diesel (invoices / fuel cards)
Fleet mileage (expense claims)
F-Gas (service notes / invoices)

2

Scope 2:

Electricity (meter / utility bills)

3

Scope 3:

Purchased goods and services (invoices)
Capital goods (invoices)
Upstream logistics (supplier)
Waste streams (waste provider / estimate)
Business travel (expense claims)
Downstream logistics (supplier)

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Converting data to GHG emissions

- DEFRA produces GHG conversion factors annually
- These factors are broken into sections; emission source type covering fuels, bioenergy, electricity, travel, gases, etc., and Scope
- Locate the appropriate factor, multiply the annual use value, to calculate kgCO2e, divide by 1000 to calculate tonne CO2e
- It is important to ensure your data measurement (e.g. kg, tonne, litres, etc.) matches the conversion measurement requirement
- Ensure each output is categorised correctly to calculate total amounts of each scope
- https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting

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What you can do to get to Net Zero

1. **Measure your carbon emissions** using a **free carbon calculator**.

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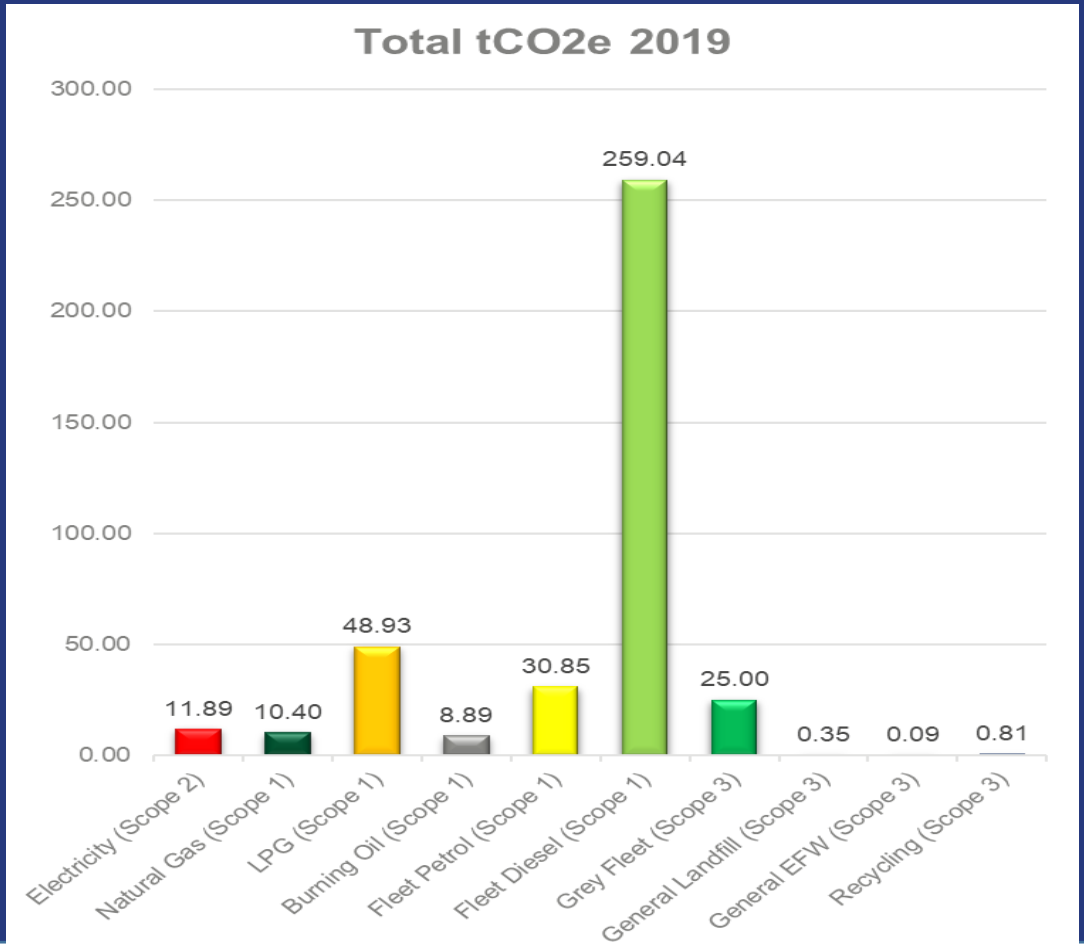
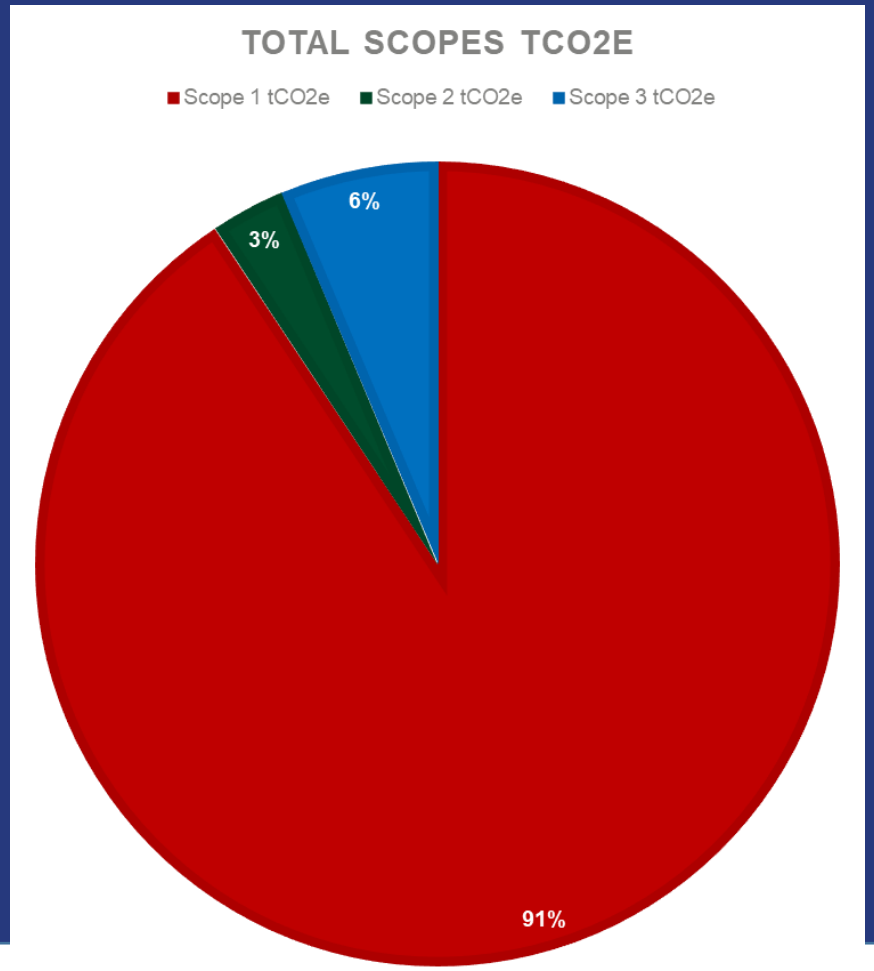
Carbon footprints and interpretation





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Understanding data – need for energy management

- Accurate monitoring and recording of resource use is critical for accurate reporting
- Target setting and action plans co-ordinate efforts to making improvements for high priority resources
- Auditing yourself helps to continually review performance and identify improvement opportunities
- Good communication keeps employees engaged

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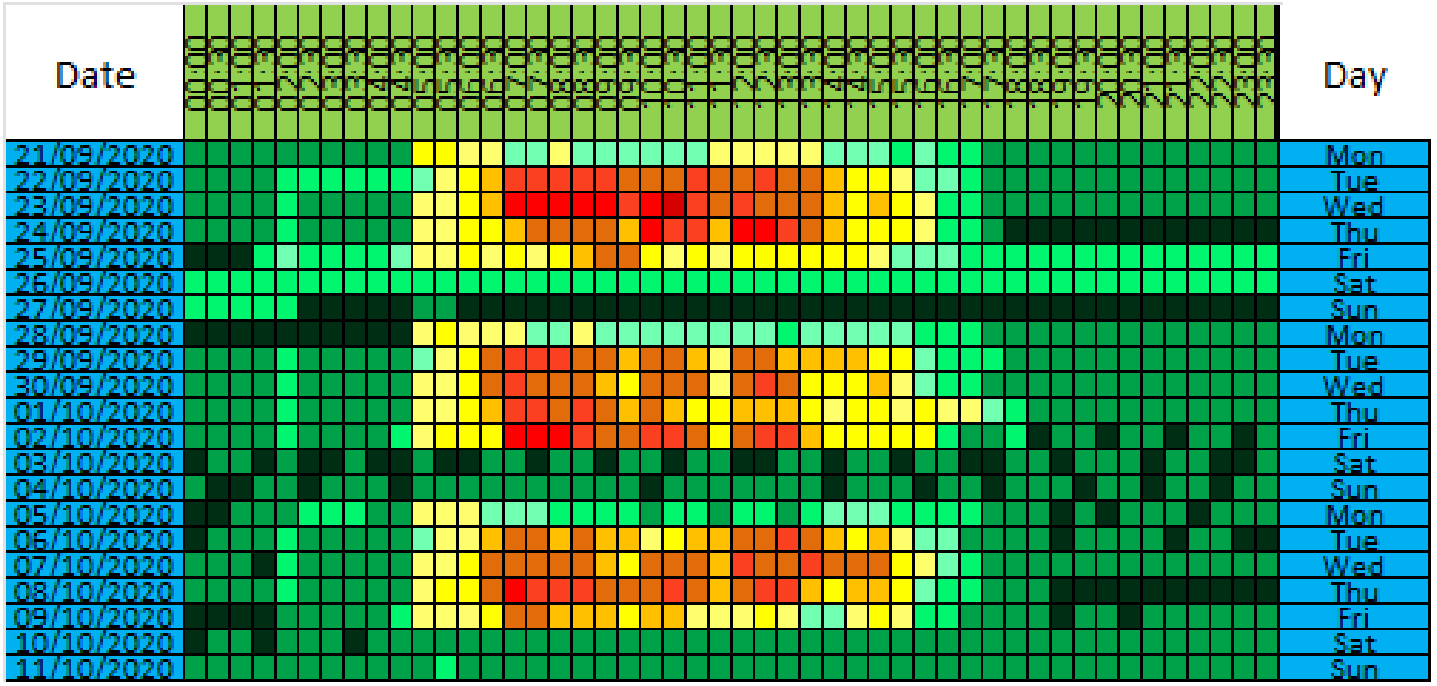
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100% 103.80
90% 93.42 - 103.8
80% 83.04 - 93.42
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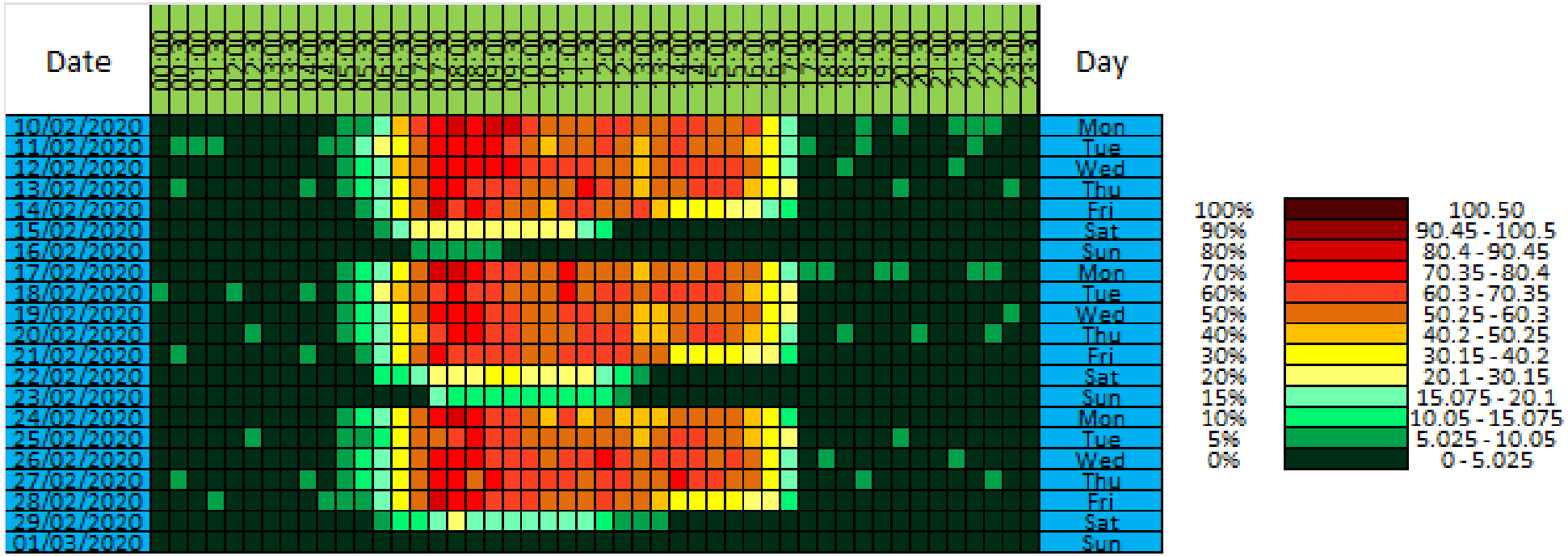
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100% 100.50
90% 90.45 - 100.5
80% 80.4 - 90.45
70% 70.35 - 80.4
60% 60.3 - 70.35
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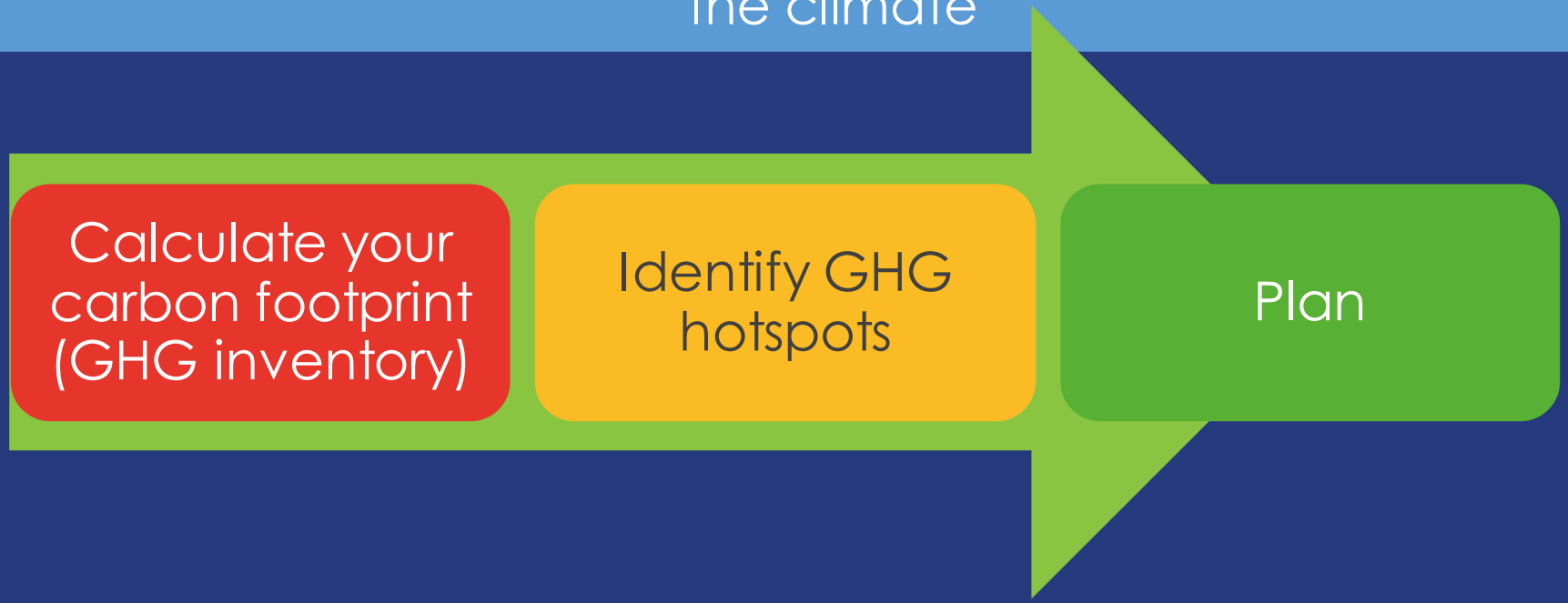
40% 40.2 - 50.25
30% 30.15 - 40.2
20% 20.1 - 30.15
15% 15.075 - 20.1
10% 10.05 - 15.075
5% 5.025 - 10.05
0% 0 - 5.025

Decarbonisation plans

A decarbonisation plan translates the GHG reduction target into a series of **actions** to **reduce** an organisation's **carbon footprint** and **impact** on the climate



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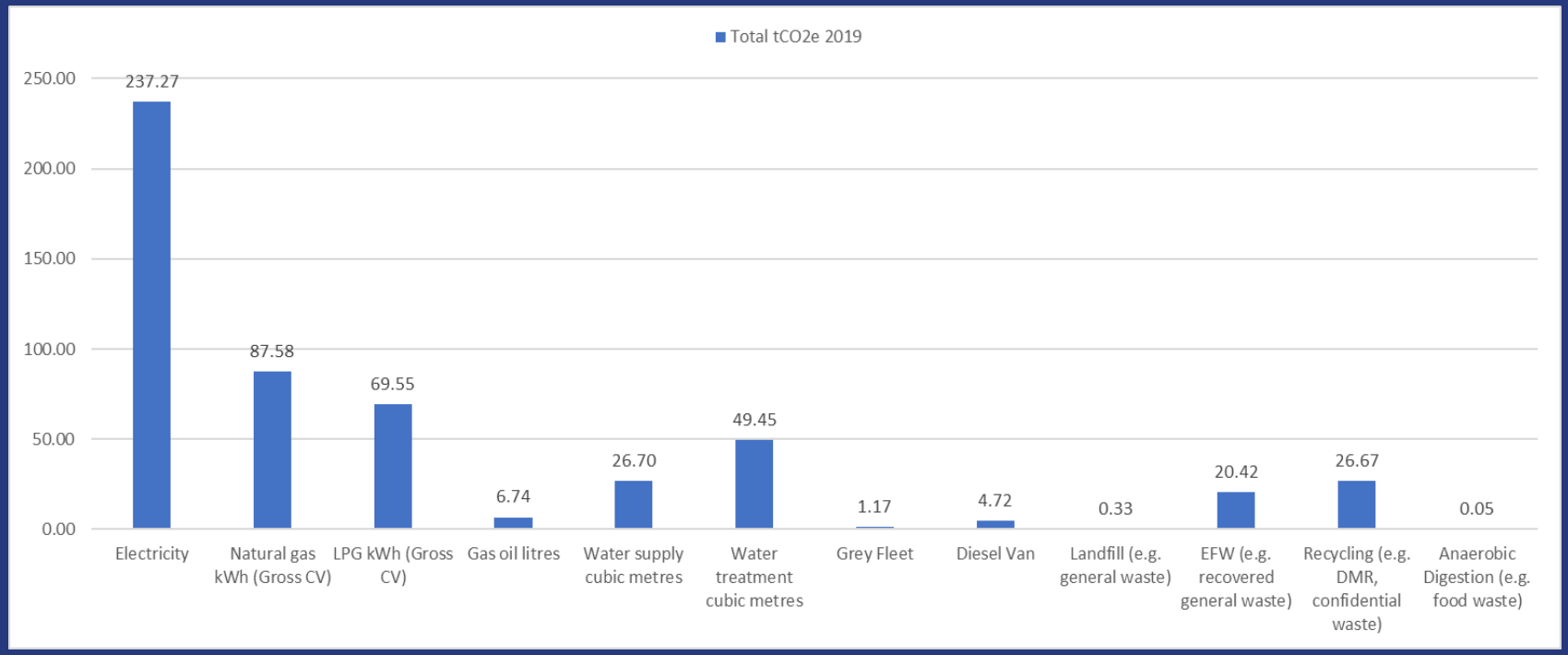
Decarbonisation plans

Calculate your carbon footprint (GHG inventory)



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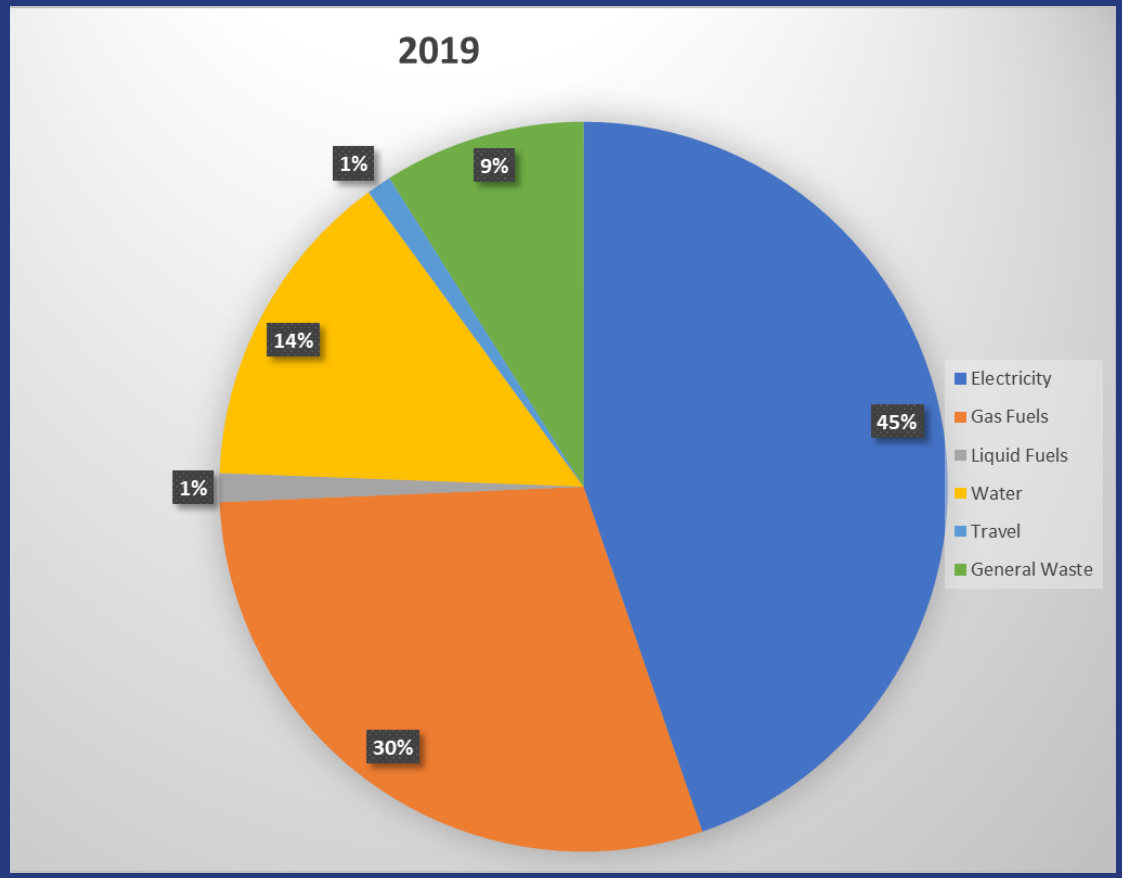
Decarbonisation plans

Identify GHG Hotspots



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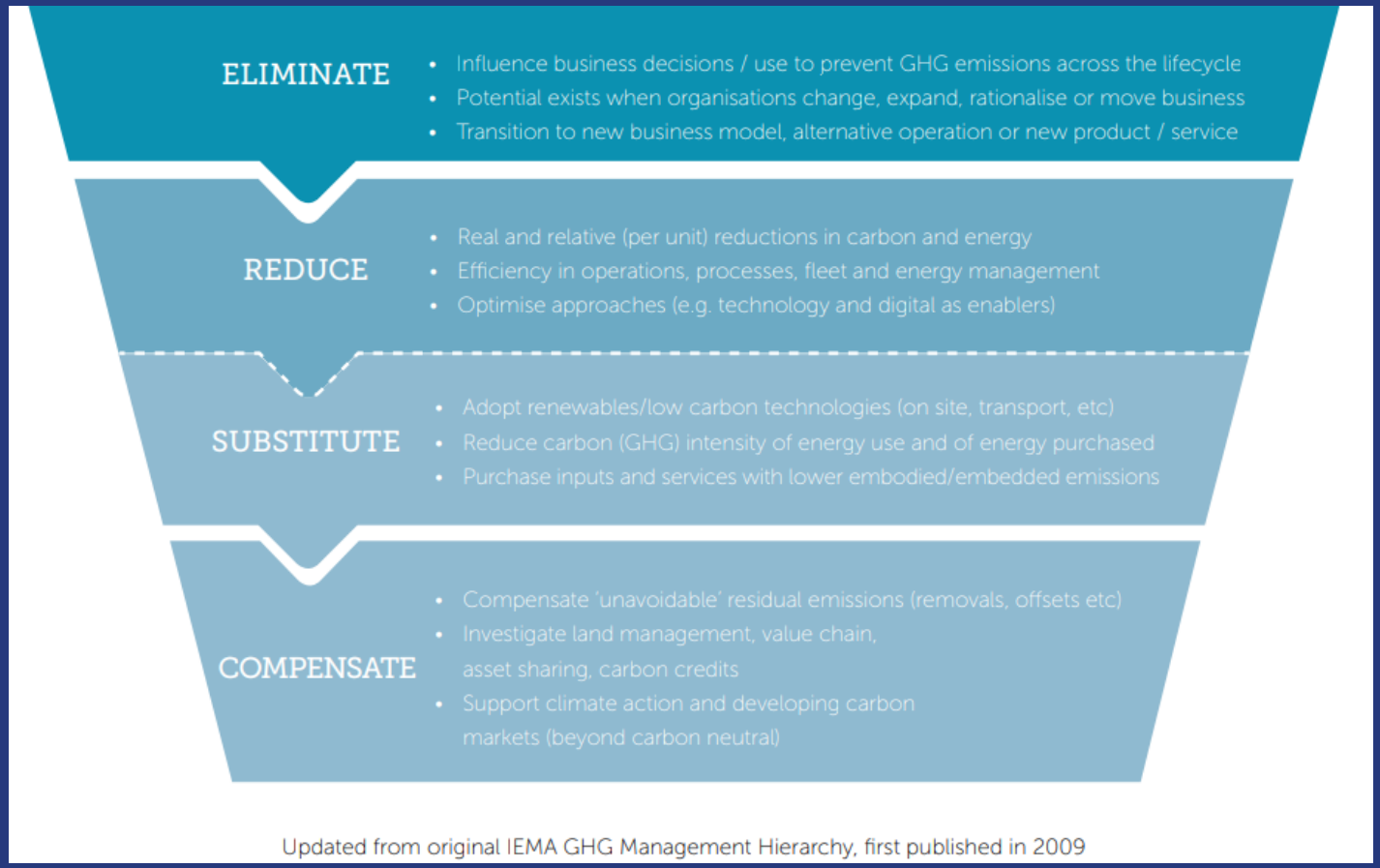
Decarbonisation plans

Plan



Updated from original IEMA GHG Management Hierarchy, first published in 2009

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Decarbonisation process

Efficiency and behaviours must be addressed as priority one

- Processes and equipment must be optimised to achieve efficiency and generate the initial savings
- **Controls and behaviours** are first place to start – are no / low cost quick wins and can achieve 10-40% savings depending on current system
- **Buildings are problematic** and may require significant investment to improve, or cannot be improved – optimisation of heating and cooling systems are essential (in the short term)
- Vehicle efficiency should also be considered – driver training, maintenance of vehicles, etc.

Asset replacement should be considered second priority

- Replacement of equipment will lead to reductions but comes at high capital cost
- Priority should consider biggest emissions savings – either through replacement of oldest but also frequency of use
- Heating replacement from fossil fuels to electric should be considered where possible

Self generation should be considered as third priority

- Reduce emissions through solar PV or thermal, wind turbines, heat pumps, etc. – usually highest capital investment

Decarbonisation focus: buildings

DECARBONISATION STEPS

- Energy efficiency is a **huge under-utilised opportunity** – quickest and most affordable way for many organisation to decarbonise
- Employee behaviour is key, ensure systems not left on, timers are correct and match operation, check shutdown procedures to avoid waste outside hours
- Depending on building, retrofit with better insulation, utilise natural ventilation (avoiding air-conditioning), low-carbon heating systems

DECARBONISATION STEPS

- Lighting is easiest element to consider – ensure LEDs installed, sensors used appropriately, and behaviours to switch off
- Consider use of energy management software, BMS, etc. to improve efficiencies
- Review all control systems to ensure they operate as required, according to occupancy, temperature needs, etc.
- Well-maintained, older equipment, is still not going to be as efficient as a modern system

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Control checklist

- What is the purpose of the control – timer, temperature, speed, etc.
- Is it performing as expected?

- What is the occupancy need and does the control match this (movement sensor, timer, etc.)
- What still operates outside operational hours?

- How is it the equipment setup to run; on/off control, full speed, variable speed, modulated, etc.?
- How does it actually run?

- Is there a better way to control the equipment?

- How easy is it to change the control system, can it be automated and is it likely to be financially viable?

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Heating example: Compensated control – Outside air temperature

- Used as a secondary control system for boilers to actively track changes in temperature
- Allows boiler to adjust the water flow temperature, reducing energy need and maintain efficiency (up to 20% saving)
- Weather compensation – tracks external temperature; ideal for long heating periods
- Load compensation – tracks internal temperature, ideal for intermittent heating

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Decarbonisation focus: transport

- Use travel hierarchy processes and minimise travel wherever possible through use of online and virtual working
- Where travel is necessary, public transport should be considered as the priority
- Where vehicles are needed:
- Vehicle maintenance and driver behaviour can result in significant fuel saving
- Use of telematics systems to monitor performance to identify inefficiencies early on
- Use scheduling software to optimise routes and ensure most efficient journeys are plotted
- Electric vehicles are currently the alternative to fossil fuels, but do come with challenges
- Hydrogen is still an up and coming technology, although infrastructure is lagging due to slow market

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Decarbonisation of the UK grid

UK Grid has decarbonised by over 50% in last 10 years, and is now similar levels to natural gas
Potential for UK grid to achieve Net Zero status between 2030-2040
Shifting to electricity over use of fossil fuel is preferred as electricity can be decarbonised whereas fossil fuels cannot
Minimising energy use through efficiency is the priority action as can make shifting fuel source easier
However, with current cost of electricity, shifting is likely to realise carbon savings but unlikely to realise cost savings

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Decarbonising Scopes

- Scope 1 heat and fuel use; can also include generators, forklifts, etc.
- Fugitive emission increase likely to be seen through increase in AC or heat pumps – low carbon refrigerant innovations on horizon
- Given high energy demand, shifting to electric may require capacity infrastructure review
- Scope 2 mostly electric, although heat networks are increasing – good opportunity to minimise carbon in heat
- While electricity is higher carbon currently, has opportunity to decarbonise through grid improvements
- Renewables presents opportunity to decarbonise quickly, but should be last resort after efficiencies achieved

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What about Scope 3?

- Focus on more immediate Scope 3 elements that can be changed through behaviours or internal policy
- Water efficiency, while reduces carbon, also protects an extremely valuable resource, also consider heated water for both energy and water saving
- Ensure all leaks are reported and fixed, check pressures on taps for minimised water flow, use of push button taps, aerators, etc., are low cost options of minimising water waste
- Introduce a waste management plan to ensure correct segregation and use of audits to review waste and potentials for improvement
- Packaging often a large source of waste and may be harder to manage and often requires engagement with suppliers
- Look to encourage good travel behaviours through the use of a travel hierarchy, encouraging active and public travel over vehicle use

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What about Scope 3?

- Consider installation of EV points to encourage uptake of EVs for staff, also consider access to site, cycle schemes, active travel provisions
- Procurement policies will be a must when considering Scope 3 as a significant proportion will exist within your procurement
- Consider plan around how to select suppliers who are managing carbon emissions better, or offer lower carbon products
- Consider introduction of carbon / sustainability weighting in procurement decisions – may not be the major factor (as cost often is) but could be a deciding factor

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Energy Management & Monitoring Systems

- There are a number of varying products will allow automated measuring, which can utilise Wi Fi or local Ethernet networks
- The measuring devices can also measure water, gas and also heat, depending on what method of recording is required
- Installation of energy monitoring equipment to circuits from the main meter to monitor all equipment will help determine areas of the business that consume the largest amounts of energy
- Plethora of energy monitoring software systems that can be used, but speak with supplier to see if they offer any packages

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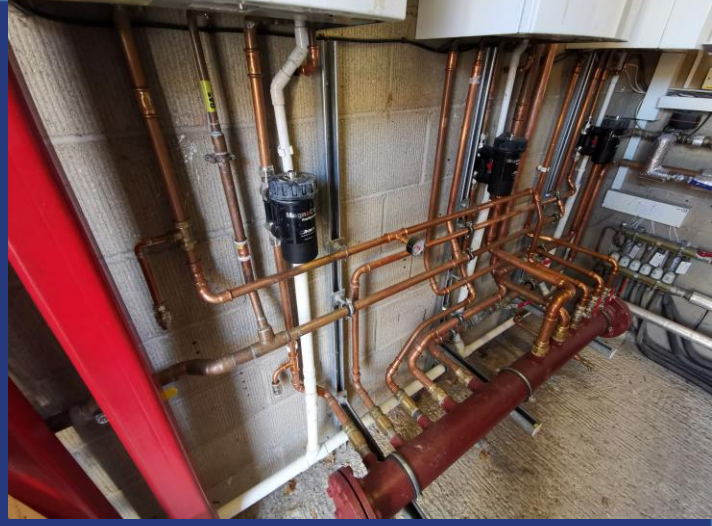
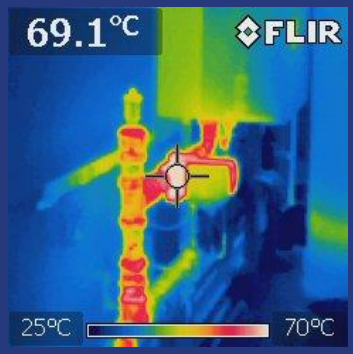
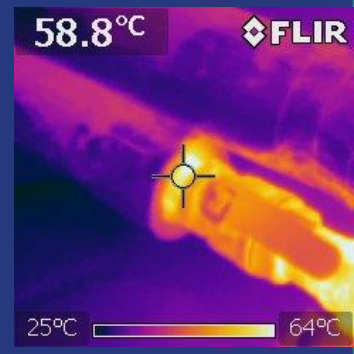
Heating example: Pipe insulation

- All pipes should be lagged, but it is often that plant rooms do not have valves or fittings lagged due to the shape
- Costs of jackets range £20 - £60 and can payback in under 4 years
- Important to consider water piping as well, this is often ignored







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Heating example: Infrared

- Works the same as sunlight, heats thermal mass and not the air
- Is not heavily impacted by air movement or open doors
- Ideal for high ceilings, areas with frequent access such as factories, warehouses, storage buildings, etc.
- Works well for dynamic heat where heat is only needed for short periods
- Allows heat to be zoned to specific area rather than heat entire space
- No air movement – useful in areas with high levels of dust, etc.

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Efficient power and electricals

- VSD alter the speed of motors within systems, useful for applications where the output needs to vary
- Can be applied to most motor systems, such as compressors and cooling systems
- Very inefficient use of energy – extremely high cost to business
- Leak detection – Ultrasound detectors
- Check pressure needs (reduce pressure to required levels) and ensure air filtering is suited for job – zone where necessary
- Get performance survey

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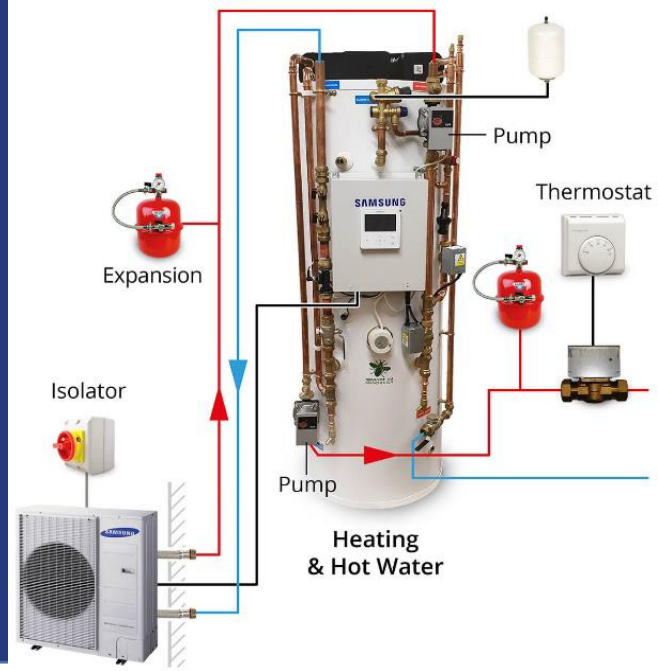
Generate heating example: Heat pumps

COP – Coefficiency of performance Uses less electrical energy to produce more thermal energy 1kW(e) = 3-4kW(th)	Low temperature heating ideal at 45°C Can go higher but COP reduces significantly	Useful in pre-heat applications for hot water use Ideal for underfloor heating
Can be used in 'leaky' buildings but not ideal Insulation improvements should be considered first where possible	Dual heating can be problematic as hot water needs to be around 60° Consider separating on upgrade where possible	Heat pumps can heat water and air (AC systems) Refrigerants are used in heat pumps and need to be included



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Process and fugitive emissions

- Process emissions are difficult to address without changing manufacturing processes, however, abatement and capture systems are possible
- Emissions through combustion can also provide opportunities for heat capture to improve efficiencies and lower carbon emissions elsewhere
- Refrigerants, while low in volume, have significant impacts with much higher GWP
- F-Gas regulations have banned older refrigerants accordingly, although these still exist in older units (R22 for example)
- Systems can be ‘re-gassed’ replacing older high impact refrigerants with modern lower GWP refrigerants
- CO2 is currently being introduced in newer systems with a COP of 1, so future potential for significant reductions on the horizon

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Heat recovery

- Waste heat can be exchanged at expulsion points to be used in other processes – ideally pre-heat applications or other hot water systems
- Waste heat can be produced through combustion (furnaces, ovens, etc.), but also through large refrigerant plants
- Heat capture can vary wildly in cost and complexity dependent on heat load, distance to application, cleanliness of heat, etc., but where suitable can offer ROI <10years
- Organic Rankin Cycle (ORC) generators provide a solution to lower temperature (110°-250°C), intermittent, heat loads that would otherwise not be suitable for alternative applications
- ORC generators use waste heat to provide electricity – while very inefficient as a stand alone technology, using wasted energy negates the inefficiency

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Generation

- On-site generation of energy reduced grid energy reliance, saving costs, and provides zero emission source of energy
- Solar PV is most common technology, but wind could be considered (subject to changes in legislation), heat pumps are considered generation, and energy from waste
- Electricity generation over 4kW requires permission from the district network operator (DNO) who may, depending on size, limit or refuse connection
- If connection is achieved, excess electricity can be exported back into the grid for income (SEG) but note this is at a significantly lower cost
- Sizing appropriately for generation helps to minimize wasted excess generation and minimize installation costs – essential to maximise efficiency before installing

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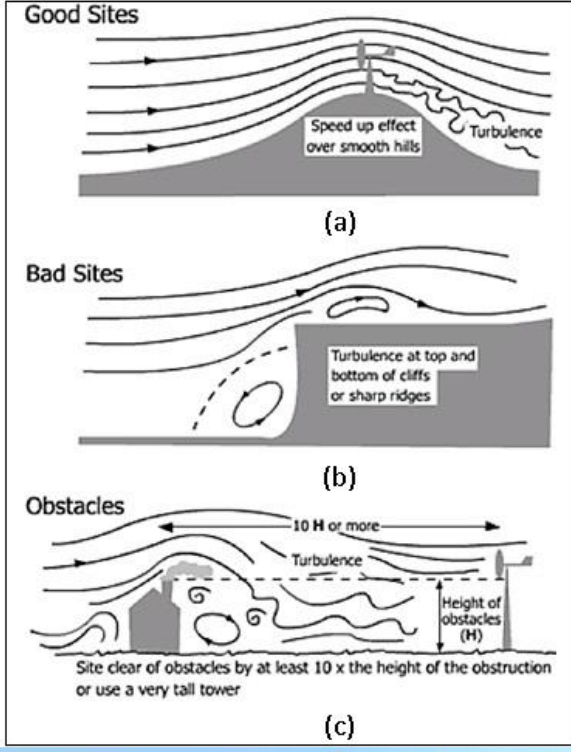
Generate heating example: Heat pumps

UK great potential for wind but not all UK experiences same level so surveys required	Better suited for large energy applications but can be done at rooftop level	Wind produces more energy but comes at significantly higher cost All year with better winter performance
Best known technology, but UK sunshine not ideal Performs very well in summer, poorly in winter	Requires a lot of space for generation and shading is problematic Generally easy to maintain	Paybacks are very good for solar but seasonal performance needs to be considered



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Net Zero

- Carbon saving and cost saving are not the same and reduction in carbon does not strictly lead to reduction in cost
- Cost reduction is achieved through energy efficiencies (reduction in energy use) and should be prioritised to achieve initial reduction
- Consider use of efficiency savings to help fund asset replacement and energy generation schemes to help offset high costs
- Shifting to electricity will not directly lead to carbon savings, but does futureproof reductions as the grid continues to decarbonise
- Shifting to electricity, while more efficient and holds potential for carbon reduction, will come at a higher consumption cost for most – this will change with time however
- Asset replacement and generation will be required to decarbonise fully – this needs to be considered within your Net Zero planning

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More information & support

Low Carbon Lincolnshire webpage:

Low Carbon Lincolnshire | Make Savings to Grow | Business Lincolnshire | Business Lincolnshire

Our full workshop schedule and resources

Business Lincolnshire Specialist Advisor:

Tony Neul, Low Carbon Specialist

Tony Neul

Low Carbon Specialist

Contact

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Examples of further support

Lincs Zellar programmes

Business Lincolnshire and North Kesteven District Council have launched programmes with Zellar to support local businesses on their sustainability journeys. 400 businesses are invited to claim free access to Zellar's online sustainability platform to enable them to reduce their carbon emissions and save up to £4,100 in energy bills. Scan the QR codes to visit the sign-up page.

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Investors in the Environment (iiE)

PECT's flagship iiE programme supports businesses to get started or elevate their sustainability journey - and become recognised for it! With over 300 members across the UK in all sectors and sizes, we offer a proven framework for organisations to save time and money and reduce their impact on the environment. Find out more at www.iie.uk.com.

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Coming up next…

Webinars:

- ~~Net Zero - Thursday 1st February 2024,12-1pm~~
- ~~Decarbonisation – Wednesday 7th February 2024,12-1pm~~
- Energy Management - Wednesday 21st February 2024,1pm-2pm
- Supply Chains - Thursday 29th February 2024, 9am-10am

Upcoming workshops:

- Net Zero – **Lincoln** – AM Tuesday 16th April 2024
- Decarbonisation – **Lincoln** – PM Tuesday 16th April 2024
- Net Zero - **Grantham** – AM Thursday 4th July 2024
- Decarbonisation - **Grantham** – PM Thursday 4th July 2024
- Net Zero - **Market Rasen** – AM Tuesday 10th September 2024
- Decarbonisation - **Market Rasen** – PM Tuesday 10th September 2024

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